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29 May 2020

Ms. Katrina Higgins-Coltrain
Task Order Monitor
1201 Elm St; Ste 500
Mail Code: SEDRL
Dallas, Tx 75270-2102

RE: Final Human Health Risk Assessment, Revision 03
Wilcox Oil Company Superfund Site
Remedial Investigation/Feasibility Study
Remedial Action Contract 2
Contract: EP-W-06-004
Task Order 0128-RICO-06GG

Dear Ms. Higgins-Coltrain:

This letter serves to notify EPA that EA Engineering, Science, and Technology, Inc., PBC (EA) has uploaded the Final Human Health Risk Assessment, Revision 03 for the above-referenced Task Order to its SharePoint site. EA will email access instructions for the SharePoint site to EPA.

An electronic copy is also being emailed to Mr. Todd Downham at Oklahoma Department of Environmental Quality (ODEQ).

Please do not hesitate to contact me at (972) 459-5038 if you have any questions.

A handwritten signature in black ink, appearing to read 'Patrick Appel'.

Patrick Appel
Project Manager

cc: Latrice Haggerty, EPA Contracting Officer (letter only)
William G. Johnson Jr., EPA Project Officer
Todd Downham, ODEQ (via email)
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File



100022980



Human Health Risk Assessment

**Remedial Investigation/Feasibility Study
Wilcox Oil Company Superfund Site
Bristow, Creek County, Oklahoma
EPA Identification No. OK0001010917**

**Remedial Action Contract 2 Full Service
Contract: EP-W-06-004
Task Order: 0128-RICO-06GG**

Prepared for
U.S. Environmental Protection Agency
Region 6
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

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- 9.4 Summary of Receptor Risks and Hazards for COPCs, Reasonable Maximum Exposure, Wilcox Oil Company Superfund Site – North Tank Farm, Bristow, Creek County, Oklahoma, Surface Soil – Adolescent Trespasser

- 9.5 Summary of Receptor Risks and Hazards for COPCs, Reasonable Maximum Exposure, Wilcox Oil Company Superfund Site – North Tank Farm, Bristow, Creek County, Oklahoma, Subsurface Soil – Resident Child and Adult
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- 9.16 Summary of Receptor Risks and Hazards for COPCs, Reasonable Maximum Exposure, Wilcox Oil Company Superfund Site – Loading Dock Area, Bristow, Creek County, Oklahoma, Surface Soil – Adolescent Trespasser
- 9.17 Summary of Receptor Risks and Hazards for COPCs, Reasonable Maximum Exposure, Wilcox Oil Company Superfund Site – Loading Dock Area, Bristow, Creek County, Oklahoma, Subsurface Soil – Resident Child and Adult
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- 10.3 Summary of Significant Contributors to Risk, Reasonable Maximum Exposure, Wilcox Oil Company Superfund Site – North Tank Farm, Bristow, Creek County, Oklahoma, Surface Soil – Commercial/Industrial Worker
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LIST OF ACRONYMS AND ABBREVIATIONS

95UCLM	95 th percentile upper confidence limit on the mean
µg	microgram(s)
µg/dL	Microgram(s) per deciliter
µg/L	Microgram(s) per liter
µg/mg	Microgram(s) per milligram
µg/m ³	Microgram(s) per cubic meter
ABS	Absorption factor
ADAF	Age-dependent adjustment factor
ADI	Average daily intake
AF	Adherence factor/Attenuation Factor
AT	Averaging time
ATSDR	Agency for Toxic Substance and Disease Registry
bgs	Below ground surface
BW	Body weight
CalEPA	California Environmental Protection Agency
CDC	Centers for Disease Control and Prevention
CF	Conversion factor
CFR	Code of Federal Regulations
cm ²	Square centimeter(s)
COPC	Chemical of potential concern
CR	Ingestion rate
CSM	Conceptual site model
DA	Absorbed dose
DAD	Dermal absorbed dose
DA _{event}	Dermal absorbed dose per event
DAF	Dosimetric Adjustment Factor
dL	Deciliter
EA	EA Engineering, Science, and Technology, Inc., PBC
EC	Exposure concentration
ED	Exposure duration
EDB	1,2-dibromoethane
EF	Exposure frequency
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ET	Exposure time
FA	Fraction absorbed

FS	Feasibility Study
ft	Foot (feet)
GIABS	Gastrointestinal dermal absorption factor
GSD	Geometric standard deviation
HEC	Human Equivalent Concentration
HHRA	Human Health Risk Assessment
HI	Hazard index
HQ	Hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic Model
IRIS	Integrated Risk Information System
IUR	Inhalation Unit Risk
kg	Kilogram(s)
kg/mg	Kilogram(s) per milligram
K	Andelman Volatilization Factor
L	Liter(s)
LADI	Lifetime average daily intake
LNAPL	Light non-aqueous phase liquid
LOAEL	Lowest-observed-adverse-effect-level
m ³ /kg	Cubic meters per kilogram
mg/cm ²	Milligram(s) per square centimeter
mg/kg	Milligram(s) per kilogram
mg/kg/day	Milligram(s) per kilogram per day
mg/L	Milligram(s) per liter
mg/m ³	Milligram(s) per cubic meter
NA	Not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHANES	National Health and Nutrition Examination Survey
NOAEL	No-observed-adverse-effect-level
NPL	National Priorities List
ODEH	Oklahoma State Department of Health
ODEQ	Oklahoma Department of Environmental Quality
OEHHA	Office of Environmental Health Hazard Assessment
OSWER	Office of Solid Waste and Emergency Response
OWRB	Oklahoma Water Resources Board
PAH	Polycyclic aromatic hydrocarbon
PEF	Particulate emission factor

POD	Point of Department
PbB ₀	Baseline blood-lead level
Pr	Produce
RAGS	Risk Assessment Guidance for Superfund
RfC	Reference concentration
RfD	Reference dose
RI	Remedial Investigation
RL	Reporting limit
RSL	Regional screening level
SA	Surface area
SF	Slope factor
SVOC	Semivolatile organic compound
TAL	Target analyte list
TRW	Technical Review Workgroup
UF	Uncertainty factor
VF	Volatilization Factor
VIR	Vegetable Intake Rate
VOC	Volatile organic compound

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1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) has been authorized by the U.S. Environmental Protection Agency (EPA), under Remedial Action Contract Number EP-W-06-004, Task Order 0128-RICO-06GG, to conduct a Remedial Investigation (RI) / Feasibility Study (FS) at the Wilcox Oil Company Superfund Site (site or Wilcox Oil). The scope of work includes preparation of a human health risk assessment (HHRA) for the site. The HHRA is an integral part of the RI process included in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300.430) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S. Code 9605). The risk assessment estimates potential risks to human receptors due to exposure to media affected by past activities related to the site.

1.1 SITE HISTORY

The Wilcox Oil site is an abandoned and demolished oil refinery and associated tank farm located north of Bristow, Creek County, Oklahoma (Figures 1 and 2). The site spans 140 to 150 acres and consists of the former Lorraine and former Wilcox Refineries. Two refinery process facilities and storage tank areas once operated at the two facilities. The site is flanked by Route 66 to the west; a residential area and Turner Turnpike to the northwest and north; Sand Creek to the southwest; and residential, agricultural, and wooded areas to the east and south.

The property was used for oil refinery operations from 1915 until November 1963. A skimming and cracking plant was constructed in 1929. The main components of the plant consisted of a skimming plant, cracking unit, and re-distillation battery with a vapor recovery system and treatment equipment. The Wilcox Oil Company expanded when it acquired the Lorraine Refinery in 1937, which was located west of the railroad. Oil refining began in 1915 at the Lorraine Refinery. Wilcox sold the property to a private individual in 1963. Most of the equipment and storage tanks were auctioned or salvaged for scrap metal by the new property owners. On 24 May 2013, EPA proposed the site to the National Priorities List (NPL). On 12 December 2013, the site officially became a Federal Superfund site (EPA Identification No. OK0001010917), when it was added to the NPL.

The Wilcox Oil and Gas Company and Lorraine Refining Company properties contained approximately 80 storage tanks of various sizes, a cooling pond, and approximately 10 buildings housing refinery operations. Crude oil, fuel oil, gas oil, distillate, kerosene, naptha, and benzene (petroleum ether) were all stored on the property.

Based upon the process areas and site use, the facility has been divided into five (5) major former operational areas: the Wilcox and Lorraine Process Areas, the East and North Tank Farms, and the Loading Dock Area. Figure 3 presents a layout of the operational areas and historical site features. The following details each area:

- Wilcox Process Area – The Wilcox Process Area is fenced and spans approximately 26 acres. Most of the equipment and storage tanks that remained onsite in 1963 were

auctioned and salvaged for scrap iron by private landowners; any remaining structures are in ruins. Four aboveground storage tanks (12,500-gallon capacity each) remain standing, in addition to a number of discarded drums and pieces of scrap iron and piping. A former Lead Additive area is present that is barren. There are multiple areas of stressed vegetation, barren areas, and visible, black tarry waste of a hydrocarbon nature. A building in the northern part of the former refinery has been converted to a residence. This building is currently vacant, as is a residence located in the eastern portion of the process area; however, the occupancy status of the residences onsite may change at any time. An intermittent creek (West Tributary) flows southward across the eastern portion of the refinery process area through a small pond in the southeast corner of the Wilcox Process Area into Sand Creek. Hydrocarbon waste has also been observed in several drainage channels that empty into Sand Creek.

- Lorraine Process Area – The Lorraine Process Area spans approximately eight acres and covers the southwestern portion of the site, south of West 221st Street South (formerly Refinery Road) and west of the railroad tracks. No refinery structures remain in either the processing area or refined product storage area. The First Assembly of God Church (currently vacant), a playground, and a vacant residence (parsonage) are located in this area. Sand Creek borders the western boundary of the Lorraine Process Area. A drainage feature is located near the northwestern corner of the former process area that drains south into Sand Creek. There are multiple areas of stressed vegetation, barren soil, and visible, black tarry waste of a hydrocarbon nature.
- East Tank Farm – The East Tank Farm spans approximately 80 acres and includes pits, ponds, and a number of circular berms that surrounded former tank locations. All of the former crude oil storage tanks have been removed; however, remnants of the former tank locations remain visible. It is not known if piping associated with the tanks remains in place underground or was removed. Many of the berms surrounding the pits, ponds, and former tanks have been breached or leveled. Of the three residential properties, all three are occupied and are located on or directly next to former tank locations in the East Tank Farm. All three residences use groundwater wells for water supply. There are multiple areas of stressed vegetation, barren soil, and visible, black tarry waste of a hydrocarbon nature. The East Tributary is located along the eastern boundary of the East Tank Farm and perennially flows south through a series of ponds to Sand Creek. Magellan Midstream Partners, LP operates a pumping station in the north-central portion of the East Tank Farm Area, as well as an active pipeline that transects the East Tank Farm, Loading Dock, and North Tank Farm Areas from the southeast to the northwest. Magellan Midstream Partners, LP has been known to pump several different petroleum products through the active pipeline, including kerosene, gasoline, jet fuel, and diesel.
- North Tank Farm – The North Tank Farm is located north of Refinery Road and west of the railroad tracks and spans approximately 20 acres. The North Tank Farm included crude oil and fuel oil storage tanks associated with the Lorraine Refinery. All of the tanks and other structures have since been removed. An occupied residence is located in the center of the North Tank Farm. There are areas of stressed vegetation, and visible, black tarry waste of a hydrocarbon nature.

- Loading Dock Area – The triangular-shaped Loading Dock Area spans approximately seven acres and is located north of Refinery Road and east of the railroad tracks. The Loading Dock Area was used for loading and unloading product by rail. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste of a hydrocarbon nature.

1.2 OBJECTIVE

The overall objective of this HHRA is to evaluate potential human health risk under current and potential future conditions at the site. Specifically, the HHRA presents the following objectives:

- Outline the regulatory basis and guidance for conducting the HHRA
- Outline the methods for determining chemical(s) of potential concern (COPC[s]) for the HHRA
- Present the exposure setting for the site that details local land use, nearby human populations, and potential site activities
- Develop a conceptual site model (CSM) that characterizes relevant contaminant pathways and receptors of concern
- Calculate potential carcinogenic and non-carcinogenic risk to receptors of concern (e.g., any human contact at the site under present or future scenarios)
- Identify areas or media that pose no unacceptable risks to human health and require no further action
- Determine COPCs that contribute significantly to overall site risks, which will be used to determine risk-based preliminary remediation goals in the FS
- Provide baseline risks for the no-action alternative in the FS that are used to evaluate risk reduction for each proposed alternative.

1.3 GENERAL HUMAN HEALTH RISK ASSESSMENT APPROACH

The HHRA follows guidance as recommended by EPA and Oklahoma Department of Environmental Quality (ODEQ). Specific application of guidance throughout the risk assessment process is detailed in Section 2 of this document. The following guidance documents were used for this HHRA:

- Risk Assessment Guidance for Superfund (RAGS), *Volume I: Human Health Evaluation Manual (Part A) (Interim Final)*, EPA/540/1-89/002 (EPA 1989)

- RAGS, *Volume I: Human Health Evaluation Manual Supplemental Guidance – Standard Default Exposure Factors* (Interim Final), Publication 9285.6-03 (EPA 1991a)
- RAGS, *Volume I – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)*, EPA/540/R-92/003 (EPA 1991b)
- *Guidelines for Data Usability in Risk Assessment (Part A)*. Office of Solid Waste and Emergency Response (OSWER) 9285.7-09A (EPA 1992)
- RAGS, *Volume I: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessments)*, Office of Emergency and Remedial Response 9285.7-47 (EPA 2002a)
- *Human Health Toxicity Values in Superfund Risk Assessments*, OSWER 9285.7-53 (EPA 2003)
- RAGS, *Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment)* Final, Office of Superfund Remediation and Technology Innovation, EPA/540/R/99/005 (EPA 2004)
- *Guidelines for Carcinogen Risk Assessment*, Risk Assessment Forum, EPA/630/P-03/001F (EPA 2005a)
- *Supplemental Guidance for Assessing Susceptibility From Early-Life Exposure to Carcinogens*, Risk Assessment Forum, EPA/630/R-03/003F (EPA 2005b)
- RAGS, *Volume I: Human Health Evaluation Manual (Part F: Supplemental Guidance for Inhalation Risk Assessment)*, Final, Office of Superfund Remediation and Technology Innovation, EPA-540-R-070-002 (EPA 2009)
- *Exposure Factors Handbook: 2011 Edition*, EPA/600/R-090/052F (EPA 2011)
- Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. Available at: <https://www.epa.gov/risk/regional-screening-levels-rsls> (EPA 2019a)
- *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Exposure Factors*, OSWER Directive 9200.1-120, (EPA 2014a)
- *Risk-Based Decision Making for Site Cleanup*. July (ODEQ 2013).

2. HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The purpose of this HHRA is to evaluate potential human health concerns from exposure to environmental media within the site that have been affected by past activities. To determine human health concerns, the HHRA evaluates potential sources of contamination and routes of migration based on current and potential future site uses. The HHRA results are based upon potential exposure pathways that can occur or are reasonably likely to occur in the future. Risks determined in the HHRA are considered baseline risks associated with exposure to media affected by the site. The baseline risk assumes no remedial actions or other means of exposure reduction (i.e., land use controls, digging restrictions, etc.). The HHRA evaluates the reasonable maximum exposure that has the potential to occur at the site. Therefore, the results of the HHRA are considered potential and should be used as a guideline in making risk management decisions.

Following EPA guidance (EPA 1989), the HHRA methodology involves a four-step process: data evaluation and hazard assessment, exposure assessment, toxicity assessment, and risk characterization. The following sections detail each step.

2.1 DATA EVALUATION AND HAZARD ASSESSMENT

In the data evaluation and hazard assessment, available environmental data were compiled and reviewed. The site environmental data are analyzed for data quality and compared to risk-based screening values. The comparison to risk-based screening values allows the HHRA to focus on analytes that may contribute significantly to overall sites risks. Analytes that are below risk-based screening values are below a level that is considered a concern for human health and do not require further evaluation.

2.1.1 Data Included in the Human Health Risk Assessment

Sampling for the RI occurred over multiple field events from August 2016 to December 2018. As part of the RI field investigation, soil, groundwater, sediment, surface water, indoor air, and subsurface soil gas samples were collected. These samples were evaluated quantitatively in the HHRA. Additionally, waste material samples and passive soil gas samples were also collected to support the RI; however, these samples were not evaluated quantitatively in the HHRA. The HHRA also evaluated soil sample results from residential yards that were collected by the EPA in 2015. Appendix A contains a listing of all samples evaluated in the HHRA. Figures 4 through 8 present the sample locations for each media of concern. Details about the media sampling is provided in the following subsections.

2.1.1.1 Soil Sampling

Soil samples collected as part of the RI field investigations were collected from the five exposure areas, the two residential yards situated on, or adjacent to, the East Tank Farm, the background soil study area, the test pit locations, and the monitoring well locations. Figure 4 presents soil sample locations. The collected soil samples were analyzed for volatile organic compounds (VOCs) including 1,2-dibromoethane (EDB), polycyclic aromatic hydrocarbons (PAHs),

semivolatile organic compounds (SVOCs), target analyte list (TAL) Metals (including mercury), and cyanide. A portion of these soil samples were also analyzed for hexavalent chromium, polychlorinated, dioxins/furans, and soil parameters.

Typically, any potential receptors exposure to soil at depth would also result in contact with the soil that is at the surface. Additionally, the construction of buildings and associated utilities would likely result in the mixing of soil at the surface and soil at depth. Therefore, a receptor would contact an entire soil column and not individual depth horizons. However, a review of the analytical soil sample results identified that soil at the surface typically had higher chemical concentrations than soils at depth. A difference in chemical concentrations was noticeable at depths of 2 feet (ft) below ground surface (bgs) and greater. Therefore, soil was evaluated based upon different depth horizons. For the purposes of the HHRA, surface soil was defined as the top 0 to 2 ft bgs. Subsurface soil samples were identified as soils from 2 to 15 ft bgs. Soil samples collected below 15 ft bgs were used in the RI to evaluate nature and extent of contamination at the site but were not considered appropriate in context of the human health CSM. The evaluation soils collected at depths of up to 15 ft bgs allows for the evaluation of potential soils that may be disturbed due to the construction of a basement or inground pool. Soil depths of greater than 15 ft bgs are typically not feasible for direct contact by receptors and have therefore been excluded from the HHRA.

In addition to soil samples collected as part of the RI field investigations, soil samples collected within residential yards were also evaluated in the HHRA. These soil samples were collected in a grid pattern by EPA and EA in 2015. These residential yard samples collected by the EPA were combined with the two residential yard samples collected as part of the RI field investigation in 2018 and were considered one dataset, called residential yards, in the HHRA. It is noted that these samples were evaluated separately from the soil samples collected in each of the five soil exposure areas.

For the residential yard samples collected in 2015, soil samples were collected based upon grids. Each grid had five sample locations. From each of the five locations, a 24-inch soil core was taken. The soil core was divided into depth intervals of 0-2 inch bgs, 2-6 inch bgs, and 12-24 inch bgs. The soil from each depth interval was combined together to produce one sample representing that depth interval for each grid. Therefore, all of these samples are identified as surface soil samples in the residential yard dataset. For the residential yard samples collected in 2018, the sample depths were 2 ft bgs, 6 ft bgs, 12 ft bgs, and 24 ft bgs. The samples were collected from two residences located in the ETF. These samples were divided into surface soil samples (2 ft bgs) and subsurface soil samples (6 ft bgs and 12 ft bgs). The samples collected at 24 ft bgs were not evaluated in the HHRA because the depth is greater than a depth that is considered in the HHRA.

Additionally, source areas within East Tank Farm, Wilcox Process Area, and Lorraine Process Area have been identified for interim removal actions. These areas are identified within the *Source Control Record of Decision Summary* (EPA 2018). The source areas include tank waste areas and the lead additive area. Figure 5 presents the location of these source areas identified for removal. Samples collected within these source areas were excluded from the HHRA. A list

of these samples is provided within Appendix A. A figure showing the waste characterization samples is also provided in Appendix A.

2.1.1.2 Groundwater Sampling

Groundwater samples were collected from monitoring wells, private residential wells, and piezometers. Sample results collected from the piezometers and residential wells were not evaluated in the HHRA. One shallow piezometer existed at the Lorraine Process Area, and three at the Wilcox Process Area prior to the start of the RI field investigation. There are uncertainties associated with the construction of these piezometers. As a result, the data collected from the piezometers was not carried forward for evaluation in the HHRA.

Residential wells have been sampled by the EPA since June 2014 (EPA 2015). The private residential wells are completed within the regional groundwater supply aquifer. Sampling of the private residential wells has not revealed any impacts from the Site. Therefore, only sample results from the monitoring wells are evaluated quantitatively in the HHRA.

Results from the monitoring wells represent the shallow or perched groundwater at the Site that is most likely affected by site activities. Monitoring wells are only located within the Lorraine Process Area (MW-01 through MW-03) and the Wilcox Process Area (MW-04 through MW-06). Figure 6 presents the location of the monitoring wells. The monitoring well samples were analyzed for VOCs, PAHs, SVOCs, TAL metals (including mercury), dissolved TAL metals (including mercury), cyanide, and hexavalent chromium.

Following the installation of MW-04, which is located in the northeast portion of the Wilcox Process Area, the subcontracted surveyor surveying in the new monitoring wells reported when they were loosening the well cap, it acted as if it was under pressure. EA personnel also noted that when the cap was removed, vapors could be observed escaping the top of the well casing. In addition, elevated concentrations of benzene, toluene, and ethylbenzene were also detected in the groundwater sample collected from the well, suggesting the presence of gasoline distillate. Although, light non-aqueous phase liquid (LNAPL) was not observed while gauging the well, the well is constructed to where the well screen is completely submerged below the shallow groundwater unit, which may be hindering the detection of LNAPL at this location. Sample results from MW-04 were evaluated in the HHRA.

2.1.1.3 Surface Water and Sediment Sampling

The sediment and surface water exposure areas are limited to selected surface water features at the site. The surface water bodies include Sand Creek (situated west and south of the Lorraine and Wilcox Process Areas), the East Tributary to Sand Creek, which is situated east of the East Tank Farm, the West Tributary to Sand Creek, which transects the southeast corner of the Loading dock area and southward through the Wilcox Process Area, and onsite/nearby ponds situated mainly on/adjacent to the Wilcox Process Area and the East Tank Farm. Figure 7 presents the location of the surface water and sediment samples.

During the RI field activities, widespread surface seeps/staining were noted along Sand Creek. These seeps appeared to either originate from groundwater seepage across the top of lithified sandstone units or were originating from abandoned pipelines that crossed Sand Creek. In some cases, odor/sheens were noted in association with these seeps. From 31 October through 2 November 2016, EPA and ODEQ, with the assistance of EA, performed surface water sampling within Sand Creek, which included these areas. During the sampling event, surface water samples SC-SW-03, SC-SW-04, SC-SW-05, and SC-SW-08 were collected from areas where more prominent groundwater seeps were documented.

Surface water samples were collected from the mid-point of the water column using a peristaltic pump. Most of the surface water samples were co-located with the sediment sample locations. Surface water samples were analyzed for VOCs, PAHs, SVOCs, TAL metals (including mercury), dissolved TAL metals (including mercury), and cyanide. A portion of the surface water samples were also analyzed for total hexavalent chromium and dissolved hexavalent chromium.

All sediment samples were collected from the 0 to 0.5 ft bgs depth. Sediment samples were analyzed for VOCs including EDB, PAHs, SVOCs, TAL metals (including mercury), and cyanide. A portion of the sediment samples were also analyzed for hexavalent chromium.

For risk-based screening and initial evaluation, sediment and surface water samples were evaluated statewide as one dataset.

2.1.1.4 Vapor Intrusion Samples

Figure 8 illustrates the locations of the vapor intrusion samples collected during the RI field events. Samples were collected within the Lorraine Process Area and the Wilcox Process Area. The structures investigated included The First Assembly of God Church (currently vacant) and a Parsonage (used as a primary residence for the Church Pastor's family (currently vacant), which are situated on the north portion of the Lorraine Process Area, and a building situated on the north portion of the Wilcox Process Area that has been converted to a residence, which was occupied when vapor intrusion samples were collected, but is currently vacant. The air samples included ambient air samples collected outside each structure, as well as, subslab air samples for the structures that possess slab on grade foundations, one crawlspace sample associated with one of the structures crawl space, and four indoor air samples. These samples were collected using 6-Liter Summa canisters equipped with 24-hour regulators. The collected air samples were analyzed for VOCs using method TO-15.

2.1.2 Data Quality Evaluation

The inclusion or exclusion of data within the HHRA, on the basis of analytical qualifiers, was performed in accordance with EPA guidance (EPA 1989, 1992). Data without qualifiers were retained at the reported concentration. The following procedures were followed if qualifiers were present:

- Analytical results bearing the “U” qualifier (indicating that the analyte was not detected at the given reporting limit [RL]) were retained in the data set and considered non-detects at the given RL.
- Analytical results for organic and inorganic analytes bearing the “J” qualifier (indicating that the reported value was estimated because the analyte was detected at a concentration below the RL or for other reasons) and “L” qualifier (indicating the reported value is below the contract required detection limit) were retained at the reported concentration.
- Analytical results bearing the “R” qualifier (indicating that reported results were rejected by the data validator) were not used in the HHRA. The only results that were qualified “R” were sample results for 2,4-dinitrophenol in 16 samples. It is noted that most of the “R” qualified data was from waste material samples, which are not evaluated in the HHRA. Only four sample locations evaluated in the HHRA from the East Tank Farm were “R” qualified for 2,4-dinitrophenol.

If duplicate samples were collected, the following guidelines were employed to select the appropriate sample measurement:

- If both samples show that the analyte was present, the maximum detected concentration of the two results was retained in the dataset.
- If both samples show no detect values, the minimum of the two non-detect RLs was retained in the dataset.
- If only one sample indicated that the analyte was present, it was retained in the dataset and the non-detect value was discarded.

2.1.3 Risk-Based Screening

Risk-based screening identifies analytes that warrant further evaluation in the HHRA. When an analyte is detected at a concentration less than its respective risk-based criteria, exposure is not expected to result in health effects or concerns, and the analyte is not considered further in the HHRA. Analytes detected at concentrations that exceed their respective risk-based screening criteria do not necessarily represent a health concern. Instead, the results of the screening identify those analytes that warrant a more detailed, site-specific evaluation to determine whether health effects may occur. Risk-based screening was conducted by comparing maximum detected analyte concentrations to risk-based screening concentrations. Any analyte in any medium for which the maximum measured concentration exceeded the risk-based screening concentration was retained as a COPC. Risk-based screening criteria are presented in Tables 2.1 through 2.15.

The EPA Regional Screening Levels (RSLs) (EPA 2019a) were the primary screening levels used for risk-based screening purposes in the HHRA. The EPA RSLs combine human health toxicity values with “standard” exposure scenarios to estimate analyte concentrations in environmental media that are considered by EPA to be protective of human exposures (including sensitive populations) over a lifetime. For instance, a residential scenario assumes a standard exposure of 350 days per year over a 26-year duration.

The screening values are based on specific, conservative, fixed levels of risk. For carcinogens, this is 10^{-6} , which is the lower bound for excess lifetime potential carcinogenic risk as defined by the NCP (EPA 1990). For non-carcinogens, the screening values are based on a hazard quotient (HQ) of 1.0. To account for potential cumulative effects of multiple contaminants affecting the same target organ, one-tenth of the acceptable non-carcinogenic threshold was used for screening. The EPA RSL table identifies some carcinogenic contaminants where the carcinogenic RSL is greater than one-tenth the non-carcinogenic RSL (identified in the EPA RSL tables as “c**”). In these instances, the more conservative one-tenth the non-carcinogenic RSL was used.

Soil and sediment results were compared to the EPA residential soil RSLs. Groundwater and surface water analytical results were compared to the EPA tap water RSLs. The maximum detected lead concentration in groundwater and surface water was compared to the EPA action level of 15 micrograms per liter ($\mu\text{g/L}$) for lead in residential and public drinking water (EPA 2009b).

For indoor air, sample results were compared to the residential and industrial indoor air RSLs (EPA 2019a). For sub-slab soil gas samples, the selected indoor air screening level was divided by a generic attenuation factor (AF) to determine the appropriate screening level (EPA 2019a). The EPA generic AFs of 0.03 was used for sub-slab soil gas samples.

2.1.4 Analytes Exceeding Risk-Based Screening Levels

Risk-based screening results are presented for each medium by area in Tables 2.1 through 2.17. COPCs selected for further evaluation are listed in the following sections. Soil samples (surface and subsurface) were evaluated based upon the five separate areas identified within the site. Groundwater, surface water, sediment, and soil gas sample results were combined into one dataset for risk-based screening.

2.1.4.1 North Tank Farm

2.1.4.1.1 COPCs in Surface Soil

The following COPCs in surface soil (Table 2.1) were identified based on the residential soil RSL risk-based screen: aluminum, antimony, arsenic, cobalt, iron, manganese, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene.

2.1.4.1.2 COPCs in Subsurface Soil

The following COPCs in subsurface soil (Table 2.2) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, iron, and manganese.

2.1.4.2 Lorraine Process Area

2.1.4.2.1 COPCs in Surface Soil

The following COPCs in surface soil (Table 2.3) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, hexavalent chromium, cobalt, copper, iron, lead, manganese, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.

2.1.4.2.2 COPCs in Subsurface Soil

The following COPCs in subsurface soil (Table 2.4) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, copper, iron, lead, manganese, thallium, and benzo(a)pyrene.

2.1.4.3 Loading Dock Area

2.1.4.3.1 COPCs in Surface Soil

The following COPCs in surface soil (Table 2.5) were identified based on the residential soil RSL risk-based screen: aluminum, antimony, arsenic, cobalt, iron, manganese, benzo(a)pyrene, benzene, and ethylbenzene.

2.1.4.3.2 COPCs in Subsurface Soil

The following COPCs in subsurface soil (Table 2.6) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, iron, and manganese.

2.1.4.4 Wilcox Process Area

2.1.4.4.1 COPCs in Surface Soil

The following COPCs in surface soil (Table 2.7) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cadmium, hexavalent chromium, cobalt, copper, iron, lead, manganese, thallium, vanadium, zinc, 2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene.

2.1.4.4.2 COPCs in Subsurface Soil

The following COPCs in subsurface soil (Table 2.8) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, iron, lead, manganese, vanadium, 2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, naphthalene, benzene, chloroform, and ethylbenzene.

2.1.4.5 East Tank Farm

2.1.4.5.1 COPCs in Surface Soil

The following COPCs in surface soil (Table 2.9) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, iron, lead, manganese, thallium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene.

2.1.4.5.2 COPCs in Subsurface Soil

The following COPCs in subsurface soil (Table 2.10) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, iron, manganese, and benzo(a)pyrene.

2.1.4.6 COPCs in Monitoring Well Groundwater

The following COPCs were identified in groundwater (Table 2.11) based upon a comparison to the tap water RSLs: total aluminum, total arsenic, total cobalt, total cyanide, total iron, total manganese, total vanadium, 2-methylnaphthalene, naphthalene, 1,2-dichloroethane, benzene, ethylbenzene, isopropylbenzene, m,p-xylene, o-xylene, and toluene.

2.1.4.7 COPCs in Surface Water

The following COPCs were identified in surface water (Table 2.12) based upon a comparison to the tap water RSLs: aluminum, arsenic, cadmium, hexavalent chromium, cyanide, iron, lead, manganese, vanadium, benzo(a)anthracene, and benzo(a)pyrene,

2.1.4.8 COPCs in Sediment

The following COPCs were identified in sediment (Table 2.13) based upon a comparison to the residential soil RSLs: aluminum, arsenic, hexavalent chromium, cobalt, iron, manganese, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene.

2.1.4.9 COPCs in Sub-Slab Soil Gas

Sub-slab soil gas samples were compared to modified indoor air RSLs for a residential receptor (Table 2.14). Based on the results of this screening, no COPCs were identified in sub-slab soil gas for potential vapor intrusion.

2.1.4.10 COPCs in Indoor Air

Indoor air samples were compared to EPA RSLs for residential air (Table 2.15). Based on the results of this screening, 1,3-butadiene, 1,4-dichlorobenzene, benzene, chloroform, dichlorodifluoromethane, and ethylbenzene were identified as COPCs.

2.1.4.11 COPCs in Residential Yard Exposure Area

The following COPCs in surface soil for the residential yard samples (Table 2.16) were identified based on the residential soil RSL risk-based screen: aluminum, antimony, arsenic, cadmium, cobalt, iron, manganese, thallium, vanadium, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and benzene.

The following COPCs in subsurface soil for the residential yard samples (Table 2.17) were identified based on the residential soil RSL risk-based screen: aluminum, arsenic, cobalt, iron, and benzo(a)pyrene.

2.2 EXPOSURE ASSESSMENT

The second step of the HHRA process is the exposure assessment. In the exposure assessment, the receptors of concern and potential exposure pathways are identified. The COPCs in site environmental media are converted into systemic doses, taking into account contaminant concentrations, rates of contact (e.g., ingestion rates), and absorption rates of different COPCs. The magnitude, frequency, and duration of these exposures are then integrated to obtain estimates of daily doses over a specified period of time (e.g., lifetime, activity-specific duration).

The exposure assessment includes several steps:

- Evaluating the exposure setting, including a description of the site current and future land uses, adjacent property land uses, and the potentially exposed human populations
- Developing the CSM identifying the source of contamination, contamination transport and release mechanisms, exposure media, exposure routes, and potentially exposed populations
- Calculating exposure point concentrations (EPCs) for each COPC for each of the complete exposure pathways identified in the CSM
- Identifying the exposure models and parameters with which to calculate the exposure doses
- Calculating exposure doses.

2.2.1 Exposure Setting

The Wilcox Oil site is an abandoned and demolished oil refinery and associated tank farm located north of Bristow, Creek County, Oklahoma (Figure 1). The approximate geographic coordinates for the site are 35°50'31" North latitude and 96°23'02" West longitude. The site spans 140 to 150 acres. The site is flanked by Route 66 to the west; a residential area and Turner Turnpike to the northwest and north; Sand Creek to the southwest; and residential, agricultural,

and wooded areas to the east and south. Parts of the site, mainly the East Tank Farm, are presently used for cattle grazing.

A vacant church and seven residences (five of which are currently occupied) are presently located on the facility. The seven residences are located on former crude oil storage tank or refinery operations areas. The three occupied residences located on the East Tank Farm are known to use water from domestic/private wells located onsite; the occupied residence in the North Tank Farm has a private well; however, the residence uses city water. Properties where refinery waste is present at the surface are fenced and secured to deter trespassing and potential contact with the waste. Current access to the remainder of the site is not controlled.

In the Wilcox Process Area, several refined product storage tanks, refinery-related debris, dilapidated buildings and structures remain on the property. There are two residences in this portion of the site, which are currently not occupied. In the northeastern portion of the Lorraine Process Area sits the Bristow First Assembly of God Church. A playground is located just south of the building and one residence is located to the west. All buildings are presently unoccupied. An active railroad divides the former Wilcox and Lorraine Process Areas. The North Tank Farm is located in the northwestern portion of the property, west of the railroad and north of West 221st Street South/Refinery Road, and is rural land containing one occupied residence. Three occupied residences are located in the East Tank Farm area, as well as five ponds and the East Tributary. The Loading Dock Area is located immediately east of the North Tank Farm and along the railroad tracks. Throughout the entire site, there are multiple areas of stressed vegetation, barren areas, and visible black tarry waste.

Depths to seasonal perched water zones are less than 10 feet and the shallowest regional water-bearing formation is reportedly less than 25 feet below ground surface [Oklahoma Department of Health (ODEH) 1994]. Depth to groundwater ranged 4.84 to 15.97 ft bgs in the groundwater monitoring wells installed at the Lorraine and Wilcox Process Areas during the RI. Based on the relatively shallow depth to groundwater encountered in these wells, this groundwater is inferred to be part of one or more perched groundwater zones situated above the regional groundwater-bearing units associated with the Barnsdall Formation. Private water wells exist at/near the site, and based on their depths, they obtain groundwater from the regional groundwater bearing units associated with the Barnsdall Formation. However, Oklahoma Water Resources Board (OWRB) Well Reports indicate that while most of the private wells are screened at deeper depths, a portion of these wells have been constructed in such a way that their filter pack extends upward to relatively shallow depths possibly putting these wells in communication with the shallow perched groundwater units situated above the regional groundwater bearing units associated with the Barnsdall Formation. Therefore, there is a potential for the perched water zone to serve as a potable water supply. As noted in Section 2.1.1.2, only the monitoring wells installed within the Lorraine Process Area and the Wilcox Process Area are evaluated in the HHRA because results from these wells represent the shallow or perched groundwater at the Site that is most likely affected by site activities.

Regional surface water flow associated with Sand Creek and its tributaries is primarily to the south. Sand Creek is a perennial surface water body that flows from the northwest adjacent to

the west boundary of the Lorraine Process Area and along the south Boundary of the Wilcox Process area. Sand Creek meanders approximately 3.5 miles east from the site until it merges with Little Deep Fork Creek, which is a fishery. The East Tributary and West Tributary are intermittent streams that cross the site and flow into Sand Creek. There are several additional drainage channels that empty into Sand Creek, with situated on the northwest portion of the Lorraine Process Area, and several others with observed hydrocarbon waste being situated on the Wilcox Process Area (EA 2016d).

The West Tributary of Sand Creek flows south through the southeast corner of the Loading Dock Area and across the east portion of the Wilcox Former Process Area through a small pond (Pond 1). This surface water features then drains from Pond 1, which is located in the southeast corner of the Wilcox Process Area, and discharges into Sand Creek. The East Tributary of Sand Creek is located along the eastern boundary of the East Tank Farm and perennially flows southward before discharging into Sand Creek. One pond (Pond 1) exists on the southeast portion of the Wilcox Process Area, and five ponds (Ponds 2, 3, 4, 5 and 8) are situated on the East Tank Farm. Pond 6 is an offsite pond located south of the East Tank Farm, and offsite Pond 7 is situated to the east of the East Tank Farm.

As discussed in Section 2.1.1, the site has been divided into five exposure areas for the purposes of this evaluation primarily for soils, which have been selected based on physical layout and historical use. Site areas are presented in Figures 2 through 8, along with the location of samples included in the HHRA. A discussion of the exposure setting for each area is provided below.

2.2.1.1 Wilcox Process Area

The Wilcox Process Area is fenced and spans approximately 26 acres. Most of the equipment and storage tanks that remained onsite in 1963 were auctioned and salvaged for scrap iron by private landowners; any remaining structures are in ruins. Four aboveground storage tanks (12,500-gallon capacity each) remain standing, in addition to a number of discarded drums and pieces of scrap iron and piping. A former Lead Additive area is present that is barren. There are multiple areas of stressed vegetation, barren areas, and visible, black tarry waste of a hydrocarbon nature. A building in the northern part of the former refinery has been converted to a residence, which is currently vacant. A second residence located in the eastern portion of the process area is also unoccupied. An intermittent creek (West Tributary) flows southward across the eastern portion of the refinery process area through a small pond in the southeast corner of the refinery area into Sand Creek.

2.2.1.2 Lorraine Process Area

The Lorraine Process Area spans approximately 8 acres and covers the southwestern portion of the site, south of West 221st Street South (formerly Refinery Road) and west of the railroad tracks. No refinery structures remain in either the processing area or refined product storage area. The First Assembly of God Church (currently vacant), a playground, and a vacant residence are located in this area. A drainage feature borders the western boundary of the

Lorraine Process Area and drains south to Sand Creek. There are multiple areas of stressed vegetation, barren soil, and visible, black tarry waste of a hydrocarbon nature.

2.2.1.3 East Tank Farm

The East Tank Farm spans approximately 80 acres and includes pits, ponds, and a number of circular berms that surrounded former tank locations. All of the former crude oil storage tanks have been removed; however, remnants of the former tank locations remain and are visible. It is not known if all of the piping associated with the tanks remains or was removed. Many of the berms surrounding the pits, ponds, and former tanks have been breached or leveled. There are three occupied residences located on or directly next to former tank locations in the East Tank Farm. There are multiple areas of stressed vegetation, barren soil, and visible, black tarry waste of a hydrocarbon nature. Hydrocarbon waste was also observed in several drainage channels that empty into Sand Creek. The East Tributary is located along the eastern boundary of the East Tank Farm and perennially flows south through a series of ponds to Sand Creek. Magellan Midstream Partners, LP operates a pumping station in the north-central portion of the East Tank Farm Area, as well as an active pipeline that transects the East Tank Farm, Loading Dock, and North Tank Farm Areas from the southeast to the northwest. Magellan Midstream Partners, LP has been known to pump several different petroleum products through the active pipeline, including kerosene, gasoline, jet fuel, and diesel.

2.2.1.4 North Tank Farm

The North Tank Farm is located north of Refinery Road and west of the railroad tracks and spans approximately 20 acres. The North Tank Farm included crude oil and fuel oil storage tanks associated with the Lorraine Refinery. All of the tanks and other structures have since been removed. An occupied residence is located in the center of the North Tank Farm. There are areas of stressed vegetation, and visible, black tarry waste of a hydrocarbon nature.

2.2.1.5 Loading Dock Area

The triangular-shaped Loading Dock Area spans approximately 7 acres and is located north of Refinery Road and east of the railroad tracks. The Loading Dock Area was used for loading and unloading product by rail. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste of a hydrocarbon nature.

2.2.2 Conceptual Site Model

Based upon the site history and exposure setting, a CSM was formulated for the site. The CSM presents the potential sources of contamination, routes of migration, and potential receptors. Exposure pathways begin from potential source areas and progress through the environment via fate and transport processes to potential human receptors. Figure 8 illustrates the CSM. The CSM identifies which exposure pathways are complete and require further evaluation in the HHRA. An exposure pathway describes a mechanism by which a population or individual may

be exposed to COPCs at the site. A completed exposure pathway requires the following four components:

- Source and mechanism of chemical release to the environment
- Environmental transport medium for the released chemical
- Point of potential human contact with the contaminated medium
- Human exposure route at the point of exposure.

All four components must exist for an exposure pathway to be complete and for exposure to occur. Incomplete exposure pathways do not result in actual human exposure and are not included in the exposure assessment and resulting risk characterization.

2.2.2.1 Potential Source Areas

Potential source areas at the site include the Wilcox Process area, with the associated aboveground storage tanks, discarded drums, and scrap iron and piping, as well as a former Lead Additive area; the Lorraine Process Area, where refinery structures used to exist; the East Tank Farm, with remnants of former tanks; the North Tank Farm, where crude oil and fuel oil storage tanks used to sit; and the Loading Dock Area, where product was brought on and off the site. All source areas also report stressed vegetation and visible black tarry waste of a hydrocarbon nature. Figure 3 illustrates the locations where these potential source materials were identified and sampled

Potential sources include the skimming and cracking plant, re-distillation battery, stills, cooling ponds, a lead additive area, approximately 10 buildings housing refinery operations, storage tanks, and other related refinery structures historically located on the Lorraine and Wilcox Process Areas. Other potential sources include approximately 80 bulk storage tanks of various sizes located at the Lorraine and Wilcox Process Areas, as well as the East and North Tank Farms. Surficial waste material was also identified and sampled at the loading Dock Area.

Crude oil, fuel oil, gas oil, distillate, kerosene, naphtha, and benzene (petroleum ether), acids, and other refined products were reportedly stored on the property (EA 2016). Periodic releases of crude oil, sludge, and refined product occurred in these areas during operations. These releases may have been discharged to surface and subsurface soil, and subsequently migrated to groundwater, surface water, and sediment. VOCs may have also migrated into the vadose zone as soil gas.

2.2.2.2 Migration Pathways

The nature and extent of contamination are combined with source identification and physical characteristic information to evaluate migration pathways. Several migration pathways are possible at the site. The following migration pathways have been identified as the primary pathways for the site:

- Impact to subsurface soil

- Volatilization to vadose zone
- Leaching to groundwater
- Groundwater discharge to surface water
- Sediment and surface water transport
- Groundwater transport.

As a result of the migration pathways and results of site investigations, media of concern include soil, sediment, surface water, and groundwater.

2.2.2.3 Receptors of Concern

Within the exposure assessment, EPA (1989, 1991b) guidance requires that plausible exposure under both current and future land use be evaluated in the HHRA. The site is in an area with residential and agricultural land use, so these are the most likely potential exposure scenarios. There are no zoning codes or zoning classifications within Bristow or Creek County. Therefore, the Site can also be used for potential commercial/industrial uses due to its location near a railroad line and highway. It is likely that construction or maintenance activities would occur that would require excavation, construction, or regrading; therefore, a construction worker scenario was considered. There are streams and ponds located throughout the site. Most are located on private property and are not used for recreational activities. However, access to the surface water bodies is not controlled and there is a potential for trespassers to access.

The primary water supply aquifer is located within the Barnsdall formation. However, perched groundwater at the site is also considered a potential water supply in this HHRA. As noted, the filter packs of some residential wells extend upward to relatively shallow depths possibly putting these wells in communication with the shallow perched groundwater units situated above the regional groundwater bearing units associated with the Barnsdall Formation. Groundwater at the site has been encountered as shallow as approximately 5 ft bgs. The assumption was made that groundwater could be contacted during subsurface activities. It is therefore assumed that any construction or installation of underground utilities or pipelines may contact groundwater.

VOCs were detected in groundwater at the site. As a result, there is a potential for inhalation of VOCs from groundwater. Complete exposure pathway for inhalation of VOCs from groundwater is through typical use as a tap water source for any building occupants and within a trench during subsurface activities. Indoor air samples from existing buildings within the Lorraine Process Area and Wilcox Process Area did reveal COPCs. However, sub-slab soil gas samples did not reveal any COPCs below these buildings. As a result, the indoor air COPCs are likely a result of indoor source areas and not vapor intrusion from groundwater. Therefore, vapor intrusion from groundwater into existing buildings at the site is not considered complete, and indoor air COPCs were not assessed in the HHRA.

Current/Future Use Receptors

The current use receptors were also considered potential future use receptors and are described in more detail in the following paragraphs.

Residential (Current and Future)

Currently, there are residences on portions of the site. Additionally, there are no current land use restrictions or zoning so residences can be built on any portion of the site. Residential receptors were therefore evaluated in the HHRA to characterize potential risks to current residents and provide a baseline risk evaluation to fully support risk management decisions for the site. Residents are expected to contact soil at depths and use perched groundwater as a tap water source. They are also expected to contact the surface water bodies located throughout the site. Additionally, residents are also expected to have gardens and grow home-grown produce within residential yards. There is also a potential for residents to use groundwater as an irrigation water source for gardens and lawns. Contact with irrigation water is generally lower than contact with groundwater as a tap water source. Therefore, the evaluation of groundwater as a tap water source would account for other uses of groundwater at a residence. Because portions of the Site are used for cattle grazing, the residents are assumed to ingest cattle grazed exclusively at the Site. The assessment of cattle grazing is a protective evaluation since most of the site is rocky or has rock outcrops that make cattle grazing in all exposure areas challenging.

Based upon typical residential use and contact, residents could be exposed to soil, come in contact with surface water and sediment. Residential users may use site groundwater as a potential tap water supply. The following exposure pathways are considered potentially complete for the residential scenario:

- Incidental ingestion of soil
- Dermal contact with soil
- Inhalation of chemicals adsorbed to windblown soil released to outdoor air
- Incidental ingestion of surface water
- Dermal contact with sediment and surface water
- Ingestion of groundwater
- Dermal contact with groundwater
- Inhalation of chemicals volatilized from groundwater during domestic use
- Ingestion of home-grown produce
- Ingestion of beef

Trespassers

Due to the presence of streams and ponds at the site, recreational users and trespassers are potential receptors. It is noted that trespassers and recreational users are both receptors that are expected to have very intermittent rates of contact with the site. These receptors are expected to be a low frequency contact receptor and are not expected to spend extended periods of time

within the site. Because most of the Site is private owned and vacant areas are fenced, the primary receptor for this area is a trespasser who trespasses onto to property to visit the streams and ponds in the area. Therefore, the trespasser is expected to have higher rates of contact. As a result, only the trespasser was evaluated in the HHRA. Risk results for this receptor would be protective of any recreational users, site visitors, and other low frequency receptors. As a conservative measure, these receptors are assumed to be within an adolescent age range (i.e., 6 to 16 years of age). Adults are a possibility; however, the assessment of the adolescent provides an evaluation that is protective of the adult. Of the soil media considered in the HHRA, trespassers were evaluated for exposure to surface soil only, since they are not expected to dig deeper than 2 ft bgs. Trespassers are also expected to contact surface water and sediment at the site. The following exposure pathways are potentially complete for the trespasser scenario:

- Incidental ingestion of surface soil
- Dermal contact with surface soil
- Inhalation of particulates from windblown soil released to outdoor air
- Incidental ingestion of surface water
- Dermal contact with sediment and surface water

Construction Worker

Future use of the site could include the development for industrial, commercial, or residential use. As a result, the construction worker would be present during development of the site. The construction worker could also be present during any excavations for utilities, other subsurface disturbances, or remedial actions. Therefore, the construction workers could be exposed to both surface and subsurface soil. Due to the depth to groundwater within the Lorraine Process Area and Wilcox Process Area, the assumption was made that construction workers may contact groundwater during subsurface activities in these areas. Additionally, subsurface activities are assumed to involve trenching. The following exposure pathways are potentially complete for the construction worker scenario:

- Incidental ingestion of soil
- Dermal contact with soil
- Inhalation of chemicals absorbed to windblown soil in outdoor air (i.e. fugitive dust)
- Dermal contact with groundwater and subsequent incidental ingestion
- Inhalation of volatiles while working in a trench

Commercial/Industrial Worker

Currently, the site is an industrial facility that is not in use. Workers may occasionally perform mowing and maintenance tasks and have limited contact with soil or other media. The commercial/industrial worker is assessed for future reuse of the site and future buildings or other structures are constructed at the site. It was assumed that future reuse of the site would use groundwater as a potential tap water supply. Even if groundwater is not used as a tap water supply, the assessment of groundwater as a water supply source accounts for any potential groundwater use within the Lorraine Process Area and Wilcox Process Area, including as

process/production water or irrigation. The following exposure pathways are potentially complete for the commercial/industrial worker scenario:

- Incidental ingestion of surface soil
- Dermal contact with surface soil
- Inhalation of particulate from windblown soils released to outdoor air
- Ingestion of groundwater
- Dermal contact with groundwater
- Inhalation of chemicals volatilized from groundwater during use as a water supply

Commercial/industrial workers are not expected to come into contact with subsurface soil or surface water/sediment at the site, so these pathways are not complete.

2.2.3 Selection of Exposure Point Concentrations

EPCs were derived to quantify concentrations of COPCs. For the HHRA, the EPC represents the concentration of COPCs in media of concern that a potential receptor is expected to contact over a designated exposure period. Reported concentrations, as discussed in Section 2.1.2, of COPCs were used to calculate the 95 upper confidence limit of the mean (UCLM) in each medium of concern (EPA 1989, 1992). Tables 3.1 through 3.17 present the EPCs for each medium and each area evaluated.

The 95UCLM was used because assuming long-term contact with the maximum concentration is not reasonable (EPA 1989). The 95UCLM was determined through the EPA ProUCL program version 5.0.02 (EPA 2016). The EPA ProUCL program determines the distribution, sample size, variance, and 95UCLM of each COPC data set (EPA 2016). The EPC is based on the lesser of the maximum detected concentration for a medium or the 95UCLM (EPA 1989, 2016). Outputs for the ProUCL program are presented in Appendix B.

For groundwater, only total (unfiltered) inorganics data are available for evaluation. For surface water, total (unfiltered) and dissolved (filtered) inorganic data are available. Only the total (unfiltered) inorganic data for surface water were evaluated in the HHRA. The assessment of the total inorganics for direct contact with groundwater and surface water (i.e., ingestion and dermal contact) provides a protective evaluation.

For the residential yard assessment, the maximum detected concentration was used as the EPC. For the assessment of residential yard samples, all sample results were combined into one dataset for screening. Because each yard represents a separate exposure area, the use of a 95UCLM is not appropriate in the assessment of potential risk concerns. However, the dataset for each individual residential yard was not a sufficient size to calculate 95UCLMs for each residential yard. Therefore, the maximum detected concentration presents a protective evaluation of potential risk concerns. Tables 3.16 and 3.17 present 95UCLMs for the residential yard dataset that provides an evaluation of the chemical concentration across the yards.

2.2.4 Exposure Intake Equations

The next step in the exposure assessment is to estimate COPC intake or exposure for each exposure pathway considered in the HHRA. In the exposure assessment, two different measures of intake are provided, depending on the nature of the effect being evaluated. When evaluating longer-term (i.e., subchronic and chronic) exposures to chemicals that produce adverse non-carcinogenic effects, intakes are averaged over the period of exposure (i.e., the averaging time [AT]) (EPA 1989). This measure of intake is referred to as the average daily intake (ADI) and is a less than lifetime exposure. For chemicals that produce carcinogenic effects, intakes are averaged over an entire lifetime and are referred to as the lifetime average daily intake (LADI) (EPA 1989). Detailed equations for determining intake are provided on Tables 4.1 through 4.16.

2.2.4.1 Soil and Sediment Intake Equations

The generic equation to calculate ingestion intake from soil and sediment is given below:

$$(L)ADI = \frac{EPC \times CR \times EF \times ED \times CF}{BW \times AT}$$

where:

<i>(L)ADI</i>	=	(Lifetime) Average daily intake (mg/kg per day [mg/kg/day])
<i>EPC</i>	=	Concentration of a COPC in soil or sediment (mg/kg)
<i>CR</i>	=	Ingestion Rate (milligrams per day)
<i>EF</i>	=	Exposure frequency (days/year)
<i>ED</i>	=	Exposure duration (years)
<i>BW</i>	=	Body weight (kilograms [kg])
<i>AT</i>	=	Averaging time (days)
		Non-carcinogen (ED × 365 days/year)
		Carcinogen (70 years × 365 days/year = 25,550 days)
<i>CF</i>	=	Conversion Factor (10 ⁻⁶ kilograms per milligram [kg/mg]).

The generic equation to calculate dermal intake from soil and sediment is given below:

$$(L)ADI = \frac{EPC \times SA \times DA \times EF \times ED \times CF}{BW \times AT}$$

where:

<i>(L)ADI</i>	=	(Lifetime) Average daily intake (mg/kg/day)
<i>EPC</i>	=	Concentration of a COPC in soil or sediment (mg/kg)
<i>SA</i>	=	Surface Area for Contact (square centimeters [cm ²])
<i>DA</i>	=	Absorbed Dose DA = Absorption Factor (ABS) × Adherence Factor (AF) (milligrams per square centimeter [mg/cm ²])
<i>EF</i>	=	Exposure frequency (days/year)
<i>ED</i>	=	Exposure duration (years)
<i>BW</i>	=	Body weight (kg)
<i>AT</i>	=	Averaging time (days) Non-carcinogen (ED × 365 days/year) Carcinogen (70 years × 365 days/year = 25,550 days)
<i>CF</i>	=	Conversion Factor (10 ⁻⁶ kg/mg).

The intake of particulates from soil was calculated using the following equation (EPA 2009):

$$EC = \frac{C_{air} \times ET \times EF \times ED \times CF_1}{AT \times CF_2}$$

where:

<i>EC</i>	=	Exposure concentration (milligrams per cubic meter [mg/m ³] or micrograms per cubic meter [µg/m ³])
<i>C_{air}</i>	=	Concentration of chemical in air (mg/m ³)
<i>ET</i>	=	Exposure time (hours)
<i>EF</i>	=	Exposure frequency (days/year)
<i>ED</i>	=	Exposure duration (years)
<i>CF₁</i>	=	Conversion Factor (1,000 micrograms per milligram [µg/mg]) (carcinogenic intakes only)
<i>CF₂</i>	=	Conversion Factor (24 hours/day)
<i>AT</i>	=	Averaging time (days) Non-carcinogen (ED × 365 days/year) Carcinogen (70 years × 365 days/year = 25,550 days).

The concentration of chemicals in air resulting from emissions from soil is developed following procedures presented in the EPA Soil Screening guidance (EPA 2002b). Particulate emissions from sediment were not considered in the HHRA. The chemical concentration in air is calculated from:

$$C_{air} = C_{soil} \times \left[\frac{1}{PEF} + \frac{1}{VF} \right]$$

where:

C_{air}	=	Concentration of chemical in air (mg/m ³)
C_{soil}	=	Chemical concentration in soil (mg/kg)
PEF	=	Particulate emission factor (m ³ /kg)
VF	=	Volatilization Factor (m ³ /kg).

The PEF relates the concentration of a chemical in soil with the concentration of dust particles in air. For residential exposures, a PEF value of 1.31×10^9 is used based a 0.5-acre site and using EPA guidance values for Lincoln, Nebraska (EPA 2002b). For a construction worker, the PEF is based upon potential construction that may occur at the site. The PEF was calculated based upon excavation, grading, and tilling at the site which results in a PEF from other than vehicle traffic assuming 5 acres is disturbed during construction. The EPA RSL calculator was used to determine the PEF for the construction worker (EPA 2019b). Additionally, the VF was determined using the EPA RSL calculator (EPA 2019b). Outputs from the calculator are provided in Appendix C.

2.2.4.2 Groundwater and Surface Water Intake Equations

The generic equation to calculate groundwater and surface water ingestion intakes is given below:

$$(L)ADI = \frac{EPC \times CR \times EF \times ED}{BW \times AT}$$

where:

$(L)ADI$	=	(Lifetime) Average daily intake (mg/kg/day)
EPC	=	Concentration of a COPC in groundwater or surface water (milligrams per liter [mg/L])
CR	=	Ingestion Rate (liters [L] per day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)
		Non-carcinogen ($ED \times 365$ days/year)
		Carcinogen ($70 \text{ years} \times 365 \text{ days/year} = 25,550$ days).

The following equation is used to assess dermal absorbed dose from groundwater or surface water:

$$DAD = \frac{DA_{event} \times SA \times EF \times ED}{BW \times AT}$$

where:

DAD	=	Dermal absorbed dose (mg/kg/day)
DA_{event}	=	Dermal absorbed dose per event (mg/cm ² -event)
SA	=	Skin-surface area available for contact (cm ²)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)
		Non-carcinogen ($ED \times 365$ days/year)
		Carcinogen ($70 \text{ years} \times 365$ days/year = 25,550 days).

The absorbed dose per event (DA_{event}) is estimated using a non-steady state approach for organic compounds and a steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^* \text{ then : } DA_{event} = (2)(K_p)(FA)(C_w)(CF) \left(\sqrt{\frac{6\tau t_{event}}{\pi}} \right)$$

$$\text{If } t_{event} > t^* \text{ then : } DA_{event} = (K_p)(FA)(C_w)(CF) \left(\frac{t_{event}}{1+B} + 2\tau \left[\frac{1+3B+3B^2}{(1+B)^2} \right] \right)$$

where:

t_{event}	=	Event duration (hour/event)
t^*	=	Time to reach steady-state conditions (hour)
K_p	=	Permeability coefficient of water through skin (centimeters per hour)
FA	=	Chemical-specific fraction absorbed (dimensionless)
C_w	=	Chemical concentration in water (mg/L)
τ	=	Lag time (hour)
π	=	Pi (dimensionless; equal to 3.14)
CF	=	Conversion factor (0.011 L per cubic centimeter)
B	=	Dimensionless ratio of the permeability of the stratum corneum relative to permeability across the viable epidermis.

For inorganics, the following steady-state equation is used to estimate DA_{event} :

$$DA_{event} = (K_p) \times (C_w) \times (t_{event}).$$

A majority of the exposure assumptions for dermal contact with water are based on default assumptions presented in EPA RAGS E guidance (EPA 2004). For resident exposure to groundwater, a full-body exposure is assumed. Construction worker exposure to groundwater is only assumed for the head, hands, and forearms. Surface water exposures assume contact with exposure body parts, generally head, hands, forearms, legs, and feet.

For inhalation, ECs were calculated. ECs are time-weighted average concentrations from contaminant concentrations in air, adjusted based on the characteristics of the exposure scenario being evaluated. The generic equation to calculate inhalation exposure concentration from groundwater only is given below (EPA 2009):

$$EC = \frac{EPC \times ET \times EF \times ED \times CF_1}{AT \times CF_2}$$

where:

<i>EC</i>	=	Exposure Concentration (µg/m ³ or mg/m ³)
<i>EPC</i>	=	Concentration of a COPC in air (mg/m ³)
		EPC (for residential exposure) = COPC concentration in groundwater (mg/L) × K
		EPC (for construction worker) determined through Virginia Department of Environmental Quality trench model
<i>K</i>	=	Andelman Volatilization Factor (0.5 Liters per cubic meter) (for inhalation of VOCs during use as a tap water source)
<i>ET</i>	=	Exposure Time (hours/day)
<i>EF</i>	=	Exposure frequency (days/year)
<i>ED</i>	=	Exposure duration (years)
<i>AT</i>	=	Averaging time (days)
		Non-carcinogen (ED × 365 days/year)
		Carcinogen (70 years × 365 days/year = 25,550 days)
<i>CF₁</i>	=	Conversion Factor (10 ³ µg/mg) (for carcinogenic intakes only)
<i>CF₂</i>	=	Conversion Factor (24 hours/day).

2.2.4.3 Ingestion of Home-grown Produce

The EPC for home-grown produce was determined through uptake from surface soil only. The determination of COPC concentration in home-grown produce was taken from EPA guidance (EPA 2005c). The following equations were used to determine the dose for home-grown produce intake:

$$(L)ADI = \frac{EPC \times VIR \times EF_f \times ED}{AT}$$

where:

<i>EPC</i>	=	Concentration of a COPC in home-grown produce (Pr) (mg/kg)
<i>VIR</i>	=	Vegetable Intake Rate (kg vegetable/kg BW-day)
<i>EF_f</i>	=	Exposure frequency of foods (days/year)
<i>ED</i>	=	Exposure duration (years)
<i>AT</i>	=	Averaging time (days)
		Non-carcinogen (ED × 365 days/year)
		Carcinogen (70 years × 365 days/year = 25,550 days).

The COPC concentrations in home-grown produce were calculated using factors for uptake from soil into the edible portion of plants. The surface soil EPC is used as an initial concentration for

estimating chemical concentrations in home-grown produce. The wet-weight plant concentration due to root uptake (Pr) is determined by the following:

$$Pr = Cs \times Brag \times 0.12$$

where:

Pr	=	Concentration of a COPC in home-grown produce (mg/kg)
Cs	=	dry weight concentration of COPC in soil (mg/kg soil)
$Brag$	=	Plant to soil bioconcentration factor for aboveground produce (unitless)
0.12	=	dry weight to wet weight conversion factor (unitless)

The $Brag$ represents above-ground produce and applies to exposed fruits and vegetables and protected fruit and vegetables. $Brag$ values were taken directly from EPA guidance (EPA 2005c). For chemicals not available in EPA guidance, the $Brag$ was calculated based upon the following correlation presented in EPA guidance (EPA 2005c):

$$\log Brag = 1.588 - 0.578 (\log Kow)$$

2.2.4.4 Ingestion of Beef

The EPC for beef is determined through uptake from surface soil only. The determination of contaminant concentration in beef is taken from EPA guidance (EPA 2005c). The following equations were used to determine the dose for beef intake:

$$(L)ADI = \frac{EPC \times BIR \times EF_f \times ED}{AT}$$

where:

EPC	=	Concentration of a COPC in home-grown produce (Pr) (mg/kg)
BIR	=	Beef Intake Rate (kg beef/kg BW-day)
		To account for losses from food preparation:
		$BIR \times \left[\frac{100-29.7}{100} \right]$
EF_f	=	Exposure frequency of foods (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time (days)
		Non-carcinogen ($ED \times 365$ days/year)
		Carcinogen (70 years $\times 365$ days/year = 25,550 days).

The generic equation to calculate the EPC in beef is given below:

$$EPC = [(Fi \times Qp_{(forage,cattle)} \times Pr) + (Q_{soil(cattle)} \times Cs \times Bs)] \times Ba_{beef} \times MF$$

where:

EPC	=	Contaminant Concentration in beef (mg/kg)

F_i	=	Fraction of plant type grown on contaminated soil and ingested by cattle; assume cattle only consume forage grown on contaminated soil (unitless)
$Q_{p(\text{forage}, \text{cattle})}$	=	Quantity of forage ingested by cattle per day; a value of 8.8 (kg/day)
P_r	=	Concentration of COPC in plant due to root uptake and ingested by cattle (mg/kg), calculated using equation above
$Q_{S\text{soil}(\text{cattle})}$	=	Quantity of soil ingested by the cattle (kg/day)
C_s	=	Surface soil EPC (mg/kg)
B_s	=	Soil bioavailability factor (unitless). A default value of 1 is used
Ba_{beef}	=	Biotransfer factor for beef (day/kg). Taken from EPA 2005c guidance, if not available calculated based upon: $\log(Ba_{\text{beef}}) = (-7.6 + \log Kow)$, from Travis and Arms (1998).
MF	=	Metabolism factor (unitless). The default value of 1 is used for all COPCs (EPA 2005c).

2.2.5 Selection of Exposure Parameters

The second step in quantifying intake requires the identification of exposure parameters. Exposure parameters include rates of contact (e.g., ingestion rates, skin surface areas, etc.), EF and duration, BW, and AT. The contact rate reflects the amount of contaminated media contacted per unit time or event. EF and duration are used to estimate the total time of exposure to COPCs in media of concern. The BW represents the average BW over an exposure period (EPA 1989). Specific exposure parameters for each receptor are chosen based on EPA guidance (EPA 1989, 1991a, 1991b, 2004, 2011, 2014a) and other appropriate resources. Exposure parameters are presented in Tables 4.1 through 4.16.

Soil Exposure Parameters

Exposure parameters for resident adult and child exposure to soil are presented on Tables 4.1 and 4.2, exposure parameters for the construction worker are presented on Table 4.3, exposure parameters for the commercial/industrial worker are presented on Table 4.4, and exposure parameters for the adolescent trespasser are presented on Table 4.5. For all receptors, complete exposure pathways to soil include ingestion of, dermal contact with, and inhalation of chemicals absorbed to windblown soil. The ingestion rate for residential exposure to soil is presented in multiple EPA guidance documents and is assumed at 100 mg/kg for the adult and 200 mg/kg for the child (EPA 1991a, 1991b, 2011, 2014a). The ingestion rate for the construction worker is taken from guidance for the calculation of the EPA RSLs and Supplemental Guidance for Developing Soil Screening Levels (EPA 2002b, 2014a). A construction worker soil ingestion rate of 330 mg/kg is assumed. For the commercial/industrial worker, a soil ingestion rate of 100 mg/kg is assumed to account for both indoor and outdoor activities (EPA 2014a). For the adolescent trespasser, a soil ingestion rate of 100 mg/kg, similar to the adult resident, was assumed.

Dermal exposure to soil is assumed for exposed body surface areas only. The SA available for contact generally assumes hands, forearms, head, and feet for the resident. The recommended

SA for the adult is 6,032 cm² and the child is 2,373 cm², based on the mean SA (EPA 2019a). The construction worker and commercial/industrial worker is only assumed to contact soil with hands, forearms, and head with a mean SA of 3,527 cm² (EPA 2014a). For the trespasser, the mean SA for the head, hands, forearms, and lower legs for the age groups of 6 to <11 years and 11 to <16 years was determined to be 4,530 cm² (EPA 2011).

The inhalation of soil particulates assumes a 24-hour exposure period for the resident and an 8-hour work-day for the construction worker. The resident adult and construction worker are assumed to weigh 80 kg, and the resident child is assumed to weigh 15 kg. The trespasser mean weight was 45 kg. The resident adult is expected to be exposed to soil for a 20-year duration at a frequency of 350 days per year. The resident child is expected to be exposed to soil for 6 years at a frequency of 350 days per year. The construction worker is assumed to contact soil for 250 days per year over a 1-year construction period. A trespasser was assumed to visit the site 2 days/week for 6 months out of the year for a total of 52 days/year. This is assumed to occur over a 10-year exposure duration based upon the age range of 6 to 16 years for the adolescent trespasser.

Groundwater Exposure Parameters

Exposure parameters for groundwater are presented on Tables 4.6 through 4.9. Residential exposure to groundwater was evaluated as a potable water supply. For the resident adult, complete exposure pathways include ingestion of, dermal contact with, and inhalation of vapors. For the resident child, complete exposure pathways include ingestion of and dermal contact with groundwater. Inhalation of vapors is accounted for in the adult exposure estimates, so a child is not evaluated. The resident adult is assumed to weigh 80 kg and be exposed to groundwater for a 20-year duration at a frequency of 350 days per year. The resident child is assumed to weigh 15 kg and be exposed to groundwater for 6 years at a frequency of 350 days per year. The resident adult is assumed to consume 2.5 L per day of water, and the resident child is assumed to consume 0.78 L per day (EPA 2014a). For dermal contact while showering or bathing, the recommended surface area for the resident adult is 19,652 cm² and the resident child is 6,365 cm², based on the mean surface area for the total body (EPA 2014a). The adult is assumed to shower for an average of 0.71 hour per shower, and the child is assumed to bathe for 0.54 hour (EPA 2011). For inhalation of volatiles from groundwater, the resident is assessed for a 24 hour/day exposure. To determine the exposure concentration for inhalation exposures, the groundwater EPC is multiplied by the Andelman Volatilization Factor (EPA 2019a). The Andelman Volatilization Factor accounts for all inhalation exposures to VOCs within a residence. This includes potential volatilization of VOCs during household activities, including showering, dish washing, flushing of toilets, and other activities that require the use of tap water.

Construction worker exposure to groundwater was evaluated for exposure pathways that could be complete during construction activities (e.g., digging at depth or working in a trench). Exposure parameters are presented on Table 4.8. These exposure pathways include incidental ingestion of and dermal contact with groundwater and inhalation of VOCs in the air of a trench. The construction worker is assumed to weigh 80 kg and be exposed to groundwater for a 1-year duration at a frequency of 50 days per year. The construction worker is assumed to incidentally

consume 0.04 L of water per exposed day based upon an ingestion rate of 0.01 L per hour for 4 hours (EPA 2014b). For dermal contact, the recommended surface area for construction worker exposure to groundwater is assumed as the head, hands, and forearms, which is 3,527 cm² (EPA 2014a) and the exposure time is assumed to be 4 hours per exposed day.

Commercial/industrial worker exposure to groundwater was evaluated as a tap water supply. Exposure parameters are presented on Table 4.9. Complete exposure pathways include ingestion of, dermal contact with, and inhalation of vapors during a work day. The worker is assumed to be an adult that weighs 80 kg and is exposed to groundwater for a 25-year duration at a frequency of 250 days per year (i.e., 5 days per week for 50 weeks). The total daily ingestion rate for water was assumed at 1.25 L per day of water, which is equivalent to half of the daily intake for an adult of 2.5 L per day (EPA 1991a). Dermal contact with groundwater is only assumed for exposure skin surface areas, head, hands, and forearms during hand washing and other hygiene activities. Inhalation of volatiles from groundwater is evaluated similar to the resident adult.

Surface Water Exposure Parameters

Exposure parameters for surface water are presented on Tables 4.10 through 4.12. Exposure to surface water assumed wading or playing within streams near the site. It is expected that people may ingest some surface water during water activities. The ingestion rate for this type of ingestion is difficult to quantify. The EPA provides estimated water ingestion rates associated with water recreation activities in the *Region 4 Human Health Risk Assessment Supplemental Guidance* (2014b). The incidental ingestion rate of 10 milliliters (mL) per hour was selected for the resident adult based on wading in surface water (EPA 2014b). The estimated amount of time wading is 2 hours. The incidental ingestion rate for children wading is 50 mL per hour. The trespasser was assumed to have an ingestion rate similar to the child. The estimated time wading for the resident child and trespasser is 4 hours. It is expected that contact with surface water for all receptors would be primarily with the head, hands, forearms, lower legs, and feet. As a result, the recommended SA is equal to that for soil exposures, which is 6,032 cm² for the resident adult, 2,373 cm² for the resident child, and 4,530 cm² for the adolescent trespasser, based on the mean surface area (EPA 2011). It was assumed that all receptors would contact surface water 3 days per week for 6 months of the year, which results in 78 days per year.

Sediment Exposure Parameters

Exposure parameters for sediment are presented in Tables 4.13 through 4.15. Exposure to sediment is similar to surface water exposures. Sediment ingestion rates are not presented in the *EPA Exposures Factor Handbook*. Therefore, ingestion of sediment was assumed to equal the general population upper percentile ingestion rate of 200 milligrams per day shown on Table 5-1 of the *EPA Exposure Factors Handbook: 2011 Edition* was assumed for the resident child and adolescent trespasser (EPA 2011). It is expected that contact with sediment for both the adult and child would be primarily with the head, hands, forearms, lower legs, and feet. Therefore, the recommended SA for sediment is the same as for surface water. It was assumed that all

receptors would contact sediment at the same rate as surface water for 3 days per week for 6 months of the year, which results in 78 days per year.

Food Exposure Parameters (Home-grown Produce and Beef)

Exposure parameters for the resident adult and child ingestion of home-grown produce and beef are presented on Table 4.16. For home-grown produce, exposure parameters were taken from Table 13-1 of EPA 2011 *Exposure Factors Handbook*. Table 13-1 presents intake rates for home-produced fruits and vegetables. The average mean intake rates for home-produced vegetables, consumers only were selected. Average intake rates were used and not the 95th percentile based upon the EPA recommendation, “The consumer-only data presented represent average daily intake rates of food items/groups over a the 7-day survey period and do not account for variations in eating habits during the rest of the year. Thus, the recommended upper-percentile values, as well as the percentiles of the distributions presented in Section 13.3.1 may not necessarily reflect the long-term distribution of average daily intake of home-produced foods” (page 13-1, EPA 2011). It is also noted that children less than 1 year of age are not assumed to consume any portion of home-produced food (EPA 2011). The rates presented are intake rates that are averaged over a 365-day period.

Additionally, the body weight for each receptor is not taken into account in determining the overall intake or dose of home-grown produce. The EPA noted, “Thus, use of these data in calculating potential dose does not require the body-weight factor to be included in the denominator of the average daily dose in equation 1-2 in Chapter 1. Note that converting these intake rates into units of g/day by multiplying by a single average body weight is inappropriate, because individual intake rates were indexed to the reported body weights of the survey respondents” (page 13-8, EPA 2011). This also follows the intake equation provided in the EPA Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 2005c). For the resident adult, the intake rate used in the HHRA is the average of the 20- to 39-year age groups. For the resident child, the intake rate used in the HHRA is the average of the 1- to 2-year and 3- to 5-year age groups.

For beef ingestion, exposure parameters were also taken from Table 13-1 of the EPA 2011 *Exposure Factors Handbook* (EPA 2011). The intake of home-produced meats for consumers only, unadjusted, were selected. For the resident adult, the intake rate used in the HHRA is the average of the 20 to 39-year age groups. For the resident child, the intake rate used in the HHRA is the average of the 1- to 2-year and 3- to 5-year age groups. Similar to ingestion of home-grown produce, beef ingestion is presented as an intake rate and does not require the body-weight factor. Additionally, the intake rates presented in Table 13-1 are based upon uncooked weight. To account for cooking, the percent weight losses from food preparations were taken from Table 13-69 for meats. A mean net preparation/cooking loss of 29.7% is selected.

2.3 TOXICITY ASSESSMENT

The toxicity assessment considers the types of potential adverse health effects associated with exposures to COPCs, the relationship between the magnitude of exposure and potential adverse

effects, and related uncertainties, such as the weight of evidence of a particular COPC carcinogenicity in humans. EPA guidance (EPA 1989) specifies that the assessment be accomplished in two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining whether studies demonstrate that exposure to a COPC may cause the incidence of an adverse effect. EPA specifies the dose-response assessment, which involves: (1) EPA's quantitative evaluation of the existing toxicity information, and (2) EPA's characterization of the relationship between the dose of the COPC administered or received, and the incidence of potentially adverse health effects in the exposed population. From this quantitative dose-response relationship, specific toxicity values are derived by EPA that can be used to estimate the incidence of potentially adverse effects occurring in humans at different exposure levels (EPA 1989).

Toxicity values were selected in keeping with appropriate exposure durations and EPA guidance (EPA 2003). Tier 1 values were found using the Integrated Risk Information System (IRIS) (EPA 2019c) for established, current values. When toxicity values were not available from IRIS, Tier 2 values were then examined.

Tier 2 values were EPA's Provisional Peer Reviewed Toxicity Values, which are developed by the Office of Research and Development, the National Center for Environmental Assessment, and the Superfund Health Risk Technical Support Center on a chemical-specific basis when requested by the Superfund program.

Tier 3, other toxicity values, were considered when Tier 1 or Tier 2 toxicity values were not available. These toxicity values were taken from additional EPA and non-EPA sources and were chosen based on the most current and best peer-reviewed source available. The California Environmental Protection Agency (CalEPA) (2019), Office of Environmental Health Hazard Assessment (OEHHA) Toxicity Criteria Database, CalEPA (2009) Cancer Potency Values, and the Agency for Toxic Substances and Disease Registry (ATSDR) (2019) Minimal Risk Levels are the Tier 3 sources utilized for this HHRA.

2.3.1 Toxicity Assessment for Non-Carcinogens

The methodology used by EPA for deriving non-cancer reference values for non-carcinogens, and site-specific considerations for modifying or using these concentrations are discussed in detail in Barnes and Dourson (1988) and EPA guidance (EPA 2019c). Non-carcinogens are typically judged to have a threshold daily dose below which deleterious or harmful effects are unlikely to occur. This concentration is called the no-observed-adverse-effect-level (NOAEL), and may be derived from either animal laboratory experiments or human epidemiology investigations (usually workplace studies). In developing a toxicity value or human NOAEL for non-carcinogens (i.e., a Reference Dose [RfD]), the regulatory approach is to (1) identify the critical toxic effect associated with chemical exposure (i.e., the most sensitive adverse effect); (2) identify the lowest dose in either an animal or human study; and (3) modify this dose to account for interspecies variability (where appropriate), differences in individual sensitivity (within-species variability), and other uncertainty and modifying factors. For the Reference Concentrations (RfCs), experimental exposures are extrapolated to a Human Equivalent

Concentration (HEC). The HEC is determined through a two-step process that begins with a point of departure, which is adjusted (multiplied) by a Dosimetric Adjustment Factor (DAF) (EPA 2009). The point of departure can represent a NOAEL, lowest-observed-adverse-effect-level (LOAEL), benchmark concentration, lower confidence limit, and the lower limit on an effective concentration using a 10 percent response level. The DAF is for the specific site of the chemical's effects (e.g., respiratory tract, etc.). The DAF is dependent upon the nature of the contaminant and the target site of the toxic effect.

Uncertainty factors (UFs) are intended to account for specific types of uncertainty inherent in extrapolation from the available data. The UFs are generally 10-fold, default factors used in operationally deriving the RfD and RfC from experimental data. UFs less than 10 can be used. A UF of 3 can be used in place of one-half power ($10^{0.5}$) when appropriate. The UFs are intended to account for (1) variation in susceptibility among the members of the human population (i.e., inter-individual or intraspecies variability), (2) uncertainty in extrapolating animal data to humans (i.e., interspecies uncertainty), (3) uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure (i.e., extrapolating from subchronic to chronic exposure), (4) uncertainty in extrapolating from a LOAEL rather than from a NOAEL, and (5) uncertainty associated with extrapolation when the database is incomplete. The maximum UF for the derivation of the RfCs used in this HHRA is 3,000. The maximum UF for the derivation of the RfDs used in this HHRA is 3,000. To calculate the RfD, the appropriate Point of Departure (POD) is divided by the product of all the applicable UFs. This is expressed as:

$$\text{RfD} = \text{POD} / (\text{UF}_1 \times \text{UF}_2 \times \text{UF}_3 \times \text{UF}_4)$$

The resulting RfD is expressed in units of milligrams of chemical per kilogram of body weight per day. To calculate the RfC, the HEC is divided by UFs and is expressed in units of mg/m^3 . EPA-derived toxicity values for evaluating potential chronic non-carcinogenic effects for COPCs are summarized in Tables 5.1 and 5.2.

2.3.2 Toxicity Assessment for Carcinogenicity

Unlike non-carcinogens, carcinogens are generally assumed to have no threshold. There is presumed to be no level of exposure below which carcinogenic effects will not manifest themselves. This “non-threshold” concept supports the idea that there are small, finite probabilities of inducing a carcinogenic response associated with every level of exposure to a potential carcinogen. EPA uses a two-part evaluation for carcinogenic effects. This evaluation includes the assignment of a weight-of-evidence classification and the quantification of a cancer toxic potency concentration. Quantification is expressed as a slope factor (SF) for oral and dermal exposures and an Inhalation Unit Risk (IUR) for inhalation exposures, which reflects the dose-response data for the carcinogenic endpoint(s) (EPA 1989, 2009a). EPA-derived toxicity values for evaluating potential carcinogenic effects for COPCs are summarized in Tables 6.1 and 6.2.

The weight-of-evidence classification system assigns a letter or alphanumeric (A through E) to each potential carcinogen that reflects an assessment of its potential to be a human carcinogen

(EPA 1986b).¹ EPA has established six recommended standard hazard descriptors: “*Carcinogenic to Humans*,” “*Likely to Be Carcinogenic to Humans*,” “*Suggestive Evidence of Carcinogenic Potential*,” “*Inadequate Information to Assess Carcinogenic Potential*,” and “*Not Likely to Be Carcinogenic to Humans*” (EPA 2005a). The weight-of-evidence classification is based on a thorough scientific examination of the body of available data. Only compounds that have a weight-of-evidence classification of C or above are considered to have carcinogenic potential in this HHRA.

The SF and the IUR are the upper 95th percentile confidence limit of the probability of response per unit daily intake of a chemical over a lifetime. The SF is expressed in units of proportion (of a population) affected per mg/kg/day. The IUR is expressed in $\mu\text{g}/\text{m}^3$. Typically, the SF and the IUR are used to estimate the upper-bound lifetime probability of a person developing cancer from exposure to a given concentration of a carcinogen. SFs and IURs are generally based on experimental animal data, unless suitable epidemiological studies are available. Because of the difficulty in detecting and measuring carcinogenic endpoints at low exposure concentrations, SFs and IURs are typically developed by using a model to fit the available high dose, experimental animal data, and then extrapolating downward to the low-dose range to which humans are typically exposed. EPA recommends the linear multistage model to derive an SF and IUR. The model is conservative and provides an upper bound estimate of excess lifetime cancer risk. These methods and approaches are discussed in greater detail within the EPA cancer guidelines (EPA 2005a).

Carcinogenic compounds were also assessed for mutagenic modes of action. The mutagenic mode of action is assessed with a linear approach (EPA 2005b). Hexavalent chromium, benz(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene are the COPCs that have been identified with a mutagenic mode of action. COPCs identified as mutagenic have sensitivity pertaining to cancer risks associated with early-life exposures. To account for the early-life exposure and the mutagenic mode of action, the cancer potency estimates are adjusted by an age-dependent adjustment factor (ADAF). EPA recommends, for mutagenic chemicals, when no chemical-specific data exist, a default approach using estimates from chronic studies (i.e., cancer slope factors) with appropriate modifications to address the potential for differential risk of early life stage exposure (EPA 2005a, 2005b). An ADAF modification for early life stage exposure to mutagenic COPCs is required because available studies indicate higher cancer risks resulting from a given exposure occurring early in life when compared with the same amount of exposure during adulthood (EPA 2005b). For this HHRA, the intakes for COPCs identified with a mutagenic mode of action are modified by an ADAF for the following (EPA 2005b, 2019c):

¹A = A known human carcinogen; B1 = A probable human carcinogen, based on sufficient animal data and limited human data; B2 = A probable human carcinogen based on sufficient animal data and inadequate or no human data; C = A possible human carcinogen; D = Not classifiable as to human carcinogenicity; and E = Evidence of non-carcinogenicity for humans.

- For exposures before 2 years of age (i.e., spanning a 2-year time interval from the first day of birth up until a child's second birthday), a 10-fold adjustment.
- For exposures between 2 and <16 years of age (i.e., spanning a 14-year time interval from a child's second birthday up until their sixteenth birthday), a 3-fold adjustment.
- For exposures after turning 16 years of age, no adjustment.

For this HHRA, the resident and adolescent trespasser are within the age range that requires adjustment for a mutagenic mode of action. Two age groups are considered for the residential scenario, an adult and a child. The age group for the child is assumed at 0–6 years. The resident adult is evaluated from an age range of 7–26 years old (EPA 1991b, 2014a). Although adults are typically assumed at an age range of greater than 16 years of age, the resident adult is evaluated for a long-term exposure typical of residents (EPA 1991b). Residents are typically assumed at a duration of 26 years, so the resident adult spans that 7–26 years beyond childhood (EPA 1991a, 2014a). Therefore, both the resident child and the resident adult require an adjustment for potential mutagenic modes of action.

2.3.3 Toxicity Assessment Modification for Dermal Contact

Toxicity values specific to dermal exposures are not available and require adjustment of the oral toxicity values (oral RfDs or SFs). This adjustment accounts for the difference between the daily intake dose through dermal contact as opposed to ingestion. Most toxicity values are based on the actual administered dose and must be corrected for the percent of chemical-specific absorption that occurs across the gastrointestinal tract prior to use in dermal contact risk assessment (EPA 1989, 2004). EPA recommends utilizing oral absorption efficiency factors in converting oral toxicity values to dermal toxicity values (EPA 2004). This adjustment accounts for the absorption efficiency in the “critical study,” which is utilized in determining the RfD and SF. Where oral absorption in the critical study is essentially complete (i.e., 100 percent), the absorbed dose is equivalent to the administered dose, and no adjustment of oral toxicity values is necessary when evaluating dermal exposures. When gastrointestinal absorption of a chemical in the critical study is poor (e.g., 1 percent), the absorbed dose is much smaller than the administered dose, and toxicity values for dermal exposure are adjusted to account for the difference in the absorbed dose relative to the administered dose. To account for the differences between the administered (oral) and the absorbed (dermal) dose, RfDs and SFs are modified by the gastrointestinal dermal absorption factor (GIABS). Table 5.3 presents the chemical-specific parameters for dermal contact.

In addition to the GIABS modification of the toxicity values for dermal contact, dermal contact rates are also evaluated based upon a chemical's ability to be absorbed through the skin surface. For soil and sediment, EPA has identified a dermal ABS that is chemical-specific. The ABS value reflects the desorption of a chemical from soil and the absorption of the chemical across the skin and into the blood stream. Recommended values are presented that take into account

ranges of values that result from different soil types, loading rates, chemical concentrations, and other conditions.

For groundwater and surface water, dermal exposures are adjusted by two methods. For organics, the dermal exposures are adjusted by the fraction absorbed (FA), permeability coefficient (K_p), and the exposure time. The FA accounts for chemical loss due to shedding during absorption from the skin to the bloodstream, the K_p represents the ability of a chemical to cross the stratum corneum, and exposure time is used to determine the diffusion of the compound across the skin to accurately determine the dose dissolved into the bloodstream. Inorganic compounds are adjusted by the K_p only.

The chemical-specific parameters utilized in assessing dermal exposure, GIABS, ABS, FA, and K_p are selected from the EPA dermal guidance (EPA 2004, 2019a). Table 5.3 presents relative chemical-specific parameters utilized in calculating dermal exposure for COPCs.

2.3.4 Special Chemicals - Lead

Lead is classified as a B2-probable human carcinogen. However, EPA has not published an SF or IUR for quantifying carcinogenic risks. Blood lead levels are the indicator of excess lead exposure in humans. Modeled blood level results are compared to the established threshold of no more than 5 percent of the population having a blood-lead of 5, 8, and 10 micrograms (μg) lead per deciliter (dL) or greater. Due to the simplistic nature of potential lead exposures at the site, the mean soil concentration was directly compared to the RSLs to determine if blood-lead levels for potential receptors are considered acceptable at the site. It is noted that the exposure areas for soil are larger than a “typical” residential lot that is usually considered in the EPA blood-lead models. The uncertainty associated with the exposure area size is discussed further in the Section 3.2.2.

2.4 RISK CHARACTERIZATION

In this step, the toxicity values are combined with the calculated chemical intakes for the receptor populations to quantitatively estimate both carcinogenic and non-carcinogenic risks. Risks were calculated for each receptor of concern.

2.4.1 Hazard Index for Non-Carcinogenic Effects

The potential human health risks associated with exposures to non-carcinogenic COPCs are calculated by comparing the ADI or the EC with the chemical-specific RfD or RfC, as per EPA Guidance (EPA 1989, 2009a). A HQ is derived for each COPC, as shown in the equation below:

$$HQ = \frac{ADI}{RfD} \quad \text{or} \quad HQ = \frac{EC}{RfC}$$

where:

<i>HQ</i>	=	Hazard Quotient; ratio of average daily intake level to acceptable daily intake level (unitless)
<i>ADI</i>	=	Calculated non-carcinogenic average daily intake (mg/kg/day or mg/m ³)
<i>EC</i>	=	Exposure Concentration (mg/m ³)
<i>RfD</i>	=	Reference dose (mg/kg/day)
<i>RfC</i>	=	Reference concentration (mg/m ³).

If the average daily dose exceeds the RfD or RfC, the HQ will exceed a ratio of one (1.0) and there may be concern that potential adverse systemic health effects will be observed in the exposed populations. If the ADI does not exceed the RfD or the RfC, the HQ will not exceed 1.0 and there will be no concern that potential adverse systemic health effects will be observed in the exposed populations. However, if the sum of several HQs exceeds 1.0, and the COPCs affect the same target organ, there may be concern that potential adverse systemic health effects will be observed in the exposed populations. In general, the greater the value of the HQ above 1.0, the greater the level of concern. However, the HQ does not represent a statistical probability that an adverse health effect will occur.

For consideration of exposures to more than one chemical causing systemic toxicity via several different pathways, the individual HQs are summed to provide an overall hazard index (HI). If the HI is less than 1.0, then no adverse health effects are likely to be associated with exposures at the site. However, if the total HI is greater than 1.0, separate endpoint-specific HIs may be calculated based on toxic endpoint of concern or target organ (e.g., HQs for neurotoxins are summed separately from HQs for renal toxins). Only if an endpoint-specific HI is greater than 1.0 is there reason for concern about potential health effects for that endpoint.

2.4.2 Carcinogenic Risks

Carcinogenic risk is calculated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. The numerical estimate of excess lifetime cancer risk is calculated by multiplying the LADI by the risk per unit dose (the SF) or multiplying the EC by the IUR.

This is shown in the following equation:

$$\text{Risk} = \text{LADI} \times \text{SF}$$

$$\text{Risk} = \text{EC} \times \text{IUR}$$

where:

<i>Risk</i>	=	Unitless probability of an exposed individual developing cancer
<i>LADI</i>	=	Lifetime cancer average daily intake (mg/kg/day)
<i>EC</i>	=	Exposure Concentration (µg/m ³)
<i>SF</i>	=	Cancer slope factor (mg/kg/day) ⁻¹
<i>IUR</i>	=	Inhalation Unit Risk (µg/m ³) ⁻¹ .

Because the SF and the IUR are the statistical 95th percent upper-bound confidence limit on the dose-response slope, this method provides a conservative, upper-bound estimate of risk. It should be noted that the interpretation of the significance of the cancer risk estimate is based on the appropriate public policy. EPA in the NCP (40 CFR Part 300) (EPA 1990) states that:

...For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} .

2.4.3 Lead Risks

The USEPA has not established cancer SFs or noncancer RfDs for lead. In the absence of any USEPA-published toxicity values for lead, it is currently not possible to perform a quantitative risk estimate for lead exposures using standard USEPA methodology. Much of the toxicological data collected on the effects of lead in humans relates to exposure and effect in terms of the amount of lead in blood associated with an observed effect, expressed as micrograms of lead per deciliter of blood (μg lead/dL blood). The USEPA and Centers for Disease Control and Prevention (CDC) have determined that there is no safe level of lead in children (CDC 2012). The CDC recommended a reference value based on the 97.5th percentile of the National Health and Nutrition Examination Survey (NHANES)-generated blood-lead level in children 1-5 years old (CDC 2012). The 97.5th percentile blood-level level was identified as 5 $\mu\text{g}/\text{dL}$. Therefore, this blood-lead level is used to identify potential concerns for children with elevated blood-lead levels. Additionally, blood-lead levels of 8 $\mu\text{g}/\text{dL}$ and 10 $\mu\text{g}/\text{dL}$ were evaluated. According to the USEPA, lead is classified as a B2, probable human carcinogen. However, lead is not regulated as a carcinogen because it appears to be more potent as a toxicant to the hemopoietic system by inhibiting heme synthesis.

For lead in soil, lead risks for residents were evaluated using EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) Lead Model (EPA 2010) using an average lead concentration in soil. Default parameters were used in the IEUBK model, except the maternal blood-lead level at birth. The maternal blood-lead level at birth was changed to 0.6 μg Pb/dL blood based upon recent EPA lead guidance (EPA 2017). The following is a summary of some default parameters and site-specific parameters used in the IEUBK model:

- Lead concentration in soil = mean concentration (site-specific)
- Mother's Blood Lead Concentration at Childbirth = 0.6 μg Pb/dL
- Lead concentration in drinking water = 4 $\mu\text{g}/\text{L}$ (default)
- Default dietary lead intakes, no alternate dietary values entered (default)
- Outdoor air lead concentration = 0.1 $\mu\text{g}/\text{m}^3$ (default)
- Default bioavailability of lead in soil, dust, water, and diet (default)

For worker exposure scenarios, soil lead is modeled using Recommendations of the Technical Review Workgroup (TRW) for Lead, An Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil (EPA 2003b, 2009c, 2017). For the adult lead model, the

baseline blood-lead level (PbB₀) and geometric standard deviation of the blood-lead level (GSD_i) based upon the NHANES 2009-2014 data was used (EPA 2017). The following is a summary of some default parameters and site-specific parameters used in the adult lead model:

- Lead concentration in soil = mean concentration (site-specific)
- Mother's Blood Lead Concentration at Childbirth = 0.6 ug Pb/dL
- Geometric standard deviation of lead in blood = 1.8
- Soil ingestion rate = 100 mg/day (site-specific)
- Absorption fraction = 0.12 (default)
- Exposure frequency = 250 days/year (default)

For both lead models to achieve a specific level of protectiveness, the EPA has established a limit to exposure to soil lead levels such that a typical (or hypothetical) child would have an estimated risk of no more than 5 percent exceeding the reference blood-lead level. For groundwater, a qualitative comparison to the EPA AL of 15 µg/L was performed.

2.4.4 Risk Characterization Results

The methodologies used to quantify carcinogenic risks and chronic hazards for non-carcinogens are described further in Section 2.4. Calculations are presented by receptor and exposure area in Tables 7.1 through 7.60. Tables 7.61 and 7.62 present the calculation of the dermal absorbed dose of organic COPCs from groundwater. Table 7.63 presents the calculation of vapor concentrations in a trench. Groundwater calculations shown in these tables are based upon sample results from monitoring wells only. It is noted that potential exposure to groundwater from monitoring wells is only assessed within the Lorraine Process Area and the Wilcox Process Area. Residential wells were evaluated on a well by well basis.

Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects for receptors within each exposure area are presented in Tables 9.1 through 9.30. A summary of significant contributors to risk is presented in Tables 10.1 through 10.30. COPCs are only identified on Tables 10.1 through 10.30 if cumulative carcinogenic risks are greater than the upper end of the EPA acceptable cancer risk range of 10^{-6} to 10^{-4} or cumulative non-carcinogenic risks are greater than 1.0. Significant contributors to risk are identified as COPCs with carcinogenic risks greater than point of departure identified at 10^{-6} or non-carcinogenic risks greater than 0.1. Additionally, Tables 10.1 through 10.30 present a breakdown by target organ for non-carcinogenic hazards.

2.4.4.1 North Tank Farm

Media of concern for North Tank Farm include surface soil, subsurface soil, surface water, and sediment. Surface soil and subsurface soil were evaluated separately based upon chemical concentrations. In addition, uptake of chemicals in homegrown produce and beef ingestion from surface soil was also evaluated. Calculations of intake, risks, and hazards are presented in Tables 7.1 through 7.8. Tables 7.9 and 7.10 present the estimation of COPC air concentrations of

particulates from soil for the resident/commercial worker and construction worker, respectively. The determination of the PEF for the construction worker was performed using the EPA Regional Screening Table Calculator (EPA 2019b). Outputs from the calculator for the PEF are provided in Appendix C. Tables 7.11 and 7.12 present the estimation of COPC concentrations in homegrown produce and beef. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Tables 9.1 through 9.6. Tables 10.1 through 10.6 present the significant contributors to risk results.

Surface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.1. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.1. The total non-carcinogenic HI for resident adult exposures to media of concern in the North Tank Farm is 0.8, which is below the acceptable threshold of 1.0. The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 0.8, for surface water is 0.03, and for sediment is 0.006.

Calculations for the resident child are presented in Table 7.2. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.1. The total non-carcinogenic HI for the resident child is 3, which is above the acceptable threshold of 1.0 (Table 9.1). The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 2.3, for surface water is 0.3, and for sediment is 0.1.

Table 10.1 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in soil, surface water, and sediment.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 5×10^{-5} (Table 9.1), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 4.5×10^{-5} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Construction Worker

Calculations for the construction worker are presented in Table 7.3. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.2. The total non-carcinogenic HI for the construction worker is 0.2, which is below the acceptable threshold of 1.0 (Table 9.2).

The carcinogenic risk for the construction worker is 1×10^{-7} (Table 9.2), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Commercial/Industrial Worker

Calculations for the commercial/industrial worker are presented in Table 7.4. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.3. The total non-carcinogenic HI for the commercial/industrial worker is 0.05, which is below the acceptable threshold of 1.0 (Table 9.3).

The carcinogenic risk for the commercial/industrial worker is 8×10^{-7} (Table 9.3), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Adolescent Trespasser

Calculations for the adolescent trespasser are presented in Table 7.5. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.4. The total non-carcinogenic HI for the adolescent trespasser is 0.2, which is below the acceptable threshold of 1.0 (Table 9.4). The non-carcinogenic HI for surface soil is 0.02, for surface water is 0.1, and for sediment is 0.04.

The carcinogenic risk for the adolescent trespasser is 4×10^{-6} (Table 9.4), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 2.4×10^{-7} , to surface water is 2.0×10^{-6} , and to sediment is 1.4×10^{-6} .

Subsurface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.6. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.5. The total non-carcinogenic HI for resident adult exposures to media of concern in the North Tank Farm is 0.1, which is below the acceptable threshold of 1.0. The non-carcinogenic HI for subsurface soil is 0.1, for surface water is 0.03, and for sediment is 0.006.

Calculations for the resident child are presented in Table 7.7. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.5. The total non-carcinogenic HI for the resident child is 1, which is equal the acceptable threshold of 1.0 (Table 9.5). The non-carcinogenic HI for subsurface soil is 1, for surface water is 0.3, and for sediment is 0.1.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 1×10^{-5} (Table 9.5), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to subsurface soil is 5.1×10^{-6} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Construction Worker

Calculations for the construction worker are presented in Table 7.8. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.6. The total non-carcinogenic HI for the construction worker is 0.3, which is below the acceptable threshold of 1.0 (Table 9.6).

The carcinogenic risk for the construction worker is 1×10^{-7} (Table 9.6), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

2.4.4.2 Lorraine Process Area

Media of concern for Lorraine Process Area include surface soil, subsurface soil, surface water, and sediment. Surface soil and subsurface soil were evaluated separately based upon chemical concentrations. In addition, uptake of chemicals in homegrown produce and beef from surface soil was also evaluated. Calculations of intake, risks, and hazards are presented in Tables 7.13 through 7.20. Tables 7.21 and 7.22 present the estimation of COPC air concentrations of particulates from soil for the resident/commercial worker and construction worker, respectively. The determination of the PEF for the construction worker was performed using the EPA Regional Screening Table Calculator (EPA 2019b). Outputs from the calculator for the PEF are provided in Appendix C. Tables 7.23 and 7.24 present the estimation of COPC concentrations in homegrown produce and beef. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Tables 9.7 through 9.12. Tables 10.7 through 10.12 present the significant contributors to risk results.

Surface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.13. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.7. The total non-carcinogenic HI for resident adult exposures to media of concern in the Lorraine Process Area is 1, which is equal to the acceptable threshold of 1.0. The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 1, for surface water is 0.03, and for sediment is 0.006.

Calculations for the resident child are presented in Table 7.14. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.7. The total non-carcinogenic HI for the resident child is 3, which is above the acceptable threshold of 1.0 (Table 9.7). The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 3, for surface water is 0.3, and for sediment is 0.1.

Table 10.7 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in soil, surface water, and sediment.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 4×10^{-5} (Table 9.7), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 3.2×10^{-5} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Construction Worker

Calculations for the construction worker are presented in Table 7.15. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.8. The total non-carcinogenic HI for the construction worker is 0.1, which is below the acceptable threshold of 1.0 (Table 9.8).

The carcinogenic risk for the construction worker is 2×10^{-7} (Table 9.8), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Commercial/Industrial Worker

Calculations for the commercial/industrial worker are presented in Table 7.16. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.9. The total non-carcinogenic HI for the commercial/industrial worker is 0.04, which is below the acceptable threshold of 1.0 (Table 9.9).

The carcinogenic risk for the commercial/industrial worker is 1×10^{-6} (Table 9.9), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Adolescent Trespasser

Calculations for the adolescent trespasser are presented in Table 7.17. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.10. The total non-carcinogenic HI for the adolescent trespasser is 0.2, which is below the acceptable threshold of 1.0 (Table 9.10). The non-carcinogenic HI for surface soil is 0.02, for surface water is 0.1, and for sediment is 0.04.

The carcinogenic risk for the adolescent trespasser is 4×10^{-6} (Table 9.10), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 3.3×10^{-7} , to surface water is 2.0×10^{-6} , and to sediment is 1.4×10^{-6} .

Subsurface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.18. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.11. The total non-carcinogenic HI for resident adult exposures to media of concern is 0.1, which is

below the acceptable threshold of 1.0. The non-carcinogenic HI for subsurface soil is 0.06, for surface water is 0.03, and for sediment is 0.006.

Calculations for the resident child are presented in Table 7.19. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.11. The total non-carcinogenic HI for the resident child is 1, which equals the acceptable threshold of 1.0 (Table 9.11). The non-carcinogenic HI for subsurface soil is 0.6, for surface water is 0.3, and for sediment is 0.1.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 1×10^{-5} (Table 9.11), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to subsurface soil is 4.5×10^{-6} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Construction Worker

Calculations for the construction worker are presented in Table 7.20. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.12. The total non-carcinogenic HI for the construction worker is 0.2, which is below the acceptable threshold of 1.0 (Table 9.12).

The carcinogenic risk for the construction worker is 1×10^{-7} (Table 9.11), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Lead

Lead was identified as a COPC in surface and subsurface soil based upon a comparison of the maximum detected concentration to the EPA residential soil RSL. Lead was evaluated for the residential scenario with the EPA IEUBK model. Potential concerns for workers were evaluated with the EPA Adult Lead Model. Both models evaluate the percentage (%) of a target population that will have blood-lead levels above a reference concentration. A range of reference blood-lead levels were evaluated: 5 µg /dL, 8 µg /dL, and 10 µg /dL. The arithmetic mean for lead in surface soil (537 mg/kg, Table 3.3) and 95%UCLM subsurface soil (76.9 mg/kg, Table 3.4) were used as the soil lead concentration. Outputs of the IEUBK model are presented in Appendix D including probability density graphs.

Surface Soil

Reference Blood- lead Level	5 µg /dL		8 µg /dL		10 µg /dL	
	% Exceeding	Mean Blood- lead Level (µg/dL)	% Exceeding	Mean Blood- lead Level (µg /dL)	% Exceeding	Mean Blood- lead Level (µg /dL)
IEUBK Model	59.2	5.6	22.1	5.6	10.7	5.6
Adult Lead Model	7.3	5.6	1.2	5.6	0.4	5.6

The models indicate a mean blood-lead levels of approximately 5.6 µg/dL. Based upon the IEUBK, greater than 5% of the population exceeding the reference level, which reveals lead is a potential concern for resident children in surface soil. For the adult lead model, only the 5 µg/dL reference blood-lead level had greater than 5% of the population exceeding. Three sample results from two locations exceed the USEPA residential soil RSL of 400 mg/kg. These sample locations are SB-20-0.5 (20,800 mg/kg), SB-17-0.5 (8,390 mg/kg), and SB-17-2 (1,760 mg/kg). Soil samples collected at deeper depths to these sample locations revealed lead concentrations lower than 150 mg/kg.

Subsurface Soil

Reference Blood-lead Level	5 µg /dL		8 µg /dL		10 µg /dL	
	% Exceeding	Blood-lead Level (µg/dL)	% Exceeding	Blood-lead Level (µg /dL)	% Exceeding	Blood-lead Level (µg /dL)
IEUBK Model	0.7	1.6	0.03	1.6	0.004	1.6
Adult Lead Model	0.07	2.0	0.0033	2.0	0.00063	2.0

Only one sample location in subsurface soil exceeded the EPA residential soil RSL of 400 mg/kg. Sample location LPA-SB-10-6 revealed lead at 972 mg/kg. All other results were below 150 mg/kg.

2.4.4.3 Loading Dock Area

Media of concern for Loading Dock Area include surface soil, subsurface soil, surface water, and sediment. Surface soil and subsurface soil were evaluated separately based upon chemical concentrations. In addition, uptake of chemicals in homegrown produce and beef ingestion from surface soil was also evaluated. Calculations of intake, risks, and hazards are presented in Tables 7.25 through 7.32. Tables 7.33 and 7.34 present the estimation of COPC air concentrations of particulates from soil for the resident/commercial worker and construction worker, respectively. The determination of the PEF for the construction worker was performed using the EPA Regional Screening Table Calculator (EPA 2019b). Outputs from the calculator for the PEF are provided in Appendix C. Tables 7.35 and 7.36 present the estimation of COPC concentrations in homegrown produce and beef. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Tables 9.13 through 9.18. Tables 10.13 through 10.18 present the significant contributors to risk results.

Surface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.25. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.13. The total non-carcinogenic HI for resident adult exposures to media of concern is 2, which is above the acceptable threshold of 1.0. The non-carcinogenic HI for surface soil (which

includes homegrown produce and beef) is 2.0, for surface water is 0.03, and for sediment is 0.006.

Table 10.13 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk or exceedance of target organs were identified in soil, surface water, and sediment.

Calculations for the resident child are presented in Table 7.26. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.13. The total non-carcinogenic HI for the resident child is 5, which is above the acceptable threshold of 1.0 (Table 9.13). The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 5, for surface water is 0.3, and for sediment is 0.1.

Table 10.13 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in surface water and sediment. For soil, cobalt revealed potential concerns when combined across direct contact, ingestion of homegrown produce, and ingestion of homegrown beef.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 7×10^{-5} (Table 9.13), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 6.5×10^{-5} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} . Benzene and benzo(a)pyrene in soil are the only COPC with carcinogenic risks greater than 10^{-5} .

Construction Worker

Calculations for the construction worker are presented in Table 7.27. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.14. The total non-carcinogenic HI for the construction worker is 0.3, which is below the acceptable threshold of 1.0 (Table 9.14).

The carcinogenic risk for the construction worker is 2×10^{-7} (Table 9.14), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Commercial/Industrial Worker

Calculations for the commercial/industrial worker are presented in Table 7.28. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.15. The total non-carcinogenic HI for the commercial/industrial worker is 0.09, which is below the acceptable threshold of 1.0 (Table 9.15).

The carcinogenic risk for the commercial/industrial worker is 1×10^{-6} (Table 9.15), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Adolescent Trespasser

Calculations for the adolescent trespasser are presented in Table 7.29. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.16. The total non-carcinogenic HI for the adolescent trespasser is 0.2, which is below the acceptable threshold of 1.0 (Table 9.16). The non-carcinogenic HI for surface soil is 0.03, for surface water is 0.1, and for sediment is 0.04.

The carcinogenic risk for the adolescent trespasser is 4×10^{-6} (Table 9.16), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 3.3×10^{-7} , to surface water is 2.0×10^{-6} , and to sediment is 1.4×10^{-6} .

Subsurface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.30. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.17. The total non-carcinogenic HI for resident adult exposures to media of concern is 0.2, which is below the acceptable threshold of 1.0. The non-carcinogenic HI for subsurface soil is 0.2, for surface water is 0.03, and for sediment is 0.006.

Calculations for the resident child are presented in Table 7.31. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.17. The total non-carcinogenic HI for the resident child is 2, which is above the acceptable threshold of 1.0 (Table 9.17). The non-carcinogenic HI for subsurface soil is 1.7, for surface water is 0.3, and for sediment is 0.1.

Table 10.17 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk or target organ exceedances were identified in soil, surface water, and sediment.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 1×10^{-5} (Table 9.17), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to subsurface soil is 4.9×10^{-6} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Construction Worker

Calculations for the construction worker are presented in Table 7.32. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.18. The total non-carcinogenic HI for the construction worker is 0.4, which is below the acceptable threshold of 1.0 (Table 9.18).

The carcinogenic risk for the construction worker is 2×10^{-7} (Table 9.18), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

2.4.4.4 Wilcox Process Area

Media of concern for Wilcox Process Area include surface soil, subsurface soil, groundwater, surface water, and sediment. Surface soil and subsurface soil were evaluated separately based upon chemical concentrations. In addition, uptake of chemicals in homegrown produce from surface soil was also evaluated. Calculations of intake, risks, and hazards are presented in Tables 7.37 through 7.44. Tables 7.45 and 7.46 present the estimation of COPC air concentrations of particulates from soil for the resident/commercial worker and construction worker, respectively. The determination of the PEF for the construction worker was performed using the EPA Regional Screening Table Calculator (EPA 2019b). Outputs from the calculator for the PEF are provided in Appendix C. Tables 7.47 and 7.48 present the estimation of COPC concentrations in homegrown produce and beef. Tables 7.61 and 7.62 present the calculation of dermal absorbed dose for organic chemicals in groundwater. Table 7.63 presents the calculation of vapor concentrations in a trench. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Tables 9.19 through 9.24. Tables 10.19 through 10.24 present the significant contributors to risk results.

Surface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.37. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.19. The total non-carcinogenic HI for resident adult exposures to media of concern is 96, which is above the acceptable threshold of 1.0. The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 2.5, for groundwater is 93, for surface water is 0.03, and for sediment is 0.006.

Table 10.19 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in soil, surface water, and sediment. In groundwater, arsenic, cyanide, iron, naphthalene, benzene, m,p-xylene, and o-xylene are the COPCs with a chemical HQ and associated target organ HI greater than 1.

Calculations for the resident child are presented in Table 7.38. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.19. The total non-carcinogenic HI for the resident child is 60, which is above the acceptable threshold of 1.0 (Table 9.19). The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 10.0, for groundwater is 50, for surface water is 0.3, and for sediment is 0.1.

Table 10.19 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in surface water and sediment. In

groundwater, arsenic, cyanide, cobalt, iron, and benzene are the COPCs with a chemical HQ and associated target organ HI greater than 1. In soil, significant contributors to risk include metals when considered across direct contact, ingestion of homegrown produce, and homegrown beef ingestion.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 7×10^{-3} (Table 9.19), which is above EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 4.4×10^{-5} , to groundwater is 6.8×10^{-3} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Exposure to groundwater is the primary contributor to carcinogenic risks. COPCs that contribute significantly to carcinogenic risks are arsenic, naphthalene, benzene, and ethylbenzene. All of these COPCs have carcinogenic risks greater than 10^{-4} .

Construction Worker

Calculations for the construction worker are presented in Table 7.39. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.20. The total non-carcinogenic HI for the construction worker is 33, which is above the acceptable threshold of 1.0 (Table 9.20). The non-carcinogenic HI for surface soil is 0.3 and for groundwater is 33. Table 10.20 presents the significant contributors to risk results and a breakdown by target organ. In groundwater, naphthalene, benzene, and m,p-xylene have chemical HQs and associated target organ HIs greater than 1.

The carcinogenic risk for the construction worker is 9×10^{-5} (Table 9.20), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 4.0×10^{-7} and to groundwater is 9.3×10^{-5} . In groundwater, benzene is the only COPC with carcinogenic risks greater than 10^{-5} .

Commercial/Industrial Worker

Calculations for the commercial/industrial worker are presented in Table 7.40. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.21. The total non-carcinogenic HI for the commercial/industrial worker is 12, which is above the acceptable threshold of 1.0 (Table 9.21). The non-carcinogenic HI for surface soil is 0.06 and for groundwater is 12. Table 10.21 presents the significant contributors to risk results and a breakdown by target organ. In groundwater, benzene has a chemical HQ and associated target organ HI greater than 1.

The carcinogenic risk for the commercial/industrial worker is 8×10^{-4} (Table 9.21), which is above the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 2.5×10^{-6} and to groundwater is 8.3×10^{-4} . In groundwater, arsenic and benzene are COPCs with carcinogenic risks greater than 10^{-4} .

Adolescent Trespasser

Calculations for the adolescent trespasser are presented in Table 7.41. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.22. The total non-carcinogenic HI for the adolescent trespasser is 0.2, which is below the acceptable threshold of 1.0 (Table 9.22). The non-carcinogenic HI for surface soil is 0.03, for surface water is 0.1, and for sediment is 0.04.

The carcinogenic risk for the adolescent trespasser is 5×10^{-6} (Table 9.22), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 1.4×10^{-6} , to surface water is 2.0×10^{-6} , and to sediment is 1.4×10^{-6} .

Subsurface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.42. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.23. The total non-carcinogenic HI for resident adult exposures to media of concern is 93, which is above the acceptable threshold of 1.0. The non-carcinogenic HI for subsurface soil is 0.1, for groundwater is 93, for surface water is 0.03, and for sediment is 0.006.

Table 10.23 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in soil, surface water, and sediment. In groundwater, arsenic, cyanide, iron, naphthalene, benzene, m,p-xylene, and o-xylene are the COPCs with a chemical HQ and associated target organ HI greater than 1.

Calculations for the resident child are presented in Table 7.43. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.23. The total non-carcinogenic HI for the resident child is 52, which is above the acceptable threshold of 1.0 (Table 9.23). The non-carcinogenic HI for subsurface soil is 1.1, for groundwater is 50, for surface water is 0.3, and for sediment is 0.1.

Table 10.23 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk were identified in soil, surface water, and sediment. In groundwater, arsenic, cyanide, iron, and benzene are the COPCs with a chemical HQ and associated target organ HI greater than 1.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 7×10^{-3} (Table 9.23), which is above EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to subsurface soil is 2.6×10^{-5} , to groundwater is 6.8×10^{-3} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} .

Exposure to groundwater is the primary contributor to carcinogenic risks. COPCs that contribute significantly to carcinogenic risks are arsenic, naphthalene, benzene, and ethylbenzene. All of these COPCs have carcinogenic risks greater than 10^{-4} .

Construction Worker

Calculations for the construction worker are presented in Table 7.44. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.24. The total non-carcinogenic HI for the construction worker is 34, which is above the acceptable threshold of 1.0 (Table 9.24). The non-carcinogenic HI for subsurface soil is 0.3 and for groundwater is 33. Table 10.24 presents the significant contributors to risk results and a breakdown by target organ. In groundwater, naphthalene, benzene, and m,p-xylene have chemical HQs and associated target organ HIs greater than 1.

The carcinogenic risk for the construction worker is 9×10^{-5} (Table 9.24), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to subsurface soil is 3.6×10^{-7} and to groundwater is 9.3×10^{-5} . In groundwater, benzene is the only COPC with carcinogenic risks greater than 10^{-5} .

Lead

Lead was identified as a COPC in surface and subsurface soil based upon a comparison of the maximum detected concentration to the EPA residential soil RSL. Lead was evaluated for the residential scenario with the EPA IEUBK model. Potential concerns for workers were evaluated with the EPA Adult Lead Model. Both models evaluate the percentage (%) of a target population that will have blood-lead levels above a reference concentration. A range of reference blood-lead levels were evaluated: 5 µg/dL, 8 µg/dL, and 10 µg/dL. The 95%UCLM for lead in surface (720 mg/kg, Table 3.7) and subsurface (73.6 mg/kg, Table 3.8) soil were used as the soil lead concentration. Outputs of the IEUBK model are presented in Appendix D including probability density graphs.

Surface Soil

Reference Blood-lead Level	5 µg/dL		8 µg/dL		10 µg/dL	
	% Exceeding	Mean Blood-lead Level (µg/dL)	% Exceeding	Mean Blood-lead Level (µg/dL)	% Exceeding	Mean Blood-lead Level (µg/dL)
IEUBK Model	76.0	7.0	38.5	7.0	22.1	7.0
Adult Lead Model	14.3	7.0	3.1	7.0	1.2	7.0

The models indicate a mean blood-lead levels of approximately 7.0 µg/dL. Based upon the IEUBK, greater than 5% of the population exceeding the reference level, which reveals lead is a potential concern for resident children in surface soil. For the adult lead model, only the 5 µg/dL reference level was exceeded. All other reference blood-lead levels had less than 5% of the population exceeding. Nine sample results from seven locations had lead concentrations greater

than 1,000 mg/kg. These sample locations are WPA-SB-15-0.5 (19,000 mg/kg), WPA-SB-10-0.5 (3,400 mg/kg), WPA-SB-14-0.5 (2,890 mg/kg), WPA-SB-13-0.5 (2,100 mg/kg), WPA-SB-10-2.0 (2,100 mg/kg), WPA-SB-14-2.0 (1,570 mg/kg), WPA-SB-09-0.5 (1,570 mg/kg), WPA-SB-05-0.5 (1,470 mg/kg), and WPA-SB-50-0.5 (1,080 mg/kg). Soil samples collected at deeper depths to these sample locations revealed lead concentrations lower than 250 mg/kg, except sample location SB-15.

Subsurface Soil

Reference Blood-lead Level	5 µg /dL		8 µg /dL		10 µg /dL	
	Blood-lead		Blood-lead		Blood-lead	
	% Exceeding	Level (µg/dL)	% Exceeding	Level (µg /dL)	% Exceeding	Level (µg /dL)
IEUBK Model	0.7	1.6	0.02	1.6	0.004	1.6
Adult Lead Model	0.07	2.0	0.003	2.0	0.0006	2.0

Only one sample location in subsurface soil exceeded the EPA residential soil RSL of 400 mg/kg. Sample location WPA-SB-15-6 revealed lead at 921 mg/kg. All other results were below 250 mg/kg.

2.4.4.5 East Tank Farm

Media of concern for East Tank Farm include surface soil, subsurface soil, surface water, and sediment. Surface soil and subsurface soil were evaluated separately based upon chemical concentrations. In addition, uptake of chemicals in homegrown produce from surface soil was also evaluated. Calculations of intake, risks, and hazards are presented in Tables 7.49 through 7.56. Tables 7.57 and 7.58 present the estimation of COPC air concentrations of particulates from soil for the resident/commercial worker and construction worker, respectively. The determination of the PEF for the construction worker was performed using the EPA Regional Screening Table Calculator (EPA 2019b). Outputs from the calculator for the PEF are provided in Appendix C. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Tables 9.25 through 9.30. Tables 10.25 through 10.30 present the significant contributors to risk results.

Surface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.49. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.25. The total non-carcinogenic HI for resident adult exposures to media of concern is 1, which is equal to the acceptable threshold of 1.0. The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 1.0, for surface water is 0.03, and for sediment is 0.006.

Table 10.25 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk or target organ exceedances were identified in soil, surface water, and sediment.

Calculations for the resident child are presented in Table 7.50. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.25. The total non-carcinogenic HI for the resident child is 3, which is above the acceptable threshold of 1.0 (Table 9.1). The non-carcinogenic HI for surface soil (which includes homegrown produce and beef) is 2.8, for surface water is 0.3, and for sediment is 0.1.

Table 10.25 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk or target organ exceedances were identified in soil, surface water, and sediment.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 6×10^{-5} (Table 9.25), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 4.9×10^{-5} , to surface water is 5.1×10^{-6} , and to sediment is 4.1×10^{-6} . Benzo(a)pyrene in soil is the only COPC with carcinogenic risks greater than 10^{-5} .

Construction Worker

Calculations for the construction worker are presented in Table 7.51. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.26. The total non-carcinogenic HI for the construction worker is 0.2, which is below the acceptable threshold of 1.0 (Table 9.26).

The carcinogenic risk for the construction worker is 2×10^{-7} (Table 9.26), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Commercial/Industrial Worker

Calculations for the commercial/industrial worker are presented in Table 7.52. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.27. The total non-carcinogenic HI for the commercial/industrial worker is 0.05, which is below the acceptable threshold of 1.0 (Table 9.27).

The carcinogenic risk for the commercial/industrial worker is 1×10^{-6} (Table 9.27), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Adolescent Trespasser

Calculations for the adolescent trespasser are presented in Table 7.53. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in

Table 9.28. The total non-carcinogenic HI for the adolescent trespasser is 0.2, which is below the acceptable threshold of 1.0 (Table 9.28). The non-carcinogenic HI for surface soil is 0.02, for surface water is 0.1, and for sediment is 0.04.

The carcinogenic risk for the adolescent trespasser is 4×10^{-6} (Table 9.28), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for exposure to surface soil is 4.1×10^{-7} , to surface water is 2.0×10^{-6} , and to sediment is 1.4×10^{-6} .

Subsurface Soil

Resident Adult and Child

Calculations for the resident adult are presented in Table 7.54. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.29. The total non-carcinogenic HI for resident adult exposures to media of concern is 0.1, which is below the acceptable threshold of 1.0. The non-carcinogenic HI for subsurface soil is 0.1, for surface water is 0.03, and for sediment is 0.006.

Calculations for the resident child are presented in Table 7.55. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.29. The total non-carcinogenic HI for the resident child is 1, which is equal to the acceptable threshold of 1.0 (Table 9.29). The non-carcinogenic HI for subsurface soil is 1, for surface water is 0.3, and for sediment is 0.1.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 2×10^{-5} (Table 9.29), which is within EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Construction Worker

Calculations for the construction worker are presented in Table 7.56. Estimates of cumulative risks across all pathways for non-carcinogenic and carcinogenic effects are presented in Table 9.30. The total non-carcinogenic HI for the construction worker is 0.2, which is below the acceptable threshold of 1.0 (Table 9.30).

The carcinogenic risk for the construction worker is 2×10^{-7} (Table 9.30), which is below the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

Lead

Lead was identified as s COPC in surface soil based upon a comparison of the maximum detected concentration to the EPA residential soil RSL. Lead was evaluated for the residential scenario with the EPA IEUBK model. Potential concerns for workers were evaluated with the EPA Adult Lead Model. Both models evaluate the percentage (%) of a target population that

will have blood-lead levels above a reference concentration. A range of reference blood-lead levels were evaluated: 5 µg /dL, 8 µg /dL, and 10 µg /dL. The 95%UCLM for lead in surface (225 mg/kg, Table 3.9) soil was used as the soil lead concentration. Outputs of the IEUBK model are presented in Appendix D including probability density graphs.

Surface Soil

Reference Blood-lead Level	5 µg /dL		8 µg /dL		10 µg /dL	
	% Exceeding	Mean Blood-lead Level (µg/dL)	% Exceeding	Mean Blood-lead Level (µg /dL)	% Exceeding	Mean Blood-lead Level (µg /dL)
IEUBK Model	13.2	3.0	1.7	3.0	0.5	3.0
Adult Lead Model	0.8	3.2	0.06	3.2	0.02	3.2

The models indicate a mean blood-lead levels of approximately 3 µg/dL. Based upon both models, no greater than 5% of the population exceeded the reference level, except the IEUBK reference blood lead level of 5 µg/dL. This reveals lead is not a potential concern for resident children or workers in surface soil. Two sample results from one location exceeded a lead concentration of 1,000 mg/kg, ETF-SB-136-0.5 (2,100 mg/kg) and ETF-SB-136-2.0 (2,730 (mg/kg). Additionally, three sample results exceeded the USEPA residential soil RSL of 400 mg/kg. These sample locations are ETF-SB-142-2.0 (729 mg/kg), ETF-SB-131-2.0 (687 mg/kg), and ETF-SB-131-0.5 (555 mg/kg).

2.4.4.6 Residential Yards

Surface and subsurface soil samples collected within residential yards were combined in one dataset and evaluated for potential risk concerns. EPCs used to evaluate the residential yards was the maximum detected concentration. Calculations of intake, risks, and hazards are presented in Tables 7.64 through 7.67. Table 7.68 presents the estimation of COPC air concentrations of particulates from soil for the resident. Table 7.69 presents the estimation of COPC concentrations in homegrown produce. Beef ingestion was not evaluated for the residential yards due to the size of areas. Estimates of cumulative risks across all exposure pathways for non-carcinogenic and carcinogenic effects are presented in Tables 9.31 and 9.32. Tables 10.31 and 10.32 present the significant contributors to risk results.

Surface Soil

The total non-carcinogenic HI for resident adult exposure to surface soil is 2, which is above the acceptable threshold of 1.0. The non-carcinogenic HI for direct contact with surface soil is 0.7 and for ingestion of homegrown produce is 1.2. Table 10.31 presents the significant contributors to risk and provides a breakdown by target organ. No significant contributors to risk or target organ exceedances were identified.

The total non-carcinogenic HI for the resident child is 10, which is above the acceptable threshold of 1.0 (Table 9.31). The non-carcinogenic HI for direct contact with surface soil is 7.2

and for ingestion and homegrown produce is 2.3. Table 10.31 presents the significant contributors to risk and provides a breakdown by target organ. Cadmium and cobalt, and their associated target organs, exceed the acceptable threshold of 1.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 1×10^{-4} (Table 9.31), which is equal to the upper end of the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} . The cumulative carcinogenic risk for direct contact with surface soil is 6.8×10^{-5} and ingestion of homegrown produce is 3.6×10^{-5} . Benzo(a)pyrene and arsenic are the only COPCs with carcinogenic risks greater than 10^{-5} .

Subsurface Soil

The total non-carcinogenic HI for resident adult exposure to subsurface soil is 0.2, which is below the acceptable threshold of 1.0.

The total non-carcinogenic HI for the resident child is 2, which is above the acceptable threshold of 1.0 (Table 9.32). Table 10.32 presents the significant contributors to risk and provides a breakdown by target organ. No chemical or target organ exceeds the acceptable threshold of 1.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the resident adult and child combined is 3×10^{-5} (Table 9.32), which is within the EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} .

3. RISK ASSESSMENT UNCERTAINTY

There are numerous uncertainties involved in the HHRA process. These are discussed briefly in the following sections.

3.1 UNCERTAINTIES ANALYSIS OF EXPOSURE ASSESSMENT

An analysis of uncertainties is an important aspect of the exposure assessment. It provides the risk assessor and reviewer with information relevant to the individual uncertainties associated with exposure factor assumptions and their potential impact on the final assessment. Exposure is evaluated for the site based upon areas. The delineation of the areas allows for a determination of potential human health concerns for the zone itself but does not necessarily represent actual exposure that would occur. The areas were identified based upon past site use and configuration. This allows for a determination of potential human health concerns for exposure to expected site sources or source areas within each Area but is not necessarily indicative of human exposures. The size of each area is larger than expected for residential yards. However, future re-use of the site or specific areas of the site would most likely require construction across large areas of land. Therefore, the delineation of areas allows for risk management decisions about site source areas but may not be entirely representative of potential exposures.

3.1.1 Ingestion of Home-grown Produce and Beef

As part of the soil exposure pathway evaluation, residents were assessed for the ingestion of home-grown produce and beef. Potential risk concerns were found for these exposure pathways within the LDA and WPA. Exceedance of non-cancer hazards were determined for inorganic COPCs (i.e., copper, cobalt, iron, and manganese) only. It is noted that the EPCs for manganese within all exposure areas is less than the background UPL. For cobalt and iron, the EPCs only within the LDA exceed the background UPL. Copper is only a COPC within the LPA and the WPA, and the EPCs exceed the background UPL.

Home-grown produce assumes residents will have gardens that contain primarily vegetables. Beef ingestion was assessed because cattle grazing currently occurs within the ETF. The assessment of cattle grazing is a protective evaluation since most of the site is rocky or has rock outcrops that make cattle grazing in all exposure areas challenging. Potential COPC concentrations in home-grown produce and beef are modeled assuming uptake from surface soil only. As a result, a number of the model inputs are based upon default parameters and not from actual laboratory analysis.

An important input in determining intakes for home-grown produce and beef is the intake rates. The rates selected represent an averaged mean intake rate for home-produced vegetables and home-produced meats, consumers only (EPA 2011). The rates are only determined based upon a 7-day survey period and does not account long-term distribution of average daily intakes (EPA 2011). Therefore, intake rates may be overestimated over long-term exposure periods. Another important input in determining intake is the modeled concentration of soil COPCs in

home-grown produce and beef. These concentrations are estimated based upon bioconcentration factors that are modeled based upon the log K_{ow} (EPA 2005c). The beef ingestion intake also takes into account 100% soil bioavailability of COPCs. These estimations are likely to result in higher modeled COPC concentrations in both home-grown produce and beef. Non-cancer hazards estimated for these exposure pathways are likely overestimated.

3.1.2 Dermal Exposures

Dermal contact rates for COPCs in soil are evaluated based upon a chemical's ability to be absorbed through the skin surface. EPA has identified a dermal ABS that reflects the desorption of a chemical from soil and the absorption of the chemical across the skin and into the blood stream. ABS values are not available for most inorganics in EPA RAGS E guidance (EPA 2004). Dermal contact with skin is expected to be a significant exposure, especially for children. However, inorganics are often not well-absorbed through the skin. It is difficult to estimate the effects of generic ABS values on risk results. The absorption of inorganics is primarily a concern if skin is occluded (EPA 2004). However, non-occluded skin is not expected to have absorption. Therefore, risks determined for the dermal contact exposure pathway are most likely overestimated.

3.1.3 Blood-lead Modeling Exposure Areas

As noted, the mean lead concentration in soil was used as the EPC for all blood-lead modeling. The soil exposure areas evaluated are significantly larger than a "typical" residential yard, which is the recommendation for blood-lead models. Therefore, there is a possibility that the mean concentration may underestimate the average lead concentration of soil. To account for potential underestimates of lead, sample locations within each soil exposure area that exceed the residential soil RSL of 400 mg/kg and a concentration of 1,000 mg/kg are identified.

3.1.4 Exposure Point Concentrations

An uncertainty exists with the basic approach used in arriving at EPCs for COPCs. The EPA ProUCL program eliminates many uncertainties associated with EPC calculation; however, COPCs with low frequencies of detection or small sample dataset (<5 samples) still have uncertainties within ProUCL. Sufficient sample set size was achieved throughout most media types within each exposure area. In addition, most organic analytes detected in samples throughout the site had low frequencies of detection. The EPA notes, "Statistics (e.g., 95UCLM) computed based upon only a few detected values (e.g., <4-6) cannot be considered reliable enough to estimate the EPC terms having potential impact on the human health and the environment. When the number of detected data is small, it is preferable to use simple ad hoc methods rather than using statistical methods to compute the EPC terms and other upper limits" (EPA 2015). In such instances, the maximum detected concentration was used as the EPC as a conservative measure. A comparison of the mean detected concentration to the maximum detected concentration revealed results generally within an order of magnitude. The use of the maximum concentration instead of the 95UCLM may result in an overestimate of potential risks

when evaluating long-term exposures. The extent of the overestimate of potential risks is not expected to be large nor is it expected to change the overall conclusions of the HHRA.

The EPCs for the inhalation of VOCs from groundwater exposure route were determined through modeling and were not direct measurements. For the resident and commercial worker, the inhalation EPCs were determined by multiplying the groundwater EPC by the Andelman Volatilization Factor (EPA 2019a). The Andelman Volatilization Factor accounts for all inhalation exposures to VOCs within a residence. This includes potential volatilization of VOCs during household activities, including showering, dish washing, flushing of toilets, and other activities that require the use of tap water (EPA 1991b). The volatilization factor is an “upper-bound” estimate where half of the concentration of a COPC in water will be transferred into the air through all water uses (EPA 1991b). The measured transfers ranged from 30 percent for toilets to 90 percent for dishwashers (EPA 1991b). Additionally, assumptions are made about the volume of water used, the volume of a dwelling, and the air exchange rate. As a result, the VOC air EPCs determined through the use of the Andelman Volatilization Factor may result in an underestimate or overestimate of potential risks. However, given the conservative assumption of a 50 percent transfer from water to air and assumptions of water use, the VOC air EPC and the resulting risk results are overestimated. For the assessment of inhalation of VOCs from a trench, the model estimates VOCs concentrations based upon volatilization of gases from contaminated groundwater into a trench and a box model to estimate the dispersion of chemicals from the air inside the trench to the above-ground atmosphere. The model provides a protective estimation of potential vapor concentrations in a trench that a worker may inhale. The model only takes into account mass transfer of COPCs and does not take into account potential degradation of VOCs as they move through the vadose zone. Vapor concentrations estimated within the trench are likely overestimated to provide a protective evaluation. As a result, the resulting risk results for inhalation of vapors from a trench are likely overestimated.

3.2 UNCERTAINTIES OF TOXICITY ASSESSMENT

There are numerous uncertainties associated with the toxicity assessment. These are generally due to the unavailability of data to thoroughly calculate the toxicity of COPCs. These uncertainties are described in more detail in the following sections.

3.2.1 Uncertainties Associated With Non-Carcinogenic Effects

3.2.1.1 Interspecies Extrapolation

The majority of toxicological information comes from experiments with laboratory animals. Experimental animal data have been relied on by regulatory agencies to assess the hazards of chemical exposures to humans. Interspecies differences in chemical absorption, metabolism, excretion, and toxic response are not well understood; therefore, conservative assumptions are applied to animal data when extrapolating to humans. These probably result in an overestimation of toxicity.

3.2.1.2 Intraspecies Extrapolation

Differences in individual human susceptibilities to the effects of chemical exposures may be caused by such variables as genetic factors (e.g., glucose-6-phosphate dehydrogenase deficiency), lifestyle (e.g., cigarette smoking and alcohol consumption), age, hormonal status (e.g., pregnancy), and disease. To take into account the diversity of human populations and their differing susceptibilities to chemically induced injury or disease, a safety factor is used. EPA uses a factor between 1 and 10. This uncertainty may lead to overestimates of human health effects at given doses.

3.2.2 Exposure Routes

When experimental data available on one route of administration are different from the actual route of exposure that is of interest, route-to-route extrapolation must be performed before the risk can be assessed. Several criteria must be satisfied before route-to-route extrapolation can be undertaken. The most critical assumption is that a chemical injures the same organ(s) regardless of route, even though the injury can vary in degree. Another assumption is that the behavior of a substance in the body is similar by all routes of contact. This may not be the case when, for example, materials absorbed via the gastrointestinal tract pass through the liver prior to reaching the systemic circulation, whereas by inhalation the same chemical will reach other organs before the liver. However, when data are limited, these extrapolations are made and may result in overestimates of human toxicity.

3.2.3 Uncertainties Associated With Carcinogenic Effects

3.2.3.1 Interspecies Extrapolation

The majority of toxicological information for carcinogenic assessments comes from experiments with laboratory animals. There is uncertainty about whether animal carcinogens are also carcinogenic in humans. While many chemical substances are carcinogenic in one or more animal species, only a very small number of chemical substances are known to be human carcinogens. The fact that some chemicals are carcinogenic in some animal species, but not in others, raises the possibility that not all animal carcinogens are human carcinogens. Regulatory agencies assume that humans are as sensitive to carcinogens as the most sensitive animal species. This policy decision, designed to prevent underestimation of risk, introduces the potential to overestimate carcinogenic risk.

3.2.3.2 High-Dose to Low-Dose Extrapolation

Typical cancer bioassays provide limited low-dose data on responses in experimental animals for chemicals being assessed for carcinogenic or chronic effects. The usual dose regime involves three dose groups per assay. The first dose group is given the highest dose that can be tolerated, the second is exposed to one-half that dose, and the third group is unexposed (control group) (National Research Council 1983). Because this dosing method does not reflect how animals would react to much lower doses of a chemical, a dose-response assessment normally requires

extrapolation from high to low doses using mathematical modeling that incorporates to varying degrees information about physiologic processes in the body (National Research Council 1983).

A central problem with the low-dose extrapolation models is that they often fit the data from animal bioassays equally well, and it is not possible to determine their validity based on goodness of fit. Several models may fit experimental data equally well, but all may not be equally plausible biologically. The dose-response curves derived from different models diverge substantially in the dose range of interest (National Research Council 1983). Therefore, low-dose extrapolation is more than a curve-fitting process, and considerations of biological plausibility of the models must be taken into account before choosing the best model for a particular set of data.

3.2.4 Modification for Mutagenic Compounds

Carcinogenic slope factors for compounds identified with a mutagenic mode of action for early-life exposure are modified by a default adjustment factor. The default adjustment factors are used because chemical-specific data are not available to directly assess cancer susceptibility from early-life exposure to a carcinogen acting through a mutagenic mode of action. The default adjustment factors are derived from a weighted geometric mean tumor incidence ratio. Therefore, the use of the default adjustment factors may both over-estimate and under-estimate the potential potency for early-life exposure for chemicals with a mutagenic mode of action for carcinogenesis (EPA 2005b). However, the analysis of potential exposure over a lifetime reduces the effects and uncertainty of the mutagenic adjustments on estimated lifetime cancer risk. Carcinogenic risks for receptors identified within the early-life exposure age range are determined based upon a lifetime exposure. The resulting uncertainty in the use of the mutagenic default adjustment factors is reduced but some uncertainty still remains in the use of default factors over a specified age range rather than chemical-specific data. However, this uncertainty is expected to be small and is not expected to impact the overall conclusions of the HHRA.

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4. RISK ASSESSMENT SUMMARY

The site is located on approximately 140 to 150 acres of land, in Bristow, Oklahoma (Figure 1). The site consists of the former Lorraine and former Wilcox Refineries. The site is flanked by Route 66 to the west; a residential area and Turner Turnpike to the northwest and north; Sand Creek to the southwest; and residential, agricultural, and wooded areas to the east and south.

The property was used for oil refinery operations from 1915 until November 1963. The Wilcox Oil and Gas Company and Lorraine Refining Company properties contained approximately 80 storage tanks of various sizes, a cooling pond, and approximately 10 buildings housing refinery operations. Crude oil, fuel oil, gas oil, distillate, kerosene, naptha, and benzene (petroleum ether) were all stored on the property.

Based upon the process areas and site use, the facility has been divided into five (5) major former operational areas (Figures 2): the Wilcox and Lorraine Process Areas, the East and North Tank Farms, and the Loading Dock Area. In the Wilcox Process Area, several refined product storage tanks, refinery-related debris, dilapidated buildings and structures remain on the property. There are two residences in this portion of the site, which are currently not occupied. In the northeastern portion of the Lorraine Process Area sits the Bristow First Assembly of God Church. A playground is located just south of the building and one residence is located to the west. All buildings are presently unoccupied. An active railroad divides the former Wilcox and Lorraine Process Areas. The North Tank Farm is located in the northwestern portion of the property, west of the railroad and north of West 221st Street South/Refinery Road, and is rural land containing one occupied residence. Three occupied residences are located in the East Tank Farm area, as well as five ponds and the East Tributary. The Loading Dock Area is located immediately east of the North Tank Farm and along the railroad tracks. Throughout the entire site, there are multiple areas of stressed vegetation, barren areas, and visible black tarry waste.

Groundwater at the site consists of perched groundwater and a regional aquifer. Residential wells are located within the regional aquifer. Site monitoring wells were installed primarily within the perched groundwater at the site. As a result, groundwater is evaluated in two datasets: monitoring wells and residential wells. Risk calculations for all exposure areas were determined based upon sample results from monitoring wells. The residential wells were evaluated on a well by well basis in a separate assessment. The depth to perched groundwater is shallow; therefore, the assumption was made that groundwater could be contacted during subsurface investigations. It is therefore assumed that any construction or installation of underground utilities or pipelines may contact groundwater. VOCs were detected in groundwater at the site. However, soil gas samples did not reveal any potential COPCs for vapor intrusion to indoor air. As a result, the potential for inhalation of VOCs from groundwater was either through typical use as a tap water source and vapor intrusion into construction trenches. Figure 8 illustrates the CSM for the site and the complete exposure pathways evaluated in the HHRA.

The following table presents a summary of the HHRA results.

Human Health Risk Assessment Summary of Results

Receptor	HHRA Results			COPC Contributing Significantly to Results ²
	Media	Carcinogenic Risks ¹	Noncarcinogenic Hazards ¹	
North Tank Farm: Surface Soil				
Child Resident ³	Surface soil ⁴	5 × 10 ⁻⁵	2	NA ⁵
	Surface water	5 × 10 ⁻⁶	0.3	NA
	Sediment	4 × 10 ⁻⁶	0.1	NA
	Total	5 × 10 ⁻⁵	3	
Adult Resident ³	Surface soil ⁴	5 × 10 ⁻⁵	0.8	NA
	Surface water	5 × 10 ⁻⁶	0.03	NA
	Sediment	4 × 10 ⁻⁶	0.006	NA
	Total	5 × 10 ⁻⁵	0.8	
Construction Worker	Surface soil	1 × 10 ⁻⁷	0.2	NA
	Total	1 × 10 ⁻⁷	0.2	
Commercial Worker	Surface soil	8 × 10 ⁻⁷	0.05	NA
	Total	8 × 10 ⁻⁷	0.05	
Adolescent Trespasser	Surface soil	2 × 10 ⁻⁷	0.02	NA
	Surface water	2 × 10 ⁻⁶	0.1	NA
	Sediment	1 × 10 ⁻⁶	0.04	NA
	Total	4 × 10 ⁻⁶	0.2	
North Tank Farm: Subsurface Soil				
Child Resident ³	Subsurface Soil	5 × 10 ⁻⁶	1	NA
	Surface water	5 × 10 ⁻⁶	0.3	NA
	Sediment	4 × 10 ⁻⁶	0.1	NA
	Total	1 × 10 ⁻⁵	1	
Adult Resident ³	Subsurface soil	5 × 10 ⁻⁶	0.1	NA
	Surface water	5 × 10 ⁻⁶	0.03	NA
	Sediment	4 × 10 ⁻⁶	0.006	NA
	Total	1 × 10 ⁻⁵	0.1	
Construction Worker	Subsurface soil	1 × 10 ⁻⁷	0.3	NA
	Total	1 × 10 ⁻⁷	0.3	
Lorraine Process Area: Surface Soil				
Child Resident ³	Surface soil ⁴	3 × 10 ⁻⁵	3	NA ⁵
	Surface water	5 × 10 ⁻⁶	0.3	NA
	Sediment	4 × 10 ⁻⁶	0.1	NA
	Total	4 × 10 ⁻⁵	3	
Adult Resident ³	Surface soil ⁴	3 × 10 ⁻⁵	1	NA
	Surface water	5 × 10 ⁻⁶	0.03	NA
	Sediment	4 × 10 ⁻⁶	0.006	NA
	Total	4 × 10 ⁻⁵	1	
Construction Worker	Surface soil	2 × 10 ⁻⁷	0.1	NA
	Total	2 × 10 ⁻⁷	0.1	
Commercial Worker	Surface soil	1 × 10 ⁻⁶	0.04	NA
	Total	1 × 10 ⁻⁶	0.04	

Receptor	HHRA Results			COPC Contributing Significantly to Results ²
	Media	Carcinogenic Risks ¹	Noncarcinogenic Hazards ¹	
Adolescent Trespasser	Surface soil	3×10^{-7}	0.01	NA
	Surface water	2×10^{-6}	0.1	NA
	Sediment	1×10^{-6}	0.04	NA
	Total	4×10^{-6}	0.2	
Lorraine Process Area: Subsurface Soil				
Child Resident ³	Subsurface soil	5×10^{-6}	0.6	NA
	Surface water	5×10^{-6}	0.3	NA
	Sediment	4×10^{-6}	0.1	NA
	Total	1×10^{-5}	1	
Adult Resident ³	Subsurface soil	5×10^{-6}	0.06	NA
	Surface water	5×10^{-6}	0.03	NA
	Sediment	4×10^{-6}	0.006	NA
	Total	1×10^{-5}	0.1	
Construction Worker	Subsurface soil	1×10^{-7}	0.2	NA
	Total	1×10^{-7}	0.2	
Loading Dock Area: Surface Soil				
Child Resident ³	Surface soil ⁴	7×10^{-5}	5	Cancer Risks: NA Non-Cancer Hazards: Cobalt
	Surface water	5×10^{-6}	0.3	NA
	Sediment	4×10^{-6}	0.1	NA
	Total	8×10^{-5}	6	
Adult Resident ³	Surface soil ⁴	7×10^{-5}	2	NA ⁵
	Surface water	5×10^{-6}	0.03	NA
	Sediment	4×10^{-6}	0.006	NA
	Total	8×10^{-5}	2	
Construction Worker	Surface soil	2×10^{-7}	0.3	NA
	Total	2×10^{-7}	0.3	
Commercial Worker	Surface soil	1×10^{-6}	0.09	NA
	Total	1×10^{-6}	0.09	
Adolescent Trespasser	Surface soil	3×10^{-7}	0.03	NA
	Surface water	2×10^{-6}	0.1	NA
	Sediment	1×10^{-6}	0.04	NA
	Total	4×10^{-6}	0.2	
Loading Dock Area: Subsurface Soil				
Child Resident ³	Subsurface Soil	5×10^{-6}	2	NA ⁵
	Surface water	5×10^{-6}	0.3	NA
	Sediment	4×10^{-6}	0.1	NA
	Total	1×10^{-5}	2	
Adult Resident ³	Subsurface soil	5×10^{-6}	0.2	NA
	Surface water	5×10^{-6}	0.03	NA
	Sediment	4×10^{-6}	0.006	NA
	Total	1×10^{-5}	0.2	
Construction Worker	Subsurface soil	2×10^{-7}	0.4	NA
	Total	2×10^{-7}	0.4	

Receptor	HHRA Results			COPC Contributing Significantly to Results ²
	Media	Carcinogenic Risks ¹	Noncarcinogenic Hazards ¹	
Wilcox Process Area: Surface Soil				
Child Resident ³	Surface soil ⁴	4 × 10 ⁻⁵	10	Cancer Risks: NA Non-Cancer Hazards: Cobalt, copper, iron, benzo(a)pyrene
	Groundwater	7 × 10 ⁻³	50	Cancer Risks: Arsenic, benzene ethylbenzene Non-Cancer Hazards: Arsenic, cyanide, iron, benzene
	Surface water	5 × 10 ⁻⁶	0.3	NA
	Sediment	4 × 10 ⁻⁶	0.1	NA
	Total	7 × 10 ⁻³	60	
Adult Resident ³	Surface soil ⁴	4 × 10 ⁻⁵	3	NA ⁵
	Groundwater	7 × 10 ⁻³	93	Cancer Risks: Arsenic, naphthalene, benzene, ethylbenzene Non-Cancer Hazards: Arsenic, cyanide, naphthalene, benzene, m,p-xylene, o-xylene
	Surface water	5 × 10 ⁻⁶	0.03	NA
	Sediment	4 × 10 ⁻⁶	0.006	NA
	Total	7 × 10 ⁻³	96	
Construction Worker	Surface soil	4 × 10 ⁻⁷	0.3	NA
	Groundwater	9 × 10 ⁻⁵	33	Cancer Risks: NA Non-Cancer Hazards: Naphthalene, benzene, m,p-xylene
	Total	9 × 10 ⁻⁵	33	
Commercial Worker	Surface soil	2 × 10 ⁻⁶	0.06	NA
	Groundwater	8 × 10 ⁻⁴	12	Cancer Risks: Arsenic, benzene Non-Cancer Hazards: Benzene
	Total	8 × 10 ⁻⁴	12	
Adolescent Trespasser	Surface soil	1 × 10 ⁻⁶	0.03	NA
	Surface water	2 × 10 ⁻⁶	0.1	NA
	Sediment	1 × 10 ⁻⁶	0.04	NA
	Total	5 × 10 ⁻⁶	0.2	
Wilcox Process Area: Subsurface Soil				
Child Resident ³	Subsurface Soil	3 × 10 ⁻⁵	1	NA
	Groundwater	7 × 10 ⁻³	50	Cancer Risks: Arsenic, benzene, ethylbenzene Non-Cancer Hazards: Benzene, arsenic, cyanide
	Surface water	5 × 10 ⁻⁶	0.3	NA
	Sediment	4 × 10 ⁻⁶	0.1	NA
	Total	7 × 10 ⁻³	52	
	Subsurface soil	3 × 10 ⁻⁵	0.1	NA

Receptor	HHRA Results			COPC Contributing Significantly to Results ²
	Media	Carcinogenic Risks ¹	Noncarcinogenic Hazards ¹	
Adult Resident ³	Groundwater	7×10^{-3}	93	Cancer Risks: Arsenic, naphthalene, benzene, ethylbenzene Non-Cancer Hazards: Arsenic, cyanide, naphthalene, benzene, m,p-xylene, o-xylene
	Surface water	5×10^{-6}	0.03	NA
	Sediment	4×10^{-6}	0.006	NA
	Total	7×10^{-3}	93	
Construction Worker	Subsurface soil	4×10^{-7}	0.3	NA
	Groundwater	9×10^{-5}	33	Cancer Risks: NA Non-Cancer Hazards: Naphthalene, benzene, m,p-xylene
	Total	9×10^{-5}	34	
East Tank Farm: Surface Soil				
Child Resident ³	Surface soil ⁴	5×10^{-5}	3	NA ⁵
	Surface water	5×10^{-6}	0.3	NA
	Sediment	4×10^{-6}	0.1	NA
	Total	6×10^{-5}	3	
Adult Resident ³	Surface soil ⁴	5×10^{-5}	1	NA
	Surface water	5×10^{-6}	0.03	NA
	Sediment	4×10^{-6}	0.006	NA
	Total	6×10^{-5}	1	
Construction Worker	Surface soil	2×10^{-7}	0.2	NA
	Total	2×10^{-7}	0.2	
Commercial Worker	Surface soil	1×10^{-6}	0.05	NA
	Total	1×10^{-6}	0.05	
Adolescent Trespasser	Surface soil	4×10^{-7}	0.02	NA
	Surface water	2×10^{-6}	0.1	NA
	Sediment	1×10^{-6}	0.04	NA
	Total	4×10^{-6}	0.2	
East Tank Farm: Subsurface Soil				
Child Resident ³	Subsurface Soil	8×10^{-6}	1	NA
	Surface water	5×10^{-6}	0.3	NA
	Sediment	4×10^{-6}	0.1	NA
	Total	2×10^{-5}	1	
Adult Resident ³	Subsurface soil	8×10^{-6}	0.1	NA
	Surface water	5×10^{-6}	0.03	NA
	Sediment	4×10^{-6}	0.006	NA
	Total	2×10^{-5}	0.1	
Construction Worker	Subsurface soil	2×10^{-7}	0.2	NA
	Total	2×10^{-7}	0.2	

Receptor	HHRA Results			COPC Contributing Significantly to Results ²
	Media	Carcinogenic Risks ¹	Noncarcinogenic Hazards ¹	
Notes:				
1 Total Risks and hazards presented for each Area do not equal the sum of individual environmental media due to rounding.				
2 A significant contributor is defined as a COPC that contributes greater than 10 ⁻⁵ carcinogenic risk or non-carcinogenic hazard greater than 1.				
3 Carcinogenic risks for the resident adult and child are combined and presented as a total lifetime cumulative carcinogenic risk.				
4 Surface soil risks include ingestion of homegrown produce and beef.				
5 A breakdown by target organ did not reveal any non-carcinogenic hazards greater than 1.				
NA = Not Applicable.				

Potential exposures to surface water and sediment at the site were within the EPA acceptable cancer risk range and noncarcinogenic hazards were below the level of concern. Therefore, these media are not expected to pose human health concerns. Carcinogenic risks for all receptors exposure to soil were also within the EPA acceptable risk range. Potential health concerns were identified for exposure to soils (noncarcinogenic hazards and lead) and groundwater. The following sections provide a summary of site risks. The overall conclusions and evaluation of site risks is divided for soil by exposure area. The evaluation of groundwater relates potential risk concerns to site-wide exposures to perched groundwater.

Soil

Non-carcinogenic hazards for all receptor's exposure to surface and subsurface soil, except the resident child and adult exposure to surface soil, were below the acceptable level of 1. Noncarcinogenic hazards exceeded 1 for the resident child within the North Tank Farm, Lorraine Process Area, Loading Dock Area, Wilcox Process Area, and East Tank Farm. However, a breakdown by target organ only revealed potential concerns within the Wilcox Process Area and Loading Dock Area. For the resident adult, a breakdown by target organ did not reveal any noncarcinogenic concerns. Carcinogenic risks for all receptor's exposure to surface and subsurface soil were within the EPA acceptable cancer risk range of 10^{-6} to 10^{-4} . It is noted that carcinogenic risks exceeded 10^{-5} within the Lorraine Process Area, Loading Dock Area, Wilcox Process Area, North Tank Farm, and the East Tank Farm. Carcinogenic risks greater than 10^{-5} and noncarcinogenic hazards greater than 1 are primarily a result of direct contact and beef consumption exposure routes. It is noted that the beef consumption exposure route is a highly uncertain exposure route and exposure parameters used in the evaluation are also uncertain. Therefore, the risk results from this exposure route have a high uncertainty.

It is noted that the HHRA evaluated potential human health concerns based the entire exposure area. However, the exposure areas are larger than area that are typically evaluated for residential yards. To further evaluate the surface soil medium of concern and evaluate potential concerns for smaller exposure areas (i.e., potential residential yards), sample results were reviewed to determine if areas of high concentration are present within the five soil exposure areas. Areas of

high concentration were determined as concentrations that exceed the residential soil RSL by two orders of magnitude (i.e., 100 times). The only chemical that exceeded this criterion was benzo(a)pyrene within the Wilcox Process Area and East Tank Farm. The maximum detected concentration of benzo(a)pyrene in both surface soil (WPA-SB-20-2.0 at 31 mg/kg) and subsurface soil (WPA-SB-20-6.0 at 24 mg/kg) exceeded the residential soil RSL by greater than two orders of magnitude. Additionally, benzo(a)pyrene was detected within WPA-SB-18-20.0 at 23 mg/kg. The highest detections of benzo(a)pyrene were primarily within the Wilcox Process Area, except for one detection within the East Tank Farm. The maximum detected concentration of benzo(a)pyrene in surface soil (ETF-SB-02-0.5 at 12 mg/kg) within the East Tank Farm also exceeded the residential soil RSL by two orders of magnitude. Therefore, there are potential isolated areas of benzo(a)pyrene that may be a potential human health concern for residential receptors. However, it is noted that none of these detections were within existing residential yards.

Lead was identified as a COPC in surface and subsurface soil within the Lorraine Process Area and the Wilcox Process Area, and surface soil within the East Tank Farm. Potential concerns with lead in soil was evaluated through the EPA blood-lead models, the IEUBK and Adult Lead Model. A range of reference blood-lead levels were evaluated: 5 µg /dL, 8 µg /dL, and 10 µg /dL. Surface soil within the Lorraine Process Area and Wilcox Process revealed greater than 5% of the population exceed the all reference blood-lead levels evaluated in the IEUBK. This reveals lead is a potential concern for resident children in surface soil within the Lorraine Process Area and the Wilcox Process Area. For the adult lead model, only the 5 µg/dL reference blood-lead level had greater than 5% of the population exceeding in the Lorraine Process Area and none of the reference blood-lead levels exceeded in the Wilcox Process Area. For the East Tank Farm, the IEUBK and the Adult Lead Model revealed no potential concerns. Additionally, no potential concerns were identified for subsurface soil within the Lorraine Process Area and the Wilcox Process Area.

For the Lorraine Process Area surface soil, three sample results from two locations exceed the USEPA residential soil RSL of 400 mg/kg. These sample locations are SB-20-0.5 (20,800 mg/kg), SB-17-0.5 (8,390 mg/kg), and SB-17-2 (1,760 mg/kg). Soil samples collected at deeper depths to these sample locations revealed lead concentrations lower than 150 mg/kg. Within the Wilcox Process Area surface soil, nine sample results from seven locations had lead concentrations greater than 1,000 mg/kg. These sample locations are WPA-SB-15-0.5 (19,000 mg/kg), WPA-SB-10-0.5 (3,400 mg/kg), WPA-SB-14-0.5 (2,890 mg/kg), WPA-SB-13-0.5 (2,100 mg/kg), WPA-SB-10-2.0 (2,100 mg/kg), WPA-SB-14-2.0 (1,570 mg/kg), WPA-SB-09-0.5 (1,570 mg/kg), WPA-SB-05-0.5 (1,470 mg/kg), and WPA-SB-50-0.5 (1,080 mg/kg). Soil samples collected at deeper depths to these sample locations revealed lead concentrations lower than 250 mg/kg, except sample location SB-15. Although blood-lead models did not reveal potential concerns for the East Tank Farm surface soil, two sample results from one location exceeded a lead concentration of 1,000 mg/kg, ETF-SB-136-0.5 (2,100 mg/kg) and ETF-SB-136-2.0 (2,730 mg/kg).

Residential Yards

The assessment of the residential yards found potential concerns for exposure to surface soil. Carcinogenic risks were equal to the upper end of the EPA's acceptable cancer risk range, and non-carcinogenic hazards were above 1. Cadmium and cobalt were the COPCs with non-carcinogenic hazards above 1, and benzo(a)pyrene and arsenic are the primary contributors to carcinogenic risks. It is noted that the assessment of the residential yards used the maximum detected concentration of the EPC.

The HHRA results for subsurface soil within the residential yards did not reveal any potential human health concerns.

Groundwater

Potential risks were assessed for groundwater based upon monitoring well results within the perched aquifer. Potential risk concerns for exposure to groundwater within the perched aquifer were determined for all receptor's exposure to groundwater. Primary contributors to risk concerns were multiple metals (arsenic, cyanide, and iron) and VOCs (benzene, naphthalene, ethylbenzene, and m,p-xylene). The maximum detected concentration of VOCs was found in monitoring well MW-04, which is located in the Wilcox Process Area. Due to the low frequency of detection, the EPC for VOCs in monitoring wells is the maximum detected concentration. The maximum detected concentration for VOCs within MW-04 are approximately three orders of magnitude higher than detections in other wells. It is also noted that these VOCs were not detected in the residential groundwater wells. This well is located in the northeast area of the Wilcox Process Area. Therefore, groundwater risk concerns based upon monitoring well results are centralized within the Wilcox Process Area.

5. HUMAN HEALTH RISK MANAGEMENT DECISIONS

As noted in the HHRA and RI report, a number of potential source areas were present within the Site. These potential source areas include the skimming and cracking plant, re-distillation battery, stills, cooling ponds, Lead Additive Area, approximately 10 buildings housing refinery operations, storage tanks, and other related refinery structures historically located on the Lorraine and Wilcox Process Areas. Other potential source areas include approximately 80 bulk storage tanks of various sizes historically located at the Lorraine and Wilcox Process Areas, as well as the East and North Tank Farms. Surficial waste material was also identified in the Loading Dock Area.

Crude oil, fuel oil, gas oil, distillate, kerosene, naphtha, and benzene (petroleum ether), acids, and other refined products were reportedly stored on the property (EA 2016c). Site data suggest that periodic releases of crude oil, sludge, and refined product occurred in these areas during operations. These releases may have been discharged to surface and subsurface soil, and subsequently migrated to groundwater, surface water, and sediment. VOCs may have also migrated into the vadose zone as soil gas.

As a result of the varied sources and source areas, the HHRA evaluated a wide range of COPCs in site media for each of the five exposure areas. Risk results for most of the COPCs fall within EPA's risk management range. Many of these additional COPCs are suspected to be ubiquitous regional contaminants related to historical activities and/or background concentrations rather than site-specific contaminants. This section provides: (1) a basis of understanding regarding carcinogenic and non-carcinogenic risks and EPA's risk management range, (2) a discussion of chemicals that fall above EPA's acceptable risk range, and (3) an evaluation of chemicals within EPA's risk management range based on spatial extent, magnitude of exceedance, and fate and transport considerations in order to determine an appropriate path forward within the context of risk management.

5.1 BASIS OF UNDERSTANDING

Human health risks are evaluated by carcinogenic and non-carcinogenic risks as discussed in the subsections below. Additionally, potential human health concerns associated with lead in soil were evaluated using blood-lead modeling.

5.1.1 Carcinogenic Risk

For carcinogens, risks are expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the level of the carcinogen at the site. A carcinogenic risk of 10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate for the site has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an excess incremental lifetime cancer risk because it would be in addition to the risks of cancer individuals face from other causes. The chance of an

individual developing cancer from all other causes has been estimated to be as high as 40 percent (Howlader et al., 2015).

Because the cancer slope factor (used to calculate excess lifetime carcinogenic risk) is the statistical 95th percent upper-bound confidence limit on the dose-response slope, this method provides a conservative, upper-bound estimate of risk. It should be noted that the interpretation of the significance of the cancer risk estimate is based on the appropriate public policy. EPA in the NCP (40 Code of Federal Regulation Part 300) (1990a) states that:

“...For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} .”

This risk range represents EPA’s generally acceptable risk range for site-related exposures, or a 1 in 10,000 to 1 in 1,000,000 chance, respectively, of an individual developing cancer. Carcinogenic risks that are below the lower end of the acceptable risk range (i.e., 10^{-6}) are considered *de minimis* and require no action. Carcinogenic risks within the risk management range (i.e., between 10^{-4} and 10^{-6}) are subject to a risk management decision. Generally, only carcinogenic risks above the upper end of the acceptable risk range (i.e., 10^{-4}) warrant additional consideration. However, the upper end of the cancer risk range is not a discrete line and “specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks (EPA 1991c)”. Additionally, the EPA notes, “A risk manager may also decide that a lower level of risk to human health is unacceptable and that remedial action is warranted where, for example, there are uncertainties in the risk assessment results (EPA 1991c).”

5.1.2 Non-carcinogenic Risk

For non-carcinogens (systemic toxicants), potential effects are evaluated by comparing an exposure level over a specified time period (e.g., exposure duration) with a reference dose or reference concentration derived for a similar exposure period. A reference dose or reference concentration represents a level to which an individual may be exposed and not expected to cause any harmful effect. A HQ (ratio of average daily intake level to acceptable daily intake level) of less than 1.0 indicates that a receptor’s dose of a single contaminant is less than the reference dose. As a result, there will be no concern that potential adverse systemic health effects will be observed in the exposed populations. However, if the sum of several HQs exceeds 1.0, and the COPC affect the same target organ, there may be concern that potential adverse systemic health effects will be observed in the exposed populations. In general, the greater the value of the HQ above 1.0, the greater the level of concern. However, the HQ does not represent a statistical probability that an adverse health effect will occur.

For the consideration of exposures to more than one chemical causing systemic toxicity via several different pathways, the individual HQs are summed to provide an overall HI. If the HI is less than 1.0, then no adverse health effects are likely to be associated with exposures at the site.

However, if the total HI is greater than 1.0, separate endpoint-specific HIs may be calculated based on toxic endpoint of concern or target organ (e.g., HQs for neurotoxins are summed separately from HQs for renal toxins). If an endpoint-specific HI is greater than 1.0, there is reason for concern about potential health effects for that endpoint. Similar to carcinogenic risks, uncertainties associated with the risk assessment may not warrant action for noncancer hazards that are greater than 1.0.

5.1.3 Lead Modeling

Potential health concerns associated with lead exposure relates the effect in terms of the amount of lead in blood associated with an observed effect. For this HHRA, the amount of lead in blood associated with an observed effect was set to a reference value based on the 97.5th percentile of the NHANES-generated blood-lead level in children 1-5 years old (CDC 2012) which equates to 5 µg/dL. Therefore, this blood-lead level is used to identify potential concerns for children with elevated blood-lead levels. Additionally, blood-lead levels of 8 µg/dL and 10 µg/dL were evaluated. To achieve a specific level of protectiveness, the EPA has established a limit that a typical (or hypothetical) child would have an estimated risk of no more than 5 percent exceeding the reference blood-lead level.

5.1.4 Media and Chemicals With Carcinogenic Risks Above 10^{-4} , Non-carcinogenic Hazards Above a Hazard Index of 1.0, or Blood-Lead Level Exceedance

The HHRA revealed carcinogenic risks above 10^{-4} , noncarcinogenic hazards above 1.0, and/or blood-lead levels above a level of concern for soil within the Loading Dock Area, Wilcox Process Area, and Lorraine Process Area and shallow groundwater within the Wilcox Process Area. Media and chemicals that resulted in potential risk concerns are discussed below.

5.1.4.1 Soil

Lead

Surface soil within the Lorraine Process Area and Wilcox Process revealed greater than 5% of the population exceed the all reference blood-lead levels evaluated in the IEUBK. A range of reference blood-lead levels were evaluated: 5 µg/dL, 8 µg/dL, and 10 µg/dL. This reveals lead is a potential concern for resident children in surface soil within the Lorraine Process Area and the Wilcox Process Area. For the adult lead model, only the 5 µg/dL reference blood-lead level had greater than 5% of the population exceeding in the Lorraine Process Area. Additionally, the Lead Additive Area within the Wilcox Process Area has surface soil that contains high levels of leachable lead down to a depth of approximately 2 ft bgs. This source area is being addressed under the site's Source Control ROD (EPA 2018b) and was not evaluated in this HHRA. This reveals lead is a potential concern across these areas and is identified as a COC for further consideration.

Metals (Cobalt, Copper, Iron)

The HHRA revealed cobalt, copper, and iron, with noncarcinogenic hazards greater than 1 for the Loading Dock Area (cobalt) and the Wilcox Process Area (cobalt, copper, iron). The exceedance of the noncarcinogenic hazard of 1 was due to the ingestion of homegrown produce and ingestion of beef exposure pathways. As noted, these pathways are modeled from surface soil concentrations. The models used to estimate the concentration of these metals in produce and beef have a high degree of uncertainty and are likely to overestimate potential concentrations. For cobalt, the background UPL is 11.1 mg/kg. The 95UCL within the Loading Dock Area (15.2 mg/kg) is only slightly higher than the background UPL, and the Wilcox Process Area 95UCL (3.87 mg/kg) is lower than the background UPL. This reveals that cobalt is not a site concern. For copper within the Wilcox Process Area, the 95UCL is highly influenced by the maximum detected concentration of 7,490 mg/kg at WPA-SB-28-0.5. The sample collected at 2 ft bgs at WPA-SB-28 revealed a copper concentration of 8.8 mg/kg. Also, this maximum detected concentration is 60 times higher than the next highest detection of 124 mg/kg at WPA-SB-48. For iron within the Wilcox Process Area, the maximum detected concentration of 47,500 mg/kg at WPA-SB-27-0.5 slightly exceeds the background UPL of 14,700 mg/kg. Additionally, the maximum detected concentration does not exceed the full residential soil RSL of 55,000 mg/kg. As a result of the uncertainty associated with the homegrown produce and beef ingestion exposure routes and overall chemical concentrations, cobalt, copper, and iron are not considered COCs for the site.

Residential Yards

The assessment of the residential yards found potential concerns for exposure to surface soil. Carcinogenic risks were equal to the upper end of the EPA's acceptable cancer risk range, and non-carcinogenic hazards were above 1. Cadmium and cobalt were the COCs with non-carcinogenic hazards above 1, and benzo(a)pyrene and arsenic are the primary contributors to carcinogenic risks. It is noted that the assessment of the residential yards used the maximum detected concentration of the EPC. Additionally, risk concerns identified for soil also include the ingestion of homegrown produce and beef. As noted previously, these exposure routes are modeled on conservative parameters and likely overestimate risks.

The maximum detected concentration of cobalt in surface soil was 61.2 mg/kg (sample location WO-021-005-06-51) and a 95%UCLM of 3.69 mg/kg (Table 3.16). The 95%UCLM of cobalt is below the background UTL of 11.1 mg/kg (Table 2.16). This reveals the overall distribution of cobalt concentrations across the residential yards is consistent with background concentrations. Additionally, the maximum detected concentration of cobalt at residential location WO-021 is six times higher than the next detect of 10.9 mg/kg. The 95UCL for cobalt at location WO-021 15.0 mg/kg, which would result in a noncarcinogenic hazard less than 1 for cobalt. Therefore, cobalt is not retained as a COC for the residential yards.

Background concentrations of cadmium are not available; however, the non-carcinogenic hazard of 2 is a result of direct contact with soil and ingestion of homegrown produce. The ingestion of homegrown produce is a modeled exposure pathway with high uncertainty. Additionally, these risk results are based upon the maximum detected concentration of 80.2 at WO-008-001. The next highest detection of cadmium at WO-008 was 2.2 mg/kg. Additionally, the overall

95%UCLM of cadmium was 0.23 mg/kg and the arithmetic mean was 6.07 mg/kg of all residential yards combined (Table 3.16). Both of these are below the EPA RSL of 71 mg/kg. This reveals that cadmium concentrations are not a concern across the residential yards and is not retained as a COC.

Arsenic and benzo(a)pyrene were the primary contributors to carcinogenic risks of 1×10^{-4} within the residential yards. Similar to cadmium, the 95UCL for arsenic (3.29 mg/kg) and benzo(a)pyrene (0.148 mg/kg) are an order of magnitude lower than the maximum detected concentration used in the risk calculations (Table 3.16). This reveals the overall distribution of arsenic and benzo(a)pyrene in the residential yards is not a concern.

5.1.4.2 Groundwater

Potential risks were assessed for groundwater based upon monitoring well results within the perched aquifer. Potential risk concerns for exposure to groundwater within the perched aquifer were determined for all receptor's exposure to groundwater. Primary contributors to risk concerns were multiple metals (arsenic, cyanide, and iron) and VOCs (benzene, naphthalene, ethylbenzene, and m,p-xylene). The maximum detected concentration of VOCs was found in monitoring well MW-04, which is located in the Wilcox Process Area. This well is located in the northeast area of the Wilcox Process Area. Therefore, groundwater risk concerns based upon monitoring well results are centralized within the Wilcox Process Area.

The RI notes that there is localized and relatively shallow groundwater impact that is site related. The distribution of groundwater exceedances at the site indicates that while there is an area of impacted groundwater in the vicinity of MW-04, which is screened down to a depth of 38 ft bgs, a situation has not developed resulting in significant plume development within the perched groundwater zone. However, this impact has not migrated downward into the deeper groundwater units making up the Barnsdall Aquifer.

Private water wells exist at/near the site, and based on their depths, they obtain groundwater from the deeper regional groundwater-bearing units associated with the Barnsdall Formation. Most of the private wells are screened at deeper depths, a portion of these private wells have been constructed in such a way that their filter pack extends upward to relatively shallow depths possibly putting these wells in communication with the shallow perched groundwater zone situated above the regional groundwater-bearing units associated with the Barnsdall Formation.

Therefore, groundwater within the perched zone near MW-04 is retained as a media of concern. Potential human health risk concerns associated with VOCs in groundwater for the resident and commercial worker exposure as a tap water supply and construction worker exposure from direct contact are a result of concentrations found in MW-04. All VOCs identified as significant contributors to risk results are retained as COCs.

Additionally, metals (arsenic, cyanide, and iron) also had carcinogenic risks above 10^{-4} or noncarcinogenic hazards above 1. Because site related impacts were only determined near MW-04, the concentration of these metals is discussed for this monitoring well only. The

concentration of arsenic (10.4 µg/L), cyanide (10.2 µg/L), and iron (24,800 µg/L) are lower than the EPCs used in the HHRA (Table 3.11). It is noted that the arsenic concentration at MW-04 is similar to the EPA MCL of 10 µg/L. The concentration of cyanide is lower than the tap water RSL of 20 µg/L, which reveals cyanide is not a concern at MW-04. The concentration of iron is above the tap water RSL of 14,000 µg/L; however, iron was not identified as a chemical associated with sources and source areas at the site. Therefore, metals (arsenic, cyanide, iron) in groundwater are not retained as COCs.

5.1.5 Media and Chemicals Subject to a Risk Management Decision: Carcinogenic Risks Between 10^{-6} and 10^{-4}

Potential exposures to surface water and sediment at the site were within the EPA acceptable cancer risk range and noncarcinogenic hazards were below the level of concern. Therefore, these media are not expected to pose human health concerns. Carcinogenic risks for all receptors exposure to soil were also within the EPA acceptable risk range.

It is noted that the HHRA evaluated potential human health concerns based the entire exposure area. However, the exposure areas are larger than area that are typically evaluated for residential yards. To further evaluate the surface soil medium of concern and evaluate potential concerns for smaller exposure areas (i.e., potential residential yards), sample results were reviewed to determine if areas of high concentration are present within the five soil exposure areas. Areas of high concentration were determined as concentrations that exceed the residential soil RSL by two orders of magnitude (i.e., 100 times). The only chemical that exceeded this criterion was benzo(a)pyrene within the Wilcox Process Area and East Tank Farm. The maximum detected concentration of benzo(a)pyrene in both surface soil (WPA-SB-20-2.0 at 31 mg/kg) and subsurface soil (WPA-SB-20-6.0 at 24 mg/kg) exceeded the residential soil RSL by greater than two orders of magnitude. Additionally, benzo(a)pyrene was detected within WPA-SB-18-20.0 at 23 mg/kg. The highest detections of benzo(a)pyrene were primarily within the Wilcox Process Area, except for one detection within the East Tank Farm. The maximum detected concentration of benzo(a)pyrene in surface soil (ETF-SB-02-0.5 at 12 mg/kg) within the East Tank Farm also exceeded the residential soil RSL by two orders of magnitude. Therefore, there are potential isolated areas of benzo(a)pyrene that may be a potential human health concern for residential receptors. However, it is noted that none of these detections were within existing residential yards. Therefore, benzo(a)pyrene should be retained as a COC for the site.

6. CONCLUSIONS

In summary, the HHRA revealed no potential human health concerns exposure to soil and surface water/sediment for most areas within the site. However, potential human health concerns were determined for exposure to “hot spot” areas of soil within the East Tank Farm and Wilcox Process Area for exposure to PAHs (primarily benzo(a)pyrene). There are also potential concerns for exposure to lead in surface soil within the Lorraine Process Area and Wilcox Process Area. Additionally, potential risk concerns were determined for exposure to groundwater. Risk concerns for groundwater are centralized within the Wilcox Process Area.

It is noted that the HHRA did not evaluate source areas located within the five exposure areas that have been identified removal actions.

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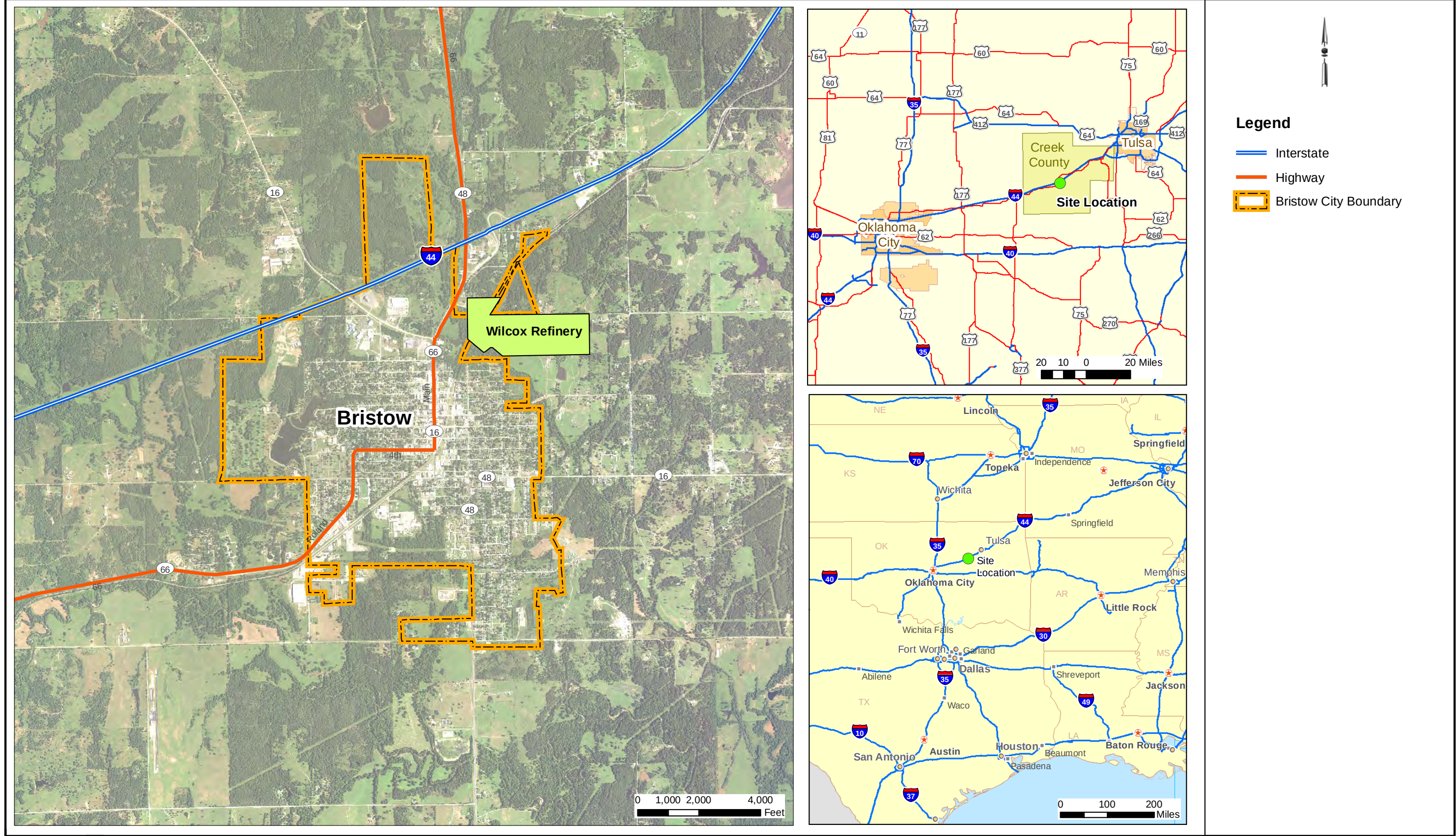
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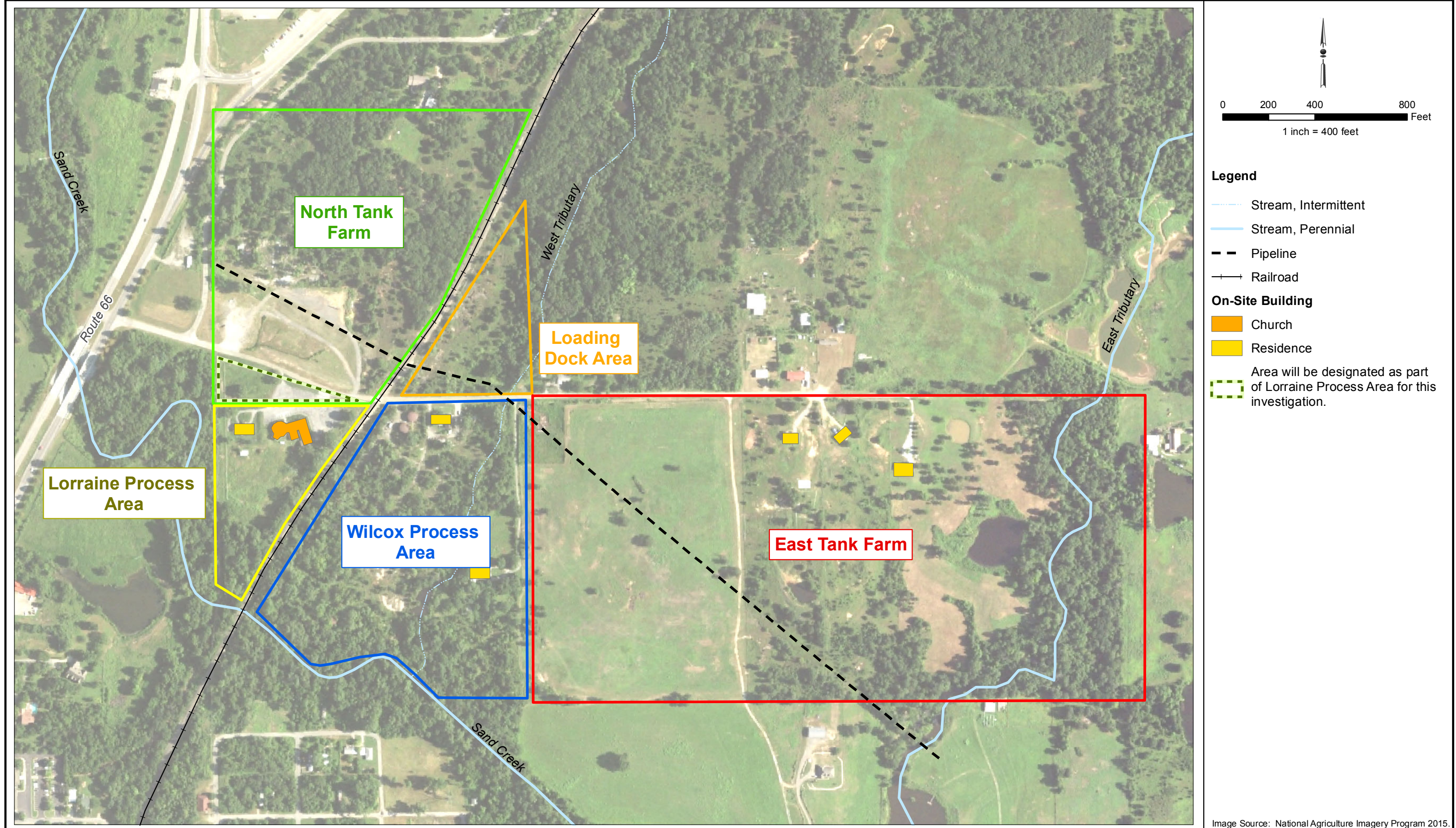
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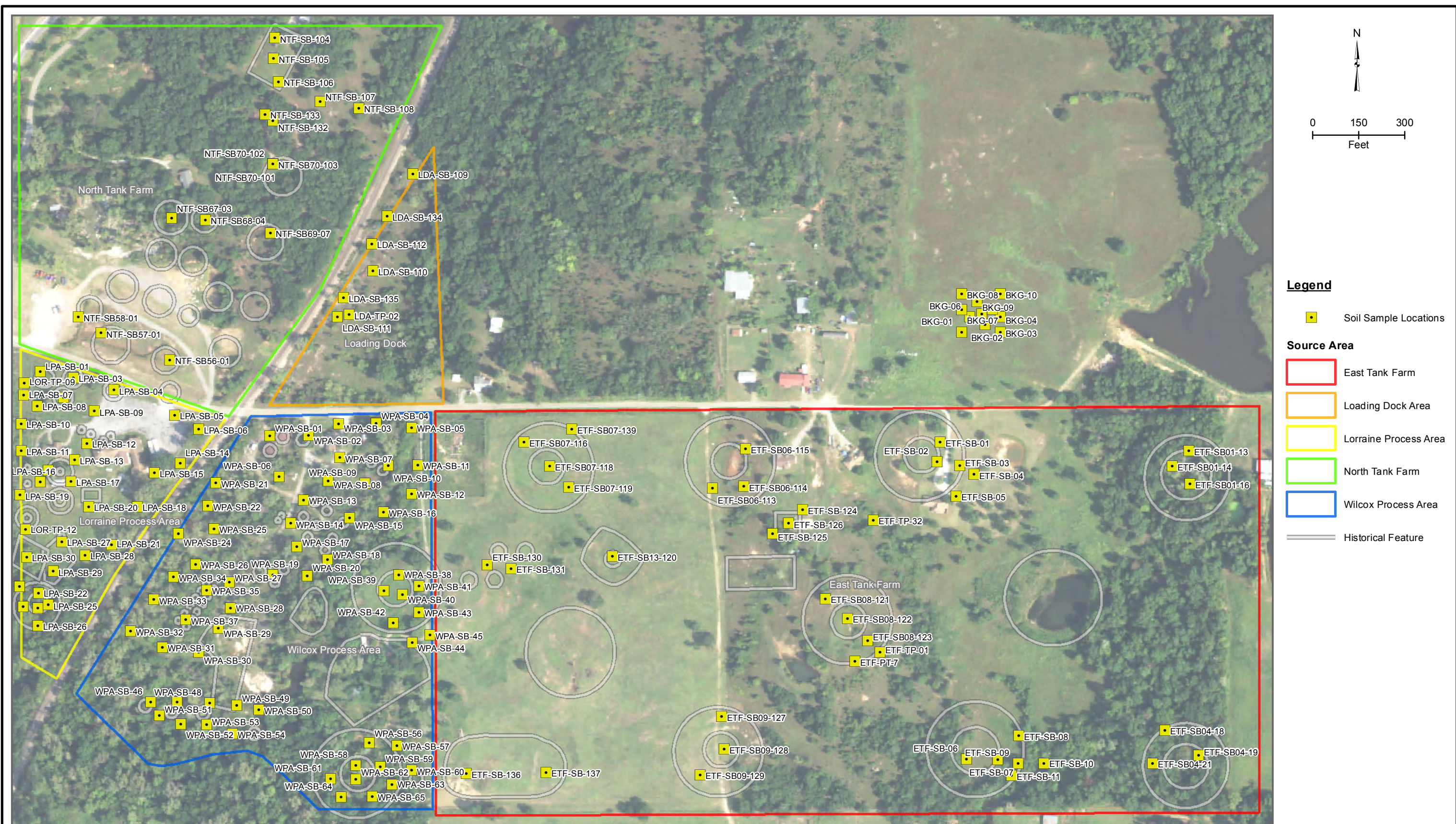
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FIGURES



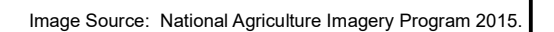


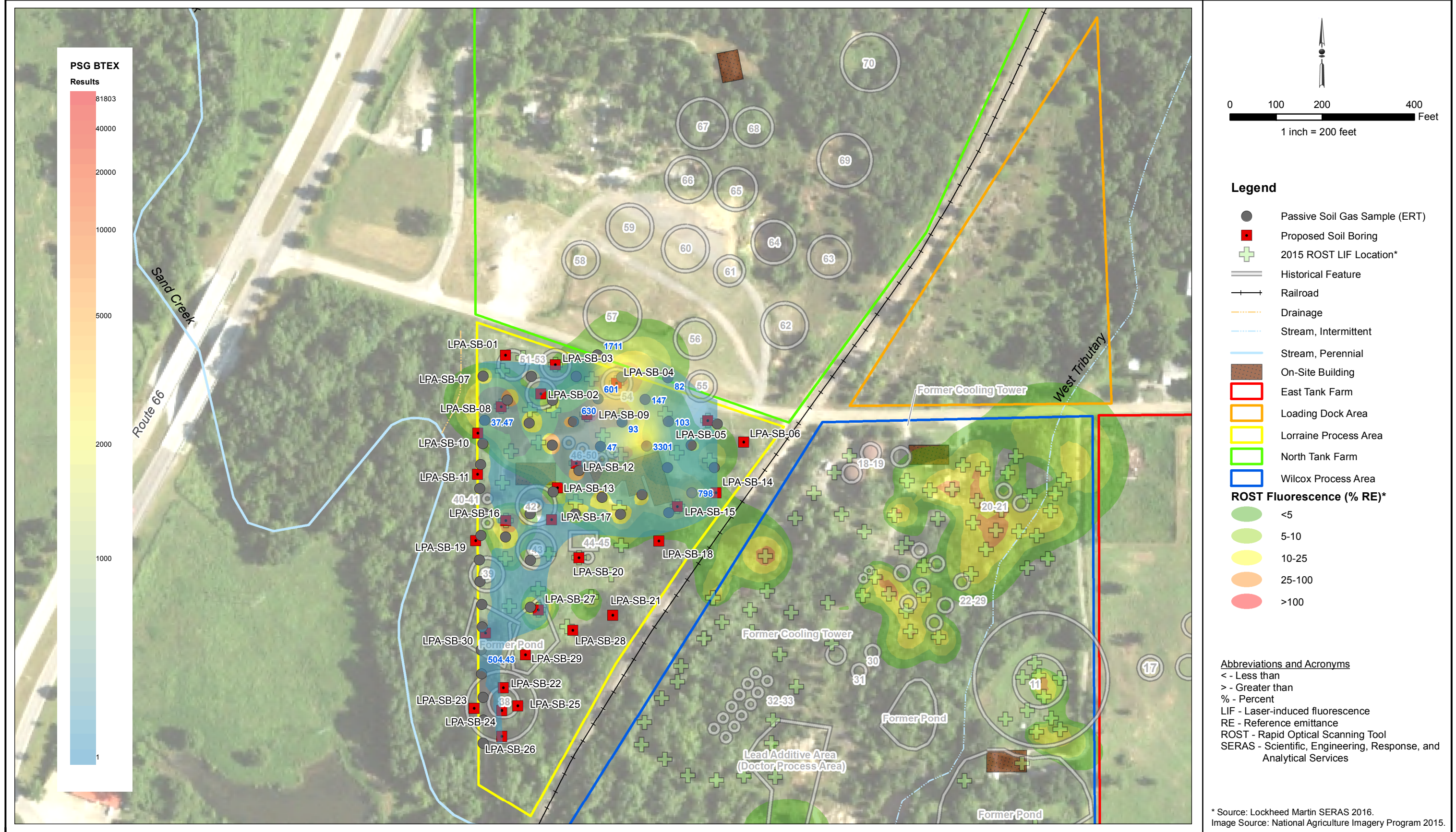


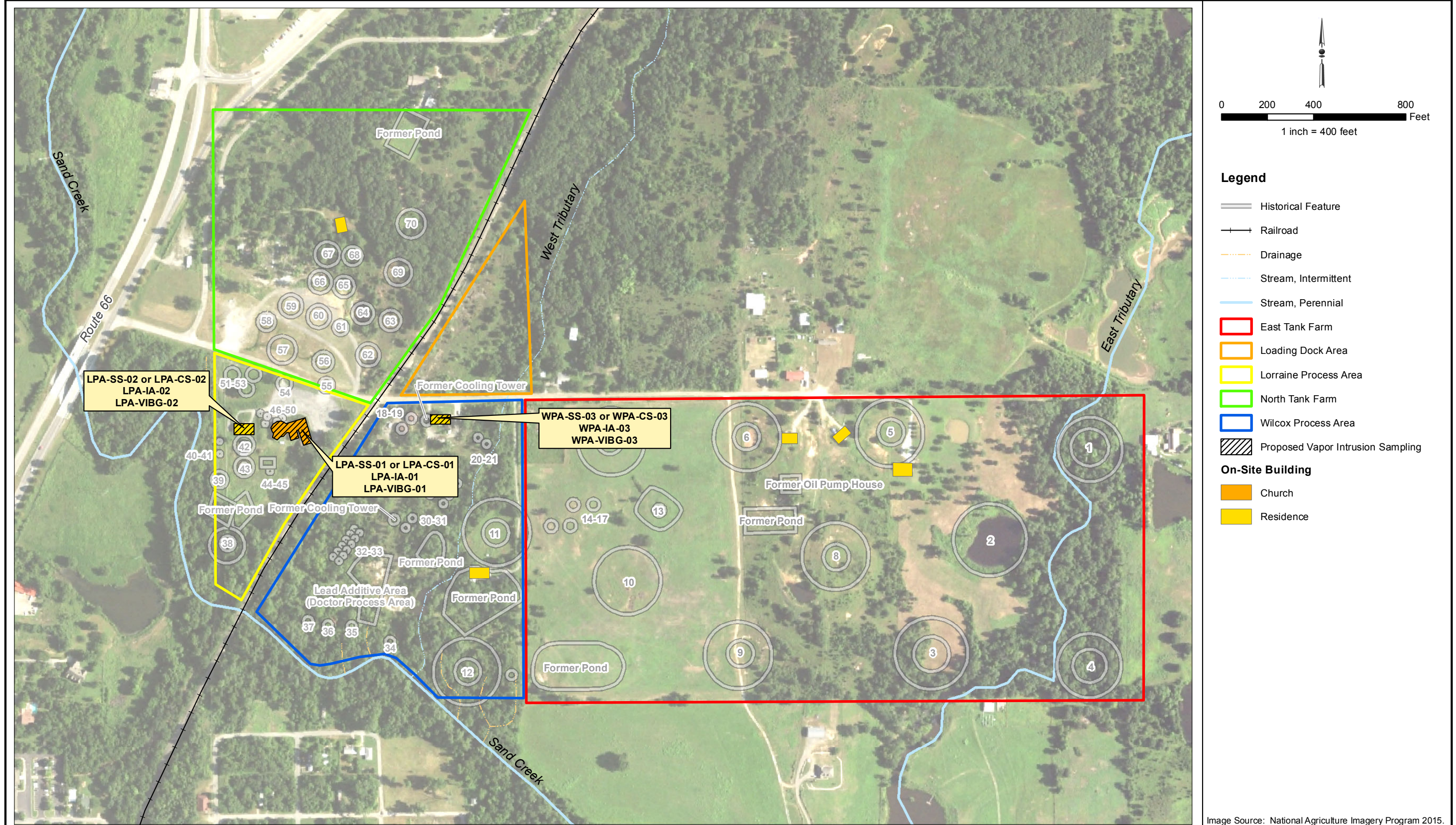
Remedial Investigation
 Wilcox Oil Company
 Bristow, Creek County, Oklahoma

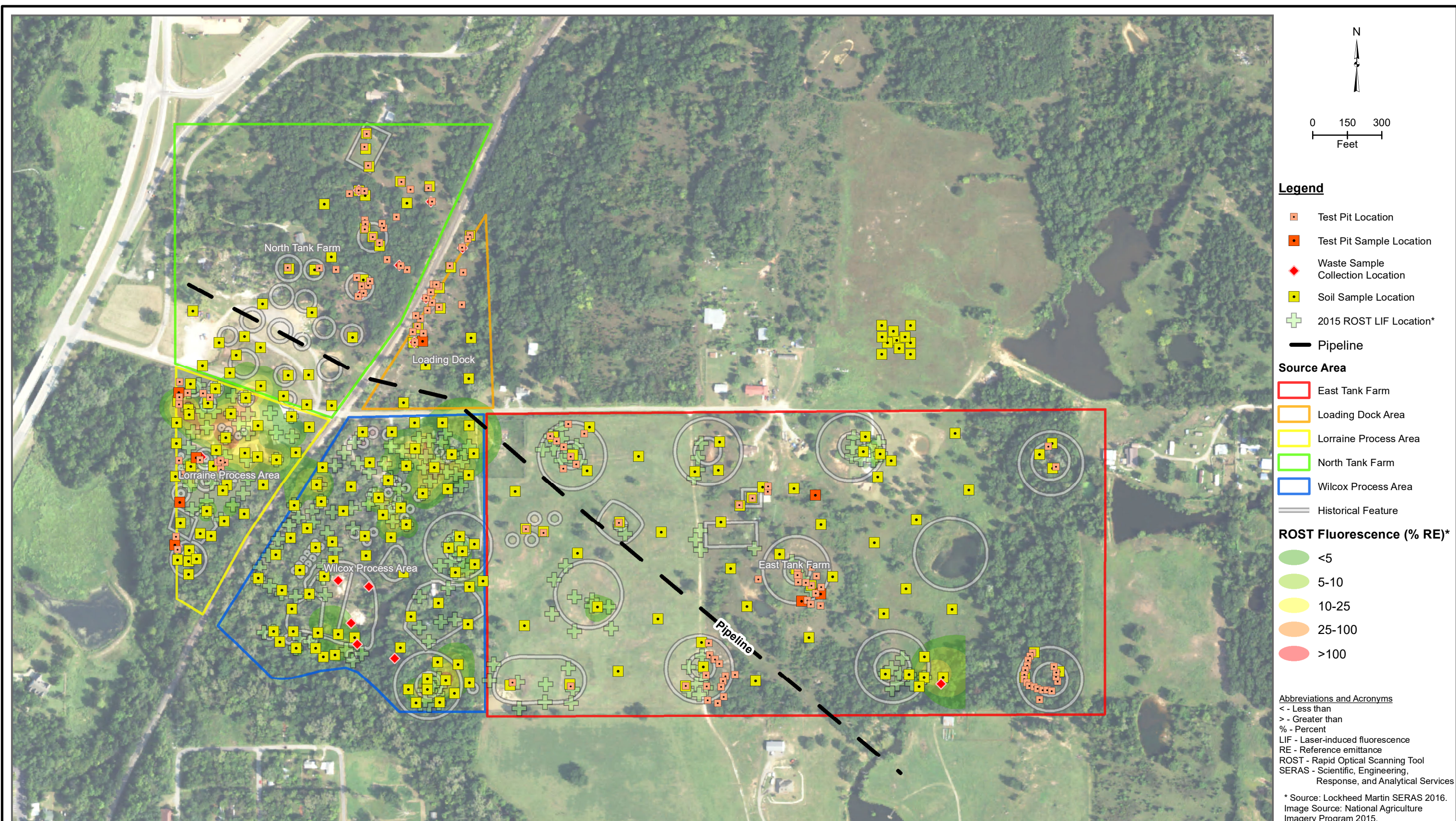
Figure 3
 Soil Sample Location Map

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Legend

- Test Pit Location
- Test Pit Sample Location
- Waste Sample Collection Location
- Soil Sample Location
- 2015 ROST LIF Location*
- Pipeline

Source Area

- East Tank Farm
- Loading Dock Area
- Lorraine Process Area
- North Tank Farm
- Wilcox Process Area
- Historical Feature

ROST Fluorescence (% RE)*

- <5
- 5-10
- 10-25
- 25-100
- >100

Abbreviations and Acronyms
< - Less than
> - Greater than
% - Percent
LIF - Laser-induced fluorescence
RE - Reference emittance
ROST - Rapid Optical Scanning Tool
SERAS - Scientific, Engineering, Response, and Analytical Services

* Source: Lockheed Martin SERAS 2016.
Image Source: National Agriculture Imagery Program 2015.

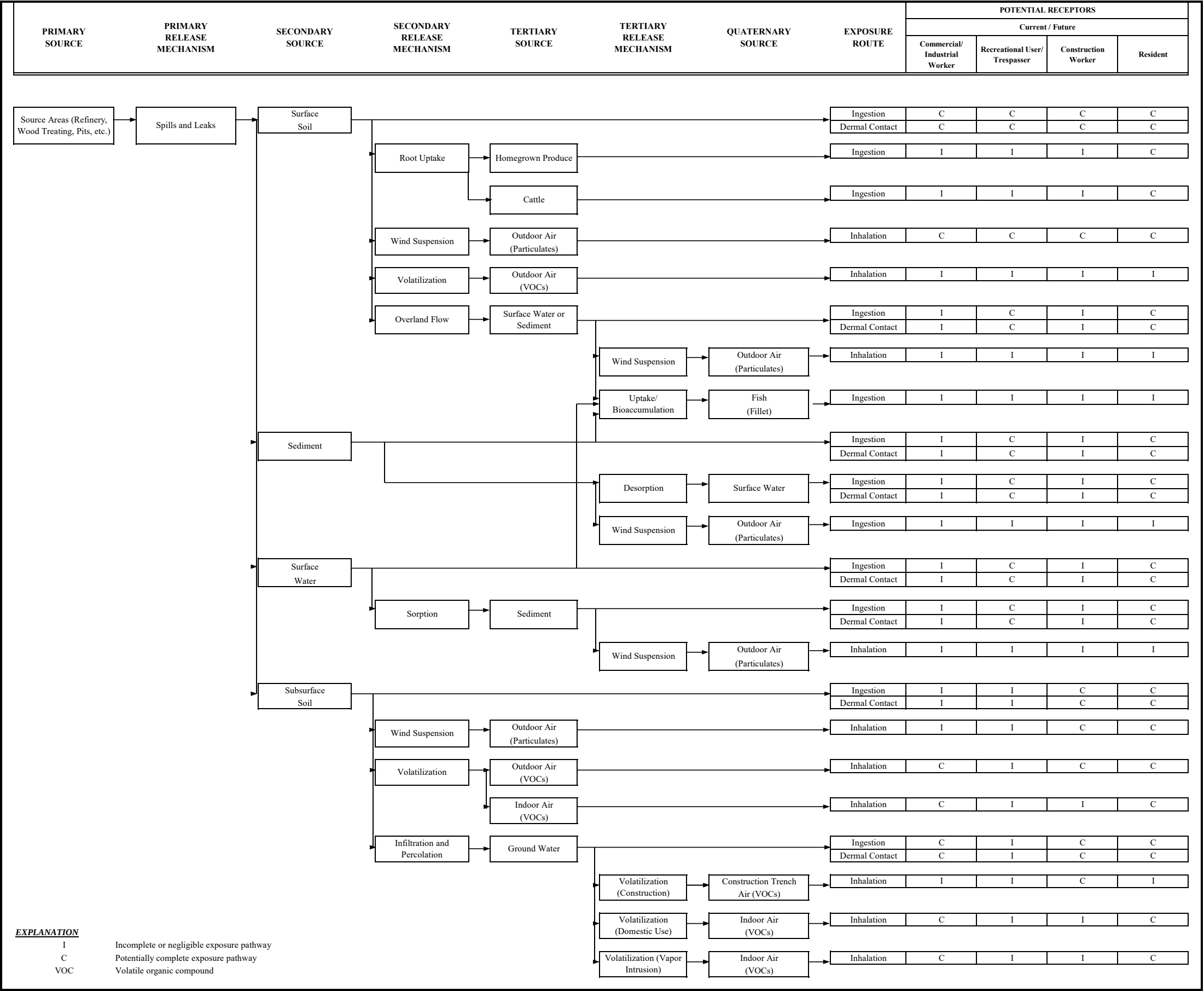


Remedial Investigation
Wilcox Oil Company
Bristow, Creek County, Oklahoma

FIGURE 7
TEST PIT AND SOIL SAMPLE LOCATIONS

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FIGURE 8 HUMAN HEALTH CONCEPTUAL SITE MODEL



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TABLES

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - NORTH TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
Metals																	
7429-90-5	Aluminum	5.28E+02		1.85E+04		mg/kg	NTF-SB-133-2.0_11/01/2017	58/58	1.50E+01 - 2.35E+01	1.85E+04	5.01E+03	7.70E+03	N	NA	NA	Yes	ASL
7440-36-0	Antimony	1.40E-01	J	4.10E+00		mg/kg	NTF-SB-142-0.5-2.0_03/05/2018	6/58	7.60E-01 - 1.20E+00	4.10E+00	NA	3.10E+00	N	NA	NA	Yes	ASL
7440-38-2	Arsenic	4.40E-01		6.20E+00		mg/kg	NTF-SB-107-2.0_11/01/2017	58/58	3.80E-01 - 5.90E-01	6.20E+00	2.30E+00	6.80E-01	C	NA	NA	Yes	ASL
7440-39-3	Barium	1.01E+01		6.07E+02		mg/kg	NTF-SB-143-0.5-2.0_03/05/2018	58/58	3.80E+00 - 5.90E+00	6.07E+02	5.15E+01	1.50E+03	N	NA	NA	No	BSL
7440-41-7	Beryllium	1.30E-01	LJ	6.60E-01		mg/kg	NTF-SB-143-0.5-2.0_03/05/2018	35/58	3.80E-01 - 5.90E-01	6.60E-01	2.10E-01	1.60E+01	N	NA	NA	No	BSL
7440-43-9	Cadmium	8.00E-02	J	2.90E+00		mg/kg	NTF-SB-151-0.5_12/04/2018	30/58	3.80E-01 - 5.90E-01	2.90E+00	NA	7.10E+00	N	NA	NA	No	BSL
7440-70-2	Calcium	1.53E+02	J	1.44E+05	J	mg/kg	NTF-SB-151-0.5_12/04/2018	53/58	3.75E+02 - 2.55E+03	1.44E+05	3.66E+02	NA	NA	NA	NA	No	NUT
7440-47-3	Chromium	9.10E-01		1.64E+01		mg/kg	NTF-SB-133-2.0_11/01/2017	58/58	7.60E-01 - 1.20E+00	1.64E+01	7.10E+00	1.20E+04	N	NA	NA	No	BSL
7440-48-4	Cobalt	5.90E-01		1.78E+01	J	mg/kg	NTF-SB68-04-2.0_11/01/2017	58/58	3.80E-01 - 5.90E-01	1.78E+01	1.11E+01	2.30E+00	N	NA	NA	Yes	ASL
7440-50-8	Copper	3.50E+00		3.57E+01	J	mg/kg	NTF-SB56-01-1.5_11/08/2017	58/58	7.60E-01 - 1.20E+00	3.57E+01	3.24E+00	3.10E+02	N	NA	NA	No	BSL
57-12-5	Cyanide	3.30E-02	J	4.40E-01	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	30/53	2.80E-01 - 6.00E-01	4.40E-01	1.68E-01	2.30E+00	N	NA	NA	No	BSL
7439-89-6	Iron	1.98E+03	J	3.51E+04	J	mg/kg	NTF-SB58-01-0.5_11/08/2017	58/58	7.50E+00 - 1.18E+01	3.51E+04	1.47E+04	5.50E+03	N	NA	NA	Yes	ASL
7439-92-1	Lead	1.40E+00	J	2.05E+02		mg/kg	NTF-SB-137-0-0.5_03/05/2018	58/58	3.80E-01 - 5.90E-01	2.05E+02	9.19E+00	4.00E+02	G	NA	NA	No	BSL
7439-95-4	Magnesium	1.46E+02	J	6.27E+04	J	mg/kg	NTF-SB-151-0.5_12/04/2018	52/58	3.75E+02 - 2.55E+03	6.27E+04	4.02E+02	NA	NA	NA	NA	No	NUT
7439-96-5	Manganese	2.08E+01	J	7.40E+03	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	58/58	1.10E+00 - 1.53E+01	7.40E+03	5.06E+02	1.80E+02	N	NA	NA	Yes	ASL
7439-97-6	Mercury	5.00E-03	J	1.80E-01		mg/kg	NTF-SB-142-0.5-2.0_03/05/2018	28/58	9.40E-02 - 1.40E-01	1.80E-01	3.80E-02	2.30E+00	N	NA	NA	No	BSL
7440-02-0	Nickel	1.10E+00		3.39E+01		mg/kg	NTF-SB-107-2.0_11/01/2017	58/58	3.80E-01 - 5.90E-01	3.39E+01	5.60E+00	1.50E+02	N	NA	NA	No	BSL
7440-09-7	Potassium	1.13E+01	J	2.41E+03		mg/kg	NTF-SB-151-2.0_12/04/2018	54/58	3.75E+02 - 5.89E+02	2.41E+03	6.42E+02	NA	NA	NA	NA	No	NUT
7782-49-2	Selenium	1.60E-01	LJ	4.50E-01	J	mg/kg	NTF-SB-151-2.0_12/04/2018	8/58	1.90E+00 - 2.90E+00	4.50E-01	NA	3.90E+01	N	NA	NA	No	BSL
7440-22-4	Silver	2.30E-02	J	5.10E-02	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	11/58	3.80E-01 - 5.90E-01	5.10E-02	NA	3.90E+01	N	NA	NA	No	BSL
7440-23-5	Sodium	1.04E+01	J	1.11E+03		mg/kg	NTF-SB-143-0.5-2.0_03/05/2018	44/58	3.75E+02 - 5.89E+02	1.11E+03	1.16E+01	NA	NA	NA	NA	No	NUT
7440-62-2	Vanadium	1.50E+00	J	2.61E+01		mg/kg	NTF-SB-105-2.0_10/31/2017	58/58	1.90E+00 - 2.90E+00	2.61E+01	1.12E+01	3.90E+01	N	NA	NA	No	BSL
7440-66-6	Zinc	1.60E+00	J	6.08E+02		mg/kg	NTF-SB-137-0-0.5_03/05/2018	57/58	7.60E-01 - 1.20E+00	6.08E+02	1.42E+01	2.30E+03	N	NA	NA	No	BSL

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - NORTH TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
PAHS																	
90-12-0	1-Methylnaphthalene	8.50E-03		1.26E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	3/6	1.85E-02 - 2.45E-02	1.26E-01	NA	1.80E+01	C	NA	NA	No	BSL
91-57-6	2-Methylnaphthalene	8.00E-04	J	1.84E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	35/58	3.40E-03 - 2.10E-01	1.84E-01	NA	2.40E+01	N	NA	NA	No	BSL
83-32-9	Acenaphthene	3.90E-03	J	5.30E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	6/58	3.60E-03 - 2.10E-01	5.30E-01	NA	3.60E+02	N	NA	NA	No	BSL
208-96-8	Acenaphthylene	9.40E-04	LJ	4.18E-02		mg/kg	NTF-SB56-01-0.5_11/08/2017	11/58	3.50E-03 - 2.10E-01	4.18E-02	NA	3.60E+02	N	NA	NA	No	BSL
120-12-7	Anthracene	9.40E-04	J	6.56E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	18/58	3.40E-03 - 2.10E-01	6.56E-01	NA	1.80E+03	N	NA	NA	No	BSL
56-55-3	Benzo (a) anthracene	1.20E-03	J	2.26E+00	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	42/58	3.60E-03 - 3.99E-01	2.26E+00	NA	1.10E+00	C	NA	NA	Yes	ASL
50-32-8	Benzo (a) pyrene	1.10E-03	LJ	2.02E+00	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	44/58	3.50E-03 - 2.10E-01	2.02E+00	NA	1.10E-01	C	NA	NA	Yes	ASL
205-99-2	Benzo (b) fluoranthene	1.80E-03	LJ	2.70E+00	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	44/58	3.40E-03 - 3.99E-01	2.70E+00	NA	1.10E+00	C	NA	NA	Yes	ASL
191-24-2	Benzo (g,h,i) perylene	8.20E-04	J	9.64E-01	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	41/58	3.40E-03 - 2.10E-01	9.64E-01	NA	1.80E+02	N	NA	NA	No	BSL
207-08-9	Benzo (k) fluoranthene	1.20E-03	J	1.52E+00	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	30/58	3.50E-03 - 3.99E-01	1.52E+00	NA	1.10E+01	C	NA	NA	No	BSL
218-01-9	Chrysene	1.60E-03	J	1.74E+00		mg/kg	NTF-SB56-01-0.5_11/08/2017	47/58	3.50E-03 - 3.99E-01	1.74E+00	NA	1.10E+02	C	NA	NA	No	BSL
53-70-3	Dibenz (a,h) anthracene	1.10E-03	J/LJ	3.64E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	27/58	3.50E-03 - 2.10E-01	3.64E-01	NA	1.10E-01	C	NA	NA	Yes	ASL
206-44-0	Fluoranthene	1.30E-03	LJ	2.44E+00		mg/kg	NTF-SB56-01-0.5_11/08/2017	45/58	3.40E-03 - 4.20E-01	2.44E+00	NA	2.40E+02	N	NA	NA	No	BSL
86-73-7	Fluorene	2.00E-03	LJ	3.36E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	8/58	3.60E-03 - 2.10E-01	3.36E-01	NA	2.40E+02	N	NA	NA	No	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	8.70E-04	J	9.70E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	35/58	3.40E-03 - 3.99E-01	9.70E-01	NA	1.10E+00	C	NA	NA	No	BSL
91-20-3	Naphthalene	1.20E-03	J	3.34E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	23/58	3.40E-03 - 2.10E-01	3.34E-01	NA	3.80E+00	C	NA	NA	No	BSL
85-01-8	Phenanthrene	8.70E-04	LJ	2.36E+00		mg/kg	NTF-SB56-01-0.5_11/08/2017	47/58	3.40E-03 - 2.00E-01	2.36E+00	NA	1.80E+02	N	NA	NA	No	BSL
129-00-0	Pyrene	2.00E-03	J	2.37E+00		mg/kg	NTF-SB56-01-0.5_11/08/2017	44/58	3.40E-03 - 2.10E-01	2.37E+00	NA	1.80E+02	N	NA	NA	No	BSL

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - NORTH TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
SVOCS																	
92-52-4	1,1'-Biphenyl	5.10E-03		3.19E-02		mg/kg	NTF-SB56-01-0.5_11/08/2017	2/58	7.41E-02 - 2.10E-01	3.19E-02	NA	4.70E+00	N	NA	NA	No	BSL
98-86-2	Acetophenone	6.10E-02	J	6.10E-02	J	mg/kg	NTF-SB-143-0.5-2.0_03/05/2018	1/58	7.41E-02 - 4.20E-01	6.10E-02	NA	7.80E+02	N	NA	NA	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	5.80E-02	LJ	1.20E-01	LJ	mg/kg	NTF-SB-145-0.5-2.0_03/06/2018	4/58	7.41E-02 - 2.10E-01	1.20E-01	NA	3.90E+01	C	NA	NA	No	BSL
86-74-8	Carbazole	5.80E-02	J	4.38E-01	J	mg/kg	NTF-SB56-01-0.5_11/08/2017	3/58	7.41E-02 - 4.20E-01	4.38E-01	NA	NA	NA	NA	NA	No	BSL
132-64-9	Dibenzofuran	9.30E-02	J	1.73E-01		mg/kg	NTF-SB56-01-0.5_11/08/2017	2/58	7.41E-02 - 2.10E-01	1.73E-01	NA	7.30E+00	N	NA	NA	No	BSL
131-11-3	Dimethyl phthalate	7.70E-02	J	2.30E-01		mg/kg	NTF-SB-137-0.5-2.0_03/05/2018, NTF-SB-144-0.0-0.5_03/05/2018	27/58	7.41E-02 - 2.10E-01	2.30E-01	NA	NA	NA	NA	NA	No	BSL
84-74-2	Di-n-butyl phthalate	4.30E-01		1.40E+00		mg/kg	NTF-SB-145-0.5-2.0_03/06/2018	2/58	7.41E-02 - 2.10E-01	1.40E+00	NA	6.30E+02	N	NA	NA	No	BSL
108-95-2	Phenol	4.80E-02	LJ	1.90E-01	J	mg/kg	NTF-SB-152-2.0_12/04/2018, NTF-SB-151-2.0_12/04/2018, NTF-SB-150-0.5_11/29/2018	15/58	7.41E-02 - 4.20E-01	1.90E-01	NA	1.90E+03	N	NA	NA	No	BSL
VOCS																	
67-64-1	Acetone	2.50E-01		2.50E-01		mg/kg	NTF-SB-133-0.5_11/01/2017	1/1	1.60E-02 - 1.60E-02	2.50E-01	NA	6.10E+03	N	NA	NA	No	BSL
75-09-2	Methylene chloride	1.00E-03	LJ	1.00E-03	LJ	mg/kg	NTF-SB-133-0.5_11/01/2017	1/1	6.10E-03 - 6.10E-03	1.00E-03	NA	3.50E+01	N	NA	NA	No	BSL
108-88-3	Toluene	7.10E-04	LJ	7.10E-04	LJ	mg/kg	NTF-SB-133-0.5_11/01/2017	1/1	8.20E-03 - 8.20E-03	7.10E-04	NA	4.90E+02	N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury, Chromium (III) Insoluble Salts for Chromium, Pyrene for Benzo (g,h,i) perylene and Phenanthrene,

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - NORTH TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximu m Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
Metals																	
7429-90-5	Aluminum	1.57E+03		1.67E+04		mg/kg	NTF-SB67-03-2.5-D_11/01/2017	27/27	1.57E+01 - 2.42E+01	1.67E+04	NA	7.70E+03	N	NA	NA	Yes	ASL
7440-38-2	Arsenic	3.60E-01	J	1.29E+01		mg/kg	NTF-SB-136-0.5-3.5_03/06/2018	27/27	3.90E-01 - 1.10E+00	1.29E+01	NA	6.80E-01	C	NA	NA	Yes	ASL
7440-39-3	Barium	9.90E+00		1.03E+03		mg/kg	NTF-SB-143-2.0-6.0_03/05/2018	27/27	3.90E+00 - 6.00E+00	1.03E+03	NA	1.50E+03	N	NA	NA	No	BSL
7440-41-7	Beryllium	1.90E-01	J	9.70E-01		mg/kg	NTF-SB-136-0.5-3.5_03/06/2018	13/27	3.90E-01 - 6.00E-01	9.70E-01	NA	1.60E+01	N	NA	NA	No	BSL
7440-43-9	Cadmium	9.70E-02	J	7.60E-01		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	4/27	3.90E-01 - 1.10E+00	7.60E-01	NA	7.10E+00	N	NA	NA	No	BSL
7440-70-2	Calcium	5.28E+01	J	9.94E+04		mg/kg	NTF-SB-150-4.5_11/29/2018	26/27	3.92E+02 - 2.47E+03	9.94E+04	NA	NA	NA	NA	NA	No	NUT
7440-47-3	Chromium	2.70E+00		1.89E+01		mg/kg	NTF-SB-136-0.5-3.5_03/06/2018	27/27	7.90E-01 - 2.20E+00	1.89E+01	NA	1.20E+04	N	NA	NA	No	BSL
7440-48-4	Cobalt	1.10E+00		2.93E+01		mg/kg	NTF-SB-136-0.5-3.5_03/06/2018	27/27	3.90E-01 - 1.10E+00	2.93E+01	NA	2.30E+00	N	NA	NA	Yes	ASL
7440-50-8	Copper	1.70E+00		4.20E+01	J	mg/kg	NTF-SB68-04-3.5_11/01/2017	27/27	7.90E-01 - 2.20E+00	4.20E+01	NA	3.10E+02	N	NA	NA	No	BSL
57-12-5	Cyanide	3.70E-02	J	5.20E-01	J	mg/kg	NTF-SB-137-2.0-6.0_03/05/2018	13/27	4.50E-01 - 6.00E-01	5.20E-01	NA	2.30E+00	N	NA	NA	No	BSL
7439-89-6	Iron	2.69E+03		4.69E+04		mg/kg	NTF-SB-137-2.0-6.0_03/05/2018	27/27	7.80E+00 - 1.21E+01	4.69E+04	NA	5.50E+03	N	NA	NA	Yes	ASL
7439-92-1	Lead	9.20E-01		2.84E+01		mg/kg	NTF-SB70-102-3.5_11/01/2017	27/27	3.90E-01 - 6.00E-01	2.84E+01	NA	4.00E+02	G	NA	NA	No	BSL
7439-95-4	Magnesium	1.14E+02	J	3.32E+03	J	mg/kg	NTF-SB-150-4.5_11/29/2018	27/27	3.92E+02 - 6.05E+02	3.32E+03	NA	NA	NA	NA	NA	No	NUT
7439-96-5	Manganese	1.37E+01		6.14E+02	J	mg/kg	NTF-SB-106-6.0_10/31/2017	27/27	1.20E+00 - 1.80E+00	6.14E+02	NA	1.80E+02	N	NA	NA	Yes	ASL
7439-97-6	Mercury	5.00E-03	J	6.00E-02	J	mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	13/27	9.30E-02 - 1.40E-01	6.00E-02	NA	2.30E+00	N	NA	NA	No	BSL
7440-02-0	Nickel	7.80E-01		4.22E+01	J	mg/kg	NTF-SB-107-6.0_11/01/2017	27/27	3.90E-01 - 1.10E+00	4.22E+01	NA	1.50E+02	N	NA	NA	No	BSL
7440-09-7	Potassium	3.76E+01	J	3.14E+03		mg/kg	NTF-SB-107-6.0_11/01/2017	26/27	3.92E+02 - 6.05E+02	3.14E+03	NA	NA	NA	NA	NA	No	NUT
7782-49-2	Selenium	1.60E-01	J	1.60E-01	J	mg/kg	NTF-SB-150-4.5_11/29/2018	1/27	2.00E+00 - 5.60E+00	1.60E-01	NA	3.90E+01	N	NA	NA	No	BSL
7440-22-4	Silver	2.20E-02	J	5.20E-02	J	mg/kg	NTF-SB-143-2.0-6.0_03/05/2018	7/27	3.90E-01 - 1.10E+00	5.20E-02	NA	3.90E+01	N	NA	NA	No	BSL
7440-23-5	Sodium	1.03E+01	J	9.15E+02		mg/kg	NTF-SB-107-6.0_11/01/2017	26/27	3.92E+02 - 6.05E+02	9.15E+02	NA	NA	NA	NA	NA	No	NUT
7440-62-2	Vanadium	4.20E+00		3.00E+01		mg/kg	NTF-SB-136-0.5-3.5_03/06/2018	27/27	2.00E+00 - 5.60E+00	3.00E+01	NA	3.90E+01	N	NA	NA	No	BSL
7440-66-6	Zinc	9.30E-01	J	1.56E+02		mg/kg	NTF-SB-143-6.0-10.0_03/05/2018	27/27	7.90E-01 - 2.00E+00	1.56E+02	NA	2.30E+03	N	NA	NA	No	BSL

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - NORTH TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PAHS																
91-57-6	2-Methylnaphthalene	3.20E-03	LJ	2.80E+00		mg/kg	LDA-SB-111-3.0_10/31/2017	9/27	3.50E-03 - 2.00E-01	2.80E+00	NA	2.40E+01	N	NA	NA	BSL
83-32-9	Acenaphthene	1.30E-03	J	1.10E-01	J	mg/kg	LDA-SB-111-3.0_10/31/2017	5/27	3.50E-03 - 2.10E-01	1.10E-01	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	2.10E-03	J	4.10E-02		mg/kg	NTF-SB-150-4.5_11/29/2018	3/27	3.50E-03 - 2.10E-01	4.10E-02	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	1.20E-03	J	6.60E-02	J	mg/kg	LDA-SB-111-3.0_10/31/2017	6/27	3.50E-03 - 2.10E-01	6.60E-02	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	8.90E-04	LJ	7.40E-02		mg/kg	NTF-SB-138-2.0-6.0_03/05/2018	11/27	3.50E-03 - 2.00E-01	7.40E-02	NA	1.10E+00	C	NA	NA	BSL
50-32-8	Benzo (a) pyrene	3.70E-03	J	1.60E-02		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	6/27	3.50E-03 - 2.00E-01	1.60E-02	NA	1.10E-01	C	NA	NA	BSL
205-99-2	Benzo (b) fluoranthene	1.50E-03	J	2.60E-02		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	9/27	3.50E-03 - 2.00E-01	2.60E-02	NA	1.10E+00	C	NA	NA	BSL
191-24-2	Benzo (g,h,i) perylene	1.20E-03	LJ	2.40E-02		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	9/27	3.50E-03 - 2.00E-01	2.40E-02	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	1.40E-03	J	7.60E-03		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	5/27	3.50E-03 - 2.00E-01	7.60E-03	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	1.10E-03	LJ	1.60E-01	J	mg/kg	NTF-SB-150-4.5_11/29/2018	17/27	3.50E-03 - 2.00E-01	1.60E-01	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	2.00E-03	J	7.80E-03		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	5/27	3.50E-03 - 2.00E-01	7.80E-03	NA	1.10E-01	C	NA	NA	BSL
206-44-0	Fluoranthene	1.00E-03	LJ	8.30E-02	J	mg/kg	NTF-SB-150-4.5_11/29/2018	12/27	3.50E-03 - 3.90E-01	8.30E-02	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	9.70E-04	J	1.80E-01	J	mg/kg	LDA-SB-111-3.0_10/31/2017	8/27	3.50E-03 - 2.00E-01	1.80E-01	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	3.60E-03	J	1.50E-02		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	5/27	3.50E-03 - 2.10E-01	1.50E-02	NA	1.10E+00	C	NA	NA	BSL
91-20-3	Naphthalene	1.80E-03	LJ	1.50E+00		mg/kg	NTF-SB-150-4.5_11/29/2018	8/27	3.50E-03 - 2.00E-01	1.50E+00	NA	3.80E+00	C	NA	NA	BSL
85-01-8	Phenanthrene	1.30E-03	LJ/J	4.10E-01		mg/kg	LDA-SB-111-3.0_10/31/2017	15/27	3.50E-03 - 2.00E-01	4.10E-01	NA	1.80E+02	N	NA	NA	BSL
129-00-0	Pyrene	1.30E-03	J	2.20E-01		mg/kg	NTF-SB-150-4.5_11/29/2018	17/27	3.50E-03 - 2.00E-01	2.20E-01	NA	1.80E+02	N	NA	NA	BSL
SVOCS																
92-52-4	1,1'-Biphenyl	5.20E-02	LJ	5.20E-02	LJ	mg/kg	NTF-SB-106-10.0_11/01/2017	1/27	1.80E-01 - 2.10E-01	5.20E-02	NA	4.70E+00	N	NA	NA	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	5.50E-02	LJ	1.50E-01	J	mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	4/27	1.80E-01 - 2.10E-01	1.50E-01	NA	3.90E+01	C	NA	NA	BSL
85-68-7	Butyl benzyl phthalate	6.60E-01		6.60E-01		mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	1/27	1.80E-01 - 2.10E-01	6.60E-01	NA	2.90E+02	C	NA	NA	BSL
105-60-2	Caprolactam	7.70E-01		1.90E+00		mg/kg	NTF-SB-106-10.0_11/01/2017	2/27	3.50E-01 - 4.10E-01	1.90E+00	NA	3.10E+03	N	NA	NA	BSL
132-64-9	Dibenzofuran	1.40E-01	J	1.40E-01	J	mg/kg	NTF-SB-150-4.5_11/29/2018	1/27	1.80E-01 - 2.10E-01	1.40E-01	NA	7.30E+00	N	NA	NA	BSL
131-11-3	Dimethyl phthalate	9.50E-02	J	3.10E-01		mg/kg	NTF-SB-137-2.0-6.0_03/05/2018	10/27	1.80E-01 - 2.10E-01	3.10E-01	NA	NA		NA	NA	BSL
84-74-2	Di-n-butyl phthalate	3.50E-01		6.50E-01		mg/kg	NTF-SB-145-6.0-10.0_03/06/2018	3/27	1.80E-01 - 2.10E-01	6.50E-01	NA	6.30E+02	N	NA	NA	BSL
108-87-2	Methylcyclohexane	3.60E+00		3.60E+00		mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	3.60E+00	NA	6.50E+02	N	NA	NA	BSL
87-86-5	Pentachlorophenol	1.10E-02	J	1.10E-02	J	mg/kg	NTF-SB-142-2.0-6.5_03/05/2018	1/27	7.00E-03 - 4.10E-01	1.10E-02	NA	1.00E+00	C	NA	NA	BSL
108-95-2	Phenol	5.70E-02	LJ	1.20E-01	J	mg/kg	NTF-SB-150-4.5_11/29/2018	4/27	3.50E-01 - 4.10E-01	1.20E-01	NA	1.90E+03	N	NA	NA	BSL

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - NORTH TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
VOCS																
71-43-2	Benzene	9.70E-02	LJ	9.70E-02	LJ	mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	9.70E-02	NA	1.20E+00	C	NA	NA	BSL
110-82-7	Cyclohexane	2.10E+00		2.10E+00		mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	2.10E+00	NA	6.50E+02	N	NA	NA	BSL
100-41-4	Ethylbenzene	2.50E-01	LJ	2.50E-01	LJ	mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	2.50E-01	NA	5.80E+00	C	NA	NA	BSL
98-82-8	Isopropylbenzene	1.00E-01	LJ	1.00E-01	LJ	mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	1.00E-01	NA	1.90E+02	N	NA	NA	BSL
95-47-6	m, p-Xylene	9.60E-01		9.60E-01		mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	8.40E-03 - 2.80E-01	9.60E-01	NA	5.80E+01	N	NA	NA	BSL
108-88-3	ortho-Xylene	3.80E-02	LJ	3.80E-02	LJ	mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	3.80E-02	NA	6.50E+01	N	NA	NA	BSL
	Toluene	9.60E-03	LJ	9.60E-03	LJ	mg/kg	NTF-SB-106-10.0_11/01/2017	1/4	4.20E-03 - 2.80E-01	9.60E-03	NA	4.90E+02	N	NA	NA	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Surrogates used: Mercuric Chloride for Mercury, Chromium (III) Insoluble Salts for Chromium, Pyrene for Benzo (g,h,i) perylene and Phenanthrene, Cyclohexane for Methylcyclohexane, ortho-Xylene for m, p-Xylene.

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening ⁽²⁾	Background Value ⁽³⁾	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Inorganics																
57-12-5	Cyanide	4.10E-02	JL	7.10E-01		mg/kg	LPA-SB-42-0.5_ 11/30/2018	13/58	4.20E-01 - 6.10E-01	7.10E-01	NA	2.30E+00	N	NA	NA	BSL
Metals																
7429-90-5	Aluminum	9.10E+02		2.27E+04	J	mg/kg	LPA-SB-41-2.0_ 11/29/2018	66/66	9.70E+00 - 2.31E+01	2.27E+04	5.01E+03	7.70E+03	N	NA	NA	ASL
7440-36-0	Antimony	1.30E+00		1.80E+00	J	mg/kg	LPA-SB-20-0.5_ 10/25/2016	2/66	5.00E-01 - 1.10E+00	1.80E+00	NA	3.10E+00	N	NA	NA	BSL
7440-38-2	Arsenic	5.00E-01		4.60E+00		mg/kg	LPA-SB-11-2.0_ 10/26/2016	66/66	3.50E-01 - 6.00E-01	4.60E+00	2.30E+00	6.80E-01	C	NA	NA	ASL
7440-39-3	Barium	1.79E+01		1.08E+02		mg/kg	LPA-SB-11-2.0_ 10/26/2016	66/66	1.00E+00 - 5.70E+00	1.08E+02	5.15E+01	1.50E+03	N	NA	NA	BSL
7440-41-7	Beryllium	4.20E-02	JL	7.70E-01		mg/kg	LPA-SB-13-2.0_ 04/13/2017	37/66	3.50E-01 - 6.00E-01	7.70E-01	2.10E-01	1.60E+01	N	NA	NA	BSL
7440-43-9	Cadmium	4.30E-02	J	4.70E+00		mg/kg	LPA-SB-21-2.0_ 04/17/2017	27/66	3.50E-01 - 6.00E-01	4.70E+00	NA	7.10E+00	N	NA	NA	BSL
7440-70-2	Calcium	2.51E+02	JL	6.39E+04		mg/kg	LPA-SB-09-0.5_ 04/10/2017	62/66	1.46E+01 - 5.78E+02	6.39E+04	3.66E+02	NA	NA	NA	NA	NUT
7440-47-3	Chromium	2.30E+00		1.59E+01		mg/kg	LPA-SB-28-2.0_ 04/13/2017	66/66	7.10E-01 - 1.10E+00	1.59E+01	7.10E+00	1.20E+04	N	NA	NA	BSL
18540-29-9	Chromium, Hexavalent	8.20E-01		1.50E+00		mg/kg	LPA-SB-27-2.0_ 04/13/2017	3/5	1.50E-01 - 4.80E-01	1.50E+00	NA	3.00E-01	C	NA	NA	ASL
7440-48-4	Cobalt	2.70E-01	JL	1.33E+01		mg/kg	LPA-SB-11-2.0_ 10/26/2016	61/66	3.50E-01 - 2.20E+00	1.33E+01	1.11E+01	2.30E+00	N	NA	NA	ASL
7440-50-8	Copper	1.80E+00		1.67E+03		mg/kg	LPA-SB-27-2.0_ 04/13/2017	65/66	7.10E-01 - 1.58E+01	1.67E+03	3.24E+00	3.10E+02	N	NA	NA	ASL
7439-89-6	Iron	2.21E+03		4.02E+04		mg/kg	LPA-SB-17-0.5_ 04/13/2017	66/66	2.40E+00 - 1.74E+01	4.02E+04	1.47E+04	5.50E+03	N	NA	NA	ASL
7439-92-1	Lead	5.00E-01		2.08E+04	J	mg/kg	LPA-SB-20-0.5_ 10/25/2016	66/66	3.70E-01 - 8.14E+01	2.08E+04	9.19E+00	4.00E+02	G	NA	NA	ASL
7439-95-4	Magnesium	7.49E+01	JL	1.26E+04		mg/kg	LPA-SB-15-0.5_ 10/25/2016	66/66	1.46E+01 - 5.78E+02	1.26E+04	4.02E+02	NA	NA	NA	NA	NUT
7439-96-5	Manganese	1.67E+01		1.43E+03		mg/kg	LPA-SB-11-2.0_ 10/26/2016	66/66	5.00E-01 - 3.50E+00	1.43E+03	5.06E+02	1.80E+02	N	NA	NA	ASL
7439-97-6	Mercury	5.60E-03	JL	9.00E-01		mg/kg	LPA-SB-27-2.0_ 04/13/2017	41/66	5.80E-02 - 1.20E-01	9.00E-01	3.80E-02	2.30E+00	N	NA	NA	BSL
7440-02-0	Nickel	1.10E+00		2.76E+01		mg/kg	LPA-SB-27-0.5_ 04/13/2017	65/66	3.50E-01 - 2.20E+00	2.76E+01	5.60E+00	1.50E+02	N	NA	NA	BSL
7440-09-7	Potassium	1.14E+02	J	1.78E+03		mg/kg	LPA-SB-41-2.0_ 11/29/2018	62/66	9.74E+01 - 5.78E+02	1.78E+03	6.42E+02	NA	NA	NA	NA	NUT
7782-49-2	Selenium	3.80E-02	JL	5.80E-01	J	mg/kg	LPA-SB-41-2.0_ 11/29/2018	13/66	1.00E+00 - 2.80E+00	5.80E-01	NA	3.90E+01	N	NA	NA	BSL
7440-22-4	Silver	2.20E-02	JL	1.40E-01	J	mg/kg	LPA-SB-27-0.5_ 04/13/2017	19/66	3.50E-01 - 1.10E+00	1.40E-01	NA	3.90E+01	N	NA	NA	BSL
7440-23-5	Sodium	3.04E+01	J	1.21E+03		mg/kg	LPA-SB-13-2.0_ 04/13/2017	14/66	4.87E+01 - 5.78E+02	1.21E+03	1.16E+01	NA	NA	NA	NA	NUT
7440-28-0	Thallium	1.50E-02	J	6.70E-02	J	mg/kg	LPA-SB-13-2.0_ 04/13/2017	12/66	3.50E-01 - 6.00E-01	6.70E-02	NA	7.80E-02	N	NA	NA	BSL
7440-62-2	Vanadium	4.20E+00		2.42E+01	J	mg/kg	LPA-SB-20-2.0_ 10/25/2016	66/66	1.80E+00 - 2.80E+00	2.42E+01	1.12E+01	3.90E+01	N	NA	NA	BSL
7440-66-6	Zinc	5.80E+00		3.96E+02		mg/kg	LPA-SB-21-2.0_ 04/17/2017	66/66	7.10E-01 - 2.20E+00	3.96E+02	1.42E+01	2.30E+03	N	NA	NA	BSL

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PAHS																
91-57-6	2-Methylnaphthalene	8.10E-04	JL	4.80E+00	J	mg/kg	LPA-SB-08-2.0_10/25/2016	43/66	1.70E-03 - 1.80E+00	4.80E+00	NA	2.40E+01	N	NA	NA	BSL
83-32-9	Acenaphthene	6.70E-04	JL	1.20E-02	JL	mg/kg	LPA-SB-14-0.5_10/24/2016	10/66	1.70E-03 - 1.90E+00	1.20E-02	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	6.20E-04	JL	3.20E-02	J	mg/kg	LPA-SB-14-0.5_10/24/2016	14/66	1.70E-03 - 1.90E+00	3.20E-02	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	1.70E-03	J	1.00E+00	J	mg/kg	LPA-SB-08-0.5_10/25/2016	28/66	1.70E-03 - 1.90E+00	1.00E+00	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	1.30E-03	J	2.10E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	51/66	1.70E-03 - 9.10E-01	2.10E+00	NA	1.10E+00	C	NA	NA	Yes
50-32-8	Benzo (a) pyrene	4.40E-04	J	3.70E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	51/66	1.70E-03 - 1.90E+00	3.70E+00	NA	1.10E-01	C	NA	NA	Yes
205-99-2	Benzo (b) fluoranthene	7.30E-04	J	7.90E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	55/66	1.70E-03 - 1.90E+00	7.90E+00	NA	1.10E+00	C	NA	NA	Yes
191-24-2	Benzo (g,h,i) perylene	5.20E-04	JL	1.60E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	55/66	1.70E-03 - 1.90E+00	1.60E+00	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	6.20E-04	JL	3.00E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	41/66	1.70E-03 - 1.90E+00	3.00E+00	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	1.60E-03	J	8.20E+00	J	mg/kg	LPA-SB-08-0.5_10/25/2016	54/66	1.70E-03 - 7.10E+00	8.20E+00	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	7.90E-04	JL	2.20E-01	J	mg/kg	LPA-SB-08-0.5_10/25/2016	9/66	1.70E-03 - 1.90E+00	2.20E-01	NA	1.10E-01	C	NA	NA	Yes
206-44-0	Fluoranthene	4.30E-04	J	6.20E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	52/66	1.70E-03 - 3.70E+00	6.20E+00	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	1.30E-03	J	3.70E-01	J	mg/kg	LPA-SB-08-0.5_10/25/2016	7/66	1.70E-03 - 1.90E+00	3.70E-01	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	4.00E-04	J	1.60E+00	J	mg/kg	LPA-SB-09-0.5_04/10/2017	50/66	1.70E-03 - 1.90E+00	1.60E+00	NA	1.10E+00	C	NA	NA	Yes
91-20-3	Naphthalene	1.20E-03	JL	3.40E-01	J	mg/kg	LPA-SB-08-0.5_10/25/2016	20/66	1.70E-03 - 1.90E+00	3.40E-01	NA	3.80E+00	C	NA	NA	BSL
85-01-8	Phenanthrene	1.30E-03	JL	1.00E+01	J	mg/kg	LPA-SB-08-0.5_10/25/2016	56/66	1.70E-03 - 7.10E+00	1.00E+01	NA	1.80E+02	N	NA	NA	BSL
129-00-0	Pyrene	8.60E-04	J	1.10E+01	J	mg/kg	LPA-SB-08-0.5_10/25/2016	56/66	1.70E-03 - 7.10E+00	1.10E+01	NA	1.80E+02	N	NA	NA	BSL
SVOCs																
92-52-4	1,1'-Biphenyl	7.30E-04	JL	7.80E-02	J	mg/kg	LPA-SB-08-0.5_10/25/2016	10/66	1.70E-03 - 9.70E-01	7.80E-02	NA	4.70E+00	N	NA	NA	No
105-67-9	2,4-Dimethylphenol	1.00E-01	J	1.00E-01	J	mg/kg	LPA-SB-28-0.5_04/13/2017	1/66	1.70E-01 - 7.10E+00	1.00E-01	NA	1.30E+02	N	NA	NA	No
95-48-7	2-Methylphenol	1.90E-01	J	1.90E-01	J	mg/kg	LPA-SB-28-0.5_04/13/2017	1/66	3.20E-01 - 1.40E+01	1.90E-01	NA	3.20E+02	N	NA	NA	No
91-94-1	3,3'-Dichlorobenzidine	1.80E-03	J	1.80E-03	J	mg/kg	LPA-SB-21-2.0_04/17/2017	1/66	3.40E-03 - 3.70E+00	1.80E-03	NA	1.20E+00	C	NA	NA	No
106-44-5	4-Methylphenol	1.10E-01	J	1.10E-01	J	mg/kg	LPA-SB-28-0.5_04/13/2017	1/66	3.20E-01 - 1.40E+01	1.10E-01	NA	6.30E+02	N	NA	NA	No
108-60-1	Bis(2-chloro-1-methylethyl)ether	3.30E-03	JL	7.90E-03	J	mg/kg	LPA-SB-17-2.0_04/13/2017	2/66	3.40E-03 - 3.70E+00	7.90E-03	NA	3.10E+02	N	NA	NA	No
117-81-7	Bis(2-ethylhexyl)phthalate	1.60E-01	JL	2.20E-01	JL	mg/kg	LPA-SB-12-0.5_04/11/2017	2/66	1.70E-01 - 7.10E+00	2.20E-01	NA	3.90E+01	C	NA	NA	No
85-68-7	Butyl benzyl phthalate	2.30E-02	JL	2.30E-02	JL	mg/kg	LPA-SB-26-0.5_10/27/2016	1/66	1.70E-01 - 7.10E+00	2.30E-02	NA	2.90E+02	C	NA	NA	No
86-74-8	Carbazole	3.00E-01	JL	3.60E-01	JL	mg/kg	LPA-SB-09-0.5_04/10/2017	2/66	3.20E-01 - 1.40E+01	3.60E-01	NA	NA	NA	NA	NA	No
132-64-9	Dibenzofuran	8.10E-04	JL	1.70E-01	J	mg/kg	LPA-SB-08-0.5_10/25/2016	23/66	1.70E-03 - 1.90E+00	1.70E-01	NA	7.30E+00	N	NA	NA	No
131-11-3	Dimethyl phthalate	1.40E-01	J	2.80E-01	J	mg/kg	LPA-SB-43-2.0_11/30/2018, LPA-SB-42-0.5_11/30/2018	6/66	1.70E-01 - 7.10E+00	2.80E-01	NA	NA	NA	NA	NA	No
108-87-2	Methylcyclohexane	1.30E-03	JL	1.60E+00	J	mg/kg	LPA-SB-08-2.0_10/25/2016	4/30	4.40E-03 - 2.70E-01	1.60E+00	NA	6.50E+02	N	NA	NA	No
98-95-3	Nitrobenzene	1.30E-03	JL	1.60E-03	JL	mg/kg	LPA-SB-02-2.0_04/10/2017	3/66	3.40E-03 - 1.90E+00	1.60E-03	NA	5.10E+00	C	NA	NA	No
87-86-5	Pentachlorophenol	2.00E-02	J	3.20E-02	J	mg/kg	LPA-SB-23-0.5_10/27/2016	3/66	3.40E-03 - 3.70E+00	3.20E-02	NA	1.00E+00	C	NA	NA	No
108-95-2	Phenol	7.10E-02	J	2.10E-01	J	mg/kg	LPA-SB-41-2.0_11/29/2018	7/66	3.20E-01 - 1.40E+01	2.10E-01	NA	1.90E+03	N	NA	NA	No

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
VOCS																
123-91-1	1,4-Dioxane	4.50E-03	J	4.50E-03	J	mg/kg	LPA-SB-21-2.0_04/17/2017	1/66	1.70E-03 - 7.80E-01	4.50E-03	NA	5.30E+00	C	NA	NA	BSL
78-93-3	2-Butanone	3.80E-03	JL	6.50E-02		mg/kg	LPA-SB-04-2.0_10/25/2016	5/30	8.70E-03 - 4.90E-01	6.50E-02	NA	2.70E+03	N	NA	NA	BSL
591-78-6	2-Hexanone	7.80E-03	JL	7.80E-03	JL	mg/kg	LPA-SB-04-2.0_10/25/2016	1/30	8.70E-03 - 5.50E-01	7.80E-03	NA	2.00E+01	N	NA	NA	BSL
67-64-1	Acetone	3.90E-03	JL	2.10E-01		mg/kg	LPA-SB-04-2.0_10/25/2016	6/30	8.70E-03 - 4.90E-01	2.10E-01	NA	6.10E+03	N	NA	NA	BSL
75-15-0	Carbon disulfide	6.30E-03		6.30E-03		mg/kg	LPA-SB-14-2.0_10/24/2016	1/30	4.40E-03 - 2.40E-01	6.30E-03	NA	7.70E+01	N	NA	NA	BSL
110-82-7	Cyclohexane	3.70E-02	J	2.50E-01	JL	mg/kg	LPA-SB-08-0.5_10/25/2016	3/30	4.40E-03 - 2.70E-01	2.50E-01	NA	6.50E+02	N	NA	NA	BSL
98-82-8	Isopropylbenzene	4.10E-03	JL	2.30E-01	JL	mg/kg	LPA-SB-08-2.0_10/25/2016	3/30	4.40E-03 - 2.70E-01	2.30E-01	NA	1.90E+02	N	NA	NA	BSL
75-09-2	Methylene chloride	9.20E-04	JL	1.60E-03	JL	mg/kg	LPA-SB-20-0.5_10/25/2016	3/30	4.40E-03 - 2.40E-01	1.60E-03	NA	3.50E+01	N	NA	NA	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Surrogates used: Mercuric Chloride for Mercury.

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: B = Indicates analyte detected in associated method blank

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Inorganics																
57-12-5	Cyanide	4.50E-02	JL	6.40E-01		mg/kg	LPA-SB-42-6.0_11/30/2018	6/69	4.10E-01 - 6.00E-01	6.40E-01	NA	2.30E+00 N	NA	NA	No	BSL
Metals																
7429-90-5	Aluminum	8.12E+02		2.19E+04		mg/kg	LPA-SB-43-6.0_11/30/2018	76/76	9.90E+00 - 2.31E+01	2.19E+04	NA	7.70E+03 N	NA	NA	Yes	ASL
7440-38-2	Arsenic	4.40E-01		9.40E+00		mg/kg	LPA-SB-19-12.5_10/26/2016	74/76	3.60E-01 - 6.00E-01	9.40E+00	NA	6.80E-01 C	NA	NA	Yes	ASL
7440-39-3	Barium	9.20E+00		1.91E+02		mg/kg	LPA-SB-22-10.0_04/18/2017	76/76	1.00E+00 - 6.00E+00	1.91E+02	NA	1.50E+03 N	NA	NA	No	BSL
7440-41-7	Beryllium	1.80E-01	JL	1.20E+00		mg/kg	LPA-SB-19-12.5_10/26/2016	51/76	3.60E-01 - 6.00E-01	1.20E+00	NA	1.60E+01 N	NA	NA	No	BSL
7440-43-9	Cadmium	4.90E-02	J	2.90E+00		mg/kg	LPA-SB-21-6.0_04/17/2017	15/76	3.80E-01 - 6.00E-01	2.90E+00	NA	7.10E+00 N	NA	NA	No	BSL
7440-70-2	Calcium	2.59E+02		2.89E+04		mg/kg	LPA-SB-21-6.0_04/17/2017	71/76	1.48E+01 - 5.78E+02	2.89E+04	NA	NA	NA	NA	No	NUT
7440-47-3	Chromium	2.40E+00		2.25E+01		mg/kg	LPA-SB-05-10.0_10/24/2016	76/76	7.70E-01 - 1.20E+00	2.25E+01	NA	1.20E+04 N	NA	NA	No	BSL
7440-48-4	Cobalt	4.80E-01		1.91E+01		mg/kg	LPA-SB-19-12.5_10/26/2016	70/76	3.80E-01 - 2.20E+00	1.91E+01	NA	2.30E+00 N	NA	NA	Yes	ASL
7440-50-8	Copper	1.80E+00		7.06E+02		mg/kg	LPA-SB-27-10.0_04/13/2017	75/76	7.70E-01 - 2.20E+00	7.06E+02	NA	3.10E+02 N	NA	NA	Yes	ASL
7439-89-6	Iron	2.08E+03		3.87E+04		mg/kg	LPA-SB-19-12.5_10/26/2016	76/76	2.50E+00 - 2.09E+01	3.87E+04	NA	5.50E+03 N	NA	NA	Yes	ASL
7439-92-1	Lead	1.40E+00		9.72E+02		mg/kg	LPA-SB-10-6.0_10/26/2016	72/76	3.60E-01 - 6.00E-01	9.72E+02	NA	4.00E+02 G	NA	NA	Yes	ASL
7439-95-4	Magnesium	1.61E+02	J	3.20E+03		mg/kg	LPA-SB-15-6.0_10/25/2016	76/76	1.48E+01 - 5.78E+02	3.20E+03	NA	NA	NA	NA	No	NUT
7439-96-5	Manganese	1.13E+01		7.42E+02		mg/kg	LPA-SB-01-6.0_10/25/2016	76/76	5.00E-01 - 1.70E+00	7.42E+02	NA	1.80E+02 N	NA	NA	Yes	ASL
7439-97-6	Mercury	2.40E-03	JL	1.67E-01		mg/kg	LPA-SB-21-6.0_04/17/2017	25/76	6.00E-02 - 1.20E-01	1.67E-01	NA	2.30E+00 N	NA	NA	No	BSL
7440-02-0	Nickel	2.40E+00		5.25E+01		mg/kg	LPA-SB-19-12.5_10/26/2016	75/76	3.60E-01 - 2.20E+00	5.25E+01	NA	1.50E+02 N	NA	NA	No	BSL
7440-09-7	Potassium	1.63E+02		2.20E+03		mg/kg	LPA-SB-43-6.0_11/30/2018	76/76	9.85E+01 - 5.78E+02	2.20E+03	NA	NA	NA	NA	No	NUT
7782-49-2	Selenium	6.80E-02	JL	5.00E-01	JL	mg/kg	LPA-SB-43-6.0_11/30/2018	12/76	1.00E+00 - 3.00E+00	5.00E-01	NA	3.90E+01 N	NA	NA	No	BSL
7440-22-4	Silver	2.60E-02	JL	6.70E-02	J	mg/kg	LPA-SB-16-10.0_04/13/2017	15/76	3.80E-01 - 1.10E+00	6.70E-02	NA	3.90E+01 N	NA	NA	No	BSL
7440-23-5	Sodium	3.10E+01	J	9.42E+02		mg/kg	LPA-SB-13-6.0_04/13/2017	23/76	4.93E+01 - 5.78E+02	9.42E+02	NA	NA	NA	NA	No	NUT
7440-28-0	Thallium	1.20E-02	J	6.00E-01		mg/kg	LPA-SB-21-6.0_04/17/2017	15/76	3.80E-01 - 6.00E-01	6.00E-01	NA	7.80E-02 N	NA	NA	Yes	ASL
7440-62-2	Vanadium	4.30E+00		3.01E+01	J	mg/kg	LPA-SB-19-12.5_10/26/2016	76/76	1.80E+00 - 3.00E+00	3.01E+01	NA	3.90E+01 N	NA	NA	No	BSL
7440-66-6	Zinc	3.20E+00		3.97E+02		mg/kg	LPA-SB-21-6.0_04/17/2017	76/76	7.60E-01 - 2.20E+00	3.97E+02	NA	2.30E+03 N	NA	NA	No	BSL

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

CAS Number	Chemical	Minimum Concentration ⁽¹⁾	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PAHS																
91-57-6	2-Methylnaphthalene	5.90E-04	JL	8.90E+00		mg/kg	LPA-SB-12-12.5_04/11/2017	38/76	1.80E-03 - 2.00E+00	8.90E+00	NA	2.40E+01	N	NA	NA	BSL
83-32-9	Acenaphthene	8.50E-04	JL	4.00E-01	J	mg/kg	LPA-SB-08-6.0_10/25/2016	10/76	1.70E-03 - 2.00E+00	4.00E-01	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	4.30E-04	JL	1.50E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	7/76	1.70E-03 - 2.00E+00	1.50E-01	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	1.50E-03	J	3.30E-01		mg/kg	LPA-SB-04-10.0_10/25/2016	23/76	1.70E-03 - 1.90E+00	3.30E-01	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	6.10E-04	J	1.80E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	19/76	1.70E-03 - 2.00E+00	1.80E-01	NA	1.10E+00	C	NA	NA	BSL
50-32-8	Benzo (a) pyrene	1.40E-03	J	2.20E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	15/76	1.70E-03 - 2.00E+00	2.20E-01	NA	1.10E-01	C	NA	NA	ASL
205-99-2	Benzo (b) fluoranthene	2.30E-03		3.90E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	19/76	1.80E-03 - 2.00E+00	3.90E-01	NA	1.10E+00	C	NA	NA	BSL
191-24-2	Benzo (g,h,i) perylene	5.50E-04	JL	1.60E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	27/76	1.70E-03 - 2.00E+00	1.60E-01	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	9.00E-04	JL	1.30E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	11/76	1.80E-03 - 2.00E+00	1.30E-01	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	6.90E-04	JL	2.50E-01	J	mg/kg	LPA-SB-12-12.5_04/11/2017, LPA-SB-21-6.0_04/17/2017	28/76	1.80E-03 - 2.00E+00	2.50E-01	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	2.50E-03	J	3.20E-02	JL	mg/kg	LPA-SB-02-14.0_04/10/2017	4/76	1.80E-03 - 2.00E+00	3.20E-02	NA	1.10E-01	C	NA	NA	BSL
206-44-0	Fluoranthene	4.60E-04	J	3.20E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	26/76	1.80E-03 - 3.80E+00	3.20E-01	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	2.00E-03		6.20E-01		mg/kg	LPA-SB-12-12.5_04/11/2017	24/76	1.80E-03 - 2.00E+00	6.20E-01	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	4.10E-04	JL	9.30E-02	J	mg/kg	LPA-SB-21-6.0_04/17/2017	19/76	1.70E-03 - 2.00E+00	9.30E-02	NA	1.10E+00	C	NA	NA	BSL
91-20-3	Naphthalene	1.30E-03	J	2.40E+00		mg/kg	LPA-SB-12-12.5_04/11/2017	25/76	1.70E-03 - 2.00E+00	2.40E+00	NA	3.80E+00	C	NA	NA	BSL
85-01-8	Phenanthrene	8.10E-04	JL	1.60E+00	J	mg/kg	LPA-SB-12-12.5_04/11/2017	40/76	1.80E-03 - 2.00E+00	1.60E+00	NA	1.80E+02	N	NA	NA	BSL
129-00-0	Pyrene	5.70E-04	JL	6.10E-01	J	mg/kg	LPA-SB-21-6.0_04/17/2017	32/76	1.70E-03 - 2.00E+00	6.10E-01	NA	1.80E+02	N	NA	NA	BSL
SVOCS																
92-52-4	1,1'-Biphenyl	2.20E-03		5.00E-03		mg/kg	LPA-SB-21-6.0_04/17/2017	2/76	1.80E-03 - 2.00E+00	5.00E-03	NA	4.70E+00	N	NA	NA	BSL
105-67-9	2,4-Dimethylphenol	7.90E-02	J	7.90E-02	J	mg/kg	LPA-SB-28-6.5_04/13/2017	1/76	1.70E-01 - 2.00E+00	7.90E-02	NA	1.30E+02	N	NA	NA	BSL
95-48-7	2-Methylphenol	1.50E-01	J	1.50E-01	J	mg/kg	LPA-SB-28-6.5_04/13/2017	1/76	3.30E-01 - 3.80E+00	1.50E-01	NA	3.20E+02	N	NA	NA	BSL
106-44-5	4-Methylphenol	8.70E-02	J	8.70E-02	J	mg/kg	LPA-SB-28-6.5_04/13/2017	1/76	3.30E-01 - 3.80E+00	8.70E-02	NA	6.30E+02	N	NA	NA	BSL
98-86-2	Acetophenone	3.60E-02	J	6.90E-02	J	mg/kg	LPA-SB-21-6.0_04/17/2017	2/76	3.30E-01 - 3.80E+00	6.90E-02	NA	7.80E+02	N	NA	NA	BSL
100-52-7	Benzaldehyde	8.60E-02	JL	8.60E-02	JL	mg/kg	LPA-SB-42-10.0_11/30/2018	1/76	3.30E-01 - 3.80E+00	8.60E-02	NA	1.70E+02	C	NA	NA	BSL
85-68-7	Butyl benzyl phthalate	5.60E-02	J	5.60E-02	J	mg/kg	LPA-SB-27-13.0_04/13/2017	1/76	1.70E-01 - 2.00E+00	5.60E-02	NA	2.90E+02	C	NA	NA	BSL
132-64-9	Dibenzofuran	9.90E-04	JL	2.60E-01		mg/kg	LPA-SB-12-12.5_04/11/2017	20/76	1.80E-03 - 2.00E+00	2.60E-01	NA	7.30E+00	N	NA	NA	BSL
131-11-3	Dimethyl phthalate	1.30E-01	J	3.30E-01		mg/kg	LPA-SB-43-13.0_11/30/2018	9/76	1.70E-01 - 2.00E+00	3.30E-01	NA			NA	NA	BSL
108-87-2	Methylcyclohexane	2.00E-03	JL	3.60E+02	J	mg/kg	LPA-SB-12-10.0_04/11/2017	15/42	4.30E-03 - 3.10E+01	3.60E+02	NA	6.50E+02	N	NA	NA	BSL
98-95-3	Nitrobenzene	1.30E-03	JL	3.10E-03	JL	mg/kg	LPA-SB-12-6.0_04/11/2017	2/76	3.40E-03 - 2.00E+00	3.10E-03	NA	5.10E+00	C	NA	NA	BSL
86-30-6	N-Nitrosodiphenylamine	1.20E-01	JL	2.00E-01	JL	mg/kg	LPA-SB-09-10.0_04/10/2017	3/76	1.70E-01 - 2.00E+00	2.00E-01	NA	1.10E+02	C	NA	NA	BSL
87-86-5	Pentachlorophenol	3.40E-03	JL	2.40E-02		mg/kg	LPA-SB-23-10.0_10/27/2016	3/76	3.40E-03 - 3.80E+00	2.40E-02	NA	1.00E+00	C	NA	NA	BSL
108-95-2	Phenol	5.50E-02	J	1.90E-01	JL	mg/kg	LPA-SB-43-6.0_11/30/2018	11/76	3.30E-01 - 3.80E+00	1.90E-01	NA	1.90E+03	N	NA	NA	BSL

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

CAS Number	Chemical	Minimum Concentration ⁽¹⁾	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
VOCS																
123-91-1	1,4-Dioxane	4.40E-03	J	2.60E-02		mg/kg	LPA-SB-24-10.0_04/17/2017	3/76	1.80E-03 - 8.10E-01	2.60E-02	NA	5.30E+00	C	NA	NA	BSL
78-93-3	2-Butanone	5.90E-03	JL	5.90E-03	JL	mg/kg	LPA-SB-05-6.0_10/24/2016	1/42	4.40E-03 - 6.30E+01	5.90E-03	NA	2.70E+03	N	NA	NA	BSL
460-00-4	4-Bromofluorobenzene	4.09E-02		4.20E-02		mg/kg	LPA-SB-21-8.5_04/17/2017	2/2	4.40E-03 - 4.80E-03	4.20E-02	NA	2.30E+00	N	NA	NA	BSL
67-64-1	Acetone	5.90E-03	J	1.70E-01		mg/kg	LPA-SB-09-15.0_04/10/2017	5/42	8.60E-03 - 6.30E+01	1.70E-01	NA	6.10E+03	N	NA	NA	BSL
110-82-7	Cyclohexane	1.40E-01	JL	1.10E+02	J	mg/kg	LPA-SB-12-10.0_04/11/2017	10/42	4.30E-03 - 3.10E+01	1.10E+02	NA	6.50E+02	N	NA	NA	BSL
98-82-8	Isopropylbenzene	2.00E-02	J	1.50E+01	JL	mg/kg	LPA-SB-12-10.0_04/11/2017	10/42	4.30E-03 - 3.10E+01	1.50E+01	NA	1.90E+02	N	NA	NA	BSL
75-09-2	Methylene chloride	1.00E-03	JL	1.30E-03	JL	mg/kg	LPA-SB-15-6.0_10/25/2016	3/42	4.30E-03 - 3.10E+01	1.30E-03	NA	3.50E+01	N	NA	NA	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: B = Indicates analyte detected in associated method blank

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LOADING DOCK AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Loading Dock Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Metals																
7429-90-5	Aluminum	1.62E+03	J	8.30E+03	J	mg/kg	LDA-SB-144-2.0_12/04/2018	20/20	1.64E+01 - 2.30E+01	8.30E+03	5.01E+03	7.70E+03	N	NA	Yes	ASL
7440-36-0	Antimony	1.70E+00	J	6.80E+00	J	mg/kg	LDA-SB-142-0.5_12/04/2018	2/20	8.50E-01 - 1.10E+00	6.80E+00	NA	3.10E+00	N	NA	Yes	ASL
7440-38-2	Arsenic	8.80E-01		9.40E+00		mg/kg	LDA-SB-109-0.5_10/31/2017	20/20	4.40E-01 - 8.50E-01	9.40E+00	2.30E+00	6.80E-01	C	NA	Yes	ASL
7440-39-3	Barium	6.70E+00		1.17E+02	J	mg/kg	LDA-SB-143-2.0_12/04/2018	20/20	4.20E+00 - 5.70E+00	1.17E+02	5.15E+01	1.50E+03	N	NA	No	BSL
7440-41-7	Beryllium	1.10E-01	J	3.30E-01	J	mg/kg	LDA-SB-112-0.5_10/31/2017	13/20	4.20E-01 - 5.70E-01	3.30E-01	2.10E-01	1.60E+01	N	NA	No	BSL
7440-43-9	Cadmium	6.80E-02	J	6.20E+00		mg/kg	LDA-SB-110-0.5_10/31/2017	14/20	4.10E-01 - 8.50E-01	6.20E+00	NA	7.10E+00	N	NA	No	BSL
7440-70-2	Calcium	2.64E+02	LJ	7.84E+03	J	mg/kg	LDA-SB-111-0.5_10/31/2017	20/20	4.11E+02 - 5.75E+02	7.84E+03	3.66E+02	NA	NA	NA	No	NUT
7440-47-3	Chromium	2.00E+00		1.05E+01		mg/kg	LDA-SB-110-0.5_10/31/2017	20/20	8.70E-01 - 1.70E+00	1.05E+01	7.10E+00	1.20E+04	N	NA	No	BSL
7440-48-4	Cobalt	5.30E-01		4.32E+01		mg/kg	LDA-SB-109-2.0_10/31/2017	20/20	4.40E-01 - 8.50E-01	4.32E+01	1.11E+01	2.30E+00	N	NA	Yes	ASL
7440-50-8	Copper	2.40E+00		6.84E+01		mg/kg	LDA-SB-109-2.0_10/31/2017	20/20	8.70E-01 - 1.70E+00	6.84E+01	3.24E+00	3.10E+02	N	NA	No	BSL
57-12-5	Cyanide	2.00E-02	LJ	7.20E-02	LJ	mg/kg	LDA-SB-110-0.5_10/31/2017	9/12	4.50E-01 - 5.40E-01	7.20E-02	1.68E-01	2.30E+00	N	NA	No	BSL
7439-89-6	Iron	4.01E+03	J	5.73E+04	J	mg/kg	LDA-SB-110-0.5_10/31/2017	20/20	8.20E+00 - 1.97E+01	5.73E+04	1.47E+04	5.50E+03	N	NA	Yes	ASL
7439-92-1	Lead	4.30E+00		2.73E+02		mg/kg	LDA-SB-110-0.5_10/31/2017	20/20	4.20E-01 - 5.70E-01	2.73E+02	9.19E+00	4.00E+02	G	NA	No	BSL
7439-95-4	Magnesium	1.18E+02	LJ	1.47E+03		mg/kg	LDA-SB-144-0.5_12/04/2018	15/20	4.11E+02 - 5.75E+02	1.47E+03	4.02E+02	NA	NA	NA	No	NUT
7439-96-5	Manganese	2.69E+01	J	1.81E+03	J	mg/kg	LDA-SB-143-2.0_12/04/2018	20/20	1.20E+00 - 3.10E+00	1.81E+03	5.06E+02	1.80E+02	N	NA	Yes	ASL
7439-97-6	Mercury	1.10E-02	LJ	1.80E-01		mg/kg	LDA-SB-142-0.5_12/04/2018	13/20	9.60E-02 - 1.30E-01	1.80E-01	3.80E-02	2.30E+00	N	NA	No	BSL
7440-02-0	Nickel	1.10E+00		1.64E+01		mg/kg	LDA-SB-112-0.5_10/31/2017	20/20	4.40E-01 - 8.50E-01	1.64E+01	5.60E+00	1.50E+02	N	NA	No	BSL
7440-09-7	Potassium	2.42E+02	LJ	9.59E+02		mg/kg	LDA-SB-112-2.0_10/31/2017	18/20	4.11E+02 - 5.75E+02	9.59E+02	6.42E+02	NA	NA	NA	No	NUT
7782-49-2	Selenium	1.60E-01	J	3.40E-01	J	mg/kg	LDA-SB-142-0.5_12/04/2018	5/20	2.20E+00 - 4.20E+00	3.40E-01	NA	3.90E+01	N	NA	No	BSL
7440-22-4	Silver	2.20E-02	J	5.20E-02	J	mg/kg	LDA-SB-112-0.5_10/31/2017	4/20	4.40E-01 - 8.50E-01	5.20E-02	NA	3.90E+01	N	NA	No	BSL
7440-23-5	Sodium	1.07E+01	LJ	1.28E+02	LJ	mg/kg	LDA-SB-134-0.5_10/31/2017	11/20	4.11E+02 - 5.75E+02	1.28E+02	1.16E+01	NA	NA	NA	No	NUT
7440-62-2	Vanadium	3.40E+00		1.30E+01		mg/kg	LDA-SB-112-2.0_10/31/2017	20/20	2.20E+00 - 4.20E+00	1.30E+01	1.12E+01	3.90E+01	N	NA	No	BSL
7440-66-6	Zinc	5.60E+00		1.11E+03		mg/kg	LDA-SB-110-0.5_10/31/2017	20/20	8.70E-01 - 4.10E+00	1.11E+03	1.42E+01	2.30E+03	N	NA	No	BSL
PAHS																
91-57-6	2-Methylnaphthalene	9.30E-04	J	1.80E+01		mg/kg	LDA-SB-109-2.0_10/31/2017	19/20	3.60E-03 - 3.80E+00	1.80E+01	NA	2.40E+01	N	NA	No	BSL
83-32-9	Acenaphthene	8.60E-04	J	4.90E-01		mg/kg	LDA-SB-135-2.0_10/31/2017	9/20	3.60E-03 - 3.80E+00	4.90E-01	NA	3.60E+02	N	NA	No	BSL
208-96-8	Acenaphthylene	5.30E-03		1.70E-01		mg/kg	LDA-SB-141-0.5_12/04/2018	10/20	3.60E-03 - 3.80E+00	1.70E-01	NA	3.60E+02	N	NA	No	BSL
120-12-7	Anthracene	1.10E-03	J	2.50E-01		mg/kg	LDA-SB-110-2.0_10/31/2017	15/20	3.60E-03 - 3.80E+00	2.50E-01	NA	1.80E+03	N	NA	No	BSL
56-55-3	Benzo (a) anthracene	8.20E-04	J	8.40E-01	LJ	mg/kg	LDA-SB-109-0.5_10/31/2017	17/20	3.60E-03 - 3.80E+00	8.40E-01	NA	1.10E+00	C	NA	No	BSL
50-32-8	Benzo (a) pyrene	5.20E-03		7.70E-01	LJ	mg/kg	LDA-SB-109-0.5_10/31/2017	16/20	3.60E-03 - 3.80E+00	7.70E-01	NA	1.10E-01	C	NA	Yes	ASL
205-99-2	Benzo (b) fluoranthene	7.30E-04	J	7.20E-01	LJ	mg/kg	LDA-SB-109-0.5_10/31/2017	18/20	3.60E-03 - 3.80E+00	7.20E-01	NA	1.10E+00	C	NA	No	BSL
191-24-2	Benzo (g,h,i) perylene	7.60E-04	J	5.50E-01	J+	mg/kg	LDA-SB-110-0.5_10/31/2017	17/20	3.60E-03 - 3.80E+00	5.50E-01	NA	1.80E+02	N	NA	No	BSL
207-08-9	Benzo (k) fluoranthene	2.60E-03	LJ	2.60E-01		mg/kg	LDA-SB-141-0.5_12/04/2018	12/18	3.60E-03 - 3.80E+00	2.60E-01	NA	1.10E+01	C	NA	No	BSL
218-01-9	Chrysene	9.10E-04	J	1.80E+00	LJ	mg/kg	LDA-SB-109-0.5_10/31/2017	19/20	3.60E-03 - 3.80E+00	1.80E+00	NA	1.10E+02	C	NA	No	BSL
53-70-3	Dibenz (a,h) anthracene	1.90E-03	J	1.00E-01		mg/kg	LDA-SB-141-0.5_12/04/2018	12/18	3.60E-03 - 3.80E+00	1.00E-01	NA	1.10E-01	C	NA	No	BSL
206-44-0	Fluoranthene	1.00E-03	J	1.50E+00		mg/kg	LDA-SB-142-0.5_12/04/2018	16/20	3.60E-03 - 3.80E+00	1.50E+00	NA	2.40E+02	N	NA	No	BSL
86-73-7	Fluorene	8.40E-04	J	1.10E+00	LJ	mg/kg	LDA-SB-109-2.0_10/31/2017	15/20	3.60E-03 - 3.80E+00	1.10E+00	NA	2.40E+02	N	NA	No	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	1.70E-03	J	2.80E-01		mg/kg	LDA-SB-141-0.5_12/04/2018	14/18	3.60E-03 - 3.80E+00	2.80E-01	NA	1.10E+00	C	NA	No	BSL
91-20-3	Naphthalene	2.10E-03	J	3.70E+00	LJ	mg/kg	LDA-SB-109-2.0_10/31/2017	17/20	3.60E-03 - 3.80E+00	3.70E+00	NA	3.80E+00	C	NA	No	BSL
85-01-8	Phenanthrene	9.80E-04	J	2.30E+00	LJ	mg/kg	LDA-SB-109-2.0_10/31/2017	20/20	3.60E-03 - 3.80E+00	2.30E+00	NA	1.80E+02	N	NA	No	BSL
129-00-0	Pyrene	1.20E-03	J	1.10E+01		mg/kg	LDA-SB-109-0.5_10/31/2017	20/20	3.60E-03 - 3.80E+00	1.10E+01	NA	1.80E+02	N	NA	No	BSL

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LOADING DOCK AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Loading Dock Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
SVOCs																
121-14-2	2,4-Dinitrotoluene	5.10E-01	LJ	5.10E-01	LJ	mg/kg	LDA-SB-109-0.5_10/31/2017	1/20	1.80E-01 - 3.80E+00	5.10E-01	NA	1.70E+00 C	NA	NA	No	BSL
86-74-8	Carbazole	1.00E-01	J	1.00E-01	J	mg/kg	LDA-SB-142-0.5_12/04/2018	1/20	3.50E-01 - 7.40E+00	1.00E-01	NA	NA	NA	NA	No	BSL
132-64-9	Dibenzofuran	2.40E-02	LJ	2.40E-02	LJ	mg/kg	LDA-SB-134-0.5_10/31/2017	1/20	1.80E-01 - 3.80E+00	2.40E-02	NA	7.30E+00 N	NA	NA	No	BSL
131-11-3	Dimethyl phthalate	1.20E-01	J	2.40E-01		mg/kg	LDA-SB-141-0.5_12/04/2018	8/20	1.80E-01 - 3.80E+00	2.40E-01	NA	NA	NA	NA	No	BSL
108-87-2	Methylcyclohexane	8.00E+00		8.40E+01		mg/kg	LDA-SB-110-2.0_10/31/2017	2/2	5.50E-01 - 4.90E+00	8.40E+01	NA	6.50E+02 N	NA	NA	No	BSL
108-95-2	Phenol	8.50E-02	J	1.80E-01	J	mg/kg	LDA-SB-141-0.5_12/04/2018	8/20	3.50E-01 - 7.40E+00	1.80E-01	NA	1.90E+03 N	NA	NA	No	BSL
VOCs																
71-43-2	Benzene	2.80E+00	J	2.80E+00	J	mg/kg	LDA-SB-110-2.0_10/31/2017	1/2	5.50E-01 - 4.90E+00	2.80E+00	NA	1.20E+00 C	NA	NA	Yes	ASL
110-82-7	Cyclohexane	2.30E+00		4.10E+01		mg/kg	LDA-SB-110-2.0_10/31/2017	2/2	5.50E-01 - 4.90E+00	4.10E+01	NA	6.50E+02 N	NA	NA	No	BSL
100-41-4	Ethylbenzene	5.90E-01		6.70E+00		mg/kg	LDA-SB-110-2.0_10/31/2017	2/2	5.50E-01 - 4.90E+00	6.70E+00	NA	5.80E+00 C	NA	NA	Yes	ASL
98-82-8	Isopropylbenzene	4.30E-01	J	3.20E+00	J	mg/kg	LDA-SB-110-2.0_10/31/2017	2/2	5.50E-01 - 4.90E+00	3.20E+00	NA	1.90E+02 N	NA	NA	No	BSL
179601-23-1	m, p-Xylene	5.90E-01	J	5.90E-01	J	mg/kg	LDA-SB-110-2.0_10/31/2017	1/2	5.50E-01 - 4.90E+00	5.90E-01	NA	5.80E+01 N	NA	NA	No	BSL
95-47-6	ortho-Xylene	3.80E-02	J	2.80E-01	J	mg/kg	LDA-SB-110-2.0_10/31/2017	2/2	5.50E-01 - 4.90E+00	2.80E-01	NA	6.50E+01 N	NA	NA	No	BSL
108-88-3	Toluene	1.70E-02	J	3.20E-01	J	mg/kg	LDA-SB-110-2.0_10/31/2017	2/2	5.50E-01 - 4.90E+00	3.20E-01	NA	4.90E+02 N	NA	NA	No	BSL
79-01-6	Trichloroethene	1.30E-01	J	1.30E-01	J	mg/kg	LDA-SB-110-2.0_10/31/2017	1/2	5.50E-01 - 4.90E+00	1.30E-01	NA	4.10E-01 N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

Deletion Reason:

ASL = Above Screening Toxicity Level

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Surrogates used: Mercuric Chloride for Mercury, Chromium (III) Insoluble Salts for Chromium, Pyrene for Benzo (g,h,i) perylene and Phenanthrene.

Cyclohexane for Methylcyclohexane, ortho-Xylene for m, p-Xylene, Pentachlorophenol for Tetrachloroethene.

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

TABLE 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LOADING DOCK AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Loading Dock Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection ⁽⁵⁾
Metals																
7429-90-5	Aluminum	1.71E+03		9.45E+03		mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	1.76E+01 - 2.00E+01	9.45E+03	NA	7.70E+03	N	NA	NA	ASL
7440-38-2	Arsenic	4.60E-01		3.30E+00		mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	4.50E-01 - 9.40E-01	3.30E+00	NA	6.80E-01	C	NA	NA	ASL
7440-39-3	Barium	5.90E+00		5.82E+01		mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	4.50E+00 - 5.40E+00	5.82E+01	NA	1.50E+03	N	NA	NA	BSL
7440-41-7	Beryllium	1.70E-01	LJ	3.70E-01	J	mg/kg	LDA-SB-112-4.5_10/31/2017	2/4	4.50E-01 - 5.40E-01	3.70E-01	NA	1.60E+01	N	NA	NA	BSL
7440-70-2	Calcium	2.85E+02	J	9.66E+02		mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	4.40E+02 - 5.00E+02	9.66E+02	NA	NA	NA	NA	NA	NUT
7440-47-3	Chromium	1.90E+00		1.21E+01	J	mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	8.90E-01 - 1.90E+00	1.21E+01	NA	1.20E+04	N	NA	NA	BSL
7440-48-4	Cobalt	3.60E-01	J	2.69E+01		mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	4.50E-01 - 9.40E-01	2.69E+01	NA	2.30E+00	N	NA	NA	ASL
7440-50-8	Copper	2.50E+00		9.70E+01		mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	8.90E-01 - 1.90E+00	9.70E+01	NA	3.10E+02	N	NA	NA	BSL
57-12-5	Cyanide	4.50E-02	J	7.30E-02	LJ	mg/kg	LDA-SB-111-3.0-D_10/31/2017	2/4	5.00E-01 - 5.60E-01	7.30E-02	NA	2.30E+00	N	NA	NA	BSL
7439-89-6	Iron	3.07E+03	J	1.44E+04	J	mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	8.80E+00 - 1.00E+01	1.44E+04	NA	5.50E+03	N	NA	NA	ASL
7439-92-1	Lead	1.50E+00		3.00E+00		mg/kg	LDA-SB-112-4.5_10/31/2017	3/4	4.50E-01 - 5.40E-01	3.00E+00	NA	4.00E+02	G	NA	NA	BSL
7439-95-4	Magnesium	1.25E+02	J	6.69E+02		mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	4.40E+02 - 5.00E+02	6.69E+02	NA	NA	NA	NA	NA	NUT
7439-96-5	Manganese	3.35E+01	J	4.53E+02	J	mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	1.30E+00 - 1.50E+00	4.53E+02	NA	1.80E+02	N	NA	NA	ASL
7439-97-6	Mercury	1.10E-02	LJ	1.80E-02	LJ	mg/kg	LDA-SB-109-4.5_10/31/2017	2/4	1.20E-01 - 1.30E-01	1.80E-02	NA	2.30E+00	N	NA	NA	BSL
7440-02-0	Nickel	5.10E-01		4.40E+00		mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	4.50E-01 - 9.40E-01	4.40E+00	NA	1.50E+02	N	NA	NA	BSL
7440-09-7	Potassium	3.16E+02	J	1.34E+03		mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	4.40E+02 - 5.00E+02	1.34E+03	NA	NA	NA	NA	NA	NUT
7440-23-5	Sodium	1.67E+01	LJ	3.29E+01	J	mg/kg	LDA-SB-112-4.5_10/31/2017	2/4	4.40E+02 - 5.00E+02	3.29E+01	NA	NA	NA	NA	NA	NUT
7440-62-2	Vanadium	2.40E+00		2.18E+01	J	mg/kg	LDA-SB-112-4.5_10/31/2017	4/4	2.20E+00 - 4.70E+00	2.18E+01	NA	3.90E+01	N	NA	NA	BSL
7440-66-6	Zinc	1.80E+00		4.00E+00		mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	8.90E-01 - 1.90E+00	4.00E+00	NA	2.30E+03	N	NA	NA	BSL

TABLE 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - LOADING DOCK AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Loading Dock Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/ TBC Value	Potential ARAR/ TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PAHS																
91-57-6	2-Methylnaphthalene	1.90E-03	J	9.00E+00		mg/kg	LDA-SB-111-3.0-D_10/31/2017	4/4	1.80E-01 - 7.50E-01	9.00E+00	NA	2.40E+01 N	NA	NA	No	BSL
83-32-9	Acenaphthene	1.70E-01	LJ	2.60E-01	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	3/4	1.80E-01 - 2.00E-01	2.60E-01	NA	3.60E+02 N	NA	NA	No	BSL
208-96-8	Acenaphthylene	2.80E-02		2.80E-02		mg/kg	LDA-SB-135-3.0_10/31/2017	1/4	3.50E-03 - 2.00E-01	2.80E-02	NA	3.60E+02 N	NA	NA	No	BSL
120-12-7	Anthracene	1.20E-01	LJ	1.40E-01	J	mg/kg	LDA-SB-135-3.0_10/31/2017	3/4	1.80E-01 - 2.00E-01	1.40E-01	NA	1.80E+03 N	NA	NA	No	BSL
56-55-3	Benzo (a) anthracene	4.70E-03		1.00E-01	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	4/4	1.80E-01 - 2.00E-01	1.00E-01	NA	1.10E+00 C	NA	NA	No	BSL
50-32-8	Benzo (a) pyrene	2.30E-03	J	5.90E-02	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	4/4	1.80E-01 - 2.00E-01	5.90E-02	NA	1.10E-01 C	NA	NA	No	BSL
205-99-2	Benzo (b) fluoranthene	5.00E-03		6.50E-02	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	4/4	3.90E-03 - 1.90E-01	6.50E-02	NA	1.10E+00 C	NA	NA	No	BSL
191-24-2	Benzo (g,h,i) perylene	2.60E-03	J	2.00E-02	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	2/4	3.50E-03 - 2.00E-01	2.00E-02	NA	1.80E+02 N	NA	NA	No	BSL
207-08-9	Benzo (k) fluoranthene	2.50E-03	J	1.00E-02	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	2/4	3.50E-03 - 2.00E-01	1.00E-02	NA	1.10E+01 C	NA	NA	No	BSL
218-01-9	Chrysene	1.80E-02		1.80E-01	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	4/4	3.90E-03 - 1.90E-01	1.80E-01	NA	1.10E+02 C	NA	NA	No	BSL
53-70-3	Dibenz (a,h) anthracene	2.00E-03	J	3.50E-03	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	2/4	3.50E-03 - 1.90E-01	3.50E-03	NA	1.10E-01 C	NA	NA	No	BSL
206-44-0	Fluoranthene	4.80E-03		1.50E-01	LJ	mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	1.80E-02 - 3.90E-01	1.50E-01	NA	2.40E+02 N	NA	NA	No	BSL
86-73-7	Fluorene	3.10E-01		3.50E-01		mg/kg	LDA-SB-109-4.5_10/31/2017	3/4	1.80E-01 - 2.00E-01	3.50E-01	NA	2.40E+02 N	NA	NA	No	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	2.30E-03	J	1.30E-02	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	2/4	3.50E-03 - 2.00E-01	1.30E-02	NA	1.10E+00 C	NA	NA	No	BSL
91-20-3	Naphthalene	3.50E-01		2.70E+00		mg/kg	LDA-SB-111-3.0-D_10/31/2017	3/4	1.80E-01 - 2.00E-01	2.70E+00	NA	3.80E+00 C	NA	NA	No	BSL
85-01-8	Phenanthrene	9.30E-03		7.40E-01		mg/kg	LDA-SB-109-4.5_10/31/2017	4/4	3.90E-03 - 1.90E-01	7.40E-01	NA	1.80E+02 N	NA	NA	No	BSL
129-00-0	Pyrene	3.90E-01		1.30E+00	J+	mg/kg	LDA-SB-135-3.0_10/31/2017	3/4	1.80E-01 - 2.00E-01	1.30E+00	NA	1.80E+02 N	NA	NA	No	BSL
SVOCS																
98-86-2	Acetophenone	7.90E-02	LJ	7.90E-02	LJ	mg/kg	LDA-SB-109-4.5_10/31/2017	1/4	3.50E-01 - 3.90E-01	7.90E-02	NA	7.80E+02 N	NA	NA	No	BSL
132-64-9	Dibenzofuran	5.80E-02	LJ	6.70E-02	LJ	mg/kg	LDA-SB-111-3.0-D_10/31/2017	2/4	1.80E-01 - 2.00E-01	6.70E-02	NA	7.30E+00 N	NA	NA	No	BSL
108-87-2	Methylcyclohexane	5.90E+00		5.90E+00		mg/kg	LDA-SB-135-3.0_10/31/2017	1/1	1.20E+00 - 1.20E+00	5.90E+00	NA	6.50E+02 N	NA	NA	No	BSL
VOCS																
110-82-7	Cyclohexane	2.10E+00		2.10E+00		mg/kg	LDA-SB-135-3.0_10/31/2017	1/1	1.20E+00 - 1.20E+00	2.10E+00	NA	6.50E+02 N	NA	NA	No	BSL
100-41-4	Ethylbenzene	1.40E-01	J	1.40E-01	J	mg/kg	LDA-SB-135-3.0_10/31/2017	1/1	1.20E+00 - 1.20E+00	1.40E-01	NA	5.80E+00 C	NA	NA	No	BSL
98-82-8	Isopropylbenzene	1.10E-01	J	1.10E-01	J	mg/kg	LDA-SB-135-3.0_10/31/2017	1/1	1.20E+00 - 1.20E+00	1.10E-01	NA	1.90E+02 N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Surrogates used: Mercuric Chloride for Mercury, Chromium (III) Insoluble Salts for Chromium, Pyrene for Benzo (g,h,i) perylene and Phenanthrene.

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
Metals																	
7429-90-5	Aluminum	9.14E+02		1.90E+04	J	mg/kg	WPA-SB-33-2.0_04/18/2017	102/102	9.90E+00 - 2.32E+01	1.90E+04	5.01E+03	7.70E+03	N	NA	NA	Yes	ASL
7440-36-0	Antimony	5.00E-01		1.30E+00	J	mg/kg	WPA-SB-21-0.5_04/18/2017	6/102	5.00E-01 - 1.20E+00	1.30E+00	NA	3.10E+00	N	NA	NA	No	BSL
7440-38-2	Arsenic	6.40E-01		2.09E+01		mg/kg	WPA-SB-32-2.0_04/19/2017	102/102	3.70E-01 - 6.00E-01	2.09E+01	2.30E+00	6.80E-01	C	NA	NA	Yes	ASL
7440-39-3	Barium	9.20E+00		2.07E+02		mg/kg	WPA-SB-47-2.0_04/25/2017	102/102	1.00E+00 - 6.00E+00	2.07E+02	5.15E+01	1.50E+03	N	NA	NA	No	BSL
7440-41-7	Beryllium	1.30E-01	J	1.30E+00		mg/kg	WPA-SB-19-2.0_04/26/2017	60/102	3.70E-01 - 6.00E-01	1.30E+00	2.10E-01	1.60E+01	N	NA	NA	No	BSL
7440-43-9	Cadmium	4.40E-02	J	1.30E+01		mg/kg	WPA-SB-21-2.0_04/18/2017	81/102	3.70E-01 - 6.00E-01	1.30E+01	NA	7.10E+00	N	NA	NA	Yes	ASL
7440-70-2	Calcium	4.48E+02		7.21E+04		mg/kg	WPA-SB-01-0.5_04/17/2017	99/102	1.47E+01 - 1.82E+03	7.21E+04	3.66E+02		NA	NA	NA	No	NUT
7440-47-3	Chromium	2.30E+00		1.49E+01		mg/kg	WPA-SB-15-0.5_04/12/2017	102/102	7.30E-01 - 1.20E+00	1.49E+01	7.10E+00	1.20E+04	N	NA	NA	No	BSL
18540-29-9	Chromium, Hexavalent	5.40E-01		1.30E+00		mg/kg	WPA-SB-22-0.5_04/18/2017	5/6	4.20E-01 - 4.70E-01	1.30E+00	NA	3.00E-01	C	NA	NA	Yes	ASL
7440-48-4	Cobalt	8.10E-01		2.25E+01		mg/kg	WPA-SB-47-2.0_04/25/2017	92/102	3.70E-01 - 2.20E+00	2.25E+01	1.11E+01	2.30E+00	N	NA	NA	Yes	ASL
7440-50-8	Copper	1.90E+00		7.49E+03		mg/kg	WPA-SB-28-0.5_04/26/2017	101/102	7.30E-01 - 2.20E+00	7.49E+03	3.24E+00	3.10E+02	N	NA	NA	Yes	ASL
57-12-5	Cyanide	9.00E-03	J	1.80E-01	J	mg/kg	WPA-SB-33-0.5_04/18/2017	32/87	3.10E-01 - 2.70E+00	1.80E-01	1.68E-01	2.30E+00	N	NA	NA	No	BSL
7439-89-6	Iron	3.58E+03		4.75E+04		mg/kg	WPA-SB-27-0.5_04/19/2017	102/102	2.50E+00 - 1.83E+01	4.75E+04	1.47E+04	5.50E+03	N	NA	NA	Yes	ASL
7439-92-1	Lead	3.00E+00		1.90E+04		mg/kg	WPA-SB-15-0.5_04/12/2017	102/102	3.70E-01 - 8.26E+01	1.90E+04	9.19E+00	4.00E+02	G	NA	NA	Yes	ASL
7439-95-4	Magnesium	1.28E+02		3.30E+04		mg/kg	WPA-SB-01-0.5_04/17/2017	99/102	1.48E+01 - 5.81E+02	3.30E+04	4.02E+02		NA	NA	NA	No	NUT
7439-96-5	Manganese	3.16E+01		1.42E+03	J	mg/kg	WPA-SB-32-0.5_04/19/2017	102/102	5.00E-01 - 2.90E+00	1.42E+03	5.06E+02	1.80E+02	N	NA	NA	Yes	ASL
7439-97-6	Mercury	1.40E-02	J	2.00E+00		mg/kg	WPA-SB-34-0.5_04/18/2017	53/102	5.70E-02 - 1.40E-01	2.00E+00	3.80E-02	2.30E+00	N	NA	NA	No	BSL
7440-02-0	Nickel	1.80E+00		4.07E+01		mg/kg	WPA-SB-24-0.5_04/18/2017	102/102	3.70E-01 - 2.20E+00	4.07E+01	5.60E+00	1.50E+02	N	NA	NA	No	BSL
7440-09-7	Potassium	1.35E+02	JL	3.14E+03	J	mg/kg	WPA-SB-41-0.5_04/20/2017	100/102	9.88E+01 - 5.81E+02	3.14E+03	6.42E+02		NA	NA	NA	No	NUT
7782-49-2	Selenium	1.90E-01	JL	1.10E+00		mg/kg	WPA-SB-22-2.0_04/18/2017	18/102	1.00E+00 - 3.00E+00	1.10E+00	NA	3.90E+01	N	NA	NA	No	BSL
7440-22-4	Silver	2.10E-02	JL	2.30E-01	J	mg/kg	WPA-SB-17-0.5_04/19/2017	22/102	3.70E-01 - 1.10E+00	2.30E-01	NA	3.90E+01	N	NA	NA	No	BSL
7440-23-5	Sodium	1.06E+01	J	3.14E+02	J	mg/kg	WPA-SB-19-2.0_04/26/2017	48/102	4.94E+01 - 5.81E+02	3.14E+02	1.16E+01		NA	NA	NA	No	NUT
7440-28-0	Thallium	1.50E-02	JL	4.80E-01	J	mg/kg	WPA-SB-21-0.5_04/18/2017	29/102	3.70E-01 - 6.00E-01	4.80E-01	NA	7.80E-02	N	NA	NA	Yes	ASL
7440-62-2	Vanadium	4.50E+00		7.92E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	102/102	1.80E+00 - 3.00E+00	7.92E+01	1.12E+01	3.90E+01	N	NA	NA	Yes	ASL
7440-66-6	Zinc	3.80E+00		3.96E+03	J	mg/kg	WPA-SB-21-2.0_04/18/2017	102/102	7.30E-01 - 5.30E+00	3.96E+03	1.42E+01	2.30E+03	N	NA	NA	Yes	ASL

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PAHS																
91-57-6	2-Methylnaphthalene	1.80E-03	J	3.00E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	71/102	1.80E-03 - 5.60E+00	3.00E+01	NA	2.40E+01	N	NA	Yes	ASL
83-32-9	Acenaphthene	7.90E-04	J	2.50E+00		mg/kg	WPA-SB-09-2.0_04/24/2017	22/102	1.80E-03 - 5.60E+00	2.50E+00	NA	3.60E+02	N	NA	No	BSL
208-96-8	Acenaphthylene	1.40E-03	JL	1.20E-01	J	mg/kg	WPA-SB-41-2.0_04/20/2017	22/102	1.80E-03 - 5.60E+00	1.20E-01	NA	3.60E+02	N	NA	No	BSL
120-12-7	Anthracene	1.00E-03	J	2.50E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	72/102	1.80E-03 - 5.60E+00	2.50E+01	NA	1.80E+03	N	NA	No	BSL
56-55-3	Benzo (a) anthracene	8.60E-04	J	4.40E+01		mg/kg	WPA-SB-18-2.0_04/19/2017	82/102	1.80E-03 - 5.00E+01	4.40E+01	NA	1.10E+00	C	NA	Yes	ASL
50-32-8	Benzo (a) pyrene	1.20E-03	J	3.10E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	82/102	1.80E-03 - 5.60E+00	3.10E+01	NA	1.10E-01	C	NA	Yes	ASL
205-99-2	Benzo (b) fluoranthene	1.20E-03	J	3.50E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	83/102	1.80E-03 - 5.60E+00	3.50E+01	NA	1.10E+00	C	NA	Yes	ASL
191-24-2	Benzo (g,h,i) perylene	5.90E-04	JL	9.10E+00		mg/kg	WPA-SB-20-2.0_04/19/2017	87/102	1.80E-03 - 5.60E+00	9.10E+00	NA	1.80E+02	N	NA	No	BSL
207-08-9	Benzo (k) fluoranthene	8.00E-04	JL	4.20E+00	JL	mg/kg	WPA-SB-20-2.0_04/19/2017	57/100	1.80E-03 - 5.60E+00	4.20E+00	NA	1.10E+01	C	NA	No	BSL
218-01-9	Chrysene	1.50E-03	JL	1.20E+02	J	mg/kg	WPA-SB-18-2.0_04/19/2017	89/102	1.90E-03 - 5.00E+01	1.20E+02	NA	1.10E+02	C	NA	Yes	ASL
53-70-3	Dibenz (a,h) anthracene	1.30E-03	JL	5.90E+00		mg/kg	WPA-SB-20-2.0_04/19/2017	52/102	1.80E-03 - 5.60E+00	5.90E+00	NA	1.10E-01	C	NA	Yes	ASL
206-44-0	Fluoranthene	4.80E-04	J	6.20E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	86/102	1.80E-03 - 1.10E+01	6.20E+01	NA	2.40E+02	N	NA	No	BSL
86-73-7	Fluorene	1.50E-03	J+	3.30E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	39/102	1.80E-03 - 5.60E+00	3.30E+01	NA	2.40E+02	N	NA	No	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	4.10E-04	J	5.70E+00		mg/kg	WPA-SB-20-2.0_04/19/2017	78/102	1.80E-03 - 5.60E+00	5.70E+00	NA	1.10E+00	C	NA	Yes	ASL
91-20-3	Naphthalene	8.60E-04	JL	8.50E+00		mg/kg	WPA-SB-20-2.0_04/19/2017	57/102	1.80E-03 - 5.60E+00	8.50E+00	NA	3.80E+00	C	NA	Yes	ASL
85-01-8	Phenanthrene	1.00E-03	JL	1.60E+02	J	mg/kg	WPA-SB-18-2.0_04/19/2017	89/102	1.90E-03 - 5.00E+01	1.60E+02	NA	1.80E+02	N	NA	No	BSL
129-00-0	Pyrene	9.00E-04	J	1.20E+02	J	mg/kg	WPA-SB-18-2.0_04/19/2017	91/102	1.80E-03 - 5.00E+01	1.20E+02	NA	1.80E+02	N	NA	No	BSL
SVOCS																
92-52-4	1,1'-Biphenyl	1.80E-03	J	9.70E-01		mg/kg	WPA-SB-09-2.0_04/24/2017	35/102	1.80E-03 - 5.60E+00	9.70E-01	NA	4.70E+00	N	NA	No	BSL
58-90-2	2,3,4,6-Tetrachlorophenol	4.80E-02	J	4.80E-02	J	mg/kg	WPA-SB-30-0.5_04/19/2017	1/102	1.80E-01 - 5.60E+00	4.80E-02	NA	1.90E+02	N	NA	No	BSL
105-67-9	2,4-Dimethylphenol	3.80E-02	J	1.20E-01	J	mg/kg	WPA-SB-13-2.0_04/13/2017, WPA-SB-13-0.5_04/13/2017	4/102	1.80E-01 - 5.60E+00	1.20E-01	NA	1.30E+02	N	NA	No	BSL
95-48-7	2-Methylphenol	3.00E-02	J	3.00E-02	J	mg/kg	WPA-SB-10-2.0_04/20/2017	1/102	3.50E-01 - 1.10E+01	3.00E-02	NA	3.20E+02	N	NA	No	BSL
106-47-8	4-Chloroaniline	1.60E-02		1.60E-02		mg/kg	WPA-SB-26-2.0_04/18/2017	1/102	3.50E-03 - 1.10E+01	1.60E-02	NA	2.70E+00	C	NA	No	BSL
106-44-5	4-Methylphenol	3.00E-02	J	1.50E-01	J	mg/kg	WPA-SB-72-0.5_12/05/2018	2/102	3.50E-01 - 1.10E+01	1.50E-01	NA	6.30E+02	N	NA	No	BSL
98-86-2	Acetophenone	3.00E-02	J	9.00E-02	J	mg/kg	WPA-SB-02-2.0_04/18/2017	3/102	3.50E-01 - 1.10E+01	9.00E-02	NA	7.80E+02	N	NA	No	BSL
108-60-1	Bis(2-chloro-1-methylethyl)ether	7.40E-03	J	1.30E-02	J	mg/kg	WPA-SB-12-0.5_04/24/2017	3/102	3.50E-03 - 1.10E+01	1.30E-02	NA	3.10E+02	N	NA	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	4.10E-02	JL	5.00E-01	J	mg/kg	WPA-SB-32-0.5_04/19/2017	2/102	1.80E-01 - 5.60E+00	5.00E-01	NA	3.90E+01	C	NA	No	BSL
86-74-8	Carbazole	3.00E-02	J	4.00E+01		mg/kg	WPA-SB-20-2.0_04/19/2017	17/102	3.50E-01 - 1.10E+01	4.00E+01	NA	NA	NA	NA	No	BSL
132-64-9	Dibenzofuran	1.30E-03	JL	1.10E+00		mg/kg	WPA-SB-09-2.0_04/24/2017	26/102	1.80E-03 - 5.60E+00	1.10E+00	NA	7.30E+00	N	NA	No	BSL
131-11-3	Dimethyl phthalate	7.60E-02	J	2.80E-01		mg/kg	WPA-SB-71-2.0_11/30/2018	14/102	1.80E-01 - 5.60E+00	2.80E-01	NA	NA	NA	NA	No	BSL
84-74-2	Di-n-butyl phthalate	5.50E-02	J	5.50E-02	J	mg/kg	WPA-SB-32-0.5_04/19/2017	1/102	1.80E-01 - 5.60E+00	5.50E-02	NA	6.30E+02	N	NA	No	BSL
67-72-1	Hexachloroethane	6.40E-03		6.40E-03		mg/kg	WPA-SB-52-0.5_04/27/2017	1/102	3.50E-03 - 5.60E+00	6.40E-03	NA	1.80E+00	C	NA	No	BSL
98-95-3	Nitrobenzene	3.10E-03	J	3.10E-03	J	mg/kg	WPA-SB-52-0.5_04/27/2017	1/102	3.50E-03 - 5.60E+00	3.10E-03	NA	5.10E+00	C	NA	No	BSL
86-30-6	N-Nitrosodiphenylamine	8.10E-02	JL	8.10E-02	JL	mg/kg	WPA-SB-20-0.5_04/19/2017	1/102	1.80E-01 - 5.60E+00	8.10E-02	NA	1.10E+02	C	NA	No	BSL
87-86-5	Pentachlorophenol	7.20E-03		2.00E-01		mg/kg	WPA-SB-30-0.5_04/19/2017	2/102	3.50E-03 - 1.10E+01	2.00E-01	NA	1.00E+00	C	NA	No	BSL
108-95-2	Phenol	8.00E-02	J	2.40E-01	J	mg/kg	WPA-SB-72-0.5_12/05/2018	14/102	3.50E-01 - 1.10E+01	2.40E-01	NA	1.90E+03	N	NA	No	BSL

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening ⁽²⁾	Background Value ⁽³⁾	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
VOCS																
123-91-1	1,4-Dioxane	7.70E-04	J	7.70E-04	J	mg/kg	WPA-SB-26-2.0_04/18/2017	1/102	3.50E-03 - 2.20E+00	7.70E-04	NA	5.30E+00 C	NA	NA	No	BSL
460-00-4	4-Bromofluorobenzene	3.96E-02		4.10E-02		mg/kg	WPA-SB-19-2.0_04/26/2017	3/3	4.40E-03 - 5.30E-03	4.10E-02	NA	2.30E+00 N	NA	NA	No	BSL
67-64-1	Acetone	2.59E-02		2.59E-02		mg/kg	WPA-SB-01-2.0_04/17/2017	1/4	8.80E-03 - 1.06E-02	2.59E-02	NA	6.10E+03 N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: B = Indicates analyte detected in associated method blank

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 2.8
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Wilcox Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Metals																
7429-90-5	Aluminum	1.19E+03		1.79E+04	J	mg/kg	WPA-SB-33-5.0_04/18/2017	96/96	9.70E+00 - 2.28E+01	1.79E+04	NA	7.70E+03	N	NA	NA	ASL
7440-38-2	Arsenic	9.00E-01		2.03E+01		mg/kg	WPA-SB-72-10.0_12/05/2018	96/96	3.70E-01 - 6.00E-01	2.03E+01	NA	6.80E-01	C	NA	NA	ASL
7440-39-3	Barium	1.23E+01		2.20E+02		mg/kg	WPA-SB-25-3.0_04/12/2017	96/96	1.00E+00 - 5.80E+00	2.20E+02	NA	1.50E+03	N	NA	NA	BSL
7440-41-7	Beryllium	1.50E-01	J	2.00E+00		mg/kg	WPA-SB-19-6.0_04/26/2017	80/96	3.70E-01 - 6.00E-01	2.00E+00	NA	1.60E+01	N	NA	NA	BSL
7440-43-9	Cadmium	3.70E-02	J	2.30E+00		mg/kg	WPA-SB-09-14.5_04/24/2017	40/96	3.70E-01 - 6.00E-01	2.30E+00	NA	7.10E+00	N	NA	NA	BSL
7440-70-2	Calcium	1.61E+02		6.60E+03		mg/kg	WPA-SB-33-5.0_04/18/2017	95/96	1.45E+01 - 5.71E+02	6.60E+03	NA			NA	NA	NUT
7440-47-3	Chromium	3.30E+00		2.64E+01		mg/kg	WPA-SB-10-10.0_04/20/2017	96/96	7.40E-01 - 1.20E+00	2.64E+01	NA	1.20E+04	N	NA	NA	BSL
7440-48-4	Cobalt	1.40E+00		3.26E+01		mg/kg	WPA-SB-06-8.0_04/12/2017	92/96	3.70E-01 - 2.20E+00	3.26E+01	NA	2.30E+00	N	NA	NA	ASL
7440-50-8	Copper	2.30E+00		2.03E+01		mg/kg	WPA-SB-22-6.0_04/18/2017	96/96	7.40E-01 - 2.20E+00	2.03E+01	NA	3.10E+02	N	NA	NA	BSL
57-12-5	Cyanide	9.00E-03	J	1.50E-01	J	mg/kg	WPA-SB-44-6.0_04/20/2017	23/85	3.60E-01 - 6.10E-01	1.50E-01	NA	2.30E+00	N	NA	NA	BSL
7439-89-6	Iron	2.98E+03		7.23E+04		mg/kg	WPA-SB-72-10.0_12/05/2018	96/96	2.40E+00 - 3.03E+01	7.23E+04	NA	5.50E+03	N	NA	NA	ASL
7439-92-1	Lead	1.90E+00	J	9.21E+02		mg/kg	WPA-SB-15-6.0_04/12/2017	95/96	3.70E-01 - 7.90E+00	9.21E+02	NA	4.00E+02	G	NA	NA	ASL
7439-95-4	Magnesium	1.14E+02		3.28E+03		mg/kg	WPA-SB-33-5.0_04/18/2017	95/96	1.45E+01 - 5.71E+02	3.28E+03	NA			NA	NA	NUT
7439-96-5	Manganese	4.06E+01		3.77E+03		mg/kg	WPA-SB-06-8.0_04/12/2017	96/96	5.00E-01 - 1.28E+01	3.77E+03	NA	1.80E+02	N	NA	NA	ASL
7439-97-6	Mercury	9.10E-03	JL	1.40E-01		mg/kg	WPA-SB-32-6.0_04/19/2017	19/96	5.60E-02 - 1.40E-01	1.40E-01	NA	2.30E+00	N	NA	NA	BSL
7440-02-0	Nickel	2.40E+00		5.17E+01		mg/kg	WPA-SB-28-10.0_04/26/2017	95/96	3.70E-01 - 2.20E+00	5.17E+01	NA	1.50E+02	N	NA	NA	BSL
7440-09-7	Potassium	1.66E+02		4.68E+03		mg/kg	WPA-SB-72-10.0_12/05/2018	96/96	9.68E+01 - 5.71E+02	4.68E+03	NA			NA	NA	NUT
7782-49-2	Selenium	1.80E-01	J	1.10E+00	JL	mg/kg	WPA-SB-72-10.0_12/05/2018	16/96	1.00E+00 - 2.90E+00	1.10E+00	NA	3.90E+01	N	NA	NA	BSL
7440-22-4	Silver	3.90E-02	JL	9.20E-02	J	mg/kg	WPA-SB-15-10.0_04/12/2017	18/96	3.70E-01 - 1.10E+00	9.20E-02	NA	3.90E+01	N	NA	NA	BSL
7440-23-5	Sodium	9.40E+00		9.68E+02		mg/kg	WPA-SB-41-8.0_04/20/2017	55/96	4.84E+01 - 5.71E+02	9.68E+02	NA			NA	NA	NUT
7440-28-0	Thallium	2.30E-02	JL	7.30E-02	J	mg/kg	WPA-SB-48-6.0_04/27/2017	38/96	3.70E-01 - 6.00E-01	7.30E-02	NA	7.80E-02	N	NA	NA	BSL
7440-62-2	Vanadium	5.00E+00		4.02E+01		mg/kg	WPA-SB-10-10.0_04/20/2017	96/96	1.90E+00 - 2.90E+00	4.02E+01	NA	3.90E+01	N	NA	NA	ASL
7440-66-6	Zinc	3.40E+00		1.05E+02		mg/kg	WPA-SB-02-6.0_04/18/2017	96/96	7.40E-01 - 2.20E+00	1.05E+02	NA	2.30E+03	N	NA	NA	BSL
PAHS																
91-57-6	2-Methylnaphthalene	1.00E-03	J	1.40E+02	J	mg/kg	WPA-SB-14-10.0_04/12/2017	51/95	1.80E-03 - 1.10E+01	1.40E+02	NA	2.40E+01	N	NA	NA	ASL
83-32-9	Acenaphthene	2.70E-03	J	2.10E+00		mg/kg	WPA-SB-14-10.0_04/12/2017	17/95	1.90E-03 - 2.20E+00	2.10E+00	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	1.70E-03	J	4.40E-01		mg/kg	WPA-SB-14-10.0_04/12/2017	5/95	1.90E-03 - 2.20E+00	4.40E-01	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	1.80E-03	J	2.00E+01	J	mg/kg	WPA-SB-20-6.0_04/19/2017	39/95	1.80E-03 - 2.00E+00	2.00E+01	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	8.90E-04	J	2.20E+01		mg/kg	WPA-SB-20-6.0_04/19/2017	49/95	1.80E-03 - 5.90E+00	2.20E+01	NA	1.10E+00	C	NA	NA	ASL
50-32-8	Benzo (a) pyrene	8.20E-04	J	2.40E+01	J	mg/kg	WPA-SB-20-6.0_04/19/2017	46/95	1.80E-03 - 5.90E+00	2.40E+01	NA	1.10E-01	C	NA	NA	ASL
205-99-2	Benzo (b) fluoranthene	1.50E-03	J	2.70E+01	J	mg/kg	WPA-SB-20-6.0_04/19/2017	41/95	1.90E-03 - 5.90E+00	2.70E+01	NA	1.10E+00	C	NA	NA	ASL
191-24-2	Benzo (g,h,i) perylene	4.80E-04	J	6.40E+00	J	mg/kg	WPA-SB-20-6.0_04/19/2017	48/95	1.80E-03 - 2.00E+00	6.40E+00	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	9.60E-04	J	2.80E+00	J	mg/kg	WPA-SB-20-6.0_04/19/2017	18/95	1.80E-03 - 2.20E+00	2.80E+00	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	9.30E-04	J	5.40E+01		mg/kg	WPA-SB-20-6.0_04/19/2017	56/95	1.80E-03 - 5.90E+00	5.40E+01	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	9.30E-04	J	4.00E+00	J	mg/kg	WPA-SB-20-6.0_04/19/2017	28/95	1.90E-03 - 2.20E+00	4.00E+00	NA	1.10E-01	C	NA	NA	ASL
206-44-0	Fluoranthene	8.50E-04	J	5.10E+01	J	mg/kg	WPA-SB-20-6.0_04/19/2017	41/95	1.80E-03 - 7.60E+00	5.10E+01	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	1.30E-03	J	2.30E+01		mg/kg	WPA-SB-20-6.0_04/19/2017	33/95	1.90E-03 - 2.00E+00	2.30E+01	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	4.80E-04	J	4.00E+00	J	mg/kg	WPA-SB-20-6.0_04/19/2017	37/95	1.80E-03 - 2.00E+00	4.00E+00	NA	1.10E+00	C	NA	NA	ASL
91-20-3	Naphthalene	1.10E-03	J	6.70E+01		mg/kg	WPA-SB-14-10.0_04/12/2017	44/95	1.80E-03 - 5.90E+00	6.70E+01	NA	3.80E+00	C	NA	NA	ASL
85-01-8	Phenanthrene	1.30E-03	J	1.50E+02	J	mg/kg	WPA-SB-20-6.0_04/19/2017	56/95	1.80E-03 - 1.70E+01	1.50E+02	NA	1.80E+02	N	NA	NA	BSL
129-00-0	Pyrene	1.20E-03	J	6.10E+01		mg/kg	WPA-SB-20-6.0_04/19/2017	54/95	1.80E-03 - 5.90E+00	6.10E+01	NA	1.80E+02	N	NA	NA	BSL

TABLE 2.8
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Wilcox Process Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
SVOCs																
92-52-4	1,1'-Biphenyl	7.00E-04	J	4.90E-01	JL	mg/kg	WPA-SB-20-6.0_04/19/2017	12/95	1.90E-03 - 2.20E+00	4.90E-01	NA	4.70E+00	N	NA	NA	BSL
105-67-9	2,4-Dimethylphenol	5.10E-02	J	1.20E-01	J	mg/kg	WPA-SB-13-10.0_04/12/2017	3/95	1.80E-01 - 2.20E+00	1.20E-01	NA	1.30E+02	N	NA	NA	BSL
95-48-7	2-Methylphenol	1.00E-01	J	2.20E-01	J	mg/kg	WPA-SB-13-10.0_04/12/2017	3/95	3.40E-01 - 4.20E+00	2.20E-01	NA	3.20E+02	N	NA	NA	BSL
106-44-5	4-Methylphenol	7.30E-02	J	1.20E-01	J	mg/kg	WPA-SB-13-10.0_04/12/2017	3/95	3.40E-01 - 4.20E+00	1.20E-01	NA	6.30E+02	N	NA	NA	BSL
98-86-2	Acetophenone	2.10E-01	J	2.10E-01	J	mg/kg	WPA-SB-02-12.0_04/18/2017	1/95	3.40E-01 - 4.20E+00	2.10E-01	NA	7.80E+02	N	NA	NA	BSL
108-60-1	Bis(2-chloro-1-methylethyl)ether	1.90E-03	JL	3.30E-03	J	mg/kg	WPA-SB-25-3.0_04/12/2017	2/95	3.70E-03 - 4.20E+00	3.30E-03	NA	3.10E+02	N	NA	NA	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	2.30E-02	J	4.00E-01		mg/kg	WPA-SB-52-6.0_04/27/2017	2/95	1.80E-01 - 2.20E+00	4.00E-01	NA	3.90E+01	C	NA	NA	BSL
86-74-8	Carbazole	7.50E-02	J	3.10E+01		mg/kg	WPA-SB-20-6.0_04/19/2017	6/95	3.40E-01 - 4.20E+00	3.10E+01	NA			NA	NA	BSL
132-64-9	Dibenzofuran	1.00E-03	J	4.50E+00		mg/kg	WPA-SB-20-6.0_04/19/2017	17/95	1.90E-03 - 2.00E+00	4.50E+00	NA	7.30E+00	N	NA	NA	BSL
84-66-2	Diethyl phthalate	9.30E-02	J	9.30E-02	J	mg/kg	WPA-SB-32-10.0_04/19/2017	1/95	1.80E-01 - 2.20E+00	9.30E-02	NA	5.10E+03	N	NA	NA	BSL
131-11-3	Dimethyl phthalate	8.70E-02	J	4.50E-01		mg/kg	WPA-SB-72-10.0_12/05/2018	13/95	1.80E-01 - 2.20E+00	4.50E-01	NA			NA	NA	BSL
108-87-2	Methylcyclohexane	4.70E-03		9.54E+01		mg/kg	WPA-SB-02-10.0_04/18/2017	20/34	4.40E-03 - 5.60E+00	9.54E+01	NA	6.50E+02	N	NA	NA	BSL
98-95-3	Nitrobenzene	1.20E-03	J		J	mg/kg	WPA-SB-12-6.0_04/24/2017	2/95	3.70E-03 - 2.20E+00	1.50E-03	NA	5.10E+00	C	NA	NA	BSL
87-86-5	Pentachlorophenol	8.30E-03		8.30E-03		mg/kg	WPA-SB-30-6.0_04/19/2017	1/95	3.60E-03 - 4.20E+00	8.30E-03	NA	1.00E+00	C	NA	NA	BSL
108-95-2	Phenol	6.50E-02	J	2.60E-01	J	mg/kg	WPA-SB-75-10.5_12/05/2018	15/95	3.40E-01 - 4.20E+00	2.60E-01	NA	1.90E+03	N	NA	NA	BSL
VOCs																
78-93-3	2-Butanone	8.20E-03		3.45E-02	B	mg/kg	WPA-SB-05-10.0_04/24/2017	6/34	4.40E-03 - 1.10E+01	3.45E-02	NA	2.70E+03	N	NA	NA	BSL
460-00-4	4-Bromofluorobenzene	3.47E-02		2.76E-01		mg/kg	WPA-SB-09-10.0_04/24/2017	28/28	1.80E-03 - 2.98E-02	2.76E-01	NA	2.30E+00	N	NA	NA	BSL
67-64-1	Acetone	1.29E-02		2.08E-01		mg/kg	WPA-SB-05-10.0_04/24/2017	10/34	8.90E-03 - 1.10E+01	2.08E-01	NA	6.10E+03	N	NA	NA	BSL
71-43-2	Benzene	6.40E-03		4.80E+00	JL	mg/kg	WPA-SB-14-6.0_04/12/2017	10/34	4.40E-03 - 5.60E+00	4.80E+00	NA	1.20E+00	C	NA	NA	Yes ASL
67-66-3	Chloroform	1.00E+01		2.20E+01		mg/kg	WPA-SB-14-6.0_04/12/2017	2/34	4.40E-03 - 5.60E+00	2.20E+01	NA	3.20E-01	C	NA	NA	Yes ASL
110-82-7	Cyclohexane	6.90E-03		3.91E+01		mg/kg	WPA-SB-05-15.0_04/24/2017	16/34	4.40E-03 - 5.60E+00	3.91E+01	NA	6.50E+02	N	NA	NA	BSL
100-41-4	Ethylbenzene	7.20E-03		2.80E+01		mg/kg	WPA-SB-14-6.0_04/12/2017	10/34	4.40E-03 - 5.60E+00	2.80E+01	NA	5.80E+00	C	NA	NA	Yes ASL
98-82-8	Isopropylbenzene	2.75E-02	J	6.64E+00		mg/kg	WPA-SB-02-10.0_04/18/2017	14/34	4.40E-03 - 5.60E+00	6.64E+00	NA	1.90E+02	N	NA	NA	BSL
179601-23-1	m, p-Xylene	2.61E-01		3.40E+01		mg/kg	WPA-SB-14-6.0_04/12/2017	10/34	4.40E-03 - 5.60E+00	3.40E+01	NA	5.80E+01	N	NA	NA	BSL
95-47-6	ortho-Xylene	8.70E-03		4.60E+00	JL	mg/kg	WPA-SB-14-6.0_04/12/2017	9/34	4.40E-03 - 5.60E+00	4.60E+00	NA	6.50E+01	N	NA	NA	BSL
108-88-3	Toluene	1.56E-02		3.80E+00	JL	mg/kg	WPA-SB-14-6.0_04/12/2017	9/34	4.40E-03 - 5.60E+00	3.80E+00	NA	4.90E+02	N	NA	NA	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: B = Indicates analyte detected in associated method blank

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 2.9
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - EAST TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
Metals																	
7429-90-5	Aluminum	1.55E+03		2.42E+04		mg/kg	ETF-SB-158-2.0_12/04/2018	108/108	9.30E+00 - 2.63E+01	2.42E+04	5.01E+03	7.70E+03	N	NA	NA	Yes	ASL
7440-36-0	Antimony	7.20E-02	JL	6.80E-01	J	mg/kg	ETF-SB-131-0.5_11/07/2017	14/108	5.00E-01 - 1.30E+00	6.80E-01	NA	3.10E+00	N	NA	NA	No	BSL
7440-38-2	Arsenic	5.00E-01		1.13E+01		mg/kg	ETF-SB07-119-2.0_11/07/2017	108/108	4.20E-01 - 6.40E-01	1.13E+01	2.30E+00	6.80E-01	C	NA	NA	Yes	ASL
7440-39-3	Barium	6.50E+00		2.83E+02		mg/kg	ETF-SB07-119-2.0_11/07/2017	107/108	9.00E-01 - 6.40E+00	2.83E+02	5.15E+01	1.50E+03	N	NA	NA	No	BSL
7440-41-7	Beryllium	1.00E-01	JL	8.40E-01		mg/kg	ETF-SB-147-2.0_12/03/2018	87/108	4.20E-01 - 6.40E-01	8.40E-01	2.10E-01	1.60E+01	N	NA	NA	No	BSL
7440-43-9	Cadmium	7.10E-02	J/JL	2.50E+00		mg/kg	ETF-SB-02-0.5_11/02/2016	28/108	4.20E-01 - 6.40E-01	2.50E+00	NA	7.10E+00	N	NA	NA	No	BSL
7440-70-2	Calcium	1.08E+02	J	6.15E+04	J	mg/kg	ETF-SB04-19-0.5_10/31/2017	94/108	1.40E+01 - 1.11E+03	6.15E+04	3.66E+02			NA	NA	No	NUT
7440-47-3	Chromium	2.60E+00		2.35E+01	J	mg/kg	ETF-SB-126-2.0_11/06/2017	107/108	8.40E-01 - 1.30E+00	2.35E+01	7.10E+00	1.20E+04	N	NA	NA	No	BSL
7440-48-4	Cobalt	3.50E-01	J	3.05E+01		mg/kg	ETF-SB07-119-2.0_11/07/2017	107/108	4.20E-01 - 2.10E+00	3.05E+01	1.11E+01	2.30E+00	N	NA	NA	Yes	ASL
7440-50-8	Copper	4.80E-01	J	5.85E+01	J-	mg/kg	ETF-SB-131-0.5_11/07/2017	108/108	8.40E-01 - 2.10E+00	5.85E+01	3.24E+00	3.10E+02	N	NA	NA	No	BSL
57-12-5	Cyanide	2.70E-02	J	1.90E-01	J/J	mg/kg	ETF-SB01-16-0.5_10/30/2017, ETF-SB06-115-0.5_11/06/2017	57/65	3.00E-01 - 6.70E-01	1.90E-01	1.68E-01	2.30E+00	N	NA	NA	No	BSL
7439-89-6	Iron	2.03E+03		7.76E+04	J	mg/kg	ETF-SB04-19-0.5_10/31/2017	108/108	2.30E+00 - 2.56E+01	7.76E+04	1.47E+04	5.50E+03	N	NA	NA	Yes	ASL
7439-92-1	Lead	1.00E+00	J	2.73E+03		mg/kg	ETF-SB-136-2.0_11/07/2017	107/108	4.20E-01 - 2.40E+00	2.73E+03	9.19E+00	4.00E+02	G	NA	NA	Yes	ASL
7439-95-4	Magnesium	1.84E+02	J	3.03E+04		mg/kg	ETF-SB04-19-0.5_10/31/2017	91/108	1.40E+01 - 6.58E+02	3.03E+04	4.02E+02			NA	NA	No	NUT
7439-96-5	Manganese	1.40E+01		6.06E+03	J	mg/kg	ETF-SB07-119-2.0_11/07/2017	108/108	4.80E-01 - 1.59E+01	6.06E+03	5.06E+02	1.80E+02	N	NA	NA	Yes	ASL
7439-97-6	Mercury	2.30E-03	JL	2.70E-01		mg/kg	ETF-SB-142-0.5_12/03/2018	42/108	6.20E-02 - 1.60E-01	2.70E-01	3.80E-02	2.30E+00	N	NA	NA	No	BSL
7440-02-0	Nickel	5.70E-02	J	6.15E+01		mg/kg	ETF-SB04-19-0.5_10/31/2017	108/108	4.20E-01 - 2.10E+00	6.15E+01	5.60E+00	1.50E+02	N	NA	NA	No	BSL
7440-09-7	Potassium	2.01E+02		5.17E+03		mg/kg	ETF-SB-158-2.0_12/04/2018	103/108	9.34E+01 - 6.58E+02	5.17E+03	6.42E+02			NA	NA	No	NUT
7782-49-2	Selenium	1.60E-01	J	6.70E-01	JL	mg/kg	ETF-SB-160-2.0_12/03/2018	35/108	9.00E-01 - 3.20E+00	6.70E-01	NA	3.90E+01	N	NA	NA	No	BSL
7440-22-4	Silver	2.20E-02	J	1.10E-01	J	mg/kg	ETF-SB-151-0.5_12/03/2018	10/108	4.20E-01 - 1.10E+00	1.10E-01	NA	3.90E+01	N	NA	NA	No	BSL
7440-23-5	Sodium	1.01E+01	J	1.06E+03		mg/kg	ETF-SB-03-2.0_11/02/2016	52/108	4.67E+01 - 6.58E+02	1.06E+03	1.16E+01			NA	NA	No	NUT
7440-28-0	Thallium	7.60E-02	JL	2.10E-01	JL	mg/kg	ETF-SB07-119-2.0_11/07/2017	3/108	4.20E-01 - 6.40E-01	2.10E-01	NA	7.80E-02	N	NA	NA	Yes	ASL
7440-62-2	Vanadium	3.80E+00		3.31E+01		mg/kg	ETF-SB07-119-2.0_11/07/2017	108/108	1.90E+00 - 3.20E+00	3.31E+01	1.12E+01	3.90E+01	N	NA	NA	No	BSL
7440-66-6	Zinc	7.30E-01	J	9.01E+01		mg/kg	ETF-SB13-120-2.0_11/07/2017	108/108	8.40E-01 - 2.10E+00	9.01E+01	1.42E+01	2.30E+03	N	NA	NA	No	BSL

TABLE 2.9
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - EAST TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection ⁽⁵⁾
PAHS																
90-12-0	1-Methylnaphthalene	5.20E-03		5.20E-03		mg/kg	ETF-SB-137-0.5_11/07/2017	1/2	3.70E-03 - 1.89E-02	5.20E-03	NA	1.80E+01	C	NA	NA	BSL
91-57-6	2-Methylnaphthalene	4.20E-04	JL	3.40E+00	JL	mg/kg	ETF-SB-03-2.0_11/02/2016	38/108	1.90E-03 - 3.80E+00	3.40E+00	NA	2.40E+01	N	NA	NA	BSL
83-32-9	Acenaphthene	1.70E-03	J	2.60E-01		mg/kg	ETF-SB08-123-2.0_11/02/2017	7/108	1.90E-03 - 2.50E-01	2.60E-01	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	6.30E-04	JL	7.70E-02		mg/kg	ETF-SB-03-2.0_11/02/2016	23/108	1.90E-03 - 2.50E-01	7.70E-02	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	3.70E-04	JL	3.40E-01		mg/kg	ETF-SB08-123-2.0_11/02/2017	36/108	1.90E-03 - 2.50E-01	3.40E-01	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	8.30E-04	JL/JL	1.10E+01		mg/kg	ETF-SB-02-0.5_11/02/2016	55/108	1.90E-03 - 1.80E+00	1.10E+01	NA	1.10E+00	C	NA	NA	Yes ASL
50-32-8	Benzo (a) pyrene	9.90E-04	J	1.20E+01		mg/kg	ETF-SB-02-0.5_11/02/2016	57/108	1.90E-03 - 1.80E+00	1.20E+01	NA	1.10E-01	C	NA	NA	Yes ASL
205-99-2	Benzo (b) fluoranthene	8.30E-04	JL	2.00E+01		mg/kg	ETF-SB-02-0.5_11/02/2016	65/108	1.90E-03 - 1.80E+00	2.00E+01	NA	1.10E+00	C	NA	NA	Yes ASL
191-24-2	Benzo (g,h,i) perylene	8.60E-04	J	2.20E+00	J	mg/kg	ETF-SB-02-0.5_11/02/2016	62/108	1.90E-03 - 1.80E+00	2.20E+00	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	8.30E-04	JL	7.50E+00		mg/kg	ETF-SB-02-0.5_11/02/2016	36/108	1.90E-03 - 1.80E+00	7.50E+00	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	8.30E-04	JL	1.30E+01		mg/kg	ETF-SB-02-0.5_11/02/2016	71/108	1.90E-03 - 1.80E+00	1.30E+01	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	1.10E-03	J	7.50E-02	J+	mg/kg	ETF-SB09-129-0.5_11/06/2017	25/108	1.90E-03 - 2.50E-01	7.50E-02	NA	1.10E-01	C	NA	NA	BSL
206-44-0	Fluoranthene	8.00E-04	JL	1.60E+01		mg/kg	ETF-SB-02-0.5_11/02/2016	65/108	1.90E-03 - 3.50E+00	1.60E+01	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	1.20E-03	J	2.30E-01		mg/kg	ETF-SB08-123-2.0_11/02/2017	12/108	1.90E-03 - 2.50E-01	2.30E-01	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	9.10E-04	JL	3.10E+00		mg/kg	ETF-SB-02-0.5_11/02/2016	54/108	1.90E-03 - 1.80E+00	3.10E+00	NA	1.10E+00	C	NA	NA	Yes ASL
91-20-3	Naphthalene	8.10E-04	JL	7.20E-01		mg/kg	ETF-SB-03-2.0_11/02/2016	32/108	1.90E-03 - 2.50E-01	7.20E-01	NA	3.80E+00	C	NA	NA	BSL
85-01-8	Phenanthrene	7.90E-04	J	1.70E+00		mg/kg	ETF-SB08-123-2.0_11/02/2017	68/108	1.90E-03 - 8.80E-01	1.70E+00	NA	1.80E+02	N	NA	NA	BSL
129-00-0	Pyrene	9.60E-04	JL	1.60E+01		mg/kg	ETF-SB-02-0.5_11/02/2016	74/108	1.90E-03 - 1.80E+00	1.60E+01	NA	1.80E+02	N	NA	NA	BSL
SVOCS																
92-52-4	1,1'-Biphenyl	2.40E-02	JL	9.70E-02		mg/kg	ETF-SB-03-2.0_11/02/2016	2/108	1.90E-03 - 2.50E-01	9.70E-02	NA	4.70E+00	N	NA	NA	BSL
118-79-6	2,4,6-Tribromophenol	2.92E-01		3.39E-01		mg/kg	ETF-SB-137-0.5_11/07/2017	2/2	0.00E+00 - 0.00E+00	3.39E-01	NA	5.70E+01	N	NA	NA	BSL
105-67-9	2,4-Dimethylphenol	1.80E-01	J	1.80E-01	J	mg/kg	ETF-SB-136-2.0_11/07/2017	1/108	7.36E-02 - 3.80E+00	1.80E-01	NA	1.30E+02	N	NA	NA	BSL
321-60-8	2-Fluorobiphenyl	1.59E-01	/	1.66E-01		mg/kg	ETF-SB-137-0.5_11/07/2017	2/2	0.00E+00 - 0.00E+00	1.66E-01	NA			NA	NA	BSL
367-12-4	2-Fluorophenol	2.31E-01		2.46E-01		mg/kg	ETF-SB-137-2.0_11/07/2017	2/2	0.00E+00 - 0.00E+00	2.46E-01	NA			NA	NA	BSL
86-74-8	Carbazole	2.80E-01	J	2.80E-01	J	mg/kg	ETF-SB08-123-2.0_11/02/2017	1/108	7.36E-02 - 7.40E+00	2.80E-01	NA			NA	NA	BSL
132-64-9	Dibenzofuran	1.80E-02	JL	1.80E-01	J	mg/kg	ETF-SB08-123-2.0_11/02/2017	3/108	1.90E-03 - 2.50E-01	1.80E-01	NA	7.30E+00	N	NA	NA	BSL
131-11-3	Dimethyl phthalate	9.60E-02	J	4.80E-01		mg/kg	ETF-SB-161-2.0_12/03/2018	43/108	7.36E-02 - 3.80E+00	4.80E-01	NA			NA	NA	BSL
108-87-2	Methylcyclohexane	4.22E+01		4.22E+01		mg/kg	ETF-SB-03-2.0_11/02/2016	1/14	4.70E-03 - 4.11E-01	4.22E+01	NA	6.50E+02	N	NA	NA	BSL
87-86-5	Pentachlorophenol	9.90E-03		9.90E-03		mg/kg	ETF-SB-137-0.5_11/07/2017	1/108	3.60E-03 - 4.80E-01	9.90E-03	NA	1.00E+00	C	NA	NA	BSL
108-95-2	Phenol	1.00E-01	JL/JL	3.00E-01	JL	mg/kg	ETF-SB-144-2.0_12/03/2018	43/108	7.36E-02 - 7.40E+00	3.00E-01	NA	1.90E+03	N	NA	NA	BSL

TABLE 2.9
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - EAST TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection ⁽⁵⁾
VOCS																
78-93-3	2-Butanone	1.46E-02		1.60E-02		mg/kg	ETF-SB-10-2.0_11/02/2016	2/14	4.70E-03 - 1.40E-02	1.60E-02	NA	2.70E+03 N	NA	NA	No	BSL
460-00-4	4-Bromofluorobenzene	3.67E-02		7.48E-02		mg/kg	ETF-SB-03-2.0_11/02/2016	11/11	0.00E+00 - 0.00E+00	7.48E-02	NA	2.30E+00 N	NA	NA	No	BSL
67-64-1	Acetone	1.90E-02		1.10E-01		mg/kg	ETF-SB01-13-2.0_10/30/2017	5/14	9.30E-03 - 2.75E-02	1.10E-01	NA	6.10E+03 N	NA	NA	No	BSL
110-82-7	Cyclohexane	9.97E+00		9.97E+00		mg/kg	ETF-SB-03-2.0_11/02/2016	1/14	4.70E-03 - 4.11E-01	9.97E+00	NA	6.50E+02 N	NA	NA	No	BSL
98-82-8	Isopropylbenzene	1.46E+00		1.46E+00		mg/kg	ETF-SB-03-2.0_11/02/2016	1/14	4.70E-03 - 4.11E-01	1.46E+00	NA	1.90E+02 N	NA	NA	No	BSL
75-09-2	Methylene chloride	1.50E-03	J	1.50E-03	J	mg/kg	ETF-SB01-13-2.0_10/30/2017	1/14	4.70E-03 - 1.38E-02	1.50E-03	NA	3.50E+01 N	NA	NA	No	BSL
108-88-3	Toluene	2.90E-04	J+	2.90E-04	J+	mg/kg	ETF-SB01-13-2.0_10/30/2017	1/14	4.70E-03 - 1.38E-02	2.90E-04	NA	4.90E+02 N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 2.10
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - EAST TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background Value ⁽³⁾	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Inorganics																
57-12-5	Cyanide	1.40E-02	J	1.60E-01	J	mg/kg	ETF-SB-137-6.0_11/07/2017	36/45	3.40E-01 - 6.20E-01	1.60E-01	NA	2.30E+00	N	NA	NA	BSL
Metals																
7429-90-5	Aluminum	1.97E+03		1.64E+04		mg/kg	ETF-SB08-121-6.0_11/02/2017	45/45	9.90E+00 - 2.22E+01	1.64E+04	NA	7.70E+03	N	NA	NA	ASL
7440-38-2	Arsenic	9.20E-01		1.44E+01	J	mg/kg	ETF-SB01-16-10_10/30/2017	45/45	4.10E-01 - 5.80E-01	1.44E+01	NA	6.80E-01	C	NA	NA	ASL
7440-39-3	Barium	1.41E+01		2.42E+02		mg/kg	ETF-SB07-119-6.0_11/07/2017	45/45	1.00E+00 - 5.80E+00	2.42E+02	NA	1.50E+03	N	NA	NA	BSL
7440-41-7	Beryllium	1.70E-01	J	2.20E+00		mg/kg	ETF-SB-05-10.0_11/01/2016	38/45	4.10E-01 - 6.00E-01	2.20E+00	NA	1.60E+01	N	NA	NA	BSL
7440-43-9	Cadmium	9.70E-02	JL	1.60E+00		mg/kg	ETF-SB-04-6.0_11/01/2016	7/45	4.10E-01 - 6.00E-01	1.60E+00	NA	7.10E+00	N	NA	NA	BSL
7440-70-2	Calcium	4.88E+01	J	6.14E+03		mg/kg	ETF-SB-124-6.0_11/06/2017	43/45	1.49E+01 - 5.56E+02	6.14E+03	NA	NA	NA	NA	NA	NUT
7440-47-3	Chromium	4.30E+00		1.89E+01		mg/kg	ETF-SB-131-6.0_11/07/2017	45/45	8.10E-01 - 1.20E+00	1.89E+01	NA	1.20E+04	N	NA	NA	BSL
7440-48-4	Cobalt	1.20E+00		2.97E+01		mg/kg	ETF-SB-130-7.0_11/07/2017	45/45	4.10E-01 - 2.20E+00	2.97E+01	NA	2.30E+00	N	NA	NA	ASL
7440-50-8	Copper	2.10E+00	J	5.99E+01		mg/kg	ETF-SB-126-5.0_11/06/2017	41/45	8.10E-01 - 2.20E+00	5.99E+01	NA	3.10E+02	N	NA	NA	BSL
7439-89-6	Iron	5.47E+03	J	6.58E+04	J	mg/kg	ETF-SB-131-6.0_11/07/2017	45/45	2.50E+00 - 2.04E+01	6.58E+04	NA	5.50E+03	N	NA	NA	ASL
7439-92-1	Lead	9.00E-01	J	7.56E+01		mg/kg	ETF-SB-136-6.0_11/07/2017	44/45	4.10E-01 - 6.00E-01	7.56E+01	NA	4.00E+02	G	NA	NA	BSL
7439-95-4	Magnesium	1.77E+02		3.00E+03		mg/kg	ETF-SB08-121-10.0_11/02/2017	45/45	1.49E+01 - 5.56E+02	3.00E+03	NA	NA	NA	NA	NA	NUT
7439-96-5	Manganese	1.15E+01		9.92E+02		mg/kg	ETF-SB07-119-6.0_11/07/2017	45/45	5.00E-01 - 2.80E+00	9.92E+02	NA	1.80E+02	N	NA	NA	ASL
7439-97-6	Mercury	8.00E-03	J	1.30E-01		mg/kg	ETF-SB06-115-3.5_11/06/2017	13/45	6.90E-02 - 1.40E-01	1.30E-01	NA	2.30E+00	N	NA	NA	BSL
7440-02-0	Nickel	2.20E+00		5.56E+01		mg/kg	ETF-SB-131-6.0_11/07/2017	45/45	4.10E-01 - 2.20E+00	5.56E+01	NA	1.50E+02	N	NA	NA	BSL
7440-09-7	Potassium	1.95E+02		4.46E+03		mg/kg	ETF-SB08-121-10.0_11/02/2017	45/45	9.94E+01 - 5.56E+02	4.46E+03	NA	NA	NA	NA	NA	NUT
7440-23-5	Sodium	1.07E+01	J	1.68E+03		mg/kg	ETF-SB-03-10.0_11/02/2016	42/45	4.97E+01 - 5.56E+02	1.68E+03	NA	NA	NA	NA	NA	NUT
7440-62-2	Vanadium	6.40E+00		3.78E+01		mg/kg	ETF-SB08-123-10.0_11/02/2017	45/45	2.00E+00 - 2.90E+00	3.78E+01	NA	3.90E+01	N	NA	NA	BSL
7440-66-6	Zinc	1.70E+00	J	2.87E+01		mg/kg	ETF-SB09-127-3.0_11/02/2017	45/45	8.10E-01 - 2.20E+00	2.87E+01	NA	2.30E+03	N	NA	NA	BSL
PAHS																
91-57-6	2-Methylnaphthalene	1.30E-03	J	3.10E+00		mg/kg	ETF-SB-03-6.0_11/02/2016	11/45	1.80E-03 - 2.00E+00	3.10E+00	NA	2.40E+01	N	NA	NA	BSL
83-32-9	Acenaphthene	1.90E-03	JL	2.50E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	4/45	1.80E-03 - 2.10E-01	2.50E-01	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	8.40E-04	JL	6.10E-02		mg/kg	ETF-SB-03-10.0_11/02/2016	6/45	1.80E-03 - 2.10E-01	6.10E-02	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	1.90E-03	J	4.50E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	10/45	1.80E-03 - 2.10E-01	4.50E-01	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	6.00E-04	JL	7.20E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	15/45	1.80E-03 - 2.10E-01	7.20E-01	NA	1.10E+00	C	NA	NA	BSL
50-32-8	Benzo (a) pyrene	3.90E-03		4.20E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	12/45	1.80E-03 - 2.10E-01	4.20E-01	NA	1.10E-01	C	NA	NA	ASL
205-99-2	Benzo (b) fluoranthene	6.20E-03		5.80E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	10/45	1.80E-03 - 2.10E-01	5.80E-01	NA	1.10E+00	C	NA	NA	BSL
191-24-2	Benzo (g,h,i) perylene	1.00E-03	JL	1.10E-01	J	mg/kg	ETF-SB09-129-2.5_11/06/2017, ETF-SB08-123-6.0_11/02/2017	19/45	1.80E-03 - 2.10E-01	1.10E-01	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	1.70E-03	J	2.10E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	9/45	1.80E-03 - 2.10E-01	2.10E-01	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	8.10E-04	JL	5.90E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	21/45	1.80E-03 - 2.10E-01	5.90E-01	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	2.50E-03	J	4.50E-02		mg/kg	ETF-SB08-123-6.0_11/02/2017	6/45	1.80E-03 - 2.10E-01	4.50E-02	NA	1.10E-01	C	NA	NA	BSL
206-44-0	Fluoranthene	8.80E-04	JL	1.30E+00		mg/kg	ETF-SB08-123-6.0_11/02/2017	15/45	1.80E-03 - 4.10E-01	1.30E+00	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	1.80E-03	J	2.70E-01		mg/kg	ETF-SB-03-10.0_11/02/2016	7/45	1.80E-03 - 2.10E-01	2.70E-01	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	2.30E-03	J	1.90E-01		mg/kg	ETF-SB08-123-6.0_11/02/2017	11/45	1.80E-03 - 2.10E-01	1.90E-01	NA	1.10E+00	C	NA	NA	BSL
91-20-3	Naphthalene	1.10E-03	JL	7.80E-01		mg/kg	ETF-SB-03-10.0_11/02/2016	13/45	1.80E-03 - 2.10E-01	7.80E-01	NA	3.80E+00	C	NA	NA	BSL
85-01-8	Phenanthrene	4.00E-04	JL	1.60E+00		mg/kg	ETF-SB08-123-6.0_11/02/2017	19/45	1.80E-03 - 2.10E-01	1.60E+00	NA	1.80E+02	N	NA	NA	BSL
129-00-0	Pyrene	1.30E-03	J	1.10E+00		mg/kg	ETF-SB08-123-6.0_11/02/2017	18/45	1.80E-03 - 2.10E-01	1.10E+00	NA	1.80E+02	N	NA	NA	BSL

TABLE 2.10
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - EAST TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background Value ⁽³⁾	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
SVOCs																
92-52-4	1,1'-Biphenyl	1.30E-01		2.30E-01		mg/kg	ETF-SB-03-10.0_11/02/2016	2/45	1.80E-03 - 2.10E-01	2.30E-01	NA	4.70E+00	N	NA	NA	BSL
118-79-6	2,4,6-Tribromophenol	2.66E-01		3.14E-01		mg/kg	ETF-SB-137-10.0_11/07/2017	2/2	0.00E+00 - 0.00E+00	3.14E-01	NA	5.70E+01	N	NA	NA	BSL
105-67-9	2,4-Dimethylphenol	7.30E-02	J	1.40E+00		mg/kg	ETF-SB-136-6.0_11/07/2017	3/45	7.70E-02 - 2.00E+00	1.40E+00	NA	1.30E+02	N	NA	NA	BSL
606-20-2	2,6-Dinitrotoluene	1.40E-03	JL	1.40E-03	JL	mg/kg	ETF-SB-02-6.0_11/02/2016	1/45	1.80E-03 - 2.10E-01	1.40E-03	NA	3.60E-01	C	NA	NA	BSL
321-60-8	2-Fluorobiphenyl	1.57E-01		1.58E-01		mg/kg	ETF-SB-137-10.0_11/07/2017	2/2	0.00E+00 - 0.00E+00	1.58E-01	NA			NA	NA	BSL
367-12-4	2-Fluorophenol	2.44E-01		2.50E-01		mg/kg	ETF-SB-137-10.0_11/07/2017	2/2	0.00E+00 - 0.00E+00	2.50E-01	NA			NA	NA	BSL
95-48-7	2-Methylphenol	2.30E-01	J	2.30E-01	J	mg/kg	ETF-SB-136-6.0_11/07/2017	1/45	7.70E-02 - 3.80E+00	2.30E-01	NA	3.20E+02	N	NA	NA	BSL
91-94-1	3,3'-Dichlorobenzidine	4.90E-02	JL	4.90E-02	JL	mg/kg	ETF-SB-03-10.0_11/02/2016	1/45	3.40E-03 - 4.10E-01	4.90E-02	NA	1.20E+00	C	NA	NA	BSL
106-44-5	4-Methylphenol	2.80E-01	J	2.80E-01	J	mg/kg	ETF-SB-136-6.0_11/07/2017	1/43	3.40E-01 - 3.80E+00	2.80E-01	NA	6.30E+02	N	NA	NA	BSL
86-74-8	Carbazole	3.10E-01	J	3.10E-01	J	mg/kg	ETF-SB08-123-6.0_11/02/2017	1/45	7.70E-02 - 3.80E+00	3.10E-01	NA			NA	NA	BSL
132-64-9	Dibenzofuran	6.20E-02		1.60E-01		mg/kg	ETF-SB-03-10.0_11/02/2016	4/45	1.80E-03 - 2.10E-01	1.60E-01	NA	7.30E+00	N	NA	NA	BSL
108-87-2	Methylcyclohexane	7.50E-03		1.18E-01		mg/kg	ETF-SB-03-10.0_11/02/2016	3/12	4.40E-03 - 6.20E-03	1.18E-01	NA	6.50E+02	N	NA	NA	BSL
VOCs																
78-93-3	2-Butanone	5.90E-03	JL	7.40E-03		mg/kg	ETF-SB-03-10.0_11/02/2016	3/12	4.70E-03 - 1.20E-02	7.40E-03	NA	2.70E+03	N	NA	NA	BSL
460-00-4	4-Bromofluorobenzene	4.51E-02		4.99E-02		mg/kg	ETF-SB-03-12.5_11/02/2016	8/8	0.00E+00 - 0.00E+00	4.99E-02	NA	2.30E+00	N	NA	NA	BSL
67-64-1	Acetone	3.80E-03	J	5.10E-02		mg/kg	ETF-SB09-128-7.0_11/02/2017	6/12	8.80E-03 - 1.20E-02	5.10E-02	NA	6.10E+03	N	NA	NA	BSL
110-82-7	Cyclohexane	6.86E-02		6.86E-02		mg/kg	ETF-SB-03-10.0_11/02/2016	1/12	4.40E-03 - 6.20E-03	6.86E-02	NA	6.50E+02	N	NA	NA	BSL
179601-23-1	m, p-Xylene	1.60E-04	J	1.60E-04	J	mg/kg	ETF-SB-136-10.0_11/07/2017	1/12	4.40E-03 - 1.15E-02	1.60E-04	NA	5.80E+01	N	NA	NA	BSL
95-47-6	ortho-Xylene	2.40E-04	J	2.40E-04	J	mg/kg	ETF-SB-136-10.0_11/07/2017	1/12	4.40E-03 - 6.20E-03	2.40E-04	NA	6.50E+01	N	NA	NA	BSL
108-88-3	Toluene	1.30E-04	JL	1.30E-04	JL	mg/kg	ETF-SB09-128-7.0_11/02/2017	1/12	4.40E-03 - 6.20E-03	1.30E-04	NA	4.90E+02	N	NA	NA	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Surrogates used: Mercuric Chloride for Mercury.

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

TABLE 2.11
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - GROUNDWATER
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Metals-Total																
7429-90-5	Aluminum	5.04E+01		1.29E+04	J	ug/L	MW-05_12/18/2018	6/6	2.00E+01 - 2.00E+01	1.29E+04	NA	2.00E+03	N	NA	NA	ASL
7440-38-2	Arsenic	4.20E+00	J	2.83E+01		ug/L	MW-01_12/18/2018	5/6	1.00E+00 - 2.00E+00	2.83E+01	NA	5.20E-02	C	10	MCL	BSL
7440-39-3	Barium	4.10E+01	J	3.76E+02	J	ug/L	MW-06_12/17/2018	6/6	1.00E+01 - 1.00E+01	3.76E+02	NA	3.80E+02	N	2000	MCL	BSL
7440-41-7	Beryllium	7.60E-01	J	7.90E-01	J	ug/L	MW-04_12/18/2018	2/6	1.00E+00 - 1.00E+00	7.90E-01	NA	2.50E+00	N	4	MCL	BSL
7440-70-2	Calcium	2.71E+04	J	7.32E+04		ug/L	MW-06_12/17/2018	6/6	5.00E+02 - 5.00E+02	7.32E+04	NA	NA	NA	NA	No	NUT
7440-47-3	Chromium	2.50E-01	J	8.40E+00	J	ug/L	MW-04_12/18/2018	4/6	2.00E+00 - 4.00E+00	8.40E+00	NA	2.20E+03	N	100	MCL	BSL
7440-48-4	Cobalt	9.10E-01	J	1.08E+01	J	ug/L	MW-01_12/18/2018	6/6	1.00E+00 - 2.00E+00	1.08E+01	NA	6.00E-01	N	NA	NA	ASL
7440-50-8	Copper	1.10E+00	J	6.70E+00	J	ug/L	MW-02_12/18/2018	4/6	2.00E+00 - 4.00E+00	6.70E+00	NA	8.00E+01	N	1300	MCL	BSL
57-12-5	Cyanide	2.90E+00	J	4.71E+01		ug/L	MW-03_12/18/2018	3/6	1.00E+01 - 1.00E+01	4.71E+01	NA	2.00E+00	N	200	MCL	ASL
7439-89-6	Iron	2.57E+02		4.94E+04		ug/L	MW-01_12/18/2018	6/6	1.00E+02 - 1.00E+02	4.94E+04	NA	1.40E+03	N	NA	NA	ASL
7439-92-1	Lead	2.70E-01	J	1.00E+01		ug/L	MW-04_12/18/2018	4/6	1.00E+00 - 1.00E+00	1.00E+01	NA	1.50E+01	G	15	MCL	BSL
7439-95-4	Magnesium	8.10E+03	J	3.09E+04	J	ug/L	MW-05_12/18/2018	6/6	5.00E+02 - 5.00E+02	3.09E+04	NA	NA	NA	NA	No	NUT
7439-96-5	Manganese	1.83E+02		1.40E+03	J	ug/L	MW-04_12/18/2018	6/6	1.00E+00 - 2.00E+00	1.40E+03	NA	4.30E+01	N	NA	NA	ASL
7440-02-0	Nickel	6.40E-01	J	1.12E+01	J	ug/L	MW-04_12/18/2018	6/6	1.00E+00 - 2.00E+00	1.12E+01	NA	3.90E+01	N	NA	NA	BSL
7440-09-7	Potassium	1.22E+03	J	2.76E+03	J	ug/L	MW-05_12/18/2018	6/6	5.00E+02 - 5.00E+02	2.76E+03	NA	NA	NA	NA	No	NUT
7782-49-2	Selenium	8.60E-01	J	1.00E+00	J	ug/L	MW-02_12/18/2018	2/6	5.00E+00 - 1.00E+01	1.00E+00	NA	1.00E+01	N	50	MCL	BSL
7440-23-5	Sodium	3.52E+03	J	3.64E+04	J	ug/L	MW-06_12/17/2018	6/6	5.00E+02 - 5.00E+02	3.64E+04	NA	NA	NA	NA	No	NUT
7440-62-2	Vanadium	1.80E+00	J	1.25E+01	J	ug/L	MW-05_12/18/2018	4/6	5.00E+00 - 1.00E+01	1.25E+01	NA	8.60E+00	N	NA	NA	ASL
7440-66-6	Zinc	1.90E+00	J	1.60E+01	J	ug/L	MW-05_12/18/2018	6/6	2.00E+00 - 4.00E+00	1.60E+01	NA	6.00E+02	N	NA	NA	BSL
PAHS																
91-57-6	2-Methylnaphthalene	8.00E-02	LJ	3.30E+01		ug/L	MW-01_12/18/2018	3/6	1.00E-01 - 5.00E+00	3.30E+01	NA	3.60E+00	N	NA	NA	ASL
83-32-9	Acenaphthene	4.00E-02	LJ	2.00E-01		ug/L	MW-01_12/18/2018	2/6	1.00E-01 - 5.00E+00	2.00E-01	NA	5.30E+01	N	NA	NA	BSL
208-96-8	Acenaphthylene	1.80E-01		1.80E-01		ug/L	MW-01_12/18/2018	1/6	1.00E-01 - 5.00E+00	1.80E-01	NA	5.30E+01	N	NA	NA	BSL
86-73-7	Fluorene	1.10E-01		1.10E+00	LJ	ug/L	MW-04_12/18/2018	3/6	1.00E-01 - 5.00E+00	1.10E+00	NA	2.90E+01	N	NA	NA	BSL
91-20-3	Naphthalene	6.00E-02	LJ	9.50E+01		ug/L	MW-04_12/18/2018	4/6	1.00E-01 - 1.00E+01	9.50E+01	NA	1.70E-01	C	NA	NA	ASL
85-01-8	Phenanthrene	6.00E-02	LJ	5.80E+00		ug/L	MW-04_12/18/2018	3/6	1.00E-01 - 5.00E+00	5.80E+00	NA	1.20E+01	N	NA	NA	BSL
129-00-0	Pyrene	1.30E+00	LJ	1.30E+00	LJ	ug/L	MW-04_12/18/2018	1/6	1.00E-01 - 5.00E+00	1.30E+00	NA	1.20E+01	N	NA	NA	BSL
SVOCs																
105-67-9	2,4-Dimethylphenol	2.50E+00	LJ	2.50E+00	LJ	ug/L	MW-04_12/18/2018	1/6	5.00E+00 - 5.00E+00	2.50E+00	NA	3.60E+01	N	NA	NA	BSL
86-74-8	Carbazole	2.40E+00	LJ	2.40E+00	LJ	ug/L	MW-04_12/18/2018	1/6	1.00E+01 - 1.00E+01	2.40E+00	NA	NA	NA	NA	No	BSL
131-11-3	Dimethyl phthalate	4.10E+00	LJ	5.30E+00		ug/L	MW-04_12/18/2018	2/6	5.00E+00 - 5.00E+00	5.30E+00	NA	NA	NA	NA	No	BSL
108-87-2	Methylcyclohexane	1.40E+02		4.10E+02		ug/L	MW-04_12/18/2018	2/6	5.00E+00 - 2.00E+02	4.10E+02	NA	1.30E+03	N	NA	NA	BSL
108-95-2	Phenol	5.90E+00	LJ	9.00E+00	LJ	ug/L	MW-04_12/18/2018	2/6	1.00E+01 - 1.00E+01	9.00E+00	NA	5.80E+02	N	NA	NA	BSL

TABLE 2.11
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - GROUNDWATER
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
VOCS																
107-06-2	1,2-Dichloroethane	4.10E+00	J	4.10E+00	J	ug/L	MW-05_12/18/2018	1/6	5.00E+00 - 5.00E+00	4.10E+00	NA	1.70E-01	C	5	MCL	Yes
67-64-1	Acetone	2.00E+00	J	3.30E+00	J	ug/L	MW-01_12/18/2018	4/6	1.00E+01 - 1.00E+01	3.30E+00	NA	1.40E+03	N	NA	NA	No
71-43-2	Benzene	5.60E-01	J	2.40E+03		ug/L	MW-04_12/18/2018	3/6	5.00E+00 - 2.00E+02	2.40E+03	NA	4.60E-01	C	5	MCL	Yes
110-82-7	Cyclohexane	1.20E+00	J	6.50E+02		ug/L	MW-04_12/18/2018	4/6	5.00E+00 - 2.00E+02	6.50E+02	NA	1.30E+03	N	NA	NA	No
100-41-4	Ethylbenzene	4.90E-01	J	1.10E+03		ug/L	MW-04_12/18/2018	3/6	5.00E+00 - 2.00E+02	1.10E+03	NA	1.50E+00	C	700	MCL	Yes
98-82-8	Isopropylbenzene	5.50E+01		6.00E+01		ug/L	MW-04_12/18/2018	2/6	5.00E+00 - 5.00E+00	6.00E+01	NA	4.50E+01	N	NA	NA	Yes
179601-23-1	m, p-Xylene	1.10E+00	J	2.30E+03		ug/L	MW-04_12/18/2018	3/6	5.00E+00 - 2.00E+02	2.30E+03	NA	1.90E+01	N	10000	MCL	Yes
95-47-6	ortho-Xylene	6.30E-01	J	5.00E+02		ug/L	MW-04_12/18/2018	2/6	5.00E+00 - 2.00E+02	5.00E+02	NA	1.90E+01	N	NA	NA	Yes
108-88-3	Toluene	1.30E+00	J	1.10E+03		ug/L	MW-04_12/18/2018	2/6	5.00E+00 - 2.00E+02	1.10E+03	NA	1.10E+02	N	1000	MCL	Yes

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the tap water value. For carcinogens the value shown is equal to the tap water value.

(5) Rationale Codes

Definitions: C = Carcinogenic
COPC = Chemical of Potential Concern
N = Non-Carcinogenic
NA = Not Applicable
ug/L = micrograms per liter

Deletion Reason: BSL = Below Screening Toxicity Level
NSL = No Screening Toxicity Level
NUT = Essential Nutrient

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported
concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 2.12
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - SURFACE WATER
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface water
Exposure Medium: Surface water
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background Value ⁽³⁾	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection ⁽⁵⁾
Inorganics-Total																
57-12-5	Cyanide	2.96E+01		2.96E+01		ug/L	ET-SW-02_10/19/2017	1/51	1.00E+01 - 4.00E+01	2.96E+01	NA	1.50E-01	N	NA	NA	Yes ASL
Metals-Total																
7429-90-5	Aluminum	1.06E+02	J	1.91E+04		ug/L	P2-SW-03_10/26/2017	22/52	2.00E+01 - 1.00E+02	1.91E+04	NA	2.00E+03	N	NA	NA	Yes ASL
7440-38-2	Arsenic	1.20E+00		5.40E+00		ug/L	SC-SW-07_11/02/2016	5/52	1.00E+00 - 5.00E+00	5.40E+00	NA	5.20E-02	C	NA	NA	Yes ASL
7440-39-3	Barium	1.12E+01		2.36E+02		ug/L	P2-SW-03_10/26/2017	50/52	1.00E+01 - 1.00E+01	2.36E+02	NA	3.80E+02	N	NA	NA	No BSL
7440-43-9	Cadmium	7.90E+00		2.50E+01	J	ug/L	P7-SW-01_10/25/2017	4/52	1.00E+00 - 5.00E+00	2.50E+01	NA	9.20E-01	N	NA	NA	Yes ASL
7440-70-2	Calcium	1.94E+03		6.74E+04		ug/L	ET-SW-07_10/18/2017	52/52	1.50E+02 - 5.00E+02	6.74E+04	NA			NA	NA	No NUT
7440-47-3	Chromium	8.70E-01	J	1.80E+01		ug/L	P2-SW-03_10/26/2017	6/52	2.00E+00 - 1.00E+01	1.80E+01	NA	2.20E+03	N	NA	NA	No BSL
18540-29-9	Chromium, Hexavalent	5.40E-02		3.42E-01		ug/L	C2-SW_11/01/2016	4/16	5.00E-02 - 5.00E-02	3.42E-01	NA	3.50E-02	C	NA	NA	Yes ASL
7440-48-4	Cobalt	4.30E-01	J	5.20E-01	J	ug/L	SC-SW-22_12/17/2018	2/52	1.00E+00 - 2.00E+01	5.20E-01	NA	6.00E-01	N	NA	NA	No BSL
7440-50-8	Copper	1.20E+00	J	2.69E+01		ug/L	P2-SW-01_10/26/2017	4/52	2.00E+00 - 2.00E+01	2.69E+01	NA	8.00E+01	N	NA	NA	No BSL
7439-89-6	Iron	1.01E+02		1.94E+04		ug/L	P2-SW-03_10/26/2017	52/52	2.50E+01 - 1.00E+02	1.94E+04	NA	1.40E+03	N	NA	NA	Yes ASL
7439-92-1	Lead	7.10E-01	J	1.81E+02		ug/L	P1-SW-04_10/23/2017	13/52	1.00E+00 - 5.00E+00	1.81E+02	NA	1.50E+01	G	NA	NA	Yes ASL
7439-95-4	Magnesium	1.10E+03		2.32E+04		ug/L	SC-SW-05_11/01/2016	52/52	1.50E+02 - 5.00E+02	2.32E+04	NA			NA	NA	No NUT
7439-96-5	Manganese	6.90E+00		1.08E+03		ug/L	SC-SW-05_11/01/2016	52/52	1.00E+00 - 5.00E+00	1.08E+03	NA	4.30E+01	N	NA	NA	Yes ASL
7440-02-0	Nickel	1.60E+00	J	1.90E+00	J	ug/L	SC-SW-22_12/17/2018	2/52	1.00E+00 - 2.00E+01	1.90E+00	NA	3.90E+01	N	NA	NA	No BSL
7440-09-7	Potassium	1.47E+03		7.47E+03		ug/L	P2-SW-03_10/26/2017	52/52	5.00E+02 - 1.00E+03	7.47E+03	NA			NA	NA	No NUT
7440-23-5	Sodium	2.51E+03		1.12E+05		ug/L	ET-SW-07_10/18/2017	52/52	5.00E+02 - 5.00E+02	1.12E+05	NA			NA	NA	No NUT
7440-62-2	Vanadium	1.70E+00	J	2.91E+01		ug/L	P2-SW-03_10/26/2017	4/52	5.00E+00 - 2.00E+01	2.91E+01	NA	8.60E+00	N	NA	NA	Yes ASL
7440-66-6	Zinc	2.90E+00	J	8.59E+01		ug/L	SC-SW-04_10/31/2016	10/52	2.00E+00 - 2.00E+01	8.59E+01	NA	6.00E+02	N	NA	NA	No BSL
PAHS																
90-12-0	1-Methylnaphthalene	2.00E-01		2.00E-01		ug/L	WT-SW-01_10/23/2017	1/20	5.00E-01 - 5.00E-01	2.00E-01	NA	1.10E+00	C	NA	NA	No BSL
120-12-7	Anthracene	2.00E-01		2.00E-01		ug/L	WT-SW-01_10/23/2017	1/52	4.80E-02 - 5.00E+00	2.00E-01	NA	1.80E+02	N	NA	NA	No BSL
56-55-3	Benzo (a) anthracene	1.00E-01		1.00E-01		ug/L	WT-SW-01_10/23/2017	1/52	4.80E-02 - 5.00E+00	1.00E-01	NA	3.00E-02	C	NA	NA	Yes ASL
50-32-8	Benzo (a) pyrene	3.50E-02	J	6.00E-02	J	ug/L	P3-SW-02_10/26/2017, P5-SW-03_10/24/2017	7/52	4.80E-02 - 5.00E+00	6.00E-02	NA	2.50E-02	C	NA	NA	Yes ASL
218-01-9	Chrysene	2.00E-01		2.00E-01		ug/L	WT-SW-01_10/23/2017	1/52	4.80E-02 - 5.00E+00	2.00E-01	NA	2.50E+01	C	NA	NA	No BSL
206-44-0	Fluoranthene	3.00E-02	J	2.00E-01		ug/L	WT-SW-01_10/23/2017	3/52	4.80E-02 - 1.00E+01	2.00E-01	NA	8.00E+01	N	NA	NA	No BSL
86-73-7	Fluorene	4.00E-01		4.00E-01		ug/L	WT-SW-01_10/23/2017	1/52	4.80E-02 - 5.00E+00	4.00E-01	NA	2.90E+01	N	NA	NA	No BSL
91-20-3	Naphthalene	8.00E-02	J	8.00E-02	J	ug/L	P1-SW-02_10/23/2017	1/52	4.80E-02 - 5.00E+00	8.00E-02	NA	1.70E-01	C	NA	NA	No BSL
85-01-8	Phenanthrene	4.90E-02		1.50E+00		ug/L	WT-SW-01_10/23/2017	3/52	4.80E-02 - 5.00E+00	1.50E+00	NA	1.20E+01	N	NA	NA	No BSL
129-00-0	Pyrene	7.00E-01		7.00E-01		ug/L	WT-SW-01_10/23/2017	1/52	4.80E-02 - 5.00E+00	7.00E-01	NA	1.20E+01	N	NA	NA	No BSL

TABLE 2.12
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - SURFACE WATER
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface water
Exposure Medium: Surface water
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
SVOCS																	
106-47-8	4-Chloroaniline	2.40E-02	LJ	4.70E-02	LJ	ug/L	SCPPE-SW-01_11/01/2016	4/52	9.50E-02 - 1.00E+01	4.70E-02	NA	3.70E-01	C	NA	NA	No	BSL
131-11-3	Dimethyl phthalate	1.80E+00	LJ	1.90E+00	LJ	ug/L	SC-SW-21_12/18/2018	2/52	1.90E+00 - 5.00E+00	1.90E+00	NA	NA	NA	NA	No	BSL	
108-95-2	Phenol	2.30E+00	LJ	3.00E+00	LJ	ug/L	SC-SW-21_12/18/2018	2/52	1.90E+00 - 1.00E+01	3.00E+00	NA	5.80E+02	N	NA	NA	No	BSL
VOCS																	
123-91-1	1,4-Dioxane	1.20E-01		1.20E-01		ug/L	SCPPE-SW-05_11/02/2016	1/32	9.50E-02 - 2.00E+00	1.20E-01	NA	4.60E-01	C	NA	NA	No	BSL
67-64-1	Acetone	1.80E+00	J	9.30E+00		ug/L	P4-SW-03_10/25/2017	28/52	5.00E+00 - 1.00E+01	9.30E+00	NA	1.40E+03	N	NA	NA	No	BSL
75-15-0	Carbon disulfide	1.00E+00		1.00E+00		ug/L	P6-SW-02_10/18/2017	1/52	5.00E-01 - 5.00E+00	1.00E+00	NA	8.10E+01	N	NA	NA	No	BSL
108-88-3	Toluene	4.10E-01	J	4.10E-01	J	ug/L	WT-SW-01_10/23/2017	1/52	5.00E-01 - 5.00E+00	4.10E-01	NA	1.10E+02	N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the tap water value. For carcinogens the value shown is equal to the tap water value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

ug/L = micrograms per liter

Data Qualifiers:

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Pyrene for Phenanthrene.

TABLE 2.13
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - SEDIMENT
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Inorganics																
57-12-5	Cyanide	2.10E-02	LJ	2.70E-01	LJ	mg/kg	SC-SD-22_12/17/2018	15/40	5.10E-01 - 1.00E+00	2.70E-01	NA	2.30E+00 N	NA	NA	No	BSL
Metals																
7429-90-5	Aluminum	9.40E+02		1.69E+04		mg/kg	P6-SD-05-0.5_10/19/2017	40/40	2.03E+01 - 4.28E+01	1.69E+04	NA	7.70E+03 N	NA	NA	Yes	ASL
7440-38-2	Arsenic	4.60E-01	J	7.20E+00	J	mg/kg	ET-SD-01-0.5_10/19/2017	40/40	4.40E-01 - 1.10E+00	7.20E+00	NA	6.80E-01 C	NA	NA	Yes	ASL
7440-39-3	Barium	9.20E+00		1.47E+02	J	mg/kg	WT-SD-01-0.5_10/23/2017	40/40	4.40E+00 - 1.08E+01	1.47E+02	NA	1.50E+03 N	NA	NA	No	BSL
7440-41-7	Beryllium	1.60E-01	LJ	5.60E-01	LJ	mg/kg	P6-SD-05-0.5_10/19/2017	6/40	4.40E-01 - 1.10E+00	5.60E-01	NA	1.60E+01 N	NA	NA	No	BSL
7440-43-9	Cadmium	1.76E-04	J	1.71E-03	J	mg/kg	P1-SD-01-0.5_10/23/2017	36/40	2.14E-03 - 1.30E+00	1.71E-03	NA	7.10E+00 N	NA	NA	No	BSL
7440-70-2	Calcium	2.08E+02	J	4.78E+04		mg/kg	WT-SD-06-0.5_10/24/2017	40/40	5.06E+02 - 1.12E+03	4.78E+04	NA		NA	NA	No	NUT
7440-47-3	Chromium	2.70E+00		1.43E+01	J	mg/kg	WT-SD-01-0.5_10/23/2017	40/40	8.80E-01 - 2.60E+00	1.43E+01	NA	1.20E+04 N	NA	NA	No	BSL
18540-29-9	Chromium, Hexavalent	8.10E-01		4.80E+00		mg/kg	P1-SD-01-0.5_10/23/2017	5/5	5.10E-01 - 5.90E-01	4.80E+00	NA	3.00E-01 C	NA	NA	Yes	ASL
7440-48-4	Cobalt	1.00E+00	J	1.40E+01	J	mg/kg	WT-SD-01-0.5_10/23/2017	40/40	4.40E-01 - 1.30E+00	1.40E+01	NA	2.30E+00 N	NA	NA	Yes	ASL
7440-50-8	Copper	1.10E+00		1.25E+01	J	mg/kg	P1-SD-04-0.5_10/23/2017	40/40	8.80E-01 - 2.60E+00	1.25E+01	NA	3.10E+02 N	NA	NA	No	BSL
7439-89-6	Iron	2.08E+03		2.49E+04		mg/kg	ET-SD-01-0.5_10/19/2017	40/40	1.01E+01 - 2.14E+01	2.49E+04	NA	5.50E+03 N	NA	NA	Yes	ASL
7439-92-1	Lead	2.20E+00	J	2.24E+02	J	mg/kg	P1-SD-01-0.5_10/23/2017, P1-SD-02-0.5_10/23/2017	40/40	4.40E-01 - 1.10E+00	2.24E+02	NA	4.00E+02 G	NA	NA	No	BSL
7439-95-4	Magnesium	1.48E+02	LJ	2.45E+04		mg/kg	WT-SD-06-0.5_10/24/2017	38/40	5.06E+02 - 1.07E+03	2.45E+04	NA		NA	NA	No	NUT
7439-96-5	Manganese	1.72E+01		1.02E+03		mg/kg	WT-SD-06-0.5_10/24/2017	40/40	1.50E+00 - 3.20E+00	1.02E+03	NA	1.80E+02 N	NA	NA	Yes	ASL
7439-97-6	Mercury	1.10E-05	J	4.90E-02	J	mg/kg	P1-SD-01-0.5_10/23/2017	23/40	7.32E-05 - 2.40E-01	4.90E-02	NA	7.80E-01 N	NA	NA	No	BSL
7440-02-0	Nickel	1.40E+00	J	1.89E+01	J	mg/kg	WT-SD-01-0.5_10/23/2017	40/40	4.40E-01 - 1.30E+00	1.89E+01	NA	1.50E+02 N	NA	NA	No	BSL
7440-09-7	Potassium	1.43E+02	LJ	2.85E+03		mg/kg	P6-SD-05-0.5_10/19/2017	38/40	5.06E+02 - 1.07E+03	2.85E+03	NA		NA	NA	No	NUT
7440-22-4	Silver	2.10E-02	LJ	7.50E-02	J	mg/kg	WT-SD-06-0.5_10/24/2017	2/40	4.40E-01 - 1.30E+00	7.50E-02	NA	3.90E+01 N	NA	NA	No	BSL
7440-23-5	Sodium	1.36E+01	LJ	1.78E+02	J	mg/kg	WT-SD-01-0.5_10/23/2017	38/40	5.06E+02 - 1.07E+03	1.78E+02	NA		NA	NA	No	NUT
7440-62-2	Vanadium	3.70E+00		3.08E+01	J	mg/kg	WT-SD-01-0.5_10/23/2017	40/40	2.20E+00 - 6.50E+00	3.08E+01	NA	3.90E+01 N	NA	NA	No	BSL
7440-66-6	Zinc	1.60E+00	J	1.34E+02		mg/kg	ET-SD-05-0.5_10/18/2017	40/40	8.80E-01 - 2.60E+00	1.34E+02	NA	2.30E+03 N	NA	NA	No	BSL

TABLE 2.13
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - SEDIMENT
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PAHS																
91-57-6	2-Methylnaphthalene	1.40E-03	J	1.00E-01	J	mg/kg	WT-SD-01-0.5_10/23/2017	9/40	3.70E-03 - 4.20E-01	1.00E-01	NA	2.40E+01 N	NA	NA	No	BSL
83-32-9	Acenaphthene	1.70E-03	LJ	7.90E-02	LJ	mg/kg	SC-SD-22_12/17/2018	4/40	3.70E-03 - 4.20E-01	7.90E-02	NA	3.60E+02 N	NA	NA	No	BSL
208-96-8	Acenaphthylene	1.30E-03	LJ	7.30E-03		mg/kg	P4-SD-03-0.5_10/25/2017	14/40	3.70E-03 - 4.20E-01	7.30E-03	NA	3.60E+02 N	NA	NA	No	BSL
120-12-7	Anthracene	1.30E-03	J	4.20E-01		mg/kg	SC-SD-22_12/17/2018	22/40	3.70E-03 - 4.20E-01	4.20E-01	NA	1.80E+03 N	NA	NA	No	BSL
56-55-3	Benzo (a) anthracene	1.40E-03	LJ	1.60E+00		mg/kg	WT-SD-01-0.5_10/23/2017	35/40	3.70E-03 - 3.40E-01	1.60E+00	NA	1.10E+00 C	NA	NA	Yes	ASL
50-32-8	Benzo (a) pyrene	1.50E-03	J	1.20E+00		mg/kg	WT-SD-01-0.5_10/23/2017	32/40	3.70E-03 - 4.20E-01	1.20E+00	NA	1.10E-01 C	NA	NA	Yes	ASL
205-99-2	Benzo (b) fluoranthene	1.20E-03	J	1.60E+00		mg/kg	WT-SD-01-0.5_10/23/2017	38/40	3.70E-03 - 4.20E-01	1.60E+00	NA	1.10E+00 C	NA	NA	Yes	ASL
191-24-2	Benzo (g,h,i) perylene	1.40E-03	J	7.30E-01		mg/kg	WT-SD-01-0.5_10/23/2017	36/40	3.70E-03 - 4.20E-01	7.30E-01	NA	1.80E+02 N	NA	NA	No	BSL
207-08-9	Benzo (k) fluoranthene	1.70E-03	J	1.70E+00		mg/kg	WT-SD-01-0.5_10/23/2017	20/40	3.70E-03 - 4.20E-01	1.70E+00	NA	1.10E+01 C	NA	NA	No	BSL
218-01-9	Chrysene	1.40E-03	J	5.10E+00		mg/kg	WT-SD-01-0.5_10/23/2017	38/40	3.70E-03 - 4.50E-01	5.10E+00	NA	1.10E+02 C	NA	NA	No	BSL
53-70-3	Dibenz (a,h) anthracene	2.40E-03	J	2.90E-01		mg/kg	WT-SD-01-0.5_10/23/2017	20/40	3.70E-03 - 4.20E-01	2.90E-01	NA	1.10E-01 C	NA	NA	Yes	ASL
206-44-0	Fluoranthene	1.60E-03	J	6.60E-01		mg/kg	SC-SD-22_12/17/2018	35/40	3.70E-03 - 8.10E-01	6.60E-01	NA	2.40E+02 N	NA	NA	No	BSL
86-73-7	Fluorene	1.30E-03	LJ	5.40E-01		mg/kg	SC-SD-22_12/17/2018	11/40	3.70E-03 - 4.20E-01	5.40E-01	NA	2.40E+02 N	NA	NA	No	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	1.50E-03	J	3.50E-01		mg/kg	WT-SD-01-0.5_10/23/2017	33/40	3.70E-03 - 4.20E-01	3.50E-01	NA	1.10E+00 C	NA	NA	No	BSL
91-20-3	Naphthalene	3.20E-03	LJ	1.80E-02		mg/kg	P1-SD-01-0.5_10/23/2017	7/40	3.70E-03 - 4.20E-01	1.80E-02	NA	3.80E+00 C	NA	NA	No	BSL
85-01-8	Phenanthrene	1.60E-03	J	8.70E+00		mg/kg	SC-SD-22_12/17/2018	26/40	3.70E-03 - 1.10E+00	8.70E+00	NA	1.80E+02 N	NA	NA	No	BSL
129-00-0	Pyrene	2.30E-03	LJ	3.30E+00		mg/kg	WT-SD-01-0.5_10/23/2017	36/40	3.70E-03 - 4.20E-01	3.30E+00	NA	1.80E+02 N	NA	NA	No	BSL
SVOCs																
87-61-6	1,2,3-Trichlorobenzene	1.50E-02	J	1.50E-02	J	mg/kg	P2-SD-01-0.5_10/26/2017	1/34	5.70E-03 - 3.90E-01	1.50E-02	NA	6.30E+00 N	NA	NA	No	BSL
106-44-5	4-Methylphenol	5.00E-02	J	2.80E-01	J	mg/kg	ET-SD-02-0.5_10/19/2017	4/40	3.70E-01 - 8.10E-01	2.80E-01	NA	6.30E+02 N	NA	NA	No	BSL
98-86-2	Acetophenone	3.70E-02	LJ	3.70E-02	LJ	mg/kg	SC-SD-04-0.5_10/17/2017	1/40	3.70E-01 - 8.10E-01	3.70E-02	NA	7.80E+02 N	NA	NA	No	BSL
86-74-8	Carbazole	9.90E-02	LJ	2.10E-01	J	mg/kg	WT-SD-01-0.5_10/23/2017	2/40	3.70E-01 - 8.10E-01	2.10E-01	NA	NA	NA	NA	No	BSL
131-11-3	Dimethyl phthalate	1.20E-01	LJ	1.40E-01	LJ	mg/kg	SC-SD-22_12/17/2018	2/40	1.90E-01 - 4.20E-01	1.40E-01	NA	NA	NA	NA	No	BSL
108-87-2	Methylcyclohexane	2.20E-02		4.40E+00		mg/kg	SC-SD-22_12/17/2018	2/33	5.70E-03 - 3.90E-01	4.40E+00	NA	6.50E+02 N	NA	NA	No	BSL
108-95-2	Phenol	1.20E-01	LJ	1.30E-01	LJ	mg/kg	SC-SD-22_12/17/2018	2/40	3.70E-01 - 8.10E-01	1.30E-01	NA	1.90E+03 N	NA	NA	No	BSL

TABLE 2.13
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - SEDIMENT
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
VOCS																
78-93-3	2-Butanone	2.10E-03	J	2.40E-01	J	mg/kg	P6-SD-05-0.5_10/19/2017	21/39	1.10E-02 - 7.70E-01	2.40E-01	NA	2.70E+03 N	NA	NA	No	BSL
67-64-1	Acetone	2.20E-03	LJ	8.60E-01	J	mg/kg	P6-SD-05-0.5_10/19/2017	31/40	1.10E-02 - 7.70E-01	8.60E-01	NA	6.10E+03 N	NA	NA	No	BSL
75-15-0	Carbon disulfide	3.00E-04	LJ	4.10E-03	J	mg/kg	P7-SD-01-0.5_10/25/2017	5/37	5.70E-03 - 3.90E-01	4.10E-03	NA	7.70E+01 N	NA	NA	No	BSL
110-82-7	Cyclohexane	1.00E-02		8.00E-01		mg/kg	SC-SD-22_12/17/2018	2/33	5.70E-03 - 3.90E-01	8.00E-01	NA	6.50E+02 N	NA	NA	No	BSL
100-41-4	Ethylbenzene	2.90E-04	J	2.90E-04	J	mg/kg	P7-SD-05-0.5_10/25/2017	1/34	5.70E-03 - 3.90E-01	2.90E-04	NA	5.80E+00 C	NA	NA	No	BSL
98-82-8	Isopropylbenzene	1.40E-02		6.50E-01		mg/kg	SC-SD-22_12/17/2018	2/33	5.70E-03 - 3.90E-01	6.50E-01	NA	1.90E+02 N	NA	NA	No	BSL
179601-23-1	m, p-Xylene	9.50E-04	J	7.70E-01		mg/kg	SC-SD-22_12/17/2018	5/37	5.70E-03 - 3.90E-01	7.70E-01	NA	5.80E+01 N	NA	NA	No	BSL
75-09-2	Methylene chloride	2.30E-04	LJ	1.30E-03	J	mg/kg	P7-SD-01-0.5_10/25/2017	11/37	5.70E-03 - 3.90E-01	1.30E-03	NA	3.50E+01 N	NA	NA	No	BSL
95-47-6	ortho-Xylene	7.00E-01		7.00E-01		mg/kg	SC-SD-22_12/17/2018	1/33	5.70E-03 - 3.90E-01	7.00E-01	NA	6.50E+01 N	NA	NA	No	BSL
108-88-3	Toluene	2.30E-04	J	1.00E-02	J	mg/kg	P2-SD-01-0.5_10/26/2017	17/38	5.70E-03 - 3.90E-01	1.00E-02	NA	4.90E+02 N	NA	NA	No	BSL
75-69-4	Trichlorofluoromethane	9.50E-04	J	9.50E-04	J	mg/kg	ET-SD-03-0.5_10/19/2017	1/36	5.70E-03 - 3.90E-01	9.50E-04	NA	2.30E+03 N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers: J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Methyl Mercury for Mercury.

TABLE 2.14
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - SUB-SLAB SOIL GAS TO INDOOR AIR - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Sub-slab soil gas
Exposure Medium: Indoor Air
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
95-63-6	1,2,4-Trimethylbenzene	2.12		2.12		ug/m ³	0188 (LPA-SS-01)_09/21/2016	1/4	2.12	NA	2.10E+02	N	BSL
78-93-3	2-Butanone	0.77		2.16		ug/m ³	0177 (LPA-SS-03)_09/21/2016	3/4	2.16	NA	1.73E+04	N	BSL
67-64-1	Acetone	11	B	16.3	B	ug/m ³	0177 (LPA-SS-03)_09/21/2016	2/4	16.3	NA	1.07E+05	N	BSL
71-43-2	Benzene	0.45		0.74		ug/m ³	0166(WPA-CS-04)_09/21/2016	3/4	0.74	NA	1.20E+01	C	BSL
74-87-3	Chloromethane	1.37		1.37		ug/m ³	0166(WPA-CS-04)_09/21/2016	1/4	1.37	NA	3.13E+02	N	BSL
75-71-8	Dichlorodifluoromethane	2.38		5.7		ug/m ³	0188 (LPA-SS-01)_09/21/2016	3/4	5.7	NA	3.33E+02	N	BSL
179601-23-1	m, p-Xylene	1.26		6.44		ug/m ³	0188 (LPA-SS-01)_09/21/2016	2/4	6.44	NA	3.33E+02	N	BSL
95-47-6	ortho-Xylene	1.09		1.09		ug/m ³	0188 (LPA-SS-01)_09/21/2016	1/4	1.09	NA	3.33E+02	N	BSL
127-18-4	Tetrachloroethene	0.75		0.75		ug/m ³	0188 (LPA-SS-01)_09/21/2016	1/4	0.75	NA	1.40E+02	N	BSL
108-88-3	Toluene	2.27		5.06		ug/m ³	0188 (LPA-SS-01)_09/21/2016	3/4	5.06	NA	1.73E+04	N	BSL
79-01-6	Trichloroethene	2.53		2.53		ug/m ³	0188 (LPA-SS-01)_09/21/2016	1/4	2.53	NA	7.00E+00	N	BSL
75-69-4	Trichlorofluoromethane	1.52		43.4		ug/m ³	0177 (LPA-SS-03)_09/21/2016	3/4	43.4	NA	NA	No	NSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential air value. For carcinogens the value shown is equal to the residential air value. To account for indoor air exposure, the residential air value is divided by 0.03.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level

Deletion Reason: BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

Definitions: C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

ug/m³ = micrograms per cubic meter

Data Qualifiers: B = Indicates analyte detected in associated method blank

TABLE 2.15
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - INDOOR AIR - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Air
Exposure Medium: Indoor Air
Exposure Point: Wilcox Oil Company

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
95-63-6	1,2,4-Trimethylbenzene	1.43		1.43		ug/m ³	H3431(WPA-IA-04)_09/21/2016	1/4	1.43	NA	6.30E+00	N	No	BSL
106-99-0	1,3-Butadiene	11.7		11.7		ug/m ³	H3431(WPA-IA-04)_09/21/2016	1/4	11.7	NA	9.40E-02	C	Yes	ASL
106-46-7	1,4-Dichlorobenzene	1.02		1.08	B	ug/m ³	H3431(WPA-IA-04)_09/21/2016	2/4	1.08	NA	2.60E-01	C	Yes	ASL
78-93-3	2-Butanone	3.66		6.47		ug/m ³	H3431(WPA-IA-04)_09/21/2016	4/4	6.47	NA	5.20E+02	N	No	BSL
67-64-1	Acetone	25.9	B	39.5	B	ug/m ³	H3431(WPA-IA-04)_09/21/2016	4/4	39.5	NA	3.20E+03	N	No	BSL
71-43-2	Benzene	0.32		5.57		ug/m ³	H3431(WPA-IA-04)_09/21/2016	4/4	5.57	NA	3.60E-01	C	Yes	ASL
67-66-3	Chloroform	0.93		0.93		ug/m ³	H3431(WPA-IA-04)_09/21/2016	1/4	0.93	NA	1.20E-01	C	Yes	ASL
74-87-3	Chloromethane	1.12		8.98		ug/m ³	H3431(WPA-IA-04)_09/21/2016	4/4	8.98	NA	9.40E+00	N	No	BSL
75-71-8	Dichlorodifluoromethane	2.23		11.2		ug/m ³	H3445 (LPA-IA-02)_09/21/2016	3/4	11.2	NA	1.00E+01	N	Yes	ASL
100-41-4	Ethylbenzene	1.44		1.44		ug/m ³	H3431(WPA-IA-04)_09/21/2016	1/4	1.44	NA	1.10E+00	C	Yes	ASL
110-54-3	Hexane	1.24		1.27		ug/m ³	H3431(WPA-IA-04)_09/21/2016	2/4	1.27	NA	7.30E+01	N	No	BSL
179601-23-1	m, p-Xylene	1.31		4.31		ug/m ³	H3431(WPA-IA-04)_09/21/2016	3/4	4.31	NA	1.00E+01	N	No	BSL
95-47-6	ortho-Xylene	1.09		1.09		ug/m ³	H3431(WPA-IA-04)_09/21/2016	1/4	1.09	NA	1.00E+01	N	No	BSL
100-42-5	Styrene	2.22		2.22		ug/m ³	H3431(WPA-IA-04)_09/21/2016	1/4	2.22	NA	1.00E+02	N	No	BSL
109-99-9	Tetrahydrofuran	3.72		3.72		ug/m ³	H3436 (LPA-IA-03)_09/21/2016	1/4	3.72	NA	NA		No	NSL
108-88-3	Toluene	1.25		10.2		ug/m ³	H3431(WPA-IA-04)_09/21/2016	4/4	10.2	NA	5.20E+02	N	No	BSL
75-69-4	Trichlorofluoromethane	1.58		19.3		ug/m ³	H3436 (LPA-IA-03)_09/21/2016	2/4	19.3	NA	NA		No	NSL
108-05-4	Vinyl acetate	2.01		3.88		ug/m ³	H3431(WPA-IA-04)_09/21/2016	3/4	3.88	NA	2.10E+01	N	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential air value. For carcinogens the value shown is equal to the residential air value.

(5) Rationale Codes

Selection Reason: ASL = Above Screening Toxicity Level
Deletion Reason: BSL = Below Screening Toxicity Level
NSL = No Screening Toxicity Level

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

ug/m³ = micrograms per cubic meter

Data Qualifiers: B = Indicates analyte detected in associated method blank

TABLE 2.16
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Metals																
7429-90-5	Aluminum	1.12E+03		2.10E+04		mg/kg	WO-005-006-06-51_05/21/2015	259/259	9.90E+00 - 2.45E+01	2.10E+04	5.01E+03	7.70E+03	N	NA	NA	ASL
7440-36-0	Antimony	6.00E-01		6.90E+00		mg/kg	R102-001-2.0_12/06/2018	4/259	5.00E-01 - 1.30E+00	6.90E+00	NA	3.10E+00	N	NA	NA	ASL
7440-38-2	Arsenic	6.00E-01		2.21E+01	J	mg/kg	R101-002-6.0_12/05/2018	258/259	3.50E-01 - 6.70E-01	2.21E+01	2.30E+00	6.80E-01	C	NA	NA	ASL
7440-39-3	Barium	1.52E+01		4.59E+02		mg/kg	WO-021-005-06-51_06/03/2015	253/253	1.00E+00 - 6.70E+00	4.59E+02	5.15E+01	1.50E+03	N	NA	NA	BSL
7440-41-7	Beryllium	1.10E-01	J	4.30E+00		mg/kg	R102-001-2.0_12/06/2018	54/259	3.50E-01 - 6.70E-01	4.30E+00	2.10E-01	1.60E+01	N	NA	NA	BSL
7440-43-9	Cadmium	7.10E-02	J	8.02E+01	J	mg/kg	WO-008-001-00-51_06/01/2015	16/259	3.50E-01 - 6.70E-01	8.02E+01	NA	7.10E+00	N	NA	NA	ASL
7440-70-2	Calcium	2.40E+02		1.17E+05	J	mg/kg	WO-008-003-00-51_06/01/2015	254/259	1.49E+01 - 1.57E+03	1.17E+05	3.66E+02		NA	NA	NA	NUT
7440-47-3	Chromium	2.10E+00		9.50E+01		mg/kg	WO-021-005-12-51_06/03/2015	259/259	7.00E-01 - 1.30E+00	9.50E+01	7.10E+00	1.20E+04	N	NA	NA	BSL
7440-48-4	Cobalt	8.00E-01		6.12E+01		mg/kg	WO-021-005-06-51_06/03/2015	226/253	3.50E-01 - 2.40E+00	6.12E+01	1.11E+01	2.30E+00	N	NA	NA	ASL
7440-50-8	Copper	1.60E+00		1.08E+02		mg/kg	WO-017-004-00-51S_06/09/2015	256/259	7.00E-01 - 2.40E+00	1.08E+02	3.24E+00	3.10E+02	N	NA	NA	BSL
57-12-5	Cyanide	1.70E-01	J	9.30E-01		mg/kg	R102-001-2.0_12/06/2018	2/24	4.10E-01 - 6.00E-01	9.30E-01	1.68E-01	2.30E+00	N	NA	NA	BSL
7439-89-6	Iron	2.21E+03		7.27E+04		mg/kg	WO-019-002-00-51_06/03/2015	259/259	2.50E+00 - 1.77E+01	7.27E+04	1.47E+04	5.50E+03	N	NA	NA	ASL
7439-92-1	Lead	2.50E+00		2.74E+02		mg/kg	WO-008-002-00-51_06/01/2015	253/253	3.50E-01 - 6.70E-01	2.74E+02	9.19E+00	4.00E+02	G	NA	NA	BSL
7439-95-4	Magnesium	1.42E+02		2.57E+04		mg/kg	R102-006-2.0_12/06/2018	241/259	1.49E+01 - 6.13E+02	2.57E+04	4.02E+02		NA	NA	NA	NUT
7439-96-5	Manganese	1.54E+01		1.88E+03	J	mg/kg	WO-021-003-24-51_06/03/2015	259/259	5.00E-01 - 1.80E+00	1.88E+03	5.06E+02	1.80E+02	N	NA	NA	ASL
7439-97-6	Mercury	1.60E-03	JL	4.30E-01		mg/kg	WO-008-002-06-51_06/01/2015	118/259	6.00E-02 - 1.40E-01	4.30E-01	3.80E-02	2.30E+00	N	NA	NA	BSL
7440-02-0	Nickel	1.10E+00		4.07E+01	J	mg/kg	R102-001-2.0_12/06/2018	229/259	3.50E-01 - 2.40E+00	4.07E+01	5.60E+00	1.50E+02	N	NA	NA	BSL
7440-09-7	Potassium	1.86E+02		1.76E+03		mg/kg	WO-008-001-12-51_06/01/2015	228/259	9.95E+01 - 6.13E+02	1.76E+03	6.42E+02		NA	NA	NA	NUT
7782-49-2	Selenium	1.70E-01	JL	8.90E+00		mg/kg	R102-001-2.0_12/06/2018	47/259	1.00E+00 - 3.30E+00	8.90E+00	NA	3.90E+01	N	NA	NA	BSL
7440-22-4	Silver	2.20E-02	J	4.70E+00		mg/kg	R102-001-2.0_12/06/2018	7/259	3.50E-01 - 1.20E+00	4.70E+00	NA	3.90E+01	N	NA	NA	BSL
7440-23-5	Sodium	2.66E+01	JL	8.15E+02		mg/kg	WO-020-001-24-51_05/18/2015	29/259	4.97E+01 - 6.13E+02	8.15E+02	1.16E+01		NA	NA	NA	NUT
7440-28-0	Thallium	3.80E+00		3.80E+00		mg/kg	R102-001-2.0_12/06/2018	1/259	3.50E-01 - 6.70E-01	3.80E+00	NA	7.80E-02	N	NA	NA	ASL
7440-62-2	Vanadium	2.80E+00		5.22E+01		mg/kg	WO-021-005-12-51_06/03/2015	253/253	1.80E+00 - 3.30E+00	5.22E+01	1.12E+01	3.90E+01	N	NA	NA	ASL
7440-66-6	Zinc	1.60E+00		1.38E+04	J	mg/kg	WO-008-001-00-51_06/01/2015	259/259	7.00E-01 - 6.70E+00	1.38E+04	1.42E+01	2.30E+03	N	NA	NA	ASL
PAHS																
91-57-6	2-Methylnaphthalene	7.50E-04	JL	6.60E+00		mg/kg	WO-008-004-12-51_06/01/2015	124/233	3.40E-03 - 3.80E+00	6.60E+00	NA	2.40E+01	N	NA	NA	BSL
83-32-9	Acenaphthene	7.90E-04	JL	7.30E-01	JL	mg/kg	WO-011-002-24-51_06/02/2015	27/233	3.40E-03 - 7.70E-01	7.30E-01	NA	3.60E+02	N	NA	NA	BSL
208-96-8	Acenaphthylene	7.40E-04	JL	5.50E-01		mg/kg	WO-008-004-00-51_06/01/2015	127/233	3.40E-03 - 7.70E-01	5.50E-01	NA	3.60E+02	N	NA	NA	BSL
120-12-7	Anthracene	8.60E-04	JL	2.10E+00		mg/kg	WO-011-002-24-51_06/02/2015	152/233	3.40E-03 - 7.70E-01	2.10E+00	NA	1.80E+03	N	NA	NA	BSL
56-55-3	Benzo (a) anthracene	8.00E-04	JL	3.60E+00		mg/kg	WO-008-004-12-51_06/01/2015	201/233	3.40E-03 - 1.90E+00	3.60E+00	NA	1.10E+00	C	NA	NA	ASL
50-32-8	Benzo (a) pyrene	9.10E-04	JL	1.90E+00		mg/kg	WO-008-004-12-51_06/01/2015	198/233	3.40E-03 - 7.70E-01	1.90E+00	NA	1.10E-01	C	NA	NA	ASL
205-99-2	Benzo (b) fluoranthene	9.20E-04	JL	2.70E+00		mg/kg	WO-008-004-00-51_06/01/2015	203/233	3.40E-03 - 2.00E+00	2.70E+00	NA	1.10E+00	C	NA	NA	ASL
191-24-2	Benzo (g,h,i) perylene	7.60E-04	JL	1.40E+00		mg/kg	WO-008-004-12-51_06/01/2015	172/233	3.40E-03 - 7.70E-01	1.40E+00	NA	1.80E+02	N	NA	NA	BSL
207-08-9	Benzo (k) fluoranthene	7.60E-04	J	8.30E-01		mg/kg	WO-008-004-00-51_06/01/2015	164/233	3.40E-03 - 7.70E-01	8.30E-01	NA	1.10E+01	C	NA	NA	BSL
218-01-9	Chrysene	7.80E-04	JL	5.20E+00		mg/kg	WO-008-004-12-51_06/01/2015	208/233	3.40E-03 - 3.80E+00	5.20E+00	NA	1.10E+02	C	NA	NA	BSL
53-70-3	Dibenz (a,h) anthracene	7.70E-04	JL	6.70E-01		mg/kg	WO-008-004-12-51_06/01/2015	141/233	3.40E-03 - 7.70E-01	6.70E-01	NA	1.10E-01	C	NA	NA	ASL
206-44-0	Fluoranthene	7.70E-04	JL	1.80E+00		mg/kg	WO-008-004-12-51_06/01/2015	203/233	3.40E-03 - 7.70E-01	1.80E+00	NA	2.40E+02	N	NA	NA	BSL
86-73-7	Fluorene	7.50E-04	JL	1.50E+00		mg/kg	WO-011-002-24-51_06/02/2015	40/233	3.40E-03 - 7.70E-01	1.50E+00	NA	2.40E+02	N	NA	NA	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	7.80E-04	JL	1.50E+00		mg/kg	WO-008-004-00-51_06/01/2015	196/233	3.40E-03 - 7.70E-01	1.50E+00	NA	1.10E+00	C	NA	NA	ASL
91-20-3	Naphthalene	7.40E-04	JL	1.60E+00		mg/kg	WO-008-004-12-51_06/01/2015	104/233	3.40E-03 - 7.70E-01	1.60E+00	NA	3.80E+00	C	NA	NA	BSL
85-01-8	Phenanthrene	8.10E-04	JL	1.10E+01		mg/kg	WO-008-004-12-51_06/01/2015	205/233	3.40E-03 - 3.80E+00	1.10E+01	NA	1.80E+02	N	NA	NA	BSL

TABLE 2.16
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
129-00-0	Pyrene	8.80E-04	JL	1.90E+01		mg/kg	WO-011-002-24-51 06/02/2015	205/233	3.40E-03 - 6.00E+00	1.90E+01	NA	1.80E+02 N	NA	NA	No	BSL

TABLE 2.16
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
PCBs																
11096-82-5	PCB-1260	1.00E-01		1.00E-01		mg/kg	WO-017-004-06-51_05/21/2015	1/209	2.16E-02 - 4.60E-01	1.00E-01	NA	2.40E-01 C	NA	NA	No	BSL
Pesticides																
72-54-8	4,4-DDD	4.90E-05	JL	1.10E-01	JL	mg/kg	WO-008-003-00-51_06/01/2015	111/209	1.08E-03 - 2.30E-01	1.10E-01	NA	1.90E-01 N	NA	NA	No	BSL
72-55-9	4,4-DDE	2.40E-05	JL	1.70E-02	JL	mg/kg	WO-008-002-06-51_06/01/2015	120/209	1.08E-03 - 2.30E-01	1.70E-02	NA	2.00E+00 C	NA	NA	No	BSL
50-29-3	4,4-DDT	5.20E-05	JL	4.00E-02	JL	mg/kg	WO-008-003-00-51_06/01/2015	118/209	1.08E-03 - 2.30E-01	4.00E-02	NA	1.90E+00 C	NA	NA	No	BSL
309-00-2	Aldrin	3.90E-05	JL	3.10E-03	J	mg/kg	WO-019-004-00-51_06/04/2015	38/209	1.08E-03 - 1.20E-01	3.10E-03	NA	3.90E-02 C	NA	NA	No	BSL
319-84-6	alpha-BHC	1.50E-05	JL	3.50E-03	JL	mg/kg	WO-008-004-12-51_06/01/2015	61/209	1.08E-03 - 1.20E-01	3.50E-03	NA	8.60E-02 C	NA	NA	No	BSL
5103-71-9	alpha-Chlordane	7.70E-05	JL	9.50E-03	J	mg/kg	WO-017-004-06-51_05/21/2015	14/209	1.08E-03 - 1.20E-01	9.50E-03	NA	1.70E+00 C	NA	NA	No	BSL
319-85-7	Beta-BHC	2.00E-05	JL	5.10E-03		mg/kg	WO-019-004-00-51_06/04/2015	54/209	1.08E-03 - 1.20E-01	5.10E-03	NA	3.00E-01 C	NA	NA	No	BSL
319-86-8	delta-BHC	1.40E-04	JL	2.40E-03	JL	mg/kg	WO-008-003-06-51_06/01/2015	8/209	1.08E-03 - 1.20E-01	2.40E-03	NA	8.60E-02 C	NA	NA	No	BSL
60-57-1	Dieldrin	2.80E-05	JL	7.50E-03	JL	mg/kg	WO-008-003-06-51_06/01/2015	61/209	1.08E-03 - 2.30E-01	7.50E-03	NA	3.40E-02 C	NA	NA	No	BSL
959-98-8	Endosulfan I	4.40E-05	JL	3.40E-03	JL	mg/kg	WO-011-002-24-51_06/02/2015	8/208	1.08E-03 - 1.20E-01	3.40E-03	NA	4.70E+01 N	NA	NA	No	BSL
33213-65-9	Endosulfan II	1.50E-05	JL	1.80E-02	JL	mg/kg	WO-008-002-06-51_06/01/2015, WO-008-003-00-51_06/01/2015	98/207	1.08E-03 - 2.30E-01	1.80E-02	NA	4.70E+01 N	NA	NA	No	BSL
1031-07-8	Endosulfan sulfate	3.50E-05	JL	1.70E-02	JL	mg/kg	WO-008-004-06-51_06/01/2015	66/206	1.08E-03 - 2.30E-01	1.70E-02	NA	3.80E+01 N	NA	NA	No	BSL
72-20-8	Endrin	5.80E-05	JL	2.90E-02	JL	mg/kg	WO-008-003-00-51_06/01/2015	84/207	1.08E-03 - 2.30E-01	2.90E-02	NA	1.90E+00 N	NA	NA	No	BSL
7421-93-4	Endrin aldehyde	3.70E-05	JL	1.20E-03	JL	mg/kg	WO-019-008-06-51_06/04/2015	29/207	1.08E-03 - 2.30E-01	1.20E-03	NA	1.90E+00 N	NA	NA	No	BSL
53494-70-5	Endrin ketone	2.40E-05	JL	6.90E-02	JL	mg/kg	WO-008-003-00-51_06/01/2015	70/204	1.08E-03 - 2.30E-01	6.90E-02	NA	1.90E+00 N	NA	NA	No	BSL
58-89-9	Gamma-BHC (Lindane)	1.50E-05	JL	2.00E-03	JL	mg/kg	WO-017-003-00-51_05/20/2015	65/209	1.08E-03 - 1.20E-01	2.00E-03	NA	5.70E-01 C	NA	NA	No	BSL
5103-74-2	gamma-Chlordane	4.80E-05	JL	5.00E-02	JL	mg/kg	WO-008-004-00-51_06/01/2015	118/209	1.08E-03 - 1.20E-01	5.00E-02	NA	1.70E+00 C	NA	NA	No	BSL
76-44-8	Heptachlor	2.20E-05	JL	4.13E-03		mg/kg	WO-020-003-00-52_05/18/2015	32/209	1.08E-03 - 1.20E-01	4.13E-03	NA	1.30E-01 C	NA	NA	No	BSL
1024-57-3	Heptachlor epoxide	1.00E-04	JL	1.39E-02		mg/kg	WO-020-003-00-52_05/18/2015	41/209	1.08E-03 - 1.20E-01	1.39E-02	NA	7.00E-02 C	NA	NA	No	BSL
72-43-5	Methoxychlor	1.40E-04	JL	8.30E-02	JL	mg/kg	WO-008-003-00-51_06/01/2015	71/195	1.08E-03 - 1.20E+00	8.30E-02	NA	3.20E+01 N	NA	NA	No	BSL
2051-24-3	PCB 209 (Decachlorobiphenyl)	1.88E-02		1.08E-01		mg/kg	WO-006-004-24-51_05/19/2015	60/60	0.00E+00 - 0.00E+00	1.08E-01	NA		NA	NA	No	BSL
877-09-8	Tetrachloro-m-xylene	9.05E-03		6.25E-02		mg/kg	WO-006-006-12-52_05/19/2015	60/60	0.00E+00 - 0.00E+00	6.25E-02	NA		NA	NA	No	BSL

TABLE 2.16
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
SVOCs																
106-44-5	4-Methylphenol	3.90E-02	JL	8.00E-02	JL	mg/kg	WO-019-001-00-51_06/03/2015	2/229	1.80E-01 - 6.00E+00	8.00E-02	NA	6.30E+02 N	NA	NA	No	BSL
100-01-6	4-Nitroaniline	5.20E-02	JL	5.20E-02	JL	mg/kg	WO-019-001-00-52_06/03/2015	1/229	3.40E-01 - 1.20E+01	5.20E-02	NA	2.50E+01 N	NA	NA	No	BSL
98-86-2	Acetophenone	8.10E-02	JL	8.10E-02	JL	mg/kg	WO-008-002-24-51_06/01/2015	1/233	1.80E-01 - 6.00E+00	8.10E-02	NA	7.80E+02 N	NA	NA	No	BSL
100-52-7	Benzaldehyde	1.60E-02	JL	2.00E-02	JL	mg/kg	WO-006-007-00-51_05/18/2015	3/233	1.80E-01 - 6.00E+00	2.00E-02	NA	1.70E+02 C	NA	NA	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	1.60E-02	JL	9.80E-01		mg/kg	WO-021-003-06-51_06/03/2015	103/233	1.80E-01 - 6.00E+00	9.80E-01	NA	3.90E+01 C	NA	NA	No	BSL
85-68-7	Butyl benzyl phthalate	9.30E-02	JL	9.30E-02	JL	mg/kg	WO-002-001-06-51_06/02/2015	1/233	1.80E-01 - 6.00E+00	9.30E-02	NA	2.90E+02 C	NA	NA	No	BSL
86-74-8	Carbazole	2.40E-02	JL	4.60E-01	JL	mg/kg	WO-008-004-24-51_06/01/2015	11/233	1.80E-01 - 6.00E+00	4.60E-01	NA		NA	NA	No	BSL
132-64-9	Dibenzofuran	2.30E-02	JL	2.80E-02	JL	mg/kg	WO-002-003-06-51_06/02/2015	2/233	1.80E-01 - 6.00E+00	2.80E-02	NA	7.30E+00 N	NA	NA	No	BSL
131-11-3	Dimethyl phthalate	8.20E-02	JL	2.70E-01		mg/kg	R101-001-2.0_12/05/2018, R102-004-6.0_12/06/2018, R102-001-2.0_12/06/2018	23/233	1.80E-01 - 6.00E+00	2.70E-01	NA		NA	NA	No	BSL
84-74-2	Di-n-butyl phthalate	1.50E-02	JL	1.30E-01	JL	mg/kg	WO-005-004-00-51_05/20/2015	10/233	1.80E-01 - 6.00E+00	1.30E-01	NA	6.30E+02 N	NA	NA	No	BSL
108-87-2	Methylcyclohexane	6.10E-04	JL	2.60E+01		mg/kg	WO-008-002-24-51_06/01/2015	8/233	3.50E-03 - 1.30E+00	2.60E+01	NA	6.50E+02 N	NA	NA	No	BSL
87-86-5	Pentachlorophenol	8.50E-04	JL	5.10E-03	JL	mg/kg	WO-020-004-00-51_05/18/2015	19/233	7.00E-03 - 1.60E+00	5.10E-03	NA	1.00E+00 C	NA	NA	No	BSL
108-95-2	Phenol	9.10E-02	JL	2.10E-01	J	mg/kg	R101-004-2.0_12/05/2018, R101-003-2.0_12/05/2018, R101-002-2.0_12/05/2018	23/233	1.80E-01 - 6.00E+00	2.10E-01	NA	1.90E+03 N	NA	NA	No	BSL

TABLE 2.16
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection	
VOCS																	
78-93-3	2-Butanone	2.80E-03	JL	6.60E-02		mg/kg	WO-021-003-06-51_06/03/2015	62/233	3.50E-03 - 2.70E+00	6.60E-02	NA	2.70E+03	N	NA	NA	No	BSL
460-00-4	4-Bromofluorobenzene	4.45E-02		5.09E-02		mg/kg	WO-020-005-00-51_05/18/2015	35/35	0.00E+00 - 0.00E+00	5.09E-02	NA	2.30E+00	N	NA	NA	No	BSL
108-10-1	4-Methyl-2-pentanone	2.70E-03	JL	5.80E-03	JL	mg/kg	WO-021-004-00-51_06/03/2015	4/233	3.50E-03 - 2.70E+00	5.80E-03	NA	3.30E+03	N	NA	NA	No	BSL
67-64-1	Acetone	1.30E-03	JL	2.10E-01		mg/kg	WO-021-004-00-51_06/03/2015	142/233	7.10E-03 - 2.70E+00	2.10E-01	NA	6.10E+03	N	NA	NA	No	BSL
71-43-2	Benzene	4.40E-03	JL	1.90E+00		mg/kg	WO-008-002-24-51_06/01/2015	5/233	3.50E-03 - 1.30E+00	1.90E+00	NA	1.20E+00	C	NA	NA	Yes	ASL
75-15-0	Carbon disulfide	3.80E-04	JL	5.90E-04	JL	mg/kg	WO-021-003-06-51_06/03/2015	3/232	3.50E-03 - 1.30E+00	5.90E-04	NA	7.70E+01	N	NA	NA	No	BSL
67-66-3	Chloroform	3.90E-04	JL	2.30E-03	JL	mg/kg	WO-008-002-06-51_06/01/2015	12/232	3.50E-03 - 1.30E+00	2.30E-03	NA	3.20E-01	C	NA	NA	No	BSL
110-82-7	Cyclohexane	1.80E-03	JL	1.30E+01		mg/kg	WO-008-002-24-51_06/01/2015	7/233	3.50E-03 - 1.30E+00	1.30E+01	NA	6.50E+02	N	NA	NA	No	BSL
100-41-4	Ethylbenzene	2.00E-04	JL	2.90E+00		mg/kg	WO-008-002-24-51_06/01/2015	14/233	3.50E-03 - 1.30E+00	2.90E+00	NA	5.80E+00	C	NA	NA	No	BSL
98-82-8	Isopropylbenzene	1.10E-01	JL	1.70E+00		mg/kg	WO-008-002-24-51_06/01/2015	4/233	3.50E-03 - 1.30E+00	1.70E+00	NA	1.90E+02	N	NA	NA	No	BSL
179601-23-1	m, p-Xylene	1.40E-04	JL	2.40E+00		mg/kg	WO-008-002-24-51_06/01/2015	50/233	4.00E-03 - 1.30E+00	2.40E+00	NA	5.80E+01	N	NA	NA	No	BSL
75-09-2	Methylene chloride	2.40E-04	JL	5.10E-03	J	mg/kg	R101-002-2.0_12/05/2018	17/232	3.50E-03 - 1.30E+00	5.10E-03	NA	3.50E+01	N	NA	NA	No	BSL
95-47-6	ortho-Xylene	1.50E-04	JL	5.40E-01	JL	mg/kg	WO-008-002-24-51_06/01/2015	21/233	3.50E-03 - 1.30E+00	5.40E-01	NA	6.50E+01	N	NA	NA	No	BSL
108-88-3	Toluene	1.60E-04	JL	6.40E-01		mg/kg	WO-008-002-12-51_06/01/2015	143/233	3.50E-03 - 1.30E+00	6.40E-01	NA	4.90E+02	N	NA	NA	No	BSL
75-69-4	Trichlorofluoromethane	2.90E-04	JL	3.30E-04	JL	mg/kg	WO-008-003-00-51_06/01/2015	2/232	3.50E-03 - 1.30E+00	3.30E-04	NA	2.30E+03	N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

(4) USEPA Regional Screening Levels, USEPA, May 2019. For non-carcinogens, value shown is equal to 1/10 the residential soil value. For carcinogens the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers:

B = Indicates analyte detected in associated method blank

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 2.17
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SUBSURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
Metals																
7429-90-5	Aluminum	2.45E+03		2.26E+04		mg/kg	R102-005-12.0_12/06/2018	12/12	1.82E+01 - 2.29E+01	2.26E+04	NA	7.70E+03	N	NA	Yes	ASL
7440-38-2	Arsenic	1.20E+00	J	1.85E+01	J	mg/kg	R102-004-12.0_12/06/2018	12/12	4.70E-01 - 6.00E-01	1.85E+01	NA	6.80E-01	C	NA	Yes	ASL
7440-39-3	Barium	1.57E+01		1.00E+02	J	mg/kg	R102-005-12.0_12/06/2018	9/9	4.70E+00 - 6.00E+00	1.00E+02	NA	1.50E+03	N	NA	No	BSL
7440-41-7	Beryllium	1.20E-01	J	1.30E+00		mg/kg	R102-005-12.0_12/06/2018	11/12	4.70E-01 - 6.00E-01	1.30E+00	NA	1.60E+01	N	NA	No	BSL
7440-43-9	Cadmium	1.10E-01	J	1.40E-01	J	mg/kg	R101-005-12.0_12/05/2018	2/12	4.70E-01 - 6.00E-01	1.40E-01	NA	7.10E+00	N	NA	No	BSL
7440-70-2	Calcium	4.67E+02	JL	1.32E+04		mg/kg	R102-004-12.0_12/06/2018	11/12	4.56E+02 - 5.71E+02	1.32E+04	NA			NA	No	NUT
7440-47-3	Chromium	1.80E+00	J	2.02E+01	J	mg/kg	R102-005-12.0_12/06/2018	12/12	9.40E-01 - 1.20E+00	2.02E+01	NA	1.20E+04	N	NA	No	BSL
7440-48-4	Cobalt	1.20E+00		7.60E+00	J	mg/kg	R102-004-12.0_12/06/2018	9/9	4.70E-01 - 6.00E-01	7.60E+00	NA	2.30E+00	N	NA	Yes	ASL
7440-50-8	Copper	1.20E+00		8.60E+00		mg/kg	R101-002-12.0_12/05/2018	12/12	9.40E-01 - 1.20E+00	8.60E+00	NA	3.10E+02	N	NA	No	BSL
7439-89-6	Iron	2.93E+03		4.37E+04	J	mg/kg	R102-005-12.0_12/06/2018	12/12	9.10E+00 - 2.21E+01	4.37E+04	NA	5.50E+03	N	NA	Yes	ASL
7439-92-1	Lead	1.80E+00	J	1.79E+01	J	mg/kg	R101-002-12.0_12/05/2018	9/9	4.70E-01 - 6.00E-01	1.79E+01	NA	4.00E+02	G	NA	No	BSL
7439-95-4	Magnesium	4.10E+02	J	3.36E+03		mg/kg	R102-005-12.0_12/06/2018	11/12	4.56E+02 - 5.71E+02	3.36E+03	NA			NA	No	NUT
7439-96-5	Manganese	1.90E+01		1.57E+02		mg/kg	R101-005-12.0_12/05/2018	12/12	1.40E+00 - 1.70E+00	1.57E+02	NA	1.80E+02	N	NA	No	BSL
7439-97-6	Mercury	2.40E-02	JL	3.20E-02	J	mg/kg	R101-005-12.0_12/05/2018	2/12	9.20E-02 - 1.10E-01	3.20E-02	NA	2.30E+00	N	NA	No	BSL
7440-02-0	Nickel	7.20E-01	J	2.39E+01	J	mg/kg	R102-005-12.0_12/06/2018	12/12	4.70E-01 - 6.00E-01	2.39E+01	NA	1.50E+02	N	NA	No	BSL
7440-09-7	Potassium	5.30E+02		3.88E+03		mg/kg	R102-005-12.0_12/06/2018	11/12	4.56E+02 - 5.71E+02	3.88E+03	NA			NA	No	NUT
7782-49-2	Selenium	1.70E-01	J	8.90E-01	J	mg/kg	R102-005-12.0_12/06/2018	10/12	2.30E+00 - 3.00E+00	8.90E-01	NA	3.90E+01	N	NA	No	BSL
7440-22-4	Silver	2.30E-02	JL	2.30E-02	JL	mg/kg	R101-002-12.0_12/05/2018	1/12	4.70E-01 - 6.00E-01	2.30E-02	NA	3.90E+01	N	NA	No	BSL
7440-23-5	Sodium	2.64E+01	JL	7.34E+02		mg/kg	R102-005-12.0_12/06/2018	5/12	4.56E+02 - 5.71E+02	7.34E+02	NA			NA	No	NUT
7440-62-2	Vanadium	4.70E+00		3.03E+01	J	mg/kg	R102-005-12.0_12/06/2018	9/9	2.30E+00 - 3.00E+00	3.03E+01	NA	3.90E+01	N	NA	No	BSL
7440-66-6	Zinc	3.70E+00		5.35E+01	J	mg/kg	R101-002-12.0_12/05/2018	12/12	9.40E-01 - 1.20E+00	5.35E+01	NA	2.30E+03	N	NA	No	BSL
PAHS																
91-57-6	2-Methylnaphthalene	1.60E-03	JL	1.60E-03	JL	mg/kg	R101-005-12.0_12/05/2018	1/12	3.60E-03 - 2.00E-01	1.60E-03	NA	2.40E+01	N	NA	No	BSL
83-32-9	Acenaphthene	1.30E-03	JL	1.30E-03	JL	mg/kg	R101-006-12.0_12/05/2018	1/12	3.60E-03 - 2.00E-01	1.30E-03	NA	3.60E+02	N	NA	No	BSL
208-96-8	Acenaphthylene	1.00E-03	J	1.10E-01		mg/kg	R101-006-12.0_12/05/2018	4/12	3.70E-03 - 2.00E-01	1.10E-01	NA	3.60E+02	N	NA	No	BSL
120-12-7	Anthracene	9.30E-04	J	6.90E-02		mg/kg	R101-006-12.0_12/05/2018	4/12	3.70E-03 - 2.00E-01	6.90E-02	NA	1.80E+03	N	NA	No	BSL
56-55-3	Benzo (a) anthracene	1.10E-03	J	1.90E-01		mg/kg	R101-006-12.0_12/05/2018	6/12	3.70E-03 - 2.00E-01	1.90E-01	NA	1.10E+00	C	NA	No	BSL
50-32-8	Benzo (a) pyrene	1.10E-03	J	1.40E-01		mg/kg	R101-006-12.0_12/05/2018	5/12	3.70E-03 - 2.00E-01	1.40E-01	NA	1.10E-01	C	NA	Yes	ASL
205-99-2	Benzo (b) fluoranthene	1.60E-03	J	2.70E-01		mg/kg	R101-006-12.0_12/05/2018	5/12	3.80E-03 - 2.00E-01	2.70E-01	NA	1.10E+00	C	NA	No	BSL
191-24-2	Benzo (g,h,i) perylene	9.50E-04	J	1.10E-01		mg/kg	R101-006-12.0_12/05/2018	5/12	3.70E-03 - 2.00E-01	1.10E-01	NA	1.80E+02	N	NA	No	BSL
207-08-9	Benzo (k) fluoranthene	1.30E-03	J	9.60E-02		mg/kg	R101-006-12.0_12/05/2018	4/12	3.70E-03 - 2.00E-01	9.60E-02	NA	1.10E+01	C	NA	No	BSL
218-01-9	Chrysene	8.90E-04	J	1.60E-01		mg/kg	R101-006-12.0_12/05/2018	6/12	3.70E-03 - 2.00E-01	1.60E-01	NA	1.10E+02	C	NA	No	BSL
53-70-3	Dibenz (a,h) anthracene	9.70E-04	J	3.20E-02		mg/kg	R101-005-12.0_12/05/2018	3/12	3.60E-03 - 2.00E-01	3.20E-02	NA	1.10E-01	C	NA	No	BSL
206-44-0	Fluoranthene	1.00E-03	J	2.20E-01		mg/kg	R101-006-12.0_12/05/2018	6/12	3.80E-03 - 4.00E-01	2.20E-01	NA	2.40E+02	N	NA	No	BSL
86-73-7	Fluorene	2.00E-03	JL	2.00E-03	JL	mg/kg	R101-006-12.0_12/05/2018	1/12	3.60E-03 - 2.00E-01	2.00E-03	NA	2.40E+02	N	NA	No	BSL
193-39-5	Indeno (1,2,3-cd) pyrene	8.00E-04	J	1.20E-01		mg/kg	R101-006-12.0_12/05/2018	6/12	3.70E-03 - 2.00E-01	1.20E-01	NA	1.10E+00	C	NA	No	BSL
85-01-8	Phenanthrene	1.30E-03	J	1.40E-02		mg/kg	R101-005-12.0_12/05/2018	6/12	3.60E-03 - 2.00E-01	1.40E-02	NA	1.80E+02	N	NA	No	BSL
129-00-0	Pyrene	1.60E-03	J	2.50E-01		mg/kg	R101-006-12.0_12/05/2018	5/12	3.70E-03 - 2.00E-01	2.50E-01	NA	1.80E+02	N	NA	No	BSL

TABLE 2.17
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SUBSURFACE SOIL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Subsurface soil Exposure Medium: Subsurface soil Exposure Point: Wilcox Oil Company - Wilcox Residential Area

CAS Number	Chemical	Minimum ⁽¹⁾ Concentration	Minimum Qualifier	Maximum ⁽¹⁾ Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration ⁽²⁾ Used for Screening	Background ⁽³⁾ Value	Screening ⁽⁴⁾ Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for ⁽⁵⁾ Contaminant Deletion or Selection
SVOCS																
131-11-3	Dimethyl phthalate	1.10E-01	JL	2.50E-01		mg/kg	R102-006-12.0_12/06/2018	12/12	1.80E-01 - 2.00E-01	2.50E-01	NA		NA	NA	No	BSL
108-95-2	Phenol	9.90E-02	J	2.30E-01	J	mg/kg	R101-003-12.0_12/05/2018	12/12	3.60E-01 - 4.00E-01	2.30E-01	NA	1.90E+03 N	NA	NA	No	BSL
VOCS																
78-93-3	2-Butanone	2.10E-01		2.10E-01		mg/kg	R101-003-12.0_12/05/2018	1/12	8.60E-03 - 1.10E-02	2.10E-01	NA	2.70E+03 N	NA	NA	No	BSL
67-64-1	Acetone	4.00E-03	J	1.00E-01		mg/kg	R101-003-12.0_12/05/2018	6/12	8.60E-03 - 1.10E-02	1.00E-01	NA	6.10E+03 N	NA	NA	No	BSL
75-09-2	Methylene chloride	2.90E-03	J	4.60E-03	J	mg/kg	R102-005-12.0_12/06/2018	4/12	4.30E-03 - 5.60E-03	4.60E-03	NA	3.50E+01 N	NA	NA	No	BSL

(1) Minimum/maximum detected concentration.

(2) Maximum concentration used as screening value.

(3) Background values are not included as part of the COPC selection process.

the value shown is equal to the residential soil value.

(5) Rationale Codes

Selection Reason:

ASL = Above Screening Toxicity Level

Deletion Reason:

BSL = Below Screening Toxicity Level

NSL = No Screening Toxicity Level

NUT = Essential Nutrient

Definitions:

C = Carcinogenic

COPC = Chemical of Potential Concern

N = Non-Carcinogenic

NA = Not Applicable

mg/kg = milligrams per kilogram

Data Qualifiers:

B = Indicates analyte detected in associated method blank

J = Indicates an estimated value

L = Reported concentration is below the CRQL (non-metals)/Reported concentration is between the MDL and the CRQL (metals)

Surrogates used: Mercuric Chloride for Mercury.

TABLE 3.1
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - NORTH TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Surface soil Exposure Medium: Surface soil Exposure Point: Wilcox Oil Company - North Tank Farm

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	5.48E+03	6.67E+03	1.85E+04		mg/kg	6.67E+03	95%UCLM-L	ProUCL
Antimony	mg/kg	8.45E-01	5.95E-01	4.10E+00		mg/kg	5.95E-01	95%UCLM-KMC	ProUCL
Arsenic	mg/kg	2.01E+00	2.33E+00	6.20E+00		mg/kg	2.33E+00	95%UCLM-L	ProUCL
Cobalt	mg/kg	4.27E+00	4.97E+00	1.78E+01	J	mg/kg	4.97E+00	95%UCLM-L	ProUCL
Iron	mg/kg	1.02E+04	1.16E+04	3.51E+04	J	mg/kg	1.16E+04	95%UCLM-G	ProUCL
Manganese	mg/kg	4.43E+02	5.55E+02	7.40E+03	J	mg/kg	5.55E+02	95%UCLM-L	ProUCL
PAHS									
Benzo (a) anthracene	mg/kg	1.07E-01	2.72E-01	2.26E+00	J	mg/kg	2.72E-01	95%UCLM-KMC	ProUCL
Benzo (a) pyrene	mg/kg	9.91E-02	2.47E-01	2.02E+00	J	mg/kg	2.47E-01	95%UCLM-KMC	ProUCL
Benzo (b) fluoranthene	mg/kg	1.19E-01	3.18E-01	2.70E+00	J	mg/kg	3.18E-01	95%UCLM-KMC	ProUCL
Dibenz (a,h) anthracene	mg/kg	3.02E-02	5.02E-02	3.64E-01		mg/kg	5.02E-02	95%UCLM-KMC	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.2
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - NORTH TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - North Tank Farm

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	6.39E+03	8.08E+03	1.67E+04		mg/kg	8.08E+03	95%UCLM-G	ProUCL
Arsenic	mg/kg	2.46E+00	3.41E+00	1.29E+01		mg/kg	3.41E+00	95%UCLM-G	ProUCL
Cobalt	mg/kg	5.52E+00	1.13E+01	2.93E+01		mg/kg	1.13E+01	95%UCLM-C	ProUCL
Iron	mg/kg	1.40E+04	1.78E+04	4.69E+04		mg/kg	1.78E+04	95%UCLM-G	ProUCL
Manganese	mg/kg	1.65E+02	2.26E+02	6.14E+02	J	mg/kg	2.26E+02	95%UCLM-G	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Lorraine Process Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	4.37E+03	5.15E+03	2.27E+04	J	mg/kg	5.15E+03	95%UCLM-L	ProUCL
Arsenic	mg/kg	2.17E+00	2.44E+00	4.60E+00		mg/kg	2.44E+00	95%UCLM-G	ProUCL
Chromium, Hexavalent	mg/kg	1.21E+00	NA	1.50E+00		mg/kg	1.50E+00	Maximum	LOW #DETECTS
Cobalt	mg/kg	3.18E+00	3.51E+00	1.33E+01		mg/kg	3.51E+00	95%UCLM-KMH	ProUCL
Copper	mg/kg	4.25E+01	1.53E+02	1.67E+03		mg/kg	1.53E+02	95%UCLM-KMC	ProUCL
Iron	mg/kg	8.93E+03	1.01E+04	4.02E+04		mg/kg	1.01E+04	95%UCLM-G	ProUCL
Lead	mg/kg	5.37E+02	3.25E+02	2.08E+04	J	mg/kg	5.37E+02	Mean	USEPA 1994
Manganese	mg/kg	1.86E+02	2.22E+02	1.43E+03		mg/kg	2.22E+02	95%UCLM-L	ProUCL
PAHS									
Benzo (a) anthracene	mg/kg	1.27E-01	2.81E-01	2.10E+00		mg/kg	2.81E-01	95%UCLM-KMC	ProUCL
Benzo (a) pyrene	mg/kg	1.94E-01	2.10E-01	3.70E+00		mg/kg	2.10E-01	95%UCLM-KMH	ProUCL
Benzo (b) fluoranthene	mg/kg	3.39E-01	4.13E-01	7.90E+00		mg/kg	4.13E-01	95%UCLM-KMH	ProUCL
Dibenz (a,h) anthracene	mg/kg	2.86E-02	3.10E-03	2.20E-01	J	mg/kg	3.10E-03	95%UCLM-KMH	ProUCL
Indeno (1,2,3-cd) pyrene	mg/kg	6.19E-02	4.82E-02	1.60E+00		mg/kg	4.82E-02	95%UCLM-KMH	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMH indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Land's H-statistics.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

LOW #DETECTS indicates low number of detects.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

TABLE 3.4
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - LORRAINE PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Subsurface soil Exposure Medium: Subsurface soil Exposure Point: Wilcox Oil Company - Lorraine Process Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	5.92E+03	6.63E+03	2.19E+04		mg/kg	6.63E+03	95%UCLM-G	ProUCL
Arsenic	mg/kg	2.60E+00	2.87E+00	9.40E+00		mg/kg	2.87E+00	95%UCLM-KMG	ProUCL
Cobalt	mg/kg	4.68E+00	5.00E+00	1.91E+01		mg/kg	5.00E+00	95%UCLM-KMG	ProUCL
Copper	mg/kg	1.80E+01	5.90E+01	7.06E+02		mg/kg	5.90E+01	95%UCLM-KMC	ProUCL
Iron	mg/kg	1.10E+04	1.22E+04	3.87E+04		mg/kg	1.22E+04	95%UCLM-G	ProUCL
Lead	mg/kg	2.21E+01	7.69E+01	9.72E+02		mg/kg	2.21E+01	Mean	USEPA 1994
Manganese	mg/kg	1.32E+02	1.59E+02	7.42E+02		mg/kg	1.59E+02	95%UCLM-G	ProUCL
Thallium	mg/kg	7.55E-02	8.09E-02	6.00E-01		mg/kg	8.09E-02	95%UCLM-KMC	ProUCL
PAHS									
Benzo (a) pyrene	mg/kg	4.15E-02	2.28E-02	2.20E-01	J+	mg/kg	2.28E-02	95%UCLM-KMG	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMG indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) approximate or adjusted gamma test.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

TABLE 3.5
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - LOADING DOCK AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Loading Dock Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	3.64E+03	4.62E+03	8.30E+03	J	mg/kg	4.62E+03	95%UCLM-L	ProUCL
Antimony	mg/kg	4.25E+00	2.98E+00	6.80E+00		mg/kg	2.98E+00	95%UCLM-KMC	ProUCL
Arsenic	mg/kg	3.05E+00	3.99E+00	9.40E+00		mg/kg	3.99E+00	95%UCLM-G	ProUCL
Cobalt	mg/kg	5.75E+00	1.52E+01	4.32E+01		mg/kg	1.52E+01	95%UCLM-C	ProUCL
Iron	mg/kg	1.15E+04	1.53E+04	5.73E+04	J	mg/kg	1.53E+04	95%UCLM-L	ProUCL
Manganese	mg/kg	2.63E+02	4.19E+02	1.81E+03	J	mg/kg	4.19E+02	95%UCLM-G	ProUCL
PAHS									
Benzo (a) pyrene	mg/kg	1.50E-01	2.83E-01	7.70E-01	LJ	mg/kg	2.83E-01	95%UCLM-G	ProUCL
VOCS									
Benzene	mg/kg	2.80E+00	NA	2.80E+00	J	mg/kg	2.80E+00	Maximum	N < 5
Ethylbenzene	mg/kg	3.65E+00	NA	6.70E+00		mg/kg	6.70E+00	Maximum	N < 5

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

N < 5 indicates that the number of samples is less than 5, so the maximum detected value was used.

UCLM>Maximum indicates that the recommended 95 UCL exceeds the maximum detected value, therefore the maximum detected value is used.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.6
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - LOADING DOCK AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Subsurface soil Exposure Medium: Subsurface soil Exposure Point: Wilcox Oil Company - Loading Dock Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	4.25E+03	8.39E+03	9.45E+03		mg/kg	8.39E+03	95%UCLM-N	ProUCL
Arsenic	mg/kg	1.84E+00	3.26E+00	3.30E+00		mg/kg	3.26E+00	95%UCLM-N	ProUCL
Cobalt	mg/kg	8.14E+00	NA	2.69E+01		mg/kg	2.69E+01	Maximum	N < 5
Iron	mg/kg	8.51E+03	1.50E+04	1.44E+04	J	mg/kg	1.44E+04	Maximum	UCLM>Maximum
Manganese	mg/kg	1.56E+02	3.91E+02	4.53E+02	J	mg/kg	3.91E+02	95%UCLM-N	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-N indicates that the 95 percent upper confidence limit on the mean is based on the student's t-test for normal distributions.

N < 5 indicates that the number of samples is less than 5, so the maximum detected value was used.

UCLM>Maximum indicates that the recommended 95 UCL exceeds the maximum detected value, therefore the maximum detected value is used.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.7
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - Wilcox Process Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	4.79E+03	5.46E+03	1.90E+04	J	mg/kg	5.46E+03	95%UCLM-L	ProUCL
Arsenic	mg/kg	2.81E+00	3.86E+00	2.09E+01		mg/kg	3.86E+00	95%UCLM-C	ProUCL
Cadmium	mg/kg	9.24E-01	1.42E+00	1.30E+01		mg/kg	1.42E+00	95%UCLM-KMC	ProUCL
Chromium, Hexavalent	mg/kg	9.40E-01	1.18E+00	1.30E+00		mg/kg	1.18E+00	95%UCLM-KMt	ProUCL
Cobalt	mg/kg	3.78E+00	3.87E+00	2.25E+01		mg/kg	3.87E+00	95%UCLM-L	ProUCL
Copper	mg/kg	9.13E+01	4.10E+02	7.49E+03		mg/kg	4.10E+02	95%UCLM-KMC	ProUCL
Iron	mg/kg	1.16E+04	1.26E+04	4.75E+04		mg/kg	1.26E+04	95%UCLM-L	ProUCL
Lead	mg/kg	4.61E+02	7.20E+02	1.90E+04		mg/kg	4.61E+02	Mean	USEPA 1994
Manganese	mg/kg	2.73E+02	3.72E+02	1.42E+03	J	mg/kg	3.72E+02	95%UCLM-C	ProUCL
Thallium	mg/kg	6.66E-02	1.20E-01	4.80E-01	J	mg/kg	1.20E-01	95%UCLM-KMC	ProUCL
Vanadium	mg/kg	1.20E+01	1.35E+01	7.92E+01		mg/kg	1.35E+01	95%UCLM-M	ProUCL
Zinc	mg/kg	1.27E+02	3.10E+02	3.96E+03	J	mg/kg	3.10E+02	95%UCLM-C	ProUCL
PAHS									
2-Methylnaphthalene	mg/kg	1.40E+00	3.12E+00	3.00E+01		mg/kg	3.12E+00	95%UCLM-KMH	ProUCL
Benzo (a) anthracene	mg/kg	1.51E+00	4.57E+00	4.40E+01		mg/kg	4.57E+00	95%UCLM-KMH	ProUCL
Benzo (a) pyrene	mg/kg	1.14E+00	2.53E+00	3.10E+01		mg/kg	2.53E+00	95%UCLM-KMH	ProUCL
Benzo (b) fluoranthene	mg/kg	1.12E+00	2.16E+00	3.50E+01		mg/kg	2.16E+00	95%UCLM-KMH	ProUCL
Chrysene	mg/kg	3.39E+00	1.16E+01	1.20E+02	J	mg/kg	1.16E+01	95%UCLM-KMH	ProUCL
Dibenz (a,h) anthracene	mg/kg	3.39E-01	3.07E-01	5.90E+00		mg/kg	3.07E-01	95%UCLM-KMH	ProUCL
Indeno (1,2,3-cd) pyrene	mg/kg	2.49E-01	4.29E-01	5.70E+00		mg/kg	4.29E-01	95%UCLM-KMH	ProUCL
Naphthalene	mg/kg	5.30E-01	8.06E-01	8.50E+00		mg/kg	8.06E-01	95%UCLM-KMH	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

95%UCLM-M indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric modified t-test.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

TABLE 3.8
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Subsurface soil Exposure Medium: Subsurface soil Exposure Point: Wilcox Oil Company - Wilcox Process Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	7.57E+03	8.29E+03	1.79E+04	J	mg/kg	8.29E+03	95%UCLM-G	ProUCL
Arsenic	mg/kg	3.42E+00	4.81E+00	2.03E+01		mg/kg	4.81E+00	95%UCLM-C	ProUCL
Cobalt	mg/kg	6.01E+00	6.61E+00	3.26E+01		mg/kg	6.61E+00	95%UCLM-KMG	ProUCL
Iron	mg/kg	1.41E+04	1.57E+04	7.23E+04		mg/kg	1.57E+04	95%UCLM-M	ProUCL
Lead	mg/kg	2.94E+01	7.36E+01	9.21E+02		mg/kg	2.94E+01	Mean	USEPA 1994
Manganese	mg/kg	2.60E+02	2.83E+02	3.77E+03		mg/kg	2.83E+02	95%UCLM-L	ProUCL
Vanadium	mg/kg	1.60E+01	1.72E+01	4.02E+01		mg/kg	1.72E+01	95%UCLM-L	ProUCL
PAHS									
2-Methylnaphthalene	mg/kg	6.31E+00	1.39E+01	1.40E+02	J	mg/kg	1.39E+01	95%UCLM-KMC	ProUCL
Benzo (a) anthracene	mg/kg	1.32E+00	2.07E+00	2.20E+01		mg/kg	2.07E+00	95%UCLM-KMC	ProUCL
Benzo (a) pyrene	mg/kg	9.44E-01	1.62E+00	2.40E+01	J	mg/kg	1.62E+00	95%UCLM-KMC	ProUCL
Benzo (b) fluoranthene	mg/kg	1.11E+00	1.78E+00	2.70E+01	J	mg/kg	1.78E+00	95%UCLM-KMC	ProUCL
Dibenz (a,h) anthracene	mg/kg	2.67E-01	5.48E-02	4.00E+00	J	mg/kg	5.48E-02	95%UCLM-KMH	ProUCL
Indeno (1,2,3-cd) pyrene	mg/kg	2.24E-01	9.09E-02	4.00E+00	J	mg/kg	9.09E-02	95%UCLM-KMH	ProUCL
Naphthalene	mg/kg	3.29E+00	6.55E+00	6.70E+01		mg/kg	6.55E+00	95%UCLM-KMC	ProUCL

TABLE 3.8
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - WILCOX PROCESS AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Subsurface soil Exposure Medium: Subsurface soil Exposure Point: Wilcox Oil Company - Wilcox Process Area

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
VOCS									
Benzene	mg/kg	1.17E+00	1.07E+00	4.80E+00	JL	mg/kg	1.07E+00	95%UCLM-KMG	ProUCL
Chloroform	mg/kg	1.60E+01	NA	2.20E+01		mg/kg	2.20E+01	Maximum	Low # Detects
Ethylbenzene	mg/kg	7.48E+00	4.00E+00	2.80E+01		mg/kg	4.00E+00	95%UCLM-KMt	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMG indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) approximate or adjusted gamma test.

95%UCLM-KMH indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Land's H-statistics.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

95%UCLM-M indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric modified t-test.

Low#Detects indicates number of detects less than 5.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.9
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - EAST TANK FARM - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	7.38E+03	8.26E+03	2.42E+04		mg/kg	8.26E+03	95%UCLM-L	ProUCL
Arsenic	mg/kg	2.66E+00	2.94E+00	1.13E+01		mg/kg	2.94E+00	95%UCLM-L	ProUCL
Cobalt	mg/kg	4.72E+00	5.38E+00	3.05E+01		mg/kg	5.38E+00	95%UCLM-KMH	ProUCL
Iron	mg/kg	1.33E+04	1.51E+04	7.76E+04	J	mg/kg	1.51E+04	95%UCLM-L	ProUCL
Lead	mg/kg	8.15E+01	2.25E+02	2.73E+03		mg/kg	8.15E+01	Mean	USEPA 1994
Manganese	mg/kg	3.19E+02	6.41E+02	6.06E+03	J	mg/kg	6.41E+02	95%UCLM-C	ProUCL
Thallium	mg/kg	1.29E-01	1.97E-01	2.10E-01	JL	mg/kg	1.97E-01	95%UCLM-KMt	ProUCL
PAHS									
Benzo (a) anthracene	mg/kg	2.39E-01	5.71E-01	1.10E+01		mg/kg	5.71E-01	95%UCLM-KMC	ProUCL
Benzo (a) pyrene	mg/kg	2.50E-01	6.22E-01	1.20E+01		mg/kg	6.22E-01	95%UCLM-KMC	ProUCL
Benzo (b) fluoranthene	mg/kg	3.54E-01	1.03E+00	2.00E+01		mg/kg	1.03E+00	95%UCLM-KMC	ProUCL
Indeno (1,2,3-cd) pyrene	mg/kg	8.50E-02	1.73E-01	3.10E+00		mg/kg	1.73E-01	95%UCLM-KMC	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMH indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Land's H-statistics.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

TABLE 3.10
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - EAST TANK FARM - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Subsurface soil
Exposure Medium: Subsurface soil
Exposure Point: Wilcox Oil Company - East Tank Farm

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	7.18E+03	8.19E+03	1.64E+04	J	mg/kg	8.19E+03	95%UCLM-G	ProUCL
Arsenic	mg/kg	3.81E+00	4.71E+00	1.44E+01		mg/kg	4.71E+00	95%UCLM-L	ProUCL
Cobalt	mg/kg	6.96E+00	8.56E+00	2.97E+01		mg/kg	8.56E+00	95%UCLM-G	ProUCL
Iron	mg/kg	1.56E+04	1.81E+04	6.58E+04	J	mg/kg	1.81E+04	95%UCLM-G	ProUCL
Manganese	mg/kg	1.83E+02	2.50E+02	9.92E+02		mg/kg	2.50E+02	95%UCLM-L	ProUCL
PAHS									
Benzo (a) pyrene	mg/kg	7.41E-02	5.98E-02	4.20E-01		mg/kg	5.98E-02	95%UCLM-KMG	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMG indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) approximate or adjusted gamma test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

TABLE 3.11
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - GROUNDWATER MONITORING WELLS
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future Medium: Groundwater Exposure Medium: Groundwater-Monitoring Wells Exposure Point: Wilcox Oil Company

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals-Total									
Aluminum	ug/L	3.92E+03	5.12E+04	1.29E+04	J	ug/L	1.29E+04	Maximum Detected	UCLM>Maximum
Arsenic	ug/L	1.35E+01	1.98E+01	2.83E+01		ug/L	1.98E+01	95%UCLM-KMt	ProUCL
Cobalt	ug/L	4.99E+00	8.64E+00	1.08E+01	J-	ug/L	8.64E+00	95%UCLM-N	ProUCL
Cyanide	ug/L	2.01E+01	NA	4.71E+01		ug/L	4.71E+01	Maximum Detected	N<5
Iron	ug/L	1.93E+04	3.34E+04	4.94E+04		ug/L	3.34E+04	95%UCLM-N	ProUCL
Manganese	ug/L	6.58E+02	1.04E+03	1.40E+03		ug/L	1.04E+03	95%UCLM-N	ProUCL
Lead	ug/L	4.62E+00	6.73E+00	1.00E+01		ug/L	6.73E+00	95%UCLM-KMt	ProUCL
Vanadium	ug/L	7.70E+00	1.02E+01	1.25E+01	J	ug/L	1.02E+01	95%UCLM-KMt	ProUcL
PAHS									
2-Methylnaphthalene	ug/L	2.17E+01	NA	3.30E+01		ug/L	3.30E+01	Maximum Detected	N<5
Naphthalene	ug/L	3.66E+01	5.92E+01	9.50E+01		ug/L	5.92E+01	95%UCLM-KMt	ProUCL
VOCS									
1,2-Dichloroethane	ug/L	4.10E+00	NA	4.10E+00	J	ug/L	4.10E+00	Maximum Detected	N<5
Benzene	ug/L	8.01E+02	NA	2.40E+03		ug/L	2.40E+03	Maximum Detected	N<5
Ethylbenzene	ug/L	3.67E+02	NA	1.10E+03		ug/L	1.10E+03	Maximum Detected	N<5
Isopropylbenzene	ug/L	5.75E+01	NA	6.00E+01		ug/L	6.00E+01	Maximum Detected	N<5
m, p-Xylene	ug/L	7.68E+02	NA	2.30E+03		ug/L	2.30E+03	Maximum Detected	N<5
ortho-Xylene	ug/L	2.50E+02	NA	5.00E+02		ug/L	5.00E+02	Maximum Detected	N<5
Toluene	ug/L	5.51E+02	NA	1.10E+03		ug/L	1.10E+03	Maximum Detected	N<5

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-N indicates that the 95 percent upper confidence limit on the mean is based on the student's t-test for normal distributions.

N < 5 indicates that the number of samples is less than 5, so the maximum detected value was used.

UCLM>Maximum indicates that the recommended 95 UCL exceeds the maximum detected value, therefore the maximum detected value is used.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.12
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - SURFACE WATER
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Surface water
Exposure Medium: Surface water
Exposure Point: Wilcox Oil Company

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Inorganics-Total									
Cyanide	ug/L	2.96E+01	NA	2.96E+01		ug/L	2.96E+01	Maximum	LOW #DETECTS
Metals-Total									
Aluminum	ug/L	2.95E+03	3.71E+03	1.91E+04	J	ug/L	3.71E+03	95%UCLM-KMC	ProUCL
Arsenic	ug/L	3.00E+00	1.88E+00	5.40E+00		ug/L	1.88E+00	95%UCLM-KMt	ProUCL
Cadmium	ug/L	1.46E+01	3.15E+00	2.50E+01		ug/L	3.15E+00	95%UCLM-KMt	ProUCL
Chromium, Hexavalent	ug/L	2.18E-01	1.39E-01	3.42E-01		ug/L	1.39E-01	95%UCLM-KMt	ProUCL
Iron	ug/L	2.00E+03	4.44E+03	1.94E+04		ug/L	4.44E+03	95%UCLM-C	ProUCL
Lead	ug/L	4.85E+01	9.75E+00	1.81E+02		ug/L	4.85E+01	Mean	USEPA 1994
Manganese	ug/L	2.28E+02	3.59E+02	1.08E+03		ug/L	3.59E+02	95%UCLM-L	ProUCL
Vanadium	ug/L	1.54E+01	4.53E+00	2.91E+01		ug/L	4.53E+00	95%UCLM-KMt	ProUCL
PAHS									
Benzo (a) anthracene	ug/L	1.00E-01	NA	1.00E-01	J	ug/L	1.00E-01	Maximum	LOW #DETECTS
Benzo (a) pyrene	ug/L	4.54E-02	4.32E-02	6.00E-02		ug/L	4.32E-02	95%UCLM-KMt	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

LOW #DETECTS indicates low number of detects.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.13
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - SEDIMENT
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment
Exposure Point: Wilcox Oil Company

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	5.58E+03	6.87E+03	1.69E+04	J	mg/kg	6.87E+03	95%UCLM-G	ProUCL
Arsenic	mg/kg	1.86E+00	2.25E+00	7.20E+00		mg/kg	2.25E+00	95%UCLM-G	ProUCL
Chromium, Hexavalent	mg/kg	2.64E+00	4.20E+00	4.80E+00		mg/kg	4.20E+00	95%UCLM-N	ProUCL
Cobalt	mg/kg	3.50E+00	4.24E+00	1.40E+01	J	mg/kg	4.24E+00	95%UCLM-L	ProUCL
Iron	mg/kg	8.69E+03	1.04E+04	2.49E+04		mg/kg	1.04E+04	95%UCLM-G	ProUCL
Manganese	mg/kg	1.73E+02	2.23E+02	1.02E+03		mg/kg	2.23E+02	95%UCLM-G	ProUCL
PAHS									
Benzo (a) anthracene	mg/kg	9.25E-02	2.73E-01	1.60E+00		mg/kg	2.73E-01	95%UCLM-KMC	ProUCL
Benzo (a) pyrene	mg/kg	6.77E-02	1.91E-01	1.20E+00		mg/kg	1.91E-01	95%UCLM-KMC	ProUCL
Benzo (b) fluoranthene	mg/kg	7.54E-02	2.49E-01	1.60E+00		mg/kg	2.49E-01	95%UCLM-KMC	ProUCL
Dibenz (a,h) anthracene	mg/kg	2.53E-02	5.21E-02	2.90E-01		mg/kg	5.21E-02	95%UCLM-KMC	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

95%UCLM-N indicates that the 95 percent upper confidence limit on the mean is based on the student's t-test for normal distributions.

TABLE 3.14
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current Medium: Air Exposure Medium: Indoor Air Exposure Point: Wilcox Oil Company

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
No Chemicals of Potential Concern									

TABLE 3.15
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - INDOOR AIR
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Air Exposure Medium: Indoor Air Exposure Point: Wilcox Oil Company

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
VOCS									
1,3-Butadiene	ug/m ³	1.17E+01	NA	1.17E+01		ug/m ³	1.17E+01	Maximum Detected	N<5
1,4-Dichlorobenzene	ug/m ³	1.05E+00	NA	1.08E+00		ug/m ³	1.08E+00	Maximum Detected	N<5
Benzene	ug/m ³	1.66E+00	NA	5.57E+00		ug/m ³	5.57E+00	Maximum Detected	N<5
Chloroform	ug/m ³	9.30E-01	NA	9.30E-01		ug/m ³	9.30E-01	Maximum Detected	N<5
Dichlorodifluoromethane	ug/m ³	8.08E+00	NA	1.12E+01		ug/m ³	1.12E+01	Maximum Detected	N<5
Ethylbenzene	ug/m ³	1.44E+00	NA	1.44E+00		ug/m ³	1.44E+00	Maximum Detected	N<5

N < 5 indicates that the number of samples is less than 5, so the maximum detected value was used.

NA = Not Applicable

TABLE 3.16
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future-Residential
Medium: Surface soil
Exposure Medium: Surface soil
Exposure Point: Residential Yards

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	4.48E+03	5.32E+03	2.10E+04		mg/kg	5.32E+03	95%UCLM-C	ProUCL
Antimony	mg/kg	2.25E+00	NA	6.90E+00		mg/kg	6.90E+00	Maximum	LOW #DETECTS
Arsenic	mg/kg	2.57E+00	3.29E+00	2.21E+01	J	mg/kg	3.29E+00	95%UCLM-KMC	ProUCL
Cadmium	mg/kg	6.07E+00	2.33E-01	8.02E+01	J	mg/kg	2.33E-01	95%UCLM-KMH	ProUCL
Cobalt	mg/kg	3.38E+00	3.69E+00	6.12E+01		mg/kg	3.69E+00	95%UCLM-BCA	ProUCL
Iron	mg/kg	8.26E+03	1.00E+04	7.27E+04		mg/kg	1.00E+04	95%UCLM-C	ProUCL
Manganese	mg/kg	1.91E+02	2.50E+02	1.88E+03	J	mg/kg	2.50E+02	95%UCLM-C	ProUCL
Thallium	mg/kg	3.80E+00	NA	3.80E+00		mg/kg	3.80E+00	Maximum	LOW #DETECTS
Vanadium	mg/kg	1.32E+01	1.40E+01	5.22E+01		mg/kg	1.40E+01	95%UCLM-L	ProUCL
Zinc	mg/kg	8.71E+01	3.19E+02	1.38E+04	J	mg/kg	3.19E+02	95%UCLM-C	ProUCL
PAHS									
Benzo (a) anthracene	mg/kg	1.24E-01	2.13E-01	3.60E+00		mg/kg	2.13E-01	95%UCLM-KMC	ProUCL
Benzo (a) pyrene	mg/kg	9.02E-02	1.48E-01	1.90E+00		mg/kg	1.48E-01	95%UCLM-KMC	ProUCL
Benzo (b) fluoranthene	mg/kg	1.09E-01	1.80E-01	2.70E+00		mg/kg	1.80E-01	95%UCLM-KMC	ProUCL
Dibenz (a,h) anthracene	mg/kg	3.48E-02	4.46E-02	6.70E-01		mg/kg	4.46E-02	95%UCLM-KMC	ProUCL
Indeno (1,2,3-cd) pyrene	mg/kg	6.72E-02	1.06E-01	1.50E+00		mg/kg	1.06E-01	95%UCLM-KMC	ProUCL
VOCS									
Benzene	mg/kg	5.97E-01	3.32E-02	1.90E+00		mg/kg	3.32E-02	95%UCLM-KMt	ProUCL

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-BCA indicates that the 95 percent upper confidence limit on the mean is based on the Kaplan-Meier (KM) Bias-Corrected Accelerated (BCA) percentile bootstrap test.

95%UCLM-C indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Chebyshev test.

95%UCLM-KMC indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Chebyshev test.

95%UCLM-KMH indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) Land's H-statistics.

95%UCLM-KMt indicates that the 95 percent upper confidence limit on the mean is based on the non-parametric Kaplan-Meier (KM) student's t-test.

95%UCLM-L indicates that the 95 percent upper confidence limit on the mean is based on the Land (H) statistic for lognormal distributions.

LOW #DETECTS indicates low number of detects.

USEPA 1994 = The arithmetic mean is used per USEPA lead model guidance (USEPA 1994).

NA = Not Applicable

TABLE 3.17
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
WILCOX OIL COMPANY - WILCOX RESIDENTIAL AREA - SUBSURFACE SOIL - RESIDENTIAL
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future-Residential

Medium: Subsurface soil

Exposure Medium: Subsurface soil

Exposure Point: Residential Yards

Chemical of Potential Concern	Units	Mean Detected Concentration	95% UCLM	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Metals									
Aluminum	mg/kg	9.88E+03	1.32E+04	2.26E+04		mg/kg	1.32E+04	95%UCLM-N	ProUCL
Arsenic	mg/kg	6.65E+00	9.50E+00	1.85E+01	J	mg/kg	9.50E+00	95%UCLM-N	ProUCL
Cobalt	mg/kg	3.43E+00	4.89E+00	7.60E+00	J	mg/kg	4.89E+00	95%UCLM-N	ProUCL
Iron	mg/kg	1.49E+04	2.67E+04	4.37E+04	J	mg/kg	2.67E+04	95%UCLM-G	ProUCL
PAHS									
Benzo (a) pyrene	mg/kg	3.11E-02	1.87E+00	1.40E-01		mg/kg	1.40E-01	Maximum	UCLM>Maximum

Note: Statistics calculated by the EPA program ProUCL.

95%UCLM-G indicates that the 95 percent upper confidence limit on the mean is based on the approximate or adjusted gamma distribution.

95%UCLM-N indicates that the 95 percent upper confidence limit on the mean is based on the student's t-test for normal distributions.

UCLM>Maximum indicates that the recommended 95 UCL exceeds the maximum detected value, therefore the maximum detected value is used.

TABLE 4.1
VALUES USED FOR RESIDENT ADULT DAILY SOIL INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil, Air
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	Chronic Daily Intake (CDI) (mg/kg/day) = $CS \times CR \times EF \times ED \times CF / (BW \times AT)$ Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) = $CS \times EF \times [(ED_{6-16} \times CR \times 3) + (ED_{16-26} \times CR \times 1)] / BW \times CF / (AT)$
	CR	Ingestion Rate	mg/day	100	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a	
	ED-NC	Exposure Duration - Noncancer	yr	20	U.S. EPA 2014a	
	ED-C	Exposure Duration-Cancer	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging Time - Noncancer	days	7,300	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
Dermal	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	CDI (mg/kg/day) = $CS \times SA \times AF \times ABS \times EF \times ED \times CF / (BW \times AT)$ Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) = $CS \times EF \times ABS \times [(ED_{6-16} \times SA \times AF \times 3) + (ED_{16-26} \times SA \times AF \times 1)] / BW \times CF / (AT)$
	SA	Surface Area for Contact	cm ² /event	6,032	U.S. EPA 2014a	
	AF	Adherence Factor	mg/cm ²	0.07	U.S. EPA 2014a (1)	
	EF	Exposure Frequency	event/yr	350	U.S. EPA 1991a	
	ED-NC	Exposure Duration - Noncancer	yr	20	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging time - Noncancer	days	7,300	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004 (2)	
Inhalation	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	Exposure Concentration (µg/m ³ or mg/m ³) = $CA \times CF_1 \times ET \times EF \times ED / AT \times CF_2$ Note: CF ₁ only used in carcinogenic intake calculations Mutagenic Exposure Concentration (MEC) (µg/m ³) = $CA \times ET \times EF \times [(ED_{6-16} \times 3) + (ED_{16-26} \times 1)] \times CF_1 / (AT \times CF_2)$
	CF ₁	Conversion Factor	µg/mg	1,000	U.S. EPA 2009a	
	ET	Exposure Time	hr/day	24	U.S. EPA 2009a	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a	
	ED-NC	Exposure Duration - Noncancer	yr	20	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging Time - Noncancer	days	7,300	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF ₂	Conversion Factor	hour/day	24	U.S. EPA 2009a	

(1) Taken from Exhibit 3-5 of USEPA 2004.

(2) Taken from Exhibit 3-4 of USEPA 2004.

BPJ = Best Professional Judgment

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meterµg/m³ = micrograms per cubic metercm²/event = square centimeters per event

µg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.2
VALUES USED FOR RESIDENT CHILD DAILY SOIL INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil, Air
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	Chronic Daily Intake (CDI) (mg/kg/day) = $CS \times CR \times EF \times ED \times CF / (BW \times AT)$ Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) = $CS \times EF \times [(ED_{0-2} \times CR \times 10) + (ED_{2-6} \times CR \times 3)] / BW \times CF / (AT)$
	CR	Ingestion Rate	mg/day	200	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a	
	ED-NC	Exposure Duration - Noncancer	yr	6	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 1989	
	AT- NC	Averaging Time - Noncancer	days	2,190	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
Dermal	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	CDI (mg/kg/day) = $CS \times SA \times AF \times ABS \times EF \times ED \times CF / (BW \times AT)$ Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) = $CS \times EF \times ABS \times [(ED_{0-2} \times SA \times AF \times 10) + (ED_{2-6} \times SA \times AF \times 3)] / BW \times CF / (AT)$
	SA	Surface Area for Contact	cm ² /event	2,373	U.S. EPA 2014a	
	AF	Adherence Factor	mg/cm ²	0.2	U.S. EPA 2014a (1)	
	EF	Exposure Frequency	event/yr	350	U.S. EPA 1991a	
	ED-NC	Exposure Duration - Noncancer	yr	6	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 1989	
	AT- NC	Averaging time - Noncancer	days	2,190	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004 (2)	
Inhalation	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	Exposure Concentration (µg/m ³ or mg/m ³) = $CA \times CF_1 \times ET \times EF \times ED / AT \times CF_2$ Note: CF ₁ only used in carcinogenic intake calculations Mutagenic Exposure Concentration (MEC) (µg/m ³) = $CA \times ET \times EF \times [(ED_{0-2} \times 10) + (ED_{2-6} \times 3)] \times CF_1 / (AT \times CF_2)$
	CF ₁	Conversion Factor	µg/mg	1,000	U.S. EPA 2009a	
	ET	Exposure Time	hr/day	24	U.S. EPA 2009a	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a	
	ED-NC	Exposure Duration - Noncancer	yr	6	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 1989	
	AT- NC	Averaging Time - Noncancer	days	2,190	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF ₂	Conversion Factor	hour/day	24	U.S. EPA 2009a	

(1) Taken from Exhibit 3-5 of USEPA 2004.

(2) Taken from Exhibit 3-4 of USEPA 2004.

BPJ = Best Professional Judgment

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meterµg/m³ = micrograms per cubic metercm²/event = square centimeters per event

µg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.3
VALUES USED FOR CONSTRUCTION WORKER DAILY SOIL INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil, Air
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	$CDI (mg/kg/day) = \frac{CS \times CR \times EF \times ED \times CF}{(BW \times AT)}$
	CR	Ingestion Rate	mg/day	330	U.S. EPA 2002b	
	EF	Exposure Frequency	day/yr	250	U.S. EPA 1991a	
	ED	Exposure Duration	yr	1	BPJ (1)	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging Time - Noncancer	days	365	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
Dermal	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	$CDI (mg/kg/day) = \frac{CS \times SA \times AF \times ABS \times EF \times ED \times CF}{(BW \times AT)}$
	SA	Surface Area for Contact	cm ² /event	3,527	U.S. EPA 2014a	
	AF	Adherence Factor	mg/cm ²	0.30	U.S. EPA 2014a	
	EF	Exposure Frequency	event/yr	250	U.S. EPA 1991a	
	ED	Exposure Duration	yr	1	BPJ (1)	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging time - Noncancer	days	365	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004 (2)	
Inhalation	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	$\text{Exposure Concentration } (\mu g/m^3 \text{ or } mg/m^3) = \frac{CA \times CF_1 \times ET \times EF \times ED}{AT \times CF_2}$ Note: CF₁ only used in carcinogenic intake calculations
	CF ₁	Conversion Factor	μg/mg	1,000	U.S. EPA 2009a	
	ET	Exposure Time	hr/day	8	U.S. EPA 2009a	
	EF	Exposure Frequency	day/yr	250	U.S. EPA 1991a	
	ED	Exposure Duration	yr	1	BPJ (1)	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging Time - Noncancer	days	365	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF ₂	Conversion Factor	hour/day	24	U.S. EPA 2009a	

(1) Construction events are assumed to extend for up to one year total in duration

(2) Taken from Exhibit 3-4 of USEPA 2004.

BPJ = Best Professional Judgment

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

Wilcox Oil Company Superfund Site

Bristow, Creek County, Oklahoma

mg/cm² = milligrams per square centimeter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meterμg/m³ = micrograms per cubic metercm²/event = square centimeters per event

μg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.4
VALUES USED FOR COMMERCIAL/INDUSTRIAL WORKER DAILY SURFACE SOIL INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Medium: Soil Exposure Medium: Surface Soil, Air Receptor Population: Commercial/Industrial Worker Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	$CDI (mg/kg/day) = CS \times CR \times EF \times ED \times CF / (BW \times AT)$
	CR	Ingestion Rate	mg/day	100	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	250	U.S. EPA 2014a	
	ED	Exposure Duration	yr	25	U.S. EPA 1991a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging Time - Noncancer	days	9,125	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
Dermal	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	$CDI (mg/kg/day) = CS \times SA \times AF \times ABS \times EF \times ED \times CF / (BW \times AT)$
	SA	Surface Area for Contact	cm ² /event	3,527	U.S. EPA 2014a	
	AF	Adherence Factor	mg/cm ²	0.02	U.S. EPA 2004 (1)	
	EF	Exposure Frequency	event/yr	250	U.S. EPA 2014a	
	ED	Exposure Duration	yr	25	U.S. EPA 1991a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging time - Noncancer	days	9,125	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004 (2)	
Inhalation	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	$Exposure Concentration (\mu g/m^3 \text{ or } mg/m^3) = CA \times CF_1 \times ET \times EF \times ED / AT \times CF_2$
	CF ₁	Conversion Factor	μg/mg	1,000	U.S. EPA 2009a	
	ET	Exposure Time	hr/day	8	U.S. EPA 2009a	
	EF	Exposure Frequency	day/yr	250	U.S. EPA 2014a	
	ED	Exposure Duration	yr	25	U.S. EPA 1991a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT- NC	Averaging Time - Noncancer	days	9,125	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF ₂	Conversion Factor	hour/day	24	U.S. EPA 2009a	

(1) Taken from Exhibit 3-3 of USEPA 2004, assuming office/commercial workers would have limited contact with soil. Therefore, a low-end contact adherence factor is selected based upon an adult gardener.

(2) Taken from Exhibit 3-4 of USEPA 2004.

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meter

μg/m³ = micrograms per cubic meter

cm² /event = square centimeters per event

μg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.5
VALUES USED FOR ADOLESCENT TRESPASSER DAILY SURFACE SOIL INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current Medium: Soil Exposure Medium: Surface Soil, Air Receptor Population: Trespasser Receptor Age: Adolescent

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	$\text{CDI (mg/kg/day)} = \text{CS} \times \text{CR} \times \text{EF} \times \text{ED} \times \text{CF} / (\text{BW} \times \text{AT})$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = \text{CS} \times \text{EF} \times [(\text{ED}_{6-16} \times \text{CR} \times 3)/\text{BW}] \times \text{CF} / (\text{AT})$
	CR	Ingestion Rate	mg/day	100	BPJ (1)	
	EF	Exposure Frequency	day/yr	52	BPJ (4)	
	ED	Exposure Duration	yr	10	BPJ (4)	
	BW	Body Weight	kg	45	U.S. EPA 2011	
	AT- NC	Averaging Time - Noncancer	days	3,650	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	$\text{CDI (mg/kg/day)} = \text{CS} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED} \times \text{CF} / (\text{BW} \times \text{AT})$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = \text{CS} \times \text{EF} \times \text{ABS} \times [(\text{ED}_{6-16} \times \text{SA} \times \text{AF} \times 3)/\text{BW}] \times \text{CF} / (\text{AT})$
	CS	Chemical Concentration in Soil	mg/kg	Chemical-Specific	Chemical-Specific	
	SA	Surface Area for Contact	cm ² /event	4,530	U.S. EPA 2011 (2)	
	AF	Adherence Factor	mg/cm ²	0.20	U.S. EPA 2014a (3)	
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2016a	
	EF	Exposure Frequency	event/yr	52	BPJ (4)	
	ED	Exposure Duration	yr	10	BPJ (4)	
	BW	Body Weight	kg	45	U.S. EPA 2011	
	AT- NC	Averaging time - Noncancer	days	3,650	U.S. EPA 1989	
Inhalation	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	$\text{Exposure Concentration (ug/m}^3 \text{ or mg/m}^3 \text{)} = \text{CA} \times \text{CF}_1 \times \text{ET} \times \text{EF} \times \text{ED} / \text{AT} \times \text{CF}_2$ Note: CF ₁ is only used in determining carcinogenic exposure concentrations $\text{Mutagenic Exposure Concentration (ug/m}^3 \text{ or mg/m}^3 \text{)} = \text{CA} \times \text{ET} \times \text{CF} \times \text{EF} \times [(\text{ED}_{6-16} \times 3)] / (\text{AT} \times \text{CF}_2)$
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	
	ET	Exposure Time	hr/day	4	BPJ (4)	
	CF ₁	Conversion Factor	ug/mg	1,000	U.S. EPA 2009a	
	EF	Exposure Frequency	day/yr	52	BPJ (4)	
	ED	Exposure Duration	yr	10	BPJ (4)	
	CF ₂	Conversion Factor	hr/day	24	U.S. EPA 2009a	
	AT- NC	Averaging Time - Noncancer	days	3,650	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	

(1) The incidental soil ingestion rate is assumed to be equal to that of an adult resident.

(2) Taken from Table 7-2 of USEPA 2011a, equal to the average of two age ranges: 6 to <11 years and 11 to <16 years. Assuming head, hands, forearms, and lower legs are exposed.

(3) Assumes soil adherence is similar to that of resident child.

(4) The exposure frequency is based on best professional judgment, assuming that the user would visit the site approximately 2 days/week for 6 months of the year for 4 hours per day. The exposure duration is based on the age range evaluated (6 - 16 years of age).

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter μg/m³ = micrograms per cubic meter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meter

cm²/event = square centimeters per event

μg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.6
VALUES USED FOR RESIDENT ADULT DAILY TOTAL GROUND WATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future Medium: Ground Water Exposure Medium: Tap Water Receptor Population: Resident Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = CW \times CR \times EF \times ED / (BW \times AT)$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = CW \times EF \times [(ED_{6-16} \times CR \times 3) + (ED_{16-26} \times CR \times 1)/BW] / (AT)$
	CR	Ingestion Rate	L/day	2.5	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a,b	
	ED-NC	Exposure Duration - Noncancer	yr	20	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging Time - Noncancer	days	7,300	U.S. EPA 1989	
Dermal	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	$CDI \text{ (mg/kg/day)} = DA_{\text{event}} \times SA \times EF \times ED \times CF / (BW \times AT)$ $\text{For inorganics, } DA_{\text{event}} = PC \times ET \times CW$ $\text{For organics, } DA_{\text{event}} = \text{see calculations presented on Tables 7.13, 7.24, and 7.40}$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = CW \times EF \times PC \times ET \times [(ED_{6-16} \times SA \times 3) + (ED_{16-26} \times SA \times 1)/BW] \times CF / (AT)$
	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	
	SA	Surface Area for Contact	cm ²	19,652	U.S. EPA 2014a	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	U.S. EPA 2019a	
	ET	Event Time	hr/day	0.71	U.S. EPA 2011	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a,b	
	ED-NC	Exposure Duration - Noncancer	yr	20	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	7,300	U.S. EPA 1989	
Inhalation	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	$\text{Exposure Concentration (mg/m}^3\text{)} = CA \times ET \times EF \times ED / AT \times CF$ $\text{where, } CA = VF \times CW$ $\text{Mutagenic Chronic Daily Intake (MCDI) (}\mu\text{g/m}^3\text{)} = CA \times ET \times EF \times [(ED_{0-2} \times 10) + (ED_{2-16} \times 3) + (ED_{16-26} \times 1)] / (AT)$
	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1991a,b	
	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	
	ET	Exposure Time	hr/day	24	U.S. EPA 2014a	
	EF	Exposure Frequency	days/yr	350	U.S. EPA 1991a,b	
	VF	Volatilization Factor	L/cm ³	0.5	U.S. EPA 2019a	
	CF	Conversion Factor	hr/day	24	U.S. EPA 2009	
	ED-NC	Exposure Duration - Noncancer	yr	26	U.S. EPA 2014a	
	ED-C	Exposure Duration - Cancer	yr	26	U.S. EPA 2014a	
	AT-NC	Averaging Time - Noncancer	days	9,490	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

cm² = square centimetermg/m³ = milligrams per cubic meters

kg = kilogram

mg/L = milligrams per liter

RME = Reasonable Maximum Exposure

DA = Dermal absorbed dose

L/m³ = liters per cubic meter

hr = hour

yr = year

TABLE 4.7
VALUES USED FOR RESIDENT CHILD DAILY TOTAL GROUND WATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future Medium: Ground Water Exposure Medium: Tap Water Receptor Population: Resident Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$\text{CDI (mg/kg/day)} = \frac{\text{CW} \times \text{CR} \times \text{EF} \times \text{ED}}{(\text{BW} \times \text{AT})}$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = \frac{\text{CW} \times \text{EF} \times ((\text{ED}_{0-2} \times \text{CR} \times 10) + (\text{ED}_{2-6} \times \text{CR} \times 3))}{(\text{BW}) \times (\text{AT})}$
	CR	Ingestion Rate	L/day	0.78	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a,b	
	ED	Exposure Duration	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 2014a	
	AT-NC	Averaging Time - Noncancer	days	2,190	U.S. EPA 1989	
Dermal	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	$\text{CDI (mg/kg/day)} = \frac{\text{DA}_{\text{event}} \times \text{SA} \times \text{EF} \times \text{ED}}{(\text{BW} \times \text{AT})}$ For inorganics, $\text{DA}_{\text{event}} = \text{PC} \times \text{ET} \times \text{CW} \times \text{CF}$ For organics, DA_{event} = see calculations presented on Tables 7.13, 7.24, and 7.40 $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = \frac{\text{CW} \times \text{EF} \times \text{PC} \times \text{ET} \times \text{CF} \times ((\text{ED}_{0-2} \times \text{SA} \times 10) + (\text{ED}_{2-6} \times \text{SA} \times 3))}{(\text{BW}) \times (\text{AT})}$
	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	
	SA	Surface Area for Contact	cm ²	6,365	U.S. EPA 2014a	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	U.S. EPA 2019a	
	ET	Event Time	hr/day	0.54	U.S. EPA 2011	
	EF	Exposure Frequency	day/yr	350	U.S. EPA 1991a,b	
	ED	Exposure Duration	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	2,190	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1989	

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

cm² = square centimeterµg/m³ = micrograms per cubic meters

kg = kilogram

mg/L = milligrams per liter

RME = Reasonable Maximum Exposure

DA = Dermal absorbed dose

L/m³ = liters per cubic meter

hr = hour

yr = year

TABLE 4.8
VALUES USED FOR CONSTRUCTION WORKER DAILY GROUND WATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future Medium: Ground Water Exposure Medium: Ground water Receptor Population: Construction Worker Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = CW \times CR \times EF \times ED / (BW \times AT)$
	CR	Ingestion Rate	L/day	0.04	U.S. EPA 2014b (1)	
	EF	Exposure Frequency	day/yr	50	BPJ (2)	
	ED	Exposure Duration	yr	1	BPJ (3)	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging Time - Noncancer	days	365	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = DA_{\text{event}} \times SA \times EF \times ED \times CF / (BW \times AT)$ For inorganics, $DA_{\text{event}} = PC \times ET \times CW$ For organics, DA_{event} = see calculations presented on Table 7.14, 7.27, and 7.41
	SA	Surface Area for Contact	cm ²	3,527	U.S. EPA 2014a (4)	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	U.S. EPA 2019a	
	ET	Event Time	hr/day	4	BPJ (5)	
	EF	Exposure Frequency	day/yr	50	BPJ (2)	
	ED	Exposure Duration - Cancer	yr	1	BPJ (3)	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	365	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Inhalation	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1989	
	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	$\text{Exposure Concentration (mg/m}^3\text{)} = CA \times ET \times EF \times ED / AT \times CF$ where, CA summarized on Tables 7.11, 7.24, and 7.38
	ET	Exposure Time	hr/day	4	BPJ	
	EF	Exposure Frequency	days/yr	50	BPJ (2)	
	CF	Conversion Factor	hr/day	24	U.S. EPA 2009a	
	ED	Exposure Duration	yr	1	U.S. EPA 1991a,b	
	AT-NC	Averaging Time - Noncancer	days	365	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	

(1) Construction worker's ingestion of groundwater is assumed to be similar to an adult ingestion rate of surface water during wading of 0.01 L/hr for 4 hr/day = 0.04 L/day

(2) Construction workers are assumed to contact groundwater only 1 day per week.

(3) Construction events are assumed to extend for up to one year total in duration.

(4) Contact with groundwater is limited to the head, hands, and forearms because the construction worker is expected to wear short-sleeved shirt, long pants, and shoes.

(5) Construction events are assumed to contact groundwater for half of their time on the site per day.

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

cm² = square centimeter

mg/m³ = milligrams per cubic meters

kg = kilogram

mg/L = milligrams per liter

RME = Reasonable Maximum Exposure

DA = Dermal absorbed dose

L/m³ = liters per cubic meter

hr = hour

yr = year

BPJ = Best Professional Judgment

TABLE 4.9
VALUES USED FOR COMMERCIAL/INDUSTRIAL WORKER DAILY GROUNDWATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI (mg/kg/day) = \frac{CW \times CR \times EF \times ED}{(BW \times AT)}$
	CR	Ingestion Rate	L/day	1.25	U.S. EPA 1991a, 2011 (1)	
	EF	Exposure Frequency	day/yr	250	U.S. EPA 1991a,b	
	ED	Exposure Duration	yr	25	U.S. EPA 1991a,b	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging Time - Noncancer	days	9,125	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CW	Chemical Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI (mg/kg/day) = \frac{DA_{event} \times SA \times EF \times ED \times CF}{(BW \times AT)}$ For inorganics, $DA_{event} = PC \times ET \times CW$ For organics, DA_{event} = see calculations presented on Table 7.14, 7.27, and 7.41
	SA	Surface Area for Contact	cm ²	3,527	U.S. EPA 2014a (2)	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	U.S. EPA 2015a	
	ET	Event Time	hr/day	1	BPJ (3)	
	EF	Exposure Frequency	day/yr	250	U.S. EPA 1991a,b	
	ED	Exposure Duration - Cancer	yr	25	U.S. EPA 1991a,b	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	9,125	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1989	
Inhalation	CA	Chemical Concentration in Air	mg/m ³	Chemical-Specific	Chemical-Specific	$Exposure\ Concentration\ (mg/m^3) = \frac{CA \times ET \times EF \times ED}{AT \times CF}$ where, $CA = VF \times CW$
	ET	Exposure Time	hr/day	1	BPJ (3)	
	EF	Exposure Frequency	days/yr	250	U.S. EPA 1991a,b	
	VF	Volatilization Factor	L/m ³	0.5	U.S. EPA 2019a	
	CF	Conversion Factor	hr/day	24	U.S. EPA 2009	
	ED	Exposure Duration	yr	25	U.S. EPA 1991a,b	
	AT- NC	Averaging Time - Noncancer	days	9,125	U.S. EPA 1989	
	AT- C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	

- (1) The ingestion rate for commercial worker tap water ingestion is assumed to be half of the total daily intake of 2.5 L.
(2) Contact with groundwater is expected to only the exposed skin surface (similar to soil contact): head, hands, and forearms.
(3) Contact with tap water is only expected to occur during hand washing and other hygiene activities so is limited to only 1 hour out of an 8 hour work day.

U.S. EPA = United States Environmental Protection Agency

CDI = chronic daily intake

cm² = square centimetermg/m³ = milligrams per cubic meters

kg = kilogram

mg/L = milligrams per liter

RME = Reasonable Maximum Exposure

DA = Dermal absorbed dose

L/m³ = liters per cubic meter

hr = hour

yr = year

BPJ = Best Professional Judgment

TABLE 4.10
VALUES USED FOR RESIDENT ADULT DAILY SURFACE WATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future Medium: Surface Water Exposure Medium: Surface Water Receptor Population: Resident Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = \frac{CW \times CR \times ET \times EF \times ED}{(BW \times AT)}$
	CR	Ingestion Rate	L/hr	0.010	U.S. EPA 2014b	
	ET	Exposure Time	hr/day	4	BPJ (2)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time-Noncancer	days	7,300	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CW	Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = \frac{DA_{\text{event}} \times SA \times EF \times ED}{(BW \times AT)}$ $DA_{\text{event}} = PC \times ET \times CW$ For inorganics, $DA_{\text{event}} = PC \times ET \times CW$ For organics, DA_{event} = see calculations presented on Table 7.15
	SA	Surface Area for Contact	cm ²	6,032	USEPA 2014a (3)	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	Chemical-Specific	
	ET	Exposure Time	hr/day	4	BPJ (2)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	7,300	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1989	

(1) The incidental ingestion rate of surface water during wading is assumed to be 0.01 L/hr.

(2) The event frequency and exposure frequency are based on best professional judgment assuming that the adult would wade in the area for 3 days per week for 6 months per year for up to 2 hours per day.

(3) Primary contact with surface water is expected to be wading, not full submersion. Therefore, exposed skin surface area is similar to sediment, which includes head, hands, forearms, and lower legs.

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/L = milligrams per liter

L/hr = liters per hour

cm/hr = centimeters per hour

day/yr = days per year

RME = Reasonable Maximum Exposure

yr = years

L/cm³ = liters per cubic centimeter

cm² = square centimeters

kg = kilogram

hr/day = hours per day

TABLE 4.11
VALUES USED FOR RESIDENT CHILD DAILY SURFACE WATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future Medium: Surface Water Exposure Medium: Surface Water Receptor Population: Resident Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = \frac{CW \times CR \times ET \times EF \times ED}{(BW \times AT)}$
	CR	Ingestion Rate	L/hr	0.050	U.S. EPA 2014b	
	ET	Exposure Time	hr/day	4	BPJ (2)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 1991a,b	
	AT-NC	Averaging time-Noncancer	days	2,190	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CW	Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = \frac{DA_{\text{event}} \times SA \times EF \times ED}{(BW \times AT)}$ $DA_{\text{event}} = PC \times ET \times CW$ For organics, DA_{event} = see calculations presented on Table 7.15
	SA	Surface Area for Contact	cm ²	2,373	USEPA 2014a (3)	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	Chemical-Specific	
	ET	Exposure Time	hr/day	4	BPJ (2)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	USEPA 1991a,b	
	AT-NC	Averaging time - Noncancer	days	2,190	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1989	

(1) The incidental ingestion rate of surface water during wading is assumed to be 0.05 L/hr.

(2) The event frequency and exposure frequency are based on best professional judgment assuming that the child would wade in the area for 3 days per week for 6 months per year for up to 2 hours per day.

(3) Primary contact with surface water is expected to be wading, not full submersion. Therefore, exposed skin surface area is similar to sediment, which includes head, hands, forearms, lower legs, and feet.

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/L = milligrams per liter

L/hr = liters per hour

cm/hr = centimeters per hour

day/yr = days per year

RME = Reasonable Maximum Exposure

yr = years

L/cm³ = liters per cubic centimeter

cm² = square centimeters

kg = kilogram

hr/day = hours per day

TABLE 4.12
VALUES USED FOR ADOLESCENT TRESPASSER DAILY SURFACE WATER INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current
Medium: Surface Water
Exposure Medium: Surface Water
Receptor Population: Trespasser
Receptor Age: Adolescent

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CW	Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$CDI \text{ (mg/kg/day)} = \frac{CW \times CR \times ET \times EF \times ED}{(BW \times AT)}$
	CR	Ingestion Rate	L/hr	0.050	U.S. EPA 2014b	
	ET	Exposure Time	hr/day	4	BPJ (2)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	10	BPJ (2)	
	BW	Body Weight	kg	45	U.S. EPA 2011	
	AT-NC	Averaging time-Noncancer	days	3,650	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CW	Concentration in Water	mg/L	Chemical-Specific	Chemical-Specific	$DA_{\text{event}} \text{ (mg/kg/day)} = \frac{DA_{\text{event}} \times SA \times EF \times ED}{(BW \times AT)}$ $DA_{\text{event}} = PC \times ET \times CW$ For organics, DA_{event} = see calculations presented on Table 7.16
	SA	Surface Area for Contact	cm ²	4,530	USEPA 2011 (3)	
	PC	Permeability Coefficient	cm/hr	Chemical-Specific	Chemical-Specific	
	ET	Exposure Time	hr/day	4	BPJ (2)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	10	BPJ (2)	
	BW	Body Weight	kg	45	U.S. EPA 2011	
	AT-NC	Averaging time - Noncancer	days	3,650	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	L/cm ³	0.001	U.S. EPA 1989	

(1) The incidental ingestion rate of surface water during wading is assumed to be similar to the child ingestion rate of 0.05 L/hr.

(2) The event frequency and exposure frequency are based on best professional judgment assuming that the user would contact surface water 3 days per week for 6 months per year for 4 hour per day. The exposure duration is based on the age range evaluated (6 - 16 years of age).

(3) Taken from Table 7-2 of USEPA 2011a, equal to the average of two age ranges: 6 to <11 years and 11 to <16 years. Assuming head, hands, forearms, lower legs, and feet are exposed.

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/L = milligrams per liter

L/hr = liters per hour

cm/hr = centimeters per hour

day/yr = days per year

RME = Reasonable Maximum Exposure

yr = years

L/cm³ = liters per cubic centimeter

cm² = square centimeters

kg = kilogram

hr/day = hours per day

TABLE 4.13
VALUES USED FOR RESIDENT ADULT DAILY SEDIMENT INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment
Receptor Population: Resident
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Sediment	Chemical-Specific	Chemical-Specific	Chemical-Specific	$\text{CDI (mg/kg/day)} = \frac{\text{CS} \times \text{CR} \times \text{EF} \times \text{ED} \times \text{CF}}{(\text{BW} \times \text{AT})}$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = \frac{\text{CS} \times \text{EF} \times [(\text{ED}_{6-16} \times \text{CR} \times 3) + (\text{ED}_{16-26} \times \text{CR} \times 1)]}{(\text{BW}) \times \text{CF} / (\text{AT})}$
	CR	Ingestion Rate	mg/day	50	U.S. EPA 2011 (1)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	7,300	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
Dermal	CS	Chemical Concentration in Sediment	Chemical-Specific	Chemical-Specific	Chemical-Specific	$\text{CDI (mg/kg/day)} = \frac{\text{CS} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED} \times \text{CF}}{(\text{BW} \times \text{AT})}$ $\text{Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day)} = \frac{\text{CS} \times \text{EF} \times \text{ABS} \times [(\text{ED}_{6-16} \times \text{SA} \times \text{AF} \times 3) + (\text{ED}_{16-26} \times \text{SA} \times \text{AF} \times 1)]}{(\text{BW}) \times \text{CF} / (\text{AT})}$
	SA	Surface Area for Contact	cm ² /event	6,032	U.S. EPA 2014a	
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004	
	AF	Adherence Factor	mg/cm ²	0.07	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	20	U.S. EPA 2014a	
	BW	Body Weight	kg	80	U.S. EPA 2014a	
	AT-NC	Averaging time - Noncancer	days	7,300	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	

(1) The incidental sediment ingestion rate is assumed to be equal to the mean soil ingestion rate presented in Table 5-1 of USEPA *Exposure Factors Handbook*.

(2) Assumes an exposure frequency of 3 days per week for 6 months per year to sediment.

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meter

µg/m³ = micrograms per cubic meter

cm²/event = square centimeters per event

µg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.14
VALUES USED FOR RESIDENT CHILD DAILY SEDIMENT INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Sediment
Receptor Population: Resident
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Sediment	Chemical-Specific	Chemical-Specific	Chemical-Specific	CDI (mg/kg/day) =
	CR	Ingestion Rate	mg/day	200	U.S. EPA 2011 (1)	CS x CR x EF x ED x CF / (BW x AT)
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	6	U.S. EPA 2014a	
	BW	Body Weight	kg	15	U.S. EPA 2014a	Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) =
	AT-NC	Averaging time - Noncancer	days	2,190	U.S. EPA 1989	CS x EF x [(ED _{0.2} x CR x 10) + (ED _{2.6} x CR x 3)]/BW x CF / (AT)
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	CS	Chemical Concentration in Sediment	Chemical-Specific	Chemical-Specific	Chemical-Specific	CDI (mg/kg/day) =
	SA	Surface Area for Contact	cm ² /event	2,373	U.S. EPA 2014a	CS x SA x AF x ABS x EF x ED x CF / (BW x AT)
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004	
	AF	Adherence Factor	mg/cm ²	0.20	U.S. EPA 2014a	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	6	U.S. EPA 2014a	Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) =
	BW	Body Weight	kg	15	U.S. EPA 2014a	CS x EF x ABS x [(ED _{0.2} x SA x AF x 10) + (ED _{2.6} x SA x AF x 3)]/BW x CF / (AT)
	AT-NC	Averaging time - Noncancer	days	2,190	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	

(1) The incidental sediment ingestion rate is assumed to be equal to the upper percentile soil ingestion rate presented in Table 5-1 of USEPA *Exposure Factors Handbook*.

(2) Based on the age range of the child, exposure frequency to sediment is assumed at 3 days per week for 6 months per year.

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter μg/m³ = micrograms per cubic meter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meter

μg/m³ = micrograms per cubic meter

cm²/event = square centimeters per event

μg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.15
VALUES USED FOR ADOLESCENT TRESPASSER DAILY SEDIMENT INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current
Medium: Sediment
Exposure Medium: Sediment
Receptor Population: Trespasser
Receptor Age: Adolescent

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	Intake Equation / Model Name
Ingestion	CS	Chemical Concentration in Sediment	Chemical-Specific	Chemical-Specific	Chemical-Specific	CDI (mg/kg/day) =
	CR	Ingestion Rate	mg/day	200	U.S. EPA 2011 (1)	CS x CR x EF x ED x CF / (BW x AT)
	EF	Exposure Frequency	day/yr	78	BPJ (2)	
	ED	Exposure Duration	yr	10	BPJ (2)	
	BW	Body Weight	kg	45	U.S. EPA 2011	Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) =
	AT-NC	Averaging time - Noncancer	days	3,650	U.S. EPA 1989	CS x EF x [(ED ₆₋₁₆ x CR x 3)/BW] x CF / (AT)
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
Dermal	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	
	CS	Chemical Concentration in Sediment	Chemical-Specific	Chemical-Specific	Chemical-Specific	CDI (mg/kg/day) =
	SA	Surface Area for Contact	cm ² /event	4,530	U.S. EPA 2011 (3)	CS x SA x AF x ABS x EF x ED x CF / (BW x AT)
	ABS	Dermal Absorption Fraction	unitless	Chemical-Specific	U.S. EPA 2004	
	AF	Adherence Factor	mg/cm ²	0.20	U.S. EPA 2014a (4)	
	EF	Exposure Frequency	day/yr	78	BPJ (2)	Mutagenic Chronic Daily Intake (MCDI) (mg/kg/day) =
	ED	Exposure Duration	yr	10	BPJ (2)	CS x EF x ABS x [(ED ₆₋₁₆ x SA x AF x 3)/BW] x CF / (AT)
	BW	Body Weight	kg	45	U.S. EPA 2011	
	AT-NC	Averaging time - Noncancer	days	3,650	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	U.S. EPA 1989	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA 1989	

(1) The incidental sediment ingestion rate is assumed to be equal to the upper percentile soil ingestion rate presented in Table 5-1 of USEPA *Exposure Factors Handbook*.

(2) The exposure frequency is based on best professional judgment, assuming that the user would visit the site approximately 3 days/week for 6 months of the year. The exposure duration is based on the age range evaluated (6 - 16 years of age).

(3) Taken from Table 7-2 of USEPA *Exposure Factors Handbook*, equal to the average of two age ranges: 6 to <11 years and 11 to <16 years. Assuming head, hands, forearms, lower legs, and feet are exposed.

(4) Assumes similar soil adherence to resident child.

BPJ = Best Professional Judgment

USEPA = United States Environmental Protection Agency

CDI = chronic daily intake

mg/kg = milligrams per kilogram

kg/mg = kilograms per milligram

mg/cm² = milligrams per square centimeter µg/m³ = micrograms per cubic meter

mg/day = milligrams per day

day/yr = days per year

RME = Reasonable Maximum Exposure

mg/m³ = milligram per cubic meter

cm²/event = square centimeters per event

µg/mg = microgram per milligram

kg = kilogram

hr/day = hours per day

TABLE 4.16
VALUES USED FOR DAILY HOMEGROWN PRODUCE EXPOSURE INTAKE EQUATIONS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Homegrown Produce
Receptor Population: Resident
Receptor Age: Adult, Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value Resident Adult	RME Value Resident Child	RME Rationale/Reference	Equation / Model Name
Ingestion	CF	Contaminant Concentration in food	mg/kg	chemical-specific	chemical-specific		CDI for Home-grown produce (mg/kg/day) = CF x VIR x EFf x ED / (AT)
	EFf	Exposure Frequency of Foods	days/yr	365	365	U.S. EPA 2011 (1)	
	FVc	Vegetable Intake Rate	kg/kg-day	0.0015	0.0039	U.S. EPA 2011 (1)	
	CFpf	Contamination fraction of plant food	unitless	1	1	BPJ	
	FB	Beef Consumption	kg/kg-day	0.0018	0.00365	U.S. EPA 2011 (1)	
	ED	Exposure Duration	years	20	6	U.S. EPA 2014a	
	AT-NC	Averaging Time - Noncancer	days	7,300	2,190	U.S. EPA 1989	
	AT-C	Averaging Time - Cancer	days	25,550	25,550	U.S. EPA 1989	

Notes:

(1) Taken from Table 13-1 of USEPA 2011 EFH. Average of mean intake rate for home-produced vegetables and home-produced meats, consumers only. For the adult, average the 20 to 39 year age groups. For the child, averaged the 1 to 2 and 3 to 5 age groups. The rate shown is an intake rate averaged over an entire year.

TABLE 5.1
NON-CANCER TOXICITY DATA - ORAL/DERMAL
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Chronic/ Subchronic	Oral RfD Value (mg/kg- day)	Oral to Dermal Adjustment Factor (GI ABS) ⁽¹⁾	Adjusted Dermal RfD ⁽²⁾ (mg/kg bw-day)	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ ⁽³⁾ (mm/dd/yy)
Inorganics								
ALUMINUM	Chronic	1.0E+00	1.00E+00	1.0E+00	Neurological	100/1	PPRTV	2/19/2019
ARSENIC	Chronic	3.0E-04	1.00E+00	3.0E-04	Skin, Cardiovascular	3/1	IRIS	2/18/2019
CADMIUM	Chronic	1.0E-03	2.50E-02	2.5E-05	Kidneys, Urinary	10/1	IRIS	2/18/2019
HEXAVALENT CHROMIUM (+6)	Chronic	3.0E-03	2.50E-02	7.5E-05	None	300/3	IRIS	2/18/2019
COBALT	Chronic	3.0E-04	1.00E+00	3.0E-04	Thyroid	3000/1	PPRTV	2/19/2019
CYANIDE	Chronic	6.0E-04	1.00E+00	6.0E-04	Gastrointestinal System	NA/NA	HEAST	1997
IRON	Chronic	7.0E-01	1.00E+00	7.0E-01	Gastrointestinal System	1.5/1	PPRTV	2/18/2019
MANGANESE	Chronic	1.4E-01	1.00E+00	1.4E-01	Central Nervous System	1/3	IRIS	2/18/2019
LEAD	Chronic	NA	1.00E+00	NA	Developmental	NA/NA	IRIS	2/19/2019
THALLIUM	Chronic	1.0E-05	1.00E+00	1.0E-05	Hair	3000/1	PPRTV-X	2/19/2019
VANADIUM	Chronic	5.0E-03	2.60E-02	1.3E-04	Kidney	3000/1	PPRTV	2/19/2019
PAHs								
BENZ(A)ANTHRACENE	Chronic	NA	1.00E+00	NA	NA	NA/NA	IRIS	2/18/2019
BENZO(B)FLUORANTHENE	Chronic	NA	1.00E+00	NA	NA	NA/NA	IRIS	2/19/2019
BENZO(A)PYRENE	Chronic	3.0E-04	1.00E+00	3.0E-04	Developmental System	300/1	IRIS	2/19/2019
INDENO(1,2,3-C,D)PYRENE	Chronic	NA	1.00E+00	NA	NA	NA/NA	IRIS	2/19/2019
2-METHYLNAPHTHALENE	Chronic	4.0E-03	1.00E+00	4.0E-03	Respiratory System	1000/1	IRIS	2/19/2019
NAPHTHALENE	Chronic	2.0E-02	1.00E+00	2.0E-02	Body Weight	3000/1	IRIS	2/19/2019
Volatiles								
BENZENE	Chronic	4.0E-03	1.00E+00	4.0E-03	Immune System	300/1	IRIS	2/19/2019
1,2-DICHLOROETHANE	Chronic	6.0E-03	1.00E+00	6.0E-03	NA	NA	PPRTV	6/18/2019
ETHYLBENZENE	Chronic	1.0E-01	1.00E+00	1.0E-01	Liver, Kidney	1000/1	IRIS	2/19/2019
ISOPROPYLBENZENE	Chronic	1.0E-01	1.00E+00	1.0E-01	Kidney	1000/1	IRIS	6/18/2019
M,P-XYLENE	Chronic	2.0E-01	1.00E+00	2.0E-01	Body Weight, Mortality	1000/1	IRIS	6/18/2019
TOLUENE	Chronic	8.0E-02	1.00E+00	8.0E-02	Urinary	3000/1	IRIS	2/19/2019
O-XYLENE	Chronic	2.0E-01	1.00E+00	2.0E-01	Central Nervous System	1000/1	IRIS	2/19/2019

NA = Not Available

mg/kg-day = milligram per kilogram-day

RfD = Reference Dose

GI ABS = Gastrointestinal Absorption Fraction

(1) Taken from USEPA 2004 Guidance.

(2) Dermal toxicological values adjusted from oral values using USEPA 2004 recommended chemical-specific gastrointestinal absorption factors (GI ABS). RfDs are multiplied by the GI ABS.

(3) IRIS - Integrated Risk Information System. For IRIS values, the date IRIS was searched is provided. Available at: <http://www.epa.gov/iris/>
PPRTV - Provisional Peer-Reviewed Toxicity Value. For PPRTV values, the date of the issue paper is provided. Available at: <http://hhpprtv.onml.gov/>
PPRTV-X - Provisional Peer-Reviewed Toxicity Value, Appendix Screening Value. The date of the issue paper is provided.

TABLE 5.2
NON-CANCER TOXICITY DATA - INHALATION
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Chronic/ Subchronic	Value Inhalation (RfC) (mg/m ³)	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC Target Organ	Dates ⁽¹⁾ (mm/dd/yy)
Inorganics						
ALUMINUM	Chronic	5.0E-03	Neurological	300/1	PPRTV	2/19/2019
ARSENIC	Chronic	1.5E-05	Cardiovascular, Nervous, Reproductive,	NA	CalEPA	6/18/2019
CADMIUM	Chronic	1.0E-05	Kidneys	9/1	ATSDR	2/18/2019
HEXAVALENT CHROMIUM (+6)	Chronic	1.0E-04	Respiratory System	300/1	IRIS	2/18/2019
COBALT	Chronic	6.0E-06	Respiratory System	300/1	PPRTV	2/19/2019
CYANIDE	NA	8.0E-04	None	NA	HEAST	1997
IRON	NA	NA	NA	NA	PPRTV	2/18/2019
MANGANESE	Chronic	5.0E-05	Central Nervous System	1000/1	IRIS	2/18/2019
LEAD	NA	NA	NA	NA	IRIS	2/18/2019
THALLIUM	NA	NA	NA	NA	IRIS	2/19/2019
VANADIUM	Chronic	1.0E-04	Respiratory System	30/1	ATSDR	2/19/2019
PAHs						
BENZ(A)ANTHRACENE	NA	NA	NA	NA	IRIS	2/18/2019
BENZO(B)FLUORANTHENE	NA	NA	NA	NA	IRIS	2/19/2019
BENZO(A)PYRENE	Chronic	2.0E-06	Developmental System	3000/1	IRIS	2/19/2019
INDENO(1,2,3-C,D)PYRENE	NA	NA	NA	NA	IRIS	2/19/2019
2-METHYLNAPHTHALENE	NA	NA	NA	NA	IRIS	2/19/2019
NAPHTHALENE	Chronic	3.0E-03	Central Nervous System, Respiratory	3000/1	IRIS	2/19/2019
Volatiles						
BENZENE	Chronic	3.0E-02	Immune System	300/1	IRIS	2/19/2019
1,2-DICHLOROETHANE		7.0E-03	NA	NA	PPRTV	6/18/2019
ETHYLBENZENE	Chronic	1.0E+00	Developmental System	300/1	IRIS	2/19/2019
ISOPROPYLBENZENE	Chronic	4.0E-01	Kidney	1000/1	IRIS	6/18/2019
M,P-XYLENE	NA	1.0E-01	Motor Coordination	300/1	IRIS	6/18/2019
TOLUENE	Chronic	5.0E+00	Central Nervous System	10/1	IRIS	2/19/2019
O-XYLENE	Chronic	1.0E-01	Central Nervous System	300/1	IRIS	2/19/2019

NA = Not Available

RfC = Reference Concentration

mg/m³ = milligrams per cubic meter(1) IRIS - Integrated Risk Information System. For IRIS values, the date IRIS was searched is provided. Available at: <http://www.epa.gov/iris/>

ATSDR - Agency for Toxic Substances and Disease Registry. For ATSDR values, the date of the analyte paper is provided.

PPRTV - Provisional Peer-Reviewed Toxicity Value. For PPRTV values, the date of the issue paper is provided. Available at: <http://hhpprtv.ornl.gov/>

CalEPA - California Environmental Protection Agency. For CalEPA values, the date searched is provided.

TABLE 5.3
CHEMICAL-SPECIFIC PARAMETERS
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Absorption Factor	Reference	GI ABS	Reference	Permeability Constant (cm/hr)	Reference
Inorganics						
ALUMINUM	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
ARSENIC	0.03	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
CADMIUM	0.001	U.S. EPA, 2004	2.50E-02	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
HEXAVALENT CHROMIUM (+6)	NA	U.S. EPA, 2004	2.50E-02	U.S. EPA, 2004	2.00E-03	U.S. EPA, 2004
COBALT	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.00E-04	U.S. EPA, 2004
CYANIDE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
IRON	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
MANGANESE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
LEAD	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
THALLIUM	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
VANADIUM	NA	U.S. EPA, 2004	2.60E-02	U.S. EPA, 2004	1.00E-03	U.S. EPA, 2004
PAHs						
BENZ(A)ANTHRACENE	0.13	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	5.29E-01	U.S. EPA, 2019
BENZO(B)FLUORANTHENE	0.13	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.00E-01	U.S. EPA, 2019
BENZO(A)PYRENE	0.13	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	6.80E-01	U.S. EPA, 2019
INDENO(1,2,3-C,D)PYRENE	0.13	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.19E+00	U.S. EPA, 2019
2-METHYLNAPHTHALENE	0.13	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	8.94E-02	U.S. EPA, 2019
NAPHTHALENE	0.13	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.57E-02	U.S. EPA, 2019
Volatiles						
BENZENE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	1.47E-02	U.S. EPA, 2019
1,2-DICHLOROETHANE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.19E-03	U.S. EPA, 2019
ETHYLBENZENE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.84E-02	U.S. EPA, 2019
ISOPROPYLBENZENE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	8.76E-02	U.S. EPA, 2019
M,P-XYLENE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.91E-02	U.S. EPA, 2019
TOLUENE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	3.06E-02	U.S. EPA, 2019
O-XYLENE	NA	U.S. EPA, 2004	1.00E+00	U.S. EPA, 2004	4.62E-02	U.S. EPA, 2019

NA = Data not available.

GI ABS = Gastrointestinal Absorption Fraction

U.S. EPA, 2004 = U.S. Environmental Protection Agency, 2004. *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. Final Guidance.

U.S. EPA, 2019 = Regional Screening Levels (RSL) Chemical-specific Parameters Supporting Table, May.

TABLE 6.1
CANCER TOXICITY DATA - ORAL/DERMAL
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (GI ABS) (1)	Absorbed Cancer Slope Factor for Dermal (2)	Units	Weight of Evidence/Cancer Guideline Description	Mutagenic Compound	Source	Date (3) (mm/dd/yy)
Inorganics								
ALUMINUM	NA	1.00E+00	NA	per (mg/kg-day)	NA		ATSDR	2/19/2019
ARSENIC	1.5E+00	1.00E+00	1.5E+00	per (mg/kg-day)	A		IRIS	2/18/2019
CADMIUM	NA	2.50E-02	NA	per (mg/kg-day)	B1		IRIS	2/18/2019
HEXAVALENT CHROMIUM (+6)	5.0E-01	2.50E-02	2.0E+01	per (mg/kg-day)	D	M	IRIS	2/18/2019
COBALT	NA	1.00E+00	NA	per (mg/kg-day)	B2		ATSDR	2/19/2019
CYANIDE	NA	1.00E+00	NA	per (mg/kg-day)	D		IRIS	2/18/2019
IRON	NA	1.00E+00	NA	per (mg/kg-day)	NA		PPRTV	2/18/2019
MANGANESE	NA	1.00E+00	NA	per (mg/kg-day)	D		IRIS	2/18/2019
LEAD	NA	1.00E+00	NA	per (mg/kg-day)	B2		IRIS	2/18/2019
THALLIUM	NA	1.00E+00	NA	per (mg/kg-day)	NA		PPRTV	2/18/2019
VANADIUM	NA	2.60E-02	NA	per (mg/kg-day)	C		ATSDR	2/19/2019
PAHs								
BENZ(A)ANTHRACENE	1.0E-01	1.00E+00	1.0E-01	per (mg/kg-day)	B2	M	IRIS	2/19/2019
BENZO(B)FLUORANTHENE	1.0E-01	1.00E+00	1.0E-01	per (mg/kg-day)	B2	M	IRIS	2/19/2019
BENZO(A)PYRENE	1.0E+00	1.00E+00	1.0E+00	per (mg/kg-day)	A	M	IRIS	2/19/2019
INDENO(1,2,3-C,D)PYRENE	1.0E-01	1.00E+00	1.0E-01	per (mg/kg-day)	B2	M	IRIS	2/19/2019
2-METHYLNAPHTHALENE	NA	1.00E+00	NA	per (mg/kg-day)	NA		IRIS	2/19/2019
NAPHTHALENE	NA	1.00E+00	NA	per (mg/kg-day)	C		IRIS	2/19/2019

TABLE 6.1
CANCER TOXICITY DATA - ORAL/DERMAL
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (GI ABS) ⁽¹⁾	Absorbed Cancer Slope Factor for Dermal ⁽²⁾	Units	Weight of Evidence/Cancer Guideline Description	Mutagenic Compound	Source	Date ⁽³⁾ (mm/dd/yy)
Volatiles								
BENZENE	5.5E-02	1.00E+00	5.5E-02	per (mg/kg-day)	A		IRIS	2/19/2019
1,2-DICHLOROETHANE	9.1E-02	1.00E+00	9.1E-02	per (mg/kg-day)	B2		IRIS	6/18/2019
ETHYLBENZENE	1.1E-02	1.00E+00	1.1E-02	per (mg/kg-day)	D		CalEPA	2/19/2019
ISOPROPYLBENZENE	NA	1.00E+00	NA	per (mg/kg-day)	D		IRIS	6/18/2019
M,P-XYLENE	NA	1.00E+00	NA	per (mg/kg-day)	NA		IRIS	6/18/2019
TOLUENE	NA	1.00E+00	NA	per (mg/kg-day)	NA		IRIS	2/19/2019
O-XYLENE	NA	1.00E+00	NA	per (mg/kg-day)	NA		IRIS	2/19/2019

M = Mutagenic mode of action

NA = Not Available

mg/kg-day = milligram per kilogram-day

GI ABS = Gastrointestinal Absorption Fraction

(1) Taken from USEPA 2004 Guidance.

(2) Dermal Toxicological values adjusted from oral values using USEPA 2004 recommended chemical-specific gastrointestinal absorption factors (GI ABS). Cancer slope factors are divided by the GI ABS.

(3) IRIS - Integrated Risk Information System. For IRIS values, the date IRIS was searched is provided. Available at: <http://www.epa.gov/iris/>

PPRTV - Provisional Peer-Reviewed Toxicity Value, the date of the issue paper is provided. Available at: <http://hhpprtv.ornl.gov/>

CalEPA - California Environmental Protection Agency, Cancer Potency Factors

ATSDR - Agency for Toxic Substances and Disease Registry. For ATSDR values, the date of the analyte paper is provided.

Weight of Evidence:

A - Human carcinogen

B1 - Probable human carcinogen - indicate that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

SU - Suggestive evidence of carcinogenic potential

TABLE 6.2
CANCER TOXICITY DATA - INHALATION
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Unit Risk		Weight of Evidence/Cancer Guideline Description	Mutagenic	Unit Risk	
	Value	Units			Source	Date ⁽¹⁾
Inorganics						
ALUMINUM	NA	per (ug/m ³)	NA	M	ATSDR	2/19/2019
ARSENIC	4.3E-03	per (ug/m ³)	A		IRIS	2/18/2019
CADMIUM	1.8E-03	per (ug/m ³)	B1		IRIS	2/18/2019
HEXAVALENT CHROMIUM (+6)	8.4E-02	per (ug/m ³)	A		IRIS	2/18/2019
COBALT	9.0E-03	per (ug/m ³)	B2		ATSDR	2/19/2019
CYANIDE	NA	per (ug/m ³)	D		IRIS	2/18/2019
IRON	NA	per (ug/m ³)	NA		PPRTV	2/19/2019
MANGANESE	NA	per (ug/m ³)	D		IRIS	2/18/2019
LEAD	NA	per (ug/m ³)	B2		IRIS	2/18/2019
THALLIUM	NA	per (ug/m ³)	NA		IRIS	2/19/2019
VANADIUM	NA	per (ug/m ³)	C		ATSDR	2/19/2019
PAHs						
BENZ(A)ANTHRACENE	6.0E-05	per (ug/m ³)	B2	M	IRIS	2/19/2019
BENZO(B)FLUORANTHENE	6.0E-05	per (ug/m ³)	B2	M	IRIS	2/19/2019
BENZO(A)PYRENE	6.0E-04	per (ug/m ³)	A	M	IRIS	2/19/2019
INDENO(1,2,3-C,D)PYRENE	6.0E-05	per (ug/m ³)	B2	M	IRIS	2/19/2019
2-METHYLNAPHTHALENE	NA	per (ug/m ³)	NA		IRIS	2/19/2019
NAPHTHALENE	3.4E-05	per (ug/m ³)	C		IRIS	2/19/2019

TABLE 6.2
CANCER TOXICITY DATA - INHALATION
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituents of Potential Concern	Unit Risk		Weight of Evidence/Cancer Guideline Description	Mutagenic	Unit Risk	
	Value	Units			Source	Date ⁽¹⁾
Volatiles						
BENZENE	7.8E-06	per (ug/m³)	A		IRIS	2/19/2019
1,2-DICHLOROETHANE	2.6E-05	per (ug/m³)	B2		IRIS	6/18/2019
ETHYLBENZENE	2.5E-06	per (ug/m³)	D		CalEPA	2/19/2019
ISOPROPYLBENZENE	NA	per (ug/m³)	NA		IRIS	6/18/2019
M,P-XYLENE	NA	per (ug/m³)	NA		IRIS	6/18/2019
TOLUENE	NA	per (ug/m³)	NA		IRIS	2/19/2019
O-XYLENE	NA	per (ug/m³)	NA		IRIS	2/19/2019

M = Mutagenic Mode of Action

NA = Not Available

(1) IRIS - Integrated Risk Information System. For IRIS values, the date IRIS was searched is provided. Available at: <http://www.epa.gov/iris/>PPRTV - Provisional Peer-Reviewed Toxicity Value, the date of the issue paper is provided. Available at: <http://hhpprtv.ornl.gov/>

CalEPA - California Environmental Protection Agency, Cancer Potency Factors

ATSDR - Agency for Toxic Substances and Disease Registry. For ATSDR values, the date of the analyte paper is provided.

Weight of Evidence:

A - Human carcinogen

B1 - Probable human carcinogen - indicate that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

SU - Suggestive evidence of carcinogenic potential

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.2E-04		
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04		
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03		
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-03		
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-04		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										2.6E-07				5.9E-03	
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										5.7E-08				3.5E-04	
			Exposure Point Total										3.2E-07				6.2E-03	
			Exposure Medium Total										3.2E-07				6.2E-03	
Sediment Total										3.2E-07				6.2E-03				

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04	
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04	
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06	
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03	
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04	
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04	
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05	
			Exp. Route Total										9.4E-08				7.7E-03
			Dermal	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04	
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04	
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04	
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03	
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04	
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04	
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03	
			Exp. Route Total										1.6E-06				2.2E-02
			Exposure Point Total										1.7E-06				2.9E-02
			Exposure Medium Total										1.7E-06				2.9E-02
Surface Water Total										1.7E-06				2.9E-02			

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	North Tank Farm	Ingestion	Inorganics														
				ALUMINUM	6.67E+03	(mg/kg)	2.28E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	8.00E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	8.0E-03		
				ANTIMONY	5.95E-01	(mg/kg)	2.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	7.13E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.8E-03		
				ARSENIC	2.33E+00	(mg/kg)	4.78E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.2E-07	1.67E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-03		
				COBALT	4.97E+00	(mg/kg)	1.70E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	5.95E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-02		
				IRON	1.16E+04	(mg/kg)	3.97E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-02		
				MANGANESE	5.55E+02	(mg/kg)	1.90E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.65E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.8E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	1.86E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-08	3.26E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	2.18E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.2E-08	3.81E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	1.69E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.7E-07	2.96E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.9E-04		
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	3.44E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.4E-08	6.02E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total											9.6E-07				6.1E-02
			Dermal ¹	Inorganics														
				ALUMINUM	6.67E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ANTIMONY	5.95E-01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--		
				ARSENIC	2.33E+00	(mg/kg)	1.01E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.5E-07	3.53E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-03		
				COBALT	4.97E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.16E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	5.55E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	1.02E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-08	1.79E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	1.20E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-08	2.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	9.29E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.3E-08	1.63E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-04		
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	1.89E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-08	3.30E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total											2.9E-07				1.7E-03
			Exposure Point Total											1.2E-06				6.3E-02
			Exposure Medium Total											1.2E-06				6.3E-02

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	North Tank Farm	Inhalation	Inorganics												
				ALUMINUM	5.09E-06	(mg/m ³)	1.40E-03	(ug/m ³)	NA	per (ug/m ³)	--	4.88E-06	(mg/m ³)	5.00E-03	(mg/m ³)	9.8E-04
				ANTIMONY	4.54E-10	(mg/m ³)	1.24E-07	(ug/m ³)	NA	per (ug/m ³)	--	4.36E-10	(mg/m ³)	NA	(mg/m ³)	--
				ARSENIC	1.77E-09	(mg/m ³)	4.86E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	2.1E-09	1.70E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.1E-04
				COBALT	3.79E-09	(mg/m ³)	1.04E-06	(ug/m ³)	9.00E-03	per (ug/m ³)	9.4E-09	3.64E-09	(mg/m ³)	6.00E-06	(mg/m ³)	6.1E-04
				IRON	8.86E-06	(mg/m ³)	2.43E-03	(ug/m ³)	NA	per (ug/m ³)	--	8.49E-06	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	4.24E-07	(mg/m ³)	1.16E-04	(ug/m ³)	NA	per (ug/m ³)	--	4.06E-07	(mg/m ³)	5.00E-05	(mg/m ³)	8.1E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.08E-10	(mg/m ³)	1.14E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	6.8E-12	1.99E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	2.43E-10	(mg/m ³)	1.33E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	8.0E-12	2.33E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	1.89E-10	(mg/m ³)	1.03E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	6.2E-11	1.81E-10	(mg/m ³)	2.00E-06	(mg/m ³)	9.0E-05
				DIBENZ(A,H)ANTHRACENE	3.83E-11	(mg/m ³)	2.10E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	1.3E-11	3.67E-11	(mg/m ³)	NA	(mg/m ³)	--
				Exp. Route Total							1.2E-08					9.9E-03
				Exposure Point Total							1.2E-08					9.9E-03
				Exposure Medium Total							1.2E-08					9.9E-03
	Surface Soil	Homegrown Produce	Ingestion	Inorganics												
				ALUMINUM	3.20E+00	(mg/kg)	1.37E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	4.80E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.8E-03
				ANTIMONY	2.28E-03	(mg/kg)	9.76E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.42E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	8.5E-03
				ARSENIC	1.77E-03	(mg/kg)	7.57E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-06	2.65E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.8E-03
				COBALT	1.19E-02	(mg/kg)	5.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.79E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-02
				IRON	5.57E+00	(mg/kg)	2.39E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	8.35E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.2E-02
				MANGANESE	1.67E+01	(mg/kg)	7.14E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.50E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.8E-01
				PAHs												
				BENZ(A)ANTHRACENE	6.43E-04	(mg/kg)	5.51E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.5E-08	9.65E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	4.27E-04	(mg/kg)	3.66E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.7E-08	6.41E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	3.91E-04	(mg/kg)	3.35E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.4E-07	5.87E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-03
				DIBENZ(A,H)ANTHRACENE	4.08E-05	(mg/kg)	3.50E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.5E-08	6.13E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							1.6E-06					2.7E-01
				Exposure Point Total							1.6E-06					2.7E-01
				Exposure Medium Total							1.6E-06					2.7E-01

TABLE 7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Beef	Ingestion	Inorganics														
				ALUMINUM	5.05E+00	(mg/kg)	1.82E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	6.39E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.4E-03		
				ANTIMONY	3.18E-04	(mg/kg)	1.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.02E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.0E-03		
				ARSENIC	2.36E-03	(mg/kg)	8.52E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.3E-06	2.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.9E-03		
				COBALT	5.18E-02	(mg/kg)	1.87E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.55E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-01		
				IRON	1.17E+02	(mg/kg)	4.23E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.48E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.1E-01		
				MANGANESE	1.70E-01	(mg/kg)	6.13E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.15E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.04E-03	(mg/kg)	1.48E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.5E-07	2.58E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.46E-03	(mg/kg)	1.78E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.8E-07	3.11E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.28E-03	(mg/kg)	3.09E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.1E-06	5.41E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02		
				DIBENZ(A,H)ANTHRACENE	1.21E-02	(mg/kg)	8.76E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.8E-06	1.53E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										1.3E-05				4.7E-01
				Exposure Point Total										1.3E-05				4.7E-01
				Exposure Medium Total										1.3E-05				4.7E-01
				Soil Total										1.6E-05				8.1E-01
				Total of Receptor Risks Across All Media											1.8E-05	Total of Receptor Hazards Across All Media		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.2
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02	
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03	
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02	
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02	
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03	
				PAHs													
				BENZO(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							3.6E-06					1.3E-01	
			Dermal	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZO(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							1.8E-07					2.1E-03	
			Exposure Point Total								3.8E-06					1.3E-01	
		Exposure Medium Total								3.8E-06					1.3E-01		
Sediment Total										3.8E-06				1.3E-01			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02	
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02	
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04	
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01	
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02	
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03	
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03	
				PAHs													
				BENZO(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04	
				Exp. Route Total							8.5E-07					2.1E-01	

TABLE 7.2
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04		
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04		
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04		
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03		
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04		
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04		
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
				Exp. Route Total										2.6E-06				4.5E-02
				Exposure Point Total										3.4E-06				2.5E-01
				Exposure Medium Total										3.4E-06				2.5E-01
				Surface Water Total										3.4E-06				2.5E-01
Soil	Surface Soil	North Tank Farm	Ingestion	Inorganics														
				ALUMINUM	6.67E+03	(mg/kg)	7.31E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	8.53E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	8.5E-02		
				ANTIMONY	5.95E-01	(mg/kg)	6.52E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	7.61E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.9E-02		
				ARSENIC	2.33E+00	(mg/kg)	1.53E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.3E-06	1.78E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.9E-02		
				COBALT	4.97E+00	(mg/kg)	5.44E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-01		
				IRON	1.16E+04	(mg/kg)	1.27E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.48E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.1E-01		
				MANGANESE	5.55E+02	(mg/kg)	6.08E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	7.10E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.1E-02		
				PAHs														
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	1.58E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.6E-07	3.48E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	1.85E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.8E-07	4.07E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	1.43E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.4E-06	3.16E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02		
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	2.92E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.9E-07	6.42E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										4.4E-06				6.5E-01

TABLE 7.2
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	North Tank Farm	Dermal ¹	Inorganics												
				ALUMINUM	6.67E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	5.95E-01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	2.33E+00	(mg/kg)	1.81E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.7E-07	2.12E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.1E-03
				COBALT	4.97E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.16E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	5.55E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	4.87E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.9E-08	1.07E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	5.70E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.7E-08	1.25E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	4.43E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-07	9.74E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.2E-03
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	8.99E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.0E-08	1.98E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							9.1E-07					1.0E-02
				Exposure Point Total							5.3E-06					6.6E-01
				Exposure Medium Total							5.3E-06					6.6E-01
	Air	North Tank Farm	Inhalation	Inorganics												
				ALUMINUM	5.09E-06	(mg/m ³)	4.19E-04	(ug/m ³)	NA	per (ug/m ³)	--	4.88E-06	(mg/m ³)	5.00E-03	(mg/m ³)	9.8E-04
				ANTIMONY	4.54E-10	(mg/m ³)	3.73E-08	(ug/m ³)	NA	per (ug/m ³)	--	4.36E-10	(mg/m ³)	NA	(mg/m ³)	--
				ARSENIC	1.77E-09	(mg/m ³)	1.46E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	6.3E-10	1.70E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.1E-04
				COBALT	3.79E-09	(mg/m ³)	3.12E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	2.8E-09	3.64E-09	(mg/m ³)	6.00E-06	(mg/m ³)	6.1E-04
				IRON	8.86E-06	(mg/m ³)	7.28E-04	(ug/m ³)	NA	per (ug/m ³)	--	8.49E-06	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	4.24E-07	(mg/m ³)	3.48E-05	(ug/m ³)	NA	per (ug/m ³)	--	4.06E-07	(mg/m ³)	5.00E-05	(mg/m ³)	8.1E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.08E-10	(mg/m ³)	9.04E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	5.4E-12	1.99E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	2.43E-10	(mg/m ³)	1.06E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	6.3E-12	2.33E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	1.89E-10	(mg/m ³)	8.21E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	4.9E-11	1.81E-10	(mg/m ³)	2.00E-06	(mg/m ³)	9.0E-05
				DIBENZ(A,H)ANTHRACENE	3.83E-11	(mg/m ³)	1.67E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	1.0E-11	3.67E-11	(mg/m ³)	NA	(mg/m ³)	--
				Exp. Route Total							3.5E-09					9.9E-03
				Exposure Point Total							3.5E-09					9.9E-03
				Exposure Medium Total							3.5E-09					9.9E-03

TABLE 7.2
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics													
				ALUMINUM	3.20E+00	(mg/kg)	1.00E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.17E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.2E-02	
				ANTIMONY	2.28E-03	(mg/kg)	7.13E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.31E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	2.1E-02	
				ARSENIC	1.77E-03	(mg/kg)	5.53E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.3E-07	6.45E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-02	
				COBALT	1.19E-02	(mg/kg)	3.73E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.35E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-01	
				IRON	5.57E+00	(mg/kg)	1.74E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.9E-02	
				MANGANESE	1.67E+01	(mg/kg)	5.21E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	6.08E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.3E-01	
				PAHs													
				BENZ(A)ANTHRACENE	6.43E-04	(mg/kg)	1.07E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-07	2.35E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	4.27E-04	(mg/kg)	7.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.1E-08	1.56E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	3.91E-04	(mg/kg)	6.49E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.5E-07	1.43E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.8E-03	
				DIBENZ(A,H)ANTHRACENE	4.08E-05	(mg/kg)	6.77E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.8E-08	1.49E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							1.7E-06					6.7E-01	
				Exposure Point Total							1.7E-06					6.7E-01	
		Exposure Medium Total							1.7E-06					6.7E-01			
	Surface Soil	Beef	Ingestion	Inorganics													
				ALUMINUM	5.05E+00	(mg/kg)	1.18E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.38E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.4E-02	
				ANTIMONY	3.18E-04	(mg/kg)	7.44E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	8.68E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	2.2E-03	
				ARSENIC	2.36E-03	(mg/kg)	5.52E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.3E-07	6.44E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-02	
				COBALT	5.18E-02	(mg/kg)	1.21E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.42E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.7E-01	
				IRON	1.17E+02	(mg/kg)	2.74E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	3.20E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.6E-01	
				MANGANESE	1.70E-01	(mg/kg)	3.98E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	4.64E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.3E-03	
				PAHs													
				BENZ(A)ANTHRACENE	2.04E-03	(mg/kg)	2.53E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.5E-07	5.58E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.46E-03	(mg/kg)	3.05E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.1E-07	6.72E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.28E-03	(mg/kg)	5.31E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.3E-06	1.17E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.9E-02	
		DIBENZ(A,H)ANTHRACENE	1.21E-02	(mg/kg)	1.51E-05	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-05	3.31E-05	(mg/kg-day)	NA	(mg/kg-day)	--			
Exp. Route Total							2.2E-05					1.0E+00					
Exposure Point Total							2.2E-05					1.0E+00					
Exposure Medium Total							2.2E-05					1.0E+00					
Soil Total											2.9E-05				2.3E+00		
Total of Receptor Risks Across All Media										3.6E-05	Total of Receptor Hazards Across All Media					2.7E+00	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	North Tank Farm	Ingestion	Inorganics														
				ALUMINUM	6.67E+03	(mg/kg)	2.69E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.89E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.9E-02		
				ANTIMONY	5.95E-01	(mg/kg)	4.16E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.16E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	2.9E-04		
				ARSENIC	2.33E+00	(mg/kg)	5.63E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.4E-08	3.94E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				COBALT	4.97E+00	(mg/kg)	2.01E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.40E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.7E-02		
				IRON	1.16E+04	(mg/kg)	4.68E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.28E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.7E-02		
				MANGANESE	5.55E+02	(mg/kg)	2.24E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.57E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.1E-02		
				PAHs														
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	1.10E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.1E-09	7.68E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	1.28E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.3E-09	8.98E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	9.97E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.0E-08	6.98E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.3E-03		
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	2.03E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	2.0E-09	1.42E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										9.9E-08				1.4E-01
			Dermal ¹	Inorganics														
				ALUMINUM	6.67E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ANTIMONY	5.95E-01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--		
				ARSENIC	2.33E+00	(mg/kg)	9.03E-09	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-08	6.32E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-03		
				COBALT	4.97E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.16E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	5.55E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	4.58E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	4.6E-10	3.20E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	5.35E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	5.4E-10	3.75E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	4.16E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	4.2E-09	2.91E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04		
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	8.45E-10	(mg/kg-day)	1.0E+00	per (mg/kg-day)	8.4E-10	5.91E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										2.0E-08				3.1E-03
			Exposure Point Total										1.2E-07				1.4E-01	
	Exposure Medium Total										1.2E-07				1.4E-01			

TABLE 7.3
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Air	North Tank Farm	Inhalation	Inorganics													
				ALUMINUM	1.09E-04	(mg/m³)	3.56E-04	(ug/m³)	NA	per (ug/m³)	--	2.49E-05	(mg/m³)	5.00E-03	(mg/m³)	5.0E-03	
				ANTIMONY	4.54E-10	(mg/m³)	1.48E-09	(ug/m³)	NA	per (ug/m³)	--	1.04E-10	(mg/m³)	NA	(mg/m³)	--	
				ARSENIC	3.81E-08	(mg/m³)	1.24E-07	(ug/m³)	4.3E-03	per (ug/m³)	5.3E-10	8.69E-09	(mg/m³)	1.50E-05	(mg/m³)	5.8E-04	
				COBALT	8.13E-08	(mg/m³)	2.65E-07	(mg/m³)	9.0E-03	per (ug/m³)	2.4E-09	1.86E-08	(mg/m³)	6.00E-06	(mg/m³)	3.1E-03	
				IRON	1.90E-04	(mg/m³)	6.20E-04	(ug/m³)	NA	per (ug/m³)	--	4.34E-05	(mg/m³)	NA	(mg/m³)	--	
				MANGANESE	9.09E-06	(mg/m³)	2.97E-05	(ug/m³)	NA	per (ug/m³)	--	2.08E-06	(mg/m³)	5.00E-05	(mg/m³)	4.2E-02	
				PAHs													
				BENZ(A)ANTHRACENE	4.45E-09	(mg/m³)	1.45E-08	(ug/m³)	6.0E-05	per (ug/m³)	8.7E-13	1.02E-09	(mg/m³)	NA	(mg/m³)	--	
				BENZO(B)FLUORANTHENE	5.21E-09	(mg/m³)	1.70E-08	(ug/m³)	6.0E-05	per (ug/m³)	1.0E-12	1.19E-09	(mg/m³)	NA	(mg/m³)	--	
				BENZO(A)PYRENE	4.04E-09	(mg/m³)	1.32E-08	(ug/m³)	6.0E-04	per (ug/m³)	7.9E-12	9.23E-10	(mg/m³)	2.00E-06	(mg/m³)	4.6E-04	
				DIBENZ(A,H)ANTHRACENE	8.22E-10	(mg/m³)	2.68E-09	(ug/m³)	6.0E-04	per (ug/m³)	1.6E-12	1.88E-10	(mg/m³)	NA	(mg/m³)	--	
				Exp. Route Total										2.9E-09			
			Exposure Point Total										2.9E-09				5.1E-02
			Exposure Medium Total										2.9E-09				5.1E-02
Soil Total										1.2E-07				1.9E-01			
Total of Receptor Risks Across All Media											1.2E-07	Total of Receptor Hazards Across All Media					1.9E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.4
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Surface Soil	North Tank Farm	Ingestion	Inorganics													
				ALUMINUM	6.67E+03	(mg/kg)	2.04E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.71E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.7E-03	
				ANTIMONY	5.95E-01	(mg/kg)	1.82E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.09E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.3E-03	
				ARSENIC	2.33E+00	(mg/kg)	4.27E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.4E-07	1.19E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-03	
				COBALT	4.97E+00	(mg/kg)	1.52E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.25E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02	
				IRON	1.16E+04	(mg/kg)	3.55E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.93E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E-02	
				MANGANESE	5.55E+02	(mg/kg)	1.70E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.75E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.4E-03	
				PAHs													
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	8.32E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	8.3E-09	2.33E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	9.72E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	9.7E-09	2.72E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	7.55E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	7.6E-08	2.11E-07	(mg/kg-day)	3.0E-04	(mg/kg-day)	7.0E-04	
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	1.53E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.5E-08	4.30E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total											7.5E-07		
			Dermal ¹	Inorganics													
				ALUMINUM	6.67E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ANTIMONY	5.95E-01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--	
				ARSENIC	2.33E+00	(mg/kg)	1.50E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.3E-08	4.21E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-04	
				COBALT	4.97E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.16E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	5.55E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	7.63E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	7.6E-10	2.14E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	8.92E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	8.9E-10	2.50E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	6.93E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	6.9E-09	1.94E-08	(mg/kg-day)	3.0E-04	(mg/kg-day)	6.5E-05	
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	1.41E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.4E-09	3.94E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total											3.3E-08		
			Exposure Point Total												7.8E-07		
	Exposure Medium Total												7.8E-07			4.4E-02	

TABLE 7.4
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	North Tank Farm	Inhalation	Inorganics															
				ALUMINUM	5.09E-06	(mg/m³)	4.15E-04	(ug/m³)	NA	per (ug/m³)	--	1.16E-06	(mg/m³)	5.00E-03	(mg/m³)	2.3E-04			
				ANTIMONY	4.54E-10	(mg/m³)	3.70E-08	(ug/m³)	NA	per (ug/m³)	--	1.04E-10	(mg/m³)	NA	(mg/m³)	--			
				ARSENIC	1.77E-09	(mg/m³)	1.45E-07	(ug/m³)	4.30E-03	per (ug/m³)	6.2E-10	4.05E-10	(mg/m³)	1.50E-05	(mg/m³)	2.7E-05			
				COBALT	3.79E-09	(mg/m³)	3.09E-07	(ug/m³)	9.00E-03	per (ug/m³)	2.8E-09	8.66E-10	(mg/m³)	6.00E-06	(mg/m³)	1.4E-04			
				IRON	8.86E-06	(mg/m³)	7.22E-04	(ug/m³)	NA	per (ug/m³)	--	2.02E-06	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	4.24E-07	(mg/m³)	3.46E-05	(ug/m³)	NA	per (ug/m³)	--	9.68E-08	(mg/m³)	5.00E-05	(mg/m³)	1.9E-03			
				PAHs															
				BENZ(A)ANTHRACENE	2.08E-10	(mg/m³)	1.69E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.0E-12	4.74E-11	(mg/m³)	NA	(mg/m³)	--			
				BENZO(B)FLUORANTHENE	2.43E-10	(mg/m³)	1.98E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.2E-12	5.54E-11	(mg/m³)	NA	(mg/m³)	--			
				BENZO(A)PYRENE	1.89E-10	(mg/m³)	1.54E-08	(ug/m³)	6.00E-04	per (ug/m³)	9.2E-12	4.30E-11	(mg/m³)	2.00E-06	(mg/m³)	2.2E-05			
				DIBENZ(A,H)ANTHRACENE	3.83E-11	(mg/m³)	3.12E-09	(ug/m³)	6.00E-04	per (ug/m³)	1.9E-12	8.75E-12	(mg/m³)	NA	(mg/m³)	--			
				Exp. Route Total											3.4E-09				2.4E-03
				Exposure Point Total											3.4E-09				2.4E-03
				Exposure Medium Total											3.4E-09				2.4E-03
Soil Total											7.8E-07				4.6E-02				
Total of Receptor Risks Across All Media											7.8E-07	Total of Receptor Hazards Across All Media					4.6E-02		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	9.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.5E-03
				ARSENIC	2.25E+00	(mg/kg)	1.83E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.7E-07	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	1.71E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	8.5E-07	3.99E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-03
				COBALT	4.24E+00	(mg/kg)	5.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.03E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02
				IRON	1.04E+04	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.88E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E-02
				MANGANESE	2.23E+02	(mg/kg)	3.03E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.12E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.11E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.01E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-08	2.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.77E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-08	1.81E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.12E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.95E-08	(mg/kg-day)	NA	(mg/kg-day)	--
			Exp. Route Total								1.2E-06					4.2E-02
			Dermal ¹	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.25E+00	(mg/kg)	4.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.2E-08	2.90E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	6.54E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-09	1.53E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	5.97E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-09	1.39E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	4.58E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.6E-08	1.07E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-04
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	1.25E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-08	2.91E-08	(mg/kg-day)	NA	(mg/kg-day)	--
			Exp. Route Total								1.3E-07					1.3E-03
		Exposure Point Total									1.4E-06					4.3E-02
	Exposure Medium Total										1.4E-06					4.3E-02
Sediment Total											1.4E-06					4.3E-02

TABLE 7.5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	5.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.5E-03
				ARSENIC	1.88E-03	(mg/L)	2.55E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-07	1.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-03
				CADMIUM	3.15E-03	(mg/L)	4.27E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.0E-03
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	5.66E-08	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.8E-08	1.32E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.4E-05
				CYANIDE	2.96E-02	(mg/L)	4.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.81E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.7E-02
				IRON	4.44E+00	(mg/L)	6.02E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.22E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.0E-03
				MANGANESE	3.59E-01	(mg/L)	4.87E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.41E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-03
				VANADIUM	4.53E-03	(mg/L)	6.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.30E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	8.6E-04
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	4.07E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.1E-09	9.50E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.76E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-08	4.10E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-04
				Exp. Route Total							4.3E-07					6.9E-02
			Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	4.56E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.2E-04
				ARSENIC	1.88E-03	(mg/L)	2.31E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.5E-08	1.62E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-04
				CADMIUM	3.15E-03	(mg/L)	3.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.71E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.1E-02
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.03E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.1E-07	2.39E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	3.2E-04
				CYANIDE	2.96E-02	(mg/L)	3.64E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.2E-03
				IRON	4.44E+00	(mg/L)	5.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.82E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.5E-04
				MANGANESE	3.59E-01	(mg/L)	4.41E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.09E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-04
				VANADIUM	4.53E-03	(mg/L)	5.57E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.90E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	3.0E-03
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	4.73E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	2.64E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.8E-03
				Exp. Route Total							1.6E-06					2.9E-02
			Exposure Point Total								2.0E-06					9.8E-02
			Exposure Medium Total								2.0E-06					9.8E-02
			Surface Water Total								2.0E-06					9.8E-02

TABLE 7.5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	North Tank Farm	Ingestion	Inorganics												
				ALUMINUM	6.67E+03	(mg/kg)	3.02E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.11E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.1E-03
				ANTIMONY	5.95E-01	(mg/kg)	2.69E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.88E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	4.7E-04
				ARSENIC	2.33E+00	(mg/kg)	6.31E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	9.5E-08	4.42E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03
				COBALT	4.97E+00	(mg/kg)	2.25E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.57E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.2E-03
				IRON	1.16E+04	(mg/kg)	5.25E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.67E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.2E-03
				MANGANESE	5.55E+02	(mg/kg)	2.51E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.76E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.3E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	3.69E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.7E-09	8.61E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	4.31E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.3E-09	1.01E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	3.35E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.4E-08	7.82E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.6E-04
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	6.81E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.8E-09	1.59E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							1.4E-07					1.6E-02
			Dermal ¹	Inorganics												
				ALUMINUM	6.67E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	5.95E-01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	2.33E+00	(mg/kg)	2.86E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.3E-08	2.00E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04
				COBALT	4.97E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.16E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	5.55E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.72E-01	(mg/kg)	4.35E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.3E-09	1.01E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	3.18E-01	(mg/kg)	5.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.1E-09	1.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.47E-01	(mg/kg)	3.95E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.9E-08	9.21E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.1E-04
				DIBENZ(A,H)ANTHRACENE	5.02E-02	(mg/kg)	8.02E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.0E-09	1.87E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							1.0E-07					9.7E-04
			Exposure Point Total								2.4E-07					1.7E-02
			Exposure Medium Total								2.4E-07					1.7E-02

TABLE 7.5
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Air	North Tank Farm	Inhalation	Inorganics													
				ALUMINUM	5.09E-06	(mg/m³)	1.73E-05	(ug/m³)	NA	per (ug/m³)	--	1.21E-08	(mg/m³)	5.00E-03	(mg/m³)	2.4E-06	
				ANTIMONY	4.54E-10	(mg/m³)	1.54E-09	(ug/m³)	NA	per (ug/m³)	--	1.08E-12	(mg/m³)	NA	(mg/m³)	--	
				ARSENIC	1.77E-09	(mg/m³)	6.02E-09	(ug/m³)	4.30E-03	per (ug/m³)	2.6E-11	4.21E-12	(mg/m³)	1.50E-05	(mg/m³)	2.8E-07	
				COBALT	3.79E-09	(mg/m³)	1.29E-08	(ug/m³)	9.00E-03	per (ug/m³)	1.2E-10	9.00E-12	(mg/m³)	6.00E-06	(mg/m³)	1.5E-06	
				IRON	8.86E-06	(mg/m³)	3.00E-05	(ug/m³)	NA	per (ug/m³)	--	2.10E-08	(mg/m³)	NA	(mg/m³)	--	
				MANGANESE	4.24E-07	(mg/m³)	1.44E-06	(ug/m³)	NA	per (ug/m³)	--	1.01E-09	(mg/m³)	5.00E-05	(mg/m³)	2.0E-05	
				PAHs													
				BENZ(A)ANTHRACENE	2.08E-10	(mg/m³)	2.11E-09	(ug/m³)	6.00E-05	per (ug/m³)	1.3E-13	4.93E-13	(mg/m³)	NA	(mg/m³)	--	
				BENZO(B)FLUORANTHENE	2.43E-10	(mg/m³)	2.47E-09	(ug/m³)	6.00E-05	per (ug/m³)	1.5E-13	5.76E-13	(mg/m³)	NA	(mg/m³)	--	
				BENZO(A)PYRENE	1.89E-10	(mg/m³)	1.92E-09	(ug/m³)	6.00E-04	per (ug/m³)	1.2E-12	4.48E-13	(mg/m³)	2.00E-06	(mg/m³)	2.2E-07	
				DIBENZ(A,H)ANTHRACENE	3.83E-11	(mg/m³)	3.90E-10	(ug/m³)	6.00E-04	per (ug/m³)	2.3E-13	9.10E-14	(mg/m³)	NA	(mg/m³)	--	
				Exp. Route Total							1.4E-10						2.5E-05
				Exposure Point Total							1.4E-10						2.5E-05
				Exposure Medium Total							1.4E-10						2.5E-05
Soil Total												2.4E-07				1.7E-02	
Total of Receptor Risks Across All Media											3.6E-06	Total of Receptor Hazards Across All Media					1.6E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.6
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.2E-04
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-03
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-04
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.6E-07					5.9E-03
				Dermal ¹	Inorganics											
			ALUMINUM		6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
			ARSENIC		2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04
			HEXAVALENT CHROMIUM (+6)		4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
			COBALT		4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
			IRON		1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
			MANGANESE		2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
			PAHs													
			BENZ(A)ANTHRACENE		2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--
			BENZO(B)FLUORANTHENE		2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
			BENZO(A)PYRENE		1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05
			DIBENZ(A,H)ANTHRACENE		5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--
			Exp. Route Total								5.7E-08					3.5E-04
			Exposure Point Total							3.2E-07					6.2E-03	
Exposure Medium Total							3.2E-07					6.2E-03				
Sediment Total							3.2E-07					6.2E-03				
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05
				Exp. Route Total							9.4E-08					7.7E-03

TABLE 7.6
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Surface Water	Surface Water	Surface Water	Dermal	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04	
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04	
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04	
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03	
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04	
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04	
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03	
			Exp. Route Total											1.6E-06			2.2E-02
			Exposure Point Total											1.7E-06			2.9E-02
			Exposure Medium Total											1.7E-06			2.9E-02
Surface Water Total												1.7E-06			2.9E-02		
Soil	Subsurface Soil	North Tank Farm	Ingestion	Inorganics													
				ALUMINUM	8.08E+03	(mg/kg)	2.77E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.69E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.7E-03	
				ARSENIC	3.41E+00	(mg/kg)	7.01E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-06	2.45E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.2E-03	
				COBALT	1.13E+01	(mg/kg)	3.88E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.36E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.5E-02	
				IRON	1.78E+04	(mg/kg)	6.10E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.14E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.1E-02	
				MANGANESE	2.26E+02	(mg/kg)	7.72E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.70E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.9E-03	
				Exp. Route Total											1.1E-06		
			Dermal	Inorganics													
				ALUMINUM	8.08E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	3.41E+00	(mg/kg)	1.48E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.2E-07	5.18E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.7E-03	
				COBALT	1.13E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.78E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.26E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				Exp. Route Total											2.2E-07		
			Exposure Point Total											1.3E-06			9.7E-02
Exposure Medium Total											1.3E-06			9.7E-02			

TABLE 7.6
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																					
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations									
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient					
							Value	Units	Value	Units		Value	Units	Value	Units						
Soil	Air	North Tank Farm	Inhalation	Inorganics																	
				ALUMINUM	6.17E-06	(mg/m³)	1.69E-03	(ug/m³)	NA	per (ug/m³)	--	5.92E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03					
				ARSENIC	2.60E-09	(mg/m³)	7.13E-07	(ug/m³)	4.30E-03	per (ug/m³)	3.1E-09	2.50E-09	(mg/m³)	1.50E-05	(mg/m³)	1.7E-04					
				COBALT	8.64E-09	(mg/m³)	2.37E-06	(ug/m³)	9.00E-03	per (ug/m³)	2.1E-08	8.29E-09	(mg/m³)	6.00E-06	(mg/m³)	1.4E-03					
				IRON	1.36E-05	(mg/m³)	3.73E-03	(ug/m³)	NA	per (ug/m³)	--	1.30E-05	(mg/m³)	NA	(mg/m³)	--					
				MANGANESE	1.72E-07	(mg/m³)	4.72E-05	(ug/m³)	NA	per (ug/m³)	--	1.65E-07	(mg/m³)	5.00E-05	(mg/m³)	3.3E-03					
		Exp. Route Total										2.4E-08					6.0E-03				
Exposure Point Total										2.4E-08					6.0E-03						
Exposure Medium Total										2.4E-08					6.0E-03						
Soil Total										1.3E-06					1.0E-01						
Total of Receptor Risks Across All Media										3.3E-06	Total of Receptor Hazards Across All Media										1.4E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.7
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02		
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03		
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02		
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02		
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total								3.6E-06						1.3E-01	
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total								1.8E-07						2.1E-03	
			Exposure Point Total									3.8E-06						1.3E-01
			Exposure Medium Total									3.8E-06						1.3E-01
Sediment Total									3.8E-06						1.3E-01			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02		
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02		
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04		
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01		
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02		
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03		
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04		
			Exp. Route Total									8.5E-07						2.1E-01

TABLE 7.7
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04		
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04		
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04		
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03		
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04		
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04		
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
				Exp. Route Total							2.6E-06						4.5E-02	
				Exposure Point Total							3.4E-06						2.5E-01	
				Exposure Medium Total							3.4E-06						2.5E-01	
Surface Water Total												3.4E-06						2.5E-01
Soil	Subsurface Soil	North Tank Farm	Ingestion	Inorganics														
				ALUMINUM	8.08E+03	(mg/kg)	8.86E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.03E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.0E-01		
				ARSENIC	3.41E+00	(mg/kg)	2.24E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.4E-06	2.62E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.7E-02		
				COBALT	1.13E+01	(mg/kg)	1.24E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.45E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.8E-01		
				IRON	1.78E+04	(mg/kg)	1.95E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	2.28E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.3E-01		
				MANGANESE	2.26E+02	(mg/kg)	2.47E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.88E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-02		
				Exp. Route Total							3.4E-06						1.0E+00	
			Dermal ¹	Inorganics														
				ALUMINUM	8.08E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	3.41E+00	(mg/kg)	2.66E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.0E-07	3.10E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.0E-02		
				COBALT	1.13E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.78E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.26E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
			Exp. Route Total							4.0E-07						1.0E-02		
			Exposure Point Total							3.8E-06						1.0E+00		
Exposure Medium Total							3.8E-06						1.0E+00					

TABLE 7.7
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	North Tank Farm	Inhalation	Inorganics														
				ALUMINUM	6.17E-06	(mg/m³)	5.07E-04	(ug/m³)	NA	per (ug/m³)	--	5.92E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03		
				ARSENIC	2.60E-09	(mg/m³)	2.14E-07	(ug/m³)	4.30E-03	per (ug/m³)	9.2E-10	2.50E-09	(mg/m³)	1.50E-05	(mg/m³)	1.7E-04		
				COBALT	8.64E-09	(mg/m³)	7.10E-07	(ug/m³)	9.00E-03	per (ug/m³)	6.4E-09	8.29E-09	(mg/m³)	6.00E-06	(mg/m³)	1.4E-03		
				IRON	1.36E-05	(mg/m³)	1.12E-03	(ug/m³)	NA	per (ug/m³)	--	1.30E-05	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	1.72E-07	(mg/m³)	1.41E-05	(ug/m³)	NA	per (ug/m³)	--	1.65E-07	(mg/m³)	5.00E-05	(mg/m³)	3.3E-03		
			Exp. Route Total											7.3E-09				6.0E-03
			Exposure Point Total											7.3E-09				6.0E-03
			Exposure Medium Total											7.3E-09				6.0E-03
			Soil Total											3.8E-06				1.0E+00
Total of Receptor Risks Across All Media											1.1E-05	Total of Receptor Hazards Across All Media				1.4E+00		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.8
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Subsurface Soil	North Tank Farm	Ingestion	Inorganics													
				ALUMINUM	8.08E+03	(mg/kg)	3.26E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.28E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.3E-02	
				ARSENIC	3.41E+00	(mg/kg)	8.26E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-07	5.78E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-02	
				COBALT	1.13E+01	(mg/kg)	4.57E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.20E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-01	
				IRON	1.78E+04	(mg/kg)	7.19E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.03E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	7.2E-02	
				MANGANESE	2.26E+02	(mg/kg)	9.10E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	6.37E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.6E-03	
			Exp. Route Total								1.2E-07					2.3E-01	
			Dermal ¹	Inorganics													
				ALUMINUM	8.08E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	3.41E+00	(mg/kg)	1.32E-08	(mg/kg-day)	1.5E+00	per (mg/kg-day)	2.0E-08	9.27E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.1E-03	
				COBALT	1.13E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.78E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.26E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
			Exp. Route Total								2.0E-08					3.1E-03	
			Exposure Point Total									1.4E-07					2.3E-01
	Exposure Medium Total									1.4E-07					2.3E-01		
	Air	North Tank Farm	Inhalation	Inorganics													
				ALUMINUM	1.32E-04	(mg/m ³)	4.32E-04	(ug/m ³)	NA	per (ug/m ³)	--	3.02E-05	(mg/m ³)	5.00E-03	(mg/m ³)	6.0E-03	
				ARSENIC	5.59E-08	(mg/m ³)	1.82E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	7.8E-10	1.28E-08	(mg/m ³)	1.50E-05	(mg/m ³)	8.5E-04	
				COBALT	1.85E-07	(mg/m ³)	6.05E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	5.4E-09	4.23E-08	(mg/m ³)	6.00E-06	(mg/m ³)	7.1E-03	
				IRON	2.92E-04	(mg/m ³)	9.52E-04	(ug/m ³)	NA	per (ug/m ³)	--	6.66E-05	(mg/m ³)	NA	(mg/m ³)	--	
				MANGANESE	3.69E-06	(mg/m ³)	1.20E-05	(ug/m ³)	NA	per (ug/m ³)	--	8.43E-07	(mg/m ³)	5.00E-05	(mg/m ³)	1.7E-02	
			Exp. Route Total								6.2E-09					3.1E-02	
			Exposure Point Total									6.2E-09					3.1E-02
	Exposure Medium Total									6.2E-09					3.1E-02		
Soil Total									1.5E-07					2.6E-01			
Total of Receptor Risks Across All Media											1.5E-07	Total of Receptor Hazards Across All Media					2.6E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.9
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

$$PEF = Q/C \times [(3,600 \text{ s/h}) / (.36 \times (1 - V) \times (U_m/U_t)^3 \times F(x))] =$$

1.31E+09

Air Concentration

$$C_{air} = C_{soil} \times ((1/PEF) + (1/VF))$$

Where,

$$Q/C = 8.26E+01 \text{ g/m}^2\text{-s per kg/m}^3$$

Inverse Mean Concentration at Center of 0.05 square source for Lincoln, NE, USEPA 1996

$$V = 5.00E-01 \text{ unitless}$$

Default, USEPA 2019

$$U_m = 4.65E+00 \text{ m/s}$$

Mean annual wind speed, Lincoln, NE, USEPA 1996

$$U_t = 1.13E+01 \text{ m/s}$$

Equivalent threshold value of windspeed at 7 m, USEPA 2019

$$F(x) = 1.82E-02 \text{ unitless}$$

Default, USEPA 2019

$$VF = \text{Volatilization Factor m}^3/\text{kg}$$

Chemical Specific, USEPA 2019

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. November 2019.

Chemical	Csoil, Subsurface Soil		Volatilization Factor	Cair, Surface Soil		Cair, Subsurface Soil	
	Soil			Particulate		Particulate	
	RME EPC	RME EPC		VF	RME EPC	RME EPC	
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³	mg/m ³	
Inorganics							
ALUMINUM	6.67E+03	8.08E+03	--	5.09E-06		6.17E-06	
ANTIMONY	5.95E-01	NA	--	4.54E-10		NA	
ARSENIC	2.33E+00	3.41E+00	--	1.77E-09		2.60E-09	
COBALT	4.97E+00	1.13E+01	--	3.79E-09		8.64E-09	
IRON	1.16E+04	1.78E+04	--	8.86E-06		1.36E-05	
MANGANESE	5.55E+02	2.26E+02	--	4.24E-07		1.72E-07	
PAHs							
BENZ(A)ANTHRACENE	2.72E-01	NA	--	2.08E-10		NA	
BENZO(B)FLUORANTHENE	3.18E-01	NA	--	2.43E-10		NA	
BENZO(A)PYRENE	2.47E-01	NA	--	1.89E-10		NA	
DIBENZ(A,H)ANTHRACENE	5.02E-02	NA	--	3.83E-11		NA	

TABLE 7.10
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
CONSTRUCTION WORKER - OTHER THAN STANDARD VEHICLE TRAFFIC
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

6.11E+07 Calculated using EPA RSL Calculator (Calculations provided in Appendix D)

Air Concentration

 $C_{air} = C_{soil} * ((1/PEF) + (1/VF))$

Where,

Area to be excavated, graded, tilled =

5.00E+00 acres

Depth of excavation =

1.50E+00 meters

Q/C =

9.44E+00 g/m²-s per kg/m³

calculated

U_m =

4.69E+00 m/s

Mean annual wind speed, USEPA 2019

U_t =

1.13E+01 m/s

Equivalent threshold value of windspeed at 7 m, USEPA 2019

F(x) =

1.94E-01 unitless

Default, USEPA 2019

VF =

Volatilization Factor m³/kg

Chemical Specific, USEPA 2019

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. November 2019.

Chemical	Csoil, Subsurface Soil			Cair, Surface Soil	Cair, Subsurface Soil
	Csoil, Surface Soil	Soil	Volatilization Factor	Particulate	Particulate
	RME EPC	RME EPC	VF	RME EPC	RME EPC
	mg/kg	mg/kg	m³/kg	mg/m³	mg/m³
Inorganics					
ALUMINUM	6.67E+03	8.08E+03	--	1.09E-04	1.32E-04
ANTIMONY	5.95E-01	NA		9.74E-09	NA
ARSENIC	2.33E+00	3.41E+00	--	3.81E-08	5.59E-08
COBALT	4.97E+00	1.13E+01	--	8.13E-08	1.85E-07
IRON	1.16E+04	1.78E+04	--	1.90E-04	2.92E-04
MANGANESE	5.55E+02	2.26E+02	--	9.09E-06	3.69E-06
PAHs					
BENZ(A)ANTHRACENE	2.72E-01	NA		4.45E-09	NA
BENZO(B)FLUORANTHENE	3.18E-01	NA		5.21E-09	NA
BENZO(A)PYRENE	2.47E-01	NA		4.04E-09	NA
DIBENZ(A,H)ANTHRACENE	5.02E-02	NA		8.22E-10	NA

TABLE 7.11
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN HOME GROWN PRODUCE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:				
	$Pr = Cs * Br_{ag} * 0.12$		mg/kg	Concentration of COPC in plant due to root uptake
Model Constants:				
	C_s	chemical-specific	mg/kg	COPC concentration in soil (mg/kg)
	$Br_{ag} =$	chemical-specific	unitless	Plant to soil bioconcentration factor (unitless), above ground produce and forage
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA 2005.				
Constituent of Potential Concern	Cs, Surface Soil RME EPC mg/kg	$Br_{ag}^{(1)}$ unitless	Reference	P_r RME EPC mg/kg
Inorganics				
ALUMINUM	6.67E+03	4.00E-03	RAIS 2019	3.20E+00
ANTIMONY	5.95E-01	3.19E-02	U.S. EPA 2005	2.28E-03
ARSENIC	2.33E+00	6.33E-03	U.S. EPA 2005	1.77E-03
COBALT	4.97E+00	2.00E-02	RAIS 2019	1.19E-02
IRON	1.16E+04	4.00E-03	RAIS 2019	5.57E+00
MANGANESE	5.55E+02	2.50E-01	RAIS 2019	1.67E+01
PAHs				
BENZ(A)ANTHRACENE	2.72E-01	1.97E-02	U.S. EPA 2005	6.43E-04
BENZO(B)FLUORANTHENE	3.18E-01	1.12E-02	U.S. EPA 2005	4.27E-04
BENZO(A)PYRENE	2.47E-01	1.32E-02	U.S. EPA 2005	3.91E-04
DIBENZ(A,H)ANTHRACENE	5.02E-02	6.78E-03	U.S. EPA 2005	4.08E-05

References:

U. S. EPA 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* , Final, EPA/530/R-05/006, Washington, D.C.

RAIS 2019. *Risk Assessment Information System* , online database available at: <http://rais.ornl.gov>. Assuming soil-to-dry plant uptake.

TABLE 7.12
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN BEEF
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

$$CM = ((F_i * Q_{p(\text{forage, beef})} * P_i) + (Q_{\text{soil}(\text{beef})} * C_s * B_s)) * B_{a,\text{beef}} * MF$$

Model Constants:

F_i	1	unitless	Fraction of plant type grown on contaminated soil and ingested by cattle, assume only consume forage grown on contaminated soil.
$Q_{p(\text{forage, cattle})}$	8.8	kg/day	Quantity of forage ingested by cattle per day.
P_i	calculated	mg/kg	Concentration of COPC in plant ingested by cattle.
			$C_s * Br_{ag} * 0.12$
			C_s = COPC concentration in soil (mg/kg).
			Br_{ag} = plant to soil bioconcentration factor (unitless)
$Q_{\text{soil}(\text{cattle})}$	0.5	kg/day	Quantity of soil ingested by cattle.
C_s	chemical-specific	mg/kg	Surface soil COPC concentration
B_s	1	unitless	Soil bioavailability factor.
$B_{a,\text{beef}}$	chemical-specific	day/kg	Biotransfer factor for beef.
MF	1	unitless	Metabolism factor for all constituents, except bis(2-ethylhexyl)phthalate = 0.01

Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA, 2005.

Chemical	Cs, Surface Soil RME EPC mg/kg	Br _{ag} ⁽¹⁾ unitless	P _i mg/kg	B _{a,beef} ⁽¹⁾ day/kg	Reference	CM RME EPC mg/kg
Inorganics						
ALUMINUM	6.67E+03	4.00E-03	3.20E+00	1.50E-03	RAIS 2019	5.05E+00
ANTIMONY	5.95E-01	3.19E-02	2.28E-03	1.00E-03	U.S. EPA 2005	3.18E-04
ARSENIC	2.33E+00	6.33E-03	1.77E-03	2.00E-03	U.S. EPA 2005	2.36E-03
COBALT	4.97E+00	2.00E-02	1.19E-02	2.00E-02	RAIS 2019	5.18E-02
IRON	1.16E+04	4.00E-03	5.57E+00	2.00E-02	RAIS 2019	1.17E+02
MANGANESE	5.55E+02	2.50E-01	1.67E+01	4.00E-04	RAIS 2019	1.70E-01
PAHs						
BENZ(A)ANTHRACENE	2.72E-01	1.97E-02	6.43E-04	1.44E-02	U.S. EPA 2005	2.04E-03
BENZO(B)FLUORANTHENE	3.18E-01	1.12E-02	4.27E-04	1.51E-02	U.S. EPA 2005	2.46E-03
BENZO(A)PYRENE	2.47E-01	1.32E-02	3.91E-04	3.37E-02	U.S. EPA 2005	4.28E-03
DIBENZ(A,H)ANTHRACENE	5.02E-02	6.78E-03	4.08E-05	4.76E-01	U.S. EPA 2005	1.21E-02

(1) Br_{ag} taken from USEPA, 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Final, EPA/530/R-05/006, Washington, D.C. For COPCs not listed in this document, taken from RAIS 2019, Risk Assessment Information System, online database available at: <http://rais.ornl.gov>. Assuming soil-to-wet plant uptake.

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.18E-04
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.89E-03
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.98E-03
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.13E-04
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.6E-07					5.9E-03
			Dermal ¹	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							5.7E-08					3.5E-04
			Exposure Point Total								3.2E-07					6.2E-03
			Exposure Medium Total								3.2E-07					6.2E-03
			Sediment Total								3.2E-07					6.2E-03
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05
				Exp. Route Total							9.4E-08					7.7E-03

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03
				Exp. Route Total							1.6E-06					2.2E-02
				Exposure Point Total							1.7E-06					2.9E-02
			Exposure Medium Total							1.7E-06					2.9E-02	
Surface Water Total											1.7E-06				2.9E-02	
Soil	Surface Soil	Lorraine Process Area	Ingestion	Inorganics												
				ALUMINUM	5.15E+03	(mg/kg)	1.76E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	6.17E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.2E-03
				ARSENIC	2.44E+00	(mg/kg)	5.01E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.5E-07	1.75E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.8E-03
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	1.03E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	5.1E-07	1.80E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	6.0E-04
				COPPER	1.53E+02	(mg/kg)	5.23E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.83E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	4.6E-03
				COBALT	3.51E+00	(mg/kg)	1.20E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.21E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02
				IRON	1.01E+04	(mg/kg)	3.47E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.22E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.7E-02
				MANGANESE	2.22E+02	(mg/kg)	7.62E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.67E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.9E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	1.92E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-08	3.37E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	2.83E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.8E-08	4.95E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	1.44E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.4E-07	2.52E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.4E-04
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	2.12E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-09	3.72E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	3.30E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.3E-09	5.78E-08	(mg/kg-day)	NA	(mg/kg-day)	--
			Exp. Route Total							1.5E-06					5.1E-02	

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Lorraine Process Area	Dermal ¹	Inorganics												
				ALUMINUM	5.15E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.44E+00	(mg/kg)	1.06E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.6E-07	3.70E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-03
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COPPER	1.53E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				COBALT	3.51E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.01E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.22E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	1.06E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	1.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	1.55E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.6E-08	2.72E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	7.90E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.9E-08	1.38E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.6E-04
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	1.17E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-09	2.04E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	1.81E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.8E-09	3.17E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.7E-07					1.7E-03
				Exposure Point Total							1.7E-06					5.3E-02
				Exposure Medium Total							1.7E-06					5.3E-02
Air	Lorraine Process Area	Inhalation		Inorganics												
				ALUMINUM	3.93E-06	(mg/m ³)	1.08E-03	(ug/m ³)	NA	per (ug/m ³)	--	3.77E-06	(mg/m ³)	5.00E-03	(mg/m ³)	7.5E-04
				ARSENIC	1.86E-09	(mg/m ³)	5.10E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	2.2E-09	1.79E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.2E-04
				HEXAVALENT CHROMIUM (+6)	1.15E-09	(mg/m ³)	6.27E-07	(ug/m ³)	8.40E-02	per (ug/m ³)	5.3E-08	1.10E-09	(mg/m ³)	1.00E-04	(mg/m ³)	1.1E-05
				COPPER	1.17E-07	(mg/m ³)	3.19E-05	(ug/m ³)	NA	per (ug/m ³)	--	1.12E-07	(mg/m ³)	NA	(mg/m ³)	--
				COBALT	2.68E-09	(mg/m ³)	7.34E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	6.6E-09	2.57E-09	(mg/m ³)	6.00E-06	(mg/m ³)	4.3E-04
				IRON	7.75E-06	(mg/m ³)	2.12E-03	(ug/m ³)	NA	per (ug/m ³)	--	7.43E-06	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	1.70E-07	(mg/m ³)	4.65E-05	(ug/m ³)	NA	per (ug/m ³)	--	1.63E-07	(mg/m ³)	5.00E-05	(mg/m ³)	3.3E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.15E-10	(mg/m ³)	1.18E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	7.1E-12	2.06E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	3.15E-10	(mg/m ³)	1.73E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	1.0E-11	3.02E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	1.60E-10	(mg/m ³)	8.78E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	5.3E-11	1.54E-10	(mg/m ³)	2.00E-06	(mg/m ³)	7.7E-05
				DIBENZ(A,H)ANTHRACENE	2.37E-12	(mg/m ³)	1.30E-09	(ug/m ³)	6.00E-04	per (ug/m ³)	7.8E-13	2.27E-12	(mg/m ³)	NA	(mg/m ³)	--
				INDENO(1,2,3-C,D)PYRENE	3.68E-11	(mg/m ³)	2.02E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	1.2E-12	3.53E-11	(mg/m ³)	NA	(mg/m ³)	--
				Exp. Route Total							6.2E-08					4.6E-03
				Exposure Point Total							6.2E-08					4.6E-03
				Exposure Medium Total							6.2E-08					4.6E-03

TABLE 7.13
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics												
				ALUMINUM	2.47E+00	(mg/kg)	1.06E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.71E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.7E-03
				ARSENIC	1.85E-03	(mg/kg)	7.94E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-06	2.78E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-03
				HEXAVALENT CHROMIUM (+6)	8.78E-04	(mg/kg)	7.53E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	3.8E-07	1.32E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.4E-04
				COPPER	7.33E+00	(mg/kg)	3.14E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.10E-02	(mg/kg-day)	4.00E-02	(mg/kg-day)	2.7E-01
				COBALT	8.43E-03	(mg/kg)	3.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.26E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.2E-02
				IRON	4.87E+00	(mg/kg)	2.09E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	7.31E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.0E-02
				MANGANESE	6.67E+00	(mg/kg)	2.86E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.00E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.1E-02
				PAHs												
				BENZ(A)ANTHRACENE	6.64E-04	(mg/kg)	5.69E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.7E-08	9.96E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	5.55E-04	(mg/kg)	4.76E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.8E-08	8.33E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	3.33E-04	(mg/kg)	2.85E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.9E-07	4.99E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.7E-03
				DIBENZ(A,H)ANTHRACENE	2.52E-06	(mg/kg)	2.16E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.2E-09	3.78E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	3.43E-05	(mg/kg)	2.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.9E-09	5.14E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.0E-06					4.1E-01
				Exposure Point Total							2.0E-06					4.1E-01
				Exposure Medium Total							2.0E-06					4.1E-01
	Surface Soil	Beef	Ingestion	Inorganics												
				ALUMINUM	3.90E+00	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	7.01E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	7.0E-03
				ARSENIC	2.47E-03	(mg/kg)	8.94E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.3E-06	4.45E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02
				HEXAVALENT CHROMIUM (+6)	4.17E-03	(mg/kg)	4.29E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.1E-06	7.50E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	2.5E-03
				COPPER	1.41E+00	(mg/kg)	5.09E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.54E-03	(mg/kg-day)	4.00E-02	(mg/kg-day)	6.3E-02
				COBALT	3.66E-02	(mg/kg)	1.32E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.59E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-01
				IRON	1.02E+02	(mg/kg)	3.70E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.84E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.6E-01
				MANGANESE	6.80E-02	(mg/kg)	2.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.22E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	8.7E-04
				PAHs												
				BENZ(A)ANTHRACENE	2.11E-03	(mg/kg)	1.52E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.5E-07	3.79E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	3.19E-03	(mg/kg)	2.31E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-07	5.75E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	3.64E-03	(mg/kg)	2.63E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-06	6.55E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-02
				DIBENZ(A,H)ANTHRACENE	7.48E-04	(mg/kg)	5.41E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.4E-07	1.35E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	3.05E-03	(mg/kg)	2.21E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.2E-07	5.49E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							7.3E-06					5.9E-01
				Exposure Point Total							7.3E-06					5.9E-01
				Exposure Medium Total							7.3E-06					5.9E-01
				Soil Total							1.1E-05					1.1E+00
				Total of Receptor Risks Across All Media							1.3E-05					1.1E+00

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02		
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03		
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02		
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02		
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total									3.6E-06					1.3E-01	
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total									1.8E-07					2.1E-03	
			Exposure Point Total									3.8E-06					1.3E-01	
		Exposure Medium Total									3.8E-06					1.3E-01		
Sediment Total									3.8E-06					1.3E-01				
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02		
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02		
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04		
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01		
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02		
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03		
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04		
			Exp. Route Total									8.5E-07					2.1E-01	

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04		
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04		
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02		
				HEXA VALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04		
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03		
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04		
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04		
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03		
			Dermal	PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
			Exp. Route Total							2.6E-06						4.5E-02		
		Exposure Point Total							3.4E-06						2.5E-01			
	Exposure Medium Total							3.4E-06						2.5E-01				
Surface Water Total												3.4E-06						2.5E-01
Soil	Surface Soil	Lorraine Process Area	Ingestion	Inorganics														
				ALUMINUM	5.15E+03	(mg/kg)	5.64E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	6.58E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.6E-02		
				ARSENIC	2.44E+00	(mg/kg)	1.60E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.4E-06	1.87E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.2E-02		
				HEXA VALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	8.71E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.4E-06	1.92E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	6.4E-03		
				COPPER	1.53E+02	(mg/kg)	1.67E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.95E-03	(mg/kg-day)	4.00E-02	(mg/kg-day)	4.9E-02		
				COBALT	3.51E+00	(mg/kg)	3.85E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.49E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-01		
				IRON	1.01E+04	(mg/kg)	1.11E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.30E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.9E-01		
				MANGANESE	2.22E+02	(mg/kg)	2.44E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.84E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.0E-02		
				Dermal	PAHs													
			BENZ(A)ANTHRACENE		2.81E-01	(mg/kg)	1.63E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.6E-07	3.59E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
			BENZO(B)FLUORANTHENE		4.13E-01	(mg/kg)	2.40E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.4E-07	5.28E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
			BENZO(A)PYRENE		2.10E-01	(mg/kg)	1.22E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-06	2.68E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.9E-03		
			DIBENZ(A,H)ANTHRACENE		3.10E-03	(mg/kg)	1.80E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-08	3.96E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
		INDENO(1,2,3-C,D)PYRENE	4.82E-02		(mg/kg)	2.80E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.8E-08	6.16E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
	Exp. Route Total						8.4E-06						5.5E-01					

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																			
Receptor Population: Resident																			
Receptor Age: Child																			
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Surface Soil	Lorraine Process Area	Dermal ¹	Inorganics															
				ALUMINUM	5.15E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--			
				ARSENIC	2.44E+00	(mg/kg)	1.90E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.9E-07	2.22E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.4E-03			
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--			
				COPPER	1.53E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--			
				COBALT	3.51E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--			
				IRON	1.01E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--			
				MANGANESE	2.22E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--			
				PAHs															
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	5.03E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.0E-08	1.11E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	7.40E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.4E-08	1.63E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	3.76E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.8E-07	8.28E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.8E-03			
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	5.55E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-09	1.22E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	8.64E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	8.6E-09	1.90E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
			Exp. Route Total							8.0E-07					1.0E-02				
			Exposure Point Total							9.2E-06					5.6E-01				
			Exposure Medium Total							9.2E-06					5.6E-01				
			Air	Lorraine Process Area	Inhalation	Inorganics	ALUMINUM	3.93E-06	(mg/m ³)	3.23E-04	(ug/m ³)	NA	per (ug/m ³)	--	3.77E-06	(mg/m ³)	5.00E-03	(mg/m ³)	7.5E-04
							ARSENIC	1.86E-09	(mg/m ³)	1.53E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	6.6E-10	1.79E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.2E-04
							HEXAVALENT CHROMIUM (+6)	1.15E-09	(mg/m ³)	4.99E-07	(ug/m ³)	8.40E-02	per (ug/m ³)	4.2E-08	1.10E-09	(mg/m ³)	1.00E-04	(mg/m ³)	1.1E-05
COPPER	1.17E-07	(mg/m ³)					9.58E-06	(ug/m ³)	NA	per (ug/m ³)	--	1.12E-07	(mg/m ³)	NA	(mg/m ³)	--			
COBALT	2.68E-09	(mg/m ³)					2.20E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	2.0E-09	2.57E-09	(mg/m ³)	6.00E-06	(mg/m ³)	4.3E-04			
IRON	7.75E-06	(mg/m ³)					6.37E-04	(ug/m ³)	NA	per (ug/m ³)	--	7.43E-06	(mg/m ³)	NA	(mg/m ³)	--			
MANGANESE	1.70E-07	(mg/m ³)					1.40E-05	(ug/m ³)	NA	per (ug/m ³)	--	1.63E-07	(mg/m ³)	5.00E-05	(mg/m ³)	3.3E-03			
PAHs																			
BENZ(A)ANTHRACENE	2.15E-10	(mg/m ³)					9.34E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	5.6E-12	2.06E-10	(mg/m ³)	NA	(mg/m ³)	--			
BENZO(B)FLUORANTHENE	3.15E-10	(mg/m ³)					1.37E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	8.2E-12	3.02E-10	(mg/m ³)	NA	(mg/m ³)	--			
BENZO(A)PYRENE	1.60E-10	(mg/m ³)					6.98E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	4.2E-11	1.54E-10	(mg/m ³)	2.00E-06	(mg/m ³)	7.7E-05			
DIBENZ(A,H)ANTHRACENE	2.37E-12	(mg/m ³)					1.03E-09	(ug/m ³)	6.00E-04	per (ug/m ³)	6.2E-13	2.27E-12	(mg/m ³)	NA	(mg/m ³)	--			
INDENO(1,2,3-C,D)PYRENE	3.68E-11	(mg/m ³)					1.60E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	9.6E-13	3.53E-11	(mg/m ³)	NA	(mg/m ³)	--			
Exp. Route Total											4.5E-08					4.6E-03			
Exposure Point Total										4.5E-08					4.6E-03				
Exposure Medium Total										4.5E-08					4.6E-03				

TABLE 7.14
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics														
				ALUMINUM	2.47E+00	(mg/kg)	8.16E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.5E-03		
				ARSENIC	1.85E-03	(mg/kg)	6.12E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	9.2E-07	7.14E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-02		
				HEXAVALENT CHROMIUM (+6)	8.78E-04	(mg/kg)	1.54E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	7.7E-07	3.38E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.1E-03		
				COPPER	7.33E+00	(mg/kg)	2.42E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.82E-02	(mg/kg-day)	4.00E-02	(mg/kg-day)	7.1E-01		
				COBALT	8.43E-03	(mg/kg)	2.78E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.24E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-01		
				IRON	4.87E+00	(mg/kg)	1.61E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.87E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.7E-02		
				MANGANESE	6.67E+00	(mg/kg)	2.20E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.57E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.8E-01		
				PAHs														
				BENZ(A)ANTHRACENE	6.64E-04	(mg/kg)	1.16E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-07	2.56E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	5.55E-04	(mg/kg)	9.71E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.7E-08	2.14E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	3.33E-04	(mg/kg)	5.82E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.8E-07	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03		
				DIBENZ(A,H)ANTHRACENE	2.52E-06	(mg/kg)	4.41E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	9.71E-09	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	3.43E-05	(mg/kg)	6.00E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-09	1.32E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										2.5E-06				
		Exposure Point Total										2.5E-06					1.1E+00	
	Exposure Medium Total										2.5E-06					1.1E+00		
	Surface Soil	Beef	Ingestion	Inorganics														
				ALUMINUM	3.90E+00	(mg/kg)	8.57E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.42E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.4E-02		
				ARSENIC	2.47E-03	(mg/kg)	5.44E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.2E-07	9.03E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.0E-02		
				HEXAVALENT CHROMIUM (+6)	4.17E-03	(mg/kg)	4.86E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.4E-06	1.52E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.1E-03		
				COPPER	1.41E+00	(mg/kg)	3.10E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.14E-03	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.3E-01		
				COBALT	3.66E-02	(mg/kg)	8.05E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.34E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.5E-01		
				IRON	1.02E+02	(mg/kg)	2.25E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	3.73E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.3E-01		
				MANGANESE	6.80E-02	(mg/kg)	1.49E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.48E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.8E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.11E-03	(mg/kg)	2.46E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.5E-07	7.69E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	3.19E-03	(mg/kg)	3.72E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.7E-07	1.17E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	3.64E-03	(mg/kg)	4.24E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.2E-06	1.33E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.4E-02		
				DIBENZ(A,H)ANTHRACENE	7.48E-04	(mg/kg)	8.72E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.7E-07	2.73E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	3.05E-03	(mg/kg)	3.56E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.6E-07	1.11E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										9.3E-06				1.2E+00
				Exposure Point Total										9.3E-06				1.2E+00
				Exposure Medium Total										9.3E-06				1.2E+00
Soil Total										2.1E-05				2.8E+00				
Total of Receptor Risks Across All Media											2.8E-05	Total of Receptor Hazards Across All Media					3.2E+00	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.15
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Lorraine Process Area	Ingestion	Inorganics														
				ALUMINUM	5.15E+03	(mg/kg)	2.08E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.46E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.5E-02		
				ARSENIC	2.44E+00	(mg/kg)	5.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.9E-08	4.14E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	6.05E-08	(mg/kg-day)	5.0E-01	per (mg/kg-day)	3.0E-08	4.24E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.4E-03		
				COPPER	1.53E+02	(mg/kg)	6.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.1E-02		
				COBALT	3.51E+00	(mg/kg)	1.42E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	9.92E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.3E-02		
				IRON	1.01E+04	(mg/kg)	4.10E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.87E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-02		
				MANGANESE	2.22E+02	(mg/kg)	8.98E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	6.28E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	1.13E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.1E-09	7.94E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	1.67E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.7E-09	1.17E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	8.48E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	8.5E-09	5.93E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-03		
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	1.25E-10	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.3E-10	8.76E-09	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	1.95E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.9E-10	1.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										1.3E-07				1.2E-01	
			Dermal ¹	Inorganics														
				ALUMINUM	5.15E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.44E+00	(mg/kg)	9.47E-09	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-08	6.63E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-03		
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	NA	(mg/kg-day)	2.0E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COPPER	1.53E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--		
				COBALT	3.51E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.01E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.22E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	4.73E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	4.7E-10	3.31E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	6.95E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	6.9E-10	4.86E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	3.53E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	3.5E-09	2.47E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.2E-04		
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	5.22E-11	(mg/kg-day)	1.0E+00	per (mg/kg-day)	5.2E-11	3.65E-09	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	8.11E-10	(mg/kg-day)	1.0E-01	per (mg/kg-day)	8.1E-11	5.68E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										1.9E-08				3.0E-03	
			Exposure Point Total										1.5E-07				1.2E-01	
			Exposure Medium Total										1.5E-07				1.2E-01	

TABLE 7.15
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations											
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient							
							Value	Units	Value	Units		Value	Units	Value	Units								
Soil	Air	Lorraine Process Area	Inhalation	Inorganics																			
				ALUMINUM	8.43E-05	(mg/m³)	2.75E-04	(ug/m³)	NA	per (ug/m³)	--	1.93E-05	(mg/m³)	5.00E-03	(mg/m³)	3.9E-03							
				ARSENIC	4.00E-08	(mg/m³)	1.30E-07	(ug/m³)	4.3E-03	per (ug/m³)	5.6E-10	9.12E-09	(mg/m³)	1.50E-05	(mg/m³)	6.1E-04							
				HEXAVALENT CHROMIUM (+6)	2.46E-08	(mg/m³)	8.01E-08	(ug/m³)	8.4E-02	per (ug/m³)	6.7E-09	5.61E-09	(mg/m³)	1.00E-04	(mg/m³)	5.6E-05							
				COPPER	2.50E-06	(mg/m³)	8.16E-06	(ug/m³)	NA	per (ug/m³)	--	5.71E-07	(mg/m³)	NA	(mg/m³)	--							
				COBALT	5.75E-08	(mg/m³)	1.88E-07	(ug/m³)	9.0E-03	per (ug/m³)	1.7E-09	1.31E-08	(mg/m³)	6.00E-06	(mg/m³)	2.2E-03							
				IRON	1.66E-04	(mg/m³)	5.42E-04	(ug/m³)	NA	per (ug/m³)	--	3.79E-05	(mg/m³)	NA	(mg/m³)	--							
				MANGANESE	3.64E-06	(mg/m³)	1.19E-05	(ug/m³)	NA	per (ug/m³)	--	8.31E-07	(mg/m³)	5.00E-05	(mg/m³)	1.7E-02							
				PAHs																			
				BENZ(A)ANTHRACENE	4.60E-09	(mg/m³)	1.50E-08	(ug/m³)	6.0E-05	per (ug/m³)	9.0E-13	1.05E-09	(mg/m³)	NA	(mg/m³)	--							
				BENZO(B)FLUORANTHENE	6.76E-09	(mg/m³)	2.21E-08	(ug/m³)	6.0E-05	per (ug/m³)	1.3E-12	1.54E-09	(mg/m³)	NA	(mg/m³)	--							
				BENZO(A)PYRENE	3.44E-09	(mg/m³)	1.12E-08	(ug/m³)	6.0E-04	per (ug/m³)	6.7E-12	7.85E-10	(mg/m³)	2.00E-06	(mg/m³)	3.9E-04							
				DIBENZ(A,H)ANTHRACENE	5.08E-11	(mg/m³)	1.66E-10	(ug/m³)	6.0E-04	per (ug/m³)	9.9E-14	1.16E-11	(mg/m³)	NA	(mg/m³)	--							
				INDENO(1,2,3-C,D)PYRENE	7.89E-10	(mg/m³)	2.57E-09	(ug/m³)	6.0E-05	per (ug/m³)	1.5E-13	1.80E-10	(mg/m³)	NA	(mg/m³)	--							
				Exp. Route Total					9.0E-09						2.4E-02								
				Exposure Point Total					9.0E-09						2.4E-02								
				Exposure Medium Total					9.0E-09						2.4E-02								
Soil Total					1.6E-07						1.5E-01												
Total of Receptor Risks Across All Media											1.6E-07	Total of Receptor Hazards Across All Media											1.5E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.16
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Lorraine Process Area	Ingestion	Inorganics												
				ALUMINUM	5.15E+03	(mg/kg)	1.57E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	4.41E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.4E-03
				ARSENIC	2.44E+00	(mg/kg)	4.48E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.7E-07	1.25E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.2E-03
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	4.59E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.3E-07	1.28E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.3E-04
				COPPER	1.53E+02	(mg/kg)	4.67E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.31E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	3.3E-03
				COBALT	3.51E+00	(mg/kg)	1.07E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.01E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.0E-02
				IRON	1.01E+04	(mg/kg)	3.10E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	8.69E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.2E-02
				MANGANESE	2.22E+02	(mg/kg)	6.80E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.90E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.4E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	8.59E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	8.6E-09	2.41E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	1.26E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.3E-08	3.54E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	6.42E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	6.4E-08	1.80E-07	(mg/kg-day)	3.0E-04	(mg/kg-day)	6.0E-04
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	9.48E-10	(mg/kg-day)	1.0E+00	per (mg/kg-day)	9.5E-10	2.65E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	1.47E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.5E-09	4.13E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							9.9E-07					3.7E-02
			Dermal ¹	Inorganics												
				ALUMINUM	5.15E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.44E+00	(mg/kg)	1.58E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.4E-08	4.42E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-04
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COPPER	1.53E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				COBALT	3.51E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.01E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.22E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	7.88E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	7.9E-10	2.21E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	1.16E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.2E-09	3.24E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	5.89E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	5.9E-09	1.65E-08	(mg/kg-day)	3.0E-04	(mg/kg-day)	5.5E-05
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	8.69E-11	(mg/kg-day)	1.0E+00	per (mg/kg-day)	8.7E-11	2.43E-10	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	1.35E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.4E-10	3.78E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							3.2E-08					2.0E-04
			Exposure Point Total								1.0E-06					3.7E-02
			Exposure Medium Total								1.0E-06					3.7E-02

TABLE 7.16
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Lorraine Process Area	Inhalation	Inorganics															
				ALUMINUM	3.93E-06	(mg/m³)	3.21E-04	(ug/m³)	NA	per (ug/m³)	--	8.98E-07	(mg/m³)	5.00E-03	(mg/m³)	1.8E-04			
				ARSENIC	1.86E-09	(mg/m³)	1.52E-07	(ug/m³)	4.30E-03	per (ug/m³)	6.5E-10	4.25E-10	(mg/m³)	1.50E-05	(mg/m³)	2.8E-05			
				HEXAVALENT CHROMIUM (+6)	1.15E-09	(mg/m³)	9.34E-08	(ug/m³)	8.40E-02	per (ug/m³)	7.8E-09	2.61E-10	(mg/m³)	1.00E-04	(mg/m³)	2.6E-06			
				COPPER	1.17E-07	(mg/m³)	9.50E-06	(ug/m³)	NA	per (ug/m³)	--	2.66E-08	(mg/m³)	NA	(mg/m³)	--			
				COBALT	2.68E-09	(mg/m³)	2.19E-07	(ug/m³)	9.00E-03	per (ug/m³)	2.0E-09	6.12E-10	(mg/m³)	6.00E-06	(mg/m³)	1.0E-04			
				IRON	7.75E-06	(mg/m³)	6.32E-04	(ug/m³)	NA	per (ug/m³)	--	1.77E-06	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	1.70E-07	(mg/m³)	1.38E-05	(ug/m³)	NA	per (ug/m³)	--	3.88E-08	(mg/m³)	5.00E-05	(mg/m³)	7.8E-04			
				PAHs															
				BENZ(A)ANTHRACENE	2.15E-10	(mg/m³)	1.75E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.0E-12	4.90E-11	(mg/m³)	NA	(mg/m³)	--			
				BENZO(B)FLUORANTHENE	3.15E-10	(mg/m³)	2.57E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.5E-12	7.20E-11	(mg/m³)	NA	(mg/m³)	--			
				BENZO(A)PYRENE	1.60E-10	(mg/m³)	1.31E-08	(ug/m³)	6.00E-04	per (ug/m³)	7.8E-12	3.66E-11	(mg/m³)	2.00E-06	(mg/m³)	1.8E-05			
				DIBENZ(A,H)ANTHRACENE	2.37E-12	(mg/m³)	1.93E-10	(ug/m³)	6.00E-04	per (ug/m³)	1.2E-13	5.40E-13	(mg/m³)	NA	(mg/m³)	--			
				INDENO(1,2,3-C,D)PYRENE	3.68E-11	(mg/m³)	3.00E-09	(ug/m³)	6.00E-05	per (ug/m³)	1.8E-13	8.40E-12	(mg/m³)	NA	(mg/m³)	--			
				Exp. Route Total											1.0E-08				1.1E-03
				Exposure Point Total											1.0E-08				1.1E-03
				Exposure Medium Total											1.0E-08				1.1E-03
Soil Total											1.0E-06				3.8E-02				
Total of Receptor Risks Across All Media											1.0E-06	Total of Receptor Hazards Across All Media				3.8E-02			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.17
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Recreational User
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	9.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.5E-03		
				ARSENIC	2.25E+00	(mg/kg)	1.83E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.7E-07	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	1.71E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	8.5E-07	3.99E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-03		
				COBALT	4.24E+00	(mg/kg)	5.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.03E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				IRON	1.04E+04	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.88E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E-02		
				MANGANESE	2.23E+02	(mg/kg)	3.03E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.12E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.11E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.01E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-08	2.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.77E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-08	1.81E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.12E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.95E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total						1.2E-06						4.2E-02		
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	4.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.2E-08	2.90E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	6.54E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-09	1.53E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	5.97E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-09	1.39E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	4.58E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.6E-08	1.07E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	1.25E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-08	2.91E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total						1.3E-07						1.3E-03		
			Exposure Point Total							1.4E-06						4.3E-02		
			Exposure Medium Total							1.4E-06						4.3E-02		
Sediment Total												1.4E-06						4.3E-02
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	5.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.5E-03		
				ARSENIC	1.88E-03	(mg/L)	2.55E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-07	1.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-03		
				CADMIUM	3.15E-03	(mg/L)	4.27E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	5.66E-08	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.8E-08	1.32E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.4E-05		
				CYANIDE	2.96E-02	(mg/L)	4.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.81E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.7E-02		
				IRON	4.44E+00	(mg/L)	6.02E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.22E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.0E-03		
				MANGANESE	3.59E-01	(mg/L)	4.87E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.41E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-03		
				VANADIUM	4.53E-03	(mg/L)	6.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.30E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	8.6E-04		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	4.07E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.1E-09	9.50E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.76E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-08	4.10E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-04		
				Exp. Route Total						4.3E-07						6.9E-02		

TABLE 7.17
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Recreational User
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.56E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.2E-04		
				ARSENIC	1.88E-03	(mg/L)	2.31E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.5E-08	1.62E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-04		
				CADMIUM	3.15E-03	(mg/L)	3.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.71E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.1E-02		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.03E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.1E-07	2.39E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	3.2E-04		
				CYANIDE	2.96E-02	(mg/L)	3.64E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.2E-03		
				IRON	4.44E+00	(mg/L)	5.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.82E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.5E-04		
				MANGANESE	3.59E-01	(mg/L)	4.41E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.09E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-04		
				VANADIUM	4.53E-03	(mg/L)	5.57E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.90E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	3.0E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	4.73E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	2.64E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.8E-03		
				Exp. Route Total														2.9E-02
				Exposure Point Total														
			Exposure Medium Total															
Surface Water Total																9.8E-02		
Soil	Surface Soil	Lorraine Process Area	Ingestion	Inorganics														
				ALUMINUM	5.15E+03	(mg/kg)	2.33E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.63E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.6E-03		
				ARSENIC	2.44E+00	(mg/kg)	6.62E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	9.9E-08	4.63E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	2.04E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.0E-07	4.75E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.6E-04		
				COPPER	1.53E+02	(mg/kg)	6.91E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.83E-05	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.2E-03		
				COBALT	3.51E+00	(mg/kg)	1.59E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.11E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.7E-03		
				IRON	1.01E+04	(mg/kg)	4.59E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.21E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.6E-03		
				MANGANESE	2.22E+02	(mg/kg)	1.01E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.04E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.0E-04		
				PAHs														
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	3.81E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.8E-09	8.90E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	5.60E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.6E-09	1.31E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	2.85E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.8E-08	6.65E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-04		
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	4.21E-10	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.2E-10	9.81E-10	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	6.54E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-10	1.53E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total															1.4E-02

TABLE 7.17
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Receptor Population: Recreational User
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Surface Soil	Lorraine Process Area	Dermal ¹	Inorganics													
				ALUMINUM	5.15E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.44E+00	(mg/kg)	3.00E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.5E-08	2.10E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.0E-04	
				HEXAVALENT CHROMIUM (+6)	1.50E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COPPER	1.53E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--	
				COBALT	3.51E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.01E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.22E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.81E-01	(mg/kg)	4.49E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.5E-09	1.05E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	4.13E-01	(mg/kg)	6.60E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.6E-09	1.54E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	2.10E-01	(mg/kg)	3.36E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.4E-08	7.83E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.6E-04	
				DIBENZ(A,H)ANTHRACENE	3.10E-03	(mg/kg)	4.95E-10	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.0E-10	1.16E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
				INDENO(1,2,3-C,D)PYRENE	4.82E-02	(mg/kg)	7.70E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.7E-10	1.80E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total										9.1E-08			
			Exposure Point Total										3.3E-07				1.5E-02
	Exposure Medium Total										3.3E-07				1.5E-02		
	Air	Lorraine Process Area	Inhalation	Inorganics													
				ALUMINUM	3.93E-06	(mg/m³)	1.33E-05	(ug/m³)	NA	per (ug/m³)	--	9.33E-09	(mg/m³)	5.00E-03	(mg/m³)	1.9E-06	
				ARSENIC	1.86E-09	(mg/m³)	6.32E-09	(ug/m³)	4.30E-03	per (ug/m³)	2.7E-11	4.42E-12	(mg/m³)	1.50E-05	(mg/m³)	2.9E-07	
				HEXAVALENT CHROMIUM (+6)	1.15E-09	(mg/m³)	1.17E-08	(ug/m³)	8.40E-02	per (ug/m³)	9.8E-10	2.72E-12	(mg/m³)	1.00E-04	(mg/m³)	2.7E-08	
				COPPER	1.17E-07	(mg/m³)	3.95E-07	(ug/m³)	NA	per (ug/m³)	--	2.77E-10	(mg/m³)	NA	(mg/m³)	--	
				COBALT	2.68E-09	(mg/m³)	9.09E-09	(ug/m³)	9.00E-03	per (ug/m³)	8.2E-11	6.36E-12	(mg/m³)	6.00E-06	(mg/m³)	1.1E-06	
				IRON	7.75E-06	(mg/m³)	2.63E-05	(ug/m³)	NA	per (ug/m³)	--	1.84E-08	(mg/m³)	NA	(mg/m³)	--	
				MANGANESE	1.70E-07	(mg/m³)	5.76E-07	(ug/m³)	NA	per (ug/m³)	--	4.03E-10	(mg/m³)	5.00E-05	(mg/m³)	8.1E-06	
				PAHs													
BENZ(A)ANTHRACENE			2.15E-10	(mg/m³)	2.18E-09	(ug/m³)	6.00E-05	per (ug/m³)	1.3E-13	5.09E-13	(mg/m³)	NA	(mg/m³)	--			
BENZO(B)FLUORANTHENE	3.15E-10	(mg/m³)	3.21E-09	(ug/m³)	6.00E-05	per (ug/m³)	1.9E-13	7.49E-13	(mg/m³)	NA	(mg/m³)	--					
BENZO(A)PYRENE	1.60E-10	(mg/m³)	1.63E-09	(ug/m³)	6.00E-04	per (ug/m³)	9.8E-13	3.81E-13	(mg/m³)	2.00E-06	(mg/m³)	1.9E-07					
DIBENZ(A,H)ANTHRACENE	2.37E-12	(mg/m³)	2.41E-11	(ug/m³)	6.00E-04	per (ug/m³)	1.4E-14	5.62E-15	(mg/m³)	NA	(mg/m³)	--					
INDENO(1,2,3-C,D)PYRENE	3.68E-11	(mg/m³)	3.74E-10	(ug/m³)	6.00E-05	per (ug/m³)	2.2E-14	8.74E-14	(mg/m³)	NA	(mg/m³)	--					
Exp. Route Total										1.1E-09				1.2E-05			
Exposure Point Total										1.1E-09				1.2E-05			
Exposure Medium Total										1.1E-09				1.2E-05			
Soil Total										3.3E-07				1.5E-02			
Total of Receptor Risks Across All Media											3.7E-06	Total of Receptor Hazards Across All Media				1.6E-01	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.18
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.2E-04	
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04	
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03	
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-03	
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-04	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							2.6E-07					5.9E-03	
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							5.7E-08					3.5E-04	
			Exposure Point Total								3.2E-07					6.2E-03	
			Exposure Medium Total								3.2E-07					6.2E-03	
Sediment Total								3.2E-07					6.2E-03				
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04	
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04	
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06	
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03	
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04	
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04	
				LEAD	0.00E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	NA	(mg/kg-day)	--	
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05	
				Exp. Route Total							9.4E-08					7.7E-03	

TABLE 7.18
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Surface Water	Surface Water	Surface Water	Dermal	Inorganics																
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04				
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04				
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03				
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04				
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03				
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04				
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04				
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03				
				PAHs																
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--				
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03				
				Exp. Route Total										2.2E-02						
				Exposure Point Total										2.9E-02						
				Exposure Medium Total										2.9E-02						
				Surface Water Total							1.7E-06					2.9E-02				
				Soil	Subsurface Soil	Lorraine Process Area	Ingestion	Inorganics												
ALUMINUM	6.63E+03	(mg/kg)	2.27E-03					(mg/kg-day)	NA	per (mg/kg-day)	--	7.95E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	7.9E-03				
ARSENIC	2.87E+00	(mg/kg)	5.90E-07					(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.9E-07	2.07E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.9E-03				
COPPER	5.90E+01	(mg/kg)	2.02E-05					(mg/kg-day)	NA	per (mg/kg-day)	--	7.07E-05	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.8E-03				
COBALT	5.00E+00	(mg/kg)	1.71E-06					(mg/kg-day)	NA	per (mg/kg-day)	--	5.99E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-02				
IRON	1.22E+04	(mg/kg)	4.18E-03					(mg/kg-day)	NA	per (mg/kg-day)	--	1.46E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.1E-02				
MANGANESE	1.59E+02	(mg/kg)	5.45E-05					(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.4E-03				
PAHs																				
BENZO(A)PYRENE	2.28E-02	(mg/kg)	1.56E-08					(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.73E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.1E-05				
Exp. Route Total								9.0E-07					5.9E-02							
Dermal ¹	Inorganics																			
	ALUMINUM	6.63E+03	(mg/kg)				NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--				
	ARSENIC	2.87E+00	(mg/kg)				1.25E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.9E-07	4.36E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03				
	COPPER	5.90E+01	(mg/kg)				NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--				
	COBALT	5.00E+00	(mg/kg)				NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--				
	IRON	1.22E+04	(mg/kg)				NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--				
	MANGANESE	1.59E+02	(mg/kg)				NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--				
	PAHs																			
	BENZO(A)PYRENE	2.28E-02	(mg/kg)				8.57E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.6E-09	1.50E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.0E-05				
	Exp. Route Total						2.0E-07					1.5E-03								
	Exposure Point Total						1.1E-06					6.0E-02								
	Exposure Medium Total						1.1E-06					6.0E-02								

TABLE 7.18
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	Lorraine Process Area	Inhalation	Inorganics														
				ALUMINUM	5.06E-06	(mg/m³)	1.39E-03	(ug/m³)	NA	per (ug/m³)	--	4.85E-06	(mg/m³)	5.00E-03	(mg/m³)	9.7E-04		
				ARSENIC	2.19E-09	(mg/m³)	6.01E-07	(ug/m³)	4.30E-03	per (ug/m³)	2.6E-09	2.10E-09	(mg/m³)	1.50E-05	(mg/m³)	1.4E-04		
				COPPER	4.50E-08	(mg/m³)	1.23E-05	(ug/m³)	NA	per (ug/m³)	--	4.32E-08	(mg/m³)	NA	(mg/m³)	--		
				COBALT	3.82E-09	(mg/m³)	1.05E-06	(ug/m³)	9.00E-03	per (ug/m³)	9.4E-09	3.66E-09	(mg/m³)	6.00E-06	(mg/m³)	6.1E-04		
				IRON	9.31E-06	(mg/m³)	2.55E-03	(ug/m³)	NA	per (ug/m³)	--	8.93E-06	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	1.21E-07	(mg/m³)	3.33E-05	(ug/m³)	NA	per (ug/m³)	--	1.16E-07	(mg/m³)	5.00E-05	(mg/m³)	2.3E-03		
				PAHs														
				BENZO(A)PYRENE	1.74E-11	(mg/m³)	9.54E-09	(ug/m³)	6.00E-04	per (ug/m³)	5.7E-12	1.67E-11	(mg/m³)	2.00E-06	(mg/m³)	8.3E-06		
				Exp. Route Total										1.2E-08				4.1E-03
				Exposure Point Total										1.2E-08				4.1E-03
				Exposure Medium Total										1.2E-08				4.1E-03
Soil Total											1.1E-06				6.4E-02			
Total of Receptor Risks Across All Media											3E-06	Total of Receptor Hazards Across All Media				1.0E-01		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.19
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02		
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03		
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02		
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02		
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total									3.6E-06					1.3E-01
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total									1.8E-07				2.1E-03	
			Exposure Point Total									3.8E-06				1.3E-01		
		Exposure Medium Total									3.8E-06				1.3E-01			
Sediment Total									3.8E-06				1.3E-01					
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02		
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02		
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04		
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01		
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02		
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03		
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04		
				Exp. Route Total									8.5E-07				2.1E-01	

TABLE 7.19
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child																			
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Surface Water	Surface Water	Surface Water	Dermal	Inorganics															
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04			
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04			
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02			
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04			
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03			
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04			
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04			
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03			
				PAHs															
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02			
				Exp. Route Total										2.6E-06				4.5E-02	
				Exposure Point Total										3.4E-06				2.5E-01	
				Exposure Medium Total										3.4E-06				2.5E-01	
Surface Water Total							3.4E-06				2.5E-01								
Soil	Subsurface Soil	Lorraine Process Area	Ingestion	Inorganics															
				ALUMINUM	6.63E+03	(mg/kg)	7.27E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	8.48E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	8.5E-02			
				ARSENIC	2.87E+00	(mg/kg)	1.89E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.8E-06	2.20E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.3E-02			
				COPPER	5.90E+01	(mg/kg)	6.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.54E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.9E-02			
				COBALT	5.00E+00	(mg/kg)	5.48E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	6.39E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-01			
				IRON	1.22E+04	(mg/kg)	1.34E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.56E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.2E-01			
				MANGANESE	1.59E+02	(mg/kg)	1.74E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-02			
				PAHs															
				BENZO(A)PYRENE	2.28E-02	(mg/kg)	1.32E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.3E-07	2.92E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04			
				Exp. Route Total										3.0E-06				6.3E-01	
			Dermal ¹	Inorganics															
				ALUMINUM	6.63E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--			
				ARSENIC	2.87E+00	(mg/kg)	2.24E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.4E-07	2.61E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.7E-03			
				COPPER	5.90E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--			
				COBALT	5.00E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--			
				IRON	1.22E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--			
				MANGANESE	1.59E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--			
				PAHs															
				BENZO(A)PYRENE	2.28E-02	(mg/kg)	4.09E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.1E-08	8.99E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.0E-04			
				Exp. Route Total										3.8E-07				9.0E-03	
				Exposure Point Total										3.3E-06				6.4E-01	
				Exposure Medium Total										3.3E-06				6.4E-01	

TABLE 7.19
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																			
Receptor Population: Resident																			
Receptor Age: Child																			
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Lorraine Process Area	Inhalation	Inorganics															
				ALUMINUM	5.06E-06	(mg/m³)	4.16E-04	(ug/m³)	NA	per (ug/m³)	--	4.85E-06	(mg/m³)	5.00E-03	(mg/m³)	9.7E-04			
				ARSENIC	2.19E-09	(mg/m³)	1.80E-07	(ug/m³)	4.30E-03	per (ug/m³)	7.7E-10	2.10E-09	(mg/m³)	1.50E-05	(mg/m³)	1.4E-04			
				COPPER	4.50E-08	(mg/m³)	3.70E-06	(ug/m³)	NA	per (ug/m³)	--	4.32E-08	(mg/m³)	NA	(mg/m³)	--			
				COBALT	3.82E-09	(mg/m³)	3.14E-07	(ug/m³)	9.00E-03	per (ug/m³)	2.8E-09	3.66E-09	(mg/m³)	6.00E-06	(mg/m³)	6.1E-04			
				IRON	9.31E-06	(mg/m³)	7.65E-04	(ug/m³)	NA	per (ug/m³)	--	8.93E-06	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	1.21E-07	(mg/m³)	9.98E-06	(ug/m³)	NA	per (ug/m³)	--	1.16E-07	(mg/m³)	5.00E-05	(mg/m³)	2.3E-03			
				PAHs															
				BENZO(A)PYRENE	1.74E-11	(mg/m³)	7.58E-09	(ug/m³)	6.00E-04	per (ug/m³)	4.5E-12	1.67E-11	(mg/m³)	2.00E-06	(mg/m³)	8.3E-06			
				Exp. Route Total															4.1E-03
				Exposure Point Total															4.1E-03
				Exposure Medium Total															4.1E-03
Soil Total															6.4E-01				
Total of Receptor Risks Across All Media											1.1E-05	Total of Receptor Hazards Across All Media					1.0E+00		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

RfD = Reference Dose

CSF = Cancer Slope Factor

RfC = Reference Concentration

TABLE 7.20
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Lorraine Process Area	Ingestion	Inorganics												
				ALUMINUM	6.63E+03	(mg/kg)	2.68E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.87E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.9E-02
				ARSENIC	2.87E+00	(mg/kg)	6.96E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.0E-07	4.87E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-02
				COPPER	5.90E+01	(mg/kg)	2.38E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.67E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	4.2E-03
				COBALT	5.00E+00	(mg/kg)	2.02E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.41E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.7E-02
				IRON	1.22E+04	(mg/kg)	4.92E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.45E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.9E-02
				MANGANESE	1.59E+02	(mg/kg)	6.42E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.49E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.2E-03
				PAHs												
				BENZO(A)PYRENE	2.28E-02	(mg/kg)	9.20E-10	(mg/kg-day)	1.0E+00	per (mg/kg-day)	9.2E-10	6.44E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-04
				Exp. Route Total							1.1E-07					1.4E-01
			Dermal ¹	Inorganics												
				ALUMINUM	6.63E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.87E+00	(mg/kg)	1.12E-08	(mg/kg-day)	1.5E+00	per (mg/kg-day)	1.7E-08	7.81E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.6E-03
				COPPER	5.90E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				COBALT	5.00E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.22E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	1.59E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZO(A)PYRENE	2.28E-02	(mg/kg)	3.84E-10	(mg/kg-day)	1.0E+00	per (mg/kg-day)	3.8E-10	2.69E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.0E-05
				Exp. Route Total							1.7E-08					2.7E-03
			Exposure Point Total								1.2E-07					1.4E-01
			Exposure Medium Total								1.2E-07					1.4E-01

TABLE 7.20
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	Lorraine Process Area	Inhalation	Inorganics														
				ALUMINUM	1.09E-04	(mg/m³)	3.54E-04	(ug/m³)	NA	per (ug/m³)	--	2.48E-05	(mg/m³)	5.00E-03	(mg/m³)	5.0E-03		
				ARSENIC	4.70E-08	(mg/m³)	1.53E-07	(ug/m³)	4.30E-03	per (ug/m³)	6.6E-10	1.07E-08	(mg/m³)	1.50E-05	(mg/m³)	7.2E-04		
				COPPER	9.66E-07	(mg/m³)	3.15E-06	(ug/m³)	NA	per (ug/m³)	--	2.20E-07	(mg/m³)	NA	(mg/m³)	--		
				COBALT	8.19E-08	(mg/m³)	2.67E-07	(ug/m³)	9.00E-03	per (ug/m³)	2.4E-09	1.87E-08	(mg/m³)	6.00E-06	(mg/m³)	3.1E-03		
				IRON	2.00E-04	(mg/m³)	6.51E-04	(ug/m³)	NA	per (ug/m³)	--	4.56E-05	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	2.60E-06	(mg/m³)	8.49E-06	(ug/m³)	NA	per (ug/m³)	--	5.94E-07	(mg/m³)	5.00E-05	(mg/m³)	1.2E-02		
				PAHs														
				BENZO(A)PYRENE	3.73E-10	(mg/m³)	8.77E-09	(ug/m³)	6.0E-04	per (ug/m³)	5.3E-12	8.52E-11	(mg/m³)	2.00E-06	(mg/m³)	4.3E-05		
				Exp. Route Total										3.1E-09				2.1E-02
				Exposure Point Total										3.1E-09				2.1E-02
			Exposure Medium Total										3.1E-09				2.1E-02	
Soil Total										1.3E-07				1.6E-01				
Total of Receptor Risks Across All Media											1.3E-07	Total of Receptor Hazards Across All Media				1.6E-01		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.21
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

$$PEF = Q/C \times [(3,600 \text{ s/h}) / (.36 \times (1 - V) \times (U_m/U_t)^3 \times F(x))] =$$

1.31E+09

Air Concentration

$$C_{air} = C_{soil} \times ((1/PEF) + (1/VF))$$

Where,

$$Q/C = 8.26E+01 \text{ g/m}^2\text{-s per kg/m}^3$$

Inverse Mean Concentration at Center of 0.05 square source for Lincoln, NE, USEPA 1996

$$V = 5.00E-01 \text{ unitless}$$

Default, USEPA 2019

$$U_m = 4.65E+00 \text{ m/s}$$

Mean annual wind speed, Lincoln, NE, USEPA 1996

$$U_t = 1.13E+01 \text{ m/s}$$

Equivalent threshold value of windspeed at 7 m, USEPA 2019

$$F(x) = 1.82E-02 \text{ unitless}$$

Default, USEPA 2019

$$VF = \text{Volatilization Factor m}^3/\text{kg}$$

Chemical Specific, USEPA 2019

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. November 2019.

Chemical	Csoil, Surface Soil	Csoil, Subsurface Soil	Volatilization Factor	Cair, Surface Soil	Cair, Subsurface Soil
	RME EPC	RME EPC		Particulate	Particulate
	mg/kg	mg/kg		m ³ /kg	mg/m ³
Inorganics					
ALUMINUM	5.15E+03	6.63E+03	--	3.93E-06	5.06E-06
ARSENIC	2.44E+00	2.87E+00	--	1.86E-09	2.19E-09
HEXAVALENT CHROMIUM (+6)	1.50E+00	NA		1.15E-09	NA
COPPER	1.53E+02	5.90E+01	--	1.17E-07	4.50E-08
COBALT	3.51E+00	5.00E+00	--	2.68E-09	3.82E-09
IRON	1.01E+04	1.22E+04	--	7.75E-06	9.31E-06
MANGANESE	2.22E+02	1.59E+02	--	1.70E-07	1.21E-07
PAHs					
BENZ(A)ANTHRACENE	2.81E-01	NA	--	2.15E-10	NA
BENZO(B)FLUORANTHENE	4.13E-01	NA		3.15E-10	NA
BENZO(A)PYRENE	2.10E-01	2.28E-02		1.60E-10	1.74E-11
DIBENZ(A,H)ANTHRACENE	3.10E-03	NA		2.37E-12	NA
INDENO(1,2,3-C,D)PYRENE	4.82E-02	NA	--	3.68E-11	NA

TABLE 7.22
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
CONSTRUCTION WORKER - OTHER THAN STANDARD VEHICLE TRAFFIC
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:					
	Particulate Emission Factor	6.11E+07 Calculated using EPA RSL Calculator (Calculations provided in Appendix D)			
	Air Concentration	Cair = Csoil*((1/PEF)+(1/VF))			
Where,					
Area to be excavated, graded, tilled =	5.00E+00 acres				
Depth of excavation =	1.50E+00 meters				
Q/C =	9.44E+00 g/m ² -s per kg/m ³	calculated			
Um =	4.69E+00 m/s	Mean annual wind speed, USEPA 2019			
Ut =	1.13E+01 m/s	Equivalent threshold value of windspeed at 7 m, USEPA 2019			
F(x) =	1.94E-01 unitless	Default, USEPA 2019			
VF =	Volatilization Factor m ³ /kg	Chemical Specific, USEPA 2019			
Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.					
USEPA Regional Screening Levels. November 2019.					
		Csoil, Subsurface Soil		Cair, Surface Soil	
Chemical	Csoil, Surface Soil	Soil	Volatilization Factor	Particulate	Cair, Subsurface Soil Particulate
	RME EPC	RME EPC	VF	RME EPC	RME EPC
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³
Inorganics					
ALUMINUM	5.15E+03	6.63E+03	--	8.43E-05	1.09E-04
ARSENIC	2.44E+00	2.87E+00	--	4.00E-08	4.70E-08
HEXAVALENT CHROMIUM (+6)	1.50E+00	NA		2.46E-08	NA
COPPER	1.53E+02	5.90E+01		2.50E-06	9.66E-07
COBALT	3.51E+00	5.00E+00	--	5.75E-08	8.19E-08
IRON	1.01E+04	1.22E+04	--	1.66E-04	2.00E-04
MANGANESE	2.22E+02	1.59E+02	--	3.64E-06	2.60E-06
PAHs					
BENZ(A)ANTHRACENE	2.81E-01	NA		4.60E-09	NA
BENZO(B)FLUORANTHENE	4.13E-01	NA		6.76E-09	NA
BENZO(A)PYRENE	2.10E-01	2.28E-02		3.44E-09	3.73E-10
DIBENZ(A,H)ANTHRACENE	3.10E-03	NA		5.08E-11	NA
INDENO(1,2,3-C,D)PYRENE	4.82E-02	NA		7.89E-10	NA

TABLE 7.23
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN HOME GROWN PRODUCE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:				
	$Pr = Cs * Br_{ag} * 0.12$	mg/kg	Concentration of COPC in plant due to root uptake	
Model Constants:				
	C_s	chemical-specific mg/kg	COPC concentration in soil (mg/kg)	
	$Br_{ag} =$	chemical-specific unitless	Plant to soil bioconcentration factor (unitless), above ground produce and forage	
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA 2005.				
Constituent of Potential Concern	Cs, Surface Soil	Br_{ag}⁽¹⁾	Reference	P_r
	RME EPC			RME EPC
	mg/kg	unitless		mg/kg
Inorganics				
ALUMINUM	5.15E+03	4.00E-03	RAIS 2019	2.47E+00
ARSENIC	2.44E+00	6.33E-03	U.S. EPA 2005	1.85E-03
HEXAVALENT CHROMIUM (+6)	1.50E+00	4.88E-03	U.S. EPA 2005	8.78E-04
COPPER	1.53E+02	4.00E-01	RAIS 2019	7.33E+00
COBALT	3.51E+00	2.00E-02	RAIS 2019	8.43E-03
IRON	1.01E+04	4.00E-03	RAIS 2019	4.87E+00
MANGANESE	2.22E+02	2.50E-01	RAIS 2019	6.67E+00
PAHs				
BENZ(A)ANTHRACENE	2.81E-01	1.97E-02	U.S. EPA 2005	6.64E-04
BENZO(B)FLUORANTHENE	4.13E-01	1.12E-02	U.S. EPA 2005	5.55E-04
BENZO(A)PYRENE	2.10E-01	1.32E-02	U.S. EPA 2005	3.33E-04
DIBENZ(A,H)ANTHRACENE	3.10E-03	6.78E-03	U.S. EPA 2005	2.52E-06
INDENO(1,2,3-C,D)PYRENE	4.82E-02	5.93E-03	U.S. EPA 2005	3.43E-05

References:

U. S. EPA 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* , Final, EPA/530/R-05/006, Washington, D.C.

RAIS 2019. *Risk Assessment Information System* , online database available at: <http://rais.ornl.gov>. Assuming soil-to-dry plant uptake.

TABLE 7.24
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN BEEF
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

$$CM = ((F_i * Q_{p(\text{forage, cattle})} * P_i) + (Q_{\text{soil}(\text{cattle})} * C_s * B_s)) * B_{a,\text{beef}} * MF$$

Model Constants:

F_i	1	unitless	Fraction of plant type grown on contaminated soil and ingested by cattle, assume only consume forage grown on contaminated soil.
$Q_{p(\text{forage, cattle})}$	8.8	kg/day	Quantity of forage ingested by cattle per day.
P_i	calculated	mg/kg	Concentration of COPC in plant ingested by cattle.
			$C_s * Br_{ag} * 0.12$
			C_s = COPC concentration in soil (mg/kg).
			Br_{ag} = plant to soil bioconcentration factor (unitless)
$Q_{\text{soil}(\text{cattle})}$	0.5	kg/day	Quantity of soil ingested by cattle.
C_s	chemical-specific	mg/kg	Surface soil COPC concentration
B_s	1	unitless	Soil bioavailability factor.
$B_{a,\text{beef}}$	chemical-specific	day/kg	Biotransfer factor for beef.
MF	1	unitless	Metabolism factor for all constituents, except bis(2-ethylhexyl)phthalate = 0.01

Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA, 2005.

Chemical	Cs, Surface Soil RME EPC mg/kg	Br _{ag} ⁽¹⁾ unitless	P _i mg/kg	B _{a,beef} ⁽¹⁾ day/kg	Reference	CM RME EPC mg/kg
Inorganics						
ALUMINUM	5.15E+03	4.00E-03	2.47E+00	1.50E-03	RAIS 2019	3.90E+00
ARSENIC	2.44E+00	6.33E-03	1.85E-03	2.00E-03	U.S. EPA 2005	2.47E-03
HEXAVALENT CHROMIUM (+6)	1.50E+00	4.88E-03	8.78E-04	5.50E-03	U.S. EPA 2005	4.17E-03
COPPER	1.53E+02	4.00E-01	7.33E+00	1.00E-02	RAIS 2019	1.41E+00
COBALT	3.51E+00	2.00E-02	8.43E-03	2.00E-02	RAIS 2019	3.66E-02
IRON	1.01E+04	4.00E-03	4.87E+00	2.00E-02	RAIS 2019	1.02E+02
MANGANESE	2.22E+02	2.50E-01	6.67E+00	4.00E-04	RAIS 2019	6.80E-02
PAHs						
BENZ(A)ANTHRACENE	2.81E-01	1.97E-02	6.64E-04	1.44E-02	U.S. EPA 2005	2.11E-03
BENZO(B)FLUORANTHENE	4.13E-01	1.12E-02	5.55E-04	1.51E-02	U.S. EPA 2005	3.19E-03
BENZO(A)PYRENE	2.10E-01	1.32E-02	3.33E-04	3.37E-02	U.S. EPA 2005	3.64E-03
DIBENZ(A,H)ANTHRACENE	3.10E-03	6.78E-03	2.52E-06	4.76E-01	U.S. EPA 2005	7.48E-04
INDENO(1,2,3-C,D)PYRENE	4.82E-02	5.93E-03	3.43E-05	1.25E-01	U.S. EPA 2005	3.05E-03

(1) Br_{ag} taken from USEPA, 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Final, EPA/530/R-05/006, Washington, D.C. For COPCs not listed in this document, taken from RAIS 2019, Risk Assessment Information System, online database available at: <http://rais.ornl.gov>. Assuming soil-to-wet plant uptake.

TABLE 7.25
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.18E-04
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04
				HEXA VALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.89E-03
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.98E-03
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.13E-04
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.6E-07					5.9E-03
			Dermal ¹	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04
				HEXA VALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							5.7E-08					3.5E-04
			Exposure Point Total								3.2E-07					6.2E-03
			Exposure Medium Total								3.2E-07					6.2E-03
			Sediment Total								3.2E-07					6.2E-03

TABLE 7.25
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04		
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04		
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06		
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03		
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04		
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04		
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05		
			Exp. Route Total						9.4E-08									7.7E-03
			Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04		
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04		
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04		
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03		
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04		
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04		
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03		
			Exp. Route Total						1.6E-06									2.2E-02
			Exposure Point Total										1.7E-06					2.9E-02
			Exposure Medium Total										1.7E-06					2.9E-02
Surface Water Total										1.7E-06					2.9E-02			

TABLE 7.25
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Loading Dock Area	Ingestion	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	1.58E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.54E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.5E-03
				ANTIMONY	2.98E+00	(mg/kg)	1.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.57E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	8.9E-03
				ARSENIC	3.99E+00	(mg/kg)	8.20E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-06	2.87E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.6E-03
				COBALT	1.52E+01	(mg/kg)	5.22E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.83E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.1E-02
				IRON	1.53E+04	(mg/kg)	5.23E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.83E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.6E-02
				MANGANESE	4.19E+02	(mg/kg)	1.44E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.03E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.6E-03
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	1.94E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-07	3.39E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-03
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	9.59E-07	(mg/kg-day)	5.50E-02	per (mg/kg-day)	5.3E-08	3.36E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	8.4E-04
				ETHYLBENZENE	6.70E+00	(mg/kg)	2.29E-06	(mg/kg-day)	1.10E-02	per (mg/kg-day)	2.5E-08	8.03E-06	(mg/kg-day)	1.00E-01	(mg/kg-day)	8.0E-05
			Exp. Route Total								1.5E-06					1.2E-01
			Dermal ¹	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	2.98E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	3.99E+00	(mg/kg)	1.73E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.6E-07	6.06E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-03
				COBALT	1.52E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.53E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	4.19E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	1.06E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-07	1.86E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.2E-04
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				ETHYLBENZENE	6.70E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
			Exp. Route Total								3.7E-07					2.6E-03
		Exposure Point Total									1.9E-06					1.2E-01
	Exposure Medium Total										1.9E-06					1.2E-01

TABLE 7.25
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	Loading Dock Area	Inhalation	Inorganics												
				ALUMINUM	3.53E-06	(mg/m ³)	9.66E-04	(ug/m ³)	NA	per (ug/m ³)	--	3.38E-06	(mg/m ³)	5.00E-03	(mg/m ³)	6.8E-04
				ANTIMONY	2.28E-09	(mg/m ³)	6.24E-07	(ug/m ³)	NA	per (ug/m ³)	--	2.18E-09	(mg/m ³)	NA	(mg/m ³)	--
				ARSENIC	3.05E-09	(mg/m ³)	8.35E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	3.6E-09	2.92E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.9E-04
				COBALT	1.16E-08	(mg/m ³)	3.19E-06	(ug/m ³)	9.00E-03	per (ug/m ³)	2.9E-08	1.12E-08	(mg/m ³)	6.00E-06	(mg/m ³)	1.9E-03
				IRON	1.17E-05	(mg/m ³)	3.19E-03	(ug/m ³)	NA	per (ug/m ³)	--	1.12E-05	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	3.20E-07	(mg/m ³)	8.77E-05	(ug/m ³)	NA	per (ug/m ³)	--	3.07E-07	(mg/m ³)	5.00E-05	(mg/m ³)	6.1E-03
				PAHs												
				BENZO(A)PYRENE	2.16E-10	(mg/m ³)	1.18E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	7.1E-11	2.07E-10	(mg/m ³)	2.00E-06	(mg/m ³)	1.0E-04
				Volatiles												
				BENZENE	2.14E-09	(mg/m ³)	5.86E-07	(ug/m ³)	7.80E-06	per (ug/m ³)	4.6E-12	2.05E-09	(mg/m ³)	3.00E-02	(mg/m ³)	6.8E-08
				ETHYLBENZENE	5.11E-09	(mg/m ³)	1.40E-06	(ug/m ³)	2.50E-06	per (ug/m ³)	3.5E-12	4.90E-09	(mg/m ³)	1.00E+00	(mg/m ³)	4.9E-09
				Exp. Route Total							3.2E-08					9.0E-03
				Exposure Point Total							3.2E-08					9.0E-03
				Exposure Medium Total							3.2E-08					9.0E-03
	Surface Soil	Homegrown Produce	Ingestion	Inorganics												
				ALUMINUM	2.22E+00	(mg/kg)	9.50E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.33E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.3E-03
				ANTIMONY	1.14E-02	(mg/kg)	4.89E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.71E-05	(mg/kg-day)	4.00E-04	(mg/kg-day)	4.3E-02
				ARSENIC	3.03E-03	(mg/kg)	1.30E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.9E-06	4.55E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02
				COBALT	3.66E-02	(mg/kg)	1.57E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.49E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-01
				IRON	7.33E+00	(mg/kg)	3.14E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.10E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.6E-02
				MANGANESE	1.26E+01	(mg/kg)	5.39E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.89E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.3E-01
				PAHs												
				BENZO(A)PYRENE	4.48E-04	(mg/kg)	3.84E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.8E-07	6.72E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-03
				Volatiles												
				BENZENE	7.96E-01	(mg/kg)	3.41E-04	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.9E-05	1.19E-03	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.0E-01
				ETHYLBENZENE	5.03E-01	(mg/kg)	2.15E-04	(mg/kg-day)	1.10E-02	per (mg/kg-day)	2.4E-06	7.54E-04	(mg/kg-day)	1.00E-01	(mg/kg-day)	7.5E-03
				Exp. Route Total							2.3E-05					7.0E-01
				Exposure Point Total							2.3E-05					7.0E-01
				Exposure Medium Total							2.3E-05					7.0E-01

TABLE 7.25
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Surface Soil	Beef	Ingestion	Inorganics															
				ALUMINUM	3.49E+00	(mg/kg)	1.26E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	4.42E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.4E-03			
				ANTIMONY	1.59E-03	(mg/kg)	5.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.01E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	5.0E-03			
				ARSENIC	4.04E-03	(mg/kg)	1.46E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.2E-06	5.12E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.7E-02			
				COBALT	1.59E-01	(mg/kg)	5.74E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.01E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-01			
				IRON	1.54E+02	(mg/kg)	5.56E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.95E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.8E-01			
				MANGANESE	1.28E-01	(mg/kg)	4.63E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.62E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.2E-03			
				PAHs															
				BENZO(A)PYRENE	4.90E-03	(mg/kg)	3.54E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.5E-06	6.20E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-02			
				Volatiles															
				BENZENE	2.84E-02	(mg/kg)	1.03E-05	(mg/kg-day)	5.50E-02	per (mg/kg-day)	5.7E-07	3.60E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	9.0E-03			
				ETHYLBENZENE	9.40E-02	(mg/kg)	3.40E-05	(mg/kg-day)	1.10E-02	per (mg/kg-day)	3.7E-07	1.19E-04	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.2E-03			
				Exp. Route Total											6.7E-06				1.0E+00
				Exposure Point Total											6.7E-06				1.0E+00
				Exposure Medium Total											6.7E-06				1.0E+00
Soil Total											3.2E-05				1.8E+00				
Total of Receptor Risks Across All Media											3.4E-05		Total of Receptor Hazards Across All Media					1.9E+00	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.26
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02	
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03	
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02	
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02	
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total								3.6E-06					1.3E-01
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total								1.8E-07					2.1E-03
			Exposure Point Total								3.8E-06					1.3E-01	
			Exposure Medium Total								3.8E-06					1.3E-01	
			Sediment Total								3.8E-06					1.3E-01	
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02	
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02	
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04	
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01	
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02	
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03	
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04	
				Exp. Route Total								8.5E-07					2.1E-01

TABLE 7.26
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Surface Water	Surface Water	Surface Water	Dermal	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04	
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04	
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04	
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03	
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04	
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04	
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02	
				Exp. Route Total							2.6E-06					4.5E-02	
				Exposure Point Total							3.4E-06					2.5E-01	
			Exposure Medium Total							3.4E-06					2.5E-01		
Surface Water Total												3.4E-06					2.5E-01
Soil	Surface Soil	Loading Dock Area	Ingestion	Inorganics													
				ALUMINUM	4.62E+03	(mg/kg)	5.06E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.91E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.9E-02	
				ANTIMONY	2.98E+00	(mg/kg)	3.27E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.81E-05	(mg/kg-day)	4.00E-04	(mg/kg-day)	9.5E-02	
				ARSENIC	3.99E+00	(mg/kg)	2.62E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.9E-06	3.06E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.0E-01	
				COBALT	1.52E+01	(mg/kg)	1.67E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.95E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.5E-01	
				IRON	1.53E+04	(mg/kg)	1.67E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.95E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.8E-01	
				MANGANESE	4.19E+02	(mg/kg)	4.60E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.36E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.8E-02	
				PAHs													
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	1.64E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-06	3.62E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-02	
				Volatiles													
				BENZENE	2.80E+00	(mg/kg)	3.07E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.7E-07	3.58E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	8.9E-03	
				ETHYLBENZENE	6.70E+00	(mg/kg)	7.34E-06	(mg/kg-day)	1.10E-02	per (mg/kg-day)	8.1E-08	8.57E-05	(mg/kg-day)	1.00E-01	(mg/kg-day)	8.6E-04	
				Exp. Route Total							5.8E-06					1.2E+00	

TABLE 7.26
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Loading Dock Area	Dermal ¹	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	2.98E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	3.99E+00	(mg/kg)	3.11E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.7E-07	3.63E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-02
				COBALT	1.52E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.53E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	4.19E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	5.07E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.1E-07	1.12E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.7E-03
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				ETHYLBENZENE	6.70E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
				Exp. Route Total							9.7E-07					1.6E-02
				Exposure Point Total							6.8E-06					1.3E+00
				Exposure Medium Total							6.8E-06					1.3E+00
	Air	Loading Dock Area	Inhalation	Inorganics												
				ALUMINUM	3.53E-06	(mg/m ³)	2.90E-04	(ug/m ³)	NA	per (ug/m ³)	--	3.38E-06	(mg/m ³)	5.00E-03	(mg/m ³)	6.8E-04
				ANTIMONY	2.28E-09	(mg/m ³)	1.87E-07	(ug/m ³)	NA	per (ug/m ³)	--	2.18E-09	(mg/m ³)	NA	(mg/m ³)	--
				ARSENIC	3.05E-09	(mg/m ³)	2.50E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	1.1E-09	2.92E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.9E-04
				COBALT	1.16E-08	(mg/m ³)	9.56E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	8.6E-09	1.12E-08	(mg/m ³)	6.00E-06	(mg/m ³)	1.9E-03
				IRON	1.17E-05	(mg/m ³)	9.58E-04	(ug/m ³)	NA	per (ug/m ³)	--	1.12E-05	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	3.20E-07	(mg/m ³)	2.63E-05	(ug/m ³)	NA	per (ug/m ³)	--	3.07E-07	(mg/m ³)	5.00E-05	(mg/m ³)	6.1E-03
				PAHs												
				BENZO(A)PYRENE	2.16E-10	(mg/m ³)	9.41E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	5.6E-11	2.07E-10	(mg/m ³)	2.00E-06	(mg/m ³)	1.0E-04
				Volatiles												
				BENZENE	2.14E-09	(mg/m ³)	1.76E-07	(ug/m ³)	7.80E-06	per (ug/m ³)	1.4E-12	2.05E-09	(mg/m ³)	3.00E-02	(mg/m ³)	6.8E-08
				ETHYLBENZENE	5.11E-09	(mg/m ³)	4.20E-07	(ug/m ³)	2.50E-06	per (ug/m ³)	1.1E-12	4.90E-09	(mg/m ³)	1.00E+00	(mg/m ³)	4.9E-09
				Exp. Route Total							9.7E-09					9.0E-03
				Exposure Point Total							9.7E-09					9.0E-03
				Exposure Medium Total							9.7E-09					9.0E-03

TABLE 7.26
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics													
				ALUMINUM	2.22E+00	(mg/kg)	7.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	8.54E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	8.5E-03	
				ANTIMONY	1.14E-02	(mg/kg)	3.77E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.39E-05	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.1E-01	
				ARSENIC	3.03E-03	(mg/kg)	1.00E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.5E-06	1.17E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.9E-02	
				COBALT	3.66E-02	(mg/kg)	1.21E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.41E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.7E-01	
				IRON	7.33E+00	(mg/kg)	2.42E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.82E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.0E-02	
				MANGANESE	1.26E+01	(mg/kg)	4.15E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-01	
				PAHs													
				BENZO(A)PYRENE	4.48E-04	(mg/kg)	7.84E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-07	1.73E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.8E-03	
				Volatiles													
				BENZENE	7.96E-01	(mg/kg)	2.63E-04	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.4E-05	3.07E-03	(mg/kg-day)	4.00E-03	(mg/kg-day)	7.7E-01	
				ETHYLBENZENE	5.03E-01	(mg/kg)	1.66E-04	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.8E-06	1.93E-03	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.9E-02	
				Exp. Route Total									1.9E-05				
			Exposure Point Total									1.9E-05					1.8E+00
	Exposure Medium Total									1.9E-05					1.8E+00		
	Soil	Surface Soil	Beef	Ingestion	Inorganics												
					ALUMINUM	3.49E+00	(mg/kg)	7.69E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	8.97E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.0E-03
					ANTIMONY	1.59E-03	(mg/kg)	3.50E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.08E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.0E-02
					ARSENIC	4.04E-03	(mg/kg)	8.90E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.3E-06	1.04E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.5E-02
					COBALT	1.59E-01	(mg/kg)	3.49E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	4.08E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E+00
IRON					1.54E+02	(mg/kg)	3.39E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	3.95E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.6E-01	
MANGANESE					1.28E-01	(mg/kg)	2.82E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.29E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.3E-03	
PAHs																	
BENZO(A)PYRENE					4.90E-03	(mg/kg)	5.71E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.7E-06	1.26E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.2E-02	
Volatiles																	
BENZENE					2.84E-02	(mg/kg)	6.25E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	3.4E-07	7.29E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.8E-02	
ETHYLBENZENE					9.40E-02	(mg/kg)	2.07E-05	(mg/kg-day)	1.10E-02	per (mg/kg-day)	2.3E-07	2.41E-04	(mg/kg-day)	1.00E-01	(mg/kg-day)	2.4E-03	
Exp. Route Total										7.6E-06					2.0E+00		
Exposure Point Total									7.6E-06					2.0E+00			
Exposure Medium Total									7.6E-06					2.0E+00			
Soil Total									3.3E-05					5.1E+00			
Total of Receptor Risks Across All Media										4.0E-05	Total of Receptor Hazards Across All Media					5.5E+00	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.27
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Loading Dock Area	Ingestion	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	1.86E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.31E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.3E-02
				ANTIMONY	2.98E+00	(mg/kg)	2.08E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.84E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.5E-03
				ARSENIC	3.99E+00	(mg/kg)	9.67E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-07	6.77E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.3E-02
				COBALT	1.52E+01	(mg/kg)	6.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-01
				IRON	1.53E+04	(mg/kg)	6.16E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.2E-02
				MANGANESE	4.19E+02	(mg/kg)	1.69E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.18E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	8.5E-03
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	1.14E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.1E-08	8.00E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.7E-03
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	1.13E-07	(mg/kg-day)	5.50E-02	per (mg/kg-day)	6.2E-09	7.91E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.0E-03
				ETHYLBENZENE	6.70E+00	(mg/kg)	2.70E-07	(mg/kg-day)	1.10E-02	per (mg/kg-day)	3.0E-09	1.89E-05	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.9E-04
				Exp. Route Total							1.7E-07					2.6E-01
			Dermal ¹	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	2.98E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	3.99E+00	(mg/kg)	1.55E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.3E-08	1.08E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-03
				COBALT	1.52E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.53E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	4.19E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	4.76E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	4.8E-09	3.33E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-03
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				ETHYLBENZENE	6.70E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
				Exp. Route Total							2.8E-08					4.7E-03
			Exposure Point Total								1.9E-07					2.6E-01
			Exposure Medium Total								1.9E-07					2.6E-01

TABLE 7.27
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Air	Loading Dock Area	Inhalation	Inorganics													
				ALUMINUM	7.57E-05	(mg/m³)	2.47E-04	(ug/m³)	NA	per (ug/m³)	--	1.73E-05	(mg/m³)	5.00E-03	(mg/m³)	3.5E-03	
				ANTIMONY	2.28E-09	(mg/m³)	7.42E-09	(ug/m³)	NA	per (ug/m³)	--	5.20E-10	(mg/m³)	NA	(mg/m³)	--	
				ARSENIC	6.54E-08	(mg/m³)	2.13E-07	(ug/m³)	4.3E-03	per (ug/m³)	9.2E-10	1.49E-08	(mg/m³)	1.50E-05	(mg/m³)	9.9E-04	
				COBALT	2.50E-07	(mg/m³)	8.14E-07	(ug/m³)	9.0E-03	per (ug/m³)	7.3E-09	5.70E-08	(mg/m³)	6.00E-06	(mg/m³)	9.5E-03	
				IRON	2.50E-04	(mg/m³)	8.15E-04	(ug/m³)	NA	per (ug/m³)	--	5.71E-05	(mg/m³)	NA	(mg/m³)	--	
				MANGANESE	6.87E-06	(mg/m³)	2.24E-05	(ug/m³)	NA	per (ug/m³)	--	1.57E-06	(mg/m³)	5.00E-05	(mg/m³)	3.1E-02	
				PAHs													
				BENZO(A)PYRENE	4.63E-09	(mg/m³)	1.51E-08	(ug/m³)	6.0E-04	per (ug/m³)	9.1E-12	1.06E-09	(mg/m³)	2.00E-06	(mg/m³)	5.3E-04	
				Volatiles													
				BENZENE	2.14E-09	(mg/m3)	6.97E-09	(ug/m³)	7.80E-06	per (ug/m³)	5.4E-14	4.88E-10	(mg/m³)	3.00E-02	(mg/m³)	1.6E-08	
				ETHYLBENZENE	1.10E-07	(mg/m³)	3.58E-07	(ug/m³)	2.50E-06	per (ug/m³)	8.9E-13	2.50E-08	(mg/m³)	1.00E+00	(mg/m³)	2.5E-08	
Exp. Route Total					8.3E-09						4.6E-02						
Exposure Point Total					8.3E-09						4.6E-02						
Exposure Medium Total					8.3E-09						4.6E-02						
Soil Total					2.0E-07						3.1E-01						
Total of Receptor Risks Across All Media											2.0E-07	Total of Receptor Hazards Across All Media					3.1E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.28
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RID/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Loading Dock Area	Ingestion	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-03
				ANTIMONY	2.98E+00	(mg/kg)	9.12E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	6.4E-03
				ARSENIC	3.99E+00	(mg/kg)	7.32E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-06	2.05E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.8E-03
				COBALT	1.52E+01	(mg/kg)	4.66E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.30E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-02
				IRON	1.53E+04	(mg/kg)	4.67E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.31E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.9E-02
				MANGANESE	4.19E+02	(mg/kg)	1.28E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.59E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.6E-03
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	8.65E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	8.7E-08	2.42E-07	(mg/kg-day)	3.0E-04	(mg/kg-day)	8.1E-04
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	8.56E-07	(mg/kg-day)	5.5E-02	per (mg/kg-day)	4.7E-08	2.40E-06	(mg/kg-day)	4.0E-03	(mg/kg-day)	6.0E-04
				ETHYLBENZENE	6.70E+00	(mg/kg)	2.05E-06	(mg/kg-day)	1.1E-02	per (mg/kg-day)	2.3E-08	5.74E-06	(mg/kg-day)	1.0E-01	(mg/kg-day)	5.7E-05
				Exp. Route Total							1.3E-06					8.3E-02
			Dermal ¹	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	2.98E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	3.99E+00	(mg/kg)	2.58E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.9E-08	7.23E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-04
				COBALT	1.52E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.53E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	4.19E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	7.94E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	7.9E-09	2.22E-08	(mg/kg-day)	3.0E-04	(mg/kg-day)	7.4E-05
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	NA	(mg/kg-day)	5.5E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.0E-03	(mg/kg-day)	--
				ETHYLBENZENE	6.70E+00	(mg/kg)	NA	(mg/kg-day)	1.1E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.0E-01	(mg/kg-day)	--
				Exp. Route Total							4.7E-08					3.2E-04
			Exposure Point Total								1.3E-06					8.4E-02
			Exposure Medium Total								1.3E-06					8.4E-02

TABLE 7.28
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Loading Dock Area	Inhalation	Inorganics															
				ALUMINUM	3.53E-06	(mg/m³)	2.88E-04	(ug/m³)	NA	per (ug/m³)	--	8.05E-07	(mg/m³)	5.00E-03	(mg/m³)	1.6E-04			
				ANTIMONY	2.28E-09	(mg/m³)	1.86E-07	(ug/m³)	NA	per (ug/m³)	--	5.20E-10	(mg/m³)	NA	(mg/m³)	--			
				ARSENIC	3.05E-09	(mg/m³)	2.48E-07	(ug/m³)	4.30E-03	per (ug/m³)	1.1E-09	6.96E-10	(mg/m³)	1.50E-05	(mg/m³)	4.6E-05			
				COBALT	1.16E-08	(mg/m³)	9.49E-07	(ug/m³)	9.00E-03	per (ug/m³)	8.5E-09	2.66E-09	(mg/m³)	6.00E-06	(mg/m³)	4.4E-04			
				IRON	1.17E-05	(mg/m³)	9.50E-04	(ug/m³)	NA	per (ug/m³)	--	2.66E-06	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	3.20E-07	(mg/m³)	2.61E-05	(ug/m³)	NA	per (ug/m³)	--	7.31E-08	(mg/m³)	5.00E-05	(mg/m³)	1.5E-03			
				PAHs															
				BENZO(A)PYRENE	2.16E-10	(mg/m³)	1.76E-08	(ug/m³)	6.00E-04	per (ug/m³)	1.1E-11	4.93E-11	(mg/m³)	2.00E-06	(mg/m³)	2.5E-05			
				Volatiles															
				BENZENE	2.14E-09	(mg/m³)	1.74E-07	(ug/m³)	7.80E-06	per (ug/m3)	1.4E-12	4.88E-10	(mg/m³)	3.00E-02	(mg/m³)	1.6E-08			
				ETHYLBENZENE	5.11E-09	(mg/m³)	4.17E-07	(ug/m³)	2.50E-06	per (ug/m³)	1.0E-12	1.17E-09	(mg/m³)	1.00E+00	(mg/m³)	1.2E-09			
				Exp. Route Total											9.6E-09				2.1E-03
				Exposure Point Total											9.6E-09				2.1E-03
				Exposure Medium Total											9.6E-09				2.1E-03
Soil Total											1.3E-06				8.6E-02				
Total of Receptor Risks Across All Media											1.3E-06	Total of Receptor Hazards Across All Media				8.6E-02			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.29
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	9.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.5E-03	
				ARSENIC	2.25E+00	(mg/kg)	1.83E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.7E-07	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	1.71E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	8.5E-07	3.99E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-03	
				COBALT	4.24E+00	(mg/kg)	5.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.03E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02	
				IRON	1.04E+04	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.88E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E-02	
				MANGANESE	2.23E+02	(mg/kg)	3.03E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.12E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-03	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.11E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.01E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-08	2.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.77E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-08	1.81E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.12E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.95E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							1.2E-06					4.2E-02	
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	4.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.2E-08	2.90E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	6.54E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-09	1.53E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	5.97E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-09	1.39E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	4.58E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.6E-08	1.07E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-04	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	1.25E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-08	2.91E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total							1.3E-07					1.3E-03	
			Exposure Point Total								1.4E-06					4.3E-02	
			Exposure Medium Total								1.4E-06					4.3E-02	
Sediment Total										1.4E-06				4.3E-02			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	5.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.5E-03	
				ARSENIC	1.88E-03	(mg/L)	2.55E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-07	1.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-03	
				CADMIUM	3.15E-03	(mg/L)	4.27E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.0E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	5.66E-08	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.8E-08	1.32E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.4E-05	
				CYANIDE	2.96E-02	(mg/L)	4.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.81E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.7E-02	
				IRON	4.44E+00	(mg/L)	6.02E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.22E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.0E-03	
				MANGANESE	3.59E-01	(mg/L)	4.87E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.41E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-03	
				VANADIUM	4.53E-03	(mg/L)	6.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.30E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	8.6E-04	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	4.07E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.1E-09	9.50E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.76E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-08	4.10E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-04	
				Exp. Route Total							4.3E-07					6.9E-02	

TABLE 7.29
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	4.56E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.2E-04
				ARSENIC	1.88E-03	(mg/L)	2.31E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.5E-08	1.62E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-04
				CADMIUM	3.15E-03	(mg/L)	3.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.71E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.1E-02
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.03E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.1E-07	2.39E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	3.2E-04
				CYANIDE	2.96E-02	(mg/L)	3.64E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.2E-03
				IRON	4.44E+00	(mg/L)	5.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.82E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.5E-04
				MANGANESE	3.59E-01	(mg/L)	4.41E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.09E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-04
				VANADIUM	4.53E-03	(mg/L)	5.57E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.90E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	3.0E-03
			Dermal	PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	4.73E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	2.64E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.8E-03
			Exp. Route Total								1.6E-06					2.9E-02
		Exposure Point Total								2.0E-06					9.8E-02	
	Exposure Medium Total								2.0E-06					9.8E-02		
Surface Water Total										2.0E-06				9.8E-02		
Soil	Surface Soil	Loading Dock Area	Ingestion	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	2.09E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.46E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.5E-03
				ANTIMONY	2.98E+00	(mg/kg)	1.35E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	9.44E-07	(mg/kg-day)	4.00E-04	(mg/kg-day)	2.4E-03
				ARSENIC	3.99E+00	(mg/kg)	1.08E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.6E-07	7.58E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-03
				COBALT	1.52E+01	(mg/kg)	6.89E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.82E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-02
				IRON	1.53E+04	(mg/kg)	6.90E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.83E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.9E-03
				MANGANESE	4.19E+02	(mg/kg)	1.90E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.33E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	9.5E-04
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	3.84E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.8E-08	8.96E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.0E-04
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	1.27E-07	(mg/kg-day)	5.50E-02	per (mg/kg-day)	7.0E-09	8.86E-07	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.2E-04
				ETHYLBENZENE	6.70E+00	(mg/kg)	3.03E-07	(mg/kg-day)	1.10E-02	per (mg/kg-day)	3.3E-09	2.12E-06	(mg/kg-day)	1.00E-01	(mg/kg-day)	2.1E-05
			Exp. Route Total								2.1E-07					3.1E-02
			Dermal ¹	Inorganics												
				ALUMINUM	4.62E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	2.98E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	3.99E+00	(mg/kg)	4.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.4E-08	3.43E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-03
				COBALT	1.52E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.53E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	4.19E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZO(A)PYRENE	2.83E-01	(mg/kg)	4.52E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.5E-08	1.06E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.5E-04
				Volatiles												
				BENZENE	2.80E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				ETHYLBENZENE	6.70E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
			Exp. Route Total								1.2E-07					1.5E-03
		Exposure Point Total								3.3E-07					3.2E-02	
	Exposure Medium Total								3.3E-07					3.2E-02		

TABLE 7.29
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	Loading Dock Area	Inhalation	Inorganics														
				ALUMINUM	3.53E-06	(mg/m³)	1.20E-05	(ug/m³)	NA	per (ug/m³)	--	8.37E-09	(mg/m³)	5.00E-03	(mg/m³)	1.7E-06		
				ANTIMONY	2.28E-09	(mg/m³)	7.72E-09	(ug/m³)	NA	per (ug/m³)	--	5.40E-12	(mg/m³)	NA	(mg/m³)	--		
				ARSENIC	3.05E-09	(mg/m³)	1.03E-08	(ug/m³)	4.30E-03	per (ug/m³)	4.4E-11	7.23E-12	(mg/m³)	1.50E-05	(mg/m³)	4.8E-07		
				COBALT	1.16E-08	(mg/m³)	3.95E-08	(ug/m³)	9.00E-03	per (ug/m³)	3.6E-10	2.76E-11	(mg/m³)	6.00E-06	(mg/m³)	4.6E-06		
				IRON	1.17E-05	(mg/m³)	3.95E-05	(ug/m³)	NA	per (ug/m³)	--	2.77E-08	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	3.20E-07	(mg/m³)	1.09E-06	(ug/m³)	NA	per (ug/m³)	--	7.60E-10	(mg/m³)	5.00E-05	(mg/m³)	1.5E-05		
				PAHs														
				BENZO(A)PYRENE	2.16E-10	(mg/m³)	2.20E-09	(ug/m³)	6.00E-04	per (ug/m³)	1.3E-12	5.13E-13	(mg/m³)	2.00E-06	(mg/m³)	2.6E-07		
				Volatiles														
				BENZENE	2.14E-09	(mg/m³)	7.25E-09	(ug/m³)	7.80E-06	per (ug/m³)	5.7E-14	5.08E-12	(mg/m³)	3.00E-02	(mg/m³)	1.7E-10		
				ETHYLBENZENE	5.11E-09	(mg/m³)	1.73E-08	(ug/m³)	2.50E-06	per (ug/m³)	4.3E-14	1.21E-11	(mg/m³)	1.00E+00	(mg/m³)	1.2E-11		
				Exp. Route Total										4.0E-10				2.2E-05
				Exposure Point Total										4.0E-10				2.2E-05
	Exposure Medium Total										4.0E-10				2.2E-05			
Soil Total										3.3E-07				3.2E-02				
Total of Receptor Risks Across All Media											3.7E-06	Total of Receptor Hazards Across All Media				1.7E-01		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.30
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																	
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.2E-04	
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04	
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03	
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-03	
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-04	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total									2.6E-07				
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total									5.7E-08				
			Exp. Point Total									3.2E-07					6.2E-03
			Exposure Medium Total									3.2E-07					6.2E-03
Sediment Total									3.2E-07					6.2E-03			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04	
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04	
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06	
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03	
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04	
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04	
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05	
				Exp. Route Total									9.4E-08				

TABLE 7.30
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Surface Water	Surface Water	Surface Water	Dermal	Inorganics															
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04			
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04			
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03			
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04			
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03			
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04			
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04			
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03			
				PAHs															
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03			
				Exp. Route Total										1.6E-06					2.2E-02
				Exposure Point Total										1.7E-06					2.9E-02
			Exposure Medium Total										1.7E-06					2.9E-02	
Surface Water Total												1.7E-06					2.9E-02		
Soil	Subsurface Soil	Loading Dock Area	Ingestion	Inorganics															
				ALUMINUM	8.39E+03	(mg/kg)	2.87E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.01E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.0E-02			
				ARSENIC	3.26E+00	(mg/kg)	6.69E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.0E-06	2.34E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.8E-03			
				COBALT	2.69E+01	(mg/kg)	9.21E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.22E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-01			
				IRON	1.44E+04	(mg/kg)	4.93E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.73E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.5E-02			
				MANGANESE	3.91E+02	(mg/kg)	1.34E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.69E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.3E-03			
			Exp. Route Total										1.0E-06					1.5E-01	

TABLE 7.30
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																
Receptor Population: Resident																
Receptor Age: Adult																
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Loading Dock Area	Dermal ¹	Inorganics												
				ALUMINUM	8.39E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	3.26E+00	(mg/kg)	1.41E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.1E-07	4.95E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-03
				COBALT	2.69E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.44E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	3.91E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
			Exp. Route Total							2.1E-07					1.6E-03	
			Exposure Point Total							1.2E-06					1.5E-01	
			Exposure Medium Total							1.2E-06					1.5E-01	
	Air	Loading Dock Area	Inhalation	Inorganics												
				ALUMINUM	6.40E-06	(mg/m ³)	1.75E-03	(ug/m ³)	NA	per (ug/m ³)	--	6.14E-06	(mg/m ³)	5.00E-03	(mg/m ³)	1.2E-03
				ARSENIC	2.49E-09	(mg/m ³)	6.81E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	2.9E-09	2.38E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.6E-04
				COBALT	2.05E-08	(mg/m ³)	5.63E-06	(ug/m ³)	9.00E-03	per (ug/m ³)	5.1E-08	1.97E-08	(mg/m ³)	6.00E-06	(mg/m ³)	3.3E-03
				IRON	1.10E-05	(mg/m ³)	3.01E-03	(ug/m ³)	NA	per (ug/m ³)	--	1.05E-05	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	2.99E-07	(mg/m ³)	8.18E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.86E-07	(mg/m ³)	5.00E-05	(mg/m ³)	5.7E-03
			Exp. Route Total							5.4E-08					1.0E-02	
			Exposure Point Total							5.4E-08					1.0E-02	
			Exposure Medium Total							5.4E-08					1.0E-02	
Soil Total											1.3E-06					1.7E-01
Total of Receptor Risks Across All Media										3.3E-06	Total of Receptor Hazards Across All Media					2.0E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.31
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Meidum	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02	
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03	
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02	
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02	
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total						3.6E-06						1.3E-01	
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				Exp. Route Total						1.8E-07						2.1E-03	
			Exposure Point Total					3.8E-06						1.3E-01			
			Exposure Medium Total					3.8E-06						1.3E-01			
Sediment Total					3.8E-06						1.3E-01						
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02	
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02	
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04	
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01	
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02	
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03	
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04	
				Exp. Route Total						8.5E-07						2.1E-01	

TABLE 7.31
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Meidum	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04		
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04		
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04		
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03		
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04		
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04		
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
				Exp. Route Total											2.6E-06			4.5E-02
				Exposure Point Total											3.4E-06			2.5E-01
				Exposure Medium Total											3.4E-06			2.5E-01
Surface Water Total											3.4E-06			2.5E-01				
Soil	Subsurface Soil	Loading Dock Area	Ingestion	Inorganics														
				ALUMINUM	8.39E+03	(mg/kg)	9.19E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.07E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-01		
				ARSENIC	3.26E+00	(mg/kg)	2.14E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.2E-06	2.50E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.3E-02		
				COBALT	2.69E+01	(mg/kg)	2.95E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.44E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E+00		
				IRON	1.44E+04	(mg/kg)	1.58E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.84E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.6E-01		
				MANGANESE	3.91E+02	(mg/kg)	4.29E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.00E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.6E-02		
				Exp. Route Total											3.2E-06			1.6E+00

TABLE 7.31
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Meidum	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Subsurface Soil	Loading Dock Area	Dermal ¹	Inorganics													
				ALUMINUM	8.39E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	3.26E+00	(mg/kg)	2.54E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-07	2.97E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.9E-03	
				COBALT	2.69E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.44E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
		MANGANESE	3.91E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--			
		Exp. Route Total							3.8E-07					9.9E-03			
		Exposure Point Total							3.6E-06					1.6E+00			
		Exposure Medium Total							3.6E-06					1.6E+00			
	Air	Loading Dock Area	Inhalation	Inorganics													
				ALUMINUM	6.40E-06	(mg/m ³)	5.26E-04	(ug/m ³)	NA	per (ug/m ³)	--	6.14E-06	(mg/m ³)	5.00E-03	(mg/m ³)	1.2E-03	
				ARSENIC	2.49E-09	(mg/m ³)	2.04E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	8.8E-10	2.38E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.6E-04	
				COBALT	2.05E-08	(mg/m ³)	1.69E-06	(ug/m ³)	9.00E-03	per (ug/m ³)	1.5E-08	1.97E-08	(mg/m ³)	6.00E-06	(mg/m ³)	3.3E-03	
				IRON	1.10E-05	(mg/m ³)	9.03E-04	(ug/m ³)	NA	per (ug/m ³)	--	1.05E-05	(mg/m ³)	NA	(mg/m ³)	--	
		MANGANESE	2.99E-07	(mg/m ³)	2.45E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.86E-07	(mg/m ³)	5.00E-05	(mg/m ³)	5.7E-03			
		Exp. Route Total							1.6E-08					1.0E-02			
		Exposure Point Total							1.6E-08					1.0E-02			
		Exposure Medium Total							1.6E-08					1.0E-02			
Soil Total											3.6E-06					1.7E+00	
Total of Receptor Risks Across All Media											1.1E-05	Total of Receptor Hazards Across All Media					2.0E+00

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.32
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Subsurface Soil	Loading Dock Area	Ingestion	Inorganics													
				ALUMINUM	8.39E+03	(mg/kg)	3.38E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.37E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-02	
				ARSENIC	3.26E+00	(mg/kg)	7.89E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-07	5.52E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02	
				COBALT	2.69E+01	(mg/kg)	1.09E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.60E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-01	
				IRON	1.44E+04	(mg/kg)	5.81E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.07E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.8E-02	
			MANGANESE	3.91E+02	(mg/kg)	1.58E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.10E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.9E-03		
			Exp. Route Total									1.2E-07					3.6E-01
			Dermal ¹	Inorganics													
				ALUMINUM	8.39E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	3.26E+00	(mg/kg)	1.26E-08	(mg/kg-day)	1.5E+00	per (mg/kg-day)	1.9E-08	8.85E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.0E-03	
				COBALT	2.69E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.44E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
			MANGANESE	3.91E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
			Exp. Route Total									1.9E-08					3.0E-03
			Exposure Point Total									1.4E-07					3.6E-01
	Exposure Medium Total									1.4E-07					3.6E-01		
	Air	Loading Dock Area	Inhalation	Inorganics													
				ALUMINUM	1.37E-04	(mg/m³)	4.48E-04	(ug/m³)	NA	per (ug/m³)	--	3.14E-05	(mg/m³)	5.00E-03	(mg/m³)	6.3E-03	
				ARSENIC	5.33E-08	(mg/m³)	1.74E-07	(ug/m³)	4.30E-03	per (ug/m³)	7.5E-10	1.22E-08	(mg/m³)	1.50E-05	(mg/m³)	8.1E-04	
				COBALT	4.40E-07	(mg/m³)	1.44E-06	(ug/m³)	9.00E-03	per (ug/m³)	1.3E-08	1.01E-07	(mg/m³)	6.00E-06	(mg/m³)	1.7E-02	
				IRON	2.36E-04	(mg/m³)	7.69E-04	(ug/m³)	NA	per (ug/m³)	--	5.38E-05	(mg/m³)	NA	(mg/m³)	--	
			MANGANESE	6.40E-06	(mg/m³)	2.09E-05	(ug/m³)	NA	per (ug/m³)	--	1.46E-06	(mg/m³)	5.00E-05	(mg/m³)	2.9E-02		
			Exp. Route Total									1.4E-08				5.3E-02	
			Exposure Point Total									1.4E-08				5.3E-02	
	Exposure Medium Total									1.4E-08				5.3E-02			
Soil Total									1.5E-07					4.2E-01			
Total of Receptor Risks Across All Media										1.5E-07	Total of Receptor Hazards Across All Media					4.2E-01	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.33
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

$$PEF = Q/C \times [(3,600 \text{ s/h}) / (.36 \times (1 - V) \times (U_m/U_t)^3 \times F(x))] =$$

1.31E+09

Air Concentration

$$C_{air} = C_{soil} \times ((1/PEF) + (1/VF))$$

Where,

$$Q/C = 8.26E+01 \text{ g/m}^2\text{-s per kg/m}^3$$

Inverse Mean Concentration at Center of 0.05 square source for Lincoln, NE, USEPA 1996

$$V = 5.00E-01 \text{ unitless}$$

Default, USEPA 2019

$$U_m = 4.65E+00 \text{ m/s}$$

Mean annual wind speed, Lincoln, NE, USEPA 1996

$$U_t = 1.13E+01 \text{ m/s}$$

Equivalent threshold value of windspeed at 7 m, USEPA 2019

$$F(x) = 1.82E-02 \text{ unitless}$$

Default, USEPA 2019

$$VF = \text{Volatilization Factor } \text{m}^3/\text{kg}$$

Chemical Specific, USEPA 2019

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. November 2019.

Chemical	Csoil, Surface Soil	Csoil, Subsurface Soil	Volatilization Factor	Cair, Surface Soil	Cair, Subsurface Soil
	RME EPC	RME EPC		Particulate	Particulate
	mg/kg	mg/kg		m ³ /kg	RME EPC
				mg/m ³	mg/m ³
Inorganics					
ALUMINUM	4.62E+03	8.39E+03	--	3.53E-06	6.40E-06
ANTIMONY	2.98E+00	NA		2.28E-09	NA
ARSENIC	3.99E+00	3.26E+00	--	3.05E-09	2.49E-09
COBALT	1.52E+01	2.69E+01	--	1.16E-08	2.05E-08
IRON	1.53E+04	1.44E+04	--	1.17E-05	1.10E-05
MANGANESE	4.19E+02	3.91E+02	--	3.20E-07	2.99E-07
PAHs					
BENZO(A)PYRENE	2.83E-01	NA		2.16E-10	NA
Volatiles					
BENZENE	2.80E+00	NA		2.14E-09	NA
ETHYLBENZENE	6.70E+00	NA		5.11E-09	NA

TABLE 7.34
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
CONSTRUCTION WORKER - OTHER THAN STANDARD VEHICLE TRAFFIC
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:					
	Particulate Emission Factor	6.11E+07	Calculated using EPA RSL Calculator (Calculations provided in Appendix D)		
	Air Concentration		Cair = Csoil*((1/PEF)+(1/VF))		
Where,					
Area to be excavated, graded, tilled =	5.00E+00	acres			
Depth of excavation =	1.50E+00	meters			
Q/C =	9.44E+00	g/m ² -s per kg/m ³	calculated		
Um =	4.69E+00	m/s	Mean annual wind speed, USEPA 2019		
Ut =	1.13E+01	m/s	Equivalent threshold value of windspeed at 7 m, USEPA 2019		
F(x) =	1.94E-01	unitless	Default, USEPA 2019		
VF =	Volatilization Factor	m ³ /kg	Chemical Specific, USEPA 2019		
Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.					
USEPA Regional Screening Levels. November 2019.					
		Csoil, Subsurface Soil		Cair, Surface Soil	Cair, Subsurface Soil
Chemical	Csoil, Surface Soil	Soil	Volatilization Factor	Particulate	Particulate
	RME EPC	RME EPC	VF	RME EPC	RME EPC
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³
Inorganics					
ALUMINUM	4.62E+03	8.39E+03	--	7.57E-05	1.37E-04
ANTIMONY	2.98E+00	NA		#DIV/0!	NA
ARSENIC	3.99E+00	3.26E+00	--	6.54E-08	5.33E-08
COBALT	1.52E+01	2.69E+01	--	2.50E-07	4.40E-07
IRON	1.53E+04	1.44E+04	--	2.50E-04	2.36E-04
MANGANESE	4.19E+02	3.91E+02	--	6.87E-06	6.40E-06
PAHs					
BENZO(A)PYRENE	2.83E-01	NA		4.63E-09	NA
Volatiles					
BENZENE	2.80E+00	NA		4.58E-08	NA
ETHYLBENZENE	6.70E+00	NA		1.10E-07	NA

TABLE 7.35
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN HOME GROWN PRODUCE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:				
		$Pr = C_s * Br_{ag} * 0.12$	mg/kg	Concentration of COPC in plant due to root uptake
Model Constants:				
		C_s	chemical-specific mg/kg	COPC concentration in soil (mg/kg)
		$Br_{ag} =$	chemical-specific unitless	Plant to soil bioconcentration factor (unitless), above ground produce and forage
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA 2005.				
Constituent of Potential Concern	Cs, Surface Soil RME EPC mg/kg	Br _{ag} ⁽¹⁾ unitless	Reference	P _r RME EPC mg/kg
Inorganics				
ALUMINUM	4.62E+03	4.00E-03	RAIS 2019	2.22E+00
ANTIMONY	2.98E+00	3.19E-02	U.S. EPA 2005	1.14E-02
ARSENIC	3.99E+00	6.33E-03	U.S. EPA 2005	3.03E-03
COBALT	1.52E+01	2.00E-02	RAIS 2019	3.66E-02
IRON	1.53E+04	4.00E-03	RAIS 2019	7.33E+00
MANGANESE	4.19E+02	2.50E-01	RAIS 2019	1.26E+01
PAHs				
BENZO(A)PYRENE	2.83E-01	1.32E-02	U.S. EPA 2005	4.48E-04
Volatiles				
BENZENE	2.80E+00	2.37E+00	U.S. EPA 2005	7.96E-01
ETHYLBENZENE	6.70E+00	6.25E-01	U.S. EPA 2005	5.03E-01

References:

U. S. EPA 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* , Final, EPA/530/R-05/006, Washington, D.C.

RAIS 2019. *Risk Assessment Information System* , online database available at: <http://rais.ornl.gov>. Assuming soil-to-dry plant uptake.

TABLE 7.36
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN BEEF
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:						
		$CM = ((F_i * Q_{p(\text{forage, cattle})} * P_i) + (Q_{\text{soil}(\text{cattle})} * C_s * B_s)) * B_{a,\text{beef}} * MF$				
Model Constants:						
F_i	1	unitless	Fraction of plant type grown on contaminated soil and ingested by cattle, assume only consume forage grown on contaminated soil.			
$Q_{p(\text{forage, cattle})}$	8.8	kg/day	Quantity of forage ingested by cattle per day.			
P_i	calculated	mg/kg	Concentration of COPC in plant ingested by cattle.			
			$C_s * Br_{ag} * 0.12$			
			C_s = COPC concentration in soil (mg/kg).			
			Br_{ag} = plant to soil bioconcentration factor (unitless)			
$Q_{\text{soil}(\text{cattle})}$	0.5	kg/day	Quantity of soil ingested by cattle.			
C_s	chemical-specific	mg/kg	Surface soil COPC concentration			
B_s	1	unitless	Soil bioavailability factor.			
$B_{a,\text{beef}}$	chemical-specific	day/kg	Biotransfer factor for beef.			
MF	1	unitless	Metabolism factor for all constituents, except bis(2-ethylhexyl)phthalate = 0.01			
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA, 2005.						
Chemical	Cs, Surface Soil RME EPC mg/kg	$Br_{ag}^{(1)}$ unitless	P_i mg/kg	$B_{a,\text{beef}}^{(1)}$ day/kg	Reference	CM RME EPC mg/kg
Inorganics						
ALUMINUM	4.62E+03	4.00E-03	2.22E+00	1.50E-03	RAIS 2019	3.49E+00
ANTIMONY	2.98E+00	3.19E-02	1.14E-02	1.00E-03	U.S. EPA 2005	1.59E-03
ARSENIC	3.99E+00	6.33E-03	3.03E-03	2.00E-03	U.S. EPA 2005	4.04E-03
COBALT	1.52E+01	2.00E-02	3.66E-02	2.00E-02	RAIS 2019	1.59E-01
IRON	1.53E+04	4.00E-03	7.33E+00	2.00E-02	RAIS 2019	1.54E+02
MANGANESE	4.19E+02	2.50E-01	1.26E+01	4.00E-04	RAIS 2019	1.28E-01
PAHs						
BENZO(A)PYRENE	2.83E-01	1.32E-02	4.48E-04	3.37E-02	U.S. EPA 2005	4.90E-03
Volatiles						
BENZENE	2.80E+00	2.37E+00	7.96E-01	3.38E-03	U.S. EPA 2005	2.84E-02
ETHYLBENZENE	6.70E+00	6.25E-01	5.03E-01	1.21E-02	U.S. EPA 2005	9.40E-02

(1) Br_{ag} taken from USEPA, 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Final, EPA/530/R-05/006, Washington, D.C. For COPCs not listed in this document, taken from RAIS 2019, Risk Assessment Information System, online database available at: <http://rais.ornl.gov>. Assuming soil-to-wet plant uptake.

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Groundwater	Groundwater	Tap Water	Ingestion	Inorganics															
				ALUMINUM	1.29E+01	(mg/L)	1.10E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	3.87E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.9E-01			
				ARSENIC	1.98E-02	(mg/L)	1.70E-04	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.5E-04	5.93E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E+00			
				CYANIDE	4.71E-02	(mg/L)	4.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.41E-03	(mg/kg-day)	6.00E-04	(mg/kg-day)	2.4E+00			
				COBALT	8.64E-03	(mg/L)	7.40E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.59E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.6E-01			
				IRON	3.34E+01	(mg/L)	2.86E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	1.00E+00	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E+00			
				MANGANESE	1.04E+00	(mg/L)	8.91E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.12E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-01			
				VANADIUM	1.02E-02	(mg/L)	8.76E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.07E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	6.1E-02			
				PAHs															
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	2.83E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.89E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.5E-01			
				NAPHTHALENE	5.92E-02	(mg/L)	5.07E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.77E-03	(mg/kg-day)	2.00E-02	(mg/kg-day)	8.9E-02			
				Volatiles															
				BENZENE	2.40E+00	(mg/L)	2.05E-02	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.1E-03	7.19E-02	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.8E+01			
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	3.51E-05	(mg/kg-day)	9.10E-02	per (mg/kg-day)	3.2E-06	1.23E-04	(mg/kg-day)	6.00E-03	(mg/kg-day)	2.0E-02			
				ETHYLBENZENE	1.10E+00	(mg/L)	9.42E-03	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.0E-04	3.30E-02	(mg/kg-day)	1.00E-01	(mg/kg-day)	3.3E-01			
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	5.14E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.80E-03	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.8E-02			
				M,P-XYLENE	2.30E+00	(mg/L)	1.97E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	6.89E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	3.4E-01			
				TOLUENE	1.10E+00	(mg/L)	9.42E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.30E-02	(mg/kg-day)	8.00E-02	(mg/kg-day)	4.1E-01			
				O-XYLENE	5.00E-01	(mg/L)	4.28E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.50E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	7.5E-02			
				Exp. Route Total										1.5E-03					2.7E+01
			Dermal	Inorganics															
				ALUMINUM	1.29E+01	(mg/L)	6.16E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.16E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.2E-03			
				ARSENIC	1.98E-02	(mg/L)	9.46E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-06	3.31E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02			
				CYANIDE	4.71E-02	(mg/L)	2.25E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.88E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.3E-02			
				COBALT	8.64E-03	(mg/L)	1.65E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.78E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03			
				IRON	3.34E+01	(mg/L)	1.60E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.59E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.0E-03			
				MANGANESE	1.04E+00	(mg/L)	4.97E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.74E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.2E-03			
				VANADIUM	1.02E-02	(mg/L)	4.89E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.71E-06	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.3E-02			
				PAHs															
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00			
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00			
				Volatiles															
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00			
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00			
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00			
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00			
				M,P-XYLENE	2.30E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00			
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00			
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00			
				Exp. Route Total										1.4E-06				5.1E-02	
			Exposure Point Total										1.5E-03				2.7E+01		
			Exposure Medium Total										1.5E-03				2.7E+01		

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air Household	Inhalation	PAHs	2.96E-02	(mg/m³)	1.05E+01	(µg/m³)	3.40E-05	per (µg/m³)	3.6E-04	2.84E-02	(mg/m³)	3.00E-03	(mg/m³)	9.5E+00
				Volatiles												
				BENZENE	1.20E+00	(mg/m³)	4.27E+02	(µg/m³)	7.80E-06	per (µg/m³)	3.3E-03	1.15E+00	(mg/m³)	3.00E-02	(mg/m³)	3.8E+01
				1,2-DICHLOROETHANE	2.05E-03	(mg/m³)	7.30E-01	(µg/m³)	2.60E-05	per (µg/m³)	1.9E-05	1.97E-03	(mg/m³)	7.00E-03	(mg/m³)	2.8E-01
				ETHYLBENZENE	5.50E-01	(mg/m³)	1.96E+02	(µg/m³)	2.50E-06	per (µg/m³)	4.9E-04	5.27E-01	(mg/m³)	1.00E+00	(mg/m³)	5.3E-01
				ISOPROPYLBENZENE	3.00E-02	(mg/m³)	1.07E+01	(µg/m³)	NA	per (µg/m³)	--	2.88E-02	(mg/m³)	4.00E-01	(mg/m³)	7.2E-02
				M,P-XYLENE	1.15E+00	(mg/m³)	4.10E+02	(µg/m³)	NA	per (µg/m³)	--	1.10E+00	(mg/m³)	1.00E-01	(mg/m³)	1.1E+01
				TOLUENE	5.50E-01	(mg/m³)	1.96E+02	(µg/m³)	NA	per (µg/m³)	--	5.27E-01	(mg/m³)	5.00E+00	(mg/m³)	1.1E-01
				O-XYLENE	2.50E-01	(mg/m³)	8.90E+01	(µg/m³)	NA	per (µg/m³)	--	2.40E-01	(mg/m³)	1.00E-01	(mg/m³)	2.4E+00
				Exp. Route Total							4.2E-03					6.2E+01
	Exposure Point Total							4.2E-03					6.2E+01			
	Exposure Medium Total							4.2E-03					6.2E+01			
Groundwater														8.9E+01		
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.18E-04
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.89E-03
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.98E-03
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.13E-04
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.6E-07					5.9E-03
			Dermal ¹	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							5.7E-08					3.5E-04
	Exposure Point Total							3.2E-07				6.2E-03				
	Exposure Medium Total							3.2E-07				6.2E-03				
Sediment Total													6.2E-03			

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05
				Exp. Route Total							9.4E-08					7.7E-03
			Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03
				Exp. Route Total							1.6E-06					2.2E-02
			Exposure Point Total								1.7E-06					2.9E-02
			Exposure Medium Total								1.7E-06					2.9E-02
			Surface Water Total								1.7E-06					2.9E-02

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Wilcox Process Area	Ingestion	Inorganics														
				ALUMINUM	5.46E+03	(mg/kg)	1.87E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	6.55E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.5E-03		
				ARSENIC	3.86E+00	(mg/kg)	7.94E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-06	2.78E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-03		
				CADMIUM	1.42E+00	(mg/kg)	4.87E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.70E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	1.7E-03		
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	8.08E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.0E-07	1.41E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.7E-04		
				COBALT	3.87E+00	(mg/kg)	1.32E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.63E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02		
				COPPER	4.10E+02	(mg/kg)	1.40E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.91E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.2E-02		
				IRON	1.26E+04	(mg/kg)	4.33E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.52E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.2E-02		
				MANGANESE	3.09E+02	(mg/kg)	1.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.70E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.6E-03		
				VANADIUM	1.35E+01	(mg/kg)	4.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.61E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	3.2E-03		
				ZINC	3.10E+02	(mg/kg)	1.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.71E-04	(mg/kg-day)	3.00E-01	(mg/kg-day)	1.2E-03		
				PAHs														
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	3.13E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.1E-07	5.47E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	1.48E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.5E-07	2.59E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	1.73E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.7E-06	3.04E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.0E-02		
				CHRYSENE	1.16E+01	(mg/kg)	7.92E-06	(mg/kg-day)	1.00E-03	per (mg/kg-day)	7.9E-09	1.39E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	2.10E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-07	3.68E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	2.94E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.9E-08	5.14E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	1.07E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.73E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	9.3E-04		
				NAPHTHALENE	8.06E-01	(mg/kg)	2.76E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	9.66E-07	(mg/kg-day)	2.00E-02	(mg/kg-day)	4.8E-05		
				Exp. Route Total											4.0E-06			
			Dermal ¹	Inorganics														
				ALUMINUM	5.46E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	3.86E+00	(mg/kg)	1.68E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.5E-07	5.87E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-03		
				CADMIUM	1.42E+00	(mg/kg)	2.05E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	7.19E-09	(mg/kg-day)	2.50E-05	(mg/kg-day)	2.9E-04		
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	3.87E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				COPPER	4.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--		
				IRON	1.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	3.09E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				VANADIUM	1.35E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--		
				ZINC	3.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	1.72E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.7E-07	3.00E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	8.14E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	8.1E-08	1.42E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	9.52E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.5E-07	1.67E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-03		
				CHRYSENE	1.16E+01	(mg/kg)	4.35E-06	(mg/kg-day)	1.00E-03	per (mg/kg-day)	4.3E-09	7.61E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	1.15E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-07	2.02E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	1.61E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.6E-08	2.82E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	5.86E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.05E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	5.1E-04		
				NAPHTHALENE	8.06E-01	(mg/kg)	1.52E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.30E-07	(mg/kg-day)	2.00E-02	(mg/kg-day)	2.7E-05		
				Exp. Route Total											1.6E-06			
			Exposure Point Total											5.6E-06				9.4E-02
			Exposure Medium Total											5.6E-06				9.4E-02

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	Wilcox Process Area	Inhalation	Inorganics												
				ALUMINUM	4.17E-06	(mg/m ³)	1.14E-03	(ug/m ³)	NA	per (ug/m ³)	--	4.00E-06	(mg/m ³)	5.00E-03	(mg/m ³)	8.0E-04
				ARSENIC	2.95E-09	(mg/m ³)	8.08E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	3.5E-09	2.83E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.9E-04
				CADMIUM	1.08E-09	(mg/m ³)	2.97E-07	(ug/m ³)	1.80E-03	per (ug/m ³)	5.3E-10	1.04E-09	(mg/m ³)	1.00E-05	(mg/m ³)	1.0E-04
				HEXAVALENT CHROMIUM (+6)	9.00E-10	(mg/m ³)	4.93E-07	(ug/m ³)	8.40E-02	per (ug/m ³)	4.1E-08	8.63E-10	(mg/m ³)	1.00E-04	(mg/m ³)	8.6E-06
				COBALT	2.95E-09	(mg/m ³)	8.09E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	7.3E-09	2.83E-09	(mg/m ³)	6.00E-06	(mg/m ³)	4.7E-04
				COPPER	3.13E-07	(mg/m ³)	8.57E-05	(ug/m ³)	NA	per (ug/m ³)	--	3.00E-07	(mg/m ³)	NA	(mg/m ³)	--
				IRON	9.65E-06	(mg/m ³)	2.65E-03	(ug/m ³)	NA	per (ug/m ³)	--	9.26E-06	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	2.35E-07	(mg/m ³)	6.45E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.26E-07	(mg/m ³)	5.00E-05	(mg/m ³)	4.5E-03
				VANADIUM	1.03E-08	(mg/m ³)	2.81E-06	(ug/m ³)	NA	per (ug/m ³)	--	9.85E-09	(mg/m ³)	1.00E-04	(mg/m ³)	9.8E-05
				ZINC	2.36E-07	(mg/m ³)	6.48E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.27E-07	(mg/m ³)	NA	(mg/m ³)	--
				PAHs												
				BENZ(A)ANTHRACENE	3.49E-09	(mg/m ³)	1.91E-06	(ug/m ³)	6.00E-05	per (ug/m ³)	1.1E-10	3.34E-09	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	1.65E-09	(mg/m ³)	9.05E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	5.4E-11	1.58E-09	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	1.93E-09	(mg/m ³)	1.06E-06	(ug/m ³)	6.00E-04	per (ug/m ³)	6.4E-10	1.85E-09	(mg/m ³)	2.00E-06	(mg/m ³)	9.3E-04
				CHRYSENE	8.83E-09	(mg/m ³)	4.84E-06	(ug/m ³)	6.00E-07	per (ug/m ³)	2.9E-12	8.47E-09	(mg/m ³)	NA	(mg/m ³)	--
				DIBENZ(A,H)ANTHRACENE	2.34E-10	(mg/m ³)	1.28E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	7.7E-11	2.25E-10	(mg/m ³)	NA	(mg/m ³)	--
				INDENO(1,2,3-C,D)PYRENE	3.27E-10	(mg/m ³)	1.79E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	1.1E-11	3.14E-10	(mg/m ³)	NA	(mg/m ³)	--
				2-METHYLNAPHTHALENE	2.38E-09	(mg/m ³)	6.51E-07	(ug/m ³)	NA	per (ug/m ³)	--	2.28E-09	(mg/m ³)	NA	(mg/m ³)	--
				NAPHTHALENE	6.15E-10	(mg/m ³)	1.69E-07	(ug/m ³)	3.40E-05	per (ug/m ³)	5.7E-12	5.90E-10	(mg/m ³)	3.00E-03	(mg/m ³)	2.0E-07
				Exp. Route Total							5.4E-08					7.1E-03
				Exposure Point Total							5.4E-08					7.1E-03
				Exposure Medium Total							5.4E-08					7.1E-03

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics												
				ALUMINUM	2.62E+00	(mg/kg)	3.54E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.58E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.6E-03
				ARSENIC	2.94E-03	(mg/kg)	3.96E-10	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-10	2.89E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.6E-03
				CADMIUM	2.13E-02	(mg/kg)	2.88E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	2.10E-05	(mg/kg-day)	1.00E-03	(mg/kg-day)	2.1E-02
				HEXAVALENT CHROMIUM (+6)	6.90E-04	(mg/kg)	1.86E-10	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.3E-11	6.80E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	2.3E-04
				COBALT	9.28E-03	(mg/kg)	1.25E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	9.14E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.0E-02
				COPPER	1.97E+01	(mg/kg)	2.66E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.94E-02	(mg/kg-day)	4.00E-02	(mg/kg-day)	4.8E-01
				IRON	6.07E+00	(mg/kg)	8.20E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.98E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.5E-03
				MANGANESE	9.26E+00	(mg/kg)	1.25E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	9.12E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	6.5E-02
				VANADIUM	8.88E-03	(mg/kg)	1.20E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	8.75E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.7E-03
				ZINC	3.60E+00	(mg/kg)	4.87E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.55E-03	(mg/kg-day)	3.00E-01	(mg/kg-day)	1.2E-02
				PAHs												
				BENZ(A)ANTHRACENE	1.08E-02	(mg/kg)	2.92E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.9E-10	1.06E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.91E-03	(mg/kg)	7.85E-10	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.9E-11	2.87E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.01E-03	(mg/kg)	1.08E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-09	3.95E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02
				CHRYSENE	2.74E-02	(mg/kg)	7.38E-09	(mg/kg-day)	1.00E-03	per (mg/kg-day)	7.4E-12	2.70E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	2.50E-04	(mg/kg)	6.74E-11	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-11	2.46E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	3.05E-04	(mg/kg)	8.24E-11	(mg/kg-day)	1.00E-01	per (mg/kg-day)	8.2E-12	3.01E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	8.22E-02	(mg/kg)	1.11E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	8.10E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.0E-02
				NAPHTHALENE	4.63E-02	(mg/kg)	6.25E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	4.57E-05	(mg/kg-day)	2.00E-02	(mg/kg-day)	2.3E-03
				Exp. Route Total							2.2E-09					6.7E-01
				Exposure Point Total							2.2E-09					6.7E-01
				Exposure Medium Total							2.2E-09					6.7E-01

TABLE 7.37
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Beef	Ingestion	Inorganics														
				ALUMINUM	4.11E+00	(mg/kg)	2.34E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.71E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.7E-02		
				ARSENIC	3.92E-03	(mg/kg)	2.23E-09	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-09	1.63E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-02		
				CADMIUM	1.08E-04	(mg/kg)	6.14E-11	(mg/kg-day)	NA	per (mg/kg-day)	--	4.48E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	4.5E-04		
				HEXAVALENT CHROMIUM (+6)	3.28E-03	(mg/kg)	3.73E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.9E-09	1.36E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.5E-03		
				COBALT	4.03E-02	(mg/kg)	2.29E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.67E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-01		
				COPPER	3.78E+00	(mg/kg)	2.15E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.57E-02	(mg/kg-day)	4.00E-02	(mg/kg-day)	3.9E-01		
				IRON	1.28E+02	(mg/kg)	7.26E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.30E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	7.6E-01		
				MANGANESE	6.98E-02	(mg/kg)	3.98E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.90E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-03		
				VANADIUM	1.69E-02	(mg/kg)	9.60E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	7.01E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.4E-02		
				ZINC	1.68E-02	(mg/kg)	9.56E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	6.98E-05	(mg/kg-day)	3.00E-01	(mg/kg-day)	2.3E-04		
				PAHs														
				BENZ(A)ANTHRACENE	3.43E-02	(mg/kg)	3.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.9E-09	1.42E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	1.67E-02	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	6.95E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.39E-02	(mg/kg)	5.00E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.0E-08	1.82E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.1E-01		
				CHRYSENE	2.40E+01	(mg/kg)	2.74E-05	(mg/kg-day)	1.00E-03	per (mg/kg-day)	2.7E-08	9.99E-02	(mg/kg-day)	NA	(mg/kg-day)	--		
				DIBENZ(A,H)ANTHRACENE	7.41E-02	(mg/kg)	8.44E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.4E-08	3.08E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	2.71E-02	(mg/kg)	3.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.1E-09	1.13E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				2-METHYLNAPHTHALENE	5.60E-02	(mg/kg)	3.19E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.33E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	5.8E-02		
				NAPHTHALENE	1.20E-02	(mg/kg)	6.83E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	4.99E-05	(mg/kg-day)	2.00E-02	(mg/kg-day)	2.5E-03		
				Exp. Route Total										1.8E-07	2.5E+00			
				Exposure Point Total										1.8E-07	2.5E+00			
				Exposure Medium Total										1.8E-07	2.5E+00			
Soil Total										5.9E-06	3.2E+00							
Total of Receptor Risks Across All Media											5.7E-03	Total of Receptor Hazards Across All Media				9.2E+01		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Tap Water	Ingestion	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	5.51E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	6.43E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.4E-01
				ARSENIC	1.98E-02	(mg/L)	8.46E-05	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.3E-04	9.87E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.3E+00
				CYANIDE	4.71E-02	(mg/L)	2.01E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.35E-03	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.9E+00
				COBALT	8.64E-03	(mg/L)	3.69E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E+00
				IRON	3.34E+01	(mg/L)	1.43E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	1.67E+00	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.4E+00
				MANGANESE	1.04E+00	(mg/L)	4.45E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.19E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.7E-01
				VANADIUM	1.02E-02	(mg/L)	4.37E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.10E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.0E-01
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	1.41E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.65E-03	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.1E-01
				NAPHTHALENE	5.92E-02	(mg/L)	2.53E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.95E-03	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.5E-01
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	1.03E-02	(mg/kg-day)	5.50E-02	per (mg/kg-day)	5.6E-04	1.20E-01	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.0E+01
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	1.75E-05	(mg/kg-day)	9.10E-02	per (mg/kg-day)	1.6E-06	2.04E-04	(mg/kg-day)	6.00E-03	(mg/kg-day)	3.4E-02
				ETHYLBENZENE	1.10E+00	(mg/L)	4.70E-03	(mg/kg-day)	1.10E-02	per (mg/kg-day)	5.2E-05	5.48E-02	(mg/kg-day)	1.00E-01	(mg/kg-day)	5.5E-01
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	2.56E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-03	(mg/kg-day)	1.00E-01	(mg/kg-day)	3.0E-02
				M,P-XYLENE	2.30E+00	(mg/L)	9.83E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.15E-01	(mg/kg-day)	2.00E-01	(mg/kg-day)	5.7E-01
				TOLUENE	1.10E+00	(mg/L)	4.70E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.48E-02	(mg/kg-day)	8.00E-02	(mg/kg-day)	6.9E-01
				O-XYLENE	5.00E-01	(mg/L)	2.14E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.49E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	1.2E-01
				Exp. Route Total							7.4E-04					4.5E+01
			Dermal	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	2.43E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.83E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.8E-03
				ARSENIC	1.98E-02	(mg/L)	3.73E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.6E-07	4.35E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02
				CYANIDE	4.71E-02	(mg/L)	8.87E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.03E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.7E-02
				COBALT	8.64E-03	(mg/L)	6.51E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	7.60E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-03
				IRON	3.34E+01	(mg/L)	6.30E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	7.35E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.0E-02
				MANGANESE	1.04E+00	(mg/L)	1.96E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.29E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.6E-03
				VANADIUM	1.02E-02	(mg/L)	1.93E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.25E-06	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.7E-02
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				M,P-XYLENE	2.30E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				Exp. Route Total							5.6E-07					6.7E-02
			Exposure Point Total								7.4E-04					4.5E+01
			Exposure Medium Total								7.4E-04					4.5E+01
			Groundwater Total¹								7.4E-04					4.5E+01

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02	
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03	
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02	
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02	
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
			Exp. Route Total							3.6E-06					1.3E-01		
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
			Exp. Route Total							1.8E-07					2.1E-03		
			Exposure Point Total							3.8E-06					1.3E-01		
			Exposure Medium Total							3.8E-06					1.3E-01		
Sediment Total												3.8E-06					1.3E-01
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02	
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02	
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04	
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01	
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02	
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03	
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04	
			Exp. Route Total							8.5E-07					2.1E-01		

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04		
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04		
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04		
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03		
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04		
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04		
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
				Exp. Route Total									2.6E-06					4.5E-02
				Exposure Point Total									3.4E-06					2.5E-01
			Exposure Medium Total									3.4E-06					2.5E-01	
Surface Water Total										3.4E-06					2.5E-01			
Soil	Surface Soil	Wilcox Process Area	Ingestion	Inorganics														
				ALUMINUM	5.46E+03	(mg/kg)	5.99E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	6.99E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	7.0E-02		
				ARSENIC	3.86E+00	(mg/kg)	2.54E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-06	2.96E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.9E-02		
				CADMIUM	1.42E+00	(mg/kg)	1.56E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.82E-05	(mg/kg-day)	1.00E-03	(mg/kg-day)	1.8E-02		
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	6.85E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	3.4E-06	1.51E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-03		
				COBALT	3.87E+00	(mg/kg)	4.24E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.94E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-01		
				COPPER	4.10E+02	(mg/kg)	4.49E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.24E-03	(mg/kg-day)	4.00E-02	(mg/kg-day)	1.3E-01		
				IRON	1.26E+04	(mg/kg)	1.39E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.62E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.3E-01		
				MANGANESE	3.09E+02	(mg/kg)	3.38E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.94E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.8E-02		
				VANADIUM	1.35E+01	(mg/kg)	1.47E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.72E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	3.4E-02		
				ZINC	3.10E+02	(mg/kg)	3.39E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-03	(mg/kg-day)	3.00E-01	(mg/kg-day)	1.3E-02		
				PAHs														
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	2.65E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.7E-06	5.84E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	1.26E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-06	2.77E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	1.47E-05	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-05	3.24E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-01		
				CHRYSENE	1.16E+01	(mg/kg)	6.72E-05	(mg/kg-day)	1.00E-03	per (mg/kg-day)	6.7E-08	1.48E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	1.78E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-06	3.93E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	2.49E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.5E-07	5.48E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	3.41E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.98E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.0E-02		
				NAPHTHALENE	8.06E-01	(mg/kg)	8.83E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.03E-05	(mg/kg-day)	2.00E-02	(mg/kg-day)	5.2E-04		
			Exp. Route Total									2.8E-05					9.1E-01	

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Wilcox Process Area	Dermal ¹	Inorganics												
				ALUMINUM	5.46E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	3.86E+00	(mg/kg)	3.01E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.5E-07	3.52E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-02
				CADMIUM	1.42E+00	(mg/kg)	3.70E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-08	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-03
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	3.87E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				COPPER	4.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				IRON	1.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	3.09E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.35E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				ZINC	3.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	8.18E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	8.2E-07	1.80E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	3.88E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.9E-07	8.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	4.54E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.5E-06	9.99E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.3E-02
				CHRYSENE	1.16E+01	(mg/kg)	2.07E-05	(mg/kg-day)	1.00E-03	per (mg/kg-day)	2.1E-08	4.56E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	5.50E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.5E-07	1.21E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	7.69E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.7E-08	1.69E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	1.05E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.23E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.1E-03
				NAPHTHALENE	8.06E-01	(mg/kg)	2.72E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.18E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.6E-04
				Exp. Route Total							6.8E-06					5.0E-02
				Exposure Point Total							3.5E-05					9.6E-01
				Exposure Medium Total							3.5E-05					9.6E-01

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	Wilcox Process Area	Inhalation	Inorganics												
				ALUMINUM	4.17E-06	(mg/m ³)	3.43E-04	(ug/m ³)	NA	per (ug/m ³)	--	4.00E-06	(mg/m ³)	5.00E-03	(mg/m ³)	8.0E-04
				ARSENIC	2.95E-09	(mg/m ³)	2.42E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	1.0E-09	2.83E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.9E-04
				CADMIUM	1.08E-09	(mg/m ³)	8.92E-08	(ug/m ³)	1.80E-03	per (ug/m ³)	1.6E-10	1.04E-09	(mg/m ³)	1.00E-05	(mg/m ³)	1.0E-04
				HEXAVALENT CHROMIUM (+6)	9.00E-10	(mg/m ³)	3.92E-07	(ug/m ³)	8.40E-02	per (ug/m ³)	3.3E-08	8.63E-10	(mg/m ³)	1.00E-04	(mg/m ³)	8.6E-06
				COBALT	2.95E-09	(mg/m ³)	2.43E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	2.2E-09	2.83E-09	(mg/m ³)	6.00E-06	(mg/m ³)	4.7E-04
				COPPER	3.13E-07	(mg/m ³)	2.57E-05	(ug/m ³)	NA	per (ug/m ³)	--	3.00E-07	(mg/m ³)	NA	(mg/m ³)	--
				IRON	9.65E-06	(mg/m ³)	7.94E-04	(ug/m ³)	NA	per (ug/m ³)	--	9.26E-06	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	2.35E-07	(mg/m ³)	1.94E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.26E-07	(mg/m ³)	5.00E-05	(mg/m ³)	4.5E-03
				VANADIUM	1.03E-08	(mg/m ³)	8.44E-07	(ug/m ³)	NA	per (ug/m ³)	--	9.85E-09	(mg/m ³)	1.00E-04	(mg/m ³)	9.8E-05
				ZINC	2.36E-07	(mg/m ³)	1.94E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.27E-07	(mg/m ³)	NA	(mg/m ³)	--
				PAHs												
				BENZ(A)ANTHRACENE	3.49E-09	(mg/m ³)	1.52E-06	(ug/m ³)	6.00E-05	per (ug/m ³)	9.1E-11	3.34E-09	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	1.65E-09	(mg/m ³)	7.20E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	4.3E-11	1.58E-09	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	1.93E-09	(mg/m ³)	8.42E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	5.1E-10	1.85E-09	(mg/m ³)	2.00E-06	(mg/m ³)	9.3E-04
				CHRYSENE	8.83E-09	(mg/m ³)	3.85E-06	(ug/m ³)	6.00E-07	per (ug/m ³)	2.3E-12	8.47E-09	(mg/m ³)	NA	(mg/m ³)	--
				DIBENZ(A,H)ANTHRACENE	2.34E-10	(mg/m ³)	1.02E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	6.1E-11	2.25E-10	(mg/m ³)	NA	(mg/m ³)	--
				INDENO(1,2,3-C,D)PYRENE	3.27E-10	(mg/m ³)	1.43E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	8.6E-12	3.14E-10	(mg/m ³)	NA	(mg/m ³)	--
				2-METHYLNAPHTHALENE	2.38E-09	(mg/m ³)	1.95E-07	(ug/m ³)	NA	per (ug/m ³)	--	2.28E-09	(mg/m ³)	NA	(mg/m ³)	--
				NAPHTHALENE	6.15E-10	(mg/m ³)	5.06E-08	(ug/m ³)	3.40E-05	per (ug/m ³)	1.7E-12	5.90E-10	(mg/m ³)	3.00E-03	(mg/m ³)	2.0E-07
				Exp. Route Total							3.7E-08					7.1E-03
				Exposure Point Total							3.7E-08					7.1E-03
				Exposure Medium Total							3.7E-08					7.1E-03

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics												
				ALUMINUM	2.62E+00	(mg/kg)	6.14E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.35E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.3E-02
				ARSENIC	2.94E-03	(mg/kg)	6.87E-09	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.0E-08	1.51E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.0E-02
				CADMIUM	2.13E-02	(mg/kg)	4.99E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.09E-04	(mg/kg-day)	1.00E-03	(mg/kg-day)	1.1E-01
				HEXAVALENT CHROMIUM (+6)	6.90E-04	(mg/kg)	8.57E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.3E-09	3.54E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.2E-03
				COBALT	9.28E-03	(mg/kg)	2.17E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.76E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-01
				COPPER	1.97E+01	(mg/kg)	4.61E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.01E-01	(mg/kg-day)	4.00E-02	(mg/kg-day)	2.5E+00
				IRON	6.07E+00	(mg/kg)	1.42E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.11E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.4E-02
				MANGANESE	9.26E+00	(mg/kg)	2.17E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	4.75E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.4E-01
				VANADIUM	8.88E-03	(mg/kg)	2.08E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.55E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.1E-03
				ZINC	3.60E+00	(mg/kg)	8.44E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.85E-02	(mg/kg-day)	3.00E-01	(mg/kg-day)	6.2E-02
				PAHs												
				BENZ(A)ANTHRACENE	1.08E-02	(mg/kg)	1.34E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	5.54E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.91E-03	(mg/kg)	3.61E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.6E-09	1.49E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.01E-03	(mg/kg)	4.98E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.0E-08	2.06E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.9E-02
				CHRYSENE	2.74E-02	(mg/kg)	3.40E-07	(mg/kg-day)	1.00E-03	per (mg/kg-day)	3.4E-10	1.40E-04	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	2.50E-04	(mg/kg)	3.10E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.1E-09	1.28E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	3.05E-04	(mg/kg)	3.79E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.8E-10	1.57E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	8.22E-02	(mg/kg)	1.93E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.22E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.1E-01
				NAPHTHALENE	4.63E-02	(mg/kg)	1.09E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.38E-04	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.2E-02
				Exp. Route Total							8.5E-08					3.5E+00
				Exposure Point Total							8.5E-08					3.5E+00
				Exposure Medium Total							8.5E-08					3.5E+00

TABLE 7.38
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Beef	Ingestion	Inorganics														
				ALUMINUM	4.11E+00	(mg/kg)	1.58E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.46E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.5E-02		
				ARSENIC	3.92E-03	(mg/kg)	1.51E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.3E-08	3.30E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-01		
				CADMIUM	1.08E-04	(mg/kg)	4.15E-10	(mg/kg-day)	NA	per (mg/kg-day)	--	9.08E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.1E-04		
				HEXAVALENT CHROMIUM (+6)	3.28E-03	(mg/kg)	6.68E-08	(mg/kg-day)	5.00E-01	per (mg/kg-day)	3.3E-08	2.76E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	9.2E-03		
				COBALT	4.03E-02	(mg/kg)	1.55E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.40E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E+00		
				COPPER	3.78E+00	(mg/kg)	1.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-02	(mg/kg-day)	4.00E-02	(mg/kg-day)	8.0E-01		
				IRON	1.28E+02	(mg/kg)	4.91E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.08E+00	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.5E+00		
				MANGANESE	6.98E-02	(mg/kg)	2.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.89E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.2E-03		
				VANADIUM	1.69E-02	(mg/kg)	6.49E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.42E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.8E-02		
				ZINC	1.68E-02	(mg/kg)	6.46E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.42E-04	(mg/kg-day)	3.00E-01	(mg/kg-day)	4.7E-04		
				PAHs														
				BENZ(A)ANTHRACENE	3.43E-02	(mg/kg)	6.99E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.0E-08	2.89E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	1.67E-02	(mg/kg)	3.41E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-08	1.41E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.39E-02	(mg/kg)	8.95E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.9E-07	3.70E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E+00		
				CHRYSENE	2.40E+01	(mg/kg)	4.90E-04	(mg/kg-day)	1.00E-03	per (mg/kg-day)	4.9E-07	2.03E-01	(mg/kg-day)	NA	(mg/kg-day)	--		
				DIBENZ(A,H)ANTHRACENE	7.41E-02	(mg/kg)	1.51E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-06	6.25E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	2.71E-02	(mg/kg)	5.54E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.5E-08	2.29E-04	(mg/kg-day)	NA	(mg/kg-day)	--		
				2-METHYLNAPHTHALENE	5.60E-02	(mg/kg)	2.16E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.72E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.2E-01		
				NAPHTHALENE	1.20E-02	(mg/kg)	4.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.01E-04	(mg/kg-day)	2.00E-02	(mg/kg-day)	5.1E-03		
				Exp. Route Total										3.1E-06				5.0E+00
				Exposure Point Total										3.1E-06				5.0E+00
				Exposure Medium Total										3.1E-06				5.0E+00
Soil Total										3.8E-05				9.5E+00				
Total of Receptor Risks Across All Media										7.9E-04	Total of Receptor Hazards Across All Media				5.5E+01			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

2) Inhalation risks for the child exposure to groundwater as a tap water source are included in the adult exposure estimates, Table 7.37.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.39
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Groundwater	Groundwater	Wilcox Oil	Ingestion	Inorganics														
				ALUMINUM	1.29E+01	(mg/L)	1.26E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	8.84E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	8.8E-04		
				ARSENIC	1.98E-02	(mg/L)	1.94E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.9E-08	1.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.5E-03		
				CYANIDE	4.71E-02	(mg/L)	4.61E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.23E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.4E-03		
				COBALT	8.64E-03	(mg/L)	8.46E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	5.92E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-03		
				IRON	3.34E+01	(mg/L)	3.27E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.29E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.3E-03		
				MANGANESE	1.04E+00	(mg/L)	1.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.13E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.1E-04		
				VANADIUM	1.02E-02	(mg/L)	1.00E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	7.01E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.4E-04		
				PAHs														
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	3.23E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.26E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	5.7E-04		
				NAPHTHALENE	5.92E-02	(mg/L)	5.79E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.05E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	2.0E-04		
				Volatiles														
				BENZENE	2.40E+00	(mg/L)	2.35E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.3E-07	1.64E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.1E-02		
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	4.01E-09	(mg/kg-day)	9.10E-02	per (mg/kg-day)	3.7E-10	2.81E-07	(mg/kg-day)	6.00E-03	(mg/kg-day)	4.7E-05		
				ETHYLBENZENE	1.10E+00	(mg/L)	1.08E-06	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.2E-08	7.53E-05	(mg/kg-day)	1.00E-01	(mg/kg-day)	7.5E-04		
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	5.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.11E-06	(mg/kg-day)	1.00E-01	(mg/kg-day)	4.1E-05		
				M,P-XYLENE	2.30E+00	(mg/L)	2.25E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.58E-04	(mg/kg-day)	2.00E-01	(mg/kg-day)	7.9E-04		
				TOLUENE	1.10E+00	(mg/L)	1.08E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.53E-05	(mg/kg-day)	8.00E-02	(mg/kg-day)	9.4E-04		
				O-XYLENE	5.00E-01	(mg/L)	4.89E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.42E-05	(mg/kg-day)	2.00E-01	(mg/kg-day)	1.7E-04		
				Exp. Route Total										1.7E-07				6.1E-02
			Dermal	Inorganics														
				ALUMINUM	1.29E+01	(mg/L)	4.45E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.12E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.1E-04		
				ARSENIC	1.98E-02	(mg/L)	6.83E-09	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.0E-08	4.78E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-03		
				CYANIDE	4.71E-02	(mg/L)	1.63E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.14E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.9E-03		
				COBALT	8.64E-03	(mg/L)	1.19E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	8.35E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.8E-04		
				IRON	3.34E+01	(mg/L)	1.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	8.08E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.2E-03		
				MANGANESE	1.04E+00	(mg/L)	3.59E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.51E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.8E-04		
				VANADIUM	1.02E-02	(mg/L)	3.53E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	2.47E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.9E-03		
				PAHs														
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00		
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00		
				Volatiles														
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00		
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00		
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00		
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00		
				M,P-XYLENE	2.30E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00		
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00		
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00		
				Exp. Route Total										1.0E-08				7.3E-03
			Exposure Point Total										1.8E-07				6.9E-02	
			Exposure Medium Total										1.8E-07				6.9E-02	

TABLE 7.39
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
	Air	Trench	Inhalation	PAHs													
				NAPHTHALENE	5.16E-01	(mg/m³)	1.68E-01	(ug/m³)	3.4E-05	per (ug/m³)	5.7E-06	1.18E-02	(mg/m³)	3.0E-03	(mg/m³)	3.9E+00	
				Volatiles													
				BENZENE	2.99E+01	(mg/m³)	9.75E+00	(ug/m³)	7.8E-06	per (ug/m³)	7.6E-05	6.83E-01	(mg/m³)	3.0E-02	(mg/m³)	2.3E+01	
				1,2-DICHLOROETHANE	4.37E-02	(mg/m³)	1.43E-02	(ug/m³)	2.6E-05	per (ug/m³)	3.7E-07	9.98E-04	(mg/m³)	7.0E-03	(mg/m³)	1.4E-01	
				ETHYLBENZENE	1.18E+01	(mg/m³)	3.85E+00	(ug/m³)	2.5E-06	per (ug/m³)	9.6E-06	2.69E-01	(mg/m³)	1.0E+00	(mg/m³)	2.7E-01	
				ISOPROPYLBENZENE	6.06E-01	(mg/m³)	1.98E-01	(ug/m³)	NA	per (ug/m³)	--	1.38E-02	(mg/m³)	4.0E-01	(mg/m³)	3.5E-02	
				M,P-XYLENE	2.47E+01	(mg/m³)	8.04E+00	(ug/m³)	NA	per (ug/m³)	--	5.63E-01	(mg/m³)	1.0E-01	(mg/m³)	5.6E+00	
				TOLUENE	1.26E+01	(mg/m³)	4.12E+00	(ug/m³)	NA	per (ug/m³)	--	2.89E-01	(mg/m³)	5.0E+00	(mg/m³)	5.8E-02	
				O-XYLENE	1.18E+01	(mg/m3)	3.83E+00	(ug/m³)	NA	per (ug/m³)	--	3.83E-03	(mg/m³)	1.0E-01	(mg/m³)	3.8E-02	
Exp. Route Total										9.2E-05					3.3E+01		
Exposure Point Total										9.2E-05					3.3E+01		
Exposure Medium Total										9.2E-05					3.3E+01		
Groundwater Total										9.2E-05					3.3E+01		
Soil	Surface Soil	Wilcox Process Area	Ingestion	Inorganics													
				ALUMINUM	5.46E+03	(mg/kg)	2.21E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.54E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.5E-02	
				ARSENIC	3.86E+00	(mg/kg)	9.36E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-07	6.55E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-02	
				CADMIUM	1.42E+00	(mg/kg)	5.74E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.01E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	4.0E-03	
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	4.76E-08	(mg/kg-day)	5.0E-01	per (mg/kg-day)	2.4E-08	3.33E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.1E-03	
				COBALT	3.87E+00	(mg/kg)	1.56E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.09E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-02	
				COPPER	4.10E+02	(mg/kg)	1.65E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.16E-03	(mg/kg-day)	4.00E-02	(mg/kg-day)	2.9E-02	
				IRON	1.26E+04	(mg/kg)	5.10E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.57E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.1E-02	
				MANGANESE	3.09E+02	(mg/kg)	1.25E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	8.72E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	6.2E-03	
				VANADIUM	1.35E+01	(mg/kg)	5.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.80E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	7.6E-03	
				ZINC	3.10E+02	(mg/kg)	1.25E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.68E-04	(mg/kg-day)	3.00E-01	(mg/kg-day)	8.93E-04	
				PAHs													
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	1.84E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.8E-08	1.29E-05	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	8.73E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	8.7E-09	6.11E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	1.02E-07	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.0E-07	7.16E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-02	
				CHRYSENE	1.16E+01	(mg/kg)	4.67E-07	(mg/kg-day)	1.0E-03	per (mg/kg-day)	4.7E-10	3.27E-05	(mg/kg-day)	NA	(mg/kg-day)	--	
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	1.24E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.2E-08	8.67E-07	(mg/kg-day)	NA	(mg/kg-day)	--	
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	1.73E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.7E-09	1.21E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	1.26E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.80E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.2E-03	
				NAPHTHALENE	8.06E-01	(mg/kg)	3.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.28E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.1E-04	
Exp. Route Total										3.1E-07					2.0E-01		

TABLE 7.39
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Wilcox Process Area	Dermal ¹	Inorganics												
				ALUMINUM	5.46E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	3.86E+00	(mg/kg)	1.50E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.3E-08	1.05E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.5E-03
				CADMIUM	1.42E+00	(mg/kg)	1.84E-10	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-08	(mg/kg-day)	2.50E-05	(mg/kg-day)	5.1E-04
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	NA	(mg/kg-day)	2.0E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	3.87E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				COPPER	4.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				IRON	1.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	3.09E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.35E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				ZINC	3.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	7.68E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	7.7E-09	5.38E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	3.64E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	3.6E-09	2.55E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	4.26E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	4.3E-08	2.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.9E-03
				CHRYSENE	1.16E+01	(mg/kg)	1.95E-07	(mg/kg-day)	1.0E-03	per (mg/kg-day)	1.9E-10	1.36E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	5.16E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	5.2E-09	3.62E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	7.22E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	7.2E-10	5.05E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	5.24E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.67E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	9.2E-04
				NAPHTHALENE	8.06E-01	(mg/kg)	1.36E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	9.49E-07	(mg/kg-day)	2.00E-02	(mg/kg-day)	4.7E-05
				Exp. Route Total							8.3E-08					1.5E-02
				Exposure Point Total							3.9E-07					2.1E-01
				Exposure Medium Total							3.9E-07					2.1E-01

TABLE 7.39
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	Wilcox Process Area	Inhalation	Inorganics														
				ALUMINUM	8.95E-05	(mg/m³)	2.92E-04	(ug/m³)	NA	per (ug/m³)	--	2.04E-05	(mg/m³)	5.00E-03	(mg/m³)	4.1E-03		
				ARSENIC	6.33E-08	(mg/m³)	2.06E-07	(ug/m³)	4.3E-03	per (ug/m³)	8.9E-10	1.44E-08	(mg/m³)	1.50E-05	(mg/m³)	9.6E-04		
				CADMIUM	2.33E-08	(mg/m³)	7.59E-08	(ug/m³)	1.8E-03	per (ug/m³)	1.4E-10	5.31E-09	(mg/m³)	1.00E-05	(mg/m³)	5.3E-04		
				HEXAVALENT CHROMIUM (+6)	1.93E-08	(mg/m³)	6.30E-08	(ug/m³)	8.4E-02	per (ug/m³)	5.3E-09	4.41E-09	(mg/m³)	1.00E-04	(mg/m³)	4.4E-05		
				COBALT	6.33E-08	(mg/m³)	2.06E-07	(ug/m³)	9.0E-03	per (ug/m³)	1.9E-09	1.45E-08	(mg/m³)	6.00E-06	(mg/m³)	2.4E-03		
				COPPER	6.71E-06	(mg/m³)	2.19E-05	(ug/m³)	NA	per (ug/m³)	--	1.53E-06	(mg/m³)	NA	(mg/m³)	--		
				IRON	2.07E-04	(mg/m³)	6.75E-04	(ug/m³)	NA	per (ug/m³)	--	4.73E-05	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	5.05E-06	(mg/m³)	1.65E-05	(ug/m³)	NA	per (ug/m³)	--	1.15E-06	(mg/m³)	5.00E-05	(mg/m³)	2.3E-02		
				VANADIUM	1.03E-08	(mg/m³)	3.35E-08	(ug/m³)	NA	per (ug/m³)	--	2.34E-09	(mg/m³)	1.00E-04	(mg/m³)	2.3E-05		
				ZINC	2.36E-07	(mg/m³)	4.49E-05	(ug/m³)	NA	per (ug/m³)	--	1.64E-05	(mg/m³)	NA	(mg/m³)	--		
				PAHs														
				BENZ(A)ANTHRACENE	7.48E-08	(mg/m³)	2.44E-07	(ug/m³)	6.0E-05	per (ug/m³)	1.5E-11	1.71E-08	(mg/m³)	NA	(mg/m³)	--		
				BENZO(B)FLUORANTHENE	3.54E-08	(mg/m³)	1.16E-07	(ug/m³)	6.0E-05	per (ug/m³)	6.9E-12	8.09E-09	(mg/m³)	NA	(mg/m³)	--		
				BENZO(A)PYRENE	4.15E-08	(mg/m³)	1.35E-07	(ug/m³)	6.0E-04	per (ug/m³)	8.1E-11	9.47E-09	(mg/m³)	2.00E-06	(mg/m³)	4.7E-03		
				CHRYSENE	1.89E-07	(mg/m³)	6.18E-07	(ug/m³)	6.0E-07	per (ug/m³)	3.7E-13	4.33E-08	(mg/m³)	NA	(mg/m³)	--		
				DIBENZ(A,H)ANTHRACENE	5.03E-09	(mg/m³)	1.64E-08	(ug/m³)	6.0E-04	per (ug/m³)	9.8E-12	1.15E-09	(mg/m³)	NA	(mg/m³)	--		
				INDENO(1,2,3-C,D)PYRENE	7.02E-09	(mg/m³)	2.29E-08	(ug/m³)	6.0E-05	per (ug/m³)	1.4E-12	1.60E-09	(mg/m³)	NA	(mg/m³)	--		
				2-METHYLNAPHTHALENE	5.10E-08	(mg/m³)	1.66E-07	(ug/m³)	NA	per (ug/m³)	--	1.16E-08	(mg/m³)	NA	(mg/m³)	--		
				NAPHTHALENE	1.32E-08	(mg/m³)	4.30E-08	(ug/m³)	3.40E-05	per (ug/m³)	1.5E-12	3.01E-09	(mg/m³)	3.00E-03	(mg/m³)	1.0E-06		
													8.3E-09					3.6E-02
													8.3E-09					3.6E-02
													8.3E-09					3.6E-02
									4.0E-07					2.5E-01				
Soil Total									9.2E-05	Total of Receptor Hazards Across All Media					3.3E+01			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.40
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Tap Water	Ingestion	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	4.93E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.38E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.4E-01
				ARSENIC	1.98E-02	(mg/L)	7.57E-05	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-04	2.12E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.1E-01
				CYANIDE	4.71E-02	(mg/L)	1.80E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.04E-04	(mg/kg-day)	6.00E-04	(mg/kg-day)	8.4E-01
				COBALT	8.64E-03	(mg/L)	3.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	9.25E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.1E-01
				IRON	3.34E+01	(mg/L)	1.28E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	3.58E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.1E-01
				MANGANESE	1.04E+00	(mg/L)	3.98E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.11E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	8.0E-02
				VANADIUM	1.02E-02	(mg/L)	3.91E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.09E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.2E-02
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	1.26E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.53E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	8.8E-02
				NAPHTHALENE	5.92E-02	(mg/L)	2.26E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.34E-04	(mg/kg-day)	2.00E-02	(mg/kg-day)	3.2E-02
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	9.17E-03	(mg/kg-day)	5.50E-02	per (mg/kg-day)	5.0E-04	2.57E-02	(mg/kg-day)	4.00E-03	(mg/kg-day)	6.4E+00
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	1.57E-05	(mg/kg-day)	9.10E-02	per (mg/kg-day)	1.4E-06	4.39E-05	(mg/kg-day)	6.00E-03	(mg/kg-day)	7.3E-03
				ETHYLBENZENE	1.10E+00	(mg/L)	4.20E-03	(mg/kg-day)	1.10E-02	per (mg/kg-day)	4.6E-05	1.18E-02	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.2E-01
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	2.29E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.42E-04	(mg/kg-day)	1.00E-01	(mg/kg-day)	6.4E-03
				M,P-XYLENE	2.30E+00	(mg/L)	8.79E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.46E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	1.2E-01
				TOLUENE	1.10E+00	(mg/L)	4.20E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.18E-02	(mg/kg-day)	8.00E-02	(mg/kg-day)	1.5E-01
				O-XYLENE	5.00E-01	(mg/L)	1.91E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.35E-03	(mg/kg-day)	2.00E-01	(mg/kg-day)	2.7E-02
				Exp. Route Total							6.7E-04					9.6E+00
			Dermal	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	9.24E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.59E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.6E-04
				ARSENIC	1.98E-02	(mg/L)	1.42E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.1E-07	3.97E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-03
				CYANIDE	4.71E-02	(mg/L)	3.37E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	9.45E-07	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.6E-03
				COBALT	8.64E-03	(mg/L)	2.48E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.94E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.3E-04
				IRON	3.34E+01	(mg/L)	2.40E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.71E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	9.6E-04
				MANGANESE	1.04E+00	(mg/L)	7.46E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.09E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-04
				VANADIUM	1.02E-02	(mg/L)	7.33E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.05E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.6E-03
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				M,P-XYLENE	2.30E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				Exp. Route Total							2.1E-07					6.1E-03
			Exposure Point Total								6.7E-04					9.6E+00
			Exposure Medium Total								6.7E-04					9.6E+00

TABLE 7.40
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air	Inhalation	PAHs												
				NAPHTHALENE	2.96E-02	(mg/m ³)	3.02E-01	(µg/m ³)	3.40E-05	per (µg/m ³)	1.0E-05	8.45E-04	(mg/m ³)	3.00E-03	(mg/m ³)	2.8E-01
				Volatiles												
				BENZENE	1.20E+00	(mg/m ³)	1.22E+01	(µg/m ³)	7.80E-06	per (µg/m ³)	9.5E-05	3.42E-02	(mg/m ³)	3.00E-02	(mg/m ³)	1.1E+00
				1,2-DICHLOROETHANE	2.05E-03	(mg/m ³)	2.09E-02	(µg/m ³)	2.60E-05	per (µg/m ³)	5.4E-07	5.85E-05	(mg/m ³)	7.00E-03	(mg/m ³)	8.4E-03
				ETHYLBENZENE	5.50E-01	(mg/m ³)	5.61E+00	(µg/m ³)	2.50E-06	per (µg/m ³)	1.4E-05	1.57E-02	(mg/m ³)	1.00E+00	(mg/m ³)	1.6E-02
				ISOPROPYLBENZENE	3.00E-02	(mg/m ³)	3.06E-01	(µg/m ³)	NA	per (µg/m ³)	--	8.56E-04	(mg/m ³)	4.00E-01	(mg/m ³)	2.1E-03
				M,P-XYLENE	1.15E+00	(mg/m ³)	1.17E+01	(µg/m ³)	NA	per (µg/m ³)	--	3.28E-02	(mg/m ³)	1.00E-01	(mg/m ³)	3.3E-01
				TOLUENE	5.50E-01	(mg/m ³)	5.61E+00	(µg/m ³)	NA	per (µg/m ³)	--	1.57E-02	(mg/m ³)	5.00E+00	(mg/m ³)	3.1E-03
				O-XYLENE	2.50E-01	(mg/m ³)	2.55E+00	(µg/m ³)	NA	per (µg/m ³)	--	7.13E-03	(mg/m ³)	1.00E-01	(mg/m ³)	7.1E-02
				Exp. Route Total							1.2E-04					1.9E+00
				Exposure Point Total							1.2E-04					1.9E+00
				Exposure Medium Total							1.2E-04					1.9E+00
				Groundwater Total							7.9E-04					1.1E+01
Soil	Surface Soil	Wilcox Process Area	Ingestion	Inorganics												
				ALUMINUM	5.46E+03	(mg/kg)	1.67E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	4.68E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.7E-03
				ARSENIC	3.86E+00	(mg/kg)	7.09E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03
				CADMIUM	1.42E+00	(mg/kg)	4.35E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.22E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	1.2E-03
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	3.61E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.8E-07	1.01E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	3.4E-04
				COBALT	3.87E+00	(mg/kg)	1.18E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.31E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02
				COPPER	4.10E+02	(mg/kg)	1.25E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.51E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	8.8E-03
				IRON	1.26E+04	(mg/kg)	3.87E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.08E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.5E-02
				MANGANESE	3.09E+02	(mg/kg)	9.43E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.64E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.9E-03
				VANADIUM	1.35E+01	(mg/kg)	4.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.15E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.3E-03
				ZINC	3.10E+02	(mg/kg)	9.47E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.65E-04	(mg/kg-day)	3.0E-01	(mg/kg-day)	8.8E-04
				PAHs												
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	1.40E-06	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.4E-07	3.91E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	6.62E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	6.6E-08	1.85E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	7.75E-07	(mg/kg-day)	1.0E+00	per (mg/kg-day)	7.7E-07	2.17E-06	(mg/kg-day)	3.0E-04	(mg/kg-day)	7.2E-03
				CHRYSENE	1.16E+01	(mg/kg)	3.54E-06	(mg/kg-day)	1.0E-03	per (mg/kg-day)	3.5E-09	9.91E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	9.39E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	9.4E-08	2.63E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	1.31E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.3E-08	3.67E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	9.52E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.67E-06	(mg/kg-day)	4.0E-03	(mg/kg-day)	6.7E-04
				NAPHTHALENE	8.06E-01	(mg/kg)	2.46E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	6.90E-07	(mg/kg-day)	2.0E-02	(mg/kg-day)	3.5E-05
				Exp. Route Total							2.3E-06					6.1E-02

TABLE 7.40
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Wilcox Process Area	Dermal ¹	Inorganics												
				ALUMINUM	5.46E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	3.86E+00	(mg/kg)	2.50E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-08	7.00E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.3E-04
				CADMIUM	1.42E+00	(mg/kg)	3.06E-10	(mg/kg-day)	NA	per (mg/kg-day)	--	8.58E-10	(mg/kg-day)	2.50E-05	(mg/kg-day)	3.4E-05
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	3.87E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				COPPER	4.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				IRON	1.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	3.09E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.35E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				ZINC	3.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.0E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	1.28E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.3E-08	3.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	6.07E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	6.1E-09	1.70E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	7.10E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	7.1E-08	1.99E-07	(mg/kg-day)	3.0E-04	(mg/kg-day)	6.6E-04
				CHRYSENE	1.16E+01	(mg/kg)	3.24E-07	(mg/kg-day)	1.0E-03	per (mg/kg-day)	3.2E-10	9.08E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	8.61E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	8.6E-09	2.41E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	1.20E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.2E-09	3.37E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	8.73E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.45E-07	(mg/kg-day)	4.0E-03	(mg/kg-day)	6.1E-05
				NAPHTHALENE	8.06E-01	(mg/kg)	2.26E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.33E-08	(mg/kg-day)	2.0E-02	(mg/kg-day)	3.2E-06
				Exp. Route Total							1.4E-07					9.9E-04
				Exposure Point Total							2.5E-06					6.2E-02
				Exposure Medium Total							2.5E-06					6.2E-02

TABLE 7.40
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Wilcox Process Area	Inhalation	Inorganics															
				ALUMINUM	4.17E-06	(mg/m³)	3.40E-04	(ug/m³)	NA	per (ug/m³)	--	9.52E-07	(mg/m³)	5.00E-03	(mg/m³)	1.9E-04			
				ARSENIC	2.95E-09	(mg/m³)	2.41E-07	(ug/m³)	4.30E-03	per (ug/m³)	1.0E-09	6.73E-10	(mg/m³)	1.50E-05	(mg/m³)	4.5E-05			
				CADMIUM	1.08E-09	(mg/m³)	8.84E-08	(ug/m³)	1.80E-03	per (ug/m³)	1.6E-10	2.48E-10	(mg/m³)	1.00E-05	(mg/m³)	2.5E-05			
				HEXAVALENT CHROMIUM (+6)	9.00E-10	(mg/m³)	7.34E-08	(ug/m³)	8.40E-02	per (ug/m³)	6.2E-09	2.05E-10	(mg/m³)	1.00E-04	(mg/m³)	2.1E-06			
				COBALT	2.95E-09	(mg/m³)	2.41E-07	(ug/m³)	9.00E-03	per (ug/m³)	2.2E-09	6.74E-10	(mg/m³)	6.00E-06	(mg/m³)	1.1E-04			
				COPPER	3.13E-07	(mg/m³)	2.55E-05	(ug/m³)	NA	per (ug/m³)	--	7.14E-08	(mg/m³)	NA	(mg/m³)	--			
				IRON	9.65E-06	(mg/m³)	7.87E-04	(ug/m³)	NA	per (ug/m³)	--	2.20E-06	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	2.35E-07	(mg/m³)	1.92E-05	(ug/m³)	NA	per (ug/m³)	--	5.38E-08	(mg/m³)	5.00E-05	(mg/m³)	1.1E-03			
				VANADIUM	1.03E-08	(mg/m³)	8.37E-07	(ug/m³)	NA	per (ug/m³)	--	2.34E-09	(mg/m³)	1.00E-04	(mg/m³)	2.3E-05			
				ZINC	2.36E-07	(mg/m³)	1.39E-04	(ug/m3)	NA	per (ug/m3)	--	5.40E-08	(mg/m³)	NA	(mg/m³)	--			
				PAHs															
				BENZ(A)ANTHRACENE	3.49E-09	(mg/m³)	2.84E-07	(ug/m³)	6.00E-05	per (ug/m³)	1.7E-11	7.96E-10	(mg/m³)	NA	(mg/m³)	--			
				BENZO(B)FLUORANTHENE	1.65E-09	(mg/m³)	1.35E-07	(ug/m³)	6.00E-05	per (ug/m³)	8.1E-12	3.77E-10	(mg/m³)	NA	(mg/m³)	--			
				BENZO(A)PYRENE	1.93E-09	(mg/m³)	1.58E-07	(ug/m³)	6.00E-04	per (ug/m³)	9.5E-11	4.41E-10	(mg/m³)	2.00E-06	(mg/m³)	2.2E-04			
				CHRYSENE	8.83E-09	(mg/m³)	7.20E-07	(ug/m³)	6.00E-07	per (ug/m³)	4.3E-13	2.02E-09	(mg/m³)	NA	(mg/m³)	--			
				DIBENZ(A,H)ANTHRACENE	2.34E-10	(mg/m³)	1.91E-08	(ug/m³)	6.00E-04	per (ug/m³)	1.1E-11	5.35E-11	(mg/m³)	NA	(mg/m³)	--			
				INDENO(1,2,3-C,D)PYRENE	3.27E-10	(mg/m³)	2.67E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.6E-12	7.48E-11	(mg/m³)	NA	(mg/m³)	--			
				2-METHYLNAPHTHALENE	2.38E-09	(mg/m³)	1.94E-07	(ug/m³)	NA	per (ug/m³)	--	5.43E-10	(mg/m³)	NA	(mg/m³)	--			
				NAPHTHALENE	6.15E-10	(mg/m³)	5.02E-08	(ug/m³)	3.40E-05	per (ug/m³)	1.7E-12	1.40E-10	(mg/m³)	3.00E-03	(mg/m³)	4.7E-08			
								Exp. Route Total							9.7E-09				1.7E-03
								Exposure Point Total							9.7E-09				1.7E-03
								Exposure Medium Total							9.7E-09				1.7E-03
Soil Total										2.5E-06				6.4E-02					
Total of Receptor Risks Across All Media											7.9E-04	Total of Receptor Hazards Across All Media				1.1E+01			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.41
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Sediment	Sediment	Sediment	Ingestion	Inorganics															
				ALUMINUM	6.87E+03	(mg/kg)	9.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.5E-03			
				ARSENIC	2.25E+00	(mg/kg)	1.83E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.7E-07	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03			
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	1.71E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	8.5E-07	3.99E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-03			
				COBALT	4.24E+00	(mg/kg)	5.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.03E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02			
				IRON	1.04E+04	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.88E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E-02			
				MANGANESE	2.23E+02	(mg/kg)	3.03E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.12E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-03			
				PAHs															
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.11E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.01E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-08	2.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.77E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-08	1.81E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04			
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.12E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.95E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				Exp. Route Total							1.2E-06						4.2E-02		
			Dermal ¹	Inorganics															
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--			
				ARSENIC	2.25E+00	(mg/kg)	4.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.2E-08	2.90E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04			
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--			
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--			
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--			
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--			
				PAHs															
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	6.54E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-09	1.53E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	5.97E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-09	1.39E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	4.58E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.6E-08	1.07E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-04			
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	1.25E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-08	2.91E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				Exp. Route Total							1.3E-07						1.3E-03		
			Exposure Point Total										1.4E-06						4.3E-02
			Exposure Medium Total										1.4E-06						4.3E-02
Sediment Total										1.4E-06						4.3E-02			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics															
				ALUMINUM	3.71E+00	(mg/L)	5.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.5E-03			
				ARSENIC	1.88E-03	(mg/L)	2.55E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-07	1.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-03			
				CADMIUM	3.15E-03	(mg/L)	4.27E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.0E-03			
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	5.66E-08	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.8E-08	1.32E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.4E-05			
				CYANIDE	2.96E-02	(mg/L)	4.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.81E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.7E-02			
				IRON	4.44E+00	(mg/L)	6.02E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.22E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.0E-03			
				MANGANESE	3.59E-01	(mg/L)	4.87E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.41E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-03			
				VANADIUM	4.53E-03	(mg/L)	6.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.30E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	8.6E-04			
				PAHs															
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	4.07E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.1E-09	9.50E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.76E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-08	4.10E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-04			
				Exp. Route Total							4.3E-07						6.9E-02		

TABLE 7.41
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Surface Water	Surface Water	Surface Water	Dermal	Inorganics																
				ALUMINUM	3.71E+00	(mg/L)	4.56E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.2E-04				
				ARSENIC	1.88E-03	(mg/L)	2.31E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.5E-08	1.62E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-04				
				CADMIUM	3.15E-03	(mg/L)	3.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.71E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.1E-02				
				HEXA VALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.03E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.1E-07	2.39E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	3.2E-04				
				CYANIDE	2.96E-02	(mg/L)	3.64E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.2E-03				
				IRON	4.44E+00	(mg/L)	5.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.82E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.5E-04				
				MANGANESE	3.59E-01	(mg/L)	4.41E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.09E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-04				
				VANADIUM	4.53E-03	(mg/L)	5.57E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.90E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	3.0E-03				
				PAHs																
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	4.73E-06	(mg/kg-day)	NA	(mg/kg-day)	--				
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	2.64E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.8E-03				
				Exp. Route Total															2.9E-02	
				Exposure Point Total																9.8E-02
				Exposure Medium Total																9.8E-02
Surface Water Total																9.8E-02				
Soil	Surface Soil	Wilcox Process Area	Ingestion	Inorganics																
				ALUMINUM	5.46E+03	(mg/kg)	2.47E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.73E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.7E-03				
				ARSENIC	3.86E+00	(mg/kg)	1.05E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.6E-07	7.34E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-03				
				CADMIUM	1.42E+00	(mg/kg)	6.43E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.50E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	4.5E-04				
				HEXA VALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	1.60E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	8.0E-08	3.73E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.2E-04				
				COBALT	3.87E+00	(mg/kg)	1.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.22E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-03				
				COPPER	4.10E+02	(mg/kg)	1.85E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.30E-04	(mg/kg-day)	4.00E-02	(mg/kg-day)	3.2E-03				
				IRON	1.26E+04	(mg/kg)	5.72E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.7E-03				
				MANGANESE	3.09E+02	(mg/kg)	1.40E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	9.77E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.0E-04				
				VANADIUM	1.35E+01	(mg/kg)	6.08E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	8.5E-04				
				ZINC	3.10E+02	(mg/kg)	1.40E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	9.80E-05	(mg/kg-day)	3.00E-01	(mg/kg-day)	3.3E-04				
				PAHs																
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	6.20E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.2E-08	1.45E-06	(mg/kg-day)	NA	(mg/kg-day)	--				
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	2.94E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.9E-08	6.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--				
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	3.44E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.4E-07	8.02E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.7E-03				
				CHRYSENE	1.16E+01	(mg/kg)	1.57E-06	(mg/kg-day)	1.00E-03	per (mg/kg-day)	1.6E-09	3.66E-06	(mg/kg-day)	NA	(mg/kg-day)	--				
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	4.17E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.2E-08	9.72E-08	(mg/kg-day)	NA	(mg/kg-day)	--				
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	5.82E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.8E-09	1.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--				
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	1.41E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	9.86E-07	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.5E-04				
				NAPHTHALENE	8.06E-01	(mg/kg)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-07	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.3E-05				
Exp. Route Total																2.3E-02				

TABLE 7.41
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Wilcox Process Area	Dermal ¹	Inorganics												
				ALUMINUM	5.46E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	3.86E+00	(mg/kg)	4.75E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.1E-08	3.32E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-03
				CADMIUM	1.42E+00	(mg/kg)	5.82E-10	(mg/kg-day)	NA	per (mg/kg-day)	--	4.08E-09	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.6E-04
				HEXAVALENT CHROMIUM (+6)	1.18E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	3.87E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				COPPER	4.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-02	(mg/kg-day)	--
				IRON	1.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	3.09E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.35E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				ZINC	3.10E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	4.57E+00	(mg/kg)	7.30E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.3E-08	1.70E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.16E+00	(mg/kg)	3.46E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	8.07E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.53E+00	(mg/kg)	4.05E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-07	9.45E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.1E-03
				CHRYSENE	1.16E+01	(mg/kg)	1.85E-06	(mg/kg-day)	1.00E-03	per (mg/kg-day)	1.8E-09	4.31E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				DIBENZ(A,H)ANTHRACENE	3.07E-01	(mg/kg)	4.91E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.9E-08	1.14E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	4.29E-01	(mg/kg)	6.86E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.9E-09	1.60E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	3.12E+00	(mg/kg)	1.66E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.16E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.9E-04
				NAPHTHALENE	8.06E-01	(mg/kg)	4.29E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.01E-07	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.5E-05
				Exp. Route Total							6.4E-07					4.7E-03
				Exposure Point Total							1.4E-06					2.7E-02
				Exposure Medium Total							1.4E-06					2.7E-02

TABLE 7.41
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	Wilcox Process Area	Inhalation	Inorganics												
				ALUMINUM	4.17E-06	(mg/m ³)	1.41E-05	(ug/m ³)	NA	per (ug/m ³)	--	9.90E-09	(mg/m ³)	5.00E-03	(mg/m ³)	2.0E-06
				ARSENIC	2.95E-09	(mg/m ³)	1.00E-08	(ug/m ³)	4.30E-03	per (ug/m ³)	4.3E-11	7.00E-12	(mg/m ³)	1.50E-05	(mg/m ³)	4.7E-07
				CADMIUM	1.08E-09	(mg/m ³)	3.68E-09	(ug/m ³)	1.80E-03	per (ug/m ³)	6.6E-12	2.58E-12	(mg/m ³)	1.00E-05	(mg/m ³)	2.6E-07
				HEXA VALENT CHROMIUM (+6)	9.00E-10	(mg/m ³)	9.16E-09	(ug/m ³)	8.40E-02	per (ug/m ³)	7.7E-10	2.14E-12	(mg/m ³)	1.00E-04	(mg/m ³)	2.1E-08
				COBALT	2.95E-09	(mg/m ³)	1.00E-08	(ug/m ³)	9.00E-03	per (ug/m ³)	9.0E-11	7.01E-12	(mg/m ³)	6.00E-06	(mg/m ³)	1.2E-06
				COPPER	3.13E-07	(mg/m ³)	1.06E-06	(ug/m ³)	NA	per (ug/m ³)	--	7.43E-10	(mg/m ³)	NA	(mg/m ³)	--
				IRON	9.65E-06	(mg/m ³)	3.28E-05	(ug/m ³)	NA	per (ug/m ³)	--	2.29E-08	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	2.35E-07	(mg/m ³)	7.99E-07	(ug/m ³)	NA	per (ug/m ³)	--	5.59E-10	(mg/m ³)	5.00E-05	(mg/m ³)	1.1E-05
				VANADIUM	1.03E-08	(mg/m ³)	3.48E-08	(ug/m ³)	NA	per (ug/m ³)	--	2.44E-11	(mg/m ³)	1.00E-04	(mg/m ³)	2.4E-07
				ZINC	2.36E-07	(mg/m ³)	8.02E-07	(ug/m ³)	NA	per (ug/m ³)	--	5.61E-10	(mg/m ³)	NA	(mg/m ³)	--
				PAHs												
				BENZ(A)ANTHRACENE	3.49E-09	(mg/m ³)	3.55E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	2.1E-12	8.28E-12	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	1.65E-09	(mg/m ³)	1.68E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	1.0E-12	3.92E-12	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	1.93E-09	(mg/m ³)	1.97E-08	(ug/m ³)	6.00E-04	per (ug/m ³)	1.2E-11	4.59E-12	(mg/m ³)	2.00E-06	(mg/m ³)	2.3E-06
				CHRYSENE	8.83E-09	(mg/m ³)	8.99E-08	(ug/m ³)	6.00E-07	per (ug/m ³)	5.4E-14	2.10E-11	(mg/m ³)	NA	(mg/m ³)	--
				DIBENZ(A,H)ANTHRACENE	2.34E-10	(mg/m ³)	2.38E-09	(ug/m ³)	6.00E-04	per (ug/m ³)	1.4E-12	5.56E-13	(mg/m ³)	NA	(mg/m ³)	--
				INDENO(1,2,3-C,D)PYRENE	3.27E-10	(mg/m ³)	3.33E-09	(ug/m ³)	6.00E-05	per (ug/m ³)	2.0E-13	7.78E-13	(mg/m ³)	NA	(mg/m ³)	--
				2-METHYLNAPHTHALENE	2.38E-09	(mg/m ³)	8.07E-09	(ug/m ³)	NA	per (ug/m ³)	--	5.65E-12	(mg/m ³)	NA	(mg/m ³)	--
				NAPHTHALENE	6.15E-10	(mg/m ³)	2.09E-09	(ug/m ³)	3.40E-05	per (ug/m ³)	7.1E-14	1.46E-12	(mg/m ³)	3.00E-03	(mg/m ³)	4.9E-10
Exp. Route Total							9.3E-10					1.8E-05				
Exposure Point Total							9.3E-10					1.8E-05				
Exposure Medium Total							9.3E-10					1.8E-05				
Soil Total							1.4E-06					2.7E-02				
Total of Receptor Risks Across All Media							4.8E-06					Total of Receptor Hazards Across All Media			1.7E-01	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.42
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Groundwater	Groundwater	Tap Water	Ingestion	Inorganics														
				ALUMINUM	1.29E+01	(mg/L)	1.10E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	3.87E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.9E-01		
				ARSENIC	1.98E-02	(mg/L)	1.70E-04	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.5E-04	5.93E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E+00		
				CYANIDE	4.71E-02	(mg/L)	4.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.41E-03	(mg/kg-day)	6.00E-04	(mg/kg-day)	2.4E+00		
				COBALT	8.64E-03	(mg/L)	7.40E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.59E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.6E-01		
				IRON	3.34E+01	(mg/L)	2.86E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	1.00E+00	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E+00		
				MANGANESE	1.04E+00	(mg/L)	8.91E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.12E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-01		
				VANADIUM	1.02E-02	(mg/L)	8.76E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.07E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	6.1E-02		
				PAHs														
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	2.83E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.89E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.5E-01		
				NAPHTHALENE	5.92E-02	(mg/L)	5.07E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.77E-03	(mg/kg-day)	2.00E-02	(mg/kg-day)	8.9E-02		
				Volatiles														
				BENZENE	2.40E+00	(mg/L)	2.05E-02	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.1E-03	7.19E-02	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.8E+01		
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	3.51E-05	(mg/kg-day)	9.10E-02	per (mg/kg-day)	3.2E-06	1.23E-04	(mg/kg-day)	6.00E-03	(mg/kg-day)	2.0E-02		
				ETHYLBENZENE	1.10E+00	(mg/L)	9.42E-03	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.0E-04	3.30E-02	(mg/kg-day)	1.00E-01	(mg/kg-day)	3.3E-01		
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	5.14E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.80E-03	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.8E-02		
				M,P-XYLENE	2.30E+00	(mg/L)	1.97E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	6.89E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	3.4E-01		
				TOLUENE	1.10E+00	(mg/L)	9.42E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.30E-02	(mg/kg-day)	8.00E-02	(mg/kg-day)	4.1E-01		
				O-XYLENE	5.00E-01	(mg/L)	4.28E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.50E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	7.5E-02		
				Exp. Route Total										1.5E-03				
			Dermal	Inorganics														
				ALUMINUM	1.29E+01	(mg/L)	6.16E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.16E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.2E-03		
				ARSENIC	1.98E-02	(mg/L)	9.46E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-06	3.31E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02		
				CYANIDE	4.71E-02	(mg/L)	2.25E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.88E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.3E-02		
				COBALT	8.64E-03	(mg/L)	1.65E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.78E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03		
				IRON	3.34E+01	(mg/L)	1.60E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.59E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.0E-03		
				MANGANESE	1.04E+00	(mg/L)	4.97E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.74E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.2E-03		
				VANADIUM	1.02E-02	(mg/L)	4.89E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.71E-06	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.3E-02		
				PAHs														
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00		
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00		
				Volatiles														
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00		
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00		
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00		
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00		
				M,P-XYLENE	2.30E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00		
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00		
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00		
				Exp. Route Total										1.4E-06				5.1E-02
			Exposure Point Total										1.5E-03				2.7E+01	
			Exposure Medium Total										1.5E-03				2.7E+01	

TABLE 7.42
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Air	Indoor Air Household	Inhalation	PAHs	2.96E-02	(mg/m³)	1.05E+01	(µg/m³)	3.40E-05	per (µg/m³)	3.6E-04	2.84E-02	(mg/m³)	3.00E-03	(mg/m³)	9.5E+00
				Volatiles												
				BENZENE	1.20E+00	(mg/m³)	4.27E+02	(µg/m³)	7.80E-06	per (µg/m³)	3.3E-03	1.15E+00	(mg/m³)	3.00E-02	(mg/m³)	3.8E+01
				1,2-DICHLOROETHANE	2.05E-03	(mg/m³)	7.30E-01	(µg/m³)	2.60E-05	per (µg/m³)	1.9E-05	1.97E-03	(mg/m³)	7.00E-03	(mg/m³)	2.8E-01
				ETHYLBENZENE	5.50E-01	(mg/m³)	1.96E+02	(µg/m³)	2.50E-06	per (µg/m³)	4.9E-04	5.27E-01	(mg/m³)	1.00E+00	(mg/m³)	5.3E-01
				ISOPROPYLBENZENE	3.00E-02	(mg/m³)	1.07E+01	(µg/m³)	NA	per (µg/m³)	--	2.88E-02	(mg/m³)	4.00E-01	(mg/m³)	7.2E-02
				M,P-XYLENE	1.15E+00	(mg/m³)	4.10E+02	(µg/m³)	NA	per (µg/m³)	--	1.10E+00	(mg/m³)	1.00E-01	(mg/m³)	1.1E+01
				TOLUENE	5.50E-01	(mg/m³)	1.96E+02	(µg/m³)	NA	per (µg/m³)	--	5.27E-01	(mg/m³)	5.00E+00	(mg/m³)	1.1E-01
				O-XYLENE	2.50E-01	(mg/m³)	8.90E+01	(µg/m³)	NA	per (µg/m³)	--	2.40E-01	(mg/m³)	1.00E-01	(mg/m³)	2.4E+00
				Exp. Route Total									4.2E-03			
Exposure Point Total									4.2E-03					6.2E+01		
Exposure Medium Total									4.2E-03					6.2E+01		
Groundwater Total									5.7E-03					8.9E+01		
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.2E-04
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04
				HEXA VALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-03
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-04
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total									2.6E-07			
			Dermal ¹	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04
				HEXA VALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total									5.7E-08			
Exposure Point Total									3.2E-07				6.2E-03			
Exposure Medium Total									3.2E-07				6.2E-03			
Sediment Total									3.2E-07				6.2E-03			

TABLE 7.42
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																	
Receptor Population: Resident																	
Receptor Age: Adult																	
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04	
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04	
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06	
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03	
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04	
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04	
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05	
				Exp. Route Total							9.4E-08					7.7E-03	
			Dermal	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04	
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04	
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04	
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03	
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04	
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04	
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03	
				Exp. Route Total							1.6E-06					2.2E-02	
			Exposure Point Total								1.7E-06					2.9E-02	
			Exposure Medium Total								1.7E-06					2.9E-02	
			Surface Water Total								1.7E-06					2.9E-02	

TABLE 7.42
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Wilcox Process Area	Ingestion	Inorganics												
				ALUMINUM	8.29E+03	(mg/kg)	2.84E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.94E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.9E-03
				ARSENIC	4.81E+00	(mg/kg)	9.89E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.5E-06	3.46E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-02
				COBALT	6.61E+00	(mg/kg)	2.26E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.92E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.6E-02
				IRON	1.57E+04	(mg/kg)	5.36E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.88E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.7E-02
				MANGANESE	2.83E+02	(mg/kg)	9.68E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.39E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-03
				VANADIUM	1.72E+01	(mg/kg)	5.88E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.06E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	4.1E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.07E+00	(mg/kg)	1.42E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.4E-07	2.48E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.78E+00	(mg/kg)	1.22E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-07	2.13E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.62E+00	(mg/kg)	1.11E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.95E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.5E-03
				DIBENZ(A,H)ANTHRACENE	5.48E-02	(mg/kg)	3.75E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.8E-08	6.57E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	9.09E-02	(mg/kg)	6.23E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.2E-09	1.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	1.39E+01	(mg/kg)	4.77E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.67E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.2E-03
				NAPHTHALENE	6.55E+00	(mg/kg)	2.24E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.85E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	3.9E-04
				Volatiles												
				BENZENE	1.07E+00	(mg/kg)	3.65E-07	(mg/kg-day)	5.50E-02	per (mg/kg-day)	2.0E-08	1.28E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.2E-04
				CHLOROFORM	2.20E+01	(mg/kg)	7.53E-06	(mg/kg-day)	3.10E-02	per (mg/kg-day)	2.3E-07	2.64E-05	(mg/kg-day)	1.00E-02	(mg/kg-day)	2.6E-03
				ETHYLBENZENE	4.00E+00	(mg/kg)	1.37E-06	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.5E-08	4.79E-06	(mg/kg-day)	1.00E-01	(mg/kg-day)	4.8E-05
				Exp. Route Total							3.2E-06					9.5E-02
			Dermal ¹	Inorganics												
				ALUMINUM	8.29E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	4.81E+00	(mg/kg)	2.09E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.1E-07	7.31E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-03
				COBALT	6.61E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.57E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.83E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.72E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.07E+00	(mg/kg)	7.78E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.8E-08	1.36E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.78E+00	(mg/kg)	6.69E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.7E-08	1.17E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.62E+00	(mg/kg)	6.10E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.1E-07	1.07E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-03
				DIBENZ(A,H)ANTHRACENE	5.48E-02	(mg/kg)	2.06E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	3.61E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	9.09E-02	(mg/kg)	3.42E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-09	5.98E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	1.39E+01	(mg/kg)	2.62E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	9.16E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.3E-03
				NAPHTHALENE	6.55E+00	(mg/kg)	1.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	2.2E-04
				Volatiles												
				BENZENE	1.07E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				CHLOROFORM	2.20E+01	(mg/kg)	NA	(mg/kg-day)	3.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-02	(mg/kg-day)	--
				ETHYLBENZENE	4.00E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
				Exp. Route Total							1.1E-06					8.5E-03
			Exposure Point Total								4.3E-06					1.0E-01
			Exposure Medium Total								4.3E-06					1.0E-01

TABLE 7.42
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																			
Receptor Population: Resident																			
Receptor Age: Adult																			
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Wilcox Process Area	Inhalation	Inorganics															
				ALUMINUM	6.33E-06	(mg/m³)	1.73E-03	(ug/m³)	NA	per (ug/m³)	--	6.07E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03			
				ARSENIC	3.67E-09	(mg/m³)	1.01E-06	(ug/m³)	4.30E-03	per (ug/m³)	4.3E-09	3.52E-09	(mg/m³)	1.50E-05	(mg/m³)	2.3E-04			
				COBALT	5.04E-09	(mg/m³)	1.38E-06	(ug/m³)	9.00E-03	per (ug/m³)	1.2E-08	4.84E-09	(mg/m³)	6.00E-06	(mg/m³)	8.1E-04			
				IRON	1.19E-05	(mg/m³)	3.27E-03	(ug/m³)	NA	per (ug/m³)	--	1.15E-05	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	2.16E-07	(mg/m³)	5.91E-05	(ug/m³)	NA	per (ug/m³)	--	2.07E-07	(mg/m³)	5.00E-05	(mg/m³)	4.1E-03			
				VANADIUM	1.31E-08	(mg/m³)	3.59E-06	(ug/m³)	NA	per (ug/m³)	--	1.26E-08	(mg/m³)	1.00E-04	(mg/m³)	1.3E-04			
				PAHs															
				BENZ(A)ANTHRACENE	1.58E-09	(mg/m³)	4.33E-07	(ug/m³)	6.00E-05	per (ug/m³)	2.6E-11	1.51E-09	(mg/m³)	NA	(mg/m³)	--			
				BENZO(B)FLUORANTHENE	1.36E-09	(mg/m³)	3.72E-07	(ug/m³)	6.00E-05	per (ug/m³)	2.2E-11	1.30E-09	(mg/m³)	NA	(mg/m³)	--			
				BENZO(A)PYRENE	1.24E-09	(mg/m³)	6.79E-07	(ug/m³)	6.00E-04	per (ug/m³)	4.1E-10	1.19E-09	(mg/m³)	2.00E-06	(mg/m³)	5.9E-04			
				DIBENZ(A,H)ANTHRACENE	4.18E-11	(mg/m³)	1.15E-08	(ug/m³)	6.00E-04	per (ug/m³)	6.9E-12	4.01E-11	(mg/m³)	NA	(mg/m³)	--			
				INDENO(1,2,3-C,D)PYRENE	6.94E-11	(mg/m³)	1.90E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.1E-12	6.65E-11	(mg/m³)	NA	(mg/m³)	--			
				2-METHYLNAPHTHALENE	1.06E-08	(mg/m³)	2.91E-06	(ug/m³)	NA	per (ug/m³)	--	1.02E-08	(mg/m³)	NA	(mg/m³)	--			
				NAPHTHALENE	5.00E-09	(mg/m³)	1.37E-06	(ug/m³)	3.40E-05	per (ug/m³)	4.7E-11	4.79E-09	(mg/m³)	3.00E-03	(mg/m³)	1.6E-06			
				Volatiles															
				BENZENE	8.14E-10	(mg/m³)	2.23E-07	(ug/m³)	7.80E-06	per (ug/m³)	1.7E-12	7.80E-10	(mg/m³)	3.00E-02	(mg/m³)	2.6E-08			
				CHLOROFORM	1.68E-08	(mg/m³)	4.60E-06	(ug/m³)	2.30E-05	per (ug/m³)	1.1E-10	1.61E-08	(mg/m³)	9.80E-02	(mg/m³)	1.6E-07			
				ETHYLBENZENE	3.05E-09	(mg/m³)	8.37E-07	(ug/m³)	2.50E-06	per (ug/m³)	2.1E-12	2.93E-09	(mg/m³)	1.00E+00	(mg/m³)	2.9E-09			
								Exp. Route Total							1.7E-08				7.1E-03
								Exposure Point Total							1.7E-08				7.1E-03
								Exposure Medium Total							1.7E-08				7.1E-03
															4.3E-06				1.1E-01
				Soil Total											5.7E-03				8.9E+01
				Total of Receptor Risks Across All Media							5.7E-03				Total of Receptor Hazards Across All Media	8.9E+01			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.43
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Tap Water	Ingestion	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	5.51E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	6.43E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.4E-01
				ARSENIC	1.98E-02	(mg/L)	8.46E-05	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.3E-04	9.87E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.3E+00
				CYANIDE	4.71E-02	(mg/L)	2.01E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.35E-03	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.9E+00
				COBALT	8.64E-03	(mg/L)	3.69E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	4.31E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E+00
				IRON	3.34E+01	(mg/L)	1.43E-01	(mg/kg-day)	NA	per (mg/kg-day)	--	1.67E+00	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.4E+00
				MANGANESE	1.04E+00	(mg/L)	4.45E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.19E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.7E-01
				VANADIUM	1.02E-02	(mg/L)	4.37E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.10E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.0E-01
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	1.41E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.65E-03	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.1E-01
				NAPHTHALENE	5.92E-02	(mg/L)	2.53E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.95E-03	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.5E-01
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	1.03E-02	(mg/kg-day)	5.50E-02	per (mg/kg-day)	5.6E-04	1.20E-01	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.0E+01
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	1.75E-05	(mg/kg-day)	9.10E-02	per (mg/kg-day)	1.6E-06	2.04E-04	(mg/kg-day)	6.00E-03	(mg/kg-day)	3.4E-02
				ETHYLBENZENE	1.10E+00	(mg/L)	4.70E-03	(mg/kg-day)	1.10E-02	per (mg/kg-day)	5.2E-05	5.48E-02	(mg/kg-day)	1.00E-01	(mg/kg-day)	5.5E-01
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	2.56E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-03	(mg/kg-day)	1.00E-01	(mg/kg-day)	3.0E-02
				M,P-XYLENE	2.30E+00	(mg/L)	9.83E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.15E-01	(mg/kg-day)	2.00E-01	(mg/kg-day)	5.7E-01
				TOLUENE	1.10E+00	(mg/L)	4.70E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.48E-02	(mg/kg-day)	8.00E-02	(mg/kg-day)	6.9E-01
				O-XYLENE	5.00E-01	(mg/L)	2.14E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.49E-02	(mg/kg-day)	2.00E-01	(mg/kg-day)	1.2E-01
				Exp. Route Total							7.4E-04					4.5E+01
			Dermal	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	2.43E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.83E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.8E-03
				ARSENIC	1.98E-02	(mg/L)	3.73E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.6E-07	4.35E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02
				CYANIDE	4.71E-02	(mg/L)	8.87E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.03E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.7E-02
				COBALT	8.64E-03	(mg/L)	6.51E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	7.60E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-03
				IRON	3.34E+01	(mg/L)	6.30E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	7.35E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.0E-02
				MANGANESE	1.04E+00	(mg/L)	1.96E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.29E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.6E-03
				VANADIUM	1.02E-02	(mg/L)	1.93E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.25E-06	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.7E-02
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				Exp. Route Total							5.6E-07					6.7E-02
				Exposure Point Total							7.4E-04					4.5E+01
				Exposure Medium Total							7.4E-04					4.5E+01
				Groundwater Total							7.4E-04					4.5E+01

TABLE 7.43
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02		
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03		
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02		
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02		
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total						3.6E-06								
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total						1.8E-07								
			Exposure Point Total										3.8E-06					1.3E-01
			Exposure Medium Total										3.8E-06					1.3E-01
Sediment Total										3.8E-06					1.3E-01			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02		
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02		
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04		
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01		
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02		
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03		
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04		
				Exp. Route Total						8.5E-07								

TABLE 7.43
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04		
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04		
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04		
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03		
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04		
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04		
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02		
				Exp. Route Total														4.5E-02
				Exposure Point Total														2.5E-01
				Exposure Medium Total														2.5E-01
				Surface Water Total														
	Soil	Subsurface Soil	Wilcox Process Area	Ingestion	Inorganics													
ALUMINUM					8.29E+03	(mg/kg)	9.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-01		
ARSENIC					4.81E+00	(mg/kg)	3.16E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.7E-06	3.69E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-01		
COBALT					6.61E+00	(mg/kg)	7.24E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.45E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.8E-01		
IRON					1.57E+04	(mg/kg)	1.72E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	2.00E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.9E-01		
MANGANESE					2.83E+02	(mg/kg)	3.10E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.61E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.6E-02		
VANADIUM					1.72E+01	(mg/kg)	1.88E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.20E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	4.4E-02		
PAHs																		
BENZ(A)ANTHRACENE					2.07E+00	(mg/kg)	1.20E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-06	2.65E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
BENZO(B)FLUORANTHENE					1.78E+00	(mg/kg)	1.03E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-06	2.28E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
BENZO(A)PYRENE					1.62E+00	(mg/kg)	9.43E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.4E-06	2.08E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.9E-02		
DIBENZ(A,H)ANTHRACENE					5.48E-02	(mg/kg)	3.18E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.2E-07	7.01E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
INDENO(1,2,3-C,D)PYRENE					9.09E-02	(mg/kg)	5.28E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.3E-08	1.16E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
2-METHYLNAPHTHALENE					1.39E+01	(mg/kg)	1.53E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.78E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.4E-02		
NAPHTHALENE					6.55E+00	(mg/kg)	7.18E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.37E-05	(mg/kg-day)	2.00E-02	(mg/kg-day)	4.2E-03		
Volatiles																		
BENZENE		1.07E+00	(mg/kg)	1.17E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	6.4E-08	1.36E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.4E-03					
CHLOROFORM	2.20E+01	(mg/kg)	2.41E-05	(mg/kg-day)	3.10E-02	per (mg/kg-day)	7.5E-07	2.81E-04	(mg/kg-day)	1.00E-02	(mg/kg-day)	2.8E-02						
ETHYLBENZENE	4.00E+00	(mg/kg)	4.38E-06	(mg/kg-day)	1.10E-02	per (mg/kg-day)	4.8E-08	5.11E-05	(mg/kg-day)	1.00E-01	(mg/kg-day)	5.1E-04						
Exp. Route Total														1.0E+00				

TABLE 7.43
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Wilcox Process Area	Dermal ¹	Inorganics												
				ALUMINUM	8.29E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	4.81E+00	(mg/kg)	3.75E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.6E-07	4.38E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02
				COBALT	6.61E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.57E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.83E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.72E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.07E+00	(mg/kg)	3.71E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.7E-07	8.16E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.78E+00	(mg/kg)	3.19E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-07	7.02E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.62E+00	(mg/kg)	2.91E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.9E-06	6.40E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-02
				DIBENZ(A,H)ANTHRACENE	5.48E-02	(mg/kg)	9.82E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.8E-08	2.16E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	9.09E-02	(mg/kg)	1.63E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.6E-08	3.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	1.39E+01	(mg/kg)	4.71E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	5.49E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	1.4E-02
				NAPHTHALENE	6.55E+00	(mg/kg)	2.21E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.58E-05	(mg/kg-day)	2.00E-02	(mg/kg-day)	1.3E-03
				Volatiles												
				BENZENE	1.07E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				CHLOROFORM	2.20E+01	(mg/kg)	NA	(mg/kg-day)	3.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-02	(mg/kg-day)	--
				ETHYLBENZENE	4.00E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
				Exp. Route Total							4.3E-06					5.1E-02
				Exposure Point Total							2.2E-05					1.1E+00
				Exposure Medium Total							2.2E-05					1.1E+00

TABLE 7.43
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Wilcox Process Area	Inhalation	Inorganics															
				ALUMINUM	6.33E-06	(mg/m³)	5.20E-04	(ug/m³)	NA	per (ug/m³)	--	6.07E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03			
				ARSENIC	3.67E-09	(mg/m³)	3.02E-07	(ug/m³)	4.30E-03	per (ug/m³)	1.3E-09	3.52E-09	(mg/m³)	1.50E-05	(mg/m³)	2.3E-04			
				COBALT	5.04E-09	(mg/m³)	4.15E-07	(ug/m³)	9.00E-03	per (ug/m³)	3.7E-09	4.84E-09	(mg/m³)	6.00E-06	(mg/m³)	8.1E-04			
				IRON	1.19E-05	(mg/m³)	9.82E-04	(ug/m³)	NA	per (ug/m³)	--	1.15E-05	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	2.16E-07	(mg/m³)	1.77E-05	(ug/m³)	NA	per (ug/m³)	--	2.07E-07	(mg/m³)	5.00E-05	(mg/m³)	4.1E-03			
				VANADIUM	1.31E-08	(mg/m²)	1.08E-06	(ug/m³)	NA	per (ug/m²)	--	1.26E-08	(mg/m³)	1.00E-04	(mg/m²)	1.3E-04			
				PAHs															
				BENZ(A)ANTHRACENE	1.58E-09	(mg/m³)	6.88E-07	(ug/m³)	6.00E-05	per (ug/m³)	4.1E-11	1.51E-09	(mg/m³)	NA	(mg/m³)	--			
				BENZO(B)FLUORANTHENE	1.36E-09	(mg/m³)	5.92E-07	(ug/m³)	6.00E-05	per (ug/m³)	3.6E-11	1.30E-09	(mg/m³)	NA	(mg/m³)	--			
				BENZO(A)PYRENE	1.24E-09	(mg/m³)	5.40E-07	(ug/m³)	6.00E-04	per (ug/m³)	3.2E-10	1.19E-09	(mg/m³)	2.00E-06	(mg/m³)	5.9E-04			
				DIBENZ(A,H)ANTHRACENE	4.18E-11	(mg/m³)	1.82E-08	(ug/m³)	6.00E-04	per (ug/m³)	1.1E-11	4.01E-11	(mg/m³)	NA	(mg/m³)	--			
				INDENO(1,2,3-C,D)PYRENE	6.94E-11	(mg/m³)	3.02E-08	(ug/m³)	6.00E-05	per (ug/m³)	1.8E-12	6.65E-11	(mg/m³)	NA	(mg/m³)	--			
				2-METHYLNAPHTHALENE	1.06E-08	(mg/m³)	8.73E-07	(ug/m³)	NA	per (ug/m³)	--	1.02E-08	(mg/m³)	NA	(mg/m³)	--			
				NAPHTHALENE	5.00E-09	(mg/m³)	4.11E-07	(ug/m³)	3.40E-05	per (ug/m³)	1.4E-11	4.79E-09	(mg/m³)	3.00E-03	(mg/m³)	1.6E-06			
				Volatiles															
				BENZENE	8.14E-10	(mg/m³)	6.69E-08	(ug/m³)	7.80E-06	per (ug/m³)	5.2E-13	7.80E-10	(mg/m³)	3.00E-02	(mg/m³)	2.6E-08			
				CHLOROFORM	1.68E-08	(mg/m³)	1.38E-06	(ug/m³)	2.30E-05	per (ug/m³)	3.2E-11	1.61E-08	(mg/m³)	9.80E-02	(mg/m³)	1.6E-07			
				ETHYLBENZENE	3.05E-09	(mg/m³)	2.51E-07	(ug/m³)	2.50E-06	per (ug/m³)	6.3E-13	2.93E-09	(mg/m³)	1.00E+00	(mg/m³)	2.9E-09			
				Exp. Route Total										5.5E-09					7.1E-03
				Exposure Point Total										5.5E-09					7.1E-03
				Exposure Medium Total										5.5E-09					7.1E-03
Soil Total										2.2E-05					1.1E+00				
Total of Receptor Risks Across All Media										7.7E-04	Total of Receptor Hazards Across All Media					4.6E+01			

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.44
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Wilcox Oil	Ingestion	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	1.26E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	8.84E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	8.8E-04
				ARSENIC	1.98E-02	(mg/L)	1.94E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.9E-08	1.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.5E-03
				CYANIDE	4.71E-02	(mg/L)	4.61E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.23E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.4E-03
				COBALT	8.64E-03	(mg/L)	8.46E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	5.92E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.0E-03
				IRON	3.34E+01	(mg/L)	3.27E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.29E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.3E-03
				MANGANESE	1.04E+00	(mg/L)	1.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.13E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.1E-04
				VANADIUM	1.02E-02	(mg/L)	1.00E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	7.01E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.4E-04
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	3.23E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.26E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	5.7E-04
				NAPHTHALENE	5.92E-02	(mg/L)	5.79E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.05E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	2.0E-04
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	2.35E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.3E-07	1.64E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.1E-02
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	4.01E-09	(mg/kg-day)	9.10E-02	per (mg/kg-day)	3.7E-10	2.81E-07	(mg/kg-day)	6.00E-03	(mg/kg-day)	4.7E-05
				ETHYLBENZENE	1.10E+00	(mg/L)	1.08E-06	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.2E-08	7.53E-05	(mg/kg-day)	1.00E-01	(mg/kg-day)	7.5E-04
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	5.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.11E-06	(mg/kg-day)	1.00E-01	(mg/kg-day)	4.1E-05
				M,P-XYLENE	2.30E+00	(mg/L)	2.25E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.58E-04	(mg/kg-day)	2.00E-01	(mg/kg-day)	7.9E-04
				TOLUENE	1.10E+00	(mg/L)	1.08E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	7.53E-05	(mg/kg-day)	8.00E-02	(mg/kg-day)	9.4E-04
				O-XYLENE	5.00E-01	(mg/L)	4.89E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.42E-05	(mg/kg-day)	2.00E-01	(mg/kg-day)	1.7E-04
				Exp. Route Total							1.7E-07					6.1E-02
			Dermal	Inorganics												
				ALUMINUM	1.29E+01	(mg/L)	4.45E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.12E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.1E-04
				ARSENIC	1.98E-02	(mg/L)	6.83E-09	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.0E-08	4.78E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.6E-03
				CYANIDE	4.71E-02	(mg/L)	1.63E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	1.14E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.9E-03
				COBALT	8.64E-03	(mg/L)	1.19E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	8.35E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.8E-04
				IRON	3.34E+01	(mg/L)	1.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	8.08E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.2E-03
				MANGANESE	1.04E+00	(mg/L)	3.59E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.51E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.8E-04
				VANADIUM	1.02E-02	(mg/L)	3.53E-09	(mg/kg-day)	NA	per (mg/kg-day)	--	2.47E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	1.9E-03
				PAHs												
				2-METHYLNAPHTHALENE	3.30E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				NAPHTHALENE	5.92E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-02	(mg/kg-day)	0.0E+00
				Volatiles												
				BENZENE	2.40E+00	(mg/L)	0.00E+00	(mg/kg-day)	5.50E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	4.00E-03	(mg/kg-day)	0.0E+00
				1,2-DICHLOROETHANE	4.10E-03	(mg/L)	0.00E+00	(mg/kg-day)	9.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	6.00E-03	(mg/kg-day)	0.0E+00
				ETHYLBENZENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	1.10E-02	per (mg/kg-day)	0.0E+00	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				ISOPROPYLBENZENE	6.00E-02	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	1.00E-01	(mg/kg-day)	0.0E+00
				M,P-XYLENE	2.30E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				TOLUENE	1.10E+00	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	8.00E-02	(mg/kg-day)	0.0E+00
				O-XYLENE	5.00E-01	(mg/L)	0.00E+00	(mg/kg-day)	NA	per (mg/kg-day)	--	0.00E+00	(mg/kg-day)	2.00E-01	(mg/kg-day)	0.0E+00
				Exp. Route Total							1.0E-08					7.3E-03
			Exposure Point Total								1.8E-07					6.9E-02
			Exposure Medium Total								1.8E-07					6.9E-02

TABLE 7.44
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Groundwater	Air	Trench	Inhalation	PAHs	5.16E-01	(mg/m³)	1.68E-01	(ug/m³)	3.4E-05	per (ug/m³)	5.7E-06	1.18E-02	(mg/m³)	3.0E-03	(mg/m³)	3.9E+00		
				Volatiles														
				BENZENE	2.99E+01	(mg/m³)	9.75E+00	(ug/m³)	7.8E-06	per (ug/m³)	7.6E-05	6.83E-01	(mg/m³)	3.0E-02	(mg/m³)	2.3E+01		
				BROMOMETHANE	0.00E+00	(mg/m³)	0.00E+00	(ug/m³)	NA	per (ug/m³)	--	0.00E+00	(mg/m³)	5.0E-03	(mg/m³)	0.0E+00		
				1,2-DICHLOROETHANE	4.37E-02	(mg/m³)	1.43E-02	(ug/m³)	2.6E-05	per (ug/m³)	3.7E-07	9.98E-04	(mg/m³)	7.0E-03	(mg/m³)	1.4E-01		
				1,4-DIOXANE	0.00E+00	(mg/m³)	0.00E+00	(ug/m³)	5.0E-06	per (ug/m³)	0.0E+00	0.00E+00	(mg/m³)	3.0E-02	(mg/m³)	0.0E+00		
				ETHYLBENZENE	1.18E+01	(mg/m³)	3.85E+00	(ug/m³)	2.5E-06	per (ug/m³)	9.6E-06	2.69E-01	(mg/m³)	1.0E+00	(mg/m³)	2.7E-01		
				ISOPROPYLBENZENE	6.06E-01	(mg/m³)	1.98E-01	(ug/m³)	NA	per (ug/m³)	--	1.38E-02	(mg/m³)	4.0E-01	(mg/m³)	3.5E-02		
				M,P-XYLENE	2.47E+01	(mg/m³)	8.04E+00	(ug/m³)	NA	per (ug/m³)	--	5.63E-01	(mg/m³)	1.0E-01	(mg/m³)	5.6E+00		
				TETRACHLOROETHENE	0.00E+00	(mg/m³)	0.00E+00	(ug/m³)	2.6E-07	per (ug/m³)	0.0E+00	0.00E+00	(mg/m³)	4.0E-02	(mg/m³)	0.0E+00		
				TOLUENE	1.26E+01	(mg/m³)	4.12E+00	(ug/m³)	NA	per (ug/m³)	--	2.89E-01	(mg/m³)	5.0E+00	(mg/m³)	5.8E-02		
				O-XYLENE	1.18E+01	(mg/m³)	3.83E+00	(ug/m³)	NA	per (ug/m³)	--	3.83E-03	(mg/m³)	1.0E-01	(mg/m³)	3.8E-02		
				Exp. Route Total										9.2E-05				3.3E+01
				Exposure Point Total										9.2E-05				3.3E+01
				Exposure Medium Total										9.2E-05				3.3E+01
				Groundwater Total											9.2E-05			
Soil	Subsurface Soil	Wilcox Process Area	Ingestion	Inorganics														
				ALUMINUM	8.29E+03	(mg/kg)	3.35E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.34E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.3E-02		
				ARSENIC	4.81E+00	(mg/kg)	1.17E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.7E-07	8.16E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.7E-02		
				COBALT	6.61E+00	(mg/kg)	2.67E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.87E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.2E-02		
				IRON	1.57E+04	(mg/kg)	6.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.42E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.3E-02		
				MANGANESE	2.83E+02	(mg/kg)	1.14E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.98E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.7E-03		
				VANADIUM	1.72E+01	(mg/kg)	6.93E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.07E+00	(mg/kg)	8.35E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	8.4E-09	5.85E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	1.78E+00	(mg/kg)	7.18E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	7.2E-09	5.03E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.62E+00	(mg/kg)	6.55E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	6.6E-08	4.59E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02		
				DIBENZ(A,H)ANTHRACENE	5.48E-02	(mg/kg)	2.21E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	2.2E-09	1.55E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				INDENO(1,2,3-C,D)PYRENE	9.09E-02	(mg/kg)	3.67E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	3.7E-10	2.57E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				2-METHYLNAPHTHALENE	1.39E+01	(mg/kg)	5.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.93E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	9.8E-03		
				NAPHTHALENE	6.55E+00	(mg/kg)	2.64E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.85E-05	(mg/kg-day)	2.00E-02	(mg/kg-day)	9.3E-04		
				Volatiles														
				BENZENE	1.07E+00	(mg/kg)	4.30E-08	(mg/kg-day)	5.50E-02	per (mg/kg-day)	2.37E-09	3.01E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	7.5E-04		
				CHLOROFORM	2.20E+01	(mg/kg)	8.88E-07	(mg/kg-day)	3.10E-02	per (mg/kg-day)	2.75E-08	6.22E-05	(mg/kg-day)	1.00E-02	(mg/kg-day)	6.2E-03		
				ETHYLBENZENE	4.00E+00	(mg/kg)	1.61E-07	(mg/kg-day)	1.10E-02	per (mg/kg-day)	1.78E-09	1.13E-05	(mg/kg-day)	1.00E-01	(mg/kg-day)	1.1E-04		
				Exp. Route Total										2.9E-07				2.2E-01

TABLE 7.44
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Wilcox Process Area	Dermal ¹	Inorganics												
				ALUMINUM	8.29E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	4.81E+00	(mg/kg)	1.87E-08	(mg/kg-day)	1.5E+00	per (mg/kg-day)	2.8E-08	1.31E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.4E-03
				COBALT	6.61E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.57E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.83E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	1.72E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.07E+00	(mg/kg)	3.48E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	3.5E-09	2.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.78E+00	(mg/kg)	2.99E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	3.0E-09	2.10E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.62E+00	(mg/kg)	2.73E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	2.7E-08	1.91E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.4E-03
				DIBENZ(A,H)ANTHRACENE	5.48E-02	(mg/kg)	9.22E-10	(mg/kg-day)	1.0E+00	per (mg/kg-day)	9.2E-10	6.45E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	9.09E-02	(mg/kg)	1.53E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.5E-10	1.07E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				2-METHYLNAPHTHALENE	1.39E+01	(mg/kg)	2.34E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.64E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	4.1E-03
				NAPHTHALENE	6.55E+00	(mg/kg)	1.10E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	7.71E-06	(mg/kg-day)	2.00E-02	(mg/kg-day)	3.9E-04
				Volatiles												
				BENZENE	1.07E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				CHLOROFORM	2.20E+01	(mg/kg)	NA	(mg/kg-day)	3.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-02	(mg/kg-day)	--
				ETHYLBENZENE	4.00E+00	(mg/kg)	NA	(mg/kg-day)	1.10E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E-01	(mg/kg-day)	--
				Exp. Route Total							6.3E-08					1.5E-02
				Exposure Point Total							3.5E-07					2.4E-01
				Exposure Medium Total							3.5E-07					2.4E-01

TABLE 7.44
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Air	Wilcox Process Area	Inhalation	Inorganics															
				ALUMINUM	1.36E-04	(mg/m³)	4.43E-04	(ug/m³)	NA	per (ug/m³)	--	3.10E-05	(mg/m³)	5.00E-03	(mg/m³)	6.2E-03			
				ARSENIC	7.88E-08	(mg/m³)	2.57E-07	(ug/m³)	4.30E-03	per (ug/m³)	1.1E-09	1.80E-08	(mg/m³)	1.50E-05	(mg/m³)	1.2E-03			
				COBALT	1.08E-07	(mg/m³)	3.53E-07	(ug/m³)	9.00E-03	per (ug/m³)	3.2E-09	2.47E-08	(mg/m³)	6.00E-06	(mg/m³)	4.1E-03			
				IRON	2.56E-04	(mg/m³)	8.36E-04	(ug/m³)	NA	per (ug/m³)	--	5.85E-05	(mg/m³)	NA	(mg/m³)	--			
				MANGANESE	4.63E-06	(mg/m³)	1.51E-05	(ug/m³)	NA	per (ug/m³)	--	1.06E-06	(mg/m³)	5.00E-05	(mg/m³)	2.1E-02			
				VANADIUM	2.81E-07	(mg/m³)	9.17E-07	(ug/m³)	NA	per (ug/m³)	--	6.42E-08	(mg/m³)	1.00E-04	(mg/m³)	6.4E-04			
				PAHs															
				BENZ(A)ANTHRACENE	3.39E-08	(mg/m³)	7.96E-07	(ug/m³)	6.0E-05	per (ug/m³)	4.8E-11	7.73E-09	(mg/m³)	NA	(mg/m³)	--			
				BENZO(B)FLUORANTHENE	2.91E-08	(mg/m³)	6.84E-07	(ug/m³)	6.0E-05	per (ug/m³)	4.1E-11	6.65E-09	(mg/m³)	NA	(mg/m³)	--			
				BENZO(A)PYRENE	2.66E-08	(mg/m³)	6.24E-07	(ug/m³)	6.0E-04	per (ug/m³)	3.7E-10	6.07E-09	(mg/m³)	2.00E-06	(mg/m³)	3.0E-03			
				DIBENZ(A,H)ANTHRACENE	8.97E-10	(mg/m³)	2.11E-08	(ug/m³)	6.0E-04	per (ug/m³)	1.3E-11	2.05E-10	(mg/m³)	NA	(mg/m³)	--			
				INDENO(1,2,3-C,D)PYRENE	1.49E-09	(mg/m³)	3.50E-08	(ug/m³)	6.0E-05	per (ug/m³)	2.1E-12	3.40E-10	(mg/m³)	NA	(mg/m³)	--			
				2-METHYLNAPHTHALENE	2.28E-07	(mg/m³)	5.35E-06	(ug/m³)	NA	per (ug/m³)	--	5.20E-08	(mg/m³)	NA	(mg/m³)	--			
				NAPHTHALENE	1.07E-07	(mg/m³)	2.52E-06	(ug/m³)	3.40E-05	per (ug/m³)	8.6E-11	2.45E-08	(mg/m³)	3.00E-03	(mg/m³)	8.2E-06			
				Volatiles															
				BENZENE	1.75E-08	(mg/m³)	4.10E-07	(ug/m³)	7.80E-06	per (ug/m³)	3.2E-12	3.99E-09	(mg/m³)	3.00E-02	(mg/m³)	1.3E-07			
				CHLOROFORM	3.60E-07	(mg/m³)	8.46E-06	(ug/m³)	2.30E-05	per (ug/m³)	1.9E-10	8.22E-08	(mg/m³)	9.80E-02	(mg/m³)	8.4E-07			
				ETHYLBENZENE	6.55E-08	(mg/m³)	1.54E-06	(ug/m³)	2.50E-06	per (ug/m³)	3.8E-12	1.50E-08	(mg/m³)	1.00E+00	(mg/m³)	1.5E-08			
								Exp. Route Total							5.0E-09				3.6E-02
								Exposure Point Total							5.0E-09				3.6E-02
								Exposure Medium Total							5.0E-09				3.6E-02
				Soil Total											3.6E-07				2.8E-01
										Total of Receptor Risks Across All Media					9.2E-05		Total of Receptor Hazards Across All Media		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.45
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

$$PEF = Q/C \times [(3,600 \text{ s/h}) / (.36 \times (1 - V) \times (U_m/U_t)^3 \times F(x))] =$$

1.31E+09

Air Concentration

$$C_{air} = C_{soil} \times ((1/PEF) + (1/VF))$$

Where,

$$Q/C = 8.26E+01 \text{ g/m}^2\text{-s per kg/m}^3$$

Inverse Mean Concentration at Center of 0.05 square source for Lincoln, NE, USEPA 1996

$$V = 5.00E-01 \text{ unitless}$$

Default, USEPA 2019

$$U_m = 4.65E+00 \text{ m/s}$$

Mean annual wind speed, Lincoln, NE, USEPA 1996

$$U_t = 1.13E+01 \text{ m/s}$$

Equivalent threshold value of windspeed at 7 m, USEPA 2019

$$F(x) = 1.82E-02 \text{ unitless}$$

Default, USEPA 2019

$$VF = \text{Volatilization Factor m}^3/\text{kg}$$

Chemical Specific, USEPA 2019

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. November 2019.

Chemical	Csoil, Subsurface		Volatilization Factor	Cair, Surface Soil		Cair, Subsurface Soil	
	Csoil, Surface Soil	Soil		Particulate	Particulate		
	RME EPC	RME EPC		VF	RME EPC	RME EPC	
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³		
Inorganics							
ALUMINUM	5.46E+03	8.29E+03	--	4.17E-06	6.33E-06		
ARSENIC	3.86E+00	4.81E+00	--	2.95E-09	3.67E-09		
CADMIUM	1.42E+00	NA		1.08E-09	NA		
HEXAVALENT CHROMIUM (+6)	1.18E+00	NA		9.00E-10	NA		
COBALT	3.87E+00	6.61E+00	--	2.95E-09	5.04E-09		
COPPER	4.10E+02	NA		3.13E-07	NA		
IRON	1.26E+04	1.57E+04	--	9.65E-06	1.19E-05		
MANGANESE	3.09E+02	2.83E+02	--	2.35E-07	2.16E-07		
VANADIUM	1.35E+01	1.72E+01	--	1.03E-08	1.31E-08		
ZINC	3.10E+02	NA		2.36E-07	NA		

TABLE 7.45
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

PAHs				
BENZ(A)ANTHRACENE	4.57E+00	2.07E+00	3.49E-09	1.58E-09
BENZO(B)FLUORANTHENE	2.16E+00	1.78E+00	1.65E-09	1.36E-09
BENZO(A)PYRENE	2.53E+00	1.62E+00	1.93E-09	1.24E-09
CHRYSENE	1.16E+01	NA	8.83E-09	NA
DIBENZ(A,H)ANTHRACENE	3.07E-01	5.48E-02	2.34E-10	4.18E-11
INDENO(1,2,3-C,D)PYRENE	4.29E-01	9.09E-02	3.27E-10	6.94E-11
2-METHYLNAPHTHALENE	3.12E+00	1.39E+01	2.38E-09	1.06E-08
NAPHTHALENE	8.06E-01	6.55E+00	6.15E-10	5.00E-09
Volatiles				
BENZENE	NA	1.07E+00	NA	8.14E-10
CHLOROFORM	NA	2.20E+01	NA	1.68E-08
ETHYLBENZENE	NA	4.00E+00	NA	3.05E-09
M,P-XYLENE	NA	NA	NA	NA

TABLE 7.46
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
CONSTRUCTION WORKER - OTHER THAN STANDARD VEHICLE TRAFFIC
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:					
	Particulate Emission Factor	6.11E+07 Calculated using EPA RSL Calculator (Calculations provided in Appendix D)			
	Air Concentration	Cair = Csoil*((1/PEF)+(1/VF))			
Where,					
Area to be excavated, graded, tilled =	5.00E+00 acres				
Depth of excavation =	1.50E+00 meters				
Q/C =	9.44E+00 g/m ² -s per kg/m ³	calculated			
Um =	4.69E+00 m/s	Mean annual wind speed, USEPA 2019			
Ut =	1.13E+01 m/s	Equivalent threshold value of windspeed at 7 m, USEPA 2019			
F(x) =	1.94E-01 unitless	Default, USEPA 2019			
VF =	Volatilization Factor m ³ /kg	Chemical Specific, USEPA 2019			
Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.					
USEPA Regional Screening Levels. November 2019.					
		Csoil, Subsurface Soil		Cair, Surface Soil	Cair, Subsurface Soil
Chemical	Csoil, Surface Soil	Soil	Volatilization Factor	Particulate	Particulate
	RME EPC	RME EPC	VF	RME EPC	RME EPC
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³
Inorganics					
ALUMINUM	5.46E+03	8.29E+03	--	8.95E-05	1.36E-04
ARSENIC	3.86E+00	4.81E+00	--	6.33E-08	7.88E-08
CADMIUM	1.42E+00	NA		2.33E-08	NA
HEXAVALENT CHROMIUM (+6)	1.18E+00	NA		1.93E-08	NA
COBALT	3.87E+00	6.61E+00	--	6.33E-08	1.08E-07
COPPER	4.10E+02	NA		6.71E-06	NA
IRON	1.26E+04	1.57E+04	--	2.07E-04	2.56E-04
MANGANESE	3.09E+02	2.83E+02	--	5.05E-06	4.63E-06
VANADIUM	1.35E+01	1.72E+01	--	2.20E-07	2.81E-07
ZINC	3.10E+02	NA		5.07E-06	NA

TABLE 7.46
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
CONSTRUCTION WORKER - OTHER THAN STANDARD VEHICLE TRAFFIC
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

PAHs				
BENZ(A)ANTHRACENE	4.57E+00	2.07E+00	7.48E-08	3.39E-08
BENZO(B)FLUORANTHENE	2.16E+00	1.78E+00	3.54E-08	2.91E-08
BENZO(A)PYRENE	2.53E+00	1.62E+00	4.15E-08	2.66E-08
CHRYSENE	1.16E+01	NA	1.89E-07	NA
DIBENZ(A,H)ANTHRACENE	3.07E-01	5.48E-02	5.03E-09	8.97E-10
INDENO(1,2,3-C,D)PYRENE	4.29E-01	9.09E-02	7.02E-09	1.49E-09
2-METHYLNAPHTHALENE	3.12E+00	1.39E+01	5.10E-08	2.28E-07
NAPHTHALENE	8.06E-01	6.55E+00	1.32E-08	1.07E-07
Volatiles				
BENZENE	NA	1.07E+00	NA	1.75E-08
CHLOROFORM	NA	2.20E+01	NA	3.60E-07
ETHYLBENZENE	NA	4.00E+00	NA	6.55E-08
M,P-XYLENE	NA	NA	NA	NA

TABLE 7.47
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN HOME GROWN PRODUCE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:				
		$Pr = C_s * Br_{ag} * 0.12$	mg/kg	Concentration of COPC in plant due to root uptake
Model Constants:				
		C_s	chemical-specific mg/kg	COPC concentration in soil (mg/kg)
		$Br_{ag} =$	chemical-specific unitless	Plant to soil bioconcentration factor (unitless), above ground produce and forage
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA 2005.				
Constituent of Potential Concern	Cs, Surface Soil RME EPC mg/kg	Br _{ag} ⁽¹⁾ unitless	Reference	P _r RME EPC mg/kg
Inorganics				
ALUMINUM	5.46E+03	4.00E-03	RAIS 2019	2.62E+00
ARSENIC	3.86E+00	6.33E-03	U.S. EPA 2005	2.94E-03
CADMIUM	1.42E+00	1.25E-01	U.S. EPA 2005	2.13E-02
HEXAVALENT CHROMIUM (+6)	1.18E+00	4.88E-03	U.S. EPA 2005	6.90E-04
COBALT	3.87E+00	2.00E-02	RAIS 2019	9.28E-03
COPPER	4.10E+02	4.00E-01	RAIS 2019	1.97E+01
IRON	1.26E+04	4.00E-03	RAIS 2019	6.07E+00
MANGANESE	3.09E+02	2.50E-01	RAIS 2019	9.26E+00
VANADIUM	1.35E+01	5.50E-03	RAIS 2019	8.88E-03
ZINC	3.10E+02	9.70E-02	U.S. EPA 2005	3.60E+00
PAHs				
BENZ(A)ANTHRACENE	4.57E+00	1.97E-02	U.S. EPA 2005	1.08E-02
BENZO(B)FLUORANTHENE	2.16E+00	1.12E-02	U.S. EPA 2005	2.91E-03
BENZO(A)PYRENE	2.53E+00	1.32E-02	U.S. EPA 2005	4.01E-03
CHRYSENE	1.16E+01	1.97E-02	U.S. EPA 2005	2.74E-02
DIBENZ(A,H)ANTHRACENE	3.07E-01	6.78E-03	U.S. EPA 2005	2.50E-04
INDENO(1,2,3-C,D)PYRENE	4.29E-01	5.93E-03	U.S. EPA 2005	3.05E-04
2-METHYLNAPHTHALENE	3.12E+00	2.20E-01	RAIS 2019	8.22E-02
NAPHTHALENE	8.06E-01	4.79E-01	U.S. EPA 2005	4.63E-02

References:U. S. EPA 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Final, EPA/530/R-05/006, Washington, D.C.RAIS 2019. *Risk Assessment Information System*, online database available at: <http://rais.ornl.gov>. Assuming soil-to-dry plant uptake.

TABLE 7.48
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN BEEF
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

$$CM = ((F_i * Q_{p(\text{forage, beef})} * P_i) + (Q_{\text{soil}(\text{beef})} * C_s * B_s)) * B_{a,\text{beef}} * MF$$

Model Constants:

F_i	1	unitless	Fraction of plant type grown on contaminated soil and ingested by cattle, assume only consume forage grown on contaminated soil.
$Q_{p(\text{forage, cattle})}$	8.8	kg/day	Quantity of forage ingested by cattle per day.
P_i	calculated	mg/kg	Concentration of COPC in plant ingested by cattle. $C_s * Br_{ag} * 0.12$ C_s = COPC concentration in soil (mg/kg). Br_{ag} = plant to soil bioconcentration factor (unitless)
$Q_{\text{soil}(\text{beef})}$	0.5	kg/day	Quantity of soil ingested by cattle.
C_s	chemical-specific	mg/kg	Surface soil COPC concentration
B_s	1	unitless	Soil bioavailability factor.
$B_{a,\text{beef}}$	chemical-specific	day/kg	Biotransfer factor for beef.
MF	1	unitless	Metabolism factor for all constituents, except bis(2-ethylhexyl)phthalate = 0.01

Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA, 2005.

Chemical	Cs, Surface Soil RME EPC mg/kg	Br _{ag} ⁽¹⁾ unitless	P _i mg/kg	B _{a,beef} ⁽¹⁾ day/kg	Reference	CM RME EPC mg/kg
Inorganics						
ALUMINUM	5.46E+03	1.00E-03	6.56E-01	1.50E-03	RAIS 2019	4.11E+00
ARSENIC	3.86E+00	6.33E-03	2.94E-03	2.00E-03	U.S. EPA 2005	3.92E-03
CADMIUM	1.42E+00	1.25E-01	2.13E-02	1.20E-04	U.S. EPA 2005	1.08E-04
HEXAVALENT CHROMIUM (+6)	1.18E+00	4.88E-03	6.90E-04	5.50E-03	U.S. EPA 2005	3.28E-03
COBALT	3.87E+00	2.00E-02	9.28E-03	2.00E-02	RAIS 2019	4.03E-02
COPPER	4.10E+02	4.00E-01	1.97E+01	1.00E-02	RAIS 2019	3.78E+00
IRON	1.26E+04	4.00E-03	6.07E+00	2.00E-02	RAIS 2019	1.28E+02
MANGANESE	3.09E+02	6.25E-02	2.31E+00	4.00E-04	RAIS 2019	6.98E-02
VANADIUM	1.35E+01	1.38E-03	2.22E-03	2.50E-03	RAIS 2019	1.69E-02
ZINC	3.10E+02	9.70E-02	3.60E+00	9.00E-05	U.S. EPA 2005	1.68E-02

TABLE 7.48
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN BEEF
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

PAHs						
BENZ(A)ANTHRACENE	4.57E+00	1.97E-02	1.08E-02	1.44E-02	U.S. EPA 2005	3.43E-02
BENZO(B)FLUORANTHENE	2.16E+00	1.12E-02	2.91E-03	1.51E-02	U.S. EPA 2005	1.67E-02
BENZO(A)PYRENE	2.53E+00	1.32E-02	4.01E-03	3.37E-02	U.S. EPA 2005	4.39E-02
CHRYSENE	1.16E+01	1.97E-02	2.74E-02	3.99E+00	U.S. EPA 2005	2.40E+01
DIBENZ(A,H)ANTHRACENE	3.07E-01	6.78E-03	2.50E-04	4.76E-01	U.S. EPA 2005	7.41E-02
INDENO(1,2,3-C,D)PYRENE	4.29E-01	5.93E-03	3.05E-04	1.25E-01	U.S. EPA 2005	2.71E-02
2-METHYLNAPHTHALENE	3.12E+00	2.27E-01	8.50E-02	2.43E-02	RAIS 2019	5.60E-02
NAPHTHALENE	8.06E-01	4.79E-01	4.63E-02	1.48E-02	U.S. EPA 2005	1.20E-02

(1) Br_{ag} taken from USEPA, 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Final, EPA/530/R-05/006, Washington, D.C. For COPCs not listed in this document, taken from RAIS 2019, Risk Assessment Information System, online database available at: <http://rais.ornl.gov>. Assuming soil-to-wet plant uptake.

TABLE 7.49
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future			Receptor Population: Resident			Receptor Age: Adult													
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Sediment	Sediment	Sediment	Ingestion	Inorganics															
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.18E-04			
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04			
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04			
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.89E-03			
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.98E-03			
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.13E-04			
				PAHs															
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05			
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--			
				Exp. Route Total							2.6E-07					5.9E-03			
			Dermal ¹	Inorganics															
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--			
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04			
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--			
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--			
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--			
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--			
				PAHs															
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05			
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--			
				Exp. Route Total							5.7E-08					3.5E-04			
			Exp. Point Total							3.2E-07					6.2E-03				
			Exp. Medium Total							3.2E-07					6.2E-03				
Sediment Total							3.2E-07					6.2E-03							

TABLE 7.49
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																			
Receptor Population: Resident																			
Receptor Age: Adult																			
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics															
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04			
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04			
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04			
				HEXA VALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06			
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03			
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04			
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04			
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05			
				PAHs															
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05			
			Exp. Route Total										9.4E-08					7.7E-03	
			Dermal	Inorganics															
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04			
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04			
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03			
				HEXA VALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04			
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03			
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04			
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04			
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03			
				PAHs															
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03			
			Exp. Route Total										1.6E-06					2.2E-02	
			Exposure Point Total										1.7E-06					2.9E-02	
			Exposure Medium Total										1.7E-06					2.9E-02	
Surface Water Total										1.7E-06					2.9E-02				

TABLE 7.49
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	East Tank Farm	Ingestion	Inorganics														
				ALUMINUM	8.26E+03	(mg/kg)	2.83E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.90E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.9E-03		
				ARSENIC	2.94E+00	(mg/kg)	6.03E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	9.0E-07	2.11E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.0E-03		
				COBALT	5.38E+00	(mg/kg)	1.84E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	6.45E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-02		
				IRON	1.51E+04	(mg/kg)	5.16E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.81E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.6E-02		
				MANGANESE	6.41E+02	(mg/kg)	2.20E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	7.68E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	3.91E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.9E-08	6.84E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	7.03E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.0E-08	1.23E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	4.26E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.3E-07	7.46E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-03		
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	1.18E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-08	2.07E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										1.5E-06				7.2E-02	
			Dermal ¹	Inorganics														
				ALUMINUM	8.26E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.94E+00	(mg/kg)	1.27E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.9E-07	4.46E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				COBALT	5.38E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.51E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	6.41E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	2.15E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-08	3.76E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	3.86E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.9E-08	6.76E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	2.34E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.3E-07	4.09E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-03		
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	6.50E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-09	1.14E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										4.9E-07				2.9E-03	
			Exposure Point Total										1.9E-06				7.5E-02	
			Exposure Medium Total										1.9E-06				7.5E-02	

TABLE 7.49
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	East Tank Farm	Inhalation	Inorganics														
				ALUMINUM	6.30E-06	(mg/m³)	1.73E-03	(ug/m³)	NA	per (ug/m³)	--	6.05E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03		
				ARSENIC	2.24E-09	(mg/m³)	6.14E-07	(ug/m³)	4.30E-03	per (ug/m³)	2.6E-09	2.15E-09	(mg/m³)	1.50E-05	(mg/m³)	1.4E-04		
				COBALT	4.10E-09	(mg/m³)	1.12E-06	(ug/m³)	9.00E-03	per (ug/m³)	1.0E-08	3.94E-09	(mg/m³)	6.00E-06	(mg/m³)	6.6E-04		
				IRON	1.15E-05	(mg/m³)	3.15E-03	(ug/m³)	NA	per (ug/m³)	--	1.10E-05	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	4.89E-07	(mg/m³)	1.34E-04	(ug/m³)	NA	per (ug/m³)	--	4.69E-07	(mg/m³)	5.00E-05	(mg/m³)	9.4E-03		
				PAHs														
				BENZ(A)ANTHRACENE	4.36E-10	(mg/m³)	2.39E-07	(ug/m³)	6.00E-05	per (ug/m³)	1.4E-11	4.18E-10	(mg/m³)	NA	(mg/m³)	--		
				BENZO(B)FLUORANTHENE	7.84E-10	(mg/m³)	4.30E-07	(ug/m³)	6.00E-05	per (ug/m³)	2.6E-11	7.52E-10	(mg/m³)	NA	(mg/m³)	--		
				BENZO(A)PYRENE	4.75E-10	(mg/m³)	2.60E-07	(ug/m³)	6.00E-04	per (ug/m³)	1.6E-10	4.55E-10	(mg/m³)	2.00E-06	(mg/m³)	2.3E-04		
				INDENO(1,2,3-C,D)PYRENE	1.32E-10	(mg/m³)	7.24E-08	(ug/m³)	6.00E-05	per (ug/m³)	4.3E-12	1.27E-10	(mg/m³)	NA	(mg/m³)	--		
				Exp. Route Total														1.2E-02
				Exposure Point Total														1.2E-02
				Exposure Medium Total														1.2E-02
	Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics													
					ALUMINUM	3.96E+00	(mg/kg)	1.70E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	5.95E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.9E-03	
ARSENIC					2.23E-03	(mg/kg)	9.56E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-06	3.35E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02		
COBALT					1.29E-02	(mg/kg)	5.53E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.94E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.5E-02		
IRON					7.24E+00	(mg/kg)	3.10E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.09E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.6E-02		
MANGANESE					1.92E+01	(mg/kg)	8.24E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.88E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-01		
PAHs																		
BENZ(A)ANTHRACENE					1.35E-03	(mg/kg)	1.16E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-07	2.02E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
BENZO(B)FLUORANTHENE					1.38E-03	(mg/kg)	1.18E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.2E-07	2.07E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
BENZO(A)PYRENE					9.85E-04	(mg/kg)	8.44E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.4E-07	1.48E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.9E-03		
INDENO(1,2,3-C,D)PYRENE					1.23E-04	(mg/kg)	1.06E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	1.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
Exp. Route Total													3.1E-01					
Exposure Point Total													3.1E-01					
Exposure Medium Total													3.1E-01					

TABLE 7.49
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future			Receptor Population: Resident			Receptor Age: Adult											
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Surface Soil	Beef	Ingestion	Inorganics													
				ALUMINUM	6.25E+00	(mg/kg)	2.26E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	7.90E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	7.9E-03	
				ARSENIC	2.98E-03	(mg/kg)	1.08E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.6E-06	3.76E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02	
				COBALT	5.60E-02	(mg/kg)	2.03E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.09E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-01	
				IRON	1.52E+02	(mg/kg)	5.50E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.92E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.7E-01	
				MANGANESE	1.96E-01	(mg/kg)	7.08E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.48E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.8E-03	
				PAHs													
				BENZ(A)ANTHRACENE	4.28E-03	(mg/kg)	3.10E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.1E-07	5.42E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	7.94E-03	(mg/kg)	5.74E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.7E-07	1.00E-05	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.08E-02	(mg/kg)	7.79E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-06	1.36E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.5E-02	
			INDENO(1,2,3-C,D)PYRENE	1.09E-02	(mg/kg)	7.92E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.9E-07	1.39E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										1.1E-05				5.8E-01
			Exposure Point Total										1.1E-05				5.8E-01
			Exposure Medium Total										1.1E-05				5.8E-01
Soil Total										1.6E-05				9.7E-01			
Total of Receptor Risks Across All Media											1.8E-05	Total of Receptor Hazards Across All Media				1.0E+00	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.50
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							3.6E-06					1.3E-01
			Dermal ¹	Inorganics												
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							1.8E-07					2.1E-03
			Exposure Point Total								3.8E-06					1.3E-01
			Exposure Medium Total								3.8E-06					1.3E-01
			Sediment Total								3.8E-06					1.3E-01

TABLE 7.50
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04
			Exp. Route Total							8.5E-07					2.1E-01	
			Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02
			Exp. Route Total							2.6E-06					4.5E-02	
			Exposure Point Total							3.4E-06					2.5E-01	
			Exposure Medium Total							3.4E-06					2.5E-01	
Surface Water Total							3.4E-06					2.5E-01				

TABLE 7.50
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child																
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	East Tank Farm	Ingestion	Inorganics												
				ALUMINUM	8.26E+03	(mg/kg)	9.05E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-01
				ARSENIC	2.94E+00	(mg/kg)	1.93E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.9E-06	2.25E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.5E-02
				COBALT	5.38E+00	(mg/kg)	5.89E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	6.87E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.3E-01
				IRON	1.51E+04	(mg/kg)	1.65E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.93E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.8E-01
				MANGANESE	6.41E+02	(mg/kg)	7.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	8.20E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.9E-02
				PAHs												
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	3.32E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.3E-07	7.30E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	5.97E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-07	1.31E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	3.61E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.6E-06	7.95E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.7E-02
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	1.00E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-07	2.21E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							7.5E-06					7.7E-01
			Dermal ¹	Inorganics												
				ALUMINUM	8.26E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.94E+00	(mg/kg)	2.29E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.4E-07	2.67E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.9E-03
				COBALT	5.38E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.51E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	6.41E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	1.02E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-07	2.25E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	1.84E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.8E-07	4.05E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	1.11E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	2.45E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.2E-03
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	3.10E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.1E-08	6.82E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							1.8E-06					1.7E-02
			Exposure Point Total								9.3E-06					7.9E-01
			Exposure Medium Total								9.3E-06					7.9E-01

TABLE 7.50
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child																
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	East Tank Farm	Inhalation	Inorganics												
				ALUMINUM	6.30E-06	(mg/m ³)	5.18E-04	(ug/m ³)	NA	per (ug/m ³)	--	6.05E-06	(mg/m ³)	5.00E-03	(mg/m ³)	1.2E-03
				ARSENIC	2.24E-09	(mg/m ³)	1.84E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	7.9E-10	2.15E-09	(mg/m ³)	1.50E-05	(mg/m ³)	1.4E-04
				COBALT	4.10E-09	(mg/m ³)	3.37E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	3.0E-09	3.94E-09	(mg/m ³)	6.00E-06	(mg/m ³)	6.6E-04
				IRON	1.15E-05	(mg/m ³)	9.46E-04	(ug/m ³)	NA	per (ug/m ³)	--	1.10E-05	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	4.89E-07	(mg/m ³)	4.02E-05	(ug/m ³)	NA	per (ug/m ³)	--	4.69E-07	(mg/m ³)	5.00E-05	(mg/m ³)	9.4E-03
				PAHs												
				BENZ(A)ANTHRACENE	4.36E-10	(mg/m ³)	1.90E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	1.1E-11	4.18E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	7.84E-10	(mg/m ³)	3.42E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	2.0E-11	7.52E-10	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	4.75E-10	(mg/m ³)	2.07E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	1.2E-10	4.55E-10	(mg/m ³)	2.00E-06	(mg/m ³)	2.3E-04
				INDENO(1,2,3-C,D)PYRENE	1.32E-10	(mg/m ³)	5.75E-08	(ug/m ³)	6.00E-05	per (ug/m ³)	3.5E-12	1.27E-10	(mg/m ³)	NA	(mg/m ³)	--
				Exp. Route Total							4.0E-09					1.2E-02
				Exposure Point Total							4.0E-09					1.2E-02
				Exposure Medium Total							4.0E-09					1.2E-02
	Surface Soil	Homegrown Produce	Ingestion	Inorganics												
				ALUMINUM	3.96E+00	(mg/kg)	1.31E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.53E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.5E-02
				ARSENIC	2.23E-03	(mg/kg)	7.36E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-06	8.59E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.9E-02
				COBALT	1.29E-02	(mg/kg)	4.26E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.97E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.7E-01
				IRON	7.24E+00	(mg/kg)	2.39E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.79E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.0E-02
				MANGANESE	1.92E+01	(mg/kg)	6.35E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	7.40E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.3E-01
				PAHs												
				BENZ(A)ANTHRACENE	1.35E-03	(mg/kg)	2.36E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.4E-07	5.20E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.38E-03	(mg/kg)	2.41E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.4E-07	5.31E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	9.85E-04	(mg/kg)	1.72E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.7E-06	3.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02
				INDENO(1,2,3-C,D)PYRENE	1.23E-04	(mg/kg)	2.15E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.2E-08	4.74E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							3.3E-06					7.9E-01
				Exposure Point Total							3.3E-06					7.9E-01
				Exposure Medium Total							3.3E-06					7.9E-01

TABLE 7.50
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	Beef	Ingestion	Inorganics														
				ALUMINUM	6.25E+00	(mg/kg)	1.37E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.60E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.6E-02		
				ARSENIC	2.98E-03	(mg/kg)	6.54E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	9.8E-07	7.63E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-02		
				COBALT	5.60E-02	(mg/kg)	1.23E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.44E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.8E-01		
				IRON	1.52E+02	(mg/kg)	3.34E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	3.90E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.6E-01		
				MANGANESE	1.96E-01	(mg/kg)	4.31E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.03E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.6E-03		
				PAHs														
				BENZ(A)ANTHRACENE	4.28E-03	(mg/kg)	4.99E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.0E-07	1.10E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	7.94E-03	(mg/kg)	9.25E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.3E-07	2.04E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.08E-02	(mg/kg)	1.26E-05	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.3E-05	2.76E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.2E-02		
				INDENO(1,2,3-C,D)PYRENE	1.09E-02	(mg/kg)	1.28E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-06	2.81E-05	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total										1.6E-05				1.2E+00
				Exposure Point Total										1.6E-05				1.2E+00
				Exposure Medium Total										1.6E-05				1.2E+00
Soil Total										2.9E-05				2.8E+00				
Total of Receptor Risks Across All Media											3.6E-05	Total of Receptor Hazards Across All Media				3.1E+00		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

2) Inhalation risks for the child exposure to groundwater as a tap water source are included in the adult exposure estimates, Table 7.49.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.51
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																			
Receptor Population: Construction Worker																			
Receptor Age: Adult																			
Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations							
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient			
							Value	Units	Value	Units		Value	Units	Value	Units				
Soil	Surface Soil	East Tank Farm	Ingestion	Inorganics															
				ALUMINUM	8.26E+03	(mg/kg)	3.33E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.33E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.3E-02			
				ARSENIC	2.94E+00	(mg/kg)	7.11E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-07	4.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.7E-02			
				COBALT	5.38E+00	(mg/kg)	2.17E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.52E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.1E-02			
				IRON	1.51E+04	(mg/kg)	6.09E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.1E-02			
				MANGANESE	6.41E+02	(mg/kg)	2.59E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.81E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.3E-02			
				PAHs															
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	2.30E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	2.3E-09	1.61E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	4.15E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	4.1E-09	2.90E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	2.51E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	2.5E-08	1.76E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.9E-03			
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	6.98E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	7.0E-10	4.89E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				Exp. Route Total															1.7E-01
			Dermal ¹	Inorganics															
				ALUMINUM	8.26E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--			
				ARSENIC	2.94E+00	(mg/kg)	1.14E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.7E-08	7.98E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.7E-03			
				COBALT	5.38E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--			
				IRON	1.51E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--			
				MANGANESE	6.41E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--			
				PAHs															
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	9.61E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	9.6E-10	6.72E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	1.73E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.7E-09	1.21E-06	(mg/kg-day)	NA	(mg/kg-day)	--			
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	1.05E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.0E-08	7.33E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-03			
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	2.91E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	2.9E-10	2.04E-07	(mg/kg-day)	NA	(mg/kg-day)	--			
				Exp. Route Total															5.1E-03
			Exposure Point Total															1.8E-01	
			Exposure Medium Total																1.8E-01

TABLE 7.51
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future			Receptor Population: Construction Worker															
Receptor Age: Adult																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	East Tank Farm	Inhalation	Inorganics														
				ALUMINUM	1.35E-04	(mg/m³)	4.41E-04	(ug/m³)	NA	per (ug/m³)	--	3.09E-05	(mg/m³)	5.00E-03	(mg/m³)	6.2E-03		
				ARSENIC	4.81E-08	(mg/m³)	1.57E-07	(ug/m³)	4.3E-03	per (ug/m³)	6.7E-10	1.10E-08	(mg/m³)	1.50E-05	(mg/m³)	7.3E-04		
				COBALT	8.80E-08	(mg/m³)	2.87E-07	(ug/m³)	9.0E-03	per (ug/m³)	2.6E-09	2.01E-08	(mg/m³)	6.00E-06	(mg/m³)	3.4E-03		
				IRON	2.47E-04	(mg/m³)	8.05E-04	(ug/m³)	NA	per (ug/m³)	--	5.64E-05	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	1.05E-05	(mg/m³)	3.42E-05	(ug/m³)	NA	per (ug/m³)	--	2.40E-06	(mg/m³)	5.00E-05	(mg/m³)	4.8E-02		
				PAHs														
				BENZ(A)ANTHRACENE	9.35E-09	(mg/m³)	3.05E-08	(ug/m³)	6.0E-05	per (ug/m³)	1.8E-12	2.13E-09	(mg/m³)	NA	(mg/m³)	--		
				BENZO(B)FLUORANTHENE	1.68E-08	(mg/m³)	5.48E-08	(ug/m³)	6.0E-05	per (ug/m³)	3.3E-12	3.84E-09	(mg/m³)	NA	(mg/m³)	--		
				BENZO(A)PYRENE	1.02E-08	(mg/m³)	3.32E-08	(ug/m³)	6.0E-04	per (ug/m³)	2.0E-11	2.33E-09	(mg/m³)	2.00E-06	(mg/m³)	1.2E-03		
				INDENO(1,2,3-C,D)PYRENE	2.83E-09	(mg/m³)	9.24E-09	(ug/m³)	6.0E-05	per (ug/m³)	5.5E-13	6.47E-10	(mg/m³)	NA	(mg/m³)	--		
				Exp. Route Total										3.3E-09				5.9E-02
				Exposure Point Total										3.3E-09				5.9E-02
				Exposure Medium Total										3.3E-09				5.9E-02
Soil Total										1.7E-07				2.3E-01				
Total of Receptor Risks Across All Media											1.7E-07	Total of Receptor Hazards Across All Media				2.3E-01		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.52
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	East Tank Farm	Ingestion	Inorganics												
				ALUMINUM	8.26E+03	(mg/kg)	2.53E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	7.07E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	7.1E-03
				ARSENIC	2.94E+00	(mg/kg)	5.39E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.1E-07	1.51E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.0E-03
				COBALT	5.38E+00	(mg/kg)	1.64E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.60E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-02
				IRON	1.51E+04	(mg/kg)	4.61E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02
				MANGANESE	6.41E+02	(mg/kg)	1.96E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.49E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.9E-03
				PAHs												
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	1.75E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.7E-08	4.89E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	3.14E-07	(mg/kg-day)	1.0E-01	per (mg/kg-day)	3.1E-08	8.79E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	1.90E-07	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.9E-07	5.33E-07	(mg/kg-day)	3.0E-04	(mg/kg-day)	1.8E-03
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	5.29E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	5.3E-09	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							1.1E-06					5.2E-02
			Dermal ¹	Inorganics												
				ALUMINUM	8.26E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	2.94E+00	(mg/kg)	1.90E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.8E-08	5.32E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-04
				COBALT	5.38E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.51E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	6.41E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	1.6E-09	4.48E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	2.88E-08	(mg/kg-day)	1.0E-01	per (mg/kg-day)	2.9E-09	8.06E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	1.74E-08	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.7E-08	4.88E-08	(mg/kg-day)	3.0E-04	(mg/kg-day)	1.6E-04
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	4.85E-09	(mg/kg-day)	1.0E-01	per (mg/kg-day)	4.9E-10	1.36E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							5.1E-08					3.4E-04
			Exposure Point Total								1.1E-06					5.2E-02
			Exposure Medium Total								1.1E-06					5.2E-02

TABLE 7.52
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	East Tank Farm	Inhalation	Inorganics														
				ALUMINUM	6.30E-06	(mg/m³)	5.14E-04	(ug/m³)	NA	per (ug/m³)	--	1.44E-06	(mg/m³)	5.00E-03	(mg/m³)	2.9E-04		
				ARSENIC	2.24E-09	(mg/m³)	1.83E-07	(ug/m³)	4.30E-03	per (ug/m³)	7.9E-10	5.12E-10	(mg/m³)	1.50E-05	(mg/m³)	3.4E-05		
				COBALT	4.10E-09	(mg/m³)	3.35E-07	(ug/m³)	9.00E-03	per (ug/m³)	3.0E-09	9.37E-10	(mg/m³)	6.00E-06	(mg/m³)	1.6E-04		
				IRON	1.15E-05	(mg/m³)	9.39E-04	(ug/m³)	NA	per (ug/m³)	--	2.63E-06	(mg/m³)	NA	(mg/m³)	--		
				MANGANESE	4.89E-07	(mg/m³)	3.99E-05	(ug/m³)	NA	per (ug/m³)	--	1.12E-07	(mg/m³)	5.00E-05	(mg/m³)	2.2E-03		
				PAHs														
				BENZ(A)ANTHRACENE	4.36E-10	(mg/m³)	3.55E-08	(ug/m³)	6.00E-05	per (ug/m³)	2.1E-12	9.95E-11	(mg/m³)	NA	(mg/m³)	--		
				BENZO(B)FLUORANTHENE	7.84E-10	(mg/m³)	6.39E-08	(ug/m³)	6.00E-05	per (ug/m³)	3.8E-12	1.79E-10	(mg/m³)	NA	(mg/m³)	--		
				BENZO(A)PYRENE	4.75E-10	(mg/m³)	3.87E-08	(ug/m³)	6.00E-04	per (ug/m³)	2.3E-11	1.08E-10	(mg/m³)	2.00E-06	(mg/m³)	5.4E-05		
				INDENO(1,2,3-C,D)PYRENE	1.32E-10	(mg/m³)	1.08E-08	(ug/m³)	6.00E-05	per (ug/m³)	6.5E-13	3.02E-11	(mg/m³)	NA	(mg/m³)	--		
				Exp. Route Total											3.8E-09			2.8E-03
				Exposure Point Total											3.8E-09			2.8E-03
				Exposure Medium Total											3.8E-09			2.8E-03
Soil Total											1.1E-06			5.5E-02				
Total of Receptor Risks Across All Media											1.1E-06	Total of Receptor Hazards Across All Media				5.5E-02		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.53
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	9.32E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	6.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	6.5E-03		
				ARSENIC	2.25E+00	(mg/kg)	1.83E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.7E-07	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	1.71E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	8.5E-07	3.99E-06	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-03		
				COBALT	4.24E+00	(mg/kg)	5.75E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.03E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				IRON	1.04E+04	(mg/kg)	1.41E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.88E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.4E-02		
				MANGANESE	2.23E+02	(mg/kg)	3.03E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.12E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.11E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.59E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.01E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-08	2.36E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.77E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.8E-08	1.81E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.12E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.95E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total								1.2E-06					4.2E-02	
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	4.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.2E-08	2.90E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.7E-04		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	6.54E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-09	1.53E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	5.97E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.0E-09	1.39E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	4.58E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.6E-08	1.07E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	1.25E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-08	2.91E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total								1.3E-07					1.3E-03	
			Exposure Point Total										1.4E-06					4.3E-02
			Exposure Medium Total										1.4E-06					4.3E-02
Sediment Total										1.4E-06					4.3E-02			
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	5.03E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.52E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.5E-03		
				ARSENIC	1.88E-03	(mg/L)	2.55E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.8E-07	1.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-03		
				CADMIUM	3.15E-03	(mg/L)	4.27E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	5.66E-08	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.8E-08	1.32E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.4E-05		
				CYANIDE	2.96E-02	(mg/L)	4.02E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.81E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.7E-02		
				IRON	4.44E+00	(mg/L)	6.02E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.22E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.0E-03		
				MANGANESE	3.59E-01	(mg/L)	4.87E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.41E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-03		
				VANADIUM	4.53E-03	(mg/L)	6.15E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.30E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	8.6E-04		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	4.07E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.1E-09	9.50E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.76E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-08	4.10E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-04		
				Exp. Route Total										4.3E-07				

TABLE 7.53
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	4.56E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.2E-04
				ARSENIC	1.88E-03	(mg/L)	2.31E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.5E-08	1.62E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.4E-04
				CADMIUM	3.15E-03	(mg/L)	3.87E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.71E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.1E-02
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.03E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.1E-07	2.39E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	3.2E-04
				CYANIDE	2.96E-02	(mg/L)	3.64E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.55E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	4.2E-03
				IRON	4.44E+00	(mg/L)	5.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.82E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	5.5E-04
				MANGANESE	3.59E-01	(mg/L)	4.41E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	3.09E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.2E-04
				VANADIUM	4.53E-03	(mg/L)	5.57E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.90E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	3.0E-03
				PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	4.73E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	2.64E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.8E-03
				Exp. Route Total							1.6E-06					2.9E-02
				Exposure Point Total							2.0E-06					9.8E-02
			Exposure Medium Total							2.0E-06					9.8E-02	
Surface Water Total										2.0E-06					9.8E-02	
Soil	Surface Soil	East Tank Farm	Ingestion	Inorganics												
				ALUMINUM	8.26E+03	(mg/kg)	3.74E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.61E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.6E-03
				ARSENIC	2.94E+00	(mg/kg)	7.97E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-07	5.58E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03
				COBALT	5.38E+00	(mg/kg)	2.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.70E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.7E-03
				IRON	1.51E+04	(mg/kg)	6.82E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.77E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-03
				MANGANESE	6.41E+02	(mg/kg)	2.90E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.4E-03
				PAHs												
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	7.75E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.7E-09	1.81E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	1.39E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.4E-08	3.25E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	8.44E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.4E-08	1.97E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-04
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	2.35E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	5.48E-08	(mg/kg-day)	NA	(mg/kg-day)	--
				Exp. Route Total							2.3E-07					1.9E-02

TABLE 7.53
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Surface Soil	East Tank Farm	Dermal ¹	Inorganics														
				ALUMINUM	8.26E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.94E+00	(mg/kg)	3.61E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.4E-08	2.53E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.4E-04		
				COBALT	5.38E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.51E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	6.41E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	5.71E-01	(mg/kg)	9.12E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.1E-09	2.13E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	1.03E+00	(mg/kg)	1.64E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.6E-08	3.83E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	6.22E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.9E-08	2.32E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.7E-04		
				INDENO(1,2,3-C,D)PYRENE	1.73E-01	(mg/kg)	2.76E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.8E-09	6.45E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
				Exp. Route Total								1.8E-07						1.6E-03
			Exposure Point Total								4.1E-07						2.1E-02	
	Exposure Medium Total										4.1E-07				2.1E-02			
	Air	East Tank Farm	Inhalation	Inorganics														
				ALUMINUM	6.30E-06	(mg/m³)	2.14E-05	(ug/m³)	NA	per (ug/m³)	--	1.50E-08	(mg/m³)	5.00E-03	(mg/m³)	3.0E-06		
				ARSENIC	2.24E-09	(mg/m³)	7.60E-09	(ug/m³)	4.30E-03	per (ug/m³)	3.3E-11	5.32E-12	(mg/m³)	1.50E-05	(mg/m³)	3.5E-07		
COBALT				4.10E-09	(mg/m³)	1.39E-08	(ug/m³)	9.00E-03	per (ug/m³)	1.3E-10	9.75E-12	(mg/m³)	6.00E-06	(mg/m³)	1.6E-06			
IRON				1.15E-05	(mg/m³)	3.90E-05	(ug/m³)	NA	per (ug/m³)	--	2.73E-08	(mg/m³)	NA	(mg/m³)	--			
MANGANESE				4.89E-07	(mg/m³)	1.66E-06	(ug/m³)	NA	per (ug/m³)	--	1.16E-09	(mg/m³)	5.00E-05	(mg/m³)	2.3E-05			
PAHs																		
BENZ(A)ANTHRACENE				4.36E-10	(mg/m³)	4.44E-09	(ug/m³)	6.00E-05	per (ug/m³)	2.7E-13	1.03E-12	(mg/m³)	NA	(mg/m³)	--			
BENZO(B)FLUORANTHENE				7.84E-10	(mg/m³)	7.98E-09	(ug/m³)	6.00E-05	per (ug/m³)	4.8E-13	1.86E-12	(mg/m³)	NA	(mg/m³)	--			
BENZO(A)PYRENE				4.75E-10	(mg/m³)	4.83E-09	(ug/m³)	6.00E-04	per (ug/m³)	2.9E-12	1.13E-12	(mg/m³)	2.00E-06	(mg/m³)	5.6E-07			
INDENO(1,2,3-C,D)PYRENE				1.32E-10	(mg/m³)	1.34E-09	(ug/m³)	6.00E-05	per (ug/m³)	8.1E-14	3.14E-13	(mg/m³)	NA	(mg/m³)	--			
Exp. Route Total										1.6E-10						2.9E-05		
Exposure Point Total									1.6E-10						2.9E-05			
Exposure Medium Total										1.6E-10				2.9E-05				
Soil Total										4.1E-07				2.1E-02				
						Total of Receptor Risks Across All Media					3.8E-06		Total of Receptor Hazards Across All Media					1.6E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.54
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Adult																	
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Sediment	Sediment	Sediment	Ingestion	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	2.62E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.18E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.2E-04	
				ARSENIC	2.25E+00	(mg/kg)	5.15E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	7.7E-08	1.80E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	3.21E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	1.6E-07	5.61E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.9E-04	
				COBALT	4.24E+00	(mg/kg)	1.62E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	5.66E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.9E-03	
				IRON	1.04E+04	(mg/kg)	3.97E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.39E-03	(mg/kg-day)	7.00E-01	(mg/kg-day)	2.0E-03	
				MANGANESE	2.23E+02	(mg/kg)	8.51E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.98E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-04	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	1.90E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-09	3.33E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.46E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.5E-08	2.55E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-05	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	3.98E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.0E-09	6.96E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
			Exp. Route Total								2.6E-07					5.9E-03	
			Dermal ¹	Inorganics													
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	2.25E+00	(mg/kg)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	7.61E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-04	
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--	
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	2.29E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.3E-09	4.00E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	2.09E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-09	3.65E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	1.60E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-08	2.80E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.3E-05	
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	4.37E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.4E-09	7.64E-09	(mg/kg-day)	NA	(mg/kg-day)	--	
			Exp. Route Total								5.7E-08					3.5E-04	
			Exposure Point Total								3.2E-07					6.2E-03	
			Exposure Medium Total								3.2E-07					6.2E-03	
Sediment Total								3.2E-07					6.2E-03				
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics													
				ALUMINUM	3.71E+00	(mg/L)	1.13E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.96E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	4.0E-04	
				ARSENIC	1.88E-03	(mg/L)	5.74E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.6E-08	2.01E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-04	
				CADMIUM	3.15E-03	(mg/L)	9.62E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	3.37E-07	(mg/kg-day)	1.00E-03	(mg/kg-day)	3.4E-04	
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	8.49E-09	(mg/kg-day)	5.00E-01	per (mg/kg-day)	4.2E-09	1.49E-08	(mg/kg-day)	3.00E-03	(mg/kg-day)	5.0E-06	
				CYANIDE	2.96E-02	(mg/L)	9.04E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	3.16E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	5.3E-03	
				IRON	4.44E+00	(mg/L)	1.36E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	4.74E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	6.8E-04	
				MANGANESE	3.59E-01	(mg/L)	1.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.84E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.7E-04	
				VANADIUM	4.53E-03	(mg/L)	1.38E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.84E-07	(mg/kg-day)	5.00E-03	(mg/kg-day)	9.7E-05	
				PAHs													
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	6.11E-09	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.1E-10	1.07E-08	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.32E-05	(mg/L)	2.64E-09	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.6E-09	4.62E-09	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-05	
			Exp. Route Total								9.4E-08					7.7E-03	

TABLE 7.54
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future			Receptor Population: Resident			Receptor Age: Adult												
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Surface Water	Surface Water	Surface Water	Dermal	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	6.83E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.39E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.4E-04		
				ARSENIC	1.88E-03	(mg/L)	3.46E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.2E-08	1.21E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-04		
				CADMIUM	3.15E-03	(mg/L)	5.80E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.03E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	8.1E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.02E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	2.0E-07	1.79E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	2.4E-04		
				CYANIDE	2.96E-02	(mg/L)	5.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	1.91E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	3.2E-03		
				IRON	4.44E+00	(mg/L)	8.18E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.86E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.1E-04		
				MANGANESE	3.59E-01	(mg/L)	6.61E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-04		
				VANADIUM	4.53E-03	(mg/L)	8.34E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	2.92E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	2.2E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	2.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.0E-07	3.54E-06	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.13E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-06	1.98E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.6E-03		
				Exp. Route Total							1.6E-06					2.2E-02		
				Exposure Point Total							1.7E-06					2.9E-02		
				Exposure Medium Total							1.7E-06					2.9E-02		
Surface Water Total												1.7E-06					2.9E-02	
Soil	Subsurface Soil	East Tank Farm	Ingestion	Inorganics														
				ALUMINUM	8.19E+03	(mg/kg)	2.80E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	9.82E-03	(mg/kg-day)	1.00E+00	(mg/kg-day)	9.8E-03		
				ARSENIC	4.71E+00	(mg/kg)	9.68E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.5E-06	3.39E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02		
				COBALT	8.55E+00	(mg/kg)	2.93E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.4E-02		
				IRON	1.81E+04	(mg/kg)	6.20E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.17E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.1E-02		
				MANGANESE	2.50E+02	(mg/kg)	8.55E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.99E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.1E-03		
				PAHs														
				BENZO(A)PYRENE	5.98E-02	(mg/kg)	4.10E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.1E-08	7.17E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-04		
				Exp. Route Total							1.5E-06					8.9E-02		
				Dermal ¹	Inorganics													
			ALUMINUM		8.19E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
			ARSENIC		4.71E+00	(mg/kg)	2.04E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.1E-07	7.15E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-03		
			COBALT		8.55E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
			IRON		1.81E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
			MANGANESE		2.50E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
			PAHs															
			BENZO(A)PYRENE		5.98E-02	(mg/kg)	2.25E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.2E-08	3.93E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-04		
			Exp. Route Total							3.3E-07					2.5E-03			
			Exposure Point Total							1.8E-06					9.1E-02			
			Exposure Medium Total							1.8E-06					9.1E-02			

TABLE 7.54
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Adult																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Air	East Tank Farm	Inhalation	Inorganics	6.25E-06	(mg/m³)	1.71E-03	(ug/m³)	NA	per (ug/m³)	--	5.99E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03		
				ALUMINUM	3.60E-09	(mg/m³)	9.85E-07	(ug/m³)	4.30E-03	per (ug/m³)	4.2E-09	3.45E-09	(mg/m³)	1.50E-05	(mg/m³)	2.3E-04		
				ARSENIC	6.52E-09	(mg/m³)	1.79E-06	(ug/m³)	9.00E-03	per (ug/m³)	1.6E-08	6.26E-09	(mg/m³)	6.00E-06	(mg/m³)	1.0E-03		
				COBALT	1.38E-05	(mg/m³)	3.79E-03	(ug/m³)	NA	per (ug/m³)	--	1.33E-05	(mg/m³)	NA	(mg/m³)	--		
				IRON	1.91E-07	(mg/m³)	5.22E-05	(ug/m³)	NA	per (ug/m³)	--	1.83E-07	(mg/m³)	5.00E-05	(mg/m³)	3.7E-03		
				MANGANESE														
				PAHs														
				BENZO(A)PYRENE	4.56E-11	(mg/m³)	2.50E-08	(ug/m³)	6.00E-04	per (ug/m³)	1.5E-11	4.38E-11	(mg/m³)	2.00E-06	(mg/m³)	2.2E-05		
				Exp. Route Total										2.0E-08				6.1E-03
				Exposure Point Total										2.0E-08				6.1E-03
	Exposure Medium Total									2.0E-08				6.1E-03				
Soil Total											1.8E-06				9.7E-02			
Total of Receptor Risks Across All Media											3.8E-06	Total of Receptor Hazards Across All Media					1.3E-01	

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.55
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Sediment	Sediment	Sediment	Ingestion	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	1.68E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.96E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.0E-02		
				ARSENIC	2.25E+00	(mg/kg)	3.30E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.9E-07	3.85E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.3E-02		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	5.44E-06	(mg/kg-day)	5.00E-01	per (mg/kg-day)	2.7E-06	1.20E-05	(mg/kg-day)	3.00E-03	(mg/kg-day)	4.0E-03		
				COBALT	4.24E+00	(mg/kg)	1.04E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.21E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.0E-02		
				IRON	1.04E+04	(mg/kg)	2.54E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.96E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	4.2E-02		
				MANGANESE	2.23E+02	(mg/kg)	5.45E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.35E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	4.5E-03		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	3.53E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.5E-08	7.78E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	3.22E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.2E-08	7.09E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	2.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.44E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	6.74E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	6.7E-08	1.48E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										3.6E-06				1.3E-01	
			Dermal ¹	Inorganics														
				ALUMINUM	6.87E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	2.25E+00	(mg/kg)	3.91E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.9E-08	4.56E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.5E-03		
				HEXAVALENT CHROMIUM (+6)	4.20E+00	(mg/kg)	NA	(mg/kg-day)	2.00E+01	per (mg/kg-day)	--	NA	(mg/kg-day)	7.50E-05	(mg/kg-day)	--		
				COBALT	4.24E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	1.04E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				MANGANESE	2.23E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--		
				PAHs														
				BENZ(A)ANTHRACENE	2.73E-01	(mg/kg)	1.09E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-08	2.40E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(B)FLUORANTHENE	2.49E-01	(mg/kg)	9.94E-08	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.9E-09	2.19E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	1.91E-01	(mg/kg)	7.63E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04		
				DIBENZ(A,H)ANTHRACENE	5.21E-02	(mg/kg)	2.08E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.1E-08	4.58E-08	(mg/kg-day)	NA	(mg/kg-day)	--		
			Exp. Route Total										1.8E-07				2.1E-03	
			Exposure Point Total										3.8E-06				1.3E-01	
			Exposure Medium Total										3.8E-06				1.3E-01	
Sediment Total												3.8E-06				1.3E-01		
Surface Water	Surface Water	Surface Water	Ingestion	Inorganics														
				ALUMINUM	3.71E+00	(mg/L)	9.06E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	1.06E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.1E-02		
				ARSENIC	1.88E-03	(mg/L)	4.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.9E-07	5.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-02		
				CADMIUM	3.15E-03	(mg/L)	7.69E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.98E-06	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.0E-03		
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.80E-07	(mg/kg-day)	5.00E-01	per (mg/kg-day)	9.0E-08	3.96E-07	(mg/kg-day)	3.00E-03	(mg/kg-day)	1.3E-04		
				CYANIDE	2.96E-02	(mg/L)	7.23E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.43E-05	(mg/kg-day)	6.00E-04	(mg/kg-day)	1.4E-01		
				IRON	4.44E+00	(mg/L)	1.08E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.8E-02		
				MANGANESE	3.59E-01	(mg/L)	8.77E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.02E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	7.3E-03		
				VANADIUM	4.53E-03	(mg/L)	1.11E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.29E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	2.6E-03		
				PAHs														
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	1.29E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-08	2.85E-07	(mg/kg-day)	NA	(mg/kg-day)	--		
				BENZO(A)PYRENE	4.32E-05	(mg/L)	5.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.6E-08	1.23E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.1E-04		
			Exp. Route Total										8.5E-07				2.1E-01	

TABLE 7.55
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Dermal	Inorganics												
				ALUMINUM	3.71E+00	(mg/L)	4.30E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.02E-04	(mg/kg-day)	1.00E+00	(mg/kg-day)	5.0E-04
				ARSENIC	1.88E-03	(mg/L)	2.18E-08	(mg/kg-day)	1.50E+00	per (mg/kg-day)	3.3E-08	2.54E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.5E-04
				CADMIUM	3.15E-03	(mg/L)	3.65E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	4.26E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.7E-02
				HEXAVALENT CHROMIUM (+6)	1.39E-04	(mg/L)	1.71E-08	(mg/kg-day)	2.00E+01	per (mg/kg-day)	3.4E-07	3.76E-08	(mg/kg-day)	7.50E-05	(mg/kg-day)	5.0E-04
				CYANIDE	2.96E-02	(mg/L)	3.43E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.00E-06	(mg/kg-day)	6.00E-04	(mg/kg-day)	6.7E-03
				IRON	4.44E+00	(mg/L)	5.15E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.00E-04	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.6E-04
				MANGANESE	3.59E-01	(mg/L)	4.16E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	4.85E-05	(mg/kg-day)	1.40E-01	(mg/kg-day)	3.5E-04
				VANADIUM	4.53E-03	(mg/L)	5.25E-08	(mg/kg-day)	NA	per (mg/kg-day)	--	6.13E-07	(mg/kg-day)	1.30E-04	(mg/kg-day)	4.7E-03
			Dermal	PAHs												
				BENZ(A)ANTHRACENE	1.00E-04	(mg/L)	3.38E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.44E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	4.32E-05	(mg/L)	1.88E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.9E-06	4.15E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02
			Exp. Route Total							2.6E-06						4.5E-02
		Exposure Point Total							3.4E-06						2.5E-01	
	Exposure Medium Total							3.4E-06						2.5E-01		
Surface Water Total							3.4E-06					2.5E-01				
Soil	Subsurface Soil	East Tank Farm	Ingestion	Inorganics												
				ALUMINUM	8.19E+03	(mg/kg)	8.98E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.05E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.0E-01
				ARSENIC	4.71E+00	(mg/kg)	3.10E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	4.6E-06	3.61E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-01
				COBALT	8.55E+00	(mg/kg)	9.37E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	1.09E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.6E-01
				IRON	1.81E+04	(mg/kg)	1.98E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	2.32E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.3E-01
				MANGANESE	2.50E+02	(mg/kg)	2.74E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	3.19E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.3E-02
				PAHs												
				BENZO(A)PYRENE	5.98E-02	(mg/kg)	3.47E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.5E-07	7.65E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.5E-03
			Exp. Route Total							5.0E-06						9.5E-01
			Dermal	Inorganics												
				ALUMINUM	8.19E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ARSENIC	4.71E+00	(mg/kg)	3.68E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.5E-07	4.29E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.4E-02
				COBALT	8.55E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	1.81E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
	MANGANESE			2.50E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
PAHs																
BENZO(A)PYRENE	5.98E-02			(mg/kg)	1.07E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.1E-07	2.36E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	7.9E-04		
Exp. Route Total								6.6E-07						1.5E-02		
Exposure Point Total							5.7E-06						9.6E-01			
Exposure Medium Total							5.7E-06						9.6E-01			

TABLE 7.55
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Air	East Tank Farm	Inhalation	Inorganics													
				ALUMINUM	6.25E-06	(mg/m³)	5.14E-04	(ug/m³)	NA	per (ug/m³)	--	5.99E-06	(mg/m³)	5.00E-03	(mg/m³)	1.2E-03	
				ARSENIC	3.60E-09	(mg/m³)	2.96E-07	(ug/m³)	4.30E-03	per (ug/m³)	1.3E-09	3.45E-09	(mg/m³)	1.50E-05	(mg/m³)	2.3E-04	
				COBALT	6.52E-09	(mg/m³)	5.36E-07	(ug/m³)	9.00E-03	per (ug/m³)	4.8E-09	6.26E-09	(mg/m³)	6.00E-06	(mg/m³)	1.0E-03	
				IRON	1.38E-05	(mg/m³)	1.14E-03	(ug/m³)	NA	per (ug/m³)	--	1.33E-05	(mg/m³)	NA	(mg/m³)	--	
				MANGANESE	1.91E-07	(mg/m³)	1.57E-05	(ug/m³)	NA	per (ug/m³)	--	1.83E-07	(mg/m³)	5.00E-05	(mg/m³)	3.7E-03	
			PAHs														
			BENZO(A)PYRENE	4.56E-11	(mg/m³)	3.75E-09	(ug/m³)	6.00E-04	per (ug/m³)	2.3E-12	4.38E-11	(mg/m³)	2.00E-06	(mg/m³)	2.2E-05		
			Exp. Route Total							6.1E-09					6.1E-03		
			Exposure Point Total							6.1E-09					6.1E-03		
Exposure Medium Total							6.1E-09					6.1E-03					
Soil Total												5.7E-06					9.7E-01
Total of Receptor Risks Across All Media											1.3E-05	Total of Receptor Hazards Across All Media					1.3E+00

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.56
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Constituent of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Subsurface Soil	East Tank Farm	Ingestion	Inorganics													
				ALUMINUM	8.19E+03	(mg/kg)	3.31E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.31E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.3E-02	
				ARSENIC	4.71E+00	(mg/kg)	1.14E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.7E-07	7.99E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.7E-02	
				COBALT	8.55E+00	(mg/kg)	3.45E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.41E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.0E-02	
				IRON	1.81E+04	(mg/kg)	7.31E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	5.12E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	7.3E-02	
				MANGANESE	2.50E+02	(mg/kg)	1.01E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.05E-04	(mg/kg-day)	1.40E-01	(mg/kg-day)	5.0E-03	
				PAHs													
				BENZO(A)PYRENE	5.98E-02	(mg/kg)	2.41E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	2.4E-09	1.69E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04	
				Exp. Route Total							1.7E-07					2.1E-01	
			Dermal ¹	Inorganics													
				ALUMINUM	8.19E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	4.71E+00	(mg/kg)	1.83E-08	(mg/kg-day)	1.5E+00	per (mg/kg-day)	2.7E-08	1.28E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.3E-03	
				COBALT	8.55E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	1.81E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				MANGANESE	2.50E+02	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--	
				PAHs													
				BENZO(A)PYRENE	5.98E-02	(mg/kg)	1.01E-09	(mg/kg-day)	1.0E+00	per (mg/kg-day)	1.0E-09	7.04E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.3E-04	
				Exp. Route Total							2.8E-08					4.5E-03	
			Exposure Point Total								2.0E-07					2.1E-01	
			Exposure Medium Total								2.0E-07					2.1E-01	
	Air	East Tank Farm	Inhalation	Inorganics													
				ALUMINUM	1.34E-04	(mg/m ³)	4.37E-04	(ug/m ³)	NA	per (ug/m ³)	--	3.06E-05	(mg/m ³)	5.00E-03	(mg/m ³)	6.1E-03	
				ARSENIC	7.71E-08	(mg/m ³)	2.52E-07	(ug/m ³)	4.30E-03	per (ug/m ³)	1.1E-09	1.76E-08	(mg/m ³)	1.50E-05	(mg/m ³)	1.2E-03	
				COBALT	1.40E-07	(mg/m ³)	4.56E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	4.1E-09	3.19E-08	(mg/m ³)	6.00E-06	(mg/m ³)	5.3E-03	
				IRON	2.97E-04	(mg/m ³)	9.67E-04	(ug/m ³)	NA	per (ug/m ³)	--	6.77E-05	(mg/m ³)	NA	(mg/m ³)	--	
				MANGANESE	4.09E-06	(mg/m ³)	1.33E-05	(ug/m ³)	NA	per (ug/m ³)	--	9.34E-07	(mg/m ³)	5.00E-05	(mg/m ³)	1.9E-02	
PAHs																	
BENZO(A)PYRENE				9.79E-10	(mg/m ³)	2.30E-08	(ug/m ³)	6.0E-04	per (ug/m ³)	1.4E-11	2.24E-10	(mg/m ³)	2.00E-06	(mg/m ³)	1.1E-04		
Exp. Route Total										5.2E-09					3.1E-02		
Exposure Point Total									5.2E-09					3.1E-02			
Exposure Medium Total								5.2E-09					3.1E-02				
Soil Total								2.1E-07					2.4E-01				
Total of Receptor Risks Across All Media											2.1E-07	Total of Receptor Hazards Across All Media					2.4E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.57
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:					
	Particulate Emission Factor	PEF = Q/C x [(3,600 s/h)/(.36 x (1- V) x (Um/Ut)^3 x F(x))] =			1.31E+09
	Air Concentration	Cair = Csoil*((1/PEF)+(1/VF))			
Where,					
Q/C =	8.26E+01 g/m ² -s per kg/m ³	Inverse Mean Concentration at Center of 0.05 square source for Lincoln, NE, USEPA 1996			
V =	5.00E-01 unitless	Default, USEPA 2018			
Um =	4.65E+00 m/s	Mean annual wind speed, Lincoln, NE, USEPA 1996			
Ut =	1.13E+01 m/s	Equivalent threshold value of windspeed at 7 m, USEPA 2018			
F(x) =	1.82E-02 unitless	Default, USEPA 2018			
VF =	Volatilization Factor m ³ /kg	Chemical Specific, USEPA 2018			
Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.					
USEPA Regional Screening Levels. November 2018					
		Csoil, Subsurface Soil	Volatilization	Cair, Surface Soil	Cair, Subsurface Soil
Chemical	Csoil, Surface Soil	Soil	Factor	Particulate	Particulate
	RME EPC	RME EPC	VF	RME EPC	RME EPC
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³
Inorganics					
ALUMINUM	8.26E+03	8.19E+03	--	6.30E-06	6.25E-06
ARSENIC	2.94E+00	4.71E+00	--	2.24E-09	3.60E-09
COBALT	5.38E+00	8.55E+00	--	4.10E-09	6.52E-09
IRON	1.51E+04	1.81E+04	--	1.15E-05	1.38E-05
MANGANESE	6.41E+02	2.50E+02	--	4.89E-07	1.91E-07
LEAD	NA	NA	--	NA	NA
PAHs					
BENZ(A)ANTHRACENE	5.71E-01	NA	--	4.36E-10	NA
BENZO(B)FLUORANTHENE	1.03E+00	NA	--	7.84E-10	NA
BENZO(A)PYRENE	6.22E-01	5.98E-02	--	4.75E-10	4.56E-11
INDENO(1,2,3-C,D)PYRENE	1.73E-01	NA	--	1.32E-10	NA

TABLE 7.58
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
CONSTRUCTION WORKER - OTHER THAN STANDARD VEHICLE TRAFFIC
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

6.11E+07 Calculated using EPA RSL Calculator (Calculations provided in Appendix D)

Air Concentration

 $C_{air} = C_{soil} * ((1/PEF) + (1/VF))$

Where,

Area to be excavated, graded, tilled =

5.00E+00 acres

Depth of excavation =

1.50E+00 meters

Q/C =

9.44E+00 g/m²-s per kg/m³

calculated

Um =

4.69E+00 m/s

Mean annual wind speed, USEPA 2016a

Ut =

1.13E+01 m/s

Equivalent threshold value of windspeed at 7 m, USEPA 2016a

F(x) =

1.94E-01 unitless

Default, USEPA 2016a

VF =

Volatilization Factor m³/kg

Chemical Specific, USEPA 2016a

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. May 2016.

Chemical	Csoil, Surface Soil	Csoil, Subsurface Soil	Volatilization Factor	Cair, Surface Soil	Cair, Subsurface Soil
	RME EPC	RME EPC	VF	Particulate	Particulate
	mg/kg	mg/kg	m ³ /kg	mg/m ³	mg/m ³
Inorganics					
ALUMINUM	8.26E+03	8.19E+03	--	1.35E-04	1.34E-04
ARSENIC	2.94E+00	4.71E+00	--	4.81E-08	7.71E-08
COBALT	5.38E+00	8.55E+00	--	8.80E-08	1.40E-07
IRON	1.51E+04	1.81E+04	--	2.47E-04	2.97E-04
MANGANESE	6.41E+02	2.50E+02	--	1.05E-05	4.09E-06
PAHs					
BENZ(A)ANTHRACENE	5.71E-01	NA		9.35E-09	NA
BENZO(B)FLUORANTHENE	1.03E+00	NA		1.68E-08	NA
BENZO(A)PYRENE	6.22E-01	5.98E-02		1.02E-08	9.79E-10
INDENO(1,2,3-C,D)PYRENE	1.73E-01	NA		2.83E-09	NA

TABLE 7.59
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN HOME GROWN PRODUCE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:				
		$Pr = Cs * Br_{ag} * 0.12$	mg/kg	Concentration of COPC in plant due to root uptake
Model Constants:				
		C_s	chemical-specific mg/kg	COPC concentration in soil (mg/kg)
		$Br_{ag} =$	chemical-specific unitless	Plant to soil bioconcentration factor (unitless), above ground produce and forage
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA 2005.				
Constituent of Potential Concern	Cs, Surface Soil RME EPC mg/kg	Br _{ag} ⁽¹⁾ unitless	Reference	P _r RME EPC mg/kg
Inorganics				
ALUMINUM	8.26E+03	4.00E-03	RAIS 2019	3.96E+00
ARSENIC	2.94E+00	6.33E-03	U.S. EPA 2005	2.23E-03
COBALT	5.38E+00	2.00E-02	RAIS 2019	1.29E-02
IRON	1.51E+04	4.00E-03	RAIS 2019	7.24E+00
MANGANESE	6.41E+02	2.50E-01	RAIS 2019	1.92E+01
PAHs				
BENZ(A)ANTHRACENE	5.71E-01	1.97E-02	U.S. EPA 2005	1.35E-03
BENZO(B)FLUORANTHENE	1.03E+00	1.12E-02	U.S. EPA 2005	1.38E-03
BENZO(A)PYRENE	6.22E-01	1.32E-02	U.S. EPA 2005	9.85E-04
INDENO(1,2,3-C,D)PYRENE	1.73E-01	5.93E-03	U.S. EPA 2005	1.23E-04

References:

U. S. EPA 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* , Final, EPA/530/R-05/006, Washington, D.C.
 RAIS 2019. *Risk Assessment Information System* , online database available at: <http://rais.ornl.gov>. Assuming soil-to-dry plant uptake.

TABLE 7.60
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN BEEF
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:						
		$CM = ((F_i * Q_{p(\text{forage, cattle})} * P_i) + (Q_{\text{soil}(\text{cattle})} * C_s * B_s)) * B_{a,\text{beef}} * MF$				
Model Constants:						
F_i	1	unitless	Fraction of plant type grown on contaminated soil and ingested by cattle, assume only consume forage grown on contaminated soil.			
$Q_{p(\text{forage, cattle})}$	8.8	kg/day	Quantity of forage ingested by cattle per day.			
P_i	calculated	mg/kg	Concentration of COPC in plant ingested by cattle.			
			$C_s * Br_{ag} * 0.12$			
			C_s = COPC concentration in soil (mg/kg).			
			Br_{ag} = plant to soil bioconcentration factor (unitless)			
$Q_{\text{soil}(\text{cattle})}$	0.5	kg/day	Quantity of soil ingested by cattle.			
C_s	chemical-specific	mg/kg	Surface soil COPC concentration			
B_s	1	unitless	Soil bioavailability factor.			
$B_{a,\text{beef}}$	chemical-specific	day/kg	Biotransfer factor for beef.			
MF	1	unitless	Metabolism factor for all constituents, except bis(2-ethylhexyl)phthalate = 0.01			
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA, 2005.						
Chemical	Cs, Surface Soil	Br _{ag} ⁽¹⁾	P _i	B _{a,beef} ⁽¹⁾	Reference	CM
	RME EPC					RME EPC
	mg/kg	unitless	mg/kg	day/kg		mg/kg
Inorganics						
ALUMINUM	8.26E+03	4.00E-03	3.96E+00	1.50E-03	RAIS 2019	6.25E+00
ARSENIC	2.94E+00	6.33E-03	2.23E-03	2.00E-03	U.S. EPA 2005	2.98E-03
COBALT	5.38E+00	2.00E-02	1.29E-02	2.00E-02	RAIS 2019	5.60E-02
IRON	1.51E+04	4.00E-03	7.24E+00	2.00E-02	RAIS 2019	1.52E+02
MANGANESE	6.41E+02	2.50E-01	1.92E+01	4.00E-04	RAIS 2019	1.96E-01
PAHs						
BENZ(A)ANTHRACENE	5.71E-01	1.97E-02	1.35E-03	1.44E-02	U.S. EPA 2005	4.28E-03
BENZO(B)FLUORANTHENE	1.03E+00	1.12E-02	1.38E-03	1.51E-02	U.S. EPA 2005	7.94E-03
BENZO(A)PYRENE	6.22E-01	1.32E-02	9.85E-04	3.37E-02	U.S. EPA 2005	1.08E-02
INDENO(1,2,3-C,D)PYRENE	1.73E-01	5.93E-03	1.23E-04	1.25E-01	U.S. EPA 2005	1.09E-02

(1) Br_{ag} taken from USEPA, 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, Final, EPA/530/R-05/006, Washington, D.C. For COPCs not listed in this document, taken from RAIS 2019, Risk Assessment Information System, online database available at: <http://rais.ornl.gov>. Assuming soil-to-wet plant uptake.

TABLE 7.61
CALCULATION OF DERMALLY ABSORBED DOSE FROM GROUNDWATER
RESIDENT (ADULT AND CHILD) - REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Constituent of Potential Concern	EPC (ug/L)	K _p (cm/hr)	Log K _p	MW (g/mole)	Log K _{ow}	B (unitless)	D _{sc} (cm ² /hr)	τ _{event} (hr)	b	c	t* (hr)	DA _{adult} (mg/cm ² -event)	DA _{child} (mg/cm ² -event)
PAHs													
2-METHYLNAPHTHALENE	3.30E+01	8.94E-02	-1.05E+00	142.20	3.86	4.10E-01	2.53E-07	6.58E-01	6.19E-01	6.46E-01	1.58E+00	5.6E-06	4.9E-06
NAPHTHALENE	5.92E+01	4.57E-02	-1.34E+00	128.18	3.30	1.99E-01	3.04E-07	5.49E-01	4.38E-01	4.77E-01	1.32E+00	4.7E-06	4.1E-06
Volatiles													
BENZENE	2.40E+03	1.47E-02	-1.83E+00	78.12	2.13	5.01E-02	5.79E-07	2.88E-01	3.34E-01	3.68E-01	6.91E-01	4.5E-05	3.9E-05
1,2-DICHLOROETHANE	4.10E+00	4.19E-03	-2.38E+00	98.96	1.48	1.60E-02	4.42E-07	3.77E-01	3.13E-01	3.44E-01	9.04E-01	2.5E-08	2.1E-08
ETHYLBENZENE	1.10E+03	4.84E-02	-1.32E+00	106.17	3.15	1.92E-01	4.03E-07	4.13E-01	4.33E-01	4.71E-01	9.92E-01	8.0E-05	6.9E-05
ISOPROPYLBENZENE	6.00E+01	8.76E-02	-1.06E+00	120.20	3.66	3.69E-01	3.36E-07	4.95E-01	5.81E-01	6.13E-01	1.19E+00	8.6E-06	7.5E-06
M,P-XYLENE	2.30E+03	4.91E-02	-1.31E+00	106.17	3.16	1.95E-01	4.03E-07	4.13E-01	4.35E-01	4.74E-01	9.92E-01	1.7E-04	1.5E-04
TOLUENE	1.10E+03	3.06E-02	-1.51E+00	92.14	2.73	1.13E-01	4.83E-07	3.45E-01	3.76E-01	4.12E-01	8.28E-01	4.6E-05	4.0E-05
O-XYLENE	5.00E+02	4.62E-02	-1.34E+00	106.17	3.12	1.83E-01	4.03E-07	4.13E-01	4.26E-01	4.65E-01	9.92E-01	3.5E-05	3.0E-05

Notes:

-- = Not applicable

B = Ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis

cm/hr = Centimeter per hour

cm²/hr = Square centimeter per hour

DA = Dose absorbed per event per area of skin exposed for the adult and child resident scenario

D_{sc} = Effective diffusivity for chemical transfer through the skin

USEPA = U.S. Environmental Protection Agency

EPC = Exposure point concentration (see Table 3.11)

g/mol = Gram per mole

hr = Hour

K_p = Dermal permeability coefficient of compound in water; calculated per USEPA 2004 for organicsLog K_{ow} = Log octanol/water partition coefficient (Primary source: USEPA 2004)Log K_p = Log of the dermal permeability coefficient

ug/L = Microgram per liter

mg/cm²-event = Milligram per square centimeter per event

MW = Molecular weight

τ_{event} = Lag time per event

t* = Time it takes to reach steady-state

TABLE 7.62
CALCULATION OF DERMALLY ABSORBED DOSE FROM GROUNDWATER
CONSTRUCTION AND COMMERCIAL WORKER - REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Contaminant of Potential Concern	EPC (ug/L)	K _p (cm/hr)	Log K _p	MW (g/mole)	Log K _{ow}	B (unitless)	D _{sc} (cm ² /hr)	τ _{event} (hr)	b	c	t* (hr)	DA _{ConstW} (mg/cm ² -event)	DA _{CommW} (mg/cm ² -event)
PAHs													
2-METHYLNAPHTHALENE	3.30E+01	8.94E-02	-1.05E+00	142.20	3.9	4.10E-01	2.53E-07	6.58E-01	6.19E-01	6.46E-01	1.58E+00	1.4E-05	6.6E-06
NAPHTHALENE	5.92E+01	4.57E-02	-1.34E+00	128.18	3.3	1.99E-01	3.04E-07	5.49E-01	4.38E-01	4.77E-01	1.32E+00	1.3E-05	5.5E-06
Volatiles													
BENZENE	2.40E+03	1.47E-02	-1.83E+00	78.12	2.1	5.01E-02	5.79E-07	2.88E-01	3.34E-01	3.68E-01	6.91E-01	1.6E-04	5.5E-05
1,2-DICHLOROETHANE	4.10E+00	4.19E-03	-2.38E+00	98.96	1.5	1.60E-02	4.42E-07	3.77E-01	3.13E-01	3.44E-01	9.04E-01	8.1E-08	3.0E-08
ETHYLBENZENE	1.10E+03	4.84E-02	-1.32E+00	106.17	3.2	1.92E-01	4.03E-07	4.13E-01	4.33E-01	4.71E-01	9.92E-01	2.3E-04	9.7E-05
ISOPROPYLBENZENE	6.00E+01	8.76E-02	-1.06E+00	120.20	3.7	3.69E-01	3.36E-07	4.95E-01	5.81E-01	6.13E-01	1.19E+00	2.2E-05	1.0E-05
M,P-XYLENE	2.30E+03	4.91E-02	-1.31E+00	106.17	3.2	1.95E-01	4.03E-07	4.13E-01	4.35E-01	4.74E-01	9.92E-01	4.9E-04	2.1E-04
TOLUENE	1.10E+03	3.06E-02	-1.51E+00	92.14	2.7	1.13E-01	4.83E-07	3.45E-01	3.76E-01	4.12E-01	8.28E-01	1.5E-04	5.6E-05
O-XYLENE	5.00E+02	4.62E-02	-1.34E+00	106.17	3.1	1.83E-01	4.03E-07	4.13E-01	4.26E-01	4.65E-01	9.92E-01	1.0E-04	4.2E-05

Notes:

B = Ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis

cm/hr = Centimeter per hour

cm²/hr = Square centimeter per hourDA_{IW} = Dose absorbed per event per area of skin exposed for the industrial worker (IW) scenarioD_{sc} = Effective diffusivity for chemical transfer through the skin

USEPA = U.S. Environmental Protection Agency

EPC = Exposure point concentration (see Table 3.11)

g/mol = Gram per mole

hr = Hour

IW = Industrial worker

K_p = Dermal permeability coefficient of compound in water; calculated per USEPA 2004 for organicsLog K_{ow} = Log octanol/water partition coefficient (Primary source: USEPA 2004)Log K_p = Log of the dermal permeability coefficient

ug/L = Microgram per liter

mg/cm²-event = Milligram per square centimeter per event

MW = Molecular weight

τ_{event} = Lag time per event

t* = Time it takes to reach steady-state

Log K_p = Log of the dermal permeability coefficient

TABLE 7.63
CALCULATION OF VAPOR CONCENTRATIONS IN TRENCH
FOR GROUND WATER LESS 15 FT BELOW GROUND SURFACE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

$$C_{\text{Trench}} = C_{\text{GW}} \times \text{VF}$$

Where,

 C_{Trench} = COPC concentration in trench ($\mu\text{g}/\text{m}^3$)

Calculated below

 C_{GW} = COPC concentration in ground water ($\mu\text{g}/\text{L}$)

Taken from Table 3.1

VF = volatilization factor (L/m^3)

Calculated below

$$\text{VF} = \frac{(K_i \times A \times F \times 10^{-3} \times 10^4 \times 3600)}{(\text{ACH} \times V)}$$

where,

Model Constants:

 K_i = overall mass transfer coefficient of COPC (cm/sec)
Values Used in Model

Chemical-specific

A = area of trench (m^2)

2.23

F = fraction of floor through which contaminant can enter (unitless)

1

ACH = air changes per hour (h^{-1})

2

V = volume of trench (m^3)

4.08

Measurement in feet

Length of trench (m)

2.44

8

Width of trench (m)

0.91

3

Depth of trench (m)

1.83

6

 10^{-3} = conversion factor (L/cm^3)

0.001

 10^4 = conversion factor (cm^2/m^2)

10,000

3600 = conversion factor (seconds per hour)

3,600

$$K_i = \frac{1}{\{(1/k_{iL}) + [(R * T)/(H * k_{iG})]\}}$$

where,

 k_{iL} = liquid-phase mass transfer coefficient of i (cm/sec)

calculated

R = ideal gas constant ($\text{atm} \cdot \text{m}^3/\text{mole} \cdot \text{K}$)

8.20E-05

T = average system absolute temperature ($^{\circ}\text{K}$)

298

H = Henry's Law constant for COPC ($\text{atm} \cdot \text{m}^3/\text{mol}$)

chemical-specific

 k_{iG} = gas-phase mass transfer coefficient of COPC (cm/sec)

calculated

$$k_{iL} = (\text{MW}_{\text{O}_2}/\text{MW}_{\text{COPC}})^{0.5} \times (T/298) \times k_{\text{L},\text{O}_2}$$

TABLE 7.63
CALCULATION OF VAPOR CONCENTRATIONS IN TRENCH
FOR GROUND WATER LESS 15 FT BELOW GROUND SURFACE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

where, MW_{O2} = molecular weight of O₂ (g/mol) 32 MW_{COPC} = molecular weight of COPC (g/mol) chemical-specific k_{L, O2} = liquid-phase mass transfer coefficient of oxygen at 25°C (cm/sec) 0.002 k_{iG} = (MW_{H2O} / MW_{COPC})^{0.335} x (T/298)^{1.005} x k_{G,H2O} where, k_{iG} = gas-phase mass transfer coefficient of COPC (cm/sec) calculated MW_{H2O} = molecular weight of water (g/mol) 18 k_{G,H2O} = gas-phase mass transfer coefficient of water vapor at 25°C (cm/sec) 0.833 Reference for the model: Virginia Department of Environmental Quality.									
Chemical of Potential Concern	Molecular Weight (g/mol)	Henry's Law Constant (H) (atm-m ³ /mol)	Gas-Phase Mass Transfer Coefficient k _{iG} (cm/sec)	Liquid-Phase Mass Transfer Coefficient k _{iL} (cm/sec)	Overall Mass Transfer Coefficient K _i (cm/sec)	COPC GW concentration (C _{gw}) (µg/L)	Volatilization Factor (VF) (L/m ³)	Concentration of COPC in Trench (C _{trench}) (µg/m ³)	Concentration of COPC in Trench (C _{trench}) (mg/m ³)
PAHs									
NAPHTHALENE	128.18	4.40E-04	4.32E-01	9.99E-04	8.85E-04	0.0			
Volatiles									
BENZENE	78.12	5.55E-03	5.09E-01	1.28E-03	1.27E-03	0.0			
1,2-DICHLOROETHANE	98.96	1.18E-03	4.71E-01	1.14E-03	1.08E-03	0.0			
ETHYLBENZENE	106.17	7.88E-03	4.60E-01	1.10E-03	1.09E-03	0.0			
ISOPROPYLBENZENE	120.20	1.15E-02	4.41E-01	1.03E-03	1.03E-03	0.0			
M,P-XYLENE	106.17	7.18E-03	4.60E-01	1.10E-03	1.09E-03	0.0			
TOLUENE	92.14	6.64E-03	4.82E-01	1.18E-03	1.17E-03	0.0			
XYLENES	106.17	5.18E-03	4.60E-01	1.10E-03	1.09E-03	0.0			

TABLE 7.64
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future																
Receptor Population: Resident																
Receptor Age: Adult																
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Residential Yards	Ingestion	Inorganics												
				ALUMINUM	2.10E+04	(mg/kg)	7.19E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.52E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.5E-02
				ANTIMONY	6.90E+00	(mg/kg)	2.36E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.27E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	2.1E-02
				ARSENIC	2.21E+01	(mg/kg)	4.54E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	6.8E-06	1.59E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.3E-02
				CADMIUM	8.02E+01	(mg/kg)	2.75E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	9.61E-05	(mg/kg-day)	1.00E-03	(mg/kg-day)	9.6E-02
				COBALT	6.12E+01	(mg/kg)	2.10E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.34E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.4E-01
				IRON	7.27E+04	(mg/kg)	2.49E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	8.71E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.2E-01
				MANGANESE	1.88E+03	(mg/kg)	6.44E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	2.25E-03	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.6E-02
				VANADIUM	5.22E+01	(mg/kg)	1.79E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.26E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.3E-02
				ZINC	1.38E+04	(mg/kg)	4.73E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.65E-02	(mg/kg-day)	3.00E-01	(mg/kg-day)	5.5E-02
				PAHs												
				BENZ(A)ANTHRACENE	3.60E+00	(mg/kg)	2.47E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.5E-07	4.32E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.90E+00	(mg/kg)	1.30E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.3E-07	2.28E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.70E+00	(mg/kg)	1.85E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.8E-06	3.24E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02
				DIBENZ(A,H)ANTHRACENE	6.70E-01	(mg/kg)	4.59E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.6E-07	8.03E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	1.50E+00	(mg/kg)	1.03E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.0E-07	1.80E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				Volatiles												
				BENZENE	1.90E+00	(mg/kg)	6.51E-07	(mg/kg-day)	5.50E-02	per (mg/kg-day)	3.6E-08	2.28E-06	(mg/kg-day)	4.00E-03	(mg/kg-day)	5.7E-04
			Exp. Route Total				9.6E-06					6.6E-01				
			Dermal ¹	Inorganics												
				ALUMINUM	2.10E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	6.90E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	2.21E+01	(mg/kg)	9.59E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.4E-06	3.36E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.1E-02
				CADMIUM	8.02E+01	(mg/kg)	1.16E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	4.06E-07	(mg/kg-day)	2.50E-05	(mg/kg-day)	1.6E-02
				COBALT	6.12E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	7.27E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	1.88E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	5.22E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				ZINC	1.38E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	3.60E+00	(mg/kg)	1.35E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.4E-07	2.37E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.90E+00	(mg/kg)	7.14E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.1E-08	1.25E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.70E+00	(mg/kg)	1.02E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.0E-06	1.78E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.9E-03
				DIBENZ(A,H)ANTHRACENE	6.70E-01	(mg/kg)	2.52E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	4.41E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	1.50E+00	(mg/kg)	5.64E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	5.6E-08	9.87E-07	(mg/kg-day)	NA	(mg/kg-day)	--
				Volatiles												
				BENZENE	1.90E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
			Exp. Route Total				3.0E-06					3.3E-02				
			Exposure Point Total				1.3E-05					6.9E-01				
			Exposure Medium Total				1.3E-05					6.9E-01				

TABLE 7.64
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Air	Residential Yards	Inhalation	Inorganics												
				ALUMINUM	1.60E-05	(mg/m ³)	4.39E-03	(ug/m ³)	NA	per (ug/m ³)	--	1.54E-05	(mg/m ³)	5.00E-03	(mg/m ³)	3.1E-03
				ANTIMONY	5.27E-09	(mg/m ³)	1.44E-06	(ug/m ³)	NA	per (ug/m ³)	--	5.05E-09	(mg/m ³)	NA	(mg/m ³)	--
				ARSENIC	1.69E-08	(mg/m ³)	4.62E-06	(ug/m ³)	4.30E-03	per (ug/m ³)	2.0E-08	1.62E-08	(mg/m ³)	1.50E-05	(mg/m ³)	1.1E-03
				CADMIUM	6.12E-08	(mg/m ³)	1.68E-05	(ug/m ³)	1.80E-03	per (ug/m ³)	3.0E-08	5.87E-08	(mg/m ³)	1.00E-05	(mg/m ³)	5.9E-03
				COBALT	4.67E-08	(mg/m ³)	1.28E-05	(ug/m ³)	9.00E-03	per (ug/m ³)	1.2E-07	4.48E-08	(mg/m ³)	6.00E-06	(mg/m ³)	7.5E-03
				IRON	5.55E-05	(mg/m ³)	1.52E-02	(ug/m ³)	NA	per (ug/m ³)	--	5.32E-05	(mg/m ³)	NA	(mg/m ³)	--
				MANGANESE	1.44E-06	(mg/m ³)	3.93E-04	(ug/m ³)	NA	per (ug/m ³)	--	1.38E-06	(mg/m ³)	5.00E-05	(mg/m ³)	2.8E-02
				VANADIUM	3.98E-08	(mg/m ³)	1.09E-05	(ug/m ³)	NA	per (ug/m ³)	--	3.82E-08	(mg/m ³)	1.00E-04	(mg/m ³)	3.8E-04
				ZINC	1.05E-05	(mg/m ³)	2.89E-03	(ug/m ³)	NA	per (ug/m ³)	--	1.01E-05	(mg/m ³)	NA	(mg/m ³)	--
				PAHs												
				BENZ(A)ANTHRACENE	2.75E-09	(mg/m ³)	1.51E-06	(ug/m ³)	6.00E-05	per (ug/m ³)	9.0E-11	2.64E-09	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(B)FLUORANTHENE	1.45E-09	(mg/m ³)	7.95E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	4.8E-11	1.39E-09	(mg/m ³)	NA	(mg/m ³)	--
				BENZO(A)PYRENE	2.06E-09	(mg/m ³)	1.13E-06	(ug/m ³)	6.00E-04	per (ug/m ³)	6.8E-10	1.98E-09	(mg/m ³)	2.00E-06	(mg/m ³)	9.9E-04
				DIBENZ(A,H)ANTHRACENE	5.11E-10	(mg/m ³)	2.80E-07	(ug/m ³)	6.00E-04	per (ug/m ³)	1.7E-10	4.90E-10	(mg/m ³)	NA	(mg/m ³)	--
				INDENO(1,2,3-C,D)PYRENE	1.15E-09	(mg/m ³)	6.27E-07	(ug/m ³)	6.00E-05	per (ug/m ³)	3.8E-11	1.10E-09	(mg/m ³)	NA	(mg/m ³)	--
				Volatiles												
				BENZENE	1.45E-09	(mg/m ³)	3.97E-07	(ug/m ³)	7.80E-06	per (ug/m ³)	3.1E-12	1.39E-09	(mg/m ³)	3.00E-02	(mg/m ³)	4.6E-08
				Exp. Route Total							1.7E-07					4.6E-02
				Exposure Point Total							1.7E-07					4.6E-02
				Exposure Medium Total							1.7E-07					4.6E-02

TABLE 7.64
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations								
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient				
							Value	Units	Value	Units		Value	Units	Value	Units					
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics																
				ALUMINUM	1.01E+01	(mg/kg)	4.32E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	1.51E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	1.5E-02				
				ANTIMONY	2.48E-02	(mg/kg)	1.06E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	3.73E-05	(mg/kg-day)	4.00E-04	(mg/kg-day)	9.3E-02				
				ARSENIC	1.68E-02	(mg/kg)	7.19E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.1E-05	2.52E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	8.4E-02				
				CADMIUM	1.44E-01	(mg/kg)	6.19E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	2.17E-04	(mg/kg-day)	1.00E-03	(mg/kg-day)	2.2E-01				
				COBALT	3.30E-02	(mg/kg)	1.42E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	4.96E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.7E-01				
				IRON	6.11E+01	(mg/kg)	2.62E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	9.16E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.3E-01				
				MANGANESE	2.26E+01	(mg/kg)	9.67E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.38E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	2.4E-01				
				VANADIUM	3.45E-02	(mg/kg)	1.48E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.17E-05	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.0E-02				
				ZINC	6.62E-01	(mg/kg)	2.84E-04	(mg/kg-day)	NA	per (mg/kg-day)	--	9.94E-04	(mg/kg-day)	3.00E-01	(mg/kg-day)	3.3E-03				
				PAHs																
				BENZ(A)ANTHRACENE	8.51E-03	(mg/kg)	7.29E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	7.3E-07	1.28E-05	(mg/kg-day)	NA	(mg/kg-day)	--				
				BENZO(B)FLUORANTHENE	2.55E-03	(mg/kg)	2.19E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.2E-07	3.83E-06	(mg/kg-day)	NA	(mg/kg-day)	--				
				BENZO(A)PYRENE	4.28E-03	(mg/kg)	3.67E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.7E-06	6.42E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.1E-02				
				DIBENZ(A,H)ANTHRACENE	5.45E-04	(mg/kg)	4.67E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.7E-07	8.18E-07	(mg/kg-day)	NA	(mg/kg-day)	--				
				INDENO(1,2,3-C,D)PYRENE	1.07E-03	(mg/kg)	9.15E-07	(mg/kg-day)	1.00E-01	per (mg/kg-day)	9.1E-08	1.60E-06	(mg/kg-day)	NA	(mg/kg-day)	--				
				Volatiles																
				BENZENE	5.47E-01	(mg/kg)	2.93E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.6E-07	8.21E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	2.1E-01				
				Exp. Route Total																
				Exposure Point Total																
				Exposure Medium Total																
				Soil Total																
				Total of Receptor Risks Across All Media																
Total of Receptor Hazards Across All Media																				

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.65
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Residential Yards	Ingestion	Inorganics												
				ALUMINUM	2.10E+04	(mg/kg)	2.30E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	2.68E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.7E-01
				ANTIMONY	6.90E+00	(mg/kg)	7.56E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	8.82E-05	(mg/kg-day)	4.00E-04	(mg/kg-day)	2.2E-01
				ARSENIC	2.21E+01	(mg/kg)	1.45E-05	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.2E-05	1.70E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.7E-01
				CADMIUM	8.02E+01	(mg/kg)	8.79E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.03E-03	(mg/kg-day)	1.00E-03	(mg/kg-day)	1.0E+00
				COBALT	6.12E+01	(mg/kg)	6.71E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	7.82E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.6E+00
				IRON	7.27E+04	(mg/kg)	7.97E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	9.29E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	1.3E+00
				MANGANESE	1.88E+03	(mg/kg)	2.06E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.40E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	1.7E-01
				VANADIUM	5.22E+01	(mg/kg)	5.72E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	6.67E-04	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.3E-01
				ZINC	1.38E+04	(mg/kg)	1.51E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	1.76E-01	(mg/kg-day)	3.00E-01	(mg/kg-day)	5.9E-01
				PAHs												
				BENZ(A)ANTHRACENE	3.60E+00	(mg/kg)	2.09E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.1E-06	4.60E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.90E+00	(mg/kg)	1.10E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.1E-06	2.43E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.70E+00	(mg/kg)	1.57E-05	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.6E-05	3.45E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.2E-01
				DIBENZ(A,H)ANTHRACENE	6.70E-01	(mg/kg)	3.89E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	3.9E-06	8.57E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	1.50E+00	(mg/kg)	8.71E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	8.7E-07	1.92E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				Volatiles												
				BENZENE	1.90E+00	(mg/kg)	2.08E-06	(mg/kg-day)	5.50E-02	per (mg/kg-day)	1.1E-07	2.43E-05	(mg/kg-day)	4.00E-03	(mg/kg-day)	6.1E-03
				Exp. Route Total							4.6E-05					7.0E+00
			Dermal ¹	Inorganics												
				ALUMINUM	2.10E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--
				ANTIMONY	6.90E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	6.00E-05	(mg/kg-day)	--
				ARSENIC	2.21E+01	(mg/kg)	1.72E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.6E-06	2.01E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.7E-02
				CADMIUM	8.02E+01	(mg/kg)	2.09E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	2.43E-06	(mg/kg-day)	2.50E-05	(mg/kg-day)	9.7E-02
				COBALT	6.12E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--
				IRON	7.27E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--
				MANGANESE	1.88E+03	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.40E-01	(mg/kg-day)	--
				VANADIUM	5.22E+01	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.30E-04	(mg/kg-day)	--
				ZINC	1.38E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-01	(mg/kg-day)	--
				PAHs												
				BENZ(A)ANTHRACENE	3.60E+00	(mg/kg)	6.45E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	6.5E-07	1.42E-05	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(B)FLUORANTHENE	1.90E+00	(mg/kg)	3.40E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	3.4E-07	7.49E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				BENZO(A)PYRENE	2.70E+00	(mg/kg)	4.84E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	4.8E-06	1.06E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.5E-02
				DIBENZ(A,H)ANTHRACENE	6.70E-01	(mg/kg)	1.20E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	1.2E-06	2.64E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				INDENO(1,2,3-C,D)PYRENE	1.50E+00	(mg/kg)	2.69E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	2.7E-07	5.92E-06	(mg/kg-day)	NA	(mg/kg-day)	--
				Volatiles												
				BENZENE	1.90E+00	(mg/kg)	NA	(mg/kg-day)	5.50E-02	per (mg/kg-day)	--	NA	(mg/kg-day)	4.00E-03	(mg/kg-day)	--
				Exp. Route Total							9.9E-06					2.0E-01
			Exposure Point Total								5.5E-05					7.2E+00
			Exposure Medium Total								5.5E-05					7.2E+00

TABLE 7.65
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Air	Residential Yards	Inhalation	Inorganics													
				ALUMINUM	1.60E-05	(mg/m³)	1.32E-03	(ug/m³)	NA	per (ug/m³)	--	1.54E-05	(mg/m³)	5.00E-03	(mg/m³)	3.1E-03	
				ANTIMONY	5.27E-09	(mg/m³)	4.33E-07	(ug/m³)	NA	per (ug/m³)	--	5.05E-09	(mg/m³)	NA	(mg/m³)	--	
				ARSENIC	1.69E-08	(mg/m³)	1.39E-06	(ug/m³)	4.30E-03	per (ug/m³)	6.0E-09	1.62E-08	(mg/m³)	1.50E-05	(mg/m³)	1.1E-03	
				CADMIUM	6.12E-08	(mg/m³)	5.03E-06	(ug/m³)	1.80E-03	per (ug/m³)	9.1E-09	5.87E-08	(mg/m³)	1.00E-05	(mg/m³)	5.9E-03	
				COBALT	4.67E-08	(mg/m³)	3.84E-06	(ug/m³)	9.00E-03	per (ug/m³)	3.5E-08	4.48E-08	(mg/m³)	6.00E-06	(mg/m³)	7.5E-03	
				IRON	5.55E-05	(mg/m³)	4.56E-03	(ug/m³)	NA	per (ug/m³)	--	5.32E-05	(mg/m³)	NA	(mg/m³)	--	
				MANGANESE	1.44E-06	(mg/m³)	1.18E-04	(ug/m³)	NA	per (ug/m³)	--	1.38E-06	(mg/m³)	5.00E-05	(mg/m³)	2.8E-02	
				VANADIUM	3.98E-08	(mg/m³)	3.28E-06	(ug/m³)	NA	per (ug/m³)	--	3.82E-08	(mg/m³)	1.00E-04	(mg/m³)	3.8E-04	
				ZINC	1.05E-05	(mg/m³)	8.66E-04	(ug/m³)	NA	per (ug/m³)	--	1.01E-05	(mg/m³)	NA	(mg/m³)	--	
				PAHs													
				BENZ(A)ANTHRACENE	2.75E-09	(mg/m³)	1.20E-06	(ug/m³)	6.00E-05	per (ug/m³)	7.2E-11	2.64E-09	(mg/m³)	NA	(mg/m³)	--	
				BENZO(B)FLUORANTHENE	1.45E-09	(mg/m³)	6.32E-07	(ug/m³)	6.00E-05	per (ug/m³)	3.8E-11	1.39E-09	(mg/m³)	NA	(mg/m³)	--	
				BENZO(A)PYRENE	2.06E-09	(mg/m³)	8.98E-07	(ug/m³)	6.00E-04	per (ug/m³)	5.4E-10	1.98E-09	(mg/m³)	2.00E-06	(mg/m³)	9.9E-04	
				DIBENZ(A,H)ANTHRACENE	5.11E-10	(mg/m³)	2.23E-07	(ug/m³)	6.00E-04	per (ug/m³)	1.3E-10	4.90E-10	(mg/m³)	NA	(mg/m³)	--	
				INDENO(1,2,3-C,D)PYRENE	1.15E-09	(mg/m³)	4.99E-07	(ug/m³)	6.00E-05	per (ug/m³)	3.0E-11	1.10E-09	(mg/m³)	NA	(mg/m³)	--	
				Volatiles													
				BENZENE	1.45E-09	(mg/m³)	1.19E-07	(ug/m³)	7.80E-06	per (ug/m³)	9.3E-13	1.39E-09	(mg/m³)	3.00E-02	(mg/m³)	4.6E-08	
							Exp. Route Total						5.0E-08				4.6E-02
							Exposure Point Total						5.0E-08				4.6E-02
							Exposure Medium Total						5.0E-08				4.6E-02

TABLE 7.65
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Surface Soil	Homegrown Produce	Ingestion	Inorganics													
				ALUMINUM	1.01E+01	(mg/kg)	3.33E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	3.88E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	3.9E-02	
				ANTIMONY	2.48E-02	(mg/kg)	5.46E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	6.38E-06	(mg/kg-day)	4.00E-04	(mg/kg-day)	1.6E-02	
				ARSENIC	1.68E-02	(mg/kg)	5.54E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	8.3E-06	6.46E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	2.2E-01	
				CADMIUM	1.44E-01	(mg/kg)	4.76E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	5.56E-04	(mg/kg-day)	1.00E-03	(mg/kg-day)	5.6E-01	
				COBALT	3.30E-02	(mg/kg)	1.09E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.27E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.2E-01	
				IRON	6.11E+01	(mg/kg)	2.02E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	2.35E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	3.4E-01	
				MANGANESE	2.26E+01	(mg/kg)	7.44E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	8.69E-02	(mg/kg-day)	1.40E-01	(mg/kg-day)	6.2E-01	
				VANADIUM	3.45E-02	(mg/kg)	7.58E-07	(mg/kg-day)	NA	per (mg/kg-day)	--	8.84E-06	(mg/kg-day)	5.00E-03	(mg/kg-day)	1.8E-03	
				ZINC	6.62E-01	(mg/kg)	1.46E-05	(mg/kg-day)	NA	per (mg/kg-day)	--	1.70E-04	(mg/kg-day)	3.00E-01	(mg/kg-day)	5.7E-04	
				PAHs													
				BENZ(A)ANTHRACENE	8.51E-03	(mg/kg)	1.49E-05	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.5E-06	3.28E-05	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(B)FLUORANTHENE	2.55E-03	(mg/kg)	4.47E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	4.5E-07	9.83E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				BENZO(A)PYRENE	4.28E-03	(mg/kg)	7.48E-06	(mg/kg-day)	1.00E+00	per (mg/kg-day)	7.5E-06	1.65E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.5E-02	
				DIBENZ(A,H)ANTHRACENE	5.45E-04	(mg/kg)	9.53E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.5E-07	2.10E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				INDENO(1,2,3-C,D)PYRENE	1.07E-03	(mg/kg)	1.87E-06	(mg/kg-day)	1.00E-01	per (mg/kg-day)	1.9E-07	4.11E-06	(mg/kg-day)	NA	(mg/kg-day)	--	
				Volatiles													
				BENZENE	5.47E-01	(mg/kg)	1.20E-05	(mg/kg-day)	5.50E-02	per (mg/kg-day)	6.6E-07	1.40E-04	(mg/kg-day)	4.00E-03	(mg/kg-day)	3.5E-02	
				Exp. Route Total				2.0E-05							2.3E+00		
				Exposure Point Total				2.0E-05							2.3E+00		
				Exposure Medium Total				2.0E-05							2.3E+00		
				Soil Total				7.5E-05							9.6E+00		
				Total of Receptor Risks Across All Media											7.5E-05		Total of Receptor Hazards Across All Media

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.66
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		Value	Units	Value	Units		
Soil	Subsurface Soil	Residential Yards	Ingestion	Inorganics													
				ALUMINUM	2.26E+04	(mg/kg)	7.74E-03	(mg/kg-day)	NA	per (mg/kg-day)	--	2.71E-02	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.7E-02	
				ARSENIC	1.85E+01	(mg/kg)	3.80E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	5.7E-06	1.33E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.4E-02	
				COBALT	7.60E+00	(mg/kg)	2.60E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	9.11E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.0E-02	
				IRON	4.37E+04	(mg/kg)	1.50E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	5.24E-02	(mg/kg-day)	7.00E-01	(mg/kg-day)	7.5E-02	
				PAHs													
				BENZO(A)PYRENE	1.40E-01	(mg/kg)	9.59E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	9.6E-08	1.68E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-04	
			Exp. Route Total						5.8E-06						1.8E-01		
			Dermal ¹	Inorganics													
				ALUMINUM	2.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--	
				ARSENIC	1.85E+01	(mg/kg)	8.03E-07	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.2E-06	2.81E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	9.4E-03	
				COBALT	7.60E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--	
				IRON	4.37E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--	
				PAHs													
				BENZO(A)PYRENE	1.40E-01	(mg/kg)	5.26E-08	(mg/kg-day)	1.00E+00	per (mg/kg-day)	5.3E-08	9.21E-08	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.1E-04	
			Exp. Route Total						1.3E-06						9.7E-03		
		Exposure Point Total							7.1E-06						1.9E-01		
	Exposure Medium Total							7.1E-06						1.9E-01			
	Air	Residential Yards	Inhalation	Inorganics													
				ALUMINUM	1.73E-05	(mg/m³)	4.73E-03	(ug/m³)	NA	per (ug/m³)	--	1.65E-05	(mg/m³)	5.00E-03	(mg/m³)	3.3E-03	
				ARSENIC	1.41E-08	(mg/m³)	3.87E-06	(ug/m³)	4.30E-03	per (ug/m³)	1.7E-08	1.35E-08	(mg/m³)	1.50E-05	(mg/m³)	9.0E-04	
				COBALT	5.80E-09	(mg/m³)	1.59E-06	(ug/m³)	9.00E-03	per (ug/m³)	1.4E-08	5.56E-09	(mg/m³)	6.00E-06	(mg/m³)	9.3E-04	
				IRON	3.34E-05	(mg/m³)	9.14E-03	(ug/m³)	NA	per (ug/m³)	--	3.20E-05	(mg/m³)	NA	(mg/m³)	--	
				PAHs													
				BENZO(A)PYRENE	1.07E-10	(mg/m³)	5.86E-08	(ug/m³)	6.00E-04	per (ug/m³)	3.5E-11	1.02E-10	(mg/m³)	2.00E-06	(mg/m³)	5.1E-05	
			Exp. Route Total						3.1E-08						5.2E-03		
		Exposure Point Total							3.1E-08						5.2E-03		
	Exposure Medium Total							3.1E-08						5.2E-03			
Soil Total							7.1E-06						1.9E-01				
Total of Receptor Risks Across All Media											7E-06	Total of Receptor Hazards Across All Media					1.9E-01

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance

EPC = Exposure Point Concentration

CSF = Cancer Slope Factor

RfD = Reference Dose

RfC = Reference Concentration

TABLE 7.67
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child																		
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units		Value	Units	Value	Units			
Soil	Subsurface Soil	Residential Yards	Ingestion	Inorganics														
				ALUMINUM	2.26E+04	(mg/kg)	2.48E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	2.89E-01	(mg/kg-day)	1.00E+00	(mg/kg-day)	2.9E-01		
				ARSENIC	1.85E+01	(mg/kg)	1.22E-05	(mg/kg-day)	1.50E+00	per (mg/kg-day)	1.8E-05	1.42E-04	(mg/kg-day)	3.00E-04	(mg/kg-day)	4.7E-01		
				COBALT	7.60E+00	(mg/kg)	8.33E-06	(mg/kg-day)	NA	per (mg/kg-day)	--	9.72E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	3.2E-01		
				IRON	4.37E+04	(mg/kg)	4.79E-02	(mg/kg-day)	NA	per (mg/kg-day)	--	5.59E-01	(mg/kg-day)	7.00E-01	(mg/kg-day)	8.0E-01		
				PAHs														
				BENZO(A)PYRENE	1.40E-01	(mg/kg)	8.13E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	8.1E-07	1.79E-06	(mg/kg-day)	3.00E-04	(mg/kg-day)	6.0E-03		
			Exp. Route Total								1.9E-05					1.9E+00		
			Dermal ¹	Inorganics														
				ALUMINUM	2.26E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	1.00E+00	(mg/kg-day)	--		
				ARSENIC	1.85E+01	(mg/kg)	1.44E-06	(mg/kg-day)	1.50E+00	per (mg/kg-day)	2.2E-06	1.68E-05	(mg/kg-day)	3.00E-04	(mg/kg-day)	5.6E-02		
				COBALT	7.60E+00	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	3.00E-04	(mg/kg-day)	--		
				IRON	4.37E+04	(mg/kg)	NA	(mg/kg-day)	NA	per (mg/kg-day)	--	NA	(mg/kg-day)	7.00E-01	(mg/kg-day)	--		
				PAHs														
				BENZO(A)PYRENE	1.40E-01	(mg/kg)	2.51E-07	(mg/kg-day)	1.00E+00	per (mg/kg-day)	2.5E-07	5.52E-07	(mg/kg-day)	3.00E-04	(mg/kg-day)	1.8E-03		
			Exp. Route Total								2.4E-06					5.8E-02		
			Exposure Point Total								2.1E-05					1.9E+00		
			Exposure Medium Total								2.1E-05					1.9E+00		
	Air	Residential Yards	Inhalation	Inorganics														
				ALUMINUM	1.73E-05	(mg/m ³)	1.42E-03	(ug/m ³)	NA	per (ug/m ³)	--	1.65E-05	(mg/m ³)	5.00E-03	(mg/m ³)	3.3E-03		
				ARSENIC	1.41E-08	(mg/m ³)	1.16E-06	(ug/m ³)	4.30E-03	per (ug/m ³)	5.0E-09	1.35E-08	(mg/m ³)	1.50E-05	(mg/m ³)	9.0E-04		
				COBALT	5.80E-09	(mg/m ³)	4.77E-07	(ug/m ³)	9.00E-03	per (ug/m ³)	4.3E-09	5.56E-09	(mg/m ³)	6.00E-06	(mg/m ³)	9.3E-04		
				IRON	3.34E-05	(mg/m ³)	2.74E-03	(ug/m ³)	NA	per (ug/m ³)	--	3.20E-05	(mg/m ³)	NA	(mg/m ³)	--		
				PAHs														
				BENZO(A)PYRENE	1.07E-10	(mg/m ³)	8.78E-09	(ug/m ³)	6.00E-04	per (ug/m ³)	5.3E-12	1.02E-10	(mg/m ³)	2.00E-06	(mg/m ³)	5.1E-05		
			Exp. Route Total								9.3E-09					5.2E-03		
			Exposure Point Total								9.3E-09					5.2E-03		
			Exposure Medium Total								9.3E-09					5.2E-03		
Soil Total								2.1E-05					2.0E+00					
Total of Receptor Risks Across All Media											2.1E-05	Total of Receptor Hazards Across All Media				2.0E+00		

1) Dermal intake is "NA" due to no published dermal absorption factor. Please see Table 5.3 and U.S. EPA 2004 guidance.

EPC = Exposure Point Concentration RfD = Reference Dose

CSF = Cancer Slope Factor RfC = Reference Concentration

TABLE 7.68
CALCULATIONS OF AIR CONCENTRATIONS DUE TO DUST ENTRAINMENT FROM SOIL
RESIDENTIAL/COMMERCIAL WORKER EXPOSURES
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:

Particulate Emission Factor

$$PEF = Q/C \times [(3,600 \text{ s/h}) / (.36 \times (1 - V) \times (U_m/U_t)^3 \times F(x))] =$$

1.31E+09

Air Concentration

$$C_{air} = C_{soil} \times ((1/PEF) + (1/VF))$$

Where,

$$Q/C = 8.26E+01 \text{ g/m}^2\text{-s per kg/m}^3$$

Inverse Mean Concentration at Center of 0.05 square source for Lincoln, NE, USEPA 1996

$$V = 5.00E-01 \text{ unitless}$$

Default, USEPA 2019

$$U_m = 4.65E+00 \text{ m/s}$$

Mean annual wind speed, Lincoln, NE, USEPA 1996

$$U_t = 1.13E+01 \text{ m/s}$$

Equivalent threshold value of windspeed at 7 m, USEPA 2019

$$F(x) = 1.82E-02 \text{ unitless}$$

Default, USEPA 2019

$$VF = \text{Volatilization Factor m}^3/\text{kg}$$

Chemical Specific, USEPA 2019

Reference for the model: USEPA Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response. U.S. EPA, 1996.

USEPA Regional Screening Levels. November 2019.

Chemical	Csoil, Surface Soil	Csoil, Subsurface Soil	Volatilization Factor	Cair, Surface Soil	Cair, Subsurface Soil
	RME EPC	RME EPC		Particulate	Particulate
	mg/kg	mg/kg		m³/kg	RME EPC
				mg/m³	mg/m³
Inorganics					
ALUMINUM	2.10E+04	2.26E+04	--	1.60E-05	1.73E-05
ANTIMONY	6.90E+00	NA	--	5.27E-09	NA
ARSENIC	2.21E+01	1.85E+01	--	1.69E-08	1.41E-08
CADMIUM	8.02E+01	NA	--	6.12E-08	NA
COBALT	6.12E+01	7.60E+00	--	4.67E-08	5.80E-09
IRON	7.27E+04	4.37E+04	--	5.55E-05	3.34E-05
MANGANESE	1.88E+03	NA	--	1.44E-06	NA
VANADIUM	5.22E+01	NA	--	3.98E-08	NA
ZINC	1.38E+04	NA	--	1.05E-05	NA
PAHs					
BENZ(A)ANTHRACENE	3.60E+00	NA	--	2.75E-09	NA
BENZO(B)FLUORANTHENE	1.90E+00	NA	--	1.45E-09	NA
BENZO(A)PYRENE	2.70E+00	1.40E-01	--	2.06E-09	1.07E-10
DIBENZ(A,H)ANTHRACENE	6.70E-01	NA	--	5.11E-10	NA
INDENO(1,2,3-C,D)PYRENE	1.50E+00	NA	--	1.15E-09	NA
Volatiles					
BENZENE	1.90E+00	NA	--	1.45E-09	NA

TABLE 7.69
CALCULATIONS OF CONTAMINANT CONCENTRATIONS IN HOME GROWN PRODUCE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Model Equations:				
		$Pr = Cs * Br_{ag} * 0.12$	mg/kg	Concentration of COPC in plant due to root uptake
Model Constants:				
		C_s	chemical-specific mg/kg	COPC concentration in soil (mg/kg)
		$Br_{ag} =$	chemical-specific unitless	Plant to soil bioconcentration factor (unitless), above ground produce and forage
Reference for the model: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. U.S. EPA 2005.				
Constituent of Potential Concern	Cs, Surface Soil RME EPC mg/kg	$Br_{ag}^{(1)}$ unitless	Reference	P_r RME EPC mg/kg
Inorganics				
ALUMINUM	2.10E+04	4.00E-03	RAIS 2019	1.01E+01
ANTIMONY	6.90E+00	3.00E-02	U.S. EPA 2005	2.48E-02
ARSENIC	2.21E+01	6.33E-03	U.S. EPA 2005	1.68E-02
CADMIUM	8.02E+01	1.50E-02	U.S. EPA 2005	1.44E-01
COBALT	6.12E+01	4.50E-03	RAIS 2019	3.30E-02
IRON	7.27E+04	7.00E-03	RAIS 2019	6.11E+01
MANGANESE	1.88E+03	1.00E-01	RAIS 2019	2.26E+01
VANADIUM	5.22E+01	5.50E-03	RAIS 2017	3.45E-02
ZINC	1.38E+04	4.00E-04	U.S. EPA 2005	6.62E-01
PAHs				
BENZ(A)ANTHRACENE	3.60E+00	1.97E-02	U.S. EPA 2005	8.51E-03
BENZO(B)FLUORANTHENE	1.90E+00	1.12E-02	U.S. EPA 2005	2.55E-03
BENZO(A)PYRENE	2.70E+00	1.32E-02	U.S. EPA 2005	4.28E-03
DIBENZ(A,H)ANTHRACENE	6.70E-01	6.78E-03	U.S. EPA 2005	5.45E-04
INDENO(1,2,3-C,D)PYRENE	1.50E+00	5.93E-03	U.S. EPA 2005	1.07E-03
Volatiles				
BENZENE	1.90E+00	2.40E+00	U.S. EPA 2005	5.47E-01

References:U. S. EPA 2005. *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* , Final, EPA/530/R-05/006, Washington, D.C.RAIS 2019. *Risk Assessment Information System* , online database available at: <http://rais.ornl.gov>. Assuming soil-to-dry plant uptake.

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	North Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	8.5E-02	--	9.8E-04	8.6E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.9E-02	--	--	1.9E-02
			ARSENIC	2.3E-06	2.7E-07	6.3E-10	2.6E-06	ARSENIC	Skin, Cardiovascular	5.9E-02	7.1E-03	1.1E-04	6.7E-02
			COBALT	--	--	2.8E-09	2.8E-09	COBALT	Thyroid	2.1E-01	--	6.1E-04	2.1E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.1E-01	--	--	2.1E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.1E-02	--	8.1E-03	5.9E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.6E-07	4.9E-08	5.4E-12	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.8E-07	5.7E-08	6.3E-12	2.4E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.4E-06	4.4E-07	4.9E-11	1.9E-06	BENZO(A)PYRENE	Developmental System	1.1E-02	3.2E-03	9.0E-05	1.4E-02
			DIBENZ(A,H)ANTHRACENE	2.9E-07	9.0E-08	1.0E-11	3.8E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	4.4E-06	9.1E-07	3.5E-09	5.3E-06	(Total for Child)	(Total for Child)	6.5E-01	1.0E-02	9.9E-03	6.7E-01
		North Tank Farm (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	8.0E-03	--	9.8E-04	9.0E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.8E-03	--	--	1.8E-03
			ARSENIC	7.2E-07	1.5E-07	2.1E-09	8.7E-07	ARSENIC	Skin, Cardiovascular	5.6E-03	1.2E-03	1.1E-04	6.9E-03
			COBALT	--	--	9.4E-09	9.4E-09	COBALT	Thyroid	2.0E-02	--	6.1E-04	2.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-02	--	--	2.0E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.8E-03	--	8.1E-03	1.3E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.9E-08	1.0E-08	6.8E-12	2.9E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	2.2E-08	1.2E-08	8.0E-12	3.4E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.7E-07	9.3E-08	6.2E-11	2.6E-07	BENZO(A)PYRENE	Developmental System	9.9E-04	5.4E-04	9.0E-05	1.6E-03
			DIBENZ(A,H)ANTHRACENE	3.4E-08	1.9E-08	1.3E-11	5.3E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	9.6E-07	2.9E-07	1.2E-08	1.3E-06	(Total for Adult)	(Total for Adult)	6.1E-02	1.7E-03	9.9E-03	7.2E-02
		North Tank Farm (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	3.0E-06	4.2E-07	2.7E-09	3.4E-06						
			COBALT	NA	NA	1.2E-08	1.2E-08						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.8E-07	5.9E-08	1.2E-11	2.4E-07						
			BENZO(B)FLUORANTHENE	2.1E-07	6.9E-08	1.4E-11	2.8E-07						
			BENZO(A)PYRENE	1.6E-06	5.4E-07	1.1E-10	2.1E-06						
			DIBENZ(A,H)ANTHRACENE	3.3E-07	1.1E-07	2.3E-11	4.3E-07						
			(Total for Child + Adult)	5.3E-06	1.2E-06	1.5E-08	6.5E-06						

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	North Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.2E-02	--	--	1.2E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.1E-02	--	--	2.1E-02
			ARSENIC	8.3E-07	--	--	8.3E-07	ARSENIC	Skin, Cardiovascular	2.1E-02	--	--	2.1E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	1.5E-01	--	--	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.9E-02	--	--	2.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.3E-01	--	--	4.3E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-07	--	--	1.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	7.1E-08	--	--	7.1E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	6.5E-07	--	--	6.5E-07	BENZO(A)PYRENE	Developmental System	4.8E-03	--	--	4.8E-03
			DIBENZ(A,H)ANTHRACENE	6.8E-08	--	--	6.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	1.7E-06	---	---	1.7E-06	(Total for Child)	(Total for Child)	6.7E-01	---	---	6.7E-01
		North Tank Farm (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.8E-03	--	--	4.8E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	8.5E-03	--	--	8.5E-03
			ARSENIC	1.1E-06	--	--	1.1E-06	ARSENIC	Skin, Cardiovascular	8.8E-03	--	--	8.8E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	6.0E-02	--	--	6.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.2E-02	--	--	1.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.8E-01	--	--	1.8E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	5.5E-08	--	--	5.5E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.7E-08	--	--	3.7E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	3.4E-07	--	--	3.4E-07	BENZO(A)PYRENE	Developmental System	2.0E-03	--	--	2.0E-03
			DIBENZ(A,H)ANTHRACENE	3.5E-08	--	--	3.5E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	1.6E-06	---	---	1.6E-06	(Total for Adult)	(Total for Adult)	2.7E-01	---	---	2.7E-01
		North Tank Farm (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	2.0E-06	NA	NA	2.0E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.6E-07	NA	NA	1.6E-07						
			BENZO(B)FLUORANTHENE	1.1E-07	NA	NA	1.1E-07						
			BENZO(A)PYRENE	9.8E-07	NA	NA	9.8E-07						
			DIBENZ(A,H)ANTHRACENE	1.0E-07	NA	NA	1.0E-07						
			(Total for Child + Adult)	3.3E-06	---	---	3.3E-06						

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Beef Consumption	North Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.4E-02	--	--	1.4E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.2E-03	--	--	2.2E-03
			ARSENIC	8.3E-07	--	--	8.3E-07	ARSENIC	Skin, Cardiovascular	2.1E-02	--	--	2.1E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	4.7E-01	--	--	4.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.6E-01	--	--	4.6E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.3E-03	--	--	3.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.5E-07	--	--	2.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.1E-07	--	--	3.1E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.3E-06	--	--	5.3E-06	BENZO(A)PYRENE	Developmental System	3.9E-02	--	--	3.9E-02
			DIBENZ(A,H)ANTHRACENE	1.5E-05	--	--	1.5E-05	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	2.2E-05	---	---	2.2E-05	(Total for Child)	1.0E+00	---	---	---	1.0E+00
		North Tank Farm (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.4E-03	--	--	6.4E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.0E-03	--	--	1.0E-03
			ARSENIC	1.3E-06	--	--	1.3E-06	ARSENIC	Skin, Cardiovascular	9.9E-03	--	--	9.9E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	2.2E-01	--	--	2.2E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.1E-01	--	--	2.1E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-03	--	--	1.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.5E-07	--	--	1.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.8E-07	--	--	1.8E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	3.1E-06	--	--	3.1E-06	BENZO(A)PYRENE	Developmental System	1.8E-02	--	--	1.8E-02
			DIBENZ(A,H)ANTHRACENE	8.8E-06	--	--	8.8E-06	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	1.3E-05	---	---	1.3E-05	(Total for Adult)	4.7E-01	---	---	---	4.7E-01
		North Tank Farm (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	2.1E-06	NA	NA	2.1E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	4.0E-07	NA	NA	4.0E-07						
			BENZO(B)FLUORANTHENE	4.8E-07	NA	NA	4.8E-07						
			BENZO(A)PYRENE	8.4E-06	NA	NA	8.4E-06						
			DIBENZ(A,H)ANTHRACENE	2.4E-05	NA	NA	2.4E-05						
			(Total for Child + Adult)	3.5E-05	---	---	3.5E-05	Total Hazard Index Across Surface Soil (Child)					2.3E+00
		Total Risk Across Surface Soil (Adult + Child)				4.5E-05	Total Hazard Index Across Surface Soil (Adult)					8.1E-01	

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)	2.1E-01	4.5E-02	---	2.5E-01	
		Surface Water (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02	
		Surface Water (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	--	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07						
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06						
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06						
	Total Risk Across Surface Water (Adult + Child)						5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01
									Total Hazard Index Across Surface Water (Adult)				2.9E-02

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCS
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01	
		Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.34E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)	5.9E-03	3.5E-04	---	6.2E-03	
		Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across Sediment (Adult + Child)				4.1E-06	Total Hazard Index Across Sediment (Adult)					6.2E-03			
Total Risk Across All Media and All Exposure Routes				5E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)					3			

TABLE 9.1
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
NA = Not applicable due to no toxicity values.													Total Hazard Index Across All Media and All Exposure Routes (Adult)		0.8

NA = Not applicable due to no toxicity values.
-- = No risks calculated for this exposure pathway.

TABLE 9.2
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	North Tank Farm	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.9E-02	--	5.0E-03	2.4E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.9E-04	--	--	2.9E-04
			ARSENIC	8.4E-08	1.4E-08	5.3E-10	9.9E-08	ARSENIC	Skin, Cardiovascular	1.3E-02	2.1E-03	5.8E-04	1.6E-02
			COBALT	--	--	2.4E-09	2.4E-09	COBALT	Thyroid	4.7E-02	--	3.1E-03	5.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.7E-02	--	--	4.7E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.1E-02	--	4.2E-02	5.3E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-09	4.6E-10	8.7E-13	1.6E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.3E-09	5.4E-10	1.0E-12	1.8E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.0E-08	4.2E-09	7.9E-12	1.4E-08	BENZO(A)PYRENE	Developmental System	2.3E-03	9.7E-04	4.6E-04	3.8E-03
			DIBENZ(A,H)ANTHRACENE	2.0E-09	8.4E-10	1.6E-12	2.9E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	9.9E-08	2.0E-08	2.9E-09	1.2E-07	(Total)	1.4E-01	3.1E-03	5.1E-02	1.9E-01	
			Total Risk Across Surface Soil				1.2E-07				Total Hazard Index Across Surface Soil		
Total Risk Across All Media and All Exposure Routes				1E-07				Total Hazard Index Across All Media and All Exposure Routes					0.2

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.3
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm Scenario Timeframe: Current/Future Receptor Population: Commercial/Industrial Worker Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Surface Soil	North Tank Farm	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	5.7E-03	--	2.3E-04	5.9E-03		
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.3E-03	--	--	1.3E-03		
			ARSENIC	6.4E-07	2.3E-08	6.2E-10	6.6E-07	ARSENIC	Skin, Cardiovascular	4.0E-03	1.4E-04	2.7E-05	4.1E-03		
			COBALT	--	--	2.8E-09	2.8E-09	COBALT	Thyroid	1.4E-02	--	1.4E-04	1.4E-02		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E-02	--	--	1.4E-02		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.4E-03	--	1.9E-03	5.3E-03		
			PAHs					PAHs							
			BENZ(A)ANTHRACENE	8.3E-09	7.6E-10	1.0E-12	9.1E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA		
			BENZO(B)FLUORANTHENE	9.7E-09	8.9E-10	1.2E-12	1.1E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA		
			BENZO(A)PYRENE	7.6E-08	6.9E-09	9.2E-12	8.2E-08	BENZO(A)PYRENE	Developmental System	7.0E-04	6.5E-05	2.2E-05	7.9E-04		
			DIBENZ(A,H)ANTHRACENE	1.5E-08	1.4E-09	1.9E-12	1.7E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA		
			(Total)	7.5E-07	3.3E-08	3.4E-09	7.8E-07	(Total)	4.3E-02	2.1E-04	2.4E-03	4.6E-02			
			Total Risk Across Surface Soil				7.8E-07				Total Hazard Index Across Surface Soil				4.6E-02
			Total Risk Across All Media and All Exposure Routes				8E-07				Total Hazard Index Across All Media and All Exposure Routes				0.05

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.4
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	North Tank Farm	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.1E-03	--	2.4E-06	2.1E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	4.7E-04	--	--	4.7E-04
			ARSENIC	9.5E-08	4.3E-08	2.6E-11	1.4E-07	ARSENIC	Skin, Cardiovascular	1.5E-03	6.7E-04	2.8E-07	2.1E-03
			COBALT	--	--	1.2E-10	1.2E-10	COBALT	Thyroid	5.2E-03	--	1.5E-06	5.2E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.2E-03	--	--	5.2E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.3E-03	--	2.0E-05	1.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.7E-09	4.3E-09	1.3E-13	8.0E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	4.3E-09	5.1E-09	1.5E-13	9.4E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	3.4E-08	3.9E-08	1.2E-12	7.3E-08	BENZO(A)PYRENE	Developmental System	2.6E-04	3.1E-04	2.2E-07	5.7E-04
			DIBENZ(A,H)ANTHRACENE	6.8E-09	8.0E-09	2.3E-13	1.5E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	1.4E-07	1.0E-07	1.4E-10	2.4E-07	(Total)		1.6E-02	9.7E-04	2.5E-05	1.7E-02
			Total Risk Across Surface Soil				2.4E-07	Total Hazard Index Across Surface Soil					1.7E-02
Surface Water	Surface Water	Surface Water	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.5E-03	3.2E-04	--	3.8E-03
			ARSENIC	3.8E-07	3.5E-08	--	4.2E-07	ARSENIC	Skin, Cardiovascular	6.0E-03	5.4E-04	--	6.5E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.0E-03	1.1E-02	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.8E-07	2.1E-07	--	2.3E-07	HEXAVALENT CHROMIUM (+6)	None	4.4E-05	3.2E-04	--	3.6E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	4.7E-02	4.2E-03	--	5.1E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.0E-03	5.5E-04	--	6.6E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-03	2.2E-04	--	2.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	8.6E-04	3.0E-03	--	3.9E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	4.1E-09	2.0E-07	--	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.8E-08	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.4E-04	8.8E-03	--	8.9E-03
			(Total)	4.3E-07	1.6E-06	---	2.0E-06	(Total)		6.9E-02	2.9E-02	---	9.8E-02
			Total Risk Across Surface Water				2.0E-06	Total Hazard Index Across Surface Water					9.8E-02

TABLE 9.4
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.5E-03	--	--	6.5E-03
			ARSENIC	2.7E-07	6.2E-08	--	3.4E-07	ARSENIC	Skin, Cardiovascular	4.3E-03	9.7E-04	--	5.2E-03
			HEXAVALENT CHROMIUM (+6)	8.5E-07	--	--	8.5E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-03	--	--	1.3E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	1.3E-02	--	--	1.3E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E-02	--	--	1.4E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-03	--	--	1.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-08	6.5E-09	--	1.8E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.0E-08	6.0E-09	--	1.6E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.8E-08	4.6E-08	--	1.2E-07	BENZO(A)PYRENE	Developmental System	6.0E-04	3.6E-04	--	9.6E-04
			DIBENZ(A,H)ANTHRACENE	2.1E-08	1.2E-08	--	3.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	1.2E-06	1.3E-07	---	1.4E-06	(Total)	4.2E-02	1.3E-03	---	4.3E-02	
			Total Risk Across Sediment				1.4E-06				Total Hazard Index Across Sediment		
Total Risk Across All Media and All Exposure Routes				4E-06				Total Hazard Index Across All Media and All Exposure Routes				0.2	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Soil	Subsurface Soil	North Tank Farm (Child)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.0E-01	--	1.2E-03	1.0E-01	
			ARSENIC	3.4E-06	4.0E-07	9.2E-10	3.8E-06	ARSENIC	Skin, Cardiovascular	8.7E-02	1.0E-02	1.7E-04	9.8E-02	
			COBALT	--	--	6.4E-09	6.4E-09	COBALT	Thyroid	4.8E-01	--	1.4E-03	4.8E-01	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.3E-01	--	--	3.3E-01	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-02	--	3.3E-03	2.4E-02	
			(Total for Child)	3.4E-06	4.0E-07	7.3E-09	3.8E-06	(Total for Child)	1.0E+00	1.0E-02	6.0E-03	1.0E+00		
		North Tank Farm (Adult)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.7E-03	--	1.2E-03	1.1E-02	
			ARSENIC	1.1E-06	2.2E-07	3.1E-09	1.3E-06	ARSENIC	Skin, Cardiovascular	8.2E-03	1.7E-03	1.7E-04	1.0E-02	
			COBALT	--	--	2.1E-08	2.1E-08	COBALT	Thyroid	4.5E-02	--	1.4E-03	4.7E-02	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.1E-02	--	--	3.1E-02	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.9E-03	--	3.3E-03	5.2E-03	
			(Total for Adult)	1.1E-06	2.2E-07	2.4E-08	1.3E-06	(Total for Adult)	9.6E-02	1.7E-03	6.0E-03	1.0E-01		
		North Tank Farm (Adult + Child)	Inorganics											
			ALUMINUM	NA	NA	NA	NA							
			ARSENIC	4.4E-06	6.2E-07	4.0E-09	5.0E-06							
			COBALT	NA	NA	2.8E-08	2.8E-08							
			IRON	NA	NA	NA	NA							
			MANGANESE	NA	NA	NA	NA							
			(Total for Child + Adult)	4.4E-06	6.2E-07	3.2E-08	5.1E-06	Total Hazard Index Across Subsurface Soil (Child)					1.0E+00	
Total Risk Across Subsurface Soil (Adult + Child)							5.1E-06					Total Hazard Index Across Subsurface Soil (Adult)		1.0E-01
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02	
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02	
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02	
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04	
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03	
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03	
			PAHs					PAHs						
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02	
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)	2.1E-01	4.5E-02	---	2.5E-01		

TABLE 9.5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location:	North Tank Farm
Scenario Timeframe:	Current/Future
Receptor Population:	Resident
Receptor Age:	Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
		(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02		
		Surface Water (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	NA	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
MANGANESE	NA		NA	NA	NA								
VANADIUM	NA	NA	NA	NA									
PAHs													
BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07									
BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06									
(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01			
	Total Risk Across Surface Water (Adult + Child)					5.1E-06		Total Hazard Index Across Surface Water (Adult)				2.9E-02	

TABLE 9.5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Child)	Inorganics	--	--	--	NA	Inorganics	Neurological	2.0E-02	--	--	2.0E-02
			ALUMINUM	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)		1.3E-01	2.1E-03	---	1.3E-01
		Sediment (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	9.2E-04	--	--	9.2E-04
			ALUMINUM	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.3E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)		5.9E-03	3.5E-04	---	6.2E-03

TABLE 9.5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across Sediment (Adult + Child)							4.1E-06	Total Hazard Index Across Sediment (Adult)					6.2E-03
Total Risk Across All Media and All Exposure Routes							1E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)					1
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					0.1

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	North Tank Farm	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.3E-02	--	6.0E-03	2.9E-02
			ARSENIC	1.2E-07	2.0E-08	7.8E-10	1.4E-07	ARSENIC	Skin, Cardiovascular	1.9E-02	3.1E-03	8.5E-04	2.3E-02
			COBALT	--	--	5.4E-09	5.4E-09	COBALT	Thyroid	1.1E-01	--	7.1E-03	1.1E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	7.2E-02	--	--	7.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.6E-03	--	1.7E-02	2.1E-02
			(Total)	1.2E-07	2.0E-08	6.2E-09	1.5E-07		(Total)	2.3E-01	3.1E-03	3.1E-02	2.6E-01
Total Risk Across Subsurface Soil							1.5E-07	Total Hazard Index Across Subsurface Soil					2.6E-01
Total Risk Across All Media and All Exposure Routes							1E-07	Total Hazard Index Across All Media and All Exposure Routes					0.3

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Lorraine Process Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.6E-02	--	7.5E-04	6.7E-02
			ARSENIC	2.4E-06	2.9E-07	6.6E-10	2.7E-06	ARSENIC	Skin, Cardiovascular	6.2E-02	7.4E-03	1.2E-04	7.0E-02
			HEXAVALENT CHROMIUM (+6)	4.4E-06	--	4.2E-08	4.4E-06	HEXAVALENT CHROMIUM (+6)	None	6.4E-03	--	1.1E-05	6.4E-03
			COPPER	--	--	--	NA	COPPER	None	4.9E-02	--	--	4.9E-02
			COBALT	--	--	2.0E-09	2.0E-09	COBALT	Thyroid	1.5E-01	--	4.3E-04	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.9E-01	--	--	1.9E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.0E-02	--	3.3E-03	2.4E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.6E-07	5.0E-08	5.6E-12	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	2.4E-07	7.4E-08	8.2E-12	3.1E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.2E-06	3.8E-07	4.2E-11	1.6E-06	BENZO(A)PYRENE	Developmental System	8.9E-03	2.8E-03	7.7E-05	1.2E-02
			DIBENZ(A,H)ANTHRACENE	1.8E-08	5.6E-09	6.2E-13	2.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	2.8E-08	8.6E-09	9.6E-13	3.7E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	8.4E-06	8.0E-07	4.5E-08	9.3E-06	(Total for Child)	(Total for Child)	5.5E-01	1.0E-02	4.6E-03	5.6E-01
		Lorraine Process Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.2E-03	--	7.5E-04	6.9E-03
			ARSENIC	7.5E-07	1.6E-07	2.2E-09	9.1E-07	ARSENIC	Skin, Cardiovascular	5.8E-03	1.2E-03	1.2E-04	7.2E-03
			HEXAVALENT CHROMIUM (+6)	5.1E-07	--	5.3E-08	5.7E-07	HEXAVALENT CHROMIUM (+6)	None	6.0E-04	--	1.1E-05	6.1E-04
			COPPER	--	--	--	NA	COPPER	None	4.6E-03	--	--	4.6E-03
			COBALT	--	--	6.6E-09	6.6E-09	COBALT	Thyroid	1.4E-02	--	4.3E-04	1.4E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.7E-02	--	--	1.7E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.9E-03	--	3.3E-03	5.2E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.9E-08	1.1E-08	7.1E-12	3.0E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	2.8E-08	1.6E-08	1.0E-11	4.4E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.4E-07	7.9E-08	5.3E-11	2.2E-07	BENZO(A)PYRENE	Developmental System	8.4E-04	4.6E-04	7.7E-05	1.4E-03
			DIBENZ(A,H)ANTHRACENE	2.1E-09	1.2E-09	7.8E-13	3.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	3.3E-09	1.8E-09	1.2E-12	5.1E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	1.5E-06	2.7E-07	6.2E-08	1.8E-06	(Total for Adult)	(Total for Adult)	5.1E-02	1.7E-03	4.6E-03	5.8E-02

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Lorraine Process Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	3.2E-06	4.4E-07	2.9E-09	3.6E-06						
			HEXAVALENT CHROMIUM (+6)	4.9E-06	NA	9.5E-08	5.0E-06						
			COPPER	NA	NA	NA	NA						
			COBALT	NA	NA	8.6E-09	8.6E-09						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.8E-07	6.1E-08	1.3E-11	2.4E-07						
			BENZO(B)FLUORANTHENE	2.7E-07	9.0E-08	1.9E-11	3.6E-07						
			BENZO(A)PYRENE	1.4E-06	4.6E-07	9.5E-11	1.8E-06						
			DIBENZ(A,H)ANTHRACENE	2.0E-08	6.7E-09	1.4E-12	2.7E-08						
			INDENO(1,2,3-C,D)PYRENE	3.1E-08	1.0E-08	2.2E-12	4.2E-08						
			(Total for Child + Adult)	9.9E-06	1.1E-06	1.1E-07	1.1E-05						
Soil	Homegrown Produce	Lorraine Process Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.5E-03	--	--	9.5E-03
			ARSENIC	9.2E-07	--	--	9.2E-07	ARSENIC	Skin, Cardiovascular	2.4E-02	--	--	2.4E-02
			HEXAVALENT CHROMIUM (+6)	7.7E-07	--	--	7.7E-07	HEXAVALENT CHROMIUM (+6)	None	1.1E-03	--	--	1.1E-03
			COPPER	--	--	--	NA	COPPER	None	7.1E-01	--	--	7.1E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	1.1E-01	--	--	1.1E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.7E-02	--	--	2.7E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.8E-01	--	--	1.8E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.2E-07	--	--	1.2E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	9.7E-08	--	--	9.7E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.8E-07	--	--	5.8E-07	BENZO(A)PYRENE	Developmental System	4.3E-03	--	--	4.3E-03
			DIBENZ(A,H)ANTHRACENE	4.4E-09	--	--	4.4E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	6.0E-09	--	--	6.0E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	2.5E-06	---	---	2.5E-06		(Total for Child)	1.1E+00	---	---	1.1E+00

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	Lorraine Process Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.7E-03	--	--	3.7E-03
			ARSENIC	1.2E-06	--	--	1.2E-06	ARSENIC	Skin, Cardiovascular	9.3E-03	--	--	9.3E-03
			HEXAVALENT CHROMIUM (+6)	3.8E-07	--	--	3.8E-07	HEXAVALENT CHROMIUM (+6)	None	4.4E-04	--	--	4.4E-04
			COPPER	--	--	--	NA	COPPER	None	2.7E-01	--	--	2.7E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	4.2E-02	--	--	4.2E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.0E-02	--	--	1.0E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.1E-02	--	--	7.1E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	5.7E-08	--	--	5.7E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	4.8E-08	--	--	4.8E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.9E-07	--	--	2.9E-07	BENZO(A)PYRENE	Developmental System	1.7E-03	--	--	1.7E-03
			DIBENZ(A,H)ANTHRACENE	2.2E-09	--	--	2.2E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	2.9E-09	--	--	2.9E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	2.0E-06	---	---	2.0E-06	(Total for Adult)	(Total for Adult)	4.1E-01	---	---	4.1E-01
		Lorraine Process Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	2.1E-06	NA	NA	2.1E-06						
			HEXAVALENT CHROMIUM (+6)	1.1E-06	NA	NA	1.1E-06						
			COPPER	NA	NA	NA	NA						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.7E-07	NA	NA	1.7E-07						
			BENZO(B)FLUORANTHENE	1.4E-07	NA	NA	1.4E-07						
			BENZO(A)PYRENE	8.7E-07	NA	NA	8.7E-07						
			DIBENZ(A,H)ANTHRACENE	6.6E-09	NA	NA	6.6E-09						
			INDENO(1,2,3-C,D)PYRENE	8.9E-09	NA	NA	8.9E-09						
			(Total for Child + Adult)	4.5E-06	---	---	4.5E-06						

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Beef Consumption	Lorraine Process Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.4E-02	--	--	1.4E-02
			ARSENIC	8.2E-07	--	--	8.2E-07	ARSENIC	Skin, Cardiovascular	3.0E-02	--	--	3.0E-02
			HEXAVALENT CHROMIUM (+6)	2.4E-06	--	--	2.4E-06	HEXAVALENT CHROMIUM (+6)	None	5.1E-03	--	--	5.1E-03
			COPPER	--	--	--	NA	COPPER	None	1.3E-01	--	--	1.3E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	4.5E-01	--	--	4.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.3E-01	--	--	5.3E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.8E-03	--	--	1.8E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.5E-07	--	--	2.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.7E-07	--	--	3.7E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	4.2E-06	--	--	4.2E-06	BENZO(A)PYRENE	Developmental System	4.4E-02	--	--	4.4E-02
			DIBENZ(A,H)ANTHRACENE	8.7E-07	--	--	8.7E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	3.6E-07	--	--	3.6E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	9.3E-06	---	---	9.3E-06		(Total for Child)	1.2E+00	---	---	1.2E+00
		Lorraine Process Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	7.0E-03	--	--	7.0E-03
			ARSENIC	1.3E-06	--	--	1.3E-06	ARSENIC	Skin, Cardiovascular	1.5E-02	--	--	1.5E-02
			HEXAVALENT CHROMIUM (+6)	2.1E-06	--	--	2.1E-06	HEXAVALENT CHROMIUM (+6)	None	2.5E-03	--	--	2.5E-03
			COPPER	--	--	--	NA	COPPER	None	6.3E-02	--	--	6.3E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	2.2E-01	--	--	2.2E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.6E-01	--	--	2.6E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	8.7E-04	--	--	8.7E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.5E-07	--	--	1.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	2.3E-07	--	--	2.3E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-06	--	--	2.6E-06	BENZO(A)PYRENE	Developmental System	2.2E-02	--	--	2.2E-02
			DIBENZ(A,H)ANTHRACENE	5.4E-07	--	--	5.4E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	2.2E-07	--	--	2.2E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	7.3E-06	---	---	7.3E-06		(Total for Adult)	5.9E-01	---	---	5.9E-01

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient									
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total					
Soil	Beef Consumption	Lorraine Process Area (Adult + Child)	Inorganics															
			ALUMINUM	NA	NA	NA	NA											
			ARSENIC	2.2E-06	NA	NA	2.2E-06											
			HEXAVALENT CHROMIUM (+6)	4.6E-06	NA	NA	4.6E-06											
			COPPER	NA	NA	NA	NA											
			COBALT	NA	NA	NA	NA											
			IRON	NA	NA	NA	NA											
			MANGANESE	NA	NA	NA	NA											
			PAHs															
			BENZ(A)ANTHRACENE	4.0E-07	NA	NA	4.0E-07											
			BENZO(B)FLUORANTHENE	6.0E-07	NA	NA	6.0E-07											
			BENZO(A)PYRENE	6.9E-06	NA	NA	6.9E-06											
			DIBENZ(A,H)ANTHRACENE	1.4E-06	NA	NA	1.4E-06											
			INDENO(1,2,3-C,D)PYRENE	5.8E-07	NA	NA	5.8E-07											
(Total for Child + Adult)				1.7E-05	---	---	1.7E-05	Total Hazard Index Across Surface Soil (Child)				2.8E+00						
			Total Risk Across Surface Soil (Adult + Child)				3.2E-05	Total Hazard Index Across Surface Soil (Adult)				1.1E+00						
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics										
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02					
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02					
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02					
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04					
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01					
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02					
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03					
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03					
			PAHs					PAHs										
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA					
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02					
			(Total for Child)				8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)				2.1E-01	4.5E-02	---	2.5E-01

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Surface Water	Surface Water	Surface Water (Adult)	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04		
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03		
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03		
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04		
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04		
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03		
			PAHs					PAHs							
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA		
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03		
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02			
		Surface Water (Adult + Child)	Inorganics												
			ALUMINUM	NA	NA	NA	NA								
			ARSENIC	7.7E-07	8.5E-08	--	8.6E-07								
			CADMIUM	NA	NA	NA	NA								
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07								
			CYANIDE	NA	NA	NA	NA								
			IRON	NA	NA	NA	NA								
			MANGANESE	NA	NA	NA	NA								
			VANADIUM	NA	NA	NA	NA								
			PAHs												
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07								
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06								
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06	(Total for Child + Adult)	2.5E-01						
Total Risk Across Surface Water (Adult + Child)							5.1E-06	Total Hazard Index Across Surface Water (Adult)							2.9E-02
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02		
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02		
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03		
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03		
			PAHs					PAHs							
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA		
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA		
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03		
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA		
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01			

TABLE 9.7
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.34E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)	(Total for Adult)	5.9E-03	3.5E-04	---	6.2E-03
		Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06						
Total Risk Across Sediment (Adult + Child)							4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across Sediment (Adult + Child)							4.1E-06	Total Hazard Index Across Sediment (Adult)					6.2E-03
Total Risk Across All Media and All Exposure Routes							4E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)					3
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					1

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.8
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Lorraine Process Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.5E-02	--	3.9E-03	1.8E-02
			ARSENIC	8.9E-08	1.4E-08	5.6E-10	1.0E-07	ARSENIC	Skin, Cardiovascular	1.4E-02	2.2E-03	6.1E-04	1.7E-02
			HEXAVALENT CHROMIUM (+6)	3.0E-08	--	6.7E-09	3.7E-08	HEXAVALENT CHROMIUM (+6)	None	1.4E-03	--	5.6E-05	1.5E-03
			COPPER	--	--	--	NA	COPPER	None	1.1E-02	--	--	1.1E-02
			COBALT	--	--	1.7E-09	1.7E-09	COBALT	Thyroid	3.3E-02	--	2.2E-03	3.5E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.1E-02	--	--	4.1E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	1.7E-02	2.1E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-09	4.7E-10	9.0E-13	1.6E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.7E-09	6.9E-10	1.3E-12	2.4E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	8.5E-09	3.5E-09	6.7E-12	1.2E-08	BENZO(A)PYRENE	Developmental System	2.0E-03	8.2E-04	3.9E-04	3.2E-03
			DIBENZ(A,H)ANTHRACENE	1.3E-10	5.2E-11	9.9E-14	1.8E-10	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	1.9E-10	8.1E-11	1.5E-13	2.8E-10	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total)	1.3E-07	1.9E-08	9.0E-09	1.6E-07	(Total)		1.2E-01	3.0E-03	2.4E-02	1.5E-01
			Total Risk Across Surface Soil				1.6E-07				Total Hazard Index Across Surface Soil		
Total Risk Across All Media and All Exposure Routes				2E-07				Total Hazard Index Across All Media and All Exposure Routes					0.1

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.9
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area Scenario Timeframe: Current/Future Receptor Population: Commercial/Industrial Worker Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Lorraine Process Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.4E-03	--	1.8E-04	4.6E-03
			ARSENIC	6.7E-07	2.4E-08	6.5E-10	7.0E-07	ARSENIC	Skin, Cardiovascular	4.2E-03	1.5E-04	2.8E-05	4.4E-03
			HEXAVALENT CHROMIUM (+6)	2.3E-07	--	7.8E-09	2.4E-07	HEXAVALENT CHROMIUM (+6)	None	4.3E-04	--	2.6E-06	4.3E-04
			COPPER	--	--	--	NA	COPPER	None	3.3E-03	--	--	3.3E-03
			COBALT	--	--	2.0E-09	2.0E-09	COBALT	Thyroid	1.0E-02	--	1.0E-04	1.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.2E-02	--	--	1.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.4E-03	--	7.8E-04	2.1E-03
			PAHs					PAHs					NA
			BENZ(A)ANTHRACENE	8.6E-09	7.9E-10	1.0E-12	9.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.3E-08	1.2E-09	1.5E-12	1.4E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	6.4E-08	5.9E-09	7.8E-12	7.0E-08	BENZO(A)PYRENE	Developmental System	6.0E-04	5.5E-05	1.8E-05	6.7E-04
			DIBENZ(A,H)ANTHRACENE	9.5E-10	8.7E-11	1.2E-13	1.0E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	1.5E-09	1.4E-10	1.8E-13	1.6E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total)	9.9E-07	3.2E-08	1.0E-08	1.0E-06	(Total)	(Total)	3.7E-02	2.0E-04	1.1E-03	3.8E-02
			Total Risk Across Surface Soil				1.0E-06				Total Hazard Index Across Surface Soil		
Total Risk Across All Media and All Exposure Routes				1E-06				Total Hazard Index Across All Media and All Exposure Routes					0.04

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.10
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Lorraine Process Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.6E-03	--	1.9E-06	1.6E-03
			ARSENIC	9.9E-08	4.5E-08	2.7E-11	1.4E-07	ARSENIC	Skin, Cardiovascular	1.5E-03	7.0E-04	2.9E-07	2.2E-03
			HEXAVALENT CHROMIUM (+6)	1.0E-07	--	9.8E-10	1.0E-07	HEXAVALENT CHROMIUM (+6)	None	1.6E-04	--	2.7E-08	1.6E-04
			COPPER	--	--	--	NA	COPPER	None	1.2E-03	--	--	1.2E-03
			COBALT	--	--	8.2E-11	8.2E-11	COBALT	Thyroid	3.7E-03	--	1.1E-06	3.7E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.6E-03	--	--	4.6E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.0E-04	--	8.1E-06	5.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.8E-09	4.5E-09	1.3E-13	8.3E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	5.6E-09	6.6E-09	1.9E-13	1.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.8E-08	3.4E-08	9.8E-13	6.2E-08	BENZO(A)PYRENE	Developmental System	2.2E-04	2.6E-04	1.9E-07	4.8E-04
			DIBENZ(A,H)ANTHRACENE	4.2E-10	5.0E-10	1.4E-14	9.2E-10	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	6.5E-10	7.7E-10	2.2E-14	1.4E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total)	2.4E-07	9.1E-08	1.1E-09	3.3E-07	(Total)	(Total)	1.4E-02	9.6E-04	1.2E-05	1.5E-02
			Total Risk Across Surface Soil				3.3E-07	Total Hazard Index Across Surface Soil					1.5E-02
Surface Water	Surface Water	Surface Water	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.5E-03	3.2E-04	--	3.8E-03
			ARSENIC	3.8E-07	3.5E-08	--	4.2E-07	ARSENIC	Skin, Cardiovascular	6.0E-03	5.4E-04	--	6.5E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.0E-03	1.1E-02	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.8E-08	2.1E-07	--	2.3E-07	HEXAVALENT CHROMIUM (+6)	None	4.4E-05	3.2E-04	--	3.6E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	4.7E-02	4.2E-03	--	5.1E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.0E-03	5.5E-04	--	6.6E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-03	2.2E-04	--	2.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	8.6E-04	3.0E-03	--	3.9E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	4.1E-09	2.0E-07	--	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.8E-08	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.4E-04	8.8E-03	--	8.9E-03
			(Total)	4.3E-07	1.6E-06	---	2.0E-06	(Total)	(Total)	6.9E-02	2.9E-02	---	9.8E-02
			Total Risk Across Surface Water				2.0E-06	Total Hazard Index Across Surface Water					9.8E-02

TABLE 9.10
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.5E-03	--	--	6.5E-03
			ARSENIC	2.7E-07	6.2E-08	--	3.4E-07	ARSENIC	Skin, Cardiovascular	4.3E-03	9.7E-04	--	5.2E-03
			HEXAVALENT CHROMIUM (+6)	8.5E-07	--	--	8.5E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-03	--	--	1.3E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	1.3E-02	--	--	1.3E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E-02	--	--	1.4E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-03	--	--	1.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-08	6.5E-09	--	1.8E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.0E-08	6.0E-09	--	1.6E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.8E-08	4.6E-08	--	1.2E-07	BENZO(A)PYRENE	Developmental System	6.0E-04	3.6E-04	--	9.6E-04
			DIBENZ(A,H)ANTHRACENE	2.1E-08	1.2E-08	--	3.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	1.2E-06	1.3E-07	---	1.4E-06	(Total)	4.2E-02	1.3E-03	---	4.3E-02	
			Total Risk Across Sediment				1.4E-06	Total Hazard Index Across Sediment				4.3E-02	
Total Risk Across All Media and All Exposure Routes				4E-06	Total Hazard Index Across All Media and All Exposure Routes				0.2				

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Lorraine Process Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	8.5E-02	--	9.7E-04	8.6E-02
			ARSENIC	2.8E-06	3.4E-07	7.7E-10	3.2E-06	ARSENIC	Skin, Cardiovascular	7.3E-02	8.7E-03	1.4E-04	8.2E-02
			COPPER	--	--	--	NA	COPPER	None	1.9E-02	--	--	1.9E-02
			COBALT	--	--	2.8E-09	2.8E-09	COBALT	Thyroid	2.1E-01	--	6.1E-04	2.1E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.2E-01	--	--	2.2E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-02	--	2.3E-03	1.7E-02
			PAHs					PAHs					
			BENZO(A)PYRENE	1.3E-07	4.1E-08	4.5E-12	1.7E-07	BENZO(A)PYRENE	Developmental System	9.7E-04	3.0E-04	8.3E-06	1.3E-03
			(Total for Child)	3.0E-06	3.8E-07	3.6E-09	3.3E-06	(Total for Child)	6.3E-01	9.0E-03	4.1E-03	6.4E-01	
		Lorraine Process Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	7.9E-03	--	9.7E-04	8.9E-03
			ARSENIC	8.9E-07	1.9E-07	2.6E-09	1.1E-06	ARSENIC	Skin, Cardiovascular	6.9E-03	1.5E-03	1.4E-04	8.5E-03
			COPPER	--	--	--	NA	COPPER	None	1.8E-03	--	--	1.8E-03
			COBALT	--	--	9.4E-09	9.4E-09	COBALT	Thyroid	2.0E-02	--	6.1E-04	2.1E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.1E-02	--	--	2.1E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.4E-03	--	2.3E-03	3.7E-03
			PAHs					PAHs					
			BENZO(A)PYRENE	1.6E-08	8.6E-09	5.7E-12	2.4E-08	BENZO(A)PYRENE	Developmental System	9.1E-05	5.0E-05	8.3E-06	1.5E-04
			(Total for Adult)	9.0E-07	2.0E-07	1.2E-08	1.1E-06	(Total for Adult)	5.9E-02	1.5E-03	4.1E-03	6.4E-02	
		Lorraine Process Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	3.7E-06	5.2E-07	3.4E-09	4.2E-06						
			COPPER	NA	NA	NA	NA						
			COBALT	NA	NA	1.2E-08	1.2E-08						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZO(A)PYRENE	1.5E-07	4.9E-08	1.0E-11	2.0E-07						
		(Total for Child + Adult)				3.9E-06	5.7E-07	1.6E-08	4.5E-06	Total Hazard Index Across Subsurface Soil (Child)			
Total Risk Across Subsurface Soil (Adult + Child)							4.5E-06	Total Hazard Index Across Subsurface Soil (Adult)				6.4E-02	

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)	(Total for Child)	2.1E-01	4.5E-02	---	2.5E-01
		Surface Water (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)	(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	NA	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07									
BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06									
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01
	Total Risk Across Surface Water (Adult + Child)						5.1E-06		Total Hazard Index Across Surface Water (Adult)				2.9E-02
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03			
DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA			
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06		(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01

TABLE 9.11
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	9.2E-04	--	--	9.2E-04
			ALUMINUM	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.3E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)	(Total for Adult)	5.9E-03	3.5E-04	---	6.2E-03
		Sediment (Adult + Child)	Inorganics	NA	NA	NA	NA						
			ALUMINUM	5.7E-07	9.1E-08	NA	6.6E-07						
			ARSENIC	2.9E-06	NA	NA	2.9E-06						
			HEXAVALENT CHROMIUM (+6)	NA	NA	NA	NA						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06						
Total Risk Across Sediment (Adult + Child)				4.1E-06				Total Hazard Index Across Sediment (Adult)					6.2E-03
Total Risk Across All Media and All Exposure Routes				1E-05				Total Hazard Index Across All Media and All Exposure Routes (Child)					1
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					0.1

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.12
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Lorraine Process Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.9E-02	--	5.0E-03	2.4E-02
			ARSENIC	1.0E-07	1.7E-08	6.6E-10	1.2E-07	ARSENIC	Skin, Cardiovascular	1.6E-02	2.6E-03	7.2E-04	2.0E-02
			COPPER	--	--	--	NA	COPPER	None	4.2E-03	--	--	4.2E-03
			COBALT	--	--	2.4E-09	2.4E-09	COBALT	Thyroid	4.7E-02	--	3.1E-03	5.0E-02
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	0.0E+00	--	--	NA
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.9E-02	--	--	4.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.2E-03	--	1.2E-02	1.5E-02
			PAHs					PAHs					
			BENZO(A)PYRENE	9.2E-10	3.8E-10	5.3E-12	1.3E-09	BENZO(A)PYRENE	Developmental System	2.1E-04	9.0E-05	4.3E-05	3.5E-04
			(Total)	1.1E-07	1.7E-08	3.1E-09	1.3E-07	(Total)	1.4E-01	2.7E-03	2.1E-02	1.6E-01	
			Total Risk Across Subsurface Soil				1.3E-07	Total Hazard Index Across Subsurface Soil				1.6E-01	
Total Risk Across All Media and All Exposure Routes				1E-07	Total Hazard Index Across All Media and All Exposure Routes				0.2				

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Loading Dock Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	5.9E-02	--	6.8E-04	6.0E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	9.5E-02	--	--	9.5E-02
			ARSENIC	3.9E-06	4.7E-07	1.1E-09	4.4E-06	ARSENIC	Skin, Cardiovascular	1.0E-01	1.2E-02	1.9E-04	1.1E-01
			COBALT	--	--	8.6E-09	8.6E-09	COBALT	Thyroid	6.5E-01	--	1.9E-03	6.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.8E-01	--	--	2.8E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.8E-02	--	6.1E-03	4.4E-02
			PAHs					PAHs					
			BENZO(A)PYRENE	1.6E-06	5.1E-07	5.6E-11	2.2E-06	BENZO(A)PYRENE	Developmental System	1.2E-02	3.7E-03	1.0E-04	1.6E-02
			Volatiles					Volatiles					
			BENZENE	1.7E-07	--	1.4E-12	1.7E-07	BENZENE	Immune System	8.9E-03	--	6.8E-08	8.9E-03
			ETHYLBENZENE	8.1E-08	--	1.1E-12	8.1E-08	ETHYLBENZENE	Liver, Kidney	8.6E-04	--	4.9E-09	8.6E-04
			(Total for Child)	5.8E-06	9.7E-07	9.7E-09	6.8E-06	(Total for Child)	1.2E+00	1.6E-02	9.0E-03	1.3E+00	
		Loading Dock Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	5.5E-03	--	6.8E-04	6.2E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	8.9E-03	--	--	8.9E-03
			ARSENIC	1.2E-06	2.6E-07	3.6E-09	1.5E-06	ARSENIC	Skin, Cardiovascular	9.6E-03	2.0E-03	1.9E-04	1.2E-02
			COBALT	--	--	2.9E-08	2.9E-08	COBALT	Thyroid	6.1E-02	--	1.9E-03	6.3E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.6E-02	--	--	2.6E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.6E-03	--	6.1E-03	9.7E-03
			PAHs					PAHs					
			BENZO(A)PYRENE	1.9E-07	1.1E-07	7.1E-11	3.0E-07	BENZO(A)PYRENE	Developmental System	1.1E-03	6.2E-04	1.0E-04	1.9E-03
			Volatiles					Volatiles					
			BENZENE	5.3E-08	--	4.6E-12	5.3E-08	BENZENE	Immune System	8.4E-04	--	6.8E-08	8.4E-04
			ETHYLBENZENE	2.5E-08	--	3.5E-12	2.5E-08	ETHYLBENZENE	Liver, Kidney	8.0E-05	--	4.9E-09	8.0E-05
			(Total for Adult)	1.5E-06	3.7E-07	3.2E-08	1.9E-06	(Total for Adult)	1.2E-01	2.6E-03	9.0E-03	1.3E-01	
		Loading Dock Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	5.2E-06	7.3E-07	4.7E-09	5.9E-06						
			COBALT	NA	NA	3.7E-08	3.7E-08						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZO(A)PYRENE	1.8E-06	6.1E-07	1.3E-10	2.5E-06						
			Volatiles										
			BENZENE	2.2E-07	NA	5.9E-12	2.2E-07						
			ETHYLBENZENE	1.1E-07	NA	4.6E-12	1.1E-07						
			(Total for Child + Adult)	7.3E-06	1.3E-06	4.2E-08	8.7E-06						

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	Loading Dock Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	8.5E-03	--	--	8.5E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.1E-01	--	--	1.1E-01
			ARSENIC	1.5E-06	--	--	1.5E-06	ARSENIC	Skin, Cardiovascular	3.9E-02	--	--	3.9E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	4.7E-01	--	--	4.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.0E-02	--	--	4.0E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.5E-01	--	--	3.5E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	7.8E-07	--	--	7.8E-07	BENZO(A)PYRENE	Developmental System	5.8E-03	--	--	5.8E-03
			Volatiles					Volatiles					
			BENZENE	1.4E-05	--	--	1.4E-05	BENZENE	Gastrointestinal	7.7E-01	--	--	7.7E-01
			ETHYLBENZENE	1.8E-06	--	--	1.8E-06	ETHYLBENZENE	Kidney	1.9E-02	--	--	1.9E-02
			(Total for Child)	1.9E-05	---	---	1.9E-05	(Total for Child)	1.8E+00	---	---	---	1.8E+00
		Loading Dock Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.3E-03	--	--	3.3E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	4.3E-02	--	--	4.3E-02
			ARSENIC	1.9E-06	--	--	1.9E-06	ARSENIC	Skin, Cardiovascular	1.5E-02	--	--	1.5E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	1.8E-01	--	--	1.8E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.6E-02	--	--	1.6E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.3E-01	--	--	1.3E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	3.8E-07	--	--	3.8E-07	BENZO(A)PYRENE	Developmental System	2.2E-03	--	--	2.2E-03
			Volatiles					Volatiles					
			BENZENE	1.9E-05	--	--	1.9E-05	BENZENE	Gastrointestinal	3.0E-01	--	--	3.0E-01
			ETHYLBENZENE	2.4E-06	--	--	2.4E-06	ETHYLBENZENE	Kidney	7.5E-03	--	--	7.5E-03
			(Total for Adult)	2.3E-05	---	---	2.3E-05	(Total for Adult)	7.0E-01	---	---	---	7.0E-01
		Loading Dock Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	3.4E-06	NA	NA	3.4E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZO(A)PYRENE	1.2E-06	NA	NA	1.2E-06						
			Volatiles										
			BENZENE	3.3E-05	NA	NA	3.3E-05						
			ETHYLBENZENE	4.2E-06	NA	NA	4.2E-06						
			(Total for Child + Adult)	4.2E-05	---	---	4.2E-05						

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Beef Consumption	Loading Dock Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.0E-03	--	--	9.0E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.0E-02	--	--	1.0E-02
			ARSENIC	1.3E-06	--	--	1.3E-06	ARSENIC	Skin, Cardiovascular	3.5E-02	--	--	3.5E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	1.4E+00	--	--	1.4E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.6E-01	--	--	5.6E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.3E-03	--	--	2.3E-03
			PAHs					PAHs					
			BENZO(A)PYRENE	5.7E-06	--	--	5.7E-06	BENZO(A)PYRENE	Developmental System	4.2E-02	--	--	4.2E-02
			Volatiles					Volatiles					
			BENZENE	3.4E-07	--	--	3.4E-07	BENZENE	Immune System	1.8E-02	--	--	1.8E-02
			ETHYLBENZENE	2.3E-07	--	--	2.3E-07	ETHYLBENZENE	Liver, Kidney	2.4E-03	--	--	2.4E-03
			(Total for Child)	7.6E-06	---	---	7.6E-06	(Total for Child)	2.0E+00	---	---	2.0E+00	
		Loading Dock Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.4E-03	--	--	4.4E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	5.0E-03	--	--	5.0E-03
			ARSENIC	2.2E-06	--	--	2.2E-06	ARSENIC	Skin, Cardiovascular	1.7E-02	--	--	1.7E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	6.7E-01	--	--	6.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.8E-01	--	--	2.8E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.2E-03	--	--	1.2E-03
			PAHs					PAHs					
			BENZO(A)PYRENE	3.5E-06	--	--	3.5E-06	BENZO(A)PYRENE	Developmental System	2.1E-02	--	--	2.1E-02
			Volatiles					Volatiles					
			BENZENE	5.7E-07	--	--	5.7E-07	BENZENE	Immune System	9.0E-03	--	--	9.0E-03
			ETHYLBENZENE	3.7E-07	--	--	3.7E-07	ETHYLBENZENE	Liver, Kidney	1.2E-03	--	--	1.2E-03
			(Total for Adult)	6.7E-06	---	---	6.7E-06	(Total for Adult)	1.0E+00	---	---	1.0E+00	
		Loading Dock Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	3.5E-06	NA	NA	3.5E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZO(A)PYRENE	9.3E-06	NA	NA	9.3E-06						
			Volatiles										
			BENZENE	9.1E-07	NA	NA	9.1E-07						
			ETHYLBENZENE	6.0E-07	NA	NA	6.0E-07						
			(Total for Child + Adult)	1.4E-05	---	---	1.4E-05	Total Hazard Index Across Surface Soil (Child)					5.1E+00
Total Risk Across Surface Soil (Adult + Child)				6.5E-05	Total Hazard Index Across Surface Soil (Adult)					1.8E+00			

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Child)	Inorganics	--	--	--	NA	Inorganics	Neurological	1.1E-02	5.0E-04	--	1.1E-02
			ALUMINUM	--	--	--	NA	ALUMINUM	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02
			CADMIUM	--	--	--	NA	CADMIUM	None	1.3E-04	5.0E-04	--	6.3E-04
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02
			IRON	--	--	--	NA	IRON	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03
			MANGANESE	--	--	--	NA	MANGANESE	Kidney	2.6E-03	4.7E-03	--	7.3E-03
			VANADIUM	--	--	--	NA	VANADIUM					
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)		2.1E-01	4.5E-02	---	2.5E-01
		Surface Water (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ALUMINUM	--	--	--	NA	ALUMINUM	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			CADMIUM	--	--	--	NA	CADMIUM	None	5.0E-06	2.4E-04	--	2.4E-04
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			IRON	--	--	--	NA	IRON	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			MANGANESE	--	--	--	NA	MANGANESE	Kidney	9.7E-05	2.2E-03	--	2.3E-03
			VANADIUM	--	--	--	NA	VANADIUM					
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)		7.7E-03	2.2E-02	---	2.9E-02

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Adult+Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	--	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07						
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06						
(Total for Child + Adult)				9.4E-07	4.2E-06	---	5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01
Total Risk Across Surface Water (Adult + Child)							5.1E-06		Total Hazard Index Across Surface Water (Adult)				2.9E-02
Sediment	Sediment	Sediment (Child) (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
(Total for Child)				3.6E-06	1.8E-07	---	3.8E-06		(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01

TABLE 9.13
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Adult) (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	9.2E-04	--	--	9.2E-04
			ALUMINUM	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.34E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)		5.9E-03	3.5E-04	---	6.2E-03
		Sediment (Adult + Child)	Inorganics	NA	NA	NA	NA						
			ALUMINUM	5.7E-07	9.1E-08	NA	6.6E-07						
			ARSENIC	2.9E-06	NA	NA	2.9E-06						
			HEXAVALENT CHROMIUM (+6)	NA	NA	NA	NA						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06						
Total Risk Across Sediment (Adult + Child)				4.1E-06				Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across All Media and All Exposure Routes				7E-05				Total Hazard Index Across Sediment (Adult)					6.2E-03
								Total Hazard Index Across All Media and All Exposure Routes (Child)					5
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					2

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.14
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Loading Dock Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.3E-02	--	3.5E-03	1.7E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.5E-03	--	--	1.5E-03
			ARSENIC	1.4E-07	2.3E-08	9.2E-10	1.7E-07	ARSENIC	Skin, Cardiovascular	2.3E-02	3.6E-03	9.9E-04	2.7E-02
			COBALT	--	--	7.3E-09	7.3E-09	COBALT	Thyroid	1.4E-01	--	9.5E-03	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.2E-02	--	--	6.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	8.5E-03	--	3.1E-02	4.0E-02
			PAHs					PAHs					
			BENZO(A)PYRENE	1.1E-08	4.8E-09	9.1E-12	1.6E-08	BENZO(A)PYRENE	Developmental System	2.7E-03	1.1E-03	5.3E-04	4.3E-03
			Volatiles					Volatiles					
			BENZENE	6.2E-09	--	5.4E-14	6.2E-09	BENZENE	Immune System	2.0E-03	--	1.6E-08	2.0E-03
			ETHYLBENZENE	3.0E-09	--	8.9E-13	3.0E-09	ETHYLBENZENE	Liver, Kidney	1.9E-04	--	2.5E-08	1.9E-04
		(Total)	1.7E-07	2.8E-08	8.3E-09	2.0E-07		(Total)	2.6E-01	4.7E-03	4.6E-02	3.1E-01	
Total Risk Across Surface Soil				2.0E-07				Total Hazard Index Across Surface Soil					3.1E-01
Total Risk Across All Media and All Exposure Routes				2E-07				Total Hazard Index Across All Media and All Exposure Routes					0.3

TABLE 9.15
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Loading Dock Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-03	--	1.6E-04	4.1E-03
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	6.4E-03	--	--	6.4E-03
			ARSENIC	1.1E-06	3.9E-08	1.1E-09	1.1E-06	ARSENIC	Skin, Cardiovascular	6.8E-03	2.4E-04	4.6E-05	7.1E-03
			COBALT	--	--	8.5E-09	8.5E-09	COBALT	Thyroid	4.3E-02	--	4.4E-04	4.4E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.9E-02	--	--	1.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.6E-03	--	1.5E-03	4.0E-03
			PAHs					PAHs					NA
			BENZO(A)PYRENE	8.7E-08	7.9E-09	1.1E-11	9.4E-08	BENZO(A)PYRENE	Developmental System	8.1E-04	7.4E-05	2.5E-05	9.1E-04
			Volatiles					Volatiles					NA
			BENZENE	4.7E-08	--	1.4E-12	4.7E-08	BENZENE	Immune System	6.0E-04	--	1.6E-08	6.0E-04
			ETHYLBENZENE	2.3E-08	--	1.0E-12	2.3E-08	ETHYLBENZENE	Liver, Kidney	5.7E-05	--	1.2E-09	5.7E-05
(Total)				1.3E-06	4.7E-08	9.6E-09	1.3E-06	(Total)				8.3E-02	8.6E-02
				Total Risk Across Surface Soil			1.3E-06	Total Hazard Index Across Surface Soil				8.6E-02	
Total Risk Across All Media and All Exposure Routes				1E-06			Total Hazard Index Across All Media and All Exposure Routes				0.09		

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.16
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Surface Soil	Loading Dock Area	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.5E-03	--	1.7E-06	1.5E-03		
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.4E-03	--	--	2.4E-03		
			ARSENIC	1.6E-07	7.4E-08	4.4E-11	2.4E-07	ARSENIC	Skin, Cardiovascular	2.5E-03	1.1E-03	4.8E-07	3.7E-03		
			COBALT	--	--	3.6E-10	3.6E-10	COBALT	Thyroid	1.6E-02	--	4.6E-06	1.6E-02		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.9E-03	--	--	6.9E-03		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	9.5E-04	--	1.5E-05	9.6E-04		
			PAHs					PAHs							
			BENZO(A)PYRENE	3.8E-08	4.5E-08	1.3E-12	8.4E-08	BENZO(A)PYRENE	Developmental System	3.0E-04	3.5E-04	2.6E-07	6.5E-04		
			Volatiles					Volatiles							
			BENZENE	7.0E-09	--	5.7E-14	7.0E-09	BENZENE	Urinary	2.2E-04	--	1.7E-10	2.2E-04		
			ETHYLBENZENE	3.3E-09	--	4.3E-14	3.3E-09	ETHYLBENZENE	Immune System	2.1E-05	--	1.2E-11	2.1E-05		
(Total)				2.1E-07	1.2E-07	4.0E-10	3.3E-07	(Total)				3.1E-02	1.5E-03	2.2E-05	3.2E-02
				Total Risk Across Surface Soil			3.3E-07					Total Hazard Index Across Surface Soil			3.2E-02
Surface Water	Surface Water	Surface Water	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.5E-03	3.2E-04	--	3.8E-03		
			ARSENIC	3.8E-07	3.5E-08	--	4.2E-07	ARSENIC	Skin, Cardiovascular	6.0E-03	5.4E-04	--	6.5E-03		
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.0E-03	1.1E-02	--	1.4E-02		
			HEXAVALENT CHROMIUM (+6)	2.8E-08	2.1E-07	--	2.3E-07	HEXAVALENT CHROMIUM (+6)	None	4.4E-05	3.2E-04	--	3.6E-04		
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	4.7E-02	4.2E-03	--	5.1E-02		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.0E-03	5.5E-04	--	6.6E-03		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-03	2.2E-04	--	2.7E-03		
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	8.6E-04	3.0E-03	--	3.9E-03		
			PAHs					PAHs							
			BENZ(A)ANTHRACENE	4.1E-09	2.0E-07	--	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA		
			BENZO(A)PYRENE	1.8E-08	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.4E-04	8.8E-03	--	8.9E-03		
(Total)				4.3E-07	1.6E-06	---	2.0E-06	(Total)				6.9E-02	2.9E-02	---	9.8E-02
				Total Risk Across Surface Water			2.0E-06					Total Hazard Index Across Surface Water			9.8E-02

TABLE 9.16
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.5E-03	--	--	6.5E-03
			ARSENIC	2.7E-07	6.2E-08	--	3.4E-07	ARSENIC	Skin, Cardiovascular	4.3E-03	9.7E-04	--	5.2E-03
			HEXAVALENT CHROMIUM (+6)	8.5E-07	--	--	8.5E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-03	--	--	1.3E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	1.3E-02	--	--	1.3E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E-02	--	--	1.4E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-03	--	--	1.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-08	6.5E-09	--	1.8E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.0E-08	6.0E-09	--	1.6E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.8E-08	4.6E-08	--	1.2E-07	BENZO(A)PYRENE	Developmental System	6.0E-04	3.6E-04	--	9.6E-04
			DIBENZ(A,H)ANTHRACENE	2.1E-08	1.2E-08	--	3.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	1.2E-06	1.3E-07	---	1.4E-06	(Total)	4.2E-02	1.3E-03	---	4.3E-02	
			Total Risk Across Sediment				1.4E-06	Total Hazard Index Across Sediment				4.3E-02	
Total Risk Across All Media and All Exposure Routes				4E-06	Total Hazard Index Across All Media and All Exposure Routes				0.2				

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.17
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Loading Dock Area (Child)	Inorganics	--	--	--	NA	Inorganics	Neurological	1.1E-01	--	1.2E-03	1.1E-01
			ALUMINUM	3.2E-06	3.8E-07	8.8E-10	3.6E-06	ALUMINUM	Skin, Cardiovascular	8.3E-02	9.9E-03	1.6E-04	9.3E-02
			ARSENIC	--	--	1.5E-08	1.5E-08	COBALT	Thyroid	1.1E+00	--	3.3E-03	1.1E+00
			COBALT	--	--	--	NA	IRON	Gastrointestinal System	2.6E-01	--	--	2.6E-01
			IRON	--	--	--	NA	MANGANESE	Central Nervous System	3.6E-02	--	5.7E-03	4.1E-02
			MANGANESE	--	--	--	NA		(Total for Child)	1.6E+00	9.9E-03	1.0E-02	1.7E+00
			(Total for Child)	3.2E-06	3.8E-07	1.6E-08	3.6E-06						
		Loading Dock Area (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	1.0E-02	--	1.2E-03	1.1E-02
			ALUMINUM	1.0E-06	2.1E-07	2.9E-09	1.2E-06	ALUMINUM	Skin, Cardiovascular	7.8E-03	1.6E-03	1.6E-04	9.6E-03
			ARSENIC	--	--	5.1E-08	5.1E-08	COBALT	Thyroid	1.1E-01	--	3.3E-03	1.1E-01
			COBALT	--	--	--	NA	IRON	Gastrointestinal System	2.5E-02	--	--	2.5E-02
			IRON	--	--	--	NA	MANGANESE	Central Nervous System	3.3E-03	--	5.7E-03	9.1E-03
			MANGANESE	--	--	--	NA		(Total for Adult)	1.5E-01	1.6E-03	1.0E-02	1.7E-01
			(Total for Adult)	1.0E-06	2.1E-07	5.4E-08	1.3E-06						
		Loading Dock Area (Adult + Child)	Inorganics	NA	NA	NA	NA						
			ALUMINUM	4.2E-06	5.9E-07	3.8E-09	4.8E-06						
			ARSENIC	NA	NA	6.6E-08	6.6E-08						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			(Total for Child + Adult)	4.2E-06	5.9E-07	7.0E-08	4.9E-06	Total Hazard Index Across Subsurface Soil (Child)					1.7E+00
Total Risk Across Subsurface Soil (Adult + Child)							4.9E-06	Total Hazard Index Across Subsurface Soil (Adult)					1.7E-01
Surface Water	Surface Water	Surface Water (Child)	Inorganics	--	--	--	NA	Inorganics	Neurological	1.1E-02	5.0E-04	--	1.1E-02
			ALUMINUM	6.9E-07	3.3E-08	--	7.2E-07	ALUMINUM	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02
			ARSENIC	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02
			CADMIUM	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04
			HEXAVALENT CHROMIUM (+6)	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01
			CYANIDE	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02
			IRON	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03
			MANGANESE	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03
			VANADIUM	--	--	--	NA	PAHs	NA	--	--	--	NA
			PAHs	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02
			BENZ(A)ANTHRACENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE					
			BENZO(A)PYRENE	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)					2.5E-01
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06						

TABLE 9.17
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)		7.7E-03	2.2E-02	---	2.9E-02
		Surface Water (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	NA	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07						
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06						
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06						
			Total Risk Across Surface Water (Adult + Child)				5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01
									Total Hazard Index Across Surface Water (Adult)				2.9E-02

TABLE 9.17
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)		1.3E-01	2.1E-03	---	1.3E-01
		Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.3E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)		5.9E-03	3.5E-04	---	6.2E-03

TABLE 9.17
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
			Total Risk Across Sediment (Adult + Child)				4.1E-06				Total Hazard Index Across Sediment (Adult)		
Total Risk Across All Media and All Exposure Routes				1E-05				Total Hazard Index Across All Media and All Exposure Routes (Child)					2
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					0.2

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.18
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Loading Dock Area	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.4E-02	--	6.3E-03	3.0E-02
			ARSENIC	1.2E-07	1.9E-08	7.5E-10	1.4E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	3.0E-03	8.1E-04	2.2E-02
			COBALT	--	--	1.3E-08	1.3E-08	COBALT	Thyroid	2.5E-01	--	1.7E-02	2.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.8E-02	--	--	5.8E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.9E-03	--	2.9E-02	3.7E-02
			(Total)	1.2E-07	1.9E-08	1.4E-08	1.5E-07	(Total)	3.6E-01	3.0E-03	5.3E-02	4.2E-01	
Total Risk Across Subsurface Soil							1.5E-07	Total Hazard Index Across Subsurface Soil					4.2E-01
Total Risk Across All Media and All Exposure Routes							2E-07	Total Hazard Index Across All Media and All Exposure Routes					0.4

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area																		
Scenario Timeframe: Current/Future																		
Receptor Population: Resident																		
Receptor Age: Child and Adult																		
Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient									
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total					
Soil	Surface Soil	Wilcox Process Area (Child)	Inorganics					Inorganics										
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	7.0E-02	--	8.0E-04	7.1E-02					
			ARSENIC	3.8E-06	4.5E-07	1.0E-09	4.3E-06	ARSENIC	Skin, Cardiovascular	9.9E-02	1.2E-02	1.9E-04	1.1E-01					
			CADMIUM	--	--	1.6E-10	1.6E-10	CADMIUM	Kidneys, Urinary	1.8E-02	1.7E-03	1.0E-04	2.0E-02					
			HEXAVALENT CHROMIUM (+6)	3.4E-06	--	3.3E-08	3.5E-06	HEXAVALENT CHROMIUM (+6)	None	5.0E-03	--	8.6E-06	5.0E-03					
			COBALT	--	--	2.2E-09	2.2E-09	COBALT	Thyroid	1.6E-01	--	4.7E-04	1.7E-01					
			COPPER	--	--	--	NA	COPPER	None	1.3E-01	--	--	1.3E-01					
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.3E-01	--	--	2.3E-01					
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.8E-02	--	4.5E-03	3.3E-02					
			THALLIUM	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA					
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	3.4E-02	--	9.8E-05	3.4E-02					
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	1.3E-02	--	--	1.3E-02					
			PAHs					PAHs										
			BENZ(A)ANTHRACENE	2.7E-06	8.2E-07	9.1E-11	3.5E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA					
			BENZO(B)FLUORANTHENE	1.3E-06	3.9E-07	4.3E-11	1.6E-06	BENZO(B)FLUORANTHENE	NA	--	--	--	NA					
			BENZO(A)PYRENE	1.5E-05	4.5E-06	5.1E-10	1.9E-05	BENZO(A)PYRENE	Developmental System	1.1E-01	3.3E-02	9.3E-04	1.4E-01					
			CHRYSENE	6.7E-08	2.1E-08	2.3E-12	8.8E-08	CHRYSENE	NA	--	--	--	NA					
			DIBENZ(A,H)ANTHRACENE	1.8E-06	5.5E-07	6.1E-11	2.3E-06	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA					
			INDENO(1,2,3-C,D)PYRENE	2.5E-07	7.7E-08	8.6E-12	3.3E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA					
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	1.0E-02	3.1E-03	--	1.3E-02					
			NAPHTHALENE	--	--	1.7E-12	1.7E-12	NAPHTHALENE	Body Weight	5.2E-04	1.6E-04	2.0E-07	6.7E-04					
			(Total for Child)				2.8E-05	6.8E-06	3.7E-08	3.5E-05	(Total for Child)						9.1E-01	5.0E-02
			Wilcox Process Area (Adult)	Inorganics					Inorganics									
				ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.5E-03	--	8.0E-04	7.3E-03				
				ARSENIC	1.2E-06	2.5E-07	3.5E-09	1.4E-06	ARSENIC	Skin, Cardiovascular	9.3E-03	2.0E-03	1.9E-04	1.1E-02				
				CADMIUM	--	--	5.3E-10	5.3E-10	CADMIUM	Kidneys, Urinary	1.7E-03	2.9E-04	1.0E-04	2.1E-03				
				HEXAVALENT CHROMIUM (+6)	4.0E-07	--	4.1E-08	4.5E-07	HEXAVALENT CHROMIUM (+6)	None	4.7E-04	--	8.6E-06	4.8E-04				
				COBALT	--	--	7.3E-09	7.3E-09	COBALT	Thyroid	1.5E-02	--	4.7E-04	1.6E-02				
				COPPER	--	--	--	NA	COPPER	None	1.2E-02	--	--	1.2E-02				
				IRON	--	--	--	NA	IRON	Gastrointestinal System	2.2E-02	--	--	2.2E-02				
				MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.6E-03	--	4.5E-03	7.2E-03				
				THALLIUM	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA				
				VANADIUM	--	--	--	NA	VANADIUM	Kidney	3.2E-03	--	9.8E-05	3.3E-03				
				ZINC	--	--	--	NA	ZINC	Immune System, Blood	1.2E-03	--	--	1.2E-03				
				PAHs					PAHs									
				BENZ(A)ANTHRACENE	3.1E-07	1.7E-07	1.1E-10	4.8E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA				
				BENZO(B)FLUORANTHENE	1.5E-07	8.1E-08	5.4E-11	2.3E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA				
				BENZO(A)PYRENE	1.7E-06	9.5E-07	6.4E-10	2.7E-06	BENZO(A)PYRENE	Developmental System	1.0E-02	5.6E-03	9.3E-04	1.7E-02				
				CHRYSENE	7.9E-09	4.3E-09	2.9E-12	1.2E-08	CHRYSENE	NA	--	--	--	NA				
				DIBENZ(A,H)ANTHRACENE	2.1E-07	1.2E-07	7.7E-11	3.3E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA				
				INDENO(1,2,3-C,D)PYRENE	2.9E-08	1.6E-08	1.1E-11	4.6E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA				
				2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	9.3E-04	5.1E-04	--	1.4E-03				
				NAPHTHALENE	--	--	5.7E-12	5.7E-12	NAPHTHALENE	Body Weight	4.8E-05	2.7E-05	2.0E-07	7.5E-05				
				(Total for Adult)				4.0E-06	1.6E-06	5.4E-08	5.7E-06	(Total for Adult)						8.6E-02

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Wilcox Process Area (Adult + Child)	Inorganics	NA	NA	NA	NA						
			ALUMINUM	5.0E-06	7.0E-07	4.5E-09	5.7E-06						
			ARSENIC	NA	NA	7.0E-10	7.0E-10						
			CADMIUM	3.8E-06	NA	7.4E-08	3.9E-06						
			HEXAVALENT CHROMIUM (+6)	NA	NA	9.5E-09	9.5E-09						
			COBALT	NA	NA	NA	NA						
			COPPER	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			THALLIUM	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			ZINC	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.0E-06	9.9E-07	2.1E-10	4.0E-06						
			BENZO(B)FLUORANTHENE	1.4E-06	4.7E-07	9.7E-11	1.9E-06						
			BENZO(A)PYRENE	1.6E-05	5.5E-06	1.1E-09	2.2E-05						
			CHRYSENE	7.5E-08	2.5E-08	5.2E-12	1.0E-07						
			DIBENZ(A,H)ANTHRACENE	2.0E-06	6.7E-07	1.4E-10	2.7E-06						
			INDENO(1,2,3-C,D)PYRENE	2.8E-07	9.3E-08	1.9E-11	3.7E-07						
			2-METHYLNAPHTHALENE	NA	NA	NA	NA						
			NAPHTHALENE	NA	NA	7.5E-12	7.5E-12						
			(Total for Child + Adult)	3.2E-05	8.4E-06	9.1E-08	4.1E-05						
	Homegrown Produce	Wilcox Process Area (Child)	Inorganics	--	--	--	NA	Inorganics	Neurological	1.3E-02	--	--	1.3E-02
			ALUMINUM	1.0E-08	--	--	1.0E-08	ARSENIC	Skin, Cardiovascular	5.0E-02	--	--	5.0E-02
			ARSENIC	--	--	--	NA	CADMIUM	Kidneys, Urinary	1.1E-01	--	--	1.1E-01
			CADMIUM	4.3E-09	--	--	4.3E-09	HEXAVALENT CHROMIUM (+6)	None	1.2E-03	--	--	1.2E-03
			HEXAVALENT CHROMIUM (+6)	--	--	--	NA	COBALT	Thyroid	1.6E-01	--	--	1.6E-01
			COBALT	--	--	--	NA	COPPER	None	2.5E+00	--	--	2.5E+00
			COPPER	--	--	--	NA	IRON	Gastrointestinal System	4.4E-02	--	--	4.4E-02
			IRON	--	--	--	NA	MANGANESE	Central Nervous System	3.4E-01	--	--	3.4E-01
			MANGANESE	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA
			THALLIUM	--	--	--	NA	VANADIUM	Kidney	9.1E-03	--	--	9.1E-03
			VANADIUM	--	--	--	NA	ZINC	Immune System, Blood	6.2E-02	--	--	6.2E-02
			ZINC	--	--	--	NA	PAHs					
			PAHs					BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZ(A)ANTHRACENE	1.3E-08	--	--	1.3E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.6E-09	--	--	3.6E-09	BENZO(A)PYRENE	Developmental System	6.9E-02	--	--	6.9E-02
			BENZO(A)PYRENE	5.0E-08	--	--	5.0E-08	CHRYSENE	NA	--	--	--	NA
			CHRYSENE	3.4E-10	--	--	3.4E-10	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	3.1E-09	--	--	3.1E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	3.8E-10	--	--	3.8E-10	2-METHYLNAPHTHALENE	Respiratory System	1.1E-01	--	--	1.1E-01
			2-METHYLNAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	1.2E-02	--	--	1.2E-02
			NAPHTHALENE	--	--	--	NA	(Total for Child)	3.5E+00	---	---	---	3.5E+00
			(Total for Child)	8.5E-08	---	---	8.5E-08						

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child and Adult													
Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	Wilcox Process Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.6E-03	--	--	2.6E-03
			ARSENIC	5.9E-10	--	--	5.9E-10	ARSENIC	Skin, Cardiovascular	9.6E-03	--	--	9.6E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	2.1E-02	--	--	2.1E-02
			HEXAVALENT CHROMIUM (+6)	9.3E-11	--	--	9.3E-11	HEXAVALENT CHROMIUM (+6)	None	2.3E-04	--	--	2.3E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	3.0E-02	--	--	3.0E-02
			COPPER	--	--	--	NA	COPPER	None	4.8E-01	--	--	4.8E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	8.5E-03	--	--	8.5E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	6.5E-02	--	--	6.5E-02
			THALLIUM	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.7E-03	--	--	1.7E-03
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	1.2E-02	--	--	1.2E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.9E-10	--	--	2.9E-10	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	7.9E-11	--	--	7.9E-11	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.1E-09	--	--	1.1E-09	BENZO(A)PYRENE	Developmental System	1.3E-02	--	--	1.3E-02
			CHRYSENE	7.4E-12	--	--	7.4E-12	CHRYSENE	NA	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	6.7E-11	--	--	6.7E-11	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	8.2E-12	--	--	8.2E-12	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.0E-02	--	--	2.0E-02
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	2.3E-03	--	--	2.3E-03
			(Total for Adult)	2.2E-09	---	---	2.2E-09	(Total for Adult)	6.7E-01	---	---	---	6.7E-01
		Wilcox Process Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	1.1E-08	NA	NA	1.1E-08						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	4.4E-09	NA	NA	4.4E-09						
			COBALT	NA	NA	NA	NA						
			COPPER	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			THALLIUM	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			ZINC	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.4E-08	NA	NA	1.4E-08						
			BENZO(B)FLUORANTHENE	3.7E-09	NA	NA	3.7E-09						
			BENZO(A)PYRENE	5.1E-08	NA	NA	5.1E-08						
			CHRYSENE	3.5E-10	NA	NA	3.5E-10						
			DIBENZ(A,H)ANTHRACENE	3.2E-09	NA	NA	3.2E-09						
			INDENO(1,2,3-C,D)PYRENE	3.9E-10	NA	NA	3.9E-10						
			2-METHYLNAPHTHALENE	NA	NA	NA	NA						
			NAPHTHALENE	NA	NA	NA	NA						
			(Total for Child + Adult)	8.7E-08	---	---	8.7E-08	Total Hazard Index Across Surface Soil (Child)					4.5E+00

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Beef Consumption	Wilcox Process (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.5E-02	--	--	3.5E-02
			ARSENIC	2.3E-08	--	--	2.3E-08	ARSENIC	Skin, Cardiovascular	1.1E-01	--	--	1.1E-01
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.1E-04	--	--	9.1E-04
			HEXAVALENT CHROMIUM (+6)	3.3E-08	--	--	3.3E-08	HEXAVALENT CHROMIUM (+6)	None	9.2E-03	--	--	9.2E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	1.1E+00	--	--	1.1E+00
			COPPER	--	--	--	NA	COPPER	None	8.0E-01	--	--	8.0E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.5E+00	--	--	1.5E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.2E-03	--	--	4.2E-03
			THALLIUM	--	--	--	NA	THALLIUM	Hair	NA	--	--	NA
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.8E-02	--	--	2.8E-02
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	4.7E-04	--	--	4.7E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	7.0E-08	--	--	7.0E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.4E-08	--	--	3.4E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	8.9E-07	--	--	8.9E-07	BENZO(A)PYRENE	Developmental System	1.2E+00	--	--	1.2E+00
			CHRYSENE	4.9E-07	--	--	4.9E-07	CHRYSENE	NA	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	1.5E-06	--	--	1.5E-06	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	5.5E-08	--	--	5.5E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	1.2E-01	--	--	1.2E-01
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	5.1E-03	--	--	5.1E-03
			(Total for Child)	3.1E-06	---	---	3.1E-06	(Total for Child)	5.0E+00	---	---	---	5.0E+00
	Wilcox Process (Adult)	Wilcox Process (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.7E-02	--	--	1.7E-02
			ARSENIC	3.3E-09	--	--	3.3E-09	ARSENIC	Skin, Cardiovascular	5.4E-02	--	--	5.4E-02
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	4.5E-04	--	--	4.5E-04
			HEXAVALENT CHROMIUM (+6)	1.9E-09	--	--	1.9E-09	HEXAVALENT CHROMIUM (+6)	None	4.5E-03	--	--	4.5E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	5.6E-01	--	--	5.6E-01
			COPPER	--	--	--	NA	COPPER	None	3.9E-01	--	--	3.9E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	7.6E-01	--	--	7.6E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-03	--	--	2.1E-03
			THALLIUM	--	--	--	NA	THALLIUM	Hair	NA	--	--	NA
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.4E-02	--	--	1.4E-02
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	2.3E-04	--	--	2.3E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.9E-09	--	--	3.9E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	--	--	1.9E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.0E-08	--	--	5.0E-08	BENZO(A)PYRENE	Developmental System	6.1E-01	--	--	6.1E-01
			CHRYSENE	2.7E-08	--	--	2.7E-08	CHRYSENE	NA	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	8.4E-08	--	--	8.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	3.1E-09	--	--	3.1E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	5.8E-02	--	--	5.8E-02
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	2.5E-03	--	--	2.5E-03
			(Total for Adult)	1.8E-07	---	---	1.8E-07	(Total for Adult)	2.5E+00	---	---	---	2.5E+00

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient										
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total						
Soil	Beef Consumption	Wilcox Process (Adult + Child)	Inorganics																
			ALUMINUM	NA	NA	NA	NA												
			ARSENIC	2.6E-08	NA	NA	2.6E-08												
			CADMIUM	NA	NA	NA	NA												
			HEXAVALENT CHROMIUM (+6)	3.5E-08	NA	NA	3.5E-08												
			COBALT	NA	NA	NA	NA												
			COPPER	NA	NA	NA	NA												
			IRON	NA	NA	NA	NA												
			MANGANESE	NA	NA	NA	NA												
			THALLIUM	NA	NA	NA	NA												
			VANADIUM	NA	NA	NA	NA												
			ZINC	NA	NA	NA	NA												
			PAHs																
			BENZ(A)ANTHRACENE	7.4E-08	NA	NA	7.4E-08												
			BENZO(B)FLUORANTHENE	3.6E-08	NA	NA	3.6E-08												
			BENZO(A)PYRENE	9.4E-07	NA	NA	9.4E-07												
			CHRYSENE	5.2E-07	NA	NA	5.2E-07												
			DIBENZ(A,H)ANTHRACENE	1.6E-06	NA	NA	1.6E-06												
			INDENO(1,2,3-C,D)PYRENE	5.8E-08	NA	NA	5.8E-08												
			2-METHYLNAPHTHALENE	NA	NA	NA	NA												
			NAPHTHALENE	NA	NA	NA	NA												
			(Total for Child + Adult)				3.3E-06	---	---	3.3E-06	Total Hazard Index Across Surface Soil (Child)					9.5E+00			
			Total Risk Across Surface Soil (Adult + Child)				4.4E-05	Total Hazard Index Across Surface Soil (Adult)					3.2E+00						
Groundwater	Groundwater	Tap Water (Child)	Inorganics					Inorganics											
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.4E-01	2.8E-03	--	6.5E-01						
			ARSENIC	1.3E-04	5.6E-07	--	1.3E-04	ARSENIC	Skin, Cardiovascular	3.3E+00	1.5E-02	--	3.3E+00						
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	3.9E+00	1.7E-02	--	3.9E+00						
			COBALT	--	--	--	NA	COBALT	Thyroid	1.4E+00	2.5E-03	--	1.4E+00						
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.4E+00	1.0E-02	--	2.4E+00						
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.7E-01	1.6E-03	--	3.7E-01						
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.0E-01	1.7E-02	--	1.2E-01						
			PAHs					PAHs											
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	4.1E-01	4.9E-01	--	9.1E-01						
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	1.5E-01	8.3E-02	--	2.3E-01						
			Volatiles					Volatiles											
			BENZENE	5.6E-04	7.4E-05	--	6.4E-04	BENZENE	Immune System	3.0E+01	3.9E+00	--	3.4E+01						
			1,2-DICHLOROETHANE	1.6E-06	6.8E-08	--	1.7E-06	1,2-DICHLOROETHANE	NA	3.4E-02	1.5E-03	--	3.6E-02						
			ETHYLBENZENE	5.2E-05	2.7E-05	--	7.8E-05	ETHYLBENZENE	Liver, Kidney	5.5E-01	2.8E-01	--	8.3E-01						
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	3.0E-02	3.1E-02	--	6.0E-02						
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	5.7E-01	3.0E-01	--	8.7E-01						
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	6.9E-01	2.0E-01	--	8.9E-01						
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.2E-01	6.1E-02	--	1.9E-01						
			(Total for Child)				7.4E-04	1.0E-04	---	8.5E-04	(Total for Child)					4.5E+01	5.4E+00	---	5.0E+01

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child and Adult																		
Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient									
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total					
Groundwater	Groundwater	Tap Water (Adult)	Inorganics					Inorganics										
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.9E-01	2.2E-03	--	3.9E-01					
			ARSENIC	2.5E-04	1.4E-06	--	2.6E-04	ARSENIC	Skin, Cardiovascular	2.0E+00	1.1E-02	--	2.0E+00					
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	2.4E+00	1.3E-02	--	2.4E+00					
			COBALT	--	--	--	NA	COBALT	Thyroid	8.6E-01	1.9E-03	--	8.7E-01					
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E+00	8.0E-03	--	1.4E+00					
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.2E-01	1.2E-03	--	2.2E-01					
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	6.1E-02	1.3E-02	--	7.4E-02					
			PAHs					PAHs										
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.5E-01	3.3E-01	--	5.8E-01					
			NAPHTHALENE	--	--	3.6E-04	3.6E-04	NAPHTHALENE	Body Weight	8.9E-02	5.5E-02	9.5E+00	9.6E+00					
			Volatiles					Volatiles										
			BENZENE	1.1E-03	1.7E-04	3.3E-03	4.6E-03	BENZENE	Immune System	1.8E+01	2.7E+00	3.8E+01	5.9E+01					
			1,2-DICHLOROETHANE	3.2E-06	1.5E-07	1.9E-05	2.2E-05	1,2-DICHLOROETHANE	NA	2.0E-02	9.6E-04	2.8E-01	3.0E-01					
			ETHYLBENZENE	1.0E-04	5.9E-05	4.9E-04	6.5E-04	ETHYLBENZENE	Liver, Kidney	3.3E-01	1.9E-01	5.3E-01	1.0E+00					
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	1.8E-02	2.0E-02	7.2E-02	1.1E-01					
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	3.4E-01	2.0E-01	1.1E+01	1.2E+01					
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	4.1E-01	1.4E-01	1.1E-01	6.5E-01					
		O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	7.5E-02	4.1E-02	2.4E+00	2.5E+00						
		(Total for Adult)				1.5E-03	2.3E-04	4.2E-03	5.9E-03	(Total for Adult)					2.7E+01	3.7E+00	6.2E+01	9.3E+01
		Tap Water (Adult + Child)	Inorganics															
			ALUMINUM	NA	NA	NA	NA											
			ARSENIC	3.8E-04	2.0E-06	NA	3.8E-04											
			CYANIDE	NA	NA	NA	NA											
			COBALT	NA	NA	NA	NA											
			IRON	NA	NA	NA	NA											
			MANGANESE	NA	NA	NA	NA											
			VANADIUM	NA	NA	NA	NA											
			PAHs															
			2-METHYLNAPHTHALENE	NA	NA	NA	NA											
NAPHTHALENE	NA		NA	3.6E-04	3.6E-04													
Volatiles																		
BENZENE	1.7E-03	2.4E-04	3.3E-03	5.3E-03														
1,2-DICHLOROETHANE	4.8E-06	2.2E-07	1.9E-05	2.4E-05														
ETHYLBENZENE	1.6E-04	8.6E-05	4.9E-04	7.3E-04														
ISOPROPYLBENZENE	NA	NA	NA	NA														
M,P-XYLENE	NA	NA	NA	NA														
TOLUENE	NA	NA	NA	NA														
O-XYLENE	NA	NA	NA	NA														
(Total for Child + Adult)				2.2E-03	3.3E-04	4.2E-03	6.8E-03	Total Hazard Index Across Groundwater (Child)					5.0E+01					
Total Risk Across Groundwater (Adult + Child)							6.8E-03	Total Hazard Index Across Groundwater (Adult)					9.3E+01					

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area													
Scenario Timeframe: Current/Future													
Receptor Population: Resident													
Receptor Age: Child and Adult													

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient							
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total			
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics								
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02			
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02			
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02			
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04			
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01			
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02			
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03			
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03			
			PAHs					PAHs								
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA			
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02			
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)	2.1E-01	4.5E-02	---	2.5E-01				
		Surface Water (Adult)	Inorganics					Inorganics								
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04			
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03			
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03			
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04			
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03			
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03			
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04			
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03			
			PAHs					PAHs								
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA			
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03			
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02				
		Surface Water (Adult + Child)	Inorganics													
			ALUMINUM	NA	NA	NA	NA									
			ARSENIC	7.7E-07	8.5E-08	--	8.6E-07									
			CADMIUM	NA	NA	NA	NA									
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07									
			CYANIDE	NA	NA	NA	NA									
			IRON	NA	NA	NA	NA									
			MANGANESE	NA	NA	NA	NA									
			VANADIUM	NA	NA	NA	NA									
			PAHs													
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07									
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06									
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06									
			Total Risk Across Surface Water (Adult + Child)							5.1E-06	Total Hazard Index Across Surface Water (Child)					2.5E-01
											Total Hazard Index Across Surface Water (Adult)					2.9E-02

TABLE 9.19
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01	
		Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.34E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)	5.9E-03	3.5E-04	---	6.2E-03	
		Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across Sediment (Adult + Child)							4.1E-06	Total Hazard Index Across Sediment (Adult)					6.2E-03
Total Risk Across All Media and All Exposure Routes							7E-03	Total Hazard Index Across All Media and All Exposure Routes (Child)					60
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					96

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.20
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Surface Soil	Wilcox Process Area	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.5E-02	--	4.1E-03	2.0E-02		
			ARSENIC	1.4E-07	2.3E-08	8.9E-10	1.6E-07	ARSENIC	Skin, Cardiovascular	2.2E-02	3.5E-03	9.6E-04	2.6E-02		
			CADMIUM	--	--	1.4E-10	1.4E-10	CADMIUM	Kidneys, Urinary	4.0E-03	5.1E-04	5.3E-04	5.1E-03		
			HEXAVALENT CHROMIUM (+6)	2.4E-08	--	5.3E-09	2.9E-08	HEXAVALENT CHROMIUM (+6)	None	1.1E-03	--	4.4E-05	1.2E-03		
			COBALT	--	--	1.9E-09	1.9E-09	COBALT	Thyroid	3.6E-02	--	2.4E-03	3.9E-02		
			COPPER	--	--	--	NA	COPPER	None	2.9E-02	--	--	2.9E-02		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.1E-02	--	--	5.1E-02		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	6.2E-03	--	2.3E-02	2.9E-02		
			THALLIUM	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA		
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	7.6E-03	--	2.3E-05	7.6E-03		
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	8.9E-04	--	--	8.9E-04		
			PAHs					PAHs							
			BENZ(A)ANTHRACENE	1.8E-08	7.7E-09	1.5E-11	2.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA		
			BENZO(B)FLUORANTHENE	8.7E-09	3.6E-09	6.9E-12	1.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA		
			BENZO(A)PYRENE	1.0E-07	4.3E-08	8.1E-11	1.4E-07	BENZO(A)PYRENE	Developmental System	2.4E-02	9.9E-03	4.7E-03	3.9E-02		
			CHRYSENE	4.7E-10	1.9E-10	3.7E-13	6.6E-10	CHRYSENE	NA	--	--	--	NA		
			DIBENZ(A,H)ANTHRACENE	1.2E-08	5.2E-09	9.8E-12	1.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA		
			INDENO(1,2,3-C,D)PYRENE	1.7E-09	7.2E-10	1.4E-12	2.5E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA		
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.2E-03	9.2E-04	--	3.1E-03		
			NAPHTHALENE	--	--	1.5E-12	1.5E-12	NAPHTHALENE	Body Weight	1.1E-04	4.7E-05	1.0E-06	1.6E-04		
			(Total)				3.1E-07	8.3E-08	8.3E-09	4.0E-07	(Total)				2.0E-01
				Total Risk Across Surface Soil			4.0E-07					Total Hazard Index Across Surface Soil			2.5E-01

TABLE 9.20
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Groundwater	Groundwater	Wilcox Oil	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	8.8E-04	3.1E-04	--	1.2E-03		
			ARSENIC	2.9E-08	1.0E-08	--	3.9E-08	ARSENIC	Skin, Cardiovascular	4.5E-03	1.6E-03	--	6.1E-03		
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.4E-03	1.9E-03	--	7.3E-03		
			COBALT	--	--	--	NA	COBALT	Thyroid	2.0E-03	2.8E-04	--	2.3E-03		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.3E-03	1.2E-03	--	4.4E-03		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.1E-04	1.8E-04	--	6.9E-04		
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.4E-04	1.9E-03	--	2.0E-03		
			PAHs					PAHs							
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	5.7E-04	2.1E-02	--	2.1E-02		
			NAPHTHALENE	--	--	5.7E-06	5.7E-06	NAPHTHALENE	Body Weight	2.0E-04	3.8E-03	3.9E+00	3.9E+00		
			Volatiles					Volatiles							
			BENZENE	1.3E-07	7.4E-07	7.6E-05	7.7E-05	BENZENE	Immune System	4.1E-02	2.4E-01	2.3E+01	2.3E+01		
			1,2-DICHLOROETHANE	3.7E-10	6.3E-10	3.7E-07	3.7E-07	1,2-DICHLOROETHANE	NA	4.7E-05	8.1E-05	1.4E-01	1.4E-01		
			ETHYLBENZENE	1.2E-08	2.2E-07	9.6E-06	9.9E-06	ETHYLBENZENE	Liver, Kidney	7.5E-04	1.4E-02	2.7E-01	2.8E-01		
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	4.1E-05	1.3E-03	3.5E-02	3.6E-02		
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	7.9E-04	1.5E-02	5.6E+00	5.6E+00		
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	9.4E-04	1.1E-02	5.8E-02	7.0E-02		
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.7E-04	3.0E-03	3.8E-02	4.2E-02		
			(Total)				1.7E-07	9.7E-07	9.2E-05	9.3E-05	(Total)				6.1E-02
Total Risk Across Groundwater							9.3E-05	Total Hazard Index Across Groundwater							3.3E+01
Total Risk Across All Media and All Exposure Routes							9E-05	Total Hazard Index Across All Media and All Exposure Routes							33

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.21
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient								
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total				
Soil	Surface Soil	Wilcox Process Area	Inorganics					Inorganics									
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.7E-03	--	1.9E-04	4.9E-03				
			ARSENIC	1.1E-06	3.8E-08	1.0E-09	1.1E-06	ARSENIC	Skin, Cardiovascular	6.6E-03	2.3E-04	4.5E-05	6.9E-03				
			CADMIUM	--	--	1.6E-10	1.6E-10	CADMIUM	Kidneys, Urinary	1.2E-03	3.4E-05	2.5E-05	1.3E-03				
			HEXAVALENT CHROMIUM (+6)	1.8E-07	--	6.2E-09	1.9E-07	HEXAVALENT CHROMIUM (+6)	None	3.4E-04	--	2.1E-06	3.4E-04				
			COBALT	--	--	2.2E-09	2.2E-09	COBALT	Thyroid	1.1E-02	--	1.1E-04	1.1E-02				
			COPPER	--	--	--	NA	COPPER	None	8.8E-03	--	--	8.8E-03				
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.5E-02	--	--	1.5E-02				
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.9E-03	--	1.1E-03	3.0E-03				
			THALLIUM	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA				
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.3E-03	--	2.3E-05	2.3E-03				
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	8.8E-04	--	--	8.8E-04				
			PAHs					PAHs									
			BENZ(A)ANTHRACENE	1.4E-07	1.3E-08	1.7E-11	1.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA				
			BENZO(B)FLUORANTHENE	6.6E-08	6.1E-09	8.1E-12	7.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA				
			BENZO(A)PYRENE	7.7E-07	7.1E-08	9.5E-11	8.5E-07	BENZO(A)PYRENE	Developmental System	7.2E-03	6.6E-04	2.2E-04	8.1E-03				
			CHRYSENE	3.5E-09	3.2E-10	4.3E-13	3.9E-09	CHRYSENE	NA	--	--	--	NA				
			DIBENZ(A,H)ANTHRACENE	9.4E-08	8.6E-09	1.1E-11	1.0E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA				
			INDENO(1,2,3-C,D)PYRENE	1.3E-08	1.2E-09	1.6E-12	1.4E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA				
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	6.7E-04	6.1E-05	--	7.3E-04				
			NAPHTHALENE	--	--	1.7E-12	1.7E-12	NAPHTHALENE	Body Weight	3.5E-05	3.2E-06	4.7E-08	3.8E-05				
			(Total)				2.3E-06	1.4E-07	9.7E-09	2.5E-06	(Total)				6.1E-02	9.9E-04	1.7E-03
Total Risk Across Surface Soil				2.5E-06				Total Hazard Index Across Surface Soil								6.4E-02	

TABLE 9.21
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Groundwater	Groundwater	Tap Water	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.4E-01	2.6E-04	--	1.4E-01		
			ARSENIC	1.1E-04	2.1E-07	--	1.1E-04	ARSENIC	Skin, Cardiovascular	7.1E-01	1.3E-03	--	7.1E-01		
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	8.4E-01	1.6E-03	--	8.4E-01		
			COBALT	--	--	--	NA	COBALT	Thyroid	3.1E-01	2.3E-04	--	3.1E-01		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.1E-01	9.6E-04	--	5.1E-01		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	8.0E-02	1.5E-04	--	8.0E-02		
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.2E-02	1.6E-03	--	2.3E-02		
			PAHs					PAHs							
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	8.8E-02	4.7E-02	--	1.4E-01		
			NAPHTHALENE	--	--	1.0E-05	1.0E-05	NAPHTHALENE	Body Weight	3.2E-02	7.8E-03	2.8E-01	3.2E-01		
			Volatiles					Volatiles							
			BENZENE	5.0E-04	3.1E-05	9.5E-05	6.3E-04	BENZENE	Immune System	6.4E+00	3.9E-01	1.1E+00	8.0E+00		
			1,2-DICHLOROETHANE	1.4E-06	2.8E-08	5.4E-07	2.0E-06	1,2-DICHLOROETHANE	NA	7.3E-03	1.4E-04	8.4E-03	1.6E-02		
			ETHYLBENZENE	4.6E-05	1.1E-05	1.4E-05	7.1E-05	ETHYLBENZENE	Liver, Kidney	1.2E-01	2.7E-02	1.6E-02	1.6E-01		
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	6.4E-03	2.9E-03	2.1E-03	1.1E-02		
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	1.2E-01	2.9E-02	3.3E-01	4.8E-01		
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	1.5E-01	2.0E-02	3.1E-03	1.7E-01		
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.7E-04	3.0E-03	3.8E-02	4.2E-02		
			(Total)				6.7E-04	4.2E-05	1.2E-04	8.3E-04	(Total)				9.5E+00
Total Risk Across Ground Water							8.3E-04	Total Hazard Index Across Ground Water							1.2E+01
Total Risk Across All Media and All Exposure Routes							8E-04	Total Hazard Index Across All Media and All Exposure Routes							12

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.22
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient								
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total				
Soil	Surface Soil	Wilcox Process Area	Inorganics					Inorganics									
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.7E-03	--	2.0E-06	1.7E-03				
			ARSENIC	1.6E-07	7.1E-08	4.3E-11	2.3E-07	ARSENIC	Skin, Cardiovascular	2.4E-03	1.1E-03	4.7E-07	3.6E-03				
			CADMIUM	--	--	6.6E-12	6.6E-12	CADMIUM	Kidneys, Urinary	4.5E-04	1.6E-04	2.6E-07	6.1E-04				
			HEXAVALENT CHROMIUM (+6)	8.0E-08	--	7.7E-10	8.1E-08	HEXAVALENT CHROMIUM (+6)	None	1.2E-04	--	2.1E-08	1.2E-04				
			COBALT	--	--	9.0E-11	9.0E-11	COBALT	Thyroid	4.1E-03	--	1.2E-06	4.1E-03				
			COPPER	--	--	--	NA	COPPER	None	3.2E-03	--	--	3.2E-03				
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.7E-03	--	--	5.7E-03				
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.0E-04	--	1.1E-05	7.1E-04				
			THALLIUM	--	--	--	NA	THALLIUM	Hair	0.0E+00	--	--	NA				
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	8.5E-04	--	2.4E-07	8.5E-04				
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	3.3E-04	--	--	3.3E-04				
			PAHs					PAHs									
			BENZ(A)ANTHRACENE	6.2E-08	7.3E-08	2.1E-12	1.3E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA				
			BENZO(B)FLUORANTHENE	2.9E-08	3.5E-08	1.0E-12	6.4E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA				
			BENZO(A)PYRENE	3.4E-07	4.0E-07	1.2E-11	7.5E-07	BENZO(A)PYRENE	Developmental System	2.7E-03	3.1E-03	2.3E-06	5.8E-03				
			CHRYSENE	1.6E-09	1.8E-09	5.4E-14	3.4E-09	CHRYSENE	NA	--	--	--	NA				
			DIBENZ(A,H)ANTHRACENE	4.2E-08	4.9E-08	1.4E-12	9.1E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA				
			INDENO(1,2,3-C,D)PYRENE	5.8E-09	6.9E-09	2.0E-13	1.3E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA				
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.5E-04	2.9E-04	--	5.4E-04				
			NAPHTHALENE	--	--	7.1E-14	7.1E-14	NAPHTHALENE	Body Weight	1.3E-05	1.5E-05	4.9E-10	2.8E-05				
			(Total)				7.2E-07	6.4E-07	9.3E-10	1.4E-06	(Total)				2.3E-02	4.7E-03	1.8E-05
				Total Risk Across Surface Soil				1.4E-06					Total Hazard Index Across Surface Soil				2.7E-02

TABLE 9.22
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.5E-03	3.2E-04	--	3.8E-03
			ARSENIC	3.8E-07	3.5E-08	--	4.2E-07	ARSENIC	Skin, Cardiovascular	6.0E-03	5.4E-04	--	6.5E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.0E-03	1.1E-02	--	1.4E-02
			HEXVALENT CHROMIUM (+6)	2.8E-08	2.1E-07	--	2.3E-07	HEXVALENT CHROMIUM (+6)	None	4.4E-05	3.2E-04	--	3.6E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	4.7E-02	4.2E-03	--	5.1E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.0E-03	5.5E-04	--	6.6E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-03	2.2E-04	--	2.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	8.6E-04	3.0E-03	--	3.9E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	4.1E-09	2.0E-07	--	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.8E-08	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.4E-04	8.8E-03	--	8.9E-03
			(Total)	4.3E-07	1.6E-06	---	2.0E-06	(Total)	6.9E-02	2.9E-02	---	9.8E-02	
Total Risk Across Surface Water							2.0E-06	Total Hazard Index Across Surface Water					9.8E-02
Sediment	Sediment	Sediment	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.5E-03	--	--	6.5E-03
			ARSENIC	2.7E-07	6.2E-08	--	3.4E-07	ARSENIC	Skin, Cardiovascular	4.3E-03	9.7E-04	--	5.2E-03
			HEXVALENT CHROMIUM (+6)	8.5E-07	--	--	8.5E-07	HEXVALENT CHROMIUM (+6)	None	1.3E-03	--	--	1.3E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	1.3E-02	--	--	1.3E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E-02	--	--	1.4E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-03	--	--	1.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-08	6.5E-09	--	1.8E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.0E-08	6.0E-09	--	1.6E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.8E-08	4.6E-08	--	1.2E-07	BENZO(A)PYRENE	Developmental System	6.0E-04	3.6E-04	--	9.6E-04
			DIBENZ(A,H)ANTHRACENE	2.1E-08	1.2E-08	--	3.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	1.2E-06	1.3E-07	---	1.4E-06	(Total)	4.2E-02	1.3E-03	---	4.3E-02	
Total Risk Across Sediment							1.4E-06	Total Hazard Index Across Sediment					4.3E-02
Total Risk Across All Media and All Exposure Routes							5E-06	Total Hazard Index Across All Media and All Exposure Routes					0.2

NA = Not applicable due to no toxicity values

-- = No risks calculated for this exposure pathway

TABLE 9.23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Wilcox Process Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-01	--	1.2E-03	1.1E-01
			ARSENIC	4.7E-06	5.6E-07	1.3E-09	5.3E-06	ARSENIC	Skin, Cardiovascular	1.2E-01	1.5E-02	2.3E-04	1.4E-01
			COBALT	--	--	3.7E-09	3.7E-09	COBALT	Thyroid	2.8E-01	--	8.1E-04	2.8E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.9E-01	--	--	2.9E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.6E-02	--	4.1E-03	3.0E-02
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	4.4E-02	--	1.3E-04	4.4E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.2E-06	3.7E-07	4.1E-11	1.6E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.0E-06	3.2E-07	3.6E-11	1.4E-06	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	9.4E-06	2.9E-06	3.2E-10	1.2E-05	BENZO(A)PYRENE	Developmental System	6.9E-02	2.1E-02	5.9E-04	9.1E-02
			DIBENZ(A,H)ANTHRACENE	3.2E-07	9.8E-08	1.1E-11	4.2E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	5.3E-08	1.6E-08	1.8E-12	6.9E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	4.4E-02	1.4E-02	--	5.8E-02
			NAPHTHALENE	--	--	1.4E-11	1.4E-11	NAPHTHALENE	Body Weight	4.2E-03	1.3E-03	1.6E-06	5.5E-03
			Volatiles					Volatiles					
			BENZENE	6.4E-08	--	5.2E-13	6.4E-08	BENZENE	Immune System	3.4E-03	--	2.6E-08	3.4E-03
			CHLOROFORM	7.5E-07	--	3.2E-11	7.5E-07	CHLOROFORM	Liver, Hepatic	2.8E-02	--	1.6E-07	2.8E-02
			ETHYLBENZENE	4.8E-08	--	6.3E-13	4.8E-08	ETHYLBENZENE	Liver, Kidney	5.1E-04	--	2.9E-09	5.1E-04
			(Total for Child)	1.8E-05	4.3E-06	5.5E-09	2.2E-05	(Total for Child)		1.0E+00	5.1E-02	7.1E-03	1.1E+00
		Wilcox Process Area (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.9E-03	--	1.2E-03	1.1E-02
			ARSENIC	1.5E-06	3.1E-07	4.3E-09	1.8E-06	ARSENIC	Skin, Cardiovascular	1.2E-02	2.4E-03	2.3E-04	1.4E-02
			COBALT	--	--	1.2E-08	1.2E-08	COBALT	Thyroid	2.6E-02	--	8.1E-04	2.7E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.7E-02	--	--	2.7E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-03	--	4.1E-03	6.6E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	4.1E-03	--	1.3E-04	4.2E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.4E-07	7.8E-08	2.6E-11	2.2E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.2E-07	6.7E-08	2.2E-11	1.9E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.1E-06	6.1E-07	4.1E-10	1.7E-06	BENZO(A)PYRENE	Developmental System	6.5E-03	3.6E-03	5.9E-04	1.1E-02
			DIBENZ(A,H)ANTHRACENE	3.8E-08	2.1E-08	6.9E-12	5.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	6.2E-09	3.4E-09	1.1E-12	9.6E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	4.2E-03	2.3E-03	--	6.5E-03
			NAPHTHALENE	--	--	4.7E-11	4.7E-11	NAPHTHALENE	Body Weight	3.9E-04	2.2E-04	1.6E-06	6.1E-04
			Volatiles					Volatiles					
			BENZENE	2.0E-08	--	1.7E-12	2.0E-08	BENZENE	Immune System	3.2E-04	--	2.6E-08	3.2E-04
			CHLOROFORM	2.3E-07	--	1.1E-10	2.3E-07	CHLOROFORM	Liver, Hepatic	2.6E-03	--	1.6E-07	2.6E-03
			ETHYLBENZENE	1.5E-08	--	2.1E-12	1.5E-08	ETHYLBENZENE	Liver, Kidney	4.8E-05	--	2.9E-09	4.8E-05
			(Total for Adult)	3.2E-06	1.1E-06	1.7E-08	4.3E-06	(Total for Adult)		9.5E-02	8.5E-03	7.1E-03	1.1E-01

TABLE 9.23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Wilcox Process Area (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	6.2E-06	8.8E-07	5.6E-09	7.1E-06						
			COBALT	NA	NA	1.6E-08	1.6E-08						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.3E-06	4.5E-07	6.7E-11	1.8E-06						
			BENZO(B)FLUORANTHENE	1.2E-06	3.9E-07	5.8E-11	1.5E-06						
			BENZO(A)PYRENE	1.1E-05	3.5E-06	7.3E-10	1.4E-05						
			DIBENZ(A,H)ANTHRACENE	3.6E-07	1.2E-07	1.8E-11	4.7E-07						
			INDENO(1,2,3-C,D)PYRENE	5.9E-08	2.0E-08	3.0E-12	7.9E-08						
			2-METHYLNAPHTHALENE	NA	NA	NA	NA						
			NAPHTHALENE	NA	NA	6.1E-11	6.1E-11						
			Volatiles										
			BENZENE	8.4E-08	NA	2.3E-12	8.4E-08						
			CHLOROFORM	9.8E-07	NA	1.4E-10	9.8E-07						
			ETHYLBENZENE	6.3E-08	NA	2.7E-12	6.3E-08						
(Total for Child + Adult)				2.1E-05	5.4E-06	2.3E-08	2.6E-05	Total Hazard Index Across Subsurface Soil (Child)					1.1E+00
Total Risk Across Subsurface Soil (Adult + Child)							2.6E-05	Total Hazard Index Across Subsurface Soil (Adult)					1.1E-01
Groundwater	Groundwater	Tap Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.4E-01	2.8E-03	--	6.5E-01
			ARSENIC	1.3E-04	5.6E-07	--	1.3E-04	ARSENIC	Skin, Cardiovascular	3.3E+00	1.5E-02	--	3.3E+00
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	3.9E+00	1.7E-02	--	3.9E+00
			COBALT	--	--	--	NA	COBALT	Thyroid	1.4E+00	2.5E-03	--	1.4E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.4E+00	1.0E-02	--	2.4E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.7E-01	1.6E-03	--	3.7E-01
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.0E-01	1.7E-02	--	1.2E-01
			PAHs					PAHs					
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	4.1E-01	4.9E-01	--	9.1E-01
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	1.5E-01	8.3E-02	--	2.3E-01
			Volatiles					Volatiles					
			BENZENE	5.6E-04	7.4E-05	--	6.4E-04	BENZENE	Immune System	3.0E+01	3.9E+00	--	3.4E+01
			1,2-DICHLOROETHANE	1.6E-06	6.8E-08	--	1.7E-06	1,2-DICHLOROETHANE	NA	3.4E-02	1.5E-03	--	3.6E-02
			ETHYLBENZENE	5.2E-05	2.7E-05	--	7.8E-05	ETHYLBENZENE	Liver, Kidney	5.5E-01	2.8E-01	--	8.3E-01
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	3.0E-02	3.1E-02	--	6.0E-02
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	5.7E-01	3.0E-01	--	8.7E-01
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	6.9E-01	2.0E-01	--	8.9E-01
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.2E-01	6.1E-02	--	1.9E-01
(Total for Child)				7.4E-04	1.0E-04	---	8.5E-04	(Total for Child)					5.0E+01

TABLE 9.23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Tap Water (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	3.9E-01	2.2E-03	--	3.9E-01
			ALUMINUM	--	--	--	NA	ALUMINUM	Skin, Cardiovascular	2.0E+00	1.1E-02	--	2.0E+00
			ARSENIC	2.5E-04	1.4E-06	--	2.6E-04	ARSENIC	Gastrointestinal System	2.4E+00	1.3E-02	--	2.4E+00
			CYANIDE	--	--	--	NA	CYANIDE	Thyroid	8.6E-01	1.9E-03	--	8.7E-01
			COBALT	--	--	--	NA	COBALT	Gastrointestinal System	1.4E+00	8.0E-03	--	1.4E+00
			IRON	--	--	--	NA	IRON	Central Nervous System	2.2E-01	1.2E-03	--	2.2E-01
			MANGANESE	--	--	--	NA	MANGANESE	Kidney	6.1E-02	1.3E-02	--	7.4E-02
			VANADIUM	--	--	--	NA	VANADIUM					
			PAHs					PAHs					
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.5E-01	3.3E-01	--	5.8E-01
			NAPHTHALENE	--	--	3.6E-04	3.6E-04	NAPHTHALENE	Body Weight	8.9E-02	5.5E-02	9.5E+00	9.6E+00
			Volatiles					Volatiles					
			BENZENE	1.1E-03	1.7E-04	3.3E-03	4.6E-03	BENZENE	Immune System	1.8E+01	2.7E+00	3.8E+01	5.9E+01
			1,2-DICHLOROETHANE	3.2E-06	1.5E-07	1.9E-05	2.2E-05	1,2-DICHLOROETHANE	NA	2.0E-02	9.6E-04	2.8E-01	3.0E-01
			ETHYLBENZENE	1.0E-04	5.9E-05	4.9E-04	6.5E-04	ETHYLBENZENE	Liver, Kidney	3.3E-01	1.9E-01	5.3E-01	1.0E+00
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	1.8E-02	2.0E-02	7.2E-02	1.1E-01
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	3.4E-01	2.0E-01	1.1E+01	1.2E+01
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	4.1E-01	1.4E-01	1.1E-01	6.5E-01
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	7.5E-02	4.07E-02	2.4E+00	2.5E+00
			(Total for Adult)	1.5E-03	2.3E-04	4.2E-03	5.9E-03		(Total for Adult)	2.7E+01	3.7E+00	6.2E+01	9.3E+01
		Tap Water (Adult + Child)	Inorganics	NA	NA	NA	NA						
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	3.8E-04	2.0E-06	NA	3.8E-04						
			CYANIDE	NA	NA	NA	NA						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			2-METHYLNAPHTHALENE	NA	NA	NA	NA						
			NAPHTHALENE	NA	NA	3.6E-04	3.6E-04						
			Volatiles										
			BENZENE	1.7E-03	2.4E-04	3.3E-03	5.3E-03						
			1,2-DICHLOROETHANE	4.8E-06	2.2E-07	1.9E-05	2.4E-05						
			ETHYLBENZENE	1.6E-04	8.6E-05	4.9E-04	7.3E-04						
			ISOPROPYLBENZENE	NA	NA	NA	NA						
			M,P-XYLENE	NA	NA	NA	NA						
			TOLUENE	NA	NA	NA	NA						
			O-XYLENE	NA	NA	NA	NA						
			(Total for Child + Adult)	2.2E-03	3.3E-04	4.2E-03	6.8E-03						
			(Total Risk Across Groundwater (Adult + Child))				6.8E-03		Total Hazard Index Across Groundwater (Child)				5.0E+01
									Total Hazard Index Across Groundwater (Adult)				9.3E+01

TABLE 9.23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02	
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02	
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02	
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04	
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03	
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03	
			PAHs					PAHs						
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02	
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06		(Total for Child)	2.1E-01	4.5E-02	---	2.5E-01	
		Surface Water (Adult)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04	
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03	
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03	
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04	
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04	
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03	
			PAHs					PAHs						
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03	
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06		(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02	
		Surface Water (Adult + Child)	Inorganics											
			ALUMINUM	NA	NA	NA	NA							
			ARSENIC	7.7E-07	8.5E-08	NA	8.6E-07							
			CADMIUM	NA	NA	NA	NA							
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07							
			CYANIDE	NA	NA	NA	NA							
			IRON	NA	NA	NA	NA							
			MANGANESE	NA	NA	NA	NA							
			VANADIUM	NA	NA	NA	NA							
			PAHs											
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07							
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06							
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01	
	Total Risk Across Surface Water (Adult + Child)						5.1E-06	Total Hazard Index Across Surface Water (Adult)						2.9E-02

TABLE 9.23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01	
		Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.3E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)	5.9E-03	3.5E-04	---	6.2E-03	
		Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across Sediment (Adult + Child)							4.1E-06	Total Hazard Index Across Sediment (Adult)					6.2E-03
Total Risk Across All Media and All Exposure Routes							7E-03	Total Hazard Index Across All Media and All Exposure Routes (Child)					52

TABLE 9.23
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
NA = Not applicable due to no toxicity values.										Total Hazard Index Across All Media and All Exposure Routes (Adult)					93

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.24
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area Scenario Timeframe: Current/Future Receptor Population: Construction Worker Receptor Age: Adult																	
Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient								
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total				
Soil	Subsurface Soil	Wilcox Process Area	Inorganics					Inorganics									
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.3E-02	--	6.2E-03	3.0E-02				
			ARSENIC	1.7E-07	2.8E-08	1.1E-09	2.0E-07	ARSENIC	Skin, Cardiovascular	2.7E-02	4.4E-03	1.2E-03	3.3E-02				
			COBALT	--	--	3.2E-09	3.2E-09	COBALT	Thyroid	6.2E-02	--	4.1E-03	6.6E-02				
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.3E-02	--	--	6.3E-02				
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.7E-03	--	2.1E-02	2.7E-02				
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-03	--	6.4E-04	1.0E-02				
			PAHs					PAHs									
			BENZ(A)ANTHRACENE	8.4E-09	3.5E-09	4.8E-11	1.2E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA				
			BENZO(B)FLUORANTHENE	7.2E-09	3.0E-09	4.1E-11	1.0E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA				
			BENZO(A)PYRENE	6.6E-08	2.7E-08	3.7E-10	9.3E-08	BENZO(A)PYRENE	Developmental System	1.5E-02	6.4E-03	3.0E-03	2.5E-02				
			DIBENZ(A,H)ANTHRACENE	2.2E-09	9.2E-10	1.3E-11	3.1E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA				
			INDENO(1,2,3-C,D)PYRENE	3.7E-10	1.5E-10	2.1E-12	5.2E-10	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA				
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	9.8E-03	4.1E-03	--	1.4E-02				
			NAPHTHALENE	--	--	8.6E-11	8.6E-11	NAPHTHALENE	Body Weight	9.3E-04	3.9E-04	8.2E-06	1.3E-03				
			Volatiles					Volatiles									
			BENZENE	2.4E-09	--	3.2E-12	2.4E-09	BENZENE	Immune System	7.5E-04	--	1.3E-07	7.5E-04				
			CHLOROFORM	2.8E-08	--	1.9E-10	2.8E-08	CHLOROFORM	Liver, Hepatic	6.2E-03	--	8.4E-07	6.2E-03				
			ETHYLBENZENE	1.8E-09	--	3.8E-12	1.8E-09	ETHYLBENZENE	Liver, Kidney	1.1E-04	--	1.5E-08	1.1E-04				
			(Total)				2.9E-07	6.3E-08	5.0E-09	3.6E-07	(Total)				2.2E-01	1.5E-02	3.6E-02
				Total Risk Across Subsurface Soil				3.6E-07					Total Hazard Index Across Subsurface Soil				2.8E-01
Groundwater	Groundwater	Wilcox Oil	Inorganics					Inorganics									
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	8.8E-04	3.1E-04	--	1.2E-03				
			ARSENIC	2.9E-08	1.0E-08	--	3.9E-08	ARSENIC	Skin, Cardiovascular	4.5E-03	1.6E-03	--	6.1E-03				
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.4E-03	1.9E-03	--	7.3E-03				
			COBALT	--	--	--	NA	COBALT	Thyroid	2.0E-03	2.8E-04	--	2.3E-03				
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.3E-03	1.2E-03	--	4.4E-03				
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.1E-04	1.8E-04	--	6.9E-04				
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.4E-04	1.9E-03	--	2.0E-03				
			PAHs					PAHs									
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	5.7E-04	2.1E-02	--	2.1E-02				
			NAPHTHALENE	--	--	5.7E-06	5.7E-06	NAPHTHALENE	Body Weight	2.0E-04	3.8E-03	3.9E+00	3.9E+00				
			Volatiles					Volatiles									
			BENZENE	1.3E-07	7.4E-07	7.6E-05	7.7E-05	BENZENE	Immune System	4.1E-02	2.4E-01	2.3E+01	2.3E+01				
			1,2-DICHLOROETHANE	3.7E-10	6.3E-10	3.7E-07	3.7E-07	1,2-DICHLOROETHANE	NA	4.7E-05	8.1E-05	1.4E-01	1.4E-01				
			ETHYLBENZENE	1.2E-08	2.2E-07	9.6E-06	9.9E-06	ETHYLBENZENE	Liver, Kidney	7.5E-04	1.4E-02	2.7E-01	2.8E-01				
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	4.1E-05	1.3E-03	3.5E-02	3.6E-02				
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	7.9E-04	1.5E-02	5.6E+00	5.6E+00				
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	9.4E-04	1.1E-02	5.8E-02	7.0E-02				
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.7E-04	3.0E-03	3.8E-02	4.2E-02				
			(Total)				1.7E-07	9.7E-07	9.2E-05	9.3E-05	(Total)				6.1E-02	3.1E-01	3.3E+01
				Total Risk Across Groundwater				9.3E-05					Total Hazard Index Across Groundwater				3.3E+01
				Total Risk Across All Media and All Exposure Routes				9E-05					Total Hazard Index Across All Media and All Exposure Routes				34

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	East Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-01	--	1.2E-03	1.1E-01
			ARSENIC	2.9E-06	3.4E-07	7.9E-10	3.2E-06	ARSENIC	Skin, Cardiovascular	7.5E-02	8.9E-03	1.4E-04	8.4E-02
			COBALT	--	--	3.0E-09	3.0E-09	COBALT	Thyroid	2.3E-01	--	6.6E-04	2.3E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.8E-01	--	--	2.8E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.9E-02	--	9.4E-03	6.8E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.3E-07	1.0E-07	1.1E-11	4.3E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	6.0E-07	1.8E-07	2.0E-11	7.8E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	3.6E-06	1.1E-06	1.2E-10	4.7E-06	BENZO(A)PYRENE	Developmental System	2.7E-02	8.2E-03	2.3E-04	3.5E-02
			INDENO(1,2,3-C,D)PYRENE	1.0E-07	3.1E-08	3.5E-12	1.3E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	7.5E-06	1.8E-06	4.0E-09	9.3E-06	(Total for Child)	(Total for Child)	7.7E-01	1.7E-02	1.2E-02	8.0E-01
		East Tank Farm (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.9E-03	--	1.2E-03	1.1E-02
			ARSENIC	9.0E-07	1.9E-07	2.6E-09	1.1E-06	ARSENIC	Skin, Cardiovascular	7.0E-03	1.5E-03	1.4E-04	8.7E-03
			COBALT	--	--	1.0E-08	1.0E-08	COBALT	Thyroid	2.1E-02	--	6.6E-04	2.2E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.6E-02	--	--	2.6E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.5E-03	--	9.4E-03	1.5E-02
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.9E-08	2.1E-08	1.4E-11	6.1E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	7.0E-08	3.9E-08	2.6E-11	1.1E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	4.3E-07	2.3E-07	1.6E-10	6.6E-07	BENZO(A)PYRENE	Developmental System	2.5E-03	1.4E-03	2.3E-04	4.1E-03
			INDENO(1,2,3-C,D)PYRENE	1.2E-08	6.5E-09	4.3E-12	1.8E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	1.5E-06	4.9E-07	1.3E-08	2.0E-06	(Total for Adult)	(Total for Adult)	7.2E-02	2.9E-03	1.2E-02	8.7E-02
		East Tank Farm (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	3.8E-06	5.3E-07	3.4E-09	4.3E-06						
			COBALT	NA	NA	1.3E-08	1.3E-08						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-07	1.2E-07	2.6E-11	4.9E-07						
			BENZO(B)FLUORANTHENE	6.7E-07	2.2E-07	4.6E-11	8.9E-07						
			BENZO(A)PYRENE	4.0E-06	1.3E-06	2.8E-10	5.4E-06						
			INDENO(1,2,3-C,D)PYRENE	1.1E-07	3.8E-08	7.8E-12	1.5E-07						
			(Total for Child + Adult)	9.0E-06	2.3E-06	1.7E-08	1.1E-05						

TABLE 9.25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	East Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.5E-02	--	--	1.5E-02
			ARSENIC	1.1E-06	--	--	1.1E-06	ARSENIC	Skin, Cardiovascular	2.9E-02	--	--	2.9E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	1.7E-01	--	--	1.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.0E-02	--	--	4.0E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.3E-01	--	--	5.3E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.4E-07	--	--	2.4E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	2.4E-07	--	--	2.4E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.7E-06	--	--	1.7E-06	BENZO(A)PYRENE	Developmental System	1.3E-02	--	--	1.3E-02
			INDENO(1,2,3-C,D)PYRENE	2.2E-08	--	--	2.2E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	3.3E-06	---	---	3.3E-06	(Total for Child)	(Total for Child)	7.9E-01	---	---	7.9E-01
		East Tank Farm (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	5.9E-03	--	--	5.9E-03
			ARSENIC	1.4E-06	--	--	1.4E-06	ARSENIC	Skin, Cardiovascular	1.1E-02	--	--	1.1E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	6.5E-02	--	--	6.5E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.6E-02	--	--	1.6E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-01	--	--	2.1E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.2E-07	--	--	1.2E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.2E-07	--	--	1.2E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	8.4E-07	--	--	8.4E-07	BENZO(A)PYRENE	Developmental System	4.9E-03	--	--	4.9E-03
			INDENO(1,2,3-C,D)PYRENE	1.1E-08	--	--	1.1E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	2.5E-06	---	---	2.5E-06	(Total for Adult)	(Total for Adult)	3.1E-01	---	---	3.1E-01
		East Tank Farm (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	2.5E-06	NA	NA	2.5E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.5E-07	NA	NA	3.5E-07						
			BENZO(B)FLUORANTHENE	3.6E-07	NA	NA	3.6E-07						
			BENZO(A)PYRENE	2.6E-06	NA	NA	2.6E-06						
			INDENO(1,2,3-C,D)PYRENE	3.2E-08	NA	NA	3.2E-08						
			(Total for Child + Adult)	5.8E-06	---	---	5.8E-06	Total Hazard Index Across Surface Soil (Child)					1.6E+00

TABLE 9.25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Beef Consumption	East Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.6E-02	--	--	1.6E-02
			ARSENIC	9.8E-07	--	--	9.8E-07	ARSENIC	Skin, Cardiovascular	2.5E-02	--	--	2.5E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	4.8E-01	--	--	4.8E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.6E-01	--	--	5.6E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.6E-03	--	--	3.6E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	5.0E-07	--	--	5.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	9.3E-07	--	--	9.3E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.3E-05	--	--	1.3E-05	BENZO(A)PYRENE	Developmental System	9.2E-02	--	--	9.2E-02
			INDENO(1,2,3-C,D)PYRENE	1.3E-06	--	--	1.3E-06	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	1.6E-05	---	---	1.6E-05	(Total for Child)	1.2E+00	---	---	---	1.2E+00
		East Tank Farm (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	7.9E-03	--	--	7.9E-03
			ARSENIC	1.6E-06	--	--	1.6E-06	ARSENIC	Skin, Cardiovascular	1.3E-02	--	--	1.3E-02
			COBALT	--	--	--	NA	COBALT	Thyroid	2.4E-01	--	--	2.4E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.7E-01	--	--	2.7E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.8E-03	--	--	1.8E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.1E-07	--	--	3.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	5.7E-07	--	--	5.7E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.8E-06	--	--	7.8E-06	BENZO(A)PYRENE	Developmental System	4.5E-02	--	--	4.5E-02
			INDENO(1,2,3-C,D)PYRENE	7.9E-07	--	--	7.9E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	1.1E-05	---	---	1.1E-05	(Total for Adult)	5.8E-01	---	---	---	5.8E-01
		East Tank Farm (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	2.6E-06	NA	NA	2.6E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	8.1E-07	NA	NA	8.1E-07						
			BENZO(B)FLUORANTHENE	1.5E-06	NA	NA	1.5E-06						
			BENZO(A)PYRENE	2.0E-05	NA	NA	2.0E-05						
			INDENO(1,2,3-C,D)PYRENE	2.1E-06	NA	NA	2.1E-06						
			(Total for Child + Adult)	2.7E-05	---	---	2.7E-05	Total Hazard Index Across Surface Soil (Child)					2.8E+00
		Total Risk Across Surface Soil (Adult + Child)				4.4E-05	Total Hazard Index Across Surface Soil (Adult)					9.7E-01	

TABLE 9.25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06		(Total for Child)	2.1E-01	4.5E-02	---	2.5E-01
		Surface Water (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06		(Total for Adult)	7.7E-03	2.2E-02	---	2.9E-02
		Surface Water (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	--	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07						
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06						
			(Total for Child + Adult)	9.4E-07	4.2E-06	---	5.1E-06						
	Total Risk Across Surface Water (Adult + Child)					5.1E-06		Total Hazard Index Across Surface Water (Child)					2.5E-01
								Total Hazard Index Across Surface Water (Adult)					2.9E-02

TABLE 9.25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	3.6E-06	1.8E-07	---	3.8E-06	(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01	
		Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.34E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)	5.9E-03	3.5E-04	---	6.2E-03	
		Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06	(Total Hazard Index Across Sediment (Child))					1.3E-01
Total Risk Across Sediment (Adult + Child)				4.1E-06	Total Hazard Index Across Sediment (Adult)				6.2E-03				
Total Risk Across All Media and All Exposure Routes				5E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)				3				

TABLE 9.25
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
NA = Not applicable due to no toxicity values.													Total Hazard Index Across All Media and All Exposure Routes (Adult)		1

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.26
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient							
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total			
Soil	Surface Soil	East Tank Farm	Inorganics					Inorganics								
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.3E-02	--	6.2E-03	3.0E-02			
			ARSENIC	1.1E-07	1.7E-08	6.7E-10	1.2E-07	ARSENIC	Skin, Cardiovascular	1.7E-02	2.7E-03	7.3E-04	2.0E-02			
			COBALT	--	--	2.6E-09	2.6E-09	COBALT	Thyroid	5.1E-02	--	3.4E-03	5.4E-02			
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.1E-02	--	--	6.1E-02			
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.3E-02	--	4.8E-02	6.1E-02			
			PAHs					PAHs								
			BENZ(A)ANTHRACENE	2.3E-09	9.6E-10	1.8E-12	3.3E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA			
			BENZO(B)FLUORANTHENE	4.1E-09	1.7E-09	3.3E-12	5.9E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA			
			BENZO(A)PYRENE	2.5E-08	1.0E-08	2.0E-11	3.6E-08	BENZO(A)PYRENE	Developmental System	5.9E-03	2.4E-03	1.2E-03	9.5E-03			
			INDENO(1,2,3-C,D)PYRENE	7.0E-10	2.9E-10	5.5E-13	9.9E-10	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA			
			(Total)	1.4E-07	3.1E-08	3.3E-09	1.7E-07	(Total)	1.7E-01	5.1E-03	5.9E-02	2.3E-01				
						Total Risk Across Surface Soil				1.7E-07				Total Hazard Index Across Surface Soil		
Total Risk Across All Media and All Exposure Routes				2E-07				Total Hazard Index Across All Media and All Exposure Routes							0.2	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.27
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Soil	Surface Soil	East Tank Farm	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	7.1E-03	--	2.9E-04	7.4E-03	
			ARSENIC	8.1E-07	2.8E-08	7.9E-10	8.4E-07	ARSENIC	Skin, Cardiovascular	5.0E-03	1.8E-04	3.4E-05	5.2E-03	
			COBALT	--	--	3.0E-09	3.0E-09	COBALT	Thyroid	1.5E-02	--	1.6E-04	1.6E-02	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	--	--	1.8E-02	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.9E-03	--	2.2E-03	6.2E-03	
			PAHs					PAHs					NA	
			BENZ(A)ANTHRACENE	1.7E-08	1.6E-09	2.1E-12	1.9E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
			BENZO(B)FLUORANTHENE	3.1E-08	2.9E-09	3.8E-12	3.4E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA	
			BENZO(A)PYRENE	1.9E-07	1.7E-08	2.3E-11	2.1E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	1.6E-04	5.4E-05	2.0E-03	
			INDENO(1,2,3-C,D)PYRENE	5.3E-09	4.9E-10	6.5E-13	5.8E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA	
			(Total)	1.1E-06	5.1E-08	3.8E-09	1.1E-06	(Total)	5.2E-02	3.4E-04	2.8E-03	5.5E-02		
			Total Risk Across Surface Soil			1.1E-06				Total Hazard Index Across Surface Soil			5.5E-02	
			Total Risk Across All Media and All Exposure Routes			1E-06				Total Hazard Index Across All Media and All Exposure Routes			0.05	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.28
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm Scenario Timeframe: Current/Future Receptor Population: Trespasser Receptor Age: Adolescent														
Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Soil	Surface Soil	East Tank Farm	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.6E-03	--	3.0E-06	2.6E-03	
			ARSENIC	1.2E-07	5.4E-08	3.3E-11	1.7E-07	ARSENIC	Skin, Cardiovascular	1.9E-03	8.4E-04	3.5E-07	2.7E-03	
			COBALT	--	--	1.3E-10	1.3E-10	COBALT	Thyroid	5.7E-03	--	1.6E-06	5.7E-03	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-03	--	--	6.8E-03	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.4E-03	--	2.3E-05	1.5E-03	
			PAHs					PAHs						
			BENZ(A)ANTHRACENE	7.7E-09	9.1E-09	2.7E-13	1.7E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
			BENZO(B)FLUORANTHENE	1.4E-08	1.6E-08	4.8E-13	3.0E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA	
			BENZO(A)PYRENE	8.4E-08	9.9E-08	2.9E-12	1.8E-07	BENZO(A)PYRENE	Developmental System	6.6E-04	7.7E-04	5.6E-07	1.4E-03	
			INDENO(1,2,3-C,D)PYRENE	2.3E-09	2.8E-09	8.1E-14	5.1E-09	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA	
			(Total)	2.3E-07	1.8E-07	1.6E-10	4.1E-07	(Total)	1.9E-02	1.6E-03	2.9E-05	2.1E-02		
			Total Risk Across Surface Soil				4.1E-07				Total Hazard Index Across Surface Soil			
Surface Water	Surface Water	Surface Water	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.5E-03	3.2E-04	--	3.8E-03	
			ARSENIC	3.8E-07	3.5E-08	--	4.2E-07	ARSENIC	Skin, Cardiovascular	6.0E-03	5.4E-04	--	6.5E-03	
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.0E-03	1.1E-02	--	1.4E-02	
			HEXAVALENT CHROMIUM (+6)	2.8E-08	2.1E-07	--	2.3E-07	HEXAVALENT CHROMIUM (+6)	None	4.4E-05	3.2E-04	--	3.6E-04	
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	4.7E-02	4.2E-03	--	5.1E-02	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.0E-03	5.5E-04	--	6.6E-03	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-03	2.2E-04	--	2.7E-03	
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	8.6E-04	3.0E-03	--	3.9E-03	
			PAHs					PAHs						
			BENZ(A)ANTHRACENE	4.1E-09	2.0E-07	--	2.1E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
			BENZO(A)PYRENE	1.8E-08	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.4E-04	8.8E-03	--	8.9E-03	
			(Total)	4.3E-07	1.6E-06	---	2.0E-06	(Total)	6.9E-02	2.9E-02	---	9.8E-02		
Total Risk Across Surface Water				2.0E-06				Total Hazard Index Across Surface Water					9.8E-02	

TABLE 9.28
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.5E-03	--	--	6.5E-03
			ARSENIC	2.7E-07	6.2E-08	--	3.4E-07	ARSENIC	Skin, Cardiovascular	4.3E-03	9.7E-04	--	5.2E-03
			HEXAVALENT CHROMIUM (+6)	8.5E-07	--	--	8.5E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-03	--	--	1.3E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	1.3E-02	--	--	1.3E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E-02	--	--	1.4E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.5E-03	--	--	1.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.1E-08	6.5E-09	--	1.8E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.0E-08	6.0E-09	--	1.6E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.8E-08	4.6E-08	--	1.2E-07	BENZO(A)PYRENE	Developmental System	6.0E-04	3.6E-04	--	9.6E-04
			DIBENZ(A,H)ANTHRACENE	2.1E-08	1.2E-08	--	3.4E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total)	1.2E-06	1.3E-07	---	1.4E-06		(Total)	4.2E-02	1.3E-03	---	4.3E-02
			Total Risk Across Sediment				1.4E-06	Total Hazard Index Across Sediment				4.3E-02	
Total Risk Across All Media and All Exposure Routes				4E-06	Total Hazard Index Across All Media and All Exposure Routes				0.2				

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.29
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	East Tank Farm (Child)	Inorganics	--	--	--	NA	Inorganics	Neurological	1.0E-01	--	1.2E-03	1.1E-01
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.0E-01	--	1.2E-03	1.1E-01
			ARSENIC	4.6E-06	5.5E-07	1.3E-09	5.2E-06	ARSENIC	Skin, Cardiovascular	1.2E-01	1.4E-02	2.3E-04	1.3E-01
			COBALT	--	--	4.8E-09	4.8E-09	COBALT	Thyroid	3.6E-01	--	1.0E-03	3.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.3E-01	--	--	3.3E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.3E-02	--	3.7E-03	2.6E-02
			PAHs					PAHs					
			BENZO(A)PYRENE	3.5E-07	1.1E-07	2.3E-12	4.5E-07	BENZO(A)PYRENE	Developmental System	2.5E-03	7.9E-04	2.2E-05	3.4E-03
			(Total for Child)	5.0E-06	6.6E-07	6.1E-09	5.7E-06	(Total for Child)	9.5E-01	1.5E-02	6.1E-03	9.7E-01	
		East Tank Farm (Adult)	Inorganics	--	--	--	NA	Inorganics	Neurological	9.8E-03	--	1.2E-03	1.1E-02
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.8E-03	--	1.2E-03	1.1E-02
			ARSENIC	1.5E-06	3.1E-07	4.2E-09	1.8E-06	ARSENIC	Skin, Cardiovascular	1.1E-02	2.4E-03	2.3E-04	1.4E-02
			COBALT	--	--	1.6E-08	1.6E-08	COBALT	Thyroid	3.4E-02	--	1.0E-03	3.5E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.1E-02	--	--	3.1E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-03	--	3.7E-03	5.8E-03
			PAHs					PAHs					
			BENZO(A)PYRENE	4.1E-08	2.2E-08	1.5E-11	6.3E-08	BENZO(A)PYRENE	Developmental System	2.4E-04	1.3E-04	2.2E-05	3.9E-04
			(Total for Adult)	1.5E-06	3.3E-07	2.0E-08	1.8E-06	(Total for Adult)	8.9E-02	2.5E-03	6.1E-03	9.7E-02	
		East Tank Farm (Adult + Child)	Inorganics	NA	NA	NA	NA						
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	6.1E-06	8.6E-07	5.5E-09	7.0E-06						
			COBALT	NA	NA	2.1E-08	2.1E-08						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZO(A)PYRENE	3.9E-07	1.3E-07	1.7E-11	5.2E-07						
			(Total for Child + Adult)	6.5E-06	9.9E-07	2.6E-08	7.5E-06	Total Hazard Index Across Subsurface Soil (Child)					9.7E-01
Total Risk Across Subsurface Soil (Adult + Child)				7.5E-06	Total Hazard Index Across Subsurface Soil (Adult)					9.7E-02			

TABLE 9.29
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-02	5.0E-04	--	1.1E-02
			ARSENIC	6.9E-07	3.3E-08	--	7.2E-07	ARSENIC	Skin, Cardiovascular	1.8E-02	8.5E-04	--	1.9E-02
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.0E-03	1.7E-02	--	2.6E-02
			HEXAVALENT CHROMIUM (+6)	9.0E-08	3.4E-07	--	4.3E-07	HEXAVALENT CHROMIUM (+6)	None	1.3E-04	5.0E-04	--	6.3E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	1.4E-01	6.7E-03	--	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.8E-02	8.6E-04	--	1.9E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	7.3E-03	3.5E-04	--	7.7E-03
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	2.6E-03	4.7E-03	--	7.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.3E-08	3.4E-07	--	3.5E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
Surface Water	Surface Water	Surface Water (Adult)	BENZO(A)PYRENE	5.6E-08	1.9E-06	--	1.9E-06	BENZO(A)PYRENE	Developmental System	4.1E-04	1.4E-02	--	1.4E-02
			(Total for Child)	8.5E-07	2.6E-06	---	3.4E-06	(Total for Child)		2.1E-01	4.5E-02	---	2.5E-01
			Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	4.0E-04	2.4E-04	--	6.4E-04
			ARSENIC	8.6E-08	5.2E-08	--	1.4E-07	ARSENIC	Skin, Cardiovascular	6.7E-04	4.0E-04	--	1.1E-03
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	3.4E-04	8.1E-03	--	8.5E-03
			HEXAVALENT CHROMIUM (+6)	4.2E-09	2.0E-07	--	2.1E-07	HEXAVALENT CHROMIUM (+6)	None	5.0E-06	2.4E-04	--	2.4E-04
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	5.3E-03	3.2E-03	--	8.5E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	6.8E-04	4.1E-04	--	1.1E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.7E-04	1.7E-04	--	4.4E-04
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	9.7E-05	2.2E-03	--	2.3E-03
Surface Water	Surface Water	Surface Water (Adult)	PAHs					PAHs					
			BENZ(A)ANTHRACENE	6.1E-10	2.0E-07	--	2.0E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.6E-09	1.1E-06	--	1.1E-06	BENZO(A)PYRENE	Developmental System	1.5E-05	6.6E-03	--	6.6E-03
			(Total for Adult)	9.4E-08	1.6E-06	---	1.7E-06	(Total for Adult)		7.7E-03	2.2E-02	---	2.9E-02

TABLE 9.29
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Surface Water	Surface Water	Surface Water (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	7.7E-07	8.5E-08	NA	8.6E-07						
			CADMIUM	NA	NA	NA	NA						
			HEXAVALENT CHROMIUM (+6)	9.4E-08	5.5E-07	NA	6.4E-07						
			CYANIDE	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	1.4E-08	5.4E-07	NA	5.5E-07						
			BENZO(A)PYRENE	5.9E-08	3.0E-06	NA	3.1E-06						
(Total for Child + Adult)				9.4E-07	4.2E-06	---	5.1E-06		Total Hazard Index Across Surface Water (Child)				2.5E-01
	Total Risk Across Surface Water (Adult + Child)						5.1E-06		Total Hazard Index Across Surface Water (Adult)				2.9E-02
Sediment	Sediment	Sediment (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.0E-02	--	--	2.0E-02
			ARSENIC	4.9E-07	5.9E-08	--	5.5E-07	ARSENIC	Skin, Cardiovascular	1.3E-02	1.5E-03	--	1.4E-02
			HEXAVALENT CHROMIUM (+6)	2.7E-06	--	--	2.7E-06	HEXAVALENT CHROMIUM (+6)	None	4.0E-03	--	--	4.0E-03
			COBALT	--	--	--	NA	COBALT	Thyroid	4.0E-02	--	--	4.0E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	4.2E-02	--	--	4.2E-02
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	4.5E-03	--	--	4.5E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.5E-08	1.1E-08	--	4.6E-08	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	3.2E-08	9.9E-09	--	4.2E-08	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	2.5E-07	7.6E-08	--	3.2E-07	BENZO(A)PYRENE	Developmental System	1.8E-03	5.6E-04	--	2.4E-03
			DIBENZ(A,H)ANTHRACENE	6.7E-08	2.1E-08	--	8.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
(Total for Child)				3.6E-06	1.8E-07	---	3.8E-06		(Total for Child)	1.3E-01	2.1E-03	---	1.3E-01

TABLE 9.29
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Sediment	Sediment (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	9.2E-04	--	--	9.2E-04
			ARSENIC	7.7E-08	3.3E-08	--	1.1E-07	ARSENIC	Skin, Cardiovascular	6.0E-04	2.5E-04	--	8.5E-04
			HEXAVALENT CHROMIUM (+6)	1.6E-07	--	--	1.6E-07	HEXAVALENT CHROMIUM (+6)	None	1.9E-04	--	--	1.9E-04
			COBALT	--	--	--	NA	COBALT	Thyroid	1.9E-03	--	--	1.9E-03
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.0E-03	--	--	2.0E-03
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.1E-04	--	--	2.1E-04
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-09	2.3E-09	--	4.4E-09	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.9E-09	2.1E-09	--	4.0E-09	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-08	1.6E-08	--	3.1E-08	BENZO(A)PYRENE	Developmental System	8.5E-05	9.3E-05	--	1.8E-04
			DIBENZ(A,H)ANTHRACENE	4.0E-09	4.4E-09	--	8.3E-09	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	2.6E-07	5.7E-08	---	3.2E-07	(Total for Adult)		5.9E-03	3.5E-04	---	6.2E-03
		Sediment (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	5.7E-07	9.1E-08	NA	6.6E-07						
			HEXAVALENT CHROMIUM (+6)	2.9E-06	NA	NA	2.9E-06						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	3.7E-08	1.3E-08	NA	5.1E-08						
			BENZO(B)FLUORANTHENE	3.4E-08	1.2E-08	NA	4.6E-08						
			BENZO(A)PYRENE	2.6E-07	9.2E-08	NA	3.5E-07						
			DIBENZ(A,H)ANTHRACENE	7.1E-08	2.5E-08	NA	9.7E-08						
			(Total for Child + Adult)	3.9E-06	2.3E-07	---	4.1E-06						
Total Risk Across Sediment (Adult + Child)							4.1E-06	Total Hazard Index Across Sediment (Child)					1.3E-01
Total Risk Across All Media and All Exposure Routes							2E-05	Total Hazard Index Across Sediment (Adult)					6.2E-03
								Total Hazard Index Across All Media and All Exposure Routes (Child)					1
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					0.1

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.30
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Subsurface Soil	East Tank Farm	Inorganics					Inorganics							
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.3E-02	--	6.1E-03	2.9E-02		
			ARSENIC	1.7E-07	2.7E-08	1.1E-09	2.0E-07	ARSENIC	Skin, Cardiovascular	2.7E-02	4.3E-03	1.2E-03	3.2E-02		
			COBALT	--	--	4.1E-09	4.1E-09	COBALT	Thyroid	8.0E-02	--	5.3E-03	8.6E-02		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	7.3E-02	--	--	7.3E-02		
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.0E-03	--	1.9E-02	2.4E-02		
			PAHs					PAHs							
			BENZO(A)PYRENE	2.4E-09	1.0E-09	1.4E-11	3.4E-09	BENZO(A)PYRENE	Developmental System	5.6E-04	2.3E-04	1.1E-04	9.1E-04		
			(Total)	1.7E-07	2.8E-08	5.2E-09	2.1E-07	(Total)	2.1E-01	4.5E-03	3.1E-02	2.4E-01			
Total Risk Across Subsurface Soil							2.1E-07	Total Hazard Index Across Subsurface Soil							2.4E-01
Total Risk Across All Media and All Exposure Routes							2E-07	Total Hazard Index Across All Media and All Exposure Routes							0.2

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 9.31
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Residential Yards (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.7E-01	--	3.1E-03	2.7E-01
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.2E-01	--	--	2.2E-01
			ARSENIC	2.2E-05	2.6E-06	6.0E-09	2.4E-05	ARSENIC	Skin, Cardiovascular	5.7E-01	6.7E-02	1.1E-03	6.3E-01
			CADMIUM	--	--	9.1E-09	9.1E-09	CADMIUM	Kidneys, Urinary	1.0E+00	9.7E-02	5.9E-03	1.1E+00
			COBALT	--	--	3.5E-08	3.5E-08	COBALT	Thyroid	2.6E+00	--	7.5E-03	2.6E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.3E+00	--	--	1.3E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.7E-01	--	2.8E-02	2.0E-01
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.3E-01	--	3.8E-04	1.3E-01
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	5.9E-01	--	--	5.9E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-06	6.5E-07	7.2E-11	2.7E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.1E-06	3.4E-07	3.8E-11	1.4E-06	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.6E-05	4.8E-06	5.4E-10	2.1E-05	BENZO(A)PYRENE	Developmental System	1.2E-01	3.5E-02	9.9E-04	1.5E-01
		DIBENZ(A,H)ANTHRACENE	3.9E-06	1.2E-06	1.3E-10	5.1E-06	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA	
		INDENO(1,2,3-C,D)PYRENE	8.7E-07	2.7E-07	3.0E-11	1.1E-06	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA	
		Volatiles					Volatiles						
		BENZENE	1.1E-07	--	9.3E-13	1.1E-07	BENZENE	Immune System	6.1E-03	--	4.6E-08	6.1E-03	
		(Total for Child)	4.6E-05	9.9E-06	5.0E-08	5.5E-05	(Total for Child)	7.0E+00	2.0E-01	4.6E-02	7.3E+00		
		Residential Yards (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.5E-02	--	3.1E-03	2.8E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.1E-02	--	--	2.1E-02
			ARSENIC	6.8E-06	1.4E-06	2.0E-08	8.3E-06	ARSENIC	Skin, Cardiovascular	5.3E-02	1.1E-02	1.1E-03	6.5E-02
			CADMIUM	--	--	3.0E-08	3.0E-08	CADMIUM	Kidneys, Urinary	9.6E-02	1.6E-02	5.9E-03	1.2E-01
			COBALT	--	--	1.2E-07	1.2E-07	COBALT	Thyroid	2.4E-01	--	7.5E-03	2.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.2E-01	--	--	1.2E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.6E-02	--	2.8E-02	4.4E-02
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.3E-02	--	3.8E-04	1.3E-02
ZINC	--		--	--	NA	ZINC	Immune System, Blood	5.5E-02	--	--	5.5E-02		
PAHs						PAHs							
BENZ(A)ANTHRACENE	2.5E-07		1.4E-07	9.0E-11	3.8E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA		
BENZO(B)FLUORANTHENE	1.3E-07		7.1E-08	4.8E-11	2.0E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA		
BENZO(A)PYRENE	1.8E-06		1.0E-06	6.8E-10	2.9E-06	BENZO(A)PYRENE	Developmental System	1.1E-02	5.9E-03	9.9E-04	1.8E-02		
DIBENZ(A,H)ANTHRACENE	4.6E-07	2.5E-07	1.7E-10	7.1E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA			
INDENO(1,2,3-C,D)PYRENE	1.0E-07	5.6E-08	3.8E-11	1.6E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA			
Volatiles					Volatiles								
BENZENE	3.6E-08	--	3.1E-12	3.6E-08	BENZENE	Immune System	5.7E-04	--	4.6E-08	5.7E-04			
(Total for Adult)	9.6E-06	3.0E-06	1.7E-07	1.3E-05	(Total for Adult)	6.6E-01	3.3E-02	4.6E-02	7.4E-01				

TABLE 9.31
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Residential Yards (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	2.9E-05	4.0E-06	2.6E-08	3.3E-05						
			CADMIUM	NA	NA	3.9E-08	3.9E-08						
			COBALT	NA	NA	1.5E-07	1.5E-07						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			ZINC	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	2.3E-06	7.8E-07	1.6E-10	3.1E-06						
			BENZO(B)FLUORANTHENE	1.2E-06	4.1E-07	8.6E-11	1.6E-06						
			BENZO(A)PYRENE	1.8E-05	5.9E-06	1.2E-09	2.3E-05						
	DIBENZ(A,H)ANTHRACENE	4.4E-06	1.5E-06	3.0E-10	5.8E-06								
	INDENO(1,2,3-C,D)PYRENE	9.7E-07	3.3E-07	6.8E-11	1.3E-06								
	Volatiles												
	BENZENE	1.5E-07	NA	4.0E-12	1.5E-07								
		(Total for Child + Adult)	5.5E-05	1.3E-05	2.2E-07	6.8E-05							
	Homegrown Produce	Residential Yards (Child)	Inorganics										
ALUMINUM			--	--	--	NA	ALUMINUM	Neurological	3.9E-02	--	--	3.9E-02	
ANTIMONY			--	--	--	NA	ANTIMONY	Blood	1.6E-02	--	--	1.6E-02	
ARSENIC			8.3E-06	--	--	8.3E-06	ARSENIC	Skin, Cardiovascular	2.2E-01	--	--	2.2E-01	
CADMIUM			--	--	--	NA	CADMIUM	Kidneys, Urinary	5.6E-01	--	--	5.6E-01	
COBALT			--	--	--	NA	COBALT	Thyroid	4.2E-01	--	--	4.2E-01	
IRON			--	--	--	NA	IRON	Gastrointestinal System	3.4E-01	--	--	3.4E-01	
MANGANESE			--	--	--	NA	MANGANESE	Central Nervous System	6.2E-01	--	--	6.2E-01	
VANADIUM			--	--	--	NA	VANADIUM	Kidney	1.8E-03	--	--	1.8E-03	
ZINC			--	--	--	NA	ZINC	Immune System, Blood	5.7E-04	--	--	5.7E-04	
PAHs													
BENZ(A)ANTHRACENE			1.5E-06	--	--	1.5E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA	
BENZO(B)FLUORANTHENE			4.5E-07	--	--	4.5E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA	
BENZO(A)PYRENE			7.5E-06	--	--	7.5E-06	BENZO(A)PYRENE	Developmental System	5.5E-02	--	--	5.5E-02	
DIBENZ(A,H)ANTHRACENE			9.5E-07	--	--	9.5E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA	
INDENO(1,2,3-C,D)PYRENE			1.9E-07	--	--	1.9E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA	
Volatiles													
BENZENE	6.6E-07	--	--	6.6E-07	BENZENE	Immune System	3.5E-02	--	--	3.5E-02			
	(Total for Child)	2.0E-05	---	---	2.0E-05		(Total for Child)	2.3E+00	---	---	2.3E+00		

TABLE 9.31
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	Residential Yards (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.5E-02	--	--	1.5E-02
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	9.3E-02	--	--	9.3E-02
			ARSENIC	1.1E-05	--	--	1.1E-05	ARSENIC	Skin, Cardiovascular	8.4E-02	--	--	8.4E-02
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	2.2E-01	--	--	2.2E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	1.7E-01	--	--	1.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.3E-01	--	--	1.3E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-01	--	--	2.4E-01
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.0E-02	--	--	1.0E-02
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	3.3E-03	--	--	3.3E-03
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	7.3E-07	--	--	7.3E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	2.2E-07	--	--	2.2E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	3.7E-06	--	--	3.7E-06	BENZO(A)PYRENE	Developmental System	2.1E-02	--	--	2.1E-02
			DIBENZ(A,H)ANTHRACENE	4.7E-07	--	--	4.7E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	9.1E-08	--	--	9.1E-08	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			Volatiles					Volatiles					
			BENZENE	1.6E-07	--	--	1.6E-07	BENZENE	Immune System	2.1E-01	--	--	2.1E-01
		(Total for Adult)	1.6E-05	---	---	1.6E-05		(Total for Adult)	1.2E+00	---	---	1.2E+00	
		Residential Yards (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	1.9E-05	NA	NA	1.9E-05						
			CADMIUM	NA	NA	NA	NA						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			ZINC	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	2.2E-06	NA	NA	2.2E-06						
			BENZO(B)FLUORANTHENE	6.7E-07	NA	NA	6.7E-07						
BENZO(A)PYRENE	1.1E-05		NA	NA	1.1E-05								
DIBENZ(A,H)ANTHRACENE	1.4E-06	NA	NA	1.4E-06									
INDENO(1,2,3-C,D)PYRENE	2.8E-07	NA	NA	2.8E-07									
Volatiles													
BENZENE	8.2E-07	NA	NA	8.2E-07									
(Total for Child + Adult)	3.6E-05	---	---	3.6E-05	Total Hazard Index Across Surface Soil (Child)					9.6E+00			
		Total Risk Across Surface Soil (Adult + Child)				1.0E-04	Total Hazard Index Across Surface Soil (Adult)					1.9E+00	
Total Risk Across All Media and All Exposure Routes				1E-04	Total Hazard Index Across All Media and All Exposure Routes (Child)					10			

NA = Not applicable due to no toxicity values.

TABLE 9.31
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total

-- = No risks calculated for this exposure pathway.

TABLE 9.32
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Residential Yards
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Residential Yards (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.9E-01	--	3.3E-03	2.9E-01
			ARSENIC	1.8E-05	2.2E-06	5.0E-09	2.0E-05	ARSENIC	Skin, Cardiovascular	4.7E-01	5.6E-02	9.0E-04	5.3E-01
			COBALT	--	--	4.3E-09	4.3E-09	COBALT	Thyroid	3.2E-01	--	9.3E-04	3.2E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	8.0E-01	--	--	8.0E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	8.1E-07	2.5E-07	5.3E-12	1.1E-06	BENZO(A)PYRENE	Developmental System	6.0E-03	1.8E-03	5.1E-05	7.9E-03
			(Total for Child)	1.9E-05	2.4E-06	9.3E-09	2.1E-05	(Total for Child)	1.9E+00	5.8E-02	5.2E-03	2.0E+00	
		Residential Yards (Adult)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.7E-02	--	3.3E-03	3.0E-02
			ARSENIC	5.7E-06	1.2E-06	1.7E-08	6.9E-06	ARSENIC	Skin, Cardiovascular	4.4E-02	9.4E-03	9.0E-04	5.5E-02
			COBALT	--	--	1.4E-08	1.4E-08	COBALT	Thyroid	3.0E-02	--	9.3E-04	3.1E-02
			IRON	--	--	--	NA	IRON	Gastrointestinal System	7.5E-02	--	--	7.5E-02
			PAHs					PAHs					
			BENZO(A)PYRENE	9.6E-08	5.3E-08	3.5E-11	1.5E-07	BENZO(A)PYRENE	Developmental System	5.6E-04	3.1E-04	5.1E-05	9.2E-04
			(Total for Adult)	5.8E-06	1.3E-06	3.1E-08	7.1E-06	(Total for Adult)	1.8E-01	9.7E-03	5.2E-03	1.9E-01	
		Residential Yards (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ARSENIC	2.4E-05	3.4E-06	2.2E-08	2.7E-05						
			COBALT	NA	NA	1.9E-08	1.9E-08						
			IRON	NA	NA	NA	NA						
			PAHs										
			BENZO(A)PYRENE	9.1E-07	3.0E-07	4.0E-11	1.2E-06						
			(Total for Child + Adult)	2.5E-05	3.7E-06	4.0E-08	2.9E-05	Total Hazard Index Across Subsurface Soil (Child)					2.0E+00
Total Risk Across Subsurface Soil (Adult + Child)							2.9E-05	Total Hazard Index Across Subsurface Soil (Adult)					1.9E-01
Total Risk Across All Media and All Exposure Routes							3E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)					2
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					0.2

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.1
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Surface Soil	North Tank Farm (Child)	Inorganics	--	--	--	NA	Inorganics	Thyroid	2.1E-01	--	6.1E-04	2.1E-01		
			COBALT IRON	--	--	--	NA	COBALT IRON	Gastrointestinal System	2.1E-01	--	--	2.1E-01		
			(Total for Child)	---	---	---	---	(Total for Child)	4.2E-01	---	6.1E-04	4.2E-01			
			(Total for Adult)	---	---	---	---	(Total for Adult)	---	---	---	---			
			(Total for Child + Adult)	---	---	---	---								
	Homegrown Produce	North Tank Farm (Child)	Inorganics	--	--	--	NA	Inorganics	Thyroid	1.5E-01	--	--	1.5E-01		
			COBALT MANGANESE	--	--	--	NA	COBALT MANGANESE	Central Nervous System	4.3E-01	--	--	4.3E-01		
			(Total for Child)	---	---	---	---	(Total for Child)	5.8E-01	---	---	5.8E-01			
			(Total for Adult)	---	---	---	---	(Total for Adult)	---	---	---	---			
			(Total for Child + Adult)	---	---	---	---	Total Hazard Index Across Surface Soil (Child)			1.0E+00				
	Soil	Beef Consumption	North Tank Farm (Child)	Inorganics	--	--	--	NA	Inorganics	Thyroid	4.7E-01	--	--	4.7E-01	
				COBALT IRON	--	--	--	NA	COBALT IRON	Gastrointestinal System	4.6E-01	--	--	4.6E-01	
				(Total for Child)	---	---	---	---	(Total for Child)	9.3E-01	---	---	9.3E-01		
(Total for Adult)				---	---	---	---	(Total for Adult)	---	---	---	---			
			(Total for Child + Adult)	---	---	---	---	Total Hazard Index Across Surface Soil (Child)			1.9E+00				
		Total Risk Across Surface Soil (Adult + Child)					--		Total Hazard Index Across Surface Soil (Adult)					--	
		Total Risk Across Surface Water (Adult + Child)					---		Total Hazard Index Across Surface Water (Adult)					---	
Total Risk Across Sediment (Adult + Child)							---		Total Hazard Index Across Sediment (Adult)					---	
Total Risk Across All Media and All Exposure Routes							--		Total Hazard Index Across All Media and All Exposure Routes (Child)					1	
									Total Hazard Index Across All Media and All Exposure Routes (Adult)					--	

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard CNS, soil (child)	0.4
Total Hazard thyroid, soil (child)	0.8
Total Hazard gastrointestinal system, soil (child)	0.7

TABLE 10.2
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient								
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total				
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil									---
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes									---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.3
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil					---
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes					---

NA = Not applicable due to no toxicity values.
-- = No risks calculated for this exposure pathway.

TABLE 10.4
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm Scenario Timeframe: Current/Future Receptor Population: Trespasser Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil				---	
Total Risk Across Surface Water				---				Total Hazard Index Across Surface Water				---	
Total Risk Across Sediment				---				Total Hazard Index Across Sediment				---	
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.5
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
			(Total for Child + Adult)	---	---	---	---	Total Hazard Index Across Subsurface Soil (Child)					---
Total Risk Across Subsurface Soil (Adult + Child)							---	Total Hazard Index Across Subsurface Soil (Adult)					---
Total Risk Across Surface Water (Adult + Child)							---	Total Hazard Index Across Surface Water (Adult)					---
Total Risk Across Sediment (Adult + Child)							---	Total Hazard Index Across Sediment (Adult)					---
Total Risk Across All Media and All Exposure Routes							---	Total Hazard Index Across All Media and All Exposure Routes (Child)					---
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.6
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - NORTH TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: North Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Subsurface Soil				---				Total Hazard Index Across Subsurface Soil				---	
Total Risk Across Groundwater				---				Total Hazard Index Across Groundwater				---	
Total Risk Across Sediment				---				Total Hazard Index Across Sediment				---	
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.7
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Lorraine Process Area (Child)	Inorganics					Inorganics					
			ARSENIC	2.4E-06	2.9E-07	6.6E-10	2.7E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			HEXAVALENT CHROMIUM (+6)	4.4E-06	--	4.2E-08	4.4E-06	HEXAVALENT CHROMIUM (+6)	None	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	1.5E-01	--	4.3E-04	1.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.9E-01	--	--	1.9E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	1.2E-06	3.8E-07	4.2E-11	1.6E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	8.0E-06	6.6E-07	4.3E-08	8.7E-06	(Total for Child)		3.3E-01	---	4.3E-04	3.4E-01
		Lorraine Process Area (Adult)	Inorganics					Inorganics					
			ARSENIC	7.5E-07	1.6E-07	2.2E-09	9.1E-07	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			HEXAVALENT CHROMIUM (+6)	5.1E-07	--	5.3E-08	5.7E-07	HEXAVALENT CHROMIUM (+6)	None	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	1.4E-07	7.9E-08	5.3E-11	2.2E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Adult)	1.4E-06	2.4E-07	5.5E-08	1.7E-06	(Total for Adult)		---	---	---	---
		Lorraine Process Area (Adult + Child)	Inorganics										
			ARSENIC	3.2E-06	4.4E-07	2.9E-09	3.6E-06						
			HEXAVALENT CHROMIUM (+6)	4.9E-06	NA	9.5E-08	5.0E-06						
			PAHs										
Soil	Homegrown Produce	Lorraine Process Area (Child)	ARSENIC	9.2E-07	--	--	9.2E-07	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	5.8E-07	--	--	5.8E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	1.5E-06	---	---	1.5E-06	(Total for Child)		---	---	---	---
		Lorraine Process Area (Adult)	Inorganics					Inorganics					
			ARSENIC	1.2E-06	--	--	1.2E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	2.9E-07	--	--	2.9E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Adult)	1.5E-06	---	---	1.5E-06	(Total for Adult)		---	---	---	---
		Lorraine Process Area (Adult + Child)	Inorganics										
			ARSENIC	2.1E-06	NA	NA	2.1E-06						
			PAHs										
			BENZO(A)PYRENE	8.7E-07	NA	NA	8.7E-07						
			(Total for Child + Adult)	3.0E-06	---	---	3.0E-06						

TABLE 10.7
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Beef Consumption	Lorraine Process Area (Child)	Inorganics					Inorganics							
			ARSENIC	8.2E-07	--	--	8.2E-07	ARSENIC	Skin, Cardiovascular	--	--	--	NA		
			COBALT	--	--	--	NA	COBALT	Thyroid	4.5E-01	--	--	4.5E-01		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.3E-01	--	--	5.3E-01		
			PAHs					PAHs							
			BENZO(A)PYRENE	4.2E-06	--	--	4.2E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA		
			(Total for Child)	5.1E-06	---	---	5.1E-06	(Total for Child)	1.1E+00	---	---	---	1.1E+00		
Soil	Beef Consumption	Lorraine Process Area (Adult)	Inorganics					Inorganics							
			ARSENIC	1.3E-06	--	--	1.3E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA		
			COBALT	--	--	--	NA	COBALT	Thyroid	2.2E-01	--	--	2.2E-01		
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.6E-01	--	--	2.6E-01		
			PAHs					PAHs							
					BENZO(A)PYRENE	2.6E-06	--	--	2.6E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
					(Total for Adult)	4.0E-06	---	---	4.0E-06	(Total for Adult)	5.5E-01	---	---	---	5.5E-01
		Lorraine Process Area (Adult + Child)	Inorganics												
			ARSENIC	2.2E-06	NA	NA	2.2E-06								
			PAHs												
			BENZO(A)PYRENE	6.9E-06	NA	NA	6.9E-06								
			(Total for Child + Adult)	9.0E-06	---	---	9.0E-06	Total Hazard Index Across Surface Soil (Child)					1.4E+00		
		Total Risk Across Surface Soil (Adult + Child)					2.2E-05	Total Hazard Index Across Surface Soil (Adult)					5.5E-01		
		Total Risk Across Surface Water (Adult + Child)					---		Total Hazard Index Across Surface Water (Adult)					---	
Total Risk Across Sediment (Adult + Child)							---	Total Hazard Index Across Sediment (Adult)					---		
Total Risk Across All Media and All Exposure Routes							2E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)					1		
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					---		

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard thyroid, soil (child)	0.6
Total Hazard gastrointestinal system, soil (child)	0.7

TABLE 10.8
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
			Total Risk Across Surface Soil				---	Total Hazard Index Across Surface Soil					--
			Total Risk Across All Media and All Exposure Routes				--	Total Hazard Index Across All Media and All Exposure Routes					--

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.9
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area Scenario Timeframe: Current/Future Receptor Population: Commercial/Industrial Worker Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil					--
Total Risk Across All Media and All Exposure Routes				--				Total Hazard Index Across All Media and All Exposure Routes					--

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.10
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil				---		
Total Risk Across Surface Water				---				Total Hazard Index Across Surface Water				---		
Total Risk Across Sediment				---				Total Hazard Index Across Sediment				---		
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---		

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.11
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area Scenario Timeframe: Current/Future Receptor Population: Resident Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Subsurface Soil (Adult + Child)				--				Total Hazard Index Across Subsurface Soil (Adult)				--	
	Total Risk Across Surface Water (Adult + Child)			---					Total Hazard Index Across Surface Water (Adult)				---
Total Risk Across Sediment (Adult + Child)				---				Total Hazard Index Across Sediment (Adult)				---	
Total Risk Across All Media and All Exposure Routes				--				Total Hazard Index Across All Media and All Exposure Routes (Child)				--	
								Total Hazard Index Across All Media and All Exposure Routes (Adult)				--	

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.12
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LORRAINE PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Process Area Scenario Timeframe: Current/Future Receptor Population: Construction Worker Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Subsurface Soil				---				Total Hazard Index Across Subsurface Soil				--	
Total Risk Across All Media and All Exposure Routes				--				Total Hazard Index Across All Media and All Exposure Routes				--	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.13
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Loading Dock Area (Child)	Inorganics					Inorganics					
			ARSENIC	3.9E-06	4.7E-07	1.1E-09	4.4E-06	ARSENIC	Skin, Cardiovascular Thyroid	1.0E-01	1.2E-02	1.9E-04	1.1E-01
			COBALT	--	--	--	NA	COBALT		6.5E-01	--	1.9E-03	6.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.8E-01	--	--	2.8E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	1.6E-06	5.1E-07	5.6E-11	2.2E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	5.6E-06	9.7E-07	1.1E-09	6.6E-06	(Total for Child)		1.0E+00	1.2E-02	2.1E-03	1.0E+00
		Loading Dock Area (Adult)	Inorganics					Inorganics					
			ARSENIC	1.2E-06	2.6E-07	3.6E-09	1.5E-06	ARSENIC	Skin, Cardiovascular Thyroid	--	--	--	NA
			BENZO(A)PYRENE	1.9E-07	1.1E-07	7.1E-11	3.0E-07	BENZO(A)PYRENE		--	--	--	NA
			(Total for Adult)	1.4E-06	3.7E-07	3.7E-09	1.8E-06	(Total for Adult)		---	---	---	---
		Loading Dock Area (Adult + Child)	Inorganics										
			ARSENIC	5.2E-06	7.3E-07	4.7E-09	5.9E-06						
			BENZO(A)PYRENE	1.8E-06	6.1E-07	1.3E-10	2.5E-06						
			(Total for Child + Adult)	7.0E-06	1.3E-06	4.8E-09	8.3E-06						
	Homegrown Produce	Loading Dock Area (Child)	Inorganics					Inorganics					
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	1.1E-01	--	--	1.1E-01
			ARSENIC	1.5E-06	--	--	1.5E-06	ARSENIC	Skin, Cardiovascular Thyroid	--	--	--	NA
			COBALT	--	--	--	NA	COBALT		4.7E-01	--	--	4.7E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.5E-01	--	--	3.5E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	7.8E-07	--	--	7.8E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			Volatiles					Volatiles					
			BENZENE	1.4E-05	--	--	1.4E-05	BENZENE	Gastrointestinal Kidney	7.7E-01	--	--	7.7E-01
			ETHYLBENZENE	1.8E-06	--	--	1.8E-06	ETHYLBENZENE		--	--	--	NA
			(Total for Child)	1.9E-05	---	---	1.9E-05	(Total for Child)		1.7E+00	---	---	1.7E+00

TABLE 10.13
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	Loading Dock Area (Adult)	Inorganics					Inorganics					
			ARSENIC	1.9E-06	--	--	1.9E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	1.8E-01	--	--	1.8E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.3E-01	--	--	1.3E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	3.8E-07	--	--	3.8E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			Volatiles					Volatiles					
			BENZENE	1.9E-05	--	--	1.9E-05	BENZENE	Gastrointestinal	3.0E-01	--	--	3.0E-01
			ETHYLBENZENE	2.4E-06	--	--	2.4E-06	ETHYLBENZENE	Kidney	--	--	--	NA
			(Total for Adult)	2.3E-05	---	---	2.3E-05	(Total for Adult)	6.2E-01	---	---	---	6.2E-01
	Loading Dock Area (Adult + Child)	Loading Dock Area (Adult + Child)	Inorganics										
			ARSENIC	3.4E-06	NA	NA	3.4E-06						
			PAHs										
			BENZO(A)PYRENE	1.2E-06	NA	NA	1.2E-06						
			Volatiles										
			BENZENE	3.3E-05	NA	NA	3.3E-05						
			ETHYLBENZENE	4.2E-06	NA	NA	4.2E-06						
			(Total for Child + Adult)	4.2E-05	---	---	4.2E-05	Total Hazard Index Across Surface Soil (Child)				2.7E+00	
	Beef Consumption	Loading Dock Area (Child)	Inorganics					Inorganics					
			ARSENIC	1.3E-06	--	--	1.3E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	1.4E+00	--	--	1.4E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.6E-01	--	--	5.6E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	5.7E-06	--	--	5.7E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	7.0E-06	---	---	7.0E-06	(Total for Child)	1.9E+00	---	---	---	1.9E+00
		Loading Dock Area (Adult)	Inorganics					Inorganics					
			ARSENIC	2.2E-06	--	--	2.2E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	6.7E-01	--	--	6.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.8E-01	--	--	2.8E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	3.5E-06	--	--	3.5E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Adult)	5.7E-06	---	---	5.7E-06	(Total for Adult)	9.5E-01	---	---	---	9.5E-01

TABLE 10.13
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Beef Consumption	Loading Dock Area (Adult + Child)	Inorganics												
			ARSENIC	3.5E-06	NA	NA	3.5E-06								
			PAHs												
			BENZO(A)PYRENE	9.3E-06	NA	NA	9.3E-06								
			(Total for Child + Adult)	1.3E-05	---	---	1.3E-05								
			Total Risk Across Surface Soil (Adult + Child)				6.3E-05		Total Hazard Index Across Surface Soil (Child)					4.7E+00	
									Total Hazard Index Across Surface Soil (Adult)					1.6E+00	
			Total Risk Across Surface Water (Adult + Child)				---			Total Hazard Index Across Surface Water (Adult)					---
			Total Risk Across Sediment (Adult + Child)				---			Total Hazard Index Across Sediment (Adult)					---
			Total Risk Across All Media and All Exposure Routes				6E-05		Total Hazard Index Across All Media and All Exposure Routes (Child)					5	
									Total Hazard Index Across All Media and All Exposure Routes (Adult)					2	

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard CNS, soil (child)	0.3
Total Hazard thyroid, soil (child)	2
Total Hazard gastrointestinal system, soil (child)	2
Total Hazard skin, soil (child)	0.1
Total Hazard blood, soil (child)	0.1
Total Hazard cardiovascular system, soil (child)	0.1
Total Hazard CNS, soil (adult)	0.1
Total Hazard thyroid, soil (adult)	0.9
Total Hazard gastrointestinal system, soil (adult)	0.6

TABLE 10.14
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil					---
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes					---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.15
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
 Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
				Total Risk Across Surface Soil				Total Hazard Index Across Surface Soil				---	
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.16
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area Scenario Timeframe: Current/Future Receptor Population: Trespasser Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil				---	
Total Risk Across Surface Water				---				Total Hazard Index Across Surface Water				---	
Total Risk Across Sediment				---				Total Hazard Index Across Sediment				---	
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.17
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Soil	Subsurface Soil	Loading Dock Area (Child)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-01	--	1.2E-03	1.1E-01	
			COBALT	--	--	--	NA	COBALT	Thyroid	1.1E+00	--	3.3E-03	1.1E+00	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.6E-01	--	--	2.6E-01	
			(Total for Child)	---	---	---	---		(Total for Child)	1.5E+00	---	4.5E-03	1.5E+00	
		(Total for Child + Adult)	---	---	---	---	Total Hazard Index Across Subsurface Soil (Child)					1.5E+00		
Total Risk Across Subsurface Soil (Adult + Child)							---	Total Hazard Index Across Subsurface Soil (Adult)					0.0E+00	
	Total Risk Across Surface Water (Adult + Child)						---		Total Hazard Index Across Surface Water (Adult)					---
Total Risk Across Sediment (Adult + Child)							---	Total Hazard Index Across Sediment (Adult)					---	
Total Risk Across All Media and All Exposure Routes							---	Total Hazard Index Across All Media and All Exposure Routes (Child)					2	
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					---	

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard CNS, soil (child)	0.1
Total Hazard thyroid, soil (child)	1
Total Hazard gastrointestinal system, soil (child)	0.3

TABLE 10.18
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - LOADING DOCK AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Loading Dock Area Scenario Timeframe: Current/Future Receptor Population: Construction Worker Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Subsurface Soil				---				Total Hazard Index Across Subsurface Soil				---	
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.19
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Wilcox Process Area (Child)	Inorganics					Inorganics					
			ARSENIC	3.8E-06	4.5E-07	1.0E-09	4.3E-06	ARSENIC	Skin, Cardiovascular	9.9E-02	1.2E-02	1.9E-04	1.1E-01
			HEXAVALENT CHROMIUM (+6)	3.4E-06	--	3.3E-08	3.5E-06	HEXAVALENT CHROMIUM (+6)	None	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	1.6E-01	--	4.7E-04	1.7E-01
			COPPER	--	--	--	NA	COPPER	None	1.3E-01	--	--	1.3E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.3E-01	--	--	2.3E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.7E-06	8.2E-07	9.1E-11	3.5E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.3E-06	3.9E-07	4.3E-11	1.6E-06	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.5E-05	4.5E-06	5.1E-10	1.9E-05	BENZO(A)PYRENE	Developmental System	1.1E-01	3.3E-02	9.3E-04	1.4E-01
			DIBENZ(A,H)ANTHRACENE	1.8E-06	5.5E-07	6.1E-11	2.3E-06	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	2.8E-05	6.7E-06	3.5E-08	3.4E-05		(Total for Child)	7.3E-01	4.5E-02	1.6E-03	7.8E-01
		Wilcox Process Area (Adult)	Inorganics					Inorganics					
			ARSENIC	1.2E-06	2.5E-07	3.5E-09	1.4E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			HEXAVALENT CHROMIUM (+6)	4.0E-07	--	4.1E-08	4.5E-07	HEXAVALENT CHROMIUM (+6)	None	--	--	--	NA
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	3.1E-07	1.7E-07	1.1E-10	4.8E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.5E-07	8.1E-08	5.4E-11	2.3E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.7E-06	9.5E-07	6.4E-10	2.7E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	2.1E-07	1.2E-07	7.7E-11	3.3E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Adult)	4.0E-06	1.6E-06	4.6E-08	5.6E-06		(Total for Adult)	---	---	---	---
		Wilcox Process Area (Adult + Child)	Inorganics										
			ARSENIC	5.0E-06	7.0E-07	4.5E-09	5.7E-06						
			HEXAVALENT CHROMIUM (+6)	3.8E-06	NA	7.4E-08	3.9E-06						
			PAHs										
			BENZ(A)ANTHRACENE	3.0E-06	9.9E-07	2.1E-10	4.0E-06						
			BENZO(B)FLUORANTHENE	1.4E-06	4.7E-07	9.7E-11	1.9E-06						
			BENZO(A)PYRENE	1.6E-05	5.5E-06	1.1E-09	2.2E-05						
			DIBENZ(A,H)ANTHRACENE	2.0E-06	6.7E-07	1.4E-10	2.7E-06						
			(Total for Child + Adult)	3.2E-05	8.3E-06	8.0E-08	4.0E-05						
	Homegrown Produce	Wilcox Process Area (Child)	Inorganics					Inorganics					
			COBALT	--	--	--	NA	COBALT	Thyroid	1.6E-01	--	--	1.6E-01
			COPPER	--	--	--	NA	COPPER	None	2.5E+00	--	--	2.5E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.4E-01	--	--	3.4E-01
			(Total for Child)	---	---	---	---		(Total for Child)	3.0E+00	---	---	3.0E+00
		Wilcox Process Area (Adult)	Inorganics					Inorganics					
			COPPER	--	--	--	NA	COPPER	None	4.8E-01	--	--	4.8E-01
			(Total for Adult)	---	---	---	---		(Total for Adult)	4.8E-01	---	---	4.8E-01
		Wilcox Process Area (Adult + Child)	(Total for Child + Adult)	---	---	---	---	Total Hazard Index Across Surface Soil (Child)					3.8E+00

TABLE 10.19
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
Soil	Beef Consumption	Wilcox Process (Child)	Inorganics	--	--	--	NA	Inorganics	Skin, Cardiovascular	1.1E-01	--	--	1.1E-01		
			ARSENIC	--	--	--	NA	ARSENIC	Thyroid	1.1E+00	--	--	1.1E+00		
			COBALT	--	--	--	NA	COBALT	None	8.0E-01	--	--	8.0E-01		
			COPPER	--	--	--	NA	COPPER	Gastrointestinal System	1.5E+00	--	--	1.5E+00		
			IRON	--	--	--	NA	IRON	Hair	NA	--	--	NA		
			THALLIUM	--	--	--	NA	THALLIUM							
			PAHs	--	--	--	NA	PAHs	Developmental System	1.2E+00	--	--	1.2E+00		
			BENZO(A)PYRENE	1.5E-06	--	--	1.5E-06	BENZO(A)PYRENE	NA	--	--	--	NA		
			DIBENZ(A,H)ANTHRACENE	--	--	--	NA	DIBENZ(A,H)ANTHRACENE	Respiratory System	1.2E-01	--	--	1.2E-01		
			2-METHYLNAPHTHALENE	(Total for Child)	1.5E-06	---	---	1.5E-06	(Total for Child)	4.9E+00	---	---	4.9E+00		
			Wilcox Process (Adult)	Inorganics	--	--	--	NA	Inorganics	Thyroid	5.6E-01	--	--	5.6E-01	
		COBALT		--	--	--	NA	COBALT	None	3.9E-01	--	--	3.9E-01		
		COPPER		--	--	--	NA	COPPER	Gastrointestinal System	7.6E-01	--	--	7.6E-01		
		IRON		--	--	--	NA	IRON	Hair	NA	--	--	NA		
		THALLIUM		--	--	--	NA	THALLIUM							
		PAHs		--	--	--	NA	PAHs	Developmental System	6.1E-01	--	--	6.1E-01		
		BENZO(A)PYRENE		8.4E-08	--	--	8.4E-08	BENZO(A)PYRENE	NA	--	--	--	NA		
		DIBENZ(A,H)ANTHRACENE		--	--	--	NA	DIBENZ(A,H)ANTHRACENE	Respiratory System	5.8E-02	--	--	5.8E-02		
		2-METHYLNAPHTHALENE		(Total for Adult)	8.4E-08	---	---	8.4E-08	(Total for Adult)	2.4E+00	---	---	2.4E+00		
		Wilcox Process (Adult + Child)		PAHs											
			DIBENZ(A,H)ANTHRACENE	1.6E-06	NA	NA	1.6E-06								
			(Total for Child + Adult)	1.6E-06	---	---	1.6E-06	Total Hazard Index Across Surface Soil (Child)					8.7E+00		
		Total Risk Across Surface Soil (Adult + Child)							4.2E-05	Total Hazard Index Across Surface Soil (Adult)					2.9E+00

TABLE 10.19
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Tap Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.4E-01	2.8E-03	--	6.5E-01
			ARSENIC	1.3E-04	5.6E-07	--	1.3E-04	ARSENIC	Skin, Cardiovascular	3.3E+00	1.5E-02	--	3.3E+00
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	3.9E+00	1.7E-02	--	3.9E+00
			COBALT	--	--	--	NA	COBALT	Thyroid	1.4E+00	2.5E-03	--	1.4E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.4E+00	1.0E-02	--	2.4E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.7E-01	1.6E-03	--	3.7E-01
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.0E-01	1.7E-02	--	1.2E-01
			PAHs					PAHs					
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	4.1E-01	4.9E-01	--	9.1E-01
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	1.5E-01	8.3E-02	--	2.3E-01
			Volatiles					Volatiles					
			BENZENE	5.6E-04	7.4E-05	--	6.4E-04	BENZENE	Immune System	3.0E+01	3.9E+00	--	3.4E+01
			1,2-DICHLOROETHANE	1.6E-06	6.8E-08	--	1.7E-06	1,2-DICHLOROETHANE	NA	--	--	--	NA
			ETHYLBENZENE	5.2E-05	2.7E-05	--	7.8E-05	ETHYLBENZENE	Liver, Kidney	5.5E-01	2.8E-01	--	8.3E-01
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	5.7E-01	3.0E-01	--	8.7E-01
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	6.9E-01	2.0E-01	--	8.9E-01
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.2E-01	6.1E-02	--	1.9E-01
			(Total for Child)	7.4E-04	1.0E-04	---	8.5E-04		(Total for Child)	4.5E+01	5.4E+00	---	5.0E+01

TABLE 10.19
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient									
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total					
Groundwater	Groundwater	Tap Water (Adult)	Inorganics					Inorganics										
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.9E-01	2.2E-03	--	3.9E-01					
			ARSENIC	2.5E-04	1.4E-06	--	2.6E-04	ARSENIC	Skin, Cardiovascular	2.0E+00	1.1E-02	--	2.0E+00					
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	2.4E+00	1.3E-02	--	2.4E+00					
			COBALT	--	--	--	NA	COBALT	Thyroid	8.6E-01	1.9E-03	--	8.7E-01					
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E+00	8.0E-03	--	1.4E+00					
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.2E-01	1.2E-03	--	2.2E-01					
			PAHs					PAHs										
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.5E-01	3.3E-01	--	5.8E-01					
			NAPHTHALENE	--	--	3.6E-04	3.6E-04	NAPHTHALENE	Body Weight	8.9E-02	5.5E-02	9.5E+00	9.6E+00					
			Volatiles					Volatiles										
			BENZENE	1.1E-03	1.7E-04	3.3E-03	4.6E-03	BENZENE	Immune System	1.8E+01	2.7E+00	3.8E+01	5.9E+01					
			1,2-DICHLOROETHANE	3.2E-06	1.5E-07	1.9E-05	2.2E-05	1,2-DICHLOROETHANE	NA	2.0E-02	9.6E-04	2.8E-01	3.0E-01					
			ETHYLBENZENE	1.0E-04	5.9E-05	4.9E-04	6.5E-04	ETHYLBENZENE	Liver, Kidney	3.3E-01	1.9E-01	5.3E-01	1.0E+00					
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	1.8E-02	2.0E-02	7.2E-02	1.1E-01					
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	3.4E-01	2.0E-01	1.1E+01	1.2E+01					
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	4.1E-01	1.4E-01	1.1E-01	6.5E-01					
		O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	7.5E-02	4.1E-02	2.4E+00	2.5E+00						
		(Total for Adult)				1.5E-03	2.3E-04	4.2E-03	5.9E-03		(Total for Adult)				2.7E+01	3.7E+00	6.2E+01	9.3E+01
				Tap Water (Adult + Child)	Inorganics													
					ARSENIC	3.8E-04	2.0E-06	NA	3.8E-04									
					PAHs													
					NAPHTHALENE	NA	NA	3.6E-04	3.6E-04									
Volatiles																		
BENZENE	1.7E-03				2.4E-04	3.3E-03	5.3E-03											
1,2-DICHLOROETHANE	4.8E-06				2.2E-07	1.9E-05	2.4E-05											
ETHYLBENZENE				1.6E-04	8.6E-05	4.9E-04	7.3E-04											
(Total for Child + Adult)				2.2E-03	3.3E-04	4.2E-03	6.8E-03		Total Hazard Index Across Groundwater (Child)				5.0E+01					
Total Risk Across Groundwater (Adult + Child)				6.8E-03					Total Hazard Index Across Groundwater (Adult)				9.3E+01					
	Total Risk Across Surface Water (Adult + Child)				---					Total Hazard Index Across Surface Water (Adult)				---				
Total Risk Across Sediment (Adult + Child)				---					Total Hazard Index Across Sediment (Adult)				---					
Total Risk Across All Media and All Exposure Routes				7E-03				Total Hazard Index Across All Media and All Exposure Routes (Child)				54						
								Total Hazard Index Across All Media and All Exposure Routes (Adult)				96						

NA = Not applicable due to no toxicity values.

TABLE 10.19
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total

Total Hazard CNS, soil (child)	0.3
Total Hazard thyroid, soil (child)	1
Total Hazard gastrointestinal system, soil (child)	2
Total Hazard skin, soil (child)	0.2
Total Hazard developmental, soil (child)	1
Total Hazard cardiovascular system, soil (child)	0.2
Total Hazard respiratory system, soil (child)	0.1
Total Hazard respiratory system, soil (adult)	0.1
Total Hazard developmental, soil (adult)	0.6
Total Hazard thyroid, soil (adult)	0.6
Total Hazard gastrointestinal system, soil (adult)	0.8
Total Hazard CNS, groundwater (child)	1
Total Hazard skin, groundwater (child)	3
Total Hazard cardiovascular, groundwater (child)	3
Total Hazard thyroid, groundwater (child)	1
Total Hazard gastrointestinal system, groundwater (child)	6
Total Hazard kidney, groundwater (child)	1
Total Hazard respiratory system, groundwater (child)	0.9
Total Hazard body weight, groundwater (child)	1
Total Hazard immune system, groundwater (child)	34
Total Hazard liver, groundwater (child)	0.8
Total Hazard mortality, groundwater (child)	12
Total Hazard urinary, groundwater (child)	0.9
Total Hazard CNS, groundwater (adult)	3
Total Hazard skin, groundwater (adult)	2
Total Hazard cardiovascular, groundwater (adult)	2
Total Hazard thyroid, groundwater (adult)	0.9
Total Hazard gastrointestinal system, groundwater (adult)	4
Total Hazard kidney, groundwater (adult)	1
Total Hazard respiratory system, groundwater (adult)	0.6
Total Hazard body weight, groundwater (adult)	21
Total Hazard immune system, groundwater (adult)	59
Total Hazard liver, groundwater (adult)	1
Total Hazard mortality, groundwater (adult)	12
Total Hazard urinary, groundwater (adult)	0.7

TABLE 10.21
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Wilcox Process Area	Inorganics					Inorganics					
			ARSENIC	1.1E-06	3.8E-08	1.0E-09	1.1E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			(Total)	1.1E-06	3.8E-08	1.0E-09	1.1E-06	(Total)	---	---	---	---	---
Total Risk Across Surface Soil				1.1E-06				Total Hazard Index Across Surface Soil					---
Groundwater	Groundwater	Tap Water	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.4E-01	2.6E-04	--	1.4E-01
			ARSENIC	1.1E-04	2.1E-07	--	1.1E-04	ARSENIC	Skin, Cardiovascular	7.1E-01	1.3E-03	--	7.1E-01
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	8.4E-01	1.6E-03	--	8.4E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	3.1E-01	2.3E-04	--	3.1E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.1E-01	9.6E-04	--	5.1E-01
			PAHs					PAHs					
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	8.8E-02	4.7E-02	--	1.4E-01
			NAPHTHALENE	--	--	1.0E-05	1.0E-05	NAPHTHALENE	Body Weight	3.2E-02	7.8E-03	2.8E-01	3.2E-01
			Volatiles					Volatiles					
			BENZENE	5.0E-04	3.1E-05	9.5E-05	6.3E-04	BENZENE	Immune System	6.4E+00	3.9E-01	1.1E+00	8.0E+00
			1,2-DICHLOROETHANE	1.4E-06	2.8E-08	5.4E-07	2.0E-06	1,2-DICHLOROETHANE	NA	--	--	--	NA
			ETHYLBENZENE	4.6E-05	1.1E-05	1.4E-05	7.1E-05	ETHYLBENZENE	Liver, Kidney	1.2E-01	2.7E-02	1.6E-02	1.6E-01
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	1.2E-01	2.9E-02	3.3E-01	4.8E-01
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	1.5E-01	2.0E-02	3.1E-03	1.7E-01
			(Total)	6.7E-04	4.2E-05	1.2E-04	8.3E-04	(Total)	9.4E+00	5.2E-01	1.8E+00	1.2E+01	1.2E+01
Total Risk Across Ground Water				8.3E-04				Total Hazard Index Across Ground Water					1.2E+01
Total Risk Across All Media and All Exposure Routes				8E-04				Total Hazard Index Across All Media and All Exposure Routes					12

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway

Total Hazard CNS, groundwater	0.1
Total Hazard skin, groundwater	0.7
Total Hazard cardiovascular, groundwater	0.7
Total Hazard thyroid, groundwater	0.3
Total Hazard gastrointestinal system, groundwater	1
Total Hazard kidney, groundwater	0.2
Total Hazard respiratory system, groundwater	0.1
Total Hazard body weight, groundwater	0.8
Total Hazard immune system, groundwater	8
Total Hazard liver, groundwater	0.2
Total Hazard mortality, groundwater	0.5
Total Hazard urinary, groundwater	0.2

TABLE 10.22
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
 Scenario Timeframe: Current/Future
 Receptor Population: Trespasser
 Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil					---
Total Risk Across Surface Water				---				Total Hazard Index Across Surface Water					---
Total Risk Across Sediment				---				Total Hazard Index Across Sediment					---
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes					---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.23
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Wilcox Process Area (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-01	--	1.2E-03	1.1E-01
			ARSENIC	4.7E-06	5.6E-07	1.3E-09	5.3E-06	ARSENIC	Skin, Cardiovascular	1.2E-01	1.5E-02	2.3E-04	1.4E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	2.8E-01	--	8.1E-04	2.8E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.9E-01	--	--	2.9E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	9.4E-06	2.9E-06	3.2E-10	1.2E-05	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	3.2E-07	9.8E-08	1.1E-11	4.2E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	1.4E-05	3.6E-06	1.6E-09	1.8E-05	(Total for Child)	8.0E-01	1.5E-02	2.3E-03	8.1E-01	
		Wilcox Process Area (Adult)	Inorganics					Inorganics					
			ARSENIC	1.5E-06	3.1E-07	4.3E-09	1.8E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	1.1E-06	6.1E-07	4.1E-10	1.7E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	3.8E-08	2.1E-08	6.9E-12	5.8E-08	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
		(Total for Adult)	2.6E-06	9.4E-07	4.7E-09	3.6E-06	(Total for Adult)	---	---	---	---		
		Wilcox Process Area (Adult + Child)	Inorganics										
			ARSENIC	6.2E-06	8.8E-07	5.6E-09	7.1E-06						
			PAHs										
			BENZO(A)PYRENE	1.1E-05	3.5E-06	7.3E-10	1.4E-05						
			DIBENZ(A,H)ANTHRACENE	3.6E-07	1.2E-07	1.8E-11	4.7E-07						
		(Total for Child + Adult)	1.7E-05	4.5E-06	6.4E-09	2.2E-05	Total Hazard Index Across Subsurface Soil (Child)					8.1E-01	
Total Risk Across Subsurface Soil (Adult + Child)							2.2E-05	Total Hazard Index Across Subsurface Soil (Adult)					0.0E+00

TABLE 10.23
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Tap Water (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	6.4E-01	2.8E-03	--	6.5E-01
			ARSENIC	1.3E-04	5.6E-07	--	1.3E-04	ARSENIC	Skin, Cardiovascular	3.3E+00	1.5E-02	--	3.3E+00
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	3.9E+00	1.7E-02	--	3.9E+00
			COBALT	--	--	--	NA	COBALT	Thyroid	1.4E+00	2.5E-03	--	1.4E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.4E+00	1.0E-02	--	2.4E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	3.7E-01	1.6E-03	--	3.7E-01
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.0E-01	1.7E-02	--	1.2E-01
			PAHs					PAHs					
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	4.1E-01	4.9E-01	--	9.1E-01
			NAPHTHALENE	--	--	--	NA	NAPHTHALENE	Body Weight	1.5E-01	8.3E-02	--	2.3E-01
			Volatiles					Volatiles					
			BENZENE	5.6E-04	7.4E-05	--	6.4E-04	BENZENE	Immune System	3.0E+01	3.9E+00	--	3.4E+01
			1,2-DICHLOROETHANE	1.6E-06	6.8E-08	--	1.7E-06	1,2-DICHLOROETHANE	NA	--	--	--	NA
			ETHYLBENZENE	5.2E-05	2.7E-05	--	7.8E-05	ETHYLBENZENE	Liver, Kidney	5.5E-01	2.8E-01	--	8.3E-01
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	5.7E-01	3.0E-01	--	8.7E-01
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	6.9E-01	2.0E-01	--	8.9E-01
			O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	1.2E-01	6.1E-02	--	1.9E-01
			(Total for Child)	7.4E-04	1.0E-04	---	8.5E-04	(Total for Child)		4.5E+01	5.4E+00	---	5.0E+01

TABLE 10.23
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Groundwater	Groundwater	Tap Water (Adult)	Inorganics					Inorganics						
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	3.9E-01	2.2E-03	--	3.9E-01	
			ARSENIC	2.5E-04	1.4E-06	--	2.6E-04	ARSENIC	Skin, Cardiovascular	2.0E+00	1.1E-02	--	2.0E+00	
			CYANIDE	--	--	--	NA	CYANIDE	Gastrointestinal System	2.4E+00	1.3E-02	--	2.4E+00	
			COBALT	--	--	--	NA	COBALT	Thyroid	8.6E-01	1.9E-03	--	8.7E-01	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.4E+00	8.0E-03	--	1.4E+00	
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.2E-01	1.2E-03	--	2.2E-01	
			PAHs					PAHs						
			2-METHYLNAPHTHALENE	--	--	--	NA	2-METHYLNAPHTHALENE	Respiratory System	2.5E-01	3.3E-01	--	5.8E-01	
			NAPHTHALENE	--	--	3.6E-04	3.6E-04	NAPHTHALENE	Body Weight	8.9E-02	5.5E-02	9.5E+00	9.6E+00	
			Volatiles					Volatiles						
			BENZENE	1.1E-03	1.7E-04	3.3E-03	4.6E-03	BENZENE	Immune System	1.8E+01	2.7E+00	3.8E+01	5.9E+01	
			1,2-DICHLOROETHANE	3.2E-06	1.5E-07	1.9E-05	2.2E-05	1,2-DICHLOROETHANE	NA	2.0E-02	9.6E-04	2.8E-01	3.0E-01	
			ETHYLBENZENE	1.0E-04	5.9E-05	4.9E-04	6.5E-04	ETHYLBENZENE	Liver, Kidney	3.3E-01	1.9E-01	5.3E-01	1.0E+00	
			ISOPROPYLBENZENE	--	--	--	NA	ISOPROPYLBENZENE	Kidney	1.8E-02	2.0E-02	7.2E-02	1.1E-01	
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	3.4E-01	2.0E-01	1.1E+01	1.2E+01	
			TOLUENE	--	--	--	NA	TOLUENE	Urinary	4.1E-01	1.4E-01	1.1E-01	6.5E-01	
		O-XYLENE	--	--	--	NA	O-XYLENE	Central Nervous System	7.5E-02	4.07E-02	2.4E+00	2.5E+00		
				(Total for Adult)	1.5E-03	2.3E-04	4.2E-03	5.9E-03		(Total for Adult)	2.7E+01	3.7E+00	6.2E+01	9.3E+01
				Tap Water (Adult + Child)	Inorganics									
					ARSENIC	3.8E-04	2.0E-06	NA	3.8E-04					
					PAHs									
					NAPHTHALENE	NA	NA	3.6E-04	3.6E-04					
		Volatiles												
			BENZENE	1.7E-03	2.4E-04	3.3E-03	5.3E-03							
			1,2-DICHLOROETHANE	4.8E-06	2.2E-07	1.9E-05	2.4E-05							
			ETHYLBENZENE	1.6E-04	8.6E-05	4.9E-04	7.3E-04							
			(Total for Child + Adult)	2.2E-03	3.3E-04	4.2E-03	6.8E-03			Total Hazard Index Across Groundwater (Child)		5.0E+01		
		Total Risk Across Groundwater (Adult + Child)						6.8E-03		Total Hazard Index Across Groundwater (Adult)		9.3E+01		
		Total Risk Across Surface Water (Adult + Child)						---		Total Hazard Index Across Surface Water (Adult)		---		
		Total Risk Across Sediment (Adult + Child)						---		Total Hazard Index Across Sediment (Adult)		---		
Total Risk Across All Media and All Exposure Routes								7E-03	Total Hazard Index Across All Media and All Exposure Routes (Child)				51	
									Total Hazard Index Across All Media and All Exposure Routes (Adult)				93	

NA = Not applicable due to no toxicity values.

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Wilcox Oil Company Superfund Site
Bristow, Creek County, Oklahoma

TABLE 10.24
SUMMARY OF SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - WILCOX PROCESS AREA
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Wilcox Process Area
Scenario Timeframe: Current/Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
			Total Risk Across Subsurface Soil				---	Total Hazard Index Across Subsurface Soil					---
Groundwater	Groundwater	Wilcox Oil	PAHs					PAHs					
			NAPHTHALENE	--	--	5.7E-06	5.7E-06	NAPHTHALENE	Body Weight	2.0E-04	3.8E-03	3.9E+00	3.9E+00
			Volatiles					Volatiles					
			BENZENE	1.3E-07	7.4E-07	7.6E-05	7.7E-05	BENZENE	Immune System	4.1E-02	2.4E-01	2.3E+01	2.3E+01
			1,2-DICHLOROETHANE	--	--	--	NA	1,2-DICHLOROETHANE	NA	4.7E-05	8.1E-05	1.4E-01	1.4E-01
			ETHYLBENZENE	1.2E-08	2.2E-07	9.6E-06	9.9E-06	ETHYLBENZENE	Liver, Kidney	7.5E-04	1.4E-02	2.7E-01	2.8E-01
			M,P-XYLENE	--	--	--	NA	M,P-XYLENE	Body Weight, Mortality	7.9E-04	1.5E-02	5.6E+00	5.6E+00
			(Total)	1.4E-07	9.6E-07	9.1E-05	9.3E-05	(Total)	4.3E-02	2.7E-01	3.3E+01	3.3E+01	
			Total Risk Across Groundwater				9.3E-05	Total Hazard Index Across Groundwater				3.3E+01	
			Total Risk Across All Media and All Exposure Routes				9E-05	Total Hazard Index Across All Media and All Exposure Routes				33	

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard body weight, groundwater	10
Total Hazard immune system, groundwater	23
Total Hazard liver, groundwater	0.3
Total Hazard kidney, groundwater	0.3
Total Hazard mortality, groundwater	6

TABLE 10.25
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	East Tank Farm (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	1.1E-01	--	1.2E-03	1.1E-01
			ARSENIC	2.9E-06	3.4E-07	7.9E-10	3.2E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	2.3E-01	--	6.6E-04	2.3E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	2.8E-01	--	--	2.8E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	3.6E-06	1.1E-06	1.2E-10	4.7E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	6.5E-06	1.5E-06	9.2E-10	8.0E-06	(Total for Child)		6.1E-01	---	1.9E-03	6.1E-01
		East Tank Farm	Inorganics					Inorganics					
			ARSENIC	9.0E-07	1.9E-07	2.6E-09	1.1E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	4.3E-07	2.3E-07	1.6E-10	6.6E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Adult)	1.3E-06	4.2E-07	2.8E-09	1.8E-06	(Total for Adult)		---	---	---	---
		East Tank Farm (Adult + Child)	Inorganics										
			ARSENIC	3.8E-06	5.3E-07	3.4E-09	4.3E-06						
			PAHs										
			BENZO(A)PYRENE	4.0E-06	1.3E-06	2.8E-10	5.4E-06						
			(Total for Child + Adult)	7.8E-06	1.9E-06	3.7E-09	9.7E-06						
	Homegrown Produce	East Tank Farm (Child)	Inorganics					Inorganics					
			ARSENIC	1.1E-06	--	--	1.1E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			COBALT	--	--	--	NA	COBALT	Thyroid	1.7E-01	--	--	1.7E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	5.3E-01	--	--	5.3E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	1.7E-06	--	--	1.7E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	2.8E-06	---	---	2.8E-06	(Total for Child)		6.9E-01	---	---	6.9E-01
		East Tank Farm (Adult)	Inorganics					Inorganics					
			ARSENIC	1.4E-06	--	--	1.4E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	8.4E-07	--	--	8.4E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Adult)	2.3E-06	---	---	2.3E-06	(Total for Adult)		---	---	---	---
		East Tank Farm (Adult + Child)	Inorganics										
			ARSENIC	2.5E-06	NA	NA	2.5E-06						
			PAHs										
			BENZO(A)PYRENE	2.6E-06	NA	NA	2.6E-06						
			(Total for Child + Adult)	5.1E-06	---	---	5.1E-06	Total Hazard Index Across Surface Soil (Child)					1.3E+00

TABLE 10.25
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient					
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total	
Soil	Beef Consumption	East Tank Farm (Child)	Inorganics					Inorganics						
			ARSENIC	9.8E-07	--	--	9.8E-07	ARSENIC	Skin, Cardiovascular	--	--	--	NA	
			COBALT	--	--	--	NA	COBALT	Thyroid	4.8E-01	--	--	4.8E-01	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	5.6E-01	--	--	5.6E-01	
			PAHs					PAHs						
			BENZO(A)PYRENE	1.3E-05	--	--	1.3E-05	BENZO(A)PYRENE	Developmental System	9.2E-02	--	--	9.2E-02	
			INDENO(1,2,3-C,D)PYRENE	1.3E-06	--	--	1.3E-06	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA	
			(Total for Child)	1.5E-05	---	---	1.5E-05	(Total for Child)	1.1E+00	---	---	---	1.1E+00	
		East Tank Farm (Adult)	Inorganics					Inorganics						
			ARSENIC	1.6E-06	--	--	1.6E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA	
			COBALT	--	--	--	NA	COBALT	Thyroid	--	--	--	NA	
			IRON	--	--	--	NA	IRON	Gastrointestinal System	--	--	--	NA	
			PAHs					PAHs						
			BENZO(A)PYRENE	7.8E-06	--	--	7.8E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA	
			INDENO(1,2,3-C,D)PYRENE	7.9E-07	--	--	7.9E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA	
			(Total for Adult)	1.0E-05	---	---	1.0E-05	(Total for Adult)	---	---	---	---	---	
		East Tank Farm (Adult + Child)	Inorganics											
			ARSENIC	2.6E-06	NA	NA	2.6E-06							
			PAHs											
			BENZO(A)PYRENE	2.0E-05	NA	NA	2.0E-05							
			</											

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard CNS, soil (child)	0.6
Total Hazard developmental, soil (child)	0.1
Total Hazard thyroid, soil (child)	0.9
Total Hazard gastrointestinal system, soil (child)	0.8

TABLE 10.26
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Construction Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
			Total Risk Across Surface Soil		---		Total Hazard Index Across Surface Soil			---			
Total Risk Across All Media and All Exposure Routes				---		Total Hazard Index Across All Media and All Exposure Routes			---				

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.27
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Commercial/Industrial Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil					---
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes					---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.28
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient						
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total		
			Total Risk Across Surface Soil				---				Total Hazard Index Across Surface Soil				---
			Total Risk Across Surface Water				---				Total Hazard Index Across Surface Water				---
			Total Risk Across Sediment				---				Total Hazard Index Across Sediment				---
			Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes				---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.29
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm
 Scenario Timeframe: Current/Future
 Receptor Population: Resident
 Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
			(Total for Child + Adult)	---	---	---	---	Total Hazard Index Across Subsurface Soil (Child)					---
Total Risk Across Subsurface Soil (Adult + Child)							---	Total Hazard Index Across Subsurface Soil (Adult)					---
Total Risk Across Surface Water (Adult + Child)							---	Total Hazard Index Across Surface Water (Adult)					---
Total Risk Across Sediment (Adult + Child)							---	Total Hazard Index Across Sediment (Adult)					---
Total Risk Across All Media and All Exposure Routes							---	Total Hazard Index Across All Media and All Exposure Routes (Child)					---
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					---

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.30
SUMMARY OF SIGNIFICANT CONTRIBUTORS OF RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - EAST TANK FARM
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: East Tank Farm Scenario Timeframe: Current/Future Receptor Population: Construction Worker Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Total Risk Across Subsurface Soil				---				Total Hazard Index Across Subsurface Soil					---
Total Risk Across All Media and All Exposure Routes				---				Total Hazard Index Across All Media and All Exposure Routes					---

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

TABLE 10.31
SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Residential Yards (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.7E-01	--	3.1E-03	2.7E-01
			ANTIMONY	--	--	--	NA	ANTIMONY	Blood	2.2E-01	--	--	2.2E-01
			ARSENIC	2.2E-05	2.6E-06	6.0E-09	2.4E-05	ARSENIC	Skin, Cardiovascular	5.7E-01	6.7E-02	1.1E-03	6.3E-01
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	1.0E+00	9.7E-02	5.9E-03	1.1E+00
			COBALT	--	--	--	NA	COBALT	Thyroid	2.6E+00	--	7.5E-03	2.6E+00
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.3E+00	--	--	1.3E+00
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	1.7E-01	--	2.8E-02	2.0E-01
			VANADIUM	--	--	--	NA	VANADIUM	Kidney	1.3E-01	--	3.8E-04	1.3E-01
			ZINC	--	--	--	NA	ZINC	Immune System, Blood	5.9E-01	--	--	5.9E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.1E-06	6.5E-07	7.2E-11	2.7E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.1E-06	3.4E-07	3.8E-11	1.4E-06	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.6E-05	4.8E-06	5.4E-10	2.1E-05	BENZO(A)PYRENE	Developmental System	1.2E-01	3.5E-02	9.9E-04	1.5E-01
			DIBENZ(A,H)ANTHRACENE	3.9E-06	1.2E-06	1.3E-10	5.1E-06	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	8.7E-07	2.7E-07	3.0E-11	1.1E-06	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Child)	4.5E-05	9.9E-06	6.8E-09	5.5E-05	(Total for Child)	(Total for Child)	7.0E+00	2.0E-01	4.6E-02	7.3E+00
		Residential Yards (Adult)	Inorganics					Inorganics					
			ARSENIC	6.8E-06	1.4E-06	2.0E-08	8.3E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	9.6E-02	1.6E-02	5.9E-03	1.2E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	2.4E-01	--	7.5E-03	2.5E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.2E-01	--	--	1.2E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	2.5E-07	1.4E-07	9.0E-11	3.8E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(B)FLUORANTHENE	1.3E-07	7.1E-08	4.8E-11	2.0E-07	BENZO(B)FLUORANTHENE	NA	--	--	--	NA
			BENZO(A)PYRENE	1.8E-06	1.0E-06	6.8E-10	2.9E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	4.6E-07	2.5E-07	1.7E-10	7.1E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			INDENO(1,2,3-C,D)PYRENE	1.0E-07	5.6E-08	3.8E-11	1.6E-07	INDENO(1,2,3-C,D)PYRENE	NA	--	--	--	NA
			(Total for Adult)	9.6E-06	3.0E-06	2.1E-08	1.3E-05	(Total for Adult)	(Total for Adult)	4.7E-01	1.6E-02	1.3E-02	4.9E-01

TABLE 10.31
SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	Residential Yards (Adult + Child)	Inorganics										
			ALUMINUM	NA	NA	NA	NA						
			ANTIMONY	NA	NA	NA	NA						
			ARSENIC	2.9E-05	4.0E-06	2.6E-08	3.3E-05						
			CADMIUM	NA	NA	NA	NA						
			COBALT	NA	NA	NA	NA						
			IRON	NA	NA	NA	NA						
			MANGANESE	NA	NA	NA	NA						
			VANADIUM	NA	NA	NA	NA						
			ZINC	NA	NA	NA	NA						
			PAHs										
			BENZ(A)ANTHRACENE	2.3E-06	7.8E-07	1.6E-10	3.1E-06						
			BENZO(B)FLUORANTHENE	1.2E-06	4.1E-07	8.6E-11	1.6E-06						
			BENZO(A)PYRENE	1.8E-05	5.9E-06	1.2E-09	2.3E-05						
			DIBENZ(A,H)ANTHRACENE	4.4E-06	1.5E-06	3.0E-10	5.8E-06						
			INDENO(1,2,3-C,D)PYRENE	9.7E-07	3.3E-07	6.8E-11	1.3E-06						
			(Total for Child + Adult)	5.5E-05	1.3E-05	2.8E-08	6.8E-05						
	Homegrown Produce	Residential Yards (Child)	Inorganics					Inorganics					
			ARSENIC	8.3E-06	--	--	8.3E-06	ARSENIC	Skin, Cardiovascular	2.2E-01	--	--	2.2E-01
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	5.6E-01	--	--	5.6E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	4.2E-01	--	--	4.2E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	3.4E-01	--	--	3.4E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	6.2E-01	--	--	6.2E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	1.5E-06	--	--	1.5E-06	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	7.5E-06	--	--	7.5E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	9.5E-07	--	--	9.5E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			(Total for Child)	1.8E-05	---	---	1.8E-05		(Total for Child)	2.2E+00	---	---	2.2E+00

TABLE 10.31
SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Lorraine Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Homegrown Produce	Residential Yards (Adult)	Inorganics					Inorganics					
			ARSENIC	1.1E-05	--	--	1.1E-05	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			CADMIUM	--	--	--	NA	CADMIUM	Kidneys, Urinary	2.2E-01	--	--	2.2E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	1.7E-01	--	--	1.7E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	1.3E-01	--	--	1.3E-01
			MANGANESE	--	--	--	NA	MANGANESE	Central Nervous System	2.4E-01	--	--	2.4E-01
			PAHs					PAHs					
			BENZ(A)ANTHRACENE	7.3E-07	--	--	7.3E-07	BENZ(A)ANTHRACENE	NA	--	--	--	NA
			BENZO(A)PYRENE	3.7E-06	--	--	3.7E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			DIBENZ(A,H)ANTHRACENE	4.7E-07	--	--	4.7E-07	DIBENZ(A,H)ANTHRACENE	NA	--	--	--	NA
			Volatiles					Volatiles					
			BENZENE	--	--	--	NA	BENZENE	Immune System	2.1E-01	--	--	2.1E-01
			(Total for Adult)	1.6E-05	---	---	1.6E-05		(Total for Adult)	9.6E-01	---	---	9.6E-01
		Residential Yards (Adult + Child)	Inorganics										
			ARSENIC	1.9E-05	NA	NA	1.9E-05						
			PAHs										
			BENZ(A)ANTHRACENE	2.2E-06	NA	NA	2.2E-06						
			BENZO(A)PYRENE	1.1E-05	NA	NA	1.1E-05						
		DIBENZ(A,H)ANTHRACENE	1.4E-06	NA	NA	1.4E-06							
		(Total for Child + Adult)	3.4E-05	---	---	3.4E-05	Total Hazard Index Across Surface Soil (Child)					9.4E+00	
Total Risk Across Surface Soil (Adult + Child)				1.0E-04				Total Hazard Index Across Surface Soil (Adult)					1.5E+00
Total Risk Across All Media and All Exposure Routes				1E-04				Total Hazard Index Across All Media and All Exposure Routes (Child)					9
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					1

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard Index, Central Nervous System (Child)	1
Total Hazard Index, Blood (Child)	0.8
Total Hazard Index, Skin (Child)	0.6
Total Hazard Index, Cardiovascular (Child)	0.6
Total Hazard Index, Kidneys (Child)	2
Total Hazard Index, Thyroid (Child)	3
Total Hazard Index, Gastrointestinal (Child)	1
Total Hazard Index, Immune System (Child)	0.6
Total Hazard Index, Developmental (Child)	0.2

Total Hazard Index, Central Nervous System (Adult)	0.2
Total Hazard Index, Kidneys (Adult)	0.3
Total Hazard Index, Thyroid (Adult)	0.4
Total Hazard Index, Gastrointestinal (Adult)	0.3
Total Hazard Index, Immune System (Adult)	0.2

TABLE 10.32
SIGNIFICANT CONTRIBUTORS TO RISK
REASONABLE MAXIMUM EXPOSURE
WILCOX OIL COMPANY SUPERFUND SITE - RESIDENTIAL YARDS
BRISTOW, CREEK COUNTY, OKLAHOMA

Location: Residential Yards
Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child and Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk				Chemical	Non-Carcinogenic Hazard Quotient				
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Subsurface Soil	Residential Yards (Child)	Inorganics					Inorganics					
			ALUMINUM	--	--	--	NA	ALUMINUM	Neurological	2.9E-01	--	3.3E-03	2.9E-01
			ARSENIC	1.8E-05	2.2E-06	5.0E-09	2.0E-05	ARSENIC	Skin, Cardiovascular	4.7E-01	5.6E-02	9.0E-04	5.3E-01
			COBALT	--	--	--	NA	COBALT	Thyroid	3.2E-01	--	9.3E-04	3.2E-01
			IRON	--	--	--	NA	IRON	Gastrointestinal System	8.0E-01	--	--	8.0E-01
			PAHs					PAHs					
			BENZO(A)PYRENE	8.1E-07	2.5E-07	5.3E-12	1.1E-06	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Child)	1.9E-05	2.4E-06	5.0E-09	2.1E-05	(Total for Child)	1.9E+00	5.6E-02	5.1E-03	1.9E+00	
		Residential Yards (Adult)	Inorganics					Inorganics					
			ARSENIC	5.7E-06	1.2E-06	1.7E-08	6.9E-06	ARSENIC	Skin, Cardiovascular	--	--	--	NA
			PAHs					PAHs					
			BENZO(A)PYRENE	9.6E-08	5.3E-08	3.5E-11	1.5E-07	BENZO(A)PYRENE	Developmental System	--	--	--	NA
			(Total for Adult)	5.8E-06	1.3E-06	1.7E-08	7.1E-06	(Total for Adult)	---	---	---	---	
		Residential Yards (Adult + Child)	Inorganics										
			ARSENIC	2.4E-05	3.4E-06	2.2E-08	2.7E-05						
			PAHs										
			BENZO(A)PYRENE	9.1E-07	3.0E-07	4.0E-11	1.2E-06						
			(Total for Child + Adult)	2.5E-05	3.7E-06	2.2E-08	2.9E-05	Total Hazard Index Across Subsurface Soil (Child)					1.9E+00
Total Risk Across Subsurface Soil (Adult + Child)							2.9E-05	Total Hazard Index Across Subsurface Soil (Adult)					---
Total Risk Across All Media and All Exposure Routes							3E-05	Total Hazard Index Across All Media and All Exposure Routes (Child)					2
								Total Hazard Index Across All Media and All Exposure Routes (Adult)					---

NA = Not applicable due to no toxicity values.

NA = Not applicable due to no toxicity values.

-- = No risks calculated for this exposure pathway.

Total Hazard Index, Central Nervous System (Child)	0.3
Total Hazard Index, Skin (Child)	0.5
Total Hazard Index, Cardiovascular (Child)	0.5
Total Hazard Index, Thyroid (Child)	0.3
Total Hazard Index, Gastrointestinal (Child)	0.8

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APPENDIX A

**SAMPLES USED IN THE
HUMAN HEALTH RISK ASSESSMENT**

(electronic versions only)

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Appendix A.
Samples Evaluated in the HHRA
Surface Water Samples

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Sample Code
P1-SW-01		P1-SW-01_10/23/2017	10/23/2017	P1-SW-01_10/23/2017
P1-SW-01-F		P1-SW-01-F_10/23/2017	10/23/2017	P1-SW-01-F_10/23/2017
P1-SW-02		P1-SW-02_10/23/2017	10/23/2017	P1-SW-02_10/23/2017
P1-SW-02-D	P1-SW-02	P1-SW-02_10/23/2017	10/23/2017	P1-SW-02-D_10/23/2017
P1-SW-02-F		P1-SW-02-F_10/23/2017	10/23/2017	P1-SW-02-F_10/23/2017
P1-SW-02-F-D	P1-SW-02-F	P1-SW-02-F_10/23/2017	10/23/2017	P1-SW-02-F-D_10/23/2017
P1-SW-04		P1-SW-04_10/23/2017	10/23/2017	P1-SW-04_10/23/2017
P1-SW-04-F		P1-SW-04-F_10/23/2017	10/23/2017	P1-SW-04-F_10/23/2017
P2-SW-01-F		P2-SW-01-F_10/26/2017	10/26/2017	P2-SW-01-F_10/26/2017
P2-SW-01		P2-SW-01_10/26/2017	10/26/2017	P2-SW-01_10/26/2017
P2-SW-03		P2-SW-03_10/26/2017	10/26/2017	P2-SW-03_10/26/2017
P2-SW-03-F		P2-SW-03-F_10/26/2017	10/26/2017	P2-SW-03-F_10/26/2017
P3-SW-01		P3-SW-01_10/26/2017	10/26/2017	P3-SW-01_10/26/2017
P3-SW-01-D	P3-SW-01	P3-SW-01_10/26/2017	10/26/2017	P3-SW-01-D_10/26/2017
P3-SW-01-F		P3-SW-01-F_10/26/2017	10/26/2017	P3-SW-01-F_10/26/2017
P3-SW-01-F-D	P3-SW-01-F	P3-SW-01-F_10/26/2017	10/26/2017	P3-SW-01-F-D_10/26/2017
P3-SW-02		P3-SW-02_10/26/2017	10/26/2017	P3-SW-02_10/26/2017
P3-SW-02-F		P3-SW-02-F_10/26/2017	10/26/2017	P3-SW-02-F_10/26/2017
P3-SW-03		P3-SW-03_10/26/2017	10/26/2017	P3-SW-03_10/26/2017
P3-SW-03-F		P3-SW-03-F_10/26/2017	10/26/2017	P3-SW-03-F_10/26/2017
P4-SW-01		P4-SW-01_10/25/2017	10/25/2017	P4-SW-01_10/25/2017
P4-SW-01-F		P4-SW-01-F_10/25/2017	10/25/2017	P4-SW-01-F_10/25/2017
P4-SW-03		P4-SW-03_10/25/2017	10/25/2017	P4-SW-03_10/25/2017
P4-SW-03-D	P4-SW-03	P4-SW-03_10/25/2017	10/25/2017	P4-SW-03-D_10/25/2017
P4-SW-03-F		P4-SW-03-F_10/25/2017	10/25/2017	P4-SW-03-F_10/25/2017
P4-SW-03-F-D	P4-SW-03-F	P4-SW-03-F_10/25/2017	10/25/2017	P4-SW-03-F-D_10/25/2017
P5-SW-01		P5-SW-01_10/24/2017	10/24/2017	P5-SW-01_10/24/2017
P5-SW-01-F		P5-SW-01-F_10/24/2017	10/24/2017	P5-SW-01-F_10/24/2017
P5-SW-03		P5-SW-03_10/24/2017	10/24/2017	P5-SW-03_10/24/2017
P5-SW-03-F		P5-SW-03-F_10/24/2017	10/24/2017	P5-SW-03-F_10/24/2017
P6-SW-01-F		P6-SW-01-F_10/18/2017	10/18/2017	P6-SW-01-F_10/18/2017
P6-SW-01		P6-SW-01_10/18/2017	10/18/2017	P6-SW-01_10/18/2017
P6-SW-02		P6-SW-02_10/18/2017	10/18/2017	P6-SW-02_10/18/2017
P6-SW-02-F		P6-SW-02-F_10/18/2017	10/18/2017	P6-SW-02-F_10/18/2017
P6-SW-04		P6-SW-04_10/18/2017	10/18/2017	P6-SW-04_10/18/2017
P6-SW-04-F		P6-SW-04-F_10/18/2017	10/18/2017	P6-SW-04-F_10/18/2017
P6-SW-05		P6-SW-05_10/18/2017	10/18/2017	P6-SW-05_10/18/2017
P6-SW-05-D	P6-SW-05	P6-SW-05_10/18/2017	10/18/2017	P6-SW-05-D_10/18/2017
P6-SW-05-F		P6-SW-05-F_10/18/2017	10/18/2017	P6-SW-05-F_10/18/2017
P6-SW-05-F-D	P6-SW-05-F	P6-SW-05-F_10/18/2017	10/18/2017	P6-SW-05-F-D_10/18/2017
P6-SW-07		P6-SW-07_10/18/2017	10/18/2017	P6-SW-07_10/18/2017
P6-SW-07-F		P6-SW-07-F_10/18/2017	10/18/2017	P6-SW-07-F_10/18/2017
P7-SW-01-F		P7-SW-01-F_10/25/2017	10/25/2017	P7-SW-01-F_10/25/2017
P7-SW-01		P7-SW-01_10/25/2017	10/25/2017	P7-SW-01_10/25/2017
P7-SW-03-F		P7-SW-03-F_10/25/2017	10/25/2017	P7-SW-03-F_10/25/2017
P7-SW-03		P7-SW-03_10/25/2017	10/25/2017	P7-SW-03_10/25/2017
P7-SW-05		P7-SW-05_10/25/2017	10/25/2017	P7-SW-05_10/25/2017
P7-SW-05-F		P7-SW-05-F_10/25/2017	10/25/2017	P7-SW-05-F_10/25/2017
P7-SW-06		P7-SW-06_10/25/2017	10/25/2017	P7-SW-06_10/25/2017
P7-SW-06-F		P7-SW-06-F_10/25/2017	10/25/2017	P7-SW-06-F_10/25/2017
P8-SW-01-F		P8-SW-01-F_10/24/2017	10/24/2017	P8-SW-01-F_10/24/2017
P8-SW-01		P8-SW-01_10/24/2017	10/24/2017	P8-SW-01_10/24/2017
C1-SW-F		C1-SW-F_10/16/2017	1:30:00 PM	C1-SW-F_10/16/2017

Appendix A.
Samples Evaluated in the HHRA
Surface Water Samples

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Sample Code
C1-SW		C1-SW_10/16/2017	10/16/2017	C1-SW_10/16/2017
C2-SW		C2-SW_11/01/2016	11/1/2016	C2-SW_11/01/2016
C2-SW-F		C2-SW-F_11/01/2016	11/1/2016	C2-SW-F_11/01/2016
ET-SW-01		ET-SW-01_10/19/2017	10/19/2017	ET-SW-01_10/19/2017
ET-SW-01-F		ET-SW-01-F_10/19/2017	10/19/2017	ET-SW-01-F_10/19/2017
ET-SW-02-F		ET-SW-02-F_10/19/2017	10/19/2017	ET-SW-02-F_10/19/2017
ET-SW-02		ET-SW-02_10/19/2017	10/19/2017	ET-SW-02_10/19/2017
ET-SW-03		ET-SW-03_10/19/2017	10/19/2017	ET-SW-03_10/19/2017
ET-SW-03-F		ET-SW-03-F_10/19/2017	10/19/2017	ET-SW-03-F_10/19/2017
ET-SW-04		ET-SW-04_10/19/2017	10/19/2017	ET-SW-04_10/19/2017
ET-SW-04-F		ET-SW-04-F_10/19/2017	10/19/2017	ET-SW-04-F_10/19/2017
ET-SW-05-F		ET-SW-05-F_10/18/2017	10/18/2017	ET-SW-05-F_10/18/2017
ET-SW-05		ET-SW-05_10/18/2017	10/18/2017	ET-SW-05_10/18/2017
ET-SW-07		ET-SW-07_10/18/2017	10/18/2017	ET-SW-07_10/18/2017
ET-SW-07-F		ET-SW-07-F_10/18/2017	10/18/2017	ET-SW-07-F_10/18/2017
SCBR-SW-02		SCBR-SW-02_10/16/2017	10/16/2017	SCBR-SW-02_10/16/2017
SCBR-SW-02-F		SCBR-SW-02-F_10/16/2017	10/16/2017	SCBR-SW-02-F_10/16/2017
SCPPE-SW-01-F		SCPPE-SW-01-F_11/01/2016	11/1/2016	SCPPE-SW-01-F_11/01/2016
SCPPE-SW-01-F		SCPPE-SW-01-F_10/17/2017	10/17/2017	SCPPE-SW-01-F_10/17/2017
SCPPE-SW-01		SCPPE-SW-01_11/01/2016	11/1/2016	SCPPE-SW-01_11/01/2016
SCPPE-SW-01		SCPPE-SW-01_10/17/2017	10/17/2017	SCPPE-SW-01_10/17/2017
SCPPE-SW-03		SCPPE-SW-03_11/02/2016	11/2/2016	SCPPE-SW-03_11/02/2016
SCPPE-SW-03-F		SCPPE-SW-03-F_10/17/2017	10/17/2017	SCPPE-SW-03-F_10/17/2017
SCPPE-SW-03		SCPPE-SW-03_10/17/2017	10/17/2017	SCPPE-SW-03_10/17/2017
SCPPE-SW-03-F		SCPPE-SW-03-F_11/02/2016	11/2/2016	SCPPE-SW-03-F_11/02/2016
SCPPE-SW-05		SCPPE-SW-05_11/02/2016	11/2/2016	SCPPE-SW-05_11/02/2016
SCPPE-SW-05-F		SCPPE-SW-05-F_11/02/2016	11/2/2016	SCPPE-SW-05-F_11/02/2016
SC-SW-02-F		SC-SW-02-F_10/16/2017	10/16/2017	SC-SW-02-F_10/16/2017
SC-SW-02		SC-SW-02_10/16/2017	10/16/2017	SC-SW-02_10/16/2017
SC-SW-03		SC-SW-03_10/31/2016	10/31/2016	SC-SW-03_10/31/2016
SC-SW-03-F		SC-SW-03-F_10/31/2016	10/31/2016	SC-SW-03-F_10/31/2016
SC-SW-04-F		SC-SW-04-F_10/31/2016	10/31/2016	SC-SW-04-F_10/31/2016
SC-SW-04-F		SC-SW-04-F_10/17/2017	10/17/2017	SC-SW-04-F_10/17/2017
SC-SW-04		SC-SW-04_10/17/2017	10/17/2017	SC-SW-04_10/17/2017
SC-SW-04		SC-SW-04_10/31/2016	10/31/2016	SC-SW-04_10/31/2016
SC-SW-05-F		SC-SW-05-F_11/01/2016	11/1/2016	SC-SW-05-F_11/01/2016
SC-SW-05		SC-SW-05_11/01/2016	11/1/2016	SC-SW-05_11/01/2016
SC-SW-05A-F-D	SC-SW-05A-F	SC-SW-05A-F_11/01/2016	11/1/2016	SC-SW-05A-F-D_11/01/2016
SC-SW-05A-F		SC-SW-05A-F_11/01/2016	11/1/2016	SC-SW-05A-F_11/01/2016
SC-SW-05A-D	SC-SW-05A	SC-SW-05A_11/01/2016	11/1/2016	SC-SW-05A-D_11/01/2016
SC-SW-05A		SC-SW-05A_11/01/2016	11/1/2016	SC-SW-05A_11/01/2016
SC-SW-06-F		SC-SW-06-F_10/17/2017	10/17/2017	SC-SW-06-F_10/17/2017
SC-SW-06		SC-SW-06_10/17/2017	10/17/2017	SC-SW-06_10/17/2017
SC-SW-06		SC-SW-06_11/02/2016	11/2/2016	SC-SW-06_11/02/2016
SC-SW-06-F		SC-SW-06-F_11/02/2016	11/2/2016	SC-SW-06-F_11/02/2016
SC-SW-07-D	SC-SW-07	SC-SW-07_11/02/2016	11/2/2016	SC-SW-07-D_11/02/2016
SC-SW-07-F		SC-SW-07-F_11/02/2016	11/2/2016	SC-SW-07-F_11/02/2016
SC-SW-07-F-D	SC-SW-07-F	SC-SW-07-F_11/02/2016	11/2/2016	SC-SW-07-F-D_11/02/2016
SC-SW-07		SC-SW-07_11/02/2016	11/2/2016	SC-SW-07_11/02/2016
SC-SW-08-F		SC-SW-08-F_11/02/2016	11/2/2016	SC-SW-08-F_11/02/2016
SC-SW-08		SC-SW-08_10/17/2017	10/17/2017	SC-SW-08_10/17/2017
SC-SW-08		SC-SW-08_11/02/2016	11/2/2016	SC-SW-08_11/02/2016
SC-SW-08-F		SC-SW-08-F_10/17/2017	3:30:00 PM	SC-SW-08-F_10/17/2017

Appendix A.
Samples Evaluated in the HHRA
Surface Water Samples

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Sample Code
SC-SW-21		SC-SW-21_12/18/2018	12/18/2018	SC-SW-21_12/18/2018
SC-SW-22-F		SC-SW-22-F_12/17/2018	12/17/2018	SC-SW-22-F_12/17/2018
SC-SW-22		SC-SW-22_12/17/2018	12/17/2018	SC-SW-22_12/17/2018
SC-SW-22-DUP	SC-SW-22	SC-SW-22_12/17/2018	12/17/2018	SC-SW-22-DUP_12/17/2018
SC-SW-22-F-DUP	SC-SW-22-F	SC-SW-22-F_12/17/2018	12/17/2018	SC-SW-22-F-DUP_12/17/2018
SC-SW-21-F		SC-SW-21-F_12/18/2018	12/18/2018	SC-SW-21-F_12/18/2018
WT-SW-01-F-D	WT-SW-01-F	WT-SW-01-F_10/23/2017	10/23/2017	WT-SW-01-F-D_10/23/2017
WT-SW-01-F		WT-SW-01-F_10/23/2017	10/23/2017	WT-SW-01-F_10/23/2017
WT-SW-01-D	WT-SW-01	WT-SW-01_10/23/2017	10/23/2017	WT-SW-01-D_10/23/2017
WT-SW-01		WT-SW-01_10/23/2017	10/23/2017	WT-SW-01_10/23/2017
WT-SW-03-F		WT-SW-03-F_10/23/2017	10/23/2017	WT-SW-03-F_10/23/2017
WT-SW-03		WT-SW-03_10/23/2017	10/23/2017	WT-SW-03_10/23/2017
WT-SW-06		WT-SW-06_10/24/2017	10/24/2017	WT-SW-06_10/24/2017
WT-SW-06-F		WT-SW-06-F_10/24/2017	9:45:00 AM	WT-SW-06-F_10/24/2017

Appendix A.
Samples Evaluated in the HHRA
Sediment Samples

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Sample Code
P1-SD-01-0.5		P1-SD-01-0.5_10/23/2017	10/23/2017	P1-SD-01-0.5_10/23/2017
P1-SD-01-0.5-D	P1-SD-01-0.5	P1-SD-01-0.5_10/23/2017	10/23/2017	P1-SD-01-0.5-D_10/23/2017
P1-SD-02-0.5		P1-SD-02-0.5_10/23/2017	10/23/2017	P1-SD-02-0.5_10/23/2017
P1-SD-04-0.5		P1-SD-04-0.5_10/23/2017	10/23/2017	P1-SD-04-0.5_10/23/2017
P2-SD-01-0.5		P2-SD-01-0.5_10/26/2017	10/26/2017	P2-SD-01-0.5_10/26/2017
P2-SD-03-0.5		P2-SD-03-0.5_10/26/2017	10/26/2017	P2-SD-03-0.5_10/26/2017
P3-SD-01-0.5		P3-SD-01-0.5_10/26/2017	10/26/2017	P3-SD-01-0.5_10/26/2017
P3-SD-01-0.5-D	P3-SD-01-0.5	P3-SD-01-0.5_10/26/2017	10/26/2017	P3-SD-01-0.5-D_10/26/2017
P3-SD-02-0.5		P3-SD-02-0.5_10/26/2017	10/26/2017	P3-SD-02-0.5_10/26/2017
P3-SD-03-0.5		P3-SD-03-0.5_10/26/2017	10/26/2017	P3-SD-03-0.5_10/26/2017
P4-SD-01-0.5		P4-SD-01-0.5_10/25/2017	10/25/2017	P4-SD-01-0.5_10/25/2017
P4-SD-03-0.5		P4-SD-03-0.5_10/25/2017	10/25/2017	P4-SD-03-0.5_10/25/2017
P4-SD-03-0.5-D	P4-SD-03-0.5	P4-SD-03-0.5_10/25/2017	10/25/2017	P4-SD-03-0.5-D_10/25/2017
P5-SD-01-0.5		P5-SD-01-0.5_10/24/2017	10/24/2017	P5-SD-01-0.5_10/24/2017
P5-SD-03-0.5		P5-SD-03-0.5_10/24/2017	10/24/2017	P5-SD-03-0.5_10/24/2017
P6-SD-01-0.5		P6-SD-01-0.5_10/19/2017	10/19/2017	P6-SD-01-0.5_10/19/2017
P6-SD-02-0.5		P6-SD-02-0.5_10/19/2017	10/19/2017	P6-SD-02-0.5_10/19/2017
P6-SD-04-0.5		P6-SD-04-0.5_10/19/2017	10/19/2017	P6-SD-04-0.5_10/19/2017
P6-SD-05-0.5-D	P6-SD-05-0.5	P6-SD-05-0.5_10/19/2017	10/19/2017	P6-SD-05-0.5-D_10/19/2017
P6-SD-05-0.5		P6-SD-05-0.5_10/19/2017	10/19/2017	P6-SD-05-0.5_10/19/2017
P6-SD-07-0.5		P6-SD-07-0.5_10/19/2017	10/19/2017	P6-SD-07-0.5_10/19/2017
P7-SD-01-0.5		P7-SD-01-0.5_10/25/2017	10/25/2017	P7-SD-01-0.5_10/25/2017
P7-SD-03-0.5		P7-SD-03-0.5_10/25/2017	10/25/2017	P7-SD-03-0.5_10/25/2017
P7-SD-05-0.5		P7-SD-05-0.5_10/25/2017	10/25/2017	P7-SD-05-0.5_10/25/2017
P7-SD-06-0.5		P7-SD-06-0.5_10/25/2017	10/25/2017	P7-SD-06-0.5_10/25/2017
P8-SD-01-0.5		P8-SD-01-0.5_10/24/2017	10/24/2017	P8-SD-01-0.5_10/24/2017
C1-SD-0.5		C1-SD-0.5_10/16/2017	10/16/2017	C1-SD-0.5_10/16/2017
ET-SD-01-0.5		ET-SD-01-0.5_10/19/2017	10/19/2017	ET-SD-01-0.5_10/19/2017
ET-SD-02-0.5		ET-SD-02-0.5_10/19/2017	10/19/2017	ET-SD-02-0.5_10/19/2017
ET-SD-03-0.5		ET-SD-03-0.5_10/19/2017	10/19/2017	ET-SD-03-0.5_10/19/2017
ET-SD-04-0.5		ET-SD-04-0.5_10/19/2017	10/19/2017	ET-SD-04-0.5_10/19/2017
ET-SD-05-0.5		ET-SD-05-0.5_10/18/2017	10/18/2017	ET-SD-05-0.5_10/18/2017
ET-SD-07-0.5		ET-SD-07-0.5_10/18/2017	10/18/2017	ET-SD-07-0.5_10/18/2017
SCBR-SD-02-0.5		SCBR-SD-02-0.5_10/16/2017	10/16/2017	SCBR-SD-02-0.5_10/16/2017
SCPPE-SD-01-0.5		SCPPE-SD-01-0.5_10/17/2017	10/17/2017	SCPPE-SD-01-0.5_10/17/2017
SCPPE-SD-03-0.5		SCPPE-SD-03-0.5_10/17/2017	10/17/2017	SCPPE-SD-03-0.5_10/17/2017
SC-SD-02-0.5		SC-SD-02-0.5_10/16/2017	10/16/2017	SC-SD-02-0.5_10/16/2017
SC-SD-04-0.5		SC-SD-04-0.5_10/17/2017	10/17/2017	SC-SD-04-0.5_10/17/2017
SC-SD-06-0.5		SC-SD-06-0.5_10/17/2017	10/17/2017	SC-SD-06-0.5_10/17/2017
SC-SD-08-0.5		SC-SD-08-0.5_10/17/2017	10/17/2017	SC-SD-08-0.5_10/17/2017
SC-SD-21		SC-SD-21_12/18/2018	12/18/2018	SC-SD-21_12/18/2018
SC-SD-22-DUP	SC-SD-22	SC-SD-22_12/17/2018	12/17/2018	SC-SD-22-DUP_12/17/2018
SC-SD-22		SC-SD-22_12/17/2018	12/17/2018	SC-SD-22_12/17/2018
WT-SD-01-0.5		WT-SD-01-0.5_10/23/2017	10/23/2017	WT-SD-01-0.5_10/23/2017
WT-SD-01-0.5-D	WT-SD-01-0.5	WT-SD-01-0.5_10/23/2017	10/23/2017	WT-SD-01-0.5-D_10/23/2017
WT-SD-06-0.5		WT-SD-06-0.5_10/24/2017	10/24/2017	WT-SD-06-0.5_10/24/2017

Appendix A.
Samples Evaluated in the HHRA
Groundwater Samples

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Sample Code
GW-02-195		GW-02-195 04/10/2017	4/10/2017	GW-02-195 04/10/2017
GW-02		GW-02 12/19/2018	12/19/2018	GW-02 12/19/2018
GW-03		GW-03 09/19/2016	9/19/2016	GW-03 09/19/2016
GW-03		GW-03 12/19/2018	12/19/2018	GW-03 12/19/2018
GW-03-DUP	GW-03	GW-03 12/19/2018	12/19/2018	GW-03-DUP 12/19/2018
GW-04		GW-04 09/19/2016	9/19/2016	GW-04 09/19/2016
GW-04		GW-04 12/20/2018	12/20/2018	GW-04 12/20/2018
GW-05		GW-05 12/19/2018	12/19/2018	GW-05 12/19/2018
GW-06		GW-06 09/19/2016	9/19/2016	GW-06 09/19/2016
GW-06		GW-06 12/20/2018	12/20/2018	GW-06 12/20/2018
GW-07		GW-07 12/20/2018	12/20/2018	GW-07 12/20/2018
GW-07		GW-07 09/21/2016	9/21/2016	GW-07 09/21/2016
GW-08		GW-08 09/22/2016	9/22/2016	GW-08 09/22/2016
GW-08		GW-08 12/20/2018	12/20/2018	GW-08 12/20/2018
GW-08-D	GW-08	GW-08 09/22/2016	9/22/2016	GW-08-D 09/22/2016
GW-09		GW-09 09/21/2016	9/21/2016	GW-09 09/21/2016
GW-09		GW-09 12/20/2018	12/20/2018	GW-09 12/20/2018
GW-09-Cr6		GW-09-CR6 09/22/2016	9/22/2016	GW-09-CR6 09/22/2016
GW-10-D	GW-10	GW-10 09/22/2016	9/22/2016	GW-10-D 09/22/2016
GW-10		GW-10 09/22/2016	9/22/2016	GW-10 09/22/2016
GW-12		GW-12 09/21/2016	9/21/2016	GW-12 09/21/2016
GW-13-119		GW-13-119 09/22/2016	9/22/2016	GW-13-119 09/22/2016
GW-13-119		GW-13-119 12/19/2018	12/19/2018	GW-13-119 12/19/2018
GW-13-195		GW-13-195 04/10/2017	4/10/2017	GW-13-195 04/10/2017
GW-13-195		GW-13-195 12/19/2018	12/19/2018	GW-13-195 12/19/2018
GW-14		GW-14 09/22/2016	9/22/2016	GW-14 09/22/2016
GW-14		GW-14 12/19/2018	12/19/2018	GW-14 12/19/2018
GW-17		GW-17 09/21/2016	9/21/2016	GW-17 09/21/2016
GW-17		GW-17 12/20/2018	12/20/2018	GW-17 12/20/2018
MW-01		MW-01 12/18/2018	12/18/2018	MW-01 12/18/2018
MW-02		MW-02 12/18/2018	12/18/2018	MW-02 12/18/2018
MW-03		MW-03 12/18/2018	12/18/2018	MW-03 12/18/2018
MW-04		MW-04 12/18/2018	12/18/2018	MW-04 12/18/2018
MW-05		MW-05 12/18/2018	12/18/2018	MW-05 12/18/2018
MW-06		MW-06 12/17/2018	12/17/2018	MW-06 12/17/2018
PW-01		PW-01 04/11/2017	4/11/2017	PW-01 04/11/2017
PW-03		PW-03 04/12/2017	4/12/2017	PW-03 04/12/2017
PW-04		PW-04 04/13/2017	4/13/2017	PW-04 04/13/2017

Appendix A.
Samples Evaluated in the HHRA
Soil Gas

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Sample Code
0283 (LPA-SS-01-D)	0188 (LPA-SS-01)	0188 (LPA-SS-01)_ 09/21/2016	9/21/2016	0283 (LPA-SS-01-D)_ 09/21/2016
0188 (LPA-SS-01)		0188 (LPA-SS-01)_ 09/21/2016	9/21/2016	0188 (LPA-SS-01)_ 09/21/2016
H3439 (LPA-SS-02)		H3439 (LPA-SS-02)_ 09/21/2016	9/21/2016	H3439 (LPA-SS-02)_ 09/21/2016
0177 (LPA-SS-03)		0177 (LPA-SS-03)_ 09/21/2016	9/21/2016	0177 (LPA-SS-03)_ 09/21/2016
0166(WPA-CS-04)		0166(WPA-CS-04)_ 09/21/2016	9/21/2016	0166(WPA-CS-04)_ 09/21/2016

Appendix A.
Samples Evaluated in the HHRA
North Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
Surface Soil						
NTF-SB-104-0.5		NTF-SB-104-0.5_10/31/2017	10/31/2017	0.5	0.5	NTF-SB-104-0.5_10/31/2017
NTF-SB-104-2.0		NTF-SB-104-2.0_10/31/2017	10/31/2017	2	2	NTF-SB-104-2.0_10/31/2017
NTF-SB-105-2.0		NTF-SB-105-2.0_10/31/2017	10/31/2017	2	2	NTF-SB-105-2.0_10/31/2017
NTF-SB-105-0.5		NTF-SB-105-0.5_10/31/2017	10/31/2017	0.5	0.5	NTF-SB-105-0.5_10/31/2017
NTF-SB-106-0.5		NTF-SB-106-0.5_10/31/2017	10/31/2017	0.5	0.5	NTF-SB-106-0.5_10/31/2017
NTF-SB-106-2.0		NTF-SB-106-2.0_10/31/2017	10/31/2017	2	2	NTF-SB-106-2.0_10/31/2017
NTF-SB-107-2.0		NTF-SB-107-2.0_11/01/2017	11/1/2017	2	2	NTF-SB-107-2.0_11/01/2017
NTF-SB-107-0.5		NTF-SB-107-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB-107-0.5_11/01/2017
NTF-SB-108-0.5		NTF-SB-108-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB-108-0.5_11/01/2017
NTF-SB-132-0.5		NTF-SB-132-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB-132-0.5_11/01/2017
NTF-SB-132-2.0		NTF-SB-132-2.0_11/01/2017	11/1/2017	2	2	NTF-SB-132-2.0_11/01/2017
NTF-SB-133-2.0		NTF-SB-133-2.0_11/01/2017	11/1/2017	2	2	NTF-SB-133-2.0_11/01/2017
NTF-SB-133-0.5-D	NTF-SB-106-0.5	NTF-SB-133-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB-133-0.5-D_11/01/2017
NTF-SB-133-0.5		NTF-SB-133-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB-133-0.5_11/01/2017
NTF-SB-135-0-0.5		NTF-SB-135-0-0.5_03/06/2018	3/6/2018	0	0.5	NTF-SB-135-0-0.5_03/06/2018
NTF-SB-135-0.5-2.0		NTF-SB-135-0.5-2.0_03/06/2018	3/6/2018	0.5	2	NTF-SB-135-0.5-2.0_03/06/2018
NTF-SB-136-0-0.5		NTF-SB-136-0-0.5_03/06/2018	3/6/2018	0	0.5	NTF-SB-136-0-0.5_03/06/2018
NTF-SB-137-0.5-2.0		NTF-SB-137-0.5-2.0_03/05/2018	3/5/2018	0.5	2	NTF-SB-137-0.5-2.0_03/05/2018
NTF-SB-137-0-0.5		NTF-SB-137-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-137-0-0.5_03/05/2018
NTF-SB-138-0-0.5		NTF-SB-138-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-138-0-0.5_03/05/2018
NTF-SB-138-0.5-2.0		NTF-SB-138-0.5-2.0_03/05/2018	3/5/2018	0.5	2	NTF-SB-138-0.5-2.0_03/05/2018
NTF-SB-139-0-0.5		NTF-SB-139-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-139-0-0.5_03/05/2018
NTF-SB-139-0.5-2.0		NTF-SB-139-0.5-2.0_03/05/2018	3/5/2018	0.5	2	NTF-SB-139-0.5-2.0_03/05/2018
NTF-SB-140-0-0.5		NTF-SB-140-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-140-0-0.5_03/05/2018
NTF-SB-140-0.5-1.0		NTF-SB-140-0.5-1.0_03/05/2018	3/5/2018	0.5	1	NTF-SB-140-0.5-1.0_03/05/2018
NTF-SB-141-0-0.5		NTF-SB-141-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-141-0-0.5_03/05/2018
NTF-SB-142-0.5-2.0		NTF-SB-142-0.5-2.0_03/05/2018	3/5/2018	0.5	2	NTF-SB-142-0.5-2.0_03/05/2018
NTF-SB-142-0-0.5		NTF-SB-142-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-142-0-0.5_03/05/2018
NTF-SB-143-0.5-2.0		NTF-SB-143-0.5-2.0_03/05/2018	3/5/2018	0.5	2	NTF-SB-143-0.5-2.0_03/05/2018
NTF-SB-143-0-0.5		NTF-SB-143-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-143-0-0.5_03/05/2018
NTF-SB-144-0-0.5		NTF-SB-144-0-0.5_03/05/2018	3/5/2018	0	0.5	NTF-SB-144-0-0.5_03/05/2018
NTF-SB-145-0-0.5		NTF-SB-145-0-0.5_03/06/2018	3/6/2018	0	0.5	NTF-SB-145-0-0.5_03/06/2018
NTF-SB-145-0.5-2.0		NTF-SB-145-0.5-2.0_03/06/2018	3/6/2018	0.5	2	NTF-SB-145-0.5-2.0_03/06/2018
NTF-SB-150-0.5		NTF-SB-150-0.5_11/29/2018	11/29/2018	0.5	0.5	NTF-SB-150-0.5_11/29/2018
NTF-SB-150-2.0		NTF-SB-150-2.0_11/29/2018	11/29/2018	2	2	NTF-SB-150-2.0_11/29/2018
NTF-SB-151-2.0		NTF-SB-151-2.0_12/04/2018	12/4/2018	2	2	NTF-SB-151-2.0_12/04/2018
NTF-SB-151-2.0-DUP	NTF-SB-151-2.0	NTF-SB-151-2.0_12/04/2018	12/4/2018	2	2	NTF-SB-151-2.0-DUP_12/04/2018
NTF-SB-151-0.5		NTF-SB-151-0.5_12/04/2018	12/4/2018	0.5	0.5	NTF-SB-151-0.5_12/04/2018
NTF-SB-151-0.5-DUP	NTF-SB-151-0.5	NTF-SB-151-0.5_12/04/2018	12/4/2018	0.5	0.5	NTF-SB-151-0.5-DUP_12/04/2018
NTF-SB-152-2.0		NTF-SB-152-2.0_12/04/2018	12/4/2018	2	2	NTF-SB-152-2.0_12/04/2018
NTF-SB-152-0.5		NTF-SB-152-0.5_12/04/2018	12/4/2018	0.5	0.5	NTF-SB-152-0.5_12/04/2018
NTF-SB-152-2.0-DUP	NTF-SB-152-2.0	NTF-SB-152-2.0_12/04/2018	12/4/2018	2	2	NTF-SB-152-2.0-DUP_12/04/2018
NTF-SB-153-0.5		NTF-SB-153-0.5_12/04/2018	12/4/2018	0.5	0.5	NTF-SB-153-0.5_12/04/2018
NTF-SB-153-2.0		NTF-SB-153-2.0_12/04/2018	12/4/2018	2	2	NTF-SB-153-2.0_12/04/2018
NTF-SB-154-2.0		NTF-SB-154-2.0_12/04/2018	12/4/2018	2	2	NTF-SB-154-2.0_12/04/2018
NTF-SB-154-0.5		NTF-SB-154-0.5_12/04/2018	12/4/2018	0.5	0.5	NTF-SB-154-0.5_12/04/2018
NTF-SB56-01-1.5		NTF-SB56-01-1.5_11/08/2017	11/8/2017	1.5	1.5	NTF-SB56-01-1.5_11/08/2017
NTF-SB56-01-0.5		NTF-SB56-01-0.5_11/08/2017	11/8/2017	0.5	0.5	NTF-SB56-01-0.5_11/08/2017
NTF-SB57-01-2.0		NTF-SB57-01-2.0_11/08/2017	11/8/2017	2	2	NTF-SB57-01-2.0_11/08/2017
NTF-SB57-01-0.5		NTF-SB57-01-0.5_11/08/2017	11/8/2017	0.5	0.5	NTF-SB57-01-0.5_11/08/2017
NTF-SB58-01-2.0		NTF-SB58-01-2.0_11/08/2017	11/8/2017	2	2	NTF-SB58-01-2.0_11/08/2017
NTF-SB58-01-0.5		NTF-SB58-01-0.5_11/08/2017	11/8/2017	0.5	0.5	NTF-SB58-01-0.5_11/08/2017
NTF-SB67-03-0.5		NTF-SB67-03-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB67-03-0.5_11/01/2017
NTF-SB68-04-2.0		NTF-SB68-04-2.0_11/01/2017	11/1/2017	2	2	NTF-SB68-04-2.0_11/01/2017
NTF-SB68-04-0.5		NTF-SB68-04-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB68-04-0.5_11/01/2017
NTF-SB68-04-0.5-D	NTF-SB68-04-0.5	NTF-SB68-04-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB68-04-0.5-D_11/01/2017
NTF-SB69-07-0.5		NTF-SB69-07-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB69-07-0.5_11/01/2017
NTF-SB70-101-2.0		NTF-SB70-101-2.0_11/01/2017	11/1/2017	2	2	NTF-SB70-101-2.0_11/01/2017
NTF-SB70-101-0.5		NTF-SB70-101-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB70-101-0.5_11/01/2017
NTF-SB70-102-2.0		NTF-SB70-102-2.0_11/01/2017	11/1/2017	2	2	NTF-SB70-102-2.0_11/01/2017
NTF-SB70-102-0.5		NTF-SB70-102-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB70-102-0.5_11/01/2017
NTF-SB70-103-0.5		NTF-SB70-103-0.5_11/01/2017	11/1/2017	0.5	0.5	NTF-SB70-103-0.5_11/01/2017
NTF-SB70-103-2.0		NTF-SB70-103-2.0_11/01/2017	11/1/2017	2	2	NTF-SB70-103-2.0_11/01/2017
Subsurface Soil						
NTF-SB-104-4.0		NTF-SB-104-4.0_10/31/2017	10/31/2017	4	4	NTF-SB-104-4.0_10/31/2017
NTF-SB-105-3.0		NTF-SB-105-3.0_10/31/2017	10/31/2017	3	3	NTF-SB-105-3.0_10/31/2017
NTF-SB-106-10.0		NTF-SB-106-10.0_11/01/2017	11/1/2017	10	10	NTF-SB-106-10.0_11/01/2017
NTF-SB-106-6.0		NTF-SB-106-6.0_10/31/2017	10/31/2017	6	6	NTF-SB-106-6.0_10/31/2017
NTF-SB-107-6.0		NTF-SB-107-6.0_11/01/2017	11/1/2017	6	6	NTF-SB-107-6.0_11/01/2017
NTF-SB-107-6.0-D	NTF-SB-107-6.0	NTF-SB-107-6.0_11/01/2017	11/1/2017	6	6	NTF-SB-107-6.0-D_11/01/2017
NTF-SB-108-2.5		NTF-SB-108-2.5_11/01/2017	11/1/2017	2.5	2.5	NTF-SB-108-2.5_11/01/2017
LDA-SB-111-3.0		LDA-SB-111-3.0_10/31/2017	10/31/2017	3	3	LDA-SB-111-3.0_10/31/2017
NTF-SB-132-4.0		NTF-SB-132-4.0_11/01/2017	11/1/2017	4	4	NTF-SB-132-4.0_11/01/2017

Appendix A.
Samples Evaluated in the HHRA
North Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
NTF-SB-135-2.0-6.0		NTF-SB-135-2.0-6.0_03/06/2018	3/6/2018	6	6	NTF-SB-135-2.0-6.0_03/06/2018
NTF-SB-135-6.0-8.0		NTF-SB-135-6.0-8.0_03/06/2018	3/6/2018	6	8	NTF-SB-135-6.0-8.0_03/06/2018
NTF-SB-136-0.5-3.5-DUP	NTF-SB-136-0.5-3.5	NTF-SB-136-0.5-3.5_03/06/2018	3/6/2018	3.5	3.5	NTF-SB-136-0.5-3.5-DUP_03/06/2018
NTF-SB-136-0.5-3.5		NTF-SB-136-0.5-3.5_03/06/2018	3/6/2018	3.5	3.5	NTF-SB-136-0.5-3.5_03/06/2018
NTF-SB-137-2.0-6.0		NTF-SB-137-2.0-6.0_03/05/2018	3/5/2018	2	6	NTF-SB-137-2.0-6.0_03/05/2018
NTF-SB-137-2.0-6.0-DUP	NTF-SB-137-2.0-6.0	NTF-SB-137-2.0-6.0_03/05/2018	3/5/2018	2	6	NTF-SB-137-2.0-6.0-DUP_03/05/2018
NTF-SB-138-2.0-6.0		NTF-SB-138-2.0-6.0_03/05/2018	3/5/2018	2	6	NTF-SB-138-2.0-6.0_03/05/2018
NTF-SB-138-2.0-6.0-DUP	NTF-SB-138-2.0-6.0	NTF-SB-138-2.0-6.0_03/05/2018	3/5/2018	2	6	NTF-SB-138-2.0-6.0-DUP_03/05/2018
NTF-SB-138-6.0-10.0		NTF-SB-138-6.0-10.0_03/05/2018	3/5/2018	6	10	NTF-SB-138-6.0-10.0_03/05/2018
NTF-SB-139-2.0-6.5		NTF-SB-139-2.0-6.5_03/05/2018	3/5/2018	6.5	6.5	NTF-SB-139-2.0-6.5_03/05/2018
NTF-SB-142-2.0-6.5		NTF-SB-142-2.0-6.5_03/05/2018	3/5/2018	6.5	6.5	NTF-SB-142-2.0-6.5_03/05/2018
NTF-SB-142-2.0-6.5-DUP	NTF-SB-142-2.0-6.5	NTF-SB-142-2.0-6.5_03/05/2018	3/5/2018	2	6.5	NTF-SB-142-2.0-6.5-DUP_03/05/2018
NTF-SB-143-2.0-6.0		NTF-SB-143-2.0-6.0_03/05/2018	3/5/2018	2	6	NTF-SB-143-2.0-6.0_03/05/2018
NTF-SB-143-6.0-10.0		NTF-SB-143-6.0-10.0_03/05/2018	3/5/2018	6	10	NTF-SB-143-6.0-10.0_03/05/2018
NTF-SB-145-2.0-6.0		NTF-SB-145-2.0-6.0_03/06/2018	3/6/2018	2	6	NTF-SB-145-2.0-6.0_03/06/2018
NTF-SB-145-6.0-10.0		NTF-SB-145-6.0-10.0_03/06/2018	3/6/2018	6	10	NTF-SB-145-6.0-10.0_03/06/2018
NTF-SB-150-4.5		NTF-SB-150-4.5_11/29/2018	11/29/2018	4.5	4.5	NTF-SB-150-4.5_11/29/2018
NTF-SB67-03-2.5		NTF-SB67-03-2.5_11/01/2017	11/1/2017	2.5	2.5	NTF-SB67-03-2.5_11/01/2017
NTF-SB67-03-2.5-D		NTF-SB67-03-2.5-D_11/01/2017	11/1/2017	2.5	2.5	NTF-SB67-03-2.5-D_11/01/2017
NTF-SB68-04-3.5		NTF-SB68-04-3.5_11/01/2017	11/1/2017	3.5	3.5	NTF-SB68-04-3.5_11/01/2017
NTF-SB69-07-2.5		NTF-SB69-07-2.5_11/01/2017	11/1/2017	2.5	2.5	NTF-SB69-07-2.5_11/01/2017
NTF-SB70-102-3.5		NTF-SB70-102-3.5_11/01/2017	11/1/2017	3.5	3.5	NTF-SB70-102-3.5_11/01/2017
NTF-SB70-103-5.0-D	NTF-SB70-103-5.0	NTF-SB70-103-5.0_11/01/2017	11/1/2017	5	5	NTF-SB70-103-5.0-D_11/01/2017
NTF-SB70-103-5.0		NTF-SB70-103-5.0_11/01/2017	11/1/2017	5	5	NTF-SB70-103-5.0_11/01/2017

Appendix A.
Samples Evaluated in the HHRA
Lorraine Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
Surface Soil						
LPA-SB-01-0.5		LPA-SB-01-0.5_10/25/2016	10/25/2016	0.5	0.5	LPA-SB-01-0.5_10/25/2016
LPA-SB-01-2.0		LPA-SB-01-2.0_10/25/2016	10/25/2016	2	2	LPA-SB-01-2.0_10/25/2016
LPA-SB-02-0.5		LPA-SB-02-0.5_04/10/2017	4/10/2017	0.5	0.5	LPA-SB-02-0.5_04/10/2017
LPA-SB-02-2.0		LPA-SB-02-2.0_04/10/2017	4/10/2017	2	2	LPA-SB-02-2.0_04/10/2017
LPA-SB-03-2.0		LPA-SB-03-2.0_04/10/2017	4/10/2017	2	2	LPA-SB-03-2.0_04/10/2017
LPA-SB-03-0.5		LPA-SB-03-0.5_04/10/2017	4/10/2017	0.5	0.5	LPA-SB-03-0.5_04/10/2017
LPA-SB-04-0.5		LPA-SB-04-0.5_10/25/2016	10/25/2016	0.5	0.5	LPA-SB-04-0.5_10/25/2016
LPA-SB-04-2.0		LPA-SB-04-2.0_10/25/2016	10/25/2016	2	2	LPA-SB-04-2.0_10/25/2016
LPA-SB-05-2.0		LPA-SB-05-2.0_10/24/2016	10/24/2016	2	2	LPA-SB-05-2.0_10/24/2016
LPA-SB-05-0.5		LPA-SB-05-0.5_10/24/2016	10/24/2016	0.5	0.5	LPA-SB-05-0.5_10/24/2016
LPA-SB-06-0.5		LPA-SB-06-0.5_10/24/2016	10/24/2016	0.5	0.5	LPA-SB-06-0.5_10/24/2016
LPA-SB-06-2.0		LPA-SB-06-2.0_10/24/2016	10/24/2016	2	2	LPA-SB-06-2.0_10/24/2016
LPA-SB-07-2.0		LPA-SB-07-2.0_10/25/2016	10/25/2016	2	2	LPA-SB-07-2.0_10/25/2016
LPA-SB-07-0.5		LPA-SB-07-0.5_10/25/2016	10/25/2016	0.5	0.5	LPA-SB-07-0.5_10/25/2016
LPA-SB-08-2.0		LPA-SB-08-2.0_10/25/2016	10/25/2016	2	2	LPA-SB-08-2.0_10/25/2016
LPA-SB-08-0.5		LPA-SB-08-0.5_10/25/2016	10/25/2016	0.5	0.5	LPA-SB-08-0.5_10/25/2016
LPA-SB-09-2.0		LPA-SB-09-2.0_04/10/2017	4/10/2017	2	2	LPA-SB-09-2.0_04/10/2017
LPA-SB-09-0.5		LPA-SB-09-0.5_04/10/2017	4/10/2017	0.5	0.5	LPA-SB-09-0.5_04/10/2017
LPA-SB-10-2.0		LPA-SB-10-2.0_10/26/2016	10/26/2016	2	2	LPA-SB-10-2.0_10/26/2016
LPA-SB-10-0.5		LPA-SB-10-0.5_10/26/2016	10/26/2016	0.5	0.5	LPA-SB-10-0.5_10/26/2016
LPA-SB-11-0.5		LPA-SB-11-0.5_10/26/2016	10/26/2016	0.5	0.5	LPA-SB-11-0.5_10/26/2016
LPA-SB-11-2.0		LPA-SB-11-2.0_10/26/2016	10/26/2016	2	2	LPA-SB-11-2.0_10/26/2016
LPA-SB-12-0.5		LPA-SB-12-0.5_04/11/2017	4/11/2017	0.5	0.5	LPA-SB-12-0.5_04/11/2017
LPA-SB-12-2.0		LPA-SB-12-2.0_04/11/2017	4/11/2017	2	2	LPA-SB-12-2.0_04/11/2017
LPA-SB-13-2.0		LPA-SB-13-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-13-2.0_04/13/2017
LPA-SB-13-0.5		LPA-SB-13-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-13-0.5_04/13/2017
LPA-SB-14-2.0		LPA-SB-14-2.0_10/24/2016	10/24/2016	2	2	LPA-SB-14-2.0_10/24/2016
LPA-SB-14-0.5		LPA-SB-14-0.5_10/24/2016	10/24/2016	0.5	0.5	LPA-SB-14-0.5_10/24/2016
LPA-SB-15-0.5		LPA-SB-15-0.5_10/25/2016	10/25/2016	0.5	0.5	LPA-SB-15-0.5_10/25/2016
LPA-SB-15-2.0		LPA-SB-15-2.0_10/25/2016	10/25/2016	2	2	LPA-SB-15-2.0_10/25/2016
LPA-SB-16-2.0		LPA-SB-16-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-16-2.0_04/13/2017
LPA-SB-16-0.5		LPA-SB-16-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-16-0.5_04/13/2017
LPA-SB-17-2.0-D	LPA-SB-17-2.0	LPA-SB-17-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-17-2.0-D_04/13/2017
LPA-SB-17-0.5		LPA-SB-17-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-17-0.5_04/13/2017
LPA-SB-17-2.0		LPA-SB-17-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-17-2.0_04/13/2017
LPA-SB-18-0.5		LPA-SB-18-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-18-0.5_04/13/2017
LPA-SB-18-0.5-D	LPA-SB-18-0.5	LPA-SB-18-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-18-0.5-D_04/13/2017
LPA-SB-18-2.0		LPA-SB-18-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-18-2.0_04/13/2017
LPA-SB-19-0.5		LPA-SB-19-0.5_10/26/2016	10/26/2016	0.5	0.5	LPA-SB-19-0.5_10/26/2016
LPA-SB-19-2.0		LPA-SB-19-2.0_10/26/2016	10/26/2016	2	2	LPA-SB-19-2.0_10/26/2016
LPA-SB-20-0.5		LPA-SB-20-0.5_10/25/2016	10/25/2016	0.5	0.5	LPA-SB-20-0.5_10/25/2016
LPA-SB-20-2.0		LPA-SB-20-2.0_10/25/2016	10/25/2016	2	2	LPA-SB-20-2.0_10/25/2016
LPA-SB-21-0.5		LPA-SB-21-0.5_04/17/2017	4/17/2017	0.5	0.5	LPA-SB-21-0.5_04/17/2017
LPA-SB-21-2.0		LPA-SB-21-2.0_04/17/2017	4/17/2017	2	2	LPA-SB-21-2.0_04/17/2017
LPA-SB-22-2.0		LPA-SB-22-2.0_04/18/2017	4/18/2017	2	2	LPA-SB-22-2.0_04/18/2017
LPA-SB-22-0.5		LPA-SB-22-0.5_04/18/2017	4/18/2017	0.5	0.5	LPA-SB-22-0.5_04/18/2017
LPA-SB-23-0.5		LPA-SB-23-0.5_10/27/2016	10/27/2016	0.5	0.5	LPA-SB-23-0.5_10/27/2016
LPA-SB-23-2.0		LPA-SB-23-2.0_10/27/2016	10/27/2016	2	2	LPA-SB-23-2.0_10/27/2016
LPA-SB-24-0.5		LPA-SB-24-0.5_04/17/2017	4/17/2017	0.5	0.5	LPA-SB-24-0.5_04/17/2017
LPA-SB-24-2.0		LPA-SB-24-2.0_04/17/2017	4/17/2017	2	2	LPA-SB-24-2.0_04/17/2017
LPA-SB-25-0.5		LPA-SB-25-0.5_04/18/2017	4/18/2017	0.5	0.5	LPA-SB-25-0.5_04/18/2017
LPA-SB-25-2.0		LPA-SB-25-2.0_04/18/2017	4/18/2017	2	2	LPA-SB-25-2.0_04/18/2017
LPA-SB-26-0.5		LPA-SB-26-0.5_10/27/2016	10/27/2016	0.5	0.5	LPA-SB-26-0.5_10/27/2016
LPA-SB-26-2.0		LPA-SB-26-2.0_10/27/2016	10/27/2016	2	2	LPA-SB-26-2.0_10/27/2016
LPA-SB-27-0.5		LPA-SB-27-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-27-0.5_04/13/2017
LPA-SB-27-2.0		LPA-SB-27-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-27-2.0_04/13/2017
LPA-SB-27-2.0-D	LPA-SB-27-2.0	LPA-SB-27-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-27-2.0-D_04/13/2017
LPA-SB-28-0.5		LPA-SB-28-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-28-0.5_04/13/2017
LPA-SB-28-0.5-D	LPA-SB-28-0.5	LPA-SB-28-0.5_04/13/2017	4/13/2017	0.5	0.5	LPA-SB-28-0.5-D_04/13/2017
LPA-SB-28-2.0		LPA-SB-28-2.0_04/13/2017	4/13/2017	2	2	LPA-SB-28-2.0_04/13/2017
LPA-SB-29-2.0		LPA-SB-29-2.0_04/17/2017	4/17/2017	2	2	LPA-SB-29-2.0_04/17/2017
LPA-SB-29-0.5		LPA-SB-29-0.5_04/17/2017	4/17/2017	0.5	0.5	LPA-SB-29-0.5_04/17/2017

Appendix A.
Samples Evaluated in the HHRA
Lorraine Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
LPA-SB-30-2.0		LPA-SB-30-2.0_10/26/2016	10/26/2016	2	2	LPA-SB-30-2.0_10/26/2016
LPA-SB-30-0.5		LPA-SB-30-0.5_10/26/2016	10/26/2016	0.5	0.5	LPA-SB-30-0.5_10/26/2016
LPA-SB-30-0.5-D	LPA-SB-30-0.5	LPA-SB-30-0.5_10/26/2016	10/26/2016	0.5	0.5	LPA-SB-30-0.5-D_10/26/2016
LPA-SB-41-0.5		LPA-SB-41-0.5_11/29/2018	11/29/2018	0.5	0.5	LPA-SB-41-0.5_11/29/2018
LPA-SB-41-2.0		LPA-SB-41-2.0_11/29/2018	11/29/2018	2	2	LPA-SB-41-2.0_11/29/2018
LPA-SB-42-0.5		LPA-SB-42-0.5_11/30/2018	11/30/2018	0.5	0.5	LPA-SB-42-0.5_11/30/2018
LPA-SB-42-2.0		LPA-SB-42-2.0_11/30/2018	11/30/2018	2	2	LPA-SB-42-2.0_11/30/2018
LPA-SB-43-0.5		LPA-SB-43-0.5_11/30/2018	11/30/2018	0.5	0.5	LPA-SB-43-0.5_11/30/2018
LPA-SB-43-2.0		LPA-SB-43-2.0_11/30/2018	11/30/2018	2	2	LPA-SB-43-2.0_11/30/2018
Subsurface Soil						
LPA-SB-01-6.0		LPA-SB-01-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-01-6.0_10/25/2016
LPA-SB-01-6.0-D	LPA-SB-01-6.0	LPA-SB-01-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-01-6.0-D_10/25/2016
LPA-SB-02-6.0		LPA-SB-02-6.0_04/10/2017	4/10/2017	6	6	LPA-SB-02-6.0_04/10/2017
LPA-SB-02-10.0		LPA-SB-02-10.0_04/10/2017	4/10/2017	10	10	LPA-SB-02-10.0_04/10/2017
LPA-SB-02-14.0		LPA-SB-02-14.0_04/10/2017	4/10/2017	14	14	LPA-SB-02-14.0_04/10/2017
LPA-SB-03-10.0		LPA-SB-03-10.0_04/10/2017	4/10/2017	10	10	LPA-SB-03-10.0_04/10/2017
LPA-SB-03-15.0		LPA-SB-03-15.0_04/10/2017	4/10/2017	15	15	LPA-SB-03-15.0_04/10/2017
LPA-SB-03-6.0		LPA-SB-03-6.0_04/10/2017	4/10/2017	6	6	LPA-SB-03-6.0_04/10/2017
LPA-SB-04-15.0		LPA-SB-04-15.0_10/25/2016	10/25/2016	15	15	LPA-SB-04-15.0_10/25/2016
LPA-SB-04-6.0		LPA-SB-04-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-04-6.0_10/25/2016
LPA-SB-04-6.0-D	LPA-SB-04-6.0	LPA-SB-04-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-04-6.0-D_10/25/2016
LPA-SB-04-10.0		LPA-SB-04-10.0_10/25/2016	10/25/2016	10	10	LPA-SB-04-10.0_10/25/2016
LPA-SB-05-10.0		LPA-SB-05-10.0_10/24/2016	10/24/2016	10	10	LPA-SB-05-10.0_10/24/2016
LPA-SB-05-6.0		LPA-SB-05-6.0_10/24/2016	10/24/2016	6	6	LPA-SB-05-6.0_10/24/2016
LPA-SB-05-10.0-D	LPA-SB-05-10.0	LPA-SB-05-10.0_10/24/2016	10/24/2016	10	10	LPA-SB-05-10.0-D_10/24/2016
LPA-SB-06-6.0-D	LPA-SB-06-6.0	LPA-SB-06-6.0_10/24/2016	10/24/2016	6	6	LPA-SB-06-6.0-D_10/24/2016
LPA-SB-06-6.0		LPA-SB-06-6.0_10/24/2016	10/24/2016	6	6	LPA-SB-06-6.0_10/24/2016
LPA-SB-07-10.0		LPA-SB-07-10.0_10/25/2016	10/25/2016	10	10	LPA-SB-07-10.0_10/25/2016
LPA-SB-07-6.0-D	LPA-SB-07-6.0	LPA-SB-07-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-07-6.0-D_10/25/2016
LPA-SB-07-6.0		LPA-SB-07-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-07-6.0_10/25/2016
LPA-SB-07-12.0		LPA-SB-07-12.0_10/25/2016	10/25/2016	12	12	LPA-SB-07-12.0_10/25/2016
LPA-SB-08-10.0		LPA-SB-08-10.0_10/25/2016	10/25/2016	10	10	LPA-SB-08-10.0_10/25/2016
LPA-SB-08-6.0		LPA-SB-08-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-08-6.0_10/25/2016
LPA-SB-09-12.0		LPA-SB-09-12.0_04/10/2017	4/10/2017	12	12	LPA-SB-09-12.0_04/10/2017
LPA-SB-09-15.0		LPA-SB-09-15.0_04/10/2017	4/10/2017	15	15	LPA-SB-09-15.0_04/10/2017
LPA-SB-09-6.0		LPA-SB-09-6.0_04/10/2017	4/10/2017	6	6	LPA-SB-09-6.0_04/10/2017
LPA-SB-09-10.0		LPA-SB-09-10.0_04/10/2017	4/10/2017	10	10	LPA-SB-09-10.0_04/10/2017
LPA-SB-10-6.0		LPA-SB-10-6.0_10/26/2016	10/26/2016	6	6	LPA-SB-10-6.0_10/26/2016
LPA-SB-10-10.0		LPA-SB-10-10.0_10/26/2016	10/26/2016	10	10	LPA-SB-10-10.0_10/26/2016
LPA-SB-12-6.0-D	LPA-SB-12-6.0	LPA-SB-12-6.0_04/11/2017	4/11/2017	6	6	LPA-SB-12-6.0-D_04/11/2017
LPA-SB-12-6.0		LPA-SB-12-6.0_04/11/2017	4/11/2017	6	6	LPA-SB-12-6.0_04/11/2017
LPA-SB-12-12.5-D	LPA-SB-12-12.5	LPA-SB-12-12.5_04/11/2017	4/11/2017	12.5	12.5	LPA-SB-12-12.5-D_04/11/2017
LPA-SB-12-12.5		LPA-SB-12-12.5_04/11/2017	4/11/2017	12.5	12.5	LPA-SB-12-12.5_04/11/2017
LPA-SB-12-10.0		LPA-SB-12-10.0_04/11/2017	4/11/2017	10	10	LPA-SB-12-10.0_04/11/2017
LPA-SB-13-14.0		LPA-SB-13-14.0_04/13/2017	4/13/2017	14	14	LPA-SB-13-14.0_04/13/2017
LPA-SB-13-10.0-D	LPA-SB-13-10.0	LPA-SB-13-10.0_04/13/2017	4/13/2017	10	10	LPA-SB-13-10.0-D_04/13/2017
LPA-SB-13-10.0		LPA-SB-13-10.0_04/13/2017	4/13/2017	10	10	LPA-SB-13-10.0_04/13/2017
LPA-SB-13-6.0		LPA-SB-13-6.0_04/13/2017	4/13/2017	6	6	LPA-SB-13-6.0_04/13/2017
LPA-SB-14-6.0		LPA-SB-14-6.0_10/24/2016	10/24/2016	6	6	LPA-SB-14-6.0_10/24/2016
LPA-SB-14-14.0		LPA-SB-14-14.0_10/24/2016	10/24/2016	14	14	LPA-SB-14-14.0_10/24/2016
LPA-SB-14-10.0		LPA-SB-14-10.0_10/24/2016	10/24/2016	10	10	LPA-SB-14-10.0_10/24/2016
LPA-SB-15-6.0-D	LPA-SB-15-6.0	LPA-SB-15-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-15-6.0-D_10/25/2016
LPA-SB-15-10.0		LPA-SB-15-10.0_10/25/2016	10/25/2016	10	10	LPA-SB-15-10.0_10/25/2016
LPA-SB-15-6.0		LPA-SB-15-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-15-6.0_10/25/2016
LPA-SB-16-6.0		LPA-SB-16-6.0_04/13/2017	4/13/2017	6	6	LPA-SB-16-6.0_04/13/2017
LPA-SB-16-10.0		LPA-SB-16-10.0_04/13/2017	4/13/2017	10	10	LPA-SB-16-10.0_04/13/2017
LPA-SB-17-8.0		LPA-SB-17-8.0_04/13/2017	4/13/2017	8	8	LPA-SB-17-8.0_04/13/2017
LPA-SB-17-6.0		LPA-SB-17-6.0_04/13/2017	4/13/2017	6	6	LPA-SB-17-6.0_04/13/2017
LPA-SB-18-6.0		LPA-SB-18-6.0_04/13/2017	4/13/2017	6	6	LPA-SB-18-6.0_04/13/2017
LPA-SB-18-10.0		LPA-SB-18-10.0_04/13/2017	4/13/2017	10	10	LPA-SB-18-10.0_04/13/2017
LPA-SB-19-10.0		LPA-SB-19-10.0_10/26/2016	10/26/2016	10	10	LPA-SB-19-10.0_10/26/2016
LPA-SB-19-12.5		LPA-SB-19-12.5_10/26/2016	10/26/2016	12.5	12.5	LPA-SB-19-12.5_10/26/2016
LPA-SB-19-6.0		LPA-SB-19-6.0_10/26/2016	10/26/2016	6	6	LPA-SB-19-6.0_10/26/2016

Appendix A.
Samples Evaluated in the HHRA
Lorraine Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
LPA-SB-20-6.0		LPA-SB-20-6.0_10/25/2016	10/25/2016	6	6	LPA-SB-20-6.0_10/25/2016
LPA-SB-21-8.5		LPA-SB-21-8.5_04/17/2017	4/17/2017	8.5	8.5	LPA-SB-21-8.5_04/17/2017
LPA-SB-21-6.0		LPA-SB-21-6.0_04/17/2017	4/17/2017	6	6	LPA-SB-21-6.0_04/17/2017
LPA-SB-22-6.0		LPA-SB-22-6.0_04/18/2017	4/18/2017	6	6	LPA-SB-22-6.0_04/18/2017
LPA-SB-22-10.0		LPA-SB-22-10.0_04/18/2017	4/18/2017	10	10	LPA-SB-22-10.0_04/18/2017
LPA-SB-23-10.0		LPA-SB-23-10.0_10/27/2016	10/27/2016	10	10	LPA-SB-23-10.0_10/27/2016
LPA-SB-23-6.0		LPA-SB-23-6.0_10/27/2016	10/27/2016	6	6	LPA-SB-23-6.0_10/27/2016
LPA-SB-24-6.0		LPA-SB-24-6.0_04/17/2017	4/17/2017	6	6	LPA-SB-24-6.0_04/17/2017
LPA-SB-24-10.0		LPA-SB-24-10.0_04/17/2017	4/17/2017	10	10	LPA-SB-24-10.0_04/17/2017
LPA-SB-24-10.0-D	LPA-SB-24-10.0	LPA-SB-24-10.0_04/17/2017	4/17/2017	10	10	LPA-SB-24-10.0-D_04/17/2017
LPA-SB-25-6.0		LPA-SB-25-6.0_04/18/2017	4/18/2017	6	6	LPA-SB-25-6.0_04/18/2017
LPA-SB-25-15.0		LPA-SB-25-15.0_04/18/2017	4/18/2017	15	15	LPA-SB-25-15.0_04/18/2017
LPA-SB-25-10.0		LPA-SB-25-10.0_04/18/2017	4/18/2017	10	10	LPA-SB-25-10.0_04/18/2017
LPA-SB-26-6.0		LPA-SB-26-6.0_10/27/2016	10/27/2016	6	6	LPA-SB-26-6.0_10/27/2016
LPA-SB-26-10.0		LPA-SB-26-10.0_10/27/2016	10/27/2016	10	10	LPA-SB-26-10.0_10/27/2016
LPA-SB-26-6.0-D	LPA-SB-26-6.0	LPA-SB-26-6.0_10/27/2016	10/27/2016	6	6	LPA-SB-26-6.0-D_10/27/2016
LPA-SB-27-10.0		LPA-SB-27-10.0_04/13/2017	4/13/2017	10	10	LPA-SB-27-10.0_04/13/2017
LPA-SB-27-13.0		LPA-SB-27-13.0_04/13/2017	4/13/2017	13	13	LPA-SB-27-13.0_04/13/2017
LPA-SB-27-6.0		LPA-SB-27-6.0_04/13/2017	4/13/2017	6	6	LPA-SB-27-6.0_04/13/2017
LPA-SB-28-6.5		LPA-SB-28-6.5_04/13/2017	4/13/2017	6.5	6.5	LPA-SB-28-6.5_04/13/2017
LPA-SB-28-6.0		LPA-SB-28-6.0_04/13/2017	4/13/2017	6	6	LPA-SB-28-6.0_04/13/2017
LPA-SB-29-6.0		LPA-SB-29-6.0_04/17/2017	4/17/2017	6	6	LPA-SB-29-6.0_04/17/2017
LPA-SB-29-10.0		LPA-SB-29-10.0_04/17/2017	4/17/2017	10	10	LPA-SB-29-10.0_04/17/2017
LPA-SB-30-10.0		LPA-SB-30-10.0_10/26/2016	10/26/2016	10	10	LPA-SB-30-10.0_10/26/2016
LPA-SB-30-6.0		LPA-SB-30-6.0_10/26/2016	10/26/2016	6	6	LPA-SB-30-6.0_10/26/2016
LPA-SB-41-10.0		LPA-SB-41-10.0_11/29/2018	11/29/2018	10	10	LPA-SB-41-10.0_11/29/2018
LPA-SB-41-6.0		LPA-SB-41-6.0_11/29/2018	11/29/2018	6	6	LPA-SB-41-6.0_11/29/2018
LPA-SB-42-14.0		LPA-SB-42-14.0_11/30/2018	11/30/2018	14	14	LPA-SB-42-14.0_11/30/2018
LPA-SB-42-6.0		LPA-SB-42-6.0_11/30/2018	11/30/2018	6	6	LPA-SB-42-6.0_11/30/2018
LPA-SB-42-10.0		LPA-SB-42-10.0_11/30/2018	11/30/2018	10	10	LPA-SB-42-10.0_11/30/2018
LPA-SB-43-10.0		LPA-SB-43-10.0_11/30/2018	11/30/2018	10	10	LPA-SB-43-10.0_11/30/2018
LPA-SB-43-13.0		LPA-SB-43-13.0_11/30/2018	11/30/2018	13	13	LPA-SB-43-13.0_11/30/2018
LPA-SB-43-6.0		LPA-SB-43-6.0_11/30/2018	11/30/2018	6	6	LPA-SB-43-6.0_11/30/2018
MW-03-SB-12		MW-03-SB-12_11/29/2018	11/29/2018	12	12	MW-03-SB-12_11/29/2018
LPA-SB-02-18.0		LPA-SB-02-18.0_04/10/2017	4/10/2017	18	18	LPA-SB-02-18.0_04/10/2017
LPA-SB-08-17.5		LPA-SB-08-17.5_10/25/2016	10/25/2016	17.5	17.5	LPA-SB-08-17.5_10/25/2016
LPA-SB-15-18.0		LPA-SB-15-18.0_10/25/2016	10/25/2016	18	18	LPA-SB-15-18.0_10/25/2016
LPA-SB-18-17.0		LPA-SB-18-17.0_04/13/2017	4/13/2017	17	17	LPA-SB-18-17.0_04/13/2017
LPA-SB-22-18.0		LPA-SB-22-18.0_04/18/2017	4/18/2017	18	18	LPA-SB-22-18.0_04/18/2017
LPA-SB-23-28.5		LPA-SB-23-28.5_10/27/2016	10/27/2016	28.5	28.5	LPA-SB-23-28.5_10/27/2016
LPA-SB-24-20.0		LPA-SB-24-20.0_04/17/2017	4/17/2017	20	20	LPA-SB-24-20.0_04/17/2017
LPA-SB-26-17.5		LPA-SB-26-17.5_10/27/2016	10/27/2016	17.5	17.5	LPA-SB-26-17.5_10/27/2016
LPA-SB-29-16.5		LPA-SB-29-16.5_04/17/2017	4/17/2017	16.5	16.5	LPA-SB-29-16.5_04/17/2017
LPA-SB-30-17.0		LPA-SB-30-17.0_10/26/2016	10/26/2016	17	17	LPA-SB-30-17.0_10/26/2016
LPA-SB-41-16		LPA-SB-41-16_11/29/2018	11/29/2018	16	16	LPA-SB-41-16_11/29/2018
MW-01-SB-17-DUP	MW-01-SB-17	MW-01-SB-17_11/26/2018	11/26/2018	17	17	MW-01-SB-17-DUP_11/26/2018
MW-01-SB-17		MW-01-SB-17_11/26/2018	11/26/2018	17	17	MW-01-SB-17_11/26/2018
MW-02-SB-16		MW-02-SB-16_11/26/2018	11/26/2018	16	16	MW-02-SB-16_11/26/2018

Appendix A.
Samples Evaluated in the HHRA
Loading Dock Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
Surface Soil						
LDA-SB-109-2.0		LDA-SB-109-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-109-2.0 10/31/2017
LDA-SB-109-0.5		LDA-SB-109-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-109-0.5 10/31/2017
LDA-SB-110-0.5		LDA-SB-110-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-110-0.5 10/31/2017
LDA-SB-110-0.5-D	LDA-SB-110-0.5	LDA-SB-110-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-110-0.5-D 10/31/2017
LDA-SB-110-2.0		LDA-SB-110-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-110-2.0 10/31/2017
LDA-SB-110-2.0-D	LDA-SB-110-2.0	LDA-SB-110-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-110-2.0-D 10/31/2017
LDA-SB-111-0.5		LDA-SB-111-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-111-0.5 10/31/2017
LDA-SB-111-2.0		LDA-SB-111-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-111-2.0 10/31/2017
LDA-SB-112-0.5		LDA-SB-112-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-112-0.5 10/31/2017
LDA-SB-112-2.0		LDA-SB-112-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-112-2.0 10/31/2017
LDA-SB-134-2.0		LDA-SB-134-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-134-2.0 10/31/2017
LDA-SB-134-0.5		LDA-SB-134-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-134-0.5 10/31/2017
LDA-SB-135-0.5		LDA-SB-135-0.5 10/31/2017	10/31/2017	0.5	0.5	LDA-SB-135-0.5 10/31/2017
LDA-SB-135-2.0		LDA-SB-135-2.0 10/31/2017	10/31/2017	2	2	LDA-SB-135-2.0 10/31/2017
LDA-SB-141-0.5		LDA-SB-141-0.5 12/04/2018	12/4/2018	0.5	0.5	LDA-SB-141-0.5 12/04/2018
LDA-SB-141-2.0		LDA-SB-141-2.0 12/04/2018	12/4/2018	2	2	LDA-SB-141-2.0 12/04/2018
LDA-SB-142-0.5		LDA-SB-142-0.5 12/04/2018	12/4/2018	0.5	0.5	LDA-SB-142-0.5 12/04/2018
LDA-SB-142-2.0		LDA-SB-142-2.0 12/04/2018	12/4/2018	2	2	LDA-SB-142-2.0 12/04/2018
LDA-SB-143-0.5		LDA-SB-143-0.5 12/04/2018	12/4/2018	0.5	0.5	LDA-SB-143-0.5 12/04/2018
LDA-SB-143-2.0		LDA-SB-143-2.0 12/04/2018	12/4/2018	2	2	LDA-SB-143-2.0 12/04/2018
LDA-SB-144-2.0		LDA-SB-144-2.0 12/04/2018	12/4/2018	2	2	LDA-SB-144-2.0 12/04/2018
LDA-SB-144-0.5		LDA-SB-144-0.5 12/04/2018	12/4/2018	0.5	0.5	LDA-SB-144-0.5 12/04/2018
Subsurface Soil						
LDA-SB-109-4.5		LDA-SB-109-4.5 10/31/2017	10/31/2017	4.5	4.5	LDA-SB-109-4.5 10/31/2017
LDA-SB-111-3.0-D	LDA-SB-111-3.0	LDA-SB-111-3.0-D 10/31/2017	10/31/2017	3	3	LDA-SB-111-3.0-D 10/31/2017
LDA-SB-112-4.5		LDA-SB-112-4.5 10/31/2017	10/31/2017	4.5	4.5	LDA-SB-112-4.5 10/31/2017
LDA-SB-135-3.0		LDA-SB-135-3.0 10/31/2017	10/31/2017	3	3	LDA-SB-135-3.0 10/31/2017

Appendix A.
Samples Evaluated in the HHRA
Wilcox Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
Surface Soil						
WPA-SB-01-2.0		WPA-SB-01-2.0_04/17/2017	4/17/2017	2	2	WPA-SB-01-2.0_04/17/2017
WPA-SB-01-0.5		WPA-SB-01-0.5_04/17/2017	4/17/2017	0.5	0.5	WPA-SB-01-0.5_04/17/2017
WPA-SB-02-0.5		WPA-SB-02-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-02-0.5_04/18/2017
WPA-SB-02-2.0		WPA-SB-02-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-02-2.0_04/18/2017
WPA-SB-03-2.0		WPA-SB-03-2.0_04/13/2017	4/13/2017	2	2	WPA-SB-03-2.0_04/13/2017
WPA-SB-03-0.5		WPA-SB-03-0.5_04/13/2017	4/13/2017	0.5	0.5	WPA-SB-03-0.5_04/13/2017
WPA-SB-04-0.5		WPA-SB-04-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-04-0.5_04/20/2017
WPA-SB-04-2.0		WPA-SB-04-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-04-2.0_04/20/2017
WPA-SB-05-2.0		WPA-SB-05-2.0_04/24/2017	4/24/2017	2	2	WPA-SB-05-2.0_04/24/2017
WPA-SB-05-0.5		WPA-SB-05-0.5_04/24/2017	4/24/2017	0.5	0.5	WPA-SB-05-0.5_04/24/2017
WPA-SB-06-2.0		WPA-SB-06-2.0_04/13/2017	4/13/2017	2	2	WPA-SB-06-2.0_04/13/2017
WPA-SB-06-0.5		WPA-SB-06-0.5_04/13/2017	4/13/2017	0.5	0.5	WPA-SB-06-0.5_04/13/2017
WPA-SB-07-0.5		WPA-SB-07-0.5_04/12/2017	4/12/2017	0.5	0.5	WPA-SB-07-0.5_04/12/2017
WPA-SB-07-2.0		WPA-SB-07-2.0_04/12/2017	4/12/2017	2	2	WPA-SB-07-2.0_04/12/2017
WPA-SB-08-2.0		WPA-SB-08-2.0_04/12/2017	4/12/2017	2	2	WPA-SB-08-2.0_04/12/2017
WPA-SB-08-0.5		WPA-SB-08-0.5_04/12/2017	4/12/2017	0.5	0.5	WPA-SB-08-0.5_04/12/2017
WPA-SB-09-2.0		WPA-SB-09-2.0_04/24/2017	4/24/2017	2	2	WPA-SB-09-2.0_04/24/2017
WPA-SB-09-0.5		WPA-SB-09-0.5_04/24/2017	4/24/2017	0.5	0.5	WPA-SB-09-0.5_04/24/2017
WPA-SB-10-0.5		WPA-SB-10-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-10-0.5_04/20/2017
WPA-SB-10-2.0		WPA-SB-10-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-10-2.0_04/20/2017
WPA-SB-11-0.5		WPA-SB-11-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-11-0.5_04/20/2017
WPA-SB-11-2.0		WPA-SB-11-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-11-2.0_04/20/2017
WPA-SB-12-2.0-D	WPA-SB-12-2.0	WPA-SB-12-2.0_04/24/2017	4/24/2017	2	2	WPA-SB-12-2.0-D_04/24/2017
WPA-SB-12-2.0		WPA-SB-12-2.0_04/24/2017	4/24/2017	2	2	WPA-SB-12-2.0_04/24/2017
WPA-SB-12-0.5		WPA-SB-12-0.5_04/24/2017	4/24/2017	0.5	0.5	WPA-SB-12-0.5_04/24/2017
WPA-SB-13-0.5		WPA-SB-13-0.5_04/13/2017	4/13/2017	0.5	0.5	WPA-SB-13-0.5_04/13/2017
WPA-SB-13-2.0		WPA-SB-13-2.0_04/13/2017	4/13/2017	2	2	WPA-SB-13-2.0_04/13/2017
WPA-SB-14-0.5		WPA-SB-14-0.5_04/12/2017	4/12/2017	0.5	0.5	WPA-SB-14-0.5_04/12/2017
WPA-SB-14-0.5-D	WPA-SB-14-0.5	WPA-SB-14-0.5_04/12/2017	4/12/2017	0.5	0.5	WPA-SB-14-0.5-D_04/12/2017
WPA-SB-14-2.0		WPA-SB-14-2.0_04/12/2017	4/12/2017	2	2	WPA-SB-14-2.0_04/12/2017
WPA-SB-15-0.5		WPA-SB-15-0.5_04/12/2017	4/12/2017	0.5	0.5	WPA-SB-15-0.5_04/12/2017
WPA-SB-15-2.0		WPA-SB-15-2.0_04/12/2017	4/12/2017	2	2	WPA-SB-15-2.0_04/12/2017
WPA-SB-16-2.0		WPA-SB-16-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-16-2.0_04/20/2017
WPA-SB-16-2.0-D	WPA-SB-16-2.0	WPA-SB-16-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-16-2.0-D_04/20/2017
WPA-SB-16-0.5-D	WPA-SB-16-0.5	WPA-SB-16-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-16-0.5-D_04/20/2017
WPA-SB-16-0.5		WPA-SB-16-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-16-0.5_04/20/2017
WPA-SB-17-2.0		WPA-SB-17-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-17-2.0_04/19/2017
WPA-SB-17-0.5		WPA-SB-17-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-17-0.5_04/19/2017
WPA-SB-18-2.0		WPA-SB-18-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-18-2.0_04/19/2017
WPA-SB-18-0.5		WPA-SB-18-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-18-0.5_04/19/2017
WPA-SB-19-2.0-D	WPA-SB-19-2.0	WPA-SB-19-2.0_04/26/2017	4/26/2017	2	2	WPA-SB-19-2.0-D_04/26/2017
WPA-SB-19-0.5		WPA-SB-19-0.5_04/26/2017	4/26/2017	0.5	0.5	WPA-SB-19-0.5_04/26/2017
WPA-SB-19-2.0		WPA-SB-19-2.0_04/26/2017	4/26/2017	2	2	WPA-SB-19-2.0_04/26/2017
WPA-SB-20-2.0		WPA-SB-20-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-20-2.0_04/19/2017
WPA-SB-20-0.5		WPA-SB-20-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-20-0.5_04/19/2017
WPA-SB-21-2.0		WPA-SB-21-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-21-2.0_04/18/2017
WPA-SB-21-0.5		WPA-SB-21-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-21-0.5_04/18/2017
WPA-SB-22-0.5		WPA-SB-22-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-22-0.5_04/18/2017
WPA-SB-22-2.0		WPA-SB-22-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-22-2.0_04/18/2017
WPA-SB-24-2.0		WPA-SB-24-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-24-2.0_04/18/2017
WPA-SB-24-0.5		WPA-SB-24-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-24-0.5_04/18/2017
WPA-SB-25-2.0		WPA-SB-25-2.0_04/12/2017	4/12/2017	2	2	WPA-SB-25-2.0_04/12/2017
WPA-SB-25-0.5		WPA-SB-25-0.5_04/12/2017	4/12/2017	0.5	0.5	WPA-SB-25-0.5_04/12/2017
WPA-SB-26-2.0		WPA-SB-26-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-26-2.0_04/18/2017
WPA-SB-26-0.5		WPA-SB-26-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-26-0.5_04/18/2017
WPA-SB-27-0.5		WPA-SB-27-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-27-0.5_04/19/2017
WPA-SB-27-2.0		WPA-SB-27-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-27-2.0_04/19/2017
WPA-SB-28-0.5		WPA-SB-28-0.5_04/26/2017	4/26/2017	0.5	0.5	WPA-SB-28-0.5_04/26/2017
WPA-SB-28-2.0		WPA-SB-28-2.0_04/26/2017	4/26/2017	2	2	WPA-SB-28-2.0_04/26/2017
WPA-SB-30-0.5		WPA-SB-30-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-30-0.5_04/19/2017
WPA-SB-30-2.0		WPA-SB-30-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-30-2.0_04/19/2017
WPA-SB-31-2.0		WPA-SB-31-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-31-2.0_04/19/2017
WPA-SB-31-0.5		WPA-SB-31-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-31-0.5_04/19/2017

Appendix A.
Samples Evaluated in the HHRA
Wilcox Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
WPA-SB-32-0.5		WPA-SB-32-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-32-0.5_04/19/2017
WPA-SB-32-0.5-D	WPA-SB-32-0.5	WPA-SB-32-0.5_04/19/2017	4/19/2017	0.5	0.5	WPA-SB-32-0.5-D_04/19/2017
WPA-SB-32-2.0		WPA-SB-32-2.0_04/19/2017	4/19/2017	2	2	WPA-SB-32-2.0_04/19/2017
WPA-SB-33-0.5		WPA-SB-33-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-33-0.5_04/18/2017
WPA-SB-33-2.0		WPA-SB-33-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-33-2.0_04/18/2017
WPA-SB-34-2.0		WPA-SB-34-2.0_04/18/2017	4/18/2017	2	2	WPA-SB-34-2.0_04/18/2017
WPA-SB-34-0.5		WPA-SB-34-0.5_04/18/2017	4/18/2017	0.5	0.5	WPA-SB-34-0.5_04/18/2017
WPA-SB-35-0.5		WPA-SB-35-0.5_04/26/2017	4/26/2017	0.5	0.5	WPA-SB-35-0.5_04/26/2017
WPA-SB-35-2.0		WPA-SB-35-2.0_04/26/2017	4/26/2017	2	2	WPA-SB-35-2.0_04/26/2017
WPA-SB-37-0.5		WPA-SB-37-0.5_04/26/2017	4/26/2017	0.5	0.5	WPA-SB-37-0.5_04/26/2017
WPA-SB-37-2.0		WPA-SB-37-2.0_04/26/2017	4/26/2017	2	2	WPA-SB-37-2.0_04/26/2017
WPA-SB-41-0.5		WPA-SB-41-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-41-0.5_04/20/2017
WPA-SB-41-0.5-D	WPA-SB-41-0.5	WPA-SB-41-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-41-0.5-D_04/20/2017
WPA-SB-41-2.0		WPA-SB-41-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-41-2.0_04/20/2017
WPA-SB-44-0.5		WPA-SB-44-0.5_04/20/2017	4/20/2017	0.5	0.5	WPA-SB-44-0.5_04/20/2017
WPA-SB-44-2.0		WPA-SB-44-2.0_04/20/2017	4/20/2017	2	2	WPA-SB-44-2.0_04/20/2017
WPA-SB-45-0.5		WPA-SB-45-0.5_04/24/2017	4/24/2017	0.5	0.5	WPA-SB-45-0.5_04/24/2017
WPA-SB-45-2.0		WPA-SB-45-2.0_04/24/2017	4/24/2017	2	2	WPA-SB-45-2.0_04/24/2017
WPA-SB-46-0.5		WPA-SB-46-0.5_04/25/2017	4/25/2017	0.5	0.5	WPA-SB-46-0.5_04/25/2017
WPA-SB-46-2.0		WPA-SB-46-2.0_04/25/2017	4/25/2017	2	2	WPA-SB-46-2.0_04/25/2017
WPA-SB-47-0.5		WPA-SB-47-0.5_04/25/2017	4/25/2017	0.5	0.5	WPA-SB-47-0.5_04/25/2017
WPA-SB-47-0.5-D	WPA-SB-47-0.5	WPA-SB-47-0.5_04/25/2017	4/25/2017	0.5	0.5	WPA-SB-47-0.5-D_04/25/2017
WPA-SB-47-2.0		WPA-SB-47-2.0_04/25/2017	4/25/2017	2	2	WPA-SB-47-2.0_04/25/2017
WPA-SB-48-0.5		WPA-SB-48-0.5_04/27/2017	4/27/2017	0.5	0.5	WPA-SB-48-0.5_04/27/2017
WPA-SB-48-2.0		WPA-SB-48-2.0_04/27/2017	4/27/2017	2	2	WPA-SB-48-2.0_04/27/2017
WPA-SB-51-0.5		WPA-SB-51-0.5_04/25/2017	4/25/2017	0.5	0.5	WPA-SB-51-0.5_04/25/2017
WPA-SB-51-2.0		WPA-SB-51-2.0_04/25/2017	4/25/2017	2	2	WPA-SB-51-2.0_04/25/2017
WPA-SB-52-0.5		WPA-SB-52-0.5_04/27/2017	4/27/2017	0.5	0.5	WPA-SB-52-0.5_04/27/2017
WPA-SB-52-2.0		WPA-SB-52-2.0_04/27/2017	4/27/2017	2	2	WPA-SB-52-2.0_04/27/2017
WPA-SB-53-0.5		WPA-SB-53-0.5_04/27/2017	4/27/2017	0.5	0.5	WPA-SB-53-0.5_04/27/2017
WPA-SB-53-2.0		WPA-SB-53-2.0_04/27/2017	4/27/2017	2	2	WPA-SB-53-2.0_04/27/2017
WPA-SB-54-2.0		WPA-SB-54-2.0_04/27/2017	4/27/2017	2	2	WPA-SB-54-2.0_04/27/2017
WPA-SB-54-0.5		WPA-SB-54-0.5_04/27/2017	4/27/2017	0.5	0.5	WPA-SB-54-0.5_04/27/2017
WPA-SB-71-0.5		WPA-SB-71-0.5_11/30/2018	11/30/2018	0.5	0.5	WPA-SB-71-0.5_11/30/2018
WPA-SB-71-2.0		WPA-SB-71-2.0_11/30/2018	11/30/2018	2	2	WPA-SB-71-2.0_11/30/2018
WPA-SB-72-0.5		WPA-SB-72-0.5_12/05/2018	12/5/2018	0.5	0.5	WPA-SB-72-0.5_12/05/2018
WPA-SB-72-2.0		WPA-SB-72-2.0_12/05/2018	12/5/2018	2	2	WPA-SB-72-2.0_12/05/2018
WPA-SB-74-0.5		WPA-SB-74-0.5_12/06/2018	12/6/2018	0.5	0.5	WPA-SB-74-0.5_12/06/2018
WPA-SB-74-2.0		WPA-SB-74-2.0_12/06/2018	12/6/2018	2	2	WPA-SB-74-2.0_12/06/2018
WPA-SB-75-0.5		WPA-SB-75-0.5_12/05/2018	12/5/2018	0.5	0.5	WPA-SB-75-0.5_12/05/2018
WPA-SB-75-2.0		WPA-SB-75-2.0_12/05/2018	12/5/2018	2	2	WPA-SB-75-2.0_12/05/2018
WPA-SB-76-0.5		WPA-SB-76-0.5_12/05/2018	12/5/2018	0.5	0.5	WPA-SB-76-0.5_12/05/2018
WPA-SB-76-2.0		WPA-SB-76-2.0_12/05/2018	12/5/2018	2	2	WPA-SB-76-2.0_12/05/2018
WPA-SB-77-0.5		WPA-SB-77-0.5_12/05/2018	12/5/2018	0.5	0.5	WPA-SB-77-0.5_12/05/2018
WPA-SB-77-2.0		WPA-SB-77-2.0_12/05/2018	12/5/2018	2	2	WPA-SB-77-2.0_12/05/2018
WPA-SB-78-0.5		WPA-SB-78-0.5_12/05/2018	12/5/2018	0.5	0.5	WPA-SB-78-0.5_12/05/2018
WPA-SB-78-2.0		WPA-SB-78-2.0_12/05/2018	12/5/2018	2	2	WPA-SB-78-2.0_12/05/2018
Subsurface Soil						
WPA-SB-02-6.0		WPA-SB-02-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-02-6.0_04/18/2017
WPA-SB-02-10.0		WPA-SB-02-10.0_04/18/2017	4/18/2017	10	10	WPA-SB-02-10.0_04/18/2017
WPA-SB-03-6.0		WPA-SB-03-6.0_04/13/2017	4/13/2017	6	6	WPA-SB-03-6.0_04/13/2017
WPA-SB-03-9.5		WPA-SB-03-9.5_04/13/2017	4/13/2017	9.5	9.5	WPA-SB-03-9.5_04/13/2017
WPA-SB-04-6.0		WPA-SB-04-6.0_04/20/2017	4/20/2017	6	6	WPA-SB-04-6.0_04/20/2017
WPA-SB-04-10.0		WPA-SB-04-10.0_04/20/2017	4/20/2017	10	10	WPA-SB-04-10.0_04/20/2017
WPA-SB-05-15.0		WPA-SB-05-15.0_04/24/2017	4/24/2017	15	15	WPA-SB-05-15.0_04/24/2017
WPA-SB-05-6.0		WPA-SB-05-6.0_04/24/2017	4/24/2017	6	6	WPA-SB-05-6.0_04/24/2017
WPA-SB-05-10.0		WPA-SB-05-10.0_04/24/2017	4/24/2017	10	10	WPA-SB-05-10.0_04/24/2017
WPA-SB-06-6.0		WPA-SB-06-6.0_04/12/2017	4/12/2017	6	6	WPA-SB-06-6.0_04/12/2017
WPA-SB-06-8.0		WPA-SB-06-8.0_04/12/2017	4/12/2017	8	8	WPA-SB-06-8.0_04/12/2017
WPA-SB-07-6.0		WPA-SB-07-6.0_04/12/2017	4/12/2017	6	6	WPA-SB-07-6.0_04/12/2017
WPA-SB-07-9.0		WPA-SB-07-9.0_04/12/2017	4/12/2017	9	9	WPA-SB-07-9.0_04/12/2017
WPA-SB-07-9.0-D	WPA-SB-07-9.0	WPA-SB-07-9.0_04/12/2017	4/12/2017	9	9	WPA-SB-07-9.0-D_04/12/2017
WPA-SB-08-5.5		WPA-SB-08-5.5_04/12/2017	4/12/2017	5.5	5.5	WPA-SB-08-5.5_04/12/2017
WPA-SB-09-6.0		WPA-SB-09-6.0_04/24/2017	4/24/2017	6	6	WPA-SB-09-6.0_04/24/2017

Appendix A.
Samples Evaluated in the HHRA
Wilcox Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
WPA-SB-09-6.0-D	WPA-SB-09-6.0	WPA-SB-09-6.0_04/24/2017	4/24/2017	6	6	WPA-SB-09-6.0-D_04/24/2017
WPA-SB-09-10.0		WPA-SB-09-10.0_04/24/2017	4/24/2017	10	10	WPA-SB-09-10.0_04/24/2017
WPA-SB-09-14.5		WPA-SB-09-14.5_04/24/2017	4/24/2017	14.5	14.5	WPA-SB-09-14.5_04/24/2017
WPA-SB-10-10.0		WPA-SB-10-10.0_04/20/2017	4/20/2017	10	10	WPA-SB-10-10.0_04/20/2017
WPA-SB-10-15.25		WPA-SB-10-15.25_04/20/2017	4/20/2017	15.25	15.25	WPA-SB-10-15.25_04/20/2017
WPA-SB-10-6.0		WPA-SB-10-6.0_04/20/2017	4/20/2017	6	6	WPA-SB-10-6.0_04/20/2017
WPA-SB-11-10.0-D	WPA-SB-11-10.0	WPA-SB-11-10.0_04/20/2017	4/20/2017	10	10	WPA-SB-11-10.0-D_04/20/2017
WPA-SB-11-14.0		WPA-SB-11-14.0_04/20/2017	4/20/2017	14	14	WPA-SB-11-14.0_04/20/2017
WPA-SB-11-10.0		WPA-SB-11-10.0_04/20/2017	4/20/2017	10	10	WPA-SB-11-10.0_04/20/2017
WPA-SB-11-14.0-D	WPA-SB-11-14.0	WPA-SB-11-14.0_04/20/2017	4/20/2017	14	14	WPA-SB-11-14.0-D_04/20/2017
WPA-SB-11-6.0		WPA-SB-11-6.0_04/20/2017	4/20/2017	6	6	WPA-SB-11-6.0_04/20/2017
WPA-SB-12-10.0		WPA-SB-12-10.0_04/24/2017	4/24/2017	10	10	WPA-SB-12-10.0_04/24/2017
WPA-SB-12-6.0		WPA-SB-12-6.0_04/24/2017	4/24/2017	6	6	WPA-SB-12-6.0_04/24/2017
WPA-SB-13-10.0		WPA-SB-13-10.0_04/12/2017	4/12/2017	10	10	WPA-SB-13-10.0_04/12/2017
WPA-SB-13-6.0		WPA-SB-13-6.0_04/12/2017	4/12/2017	6	6	WPA-SB-13-6.0_04/12/2017
WPA-SB-13-15.0		WPA-SB-13-15.0_04/12/2017	4/12/2017	15	15	WPA-SB-13-15.0_04/12/2017
WPA-SB-14-10.0		WPA-SB-14-10.0_04/12/2017	4/12/2017	10	10	WPA-SB-14-10.0_04/12/2017
WPA-SB-14-6.0		WPA-SB-14-6.0_04/12/2017	4/12/2017	6	6	WPA-SB-14-6.0_04/12/2017
WPA-SB-14-6.0-D	WPA-SB-14-6.0	WPA-SB-14-6.0_04/12/2017	4/12/2017	6	6	WPA-SB-14-6.0-D_04/12/2017
WPA-SB-15-6.0		WPA-SB-15-6.0_04/12/2017	4/12/2017	6	6	WPA-SB-15-6.0_04/12/2017
WPA-SB-15-10.0		WPA-SB-15-10.0_04/12/2017	4/12/2017	10	10	WPA-SB-15-10.0_04/12/2017
WPA-SB-17-6.0		WPA-SB-17-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-17-6.0_04/19/2017
WPA-SB-17-10.0		WPA-SB-17-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-17-10.0_04/19/2017
WPA-SB-17-6.0-D	WPA-SB-17-6.0	WPA-SB-17-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-17-6.0-D_04/19/2017
WPA-SB-18-6.0		WPA-SB-18-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-18-6.0_04/19/2017
WPA-SB-18-10.0		WPA-SB-18-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-18-10.0_04/19/2017
WPA-SB-18-10.0-D	WPA-SB-18-10.0	WPA-SB-18-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-18-10.0-D_04/19/2017
WPA-SB-18-13.0		WPA-SB-18-13.0_04/19/2017	4/19/2017	13	13	WPA-SB-18-13.0_04/19/2017
WPA-SB-19-6.0		WPA-SB-19-6.0_04/26/2017	4/26/2017	6	6	WPA-SB-19-6.0_04/26/2017
WPA-SB-19-6.0-D	WPA-SB-19-6.0	WPA-SB-19-6.0_04/26/2017	4/26/2017	6	6	WPA-SB-19-6.0-D_04/26/2017
WPA-SB-20-6.0		WPA-SB-20-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-20-6.0_04/19/2017
WPA-SB-20-10.0		WPA-SB-20-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-20-10.0_04/19/2017
WPA-SB-21-6.0		WPA-SB-21-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-21-6.0_04/18/2017
WPA-SB-21-9.0		WPA-SB-21-9.0_04/18/2017	4/18/2017	9	9	WPA-SB-21-9.0_04/18/2017
WPA-SB-22-8.0		WPA-SB-22-8.0_04/18/2017	4/18/2017	8	8	WPA-SB-22-8.0_04/18/2017
WPA-SB-22-8.0-D	WPA-SB-22-8.0	WPA-SB-22-8.0_04/18/2017	4/18/2017	8	8	WPA-SB-22-8.0-D_04/18/2017
WPA-SB-22-6.0		WPA-SB-22-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-22-6.0_04/18/2017
WPA-SB-24-10.0-D	WPA-SB-24-10.0	WPA-SB-24-10.0_04/18/2017	4/18/2017	10	10	WPA-SB-24-10.0-D_04/18/2017
WPA-SB-24-10.0		WPA-SB-24-10.0_04/18/2017	4/18/2017	10	10	WPA-SB-24-10.0_04/18/2017
WPA-SB-24-6.0		WPA-SB-24-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-24-6.0_04/18/2017
WPA-SB-25-3.0		WPA-SB-25-3.0_04/12/2017	4/12/2017	3	3	WPA-SB-25-3.0_04/12/2017
WPA-SB-26-6.0		WPA-SB-26-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-26-6.0_04/18/2017
WPA-SB-26-6.0-D	WPA-SB-26-6.0	WPA-SB-26-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-26-6.0-D_04/18/2017
WPA-SB-26-7.5		WPA-SB-26-7.5_04/18/2017	4/18/2017	7.5	7.5	WPA-SB-26-7.5_04/18/2017
WPA-SB-26-7.5-D	WPA-SB-26-7.5	WPA-SB-26-7.5_04/18/2017	4/18/2017	7.5	7.5	WPA-SB-26-7.5-D_04/18/2017
WPA-SB-28-10.0		WPA-SB-28-10.0_04/26/2017	4/26/2017	10	10	WPA-SB-28-10.0_04/26/2017
WPA-SB-28-10.0-D	WPA-SB-28-10.0	WPA-SB-28-10.0_04/26/2017	4/26/2017	10	10	WPA-SB-28-10.0-D_04/26/2017
WPA-SB-28-6.0		WPA-SB-28-6.0_04/26/2017	4/26/2017	6	6	WPA-SB-28-6.0_04/26/2017
WPA-SB-28-6.0-D	WPA-SB-28-6.0	WPA-SB-28-6.0_04/26/2017	4/26/2017	6	6	WPA-SB-28-6.0-D_04/26/2017
WPA-SB-30-6.0		WPA-SB-30-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-30-6.0_04/19/2017
WPA-SB-30-9.0		WPA-SB-30-9.0_04/19/2017	4/19/2017	9	9	WPA-SB-30-9.0_04/19/2017
WPA-SB-31-6.0		WPA-SB-31-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-31-6.0_04/19/2017
WPA-SB-31-10.0		WPA-SB-31-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-31-10.0_04/19/2017
WPA-SB-32-10.0-D	WPA-SB-32-10.0	WPA-SB-32-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-32-10.0-D_04/19/2017
WPA-SB-32-10.0		WPA-SB-32-10.0_04/19/2017	4/19/2017	10	10	WPA-SB-32-10.0_04/19/2017
WPA-SB-32-6.0		WPA-SB-32-6.0_04/19/2017	4/19/2017	6	6	WPA-SB-32-6.0_04/19/2017
WPA-SB-33-5.0		WPA-SB-33-5.0_04/18/2017	4/18/2017	5	5	WPA-SB-33-5.0_04/18/2017
WPA-SB-34-8.5		WPA-SB-34-8.5_04/18/2017	4/18/2017	8.5	8.5	WPA-SB-34-8.5_04/18/2017
WPA-SB-34-6.0		WPA-SB-34-6.0_04/18/2017	4/18/2017	6	6	WPA-SB-34-6.0_04/18/2017
WPA-SB-37-10.0		WPA-SB-37-10.0_04/26/2017	4/26/2017	10	10	WPA-SB-37-10.0_04/26/2017
WPA-SB-37-6.0		WPA-SB-37-6.0_04/26/2017	4/26/2017	6	6	WPA-SB-37-6.0_04/26/2017
WPA-SB-41-8.0		WPA-SB-41-8.0_04/20/2017	4/20/2017	8	8	WPA-SB-41-8.0_04/20/2017
WPA-SB-41-6.0		WPA-SB-41-6.0_04/20/2017	4/20/2017	6	6	WPA-SB-41-6.0_04/20/2017
WPA-SB-44-6.0		WPA-SB-44-6.0_04/20/2017	4/20/2017	6	6	WPA-SB-44-6.0_04/20/2017

Appendix A.
Samples Evaluated in the HHRA
Wilcox Process Area - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
WPA-SB-44-10.0		WPA-SB-44-10.0_04/20/2017	4/20/2017	10	10	WPA-SB-44-10.0_04/20/2017
WPA-SB-45-3.0		WPA-SB-45-3.0_04/24/2017	5:30:00 PM	3	3	WPA-SB-45-3.0_04/24/2017
WPA-SB-46-6.0		WPA-SB-46-6.0_04/25/2017	4/25/2017	6	6	WPA-SB-46-6.0_04/25/2017
WPA-SB-46-10.0-D	WPA-SB-46-10.0	WPA-SB-46-10.0_04/25/2017	4/25/2017	10	10	WPA-SB-46-10.0-D_04/25/2017
WPA-SB-46-10.0		WPA-SB-46-10.0_04/25/2017	4/25/2017	10	10	WPA-SB-46-10.0_04/25/2017
WPA-SB-47-10.0		WPA-SB-47-10.0_04/25/2017	4/25/2017	10	10	WPA-SB-47-10.0_04/25/2017
WPA-SB-47-6.0		WPA-SB-47-6.0_04/25/2017	4/25/2017	6	6	WPA-SB-47-6.0_04/25/2017
WPA-SB-48-6.0		WPA-SB-48-6.0_04/27/2017	4/27/2017	6	6	WPA-SB-48-6.0_04/27/2017
WPA-SB-48-10.0		WPA-SB-48-10.0_04/27/2017	4/27/2017	10	10	WPA-SB-48-10.0_04/27/2017
WPA-SB-48-6.0-D	WPA-SB-48-6.0	WPA-SB-48-6.0_04/27/2017	4/27/2017	6	6	WPA-SB-48-6.0-D_04/27/2017
WPA-SB-51-6.0		WPA-SB-51-6.0_04/25/2017	4/25/2017	6	6	WPA-SB-51-6.0_04/25/2017
WPA-SB-51-10.0		WPA-SB-51-10.0_04/25/2017	4/25/2017	10	10	WPA-SB-51-10.0_04/25/2017
WPA-SB-52-6.0		WPA-SB-52-6.0_04/27/2017	4/27/2017	6	6	WPA-SB-52-6.0_04/27/2017
WPA-SB-52-10.0		WPA-SB-52-10.0_04/27/2017	4/27/2017	10	10	WPA-SB-52-10.0_04/27/2017
WPA-SB-53-10.0-D	WPA-SB-53-10.0	WPA-SB-53-10.0_04/27/2017	4/27/2017	10	10	WPA-SB-53-10.0-D_04/27/2017
WPA-SB-53-6.0		WPA-SB-53-6.0_04/27/2017	4/27/2017	6	6	WPA-SB-53-6.0_04/27/2017
WPA-SB-53-15.0		WPA-SB-53-15.0_04/27/2017	4/27/2017	15	15	WPA-SB-53-15.0_04/27/2017
WPA-SB-53-10.0		WPA-SB-53-10.0_04/27/2017	4/27/2017	10	10	WPA-SB-53-10.0_04/27/2017
WPA-SB-54-6.0		WPA-SB-54-6.0_04/27/2017	4/27/2017	6	6	WPA-SB-54-6.0_04/27/2017
WPA-SB-54-10.0		WPA-SB-54-10.0_04/27/2017	4/27/2017	10	10	WPA-SB-54-10.0_04/27/2017
WPA-SB-71-6.0		WPA-SB-71-6.0_11/30/2018	11/30/2018	6	6	WPA-SB-71-6.0_11/30/2018
WPA-SB-71-10.0		WPA-SB-71-10.0_11/30/2018	11/30/2018	10	10	WPA-SB-71-10.0_11/30/2018
WPA-SB-72-6.0		WPA-SB-72-6.0_12/05/2018	12/5/2018	6	6	WPA-SB-72-6.0_12/05/2018
WPA-SB-72-10.0		WPA-SB-72-10.0_12/05/2018	12/5/2018	10	10	WPA-SB-72-10.0_12/05/2018
WPA-SB-75-6.0		WPA-SB-75-6.0_12/05/2018	12/5/2018	6	6	WPA-SB-75-6.0_12/05/2018
WPA-SB-75-10.5		WPA-SB-75-10.5_12/05/2018	12/5/2018	10.5	10.5	WPA-SB-75-10.5_12/05/2018
WPA-SB-76-10.5		WPA-SB-76-10.5_12/05/2018	12/5/2018	10.5	10.5	WPA-SB-76-10.5_12/05/2018
WPA-SB-76-6.0		WPA-SB-76-6.0_12/05/2018	12/5/2018	6	6	WPA-SB-76-6.0_12/05/2018
WPA-SB-77-6.0		WPA-SB-77-6.0_12/05/2018	12/5/2018	6	6	WPA-SB-77-6.0_12/05/2018
WPA-SB-77-8.0		WPA-SB-77-8.0_12/05/2018	12/5/2018	8	8	WPA-SB-77-8.0_12/05/2018
WPA-SB-78-10.0		WPA-SB-78-10.0_12/05/2018	12/5/2018	10	10	WPA-SB-78-10.0_12/05/2018
WPA-SB-78-12.5		WPA-SB-78-12.5_12/05/2018	12/5/2018	12.5	12.5	WPA-SB-78-12.5_12/05/2018
WPA-SB-78-6.0		WPA-SB-78-6.0_12/05/2018	12/5/2018	6	6	WPA-SB-78-6.0_12/05/2018
WPA-SB-02-12.0		WPA-SB-02-12.0_04/18/2017	4/18/2017	12	12	WPA-SB-02-12.0_04/18/2017
WPA-SB-31-11.0		WPA-SB-31-11.0_04/19/2017	4/19/2017	11	11	WPA-SB-31-11.0_04/19/2017
WPA-SB-32-11.0		WPA-SB-32-11.0_04/19/2017	4/19/2017	11	11	WPA-SB-32-11.0_04/19/2017
MW-04-SB-38		MW-04-SB-38_11/27/2018	11/27/2018	38	38	MW-04-SB-38_11/27/2018
MW-04-SB-38-DUP	MW-04-SB-38	MW-04-SB-38_11/27/2018	11/27/2018	38	38	MW-04-SB-38-DUP_11/27/2018
MW-05-SB-37-DUP	MW-05-SB-37	MW-05-SB-37_11/28/2018	11/28/2018	37	37	MW-05-SB-37-DUP_11/28/2018
MW-05-SB-37		MW-05-SB-37_11/28/2018	11/28/2018	37	37	MW-05-SB-37_11/28/2018
MW-06-SB-50-DUP	MW-06-SB-50	MW-06-SB-50_11/28/2018	11/28/2018	50	50	MW-06-SB-50-DUP_11/28/2018
MW-06-SB-50		MW-06-SB-50_11/28/2018	11/28/2018	50	50	MW-06-SB-50_11/28/2018
WPA-SB-04-17.0		WPA-SB-04-17.0_04/20/2017	4/20/2017	17	17	WPA-SB-04-17.0_04/20/2017
WPA-SB-05-30.0		WPA-SB-05-30.0_04/24/2017	4/24/2017	30	30	WPA-SB-05-30.0_04/24/2017
WPA-SB-11-30.0		WPA-SB-11-30.0_04/20/2017	4/20/2017	30	30	WPA-SB-11-30.0_04/20/2017
WPA-SB-12-30.0		WPA-SB-12-30.0_04/24/2017	4/24/2017	30	30	WPA-SB-12-30.0_04/24/2017
WPA-SB-12-20.0		WPA-SB-12-20.0_04/24/2017	4/24/2017	20	20	WPA-SB-12-20.0_04/24/2017
WPA-SB-15-20.0		WPA-SB-15-20.0_04/12/2017	4/12/2017	20	20	WPA-SB-15-20.0_04/12/2017
WPA-SB-17-18.0		WPA-SB-17-18.0_04/19/2017	4/19/2017	18	18	WPA-SB-17-18.0_04/19/2017
WPA-SB-37-18.0		WPA-SB-37-18.0_04/26/2017	4/26/2017	18	18	WPA-SB-37-18.0_04/26/2017
WPA-SB-37-30.0		WPA-SB-37-30.0_04/26/2017	4/26/2017	30	30	WPA-SB-37-30.0_04/26/2017
WPA-SB-44-27.0		WPA-SB-44-27.0_04/20/2017	4/20/2017	27	27	WPA-SB-44-27.0_04/20/2017
WPA-SB-46-30.0		WPA-SB-46-30.0_04/25/2017	4/25/2017	30	30	WPA-SB-46-30.0_04/25/2017
WPA-SB-47-30.0		WPA-SB-47-30.0_04/25/2017	4/25/2017	30	30	WPA-SB-47-30.0_04/25/2017
WPA-SB-48-20.0		WPA-SB-48-20.0_04/27/2017	4/27/2017	20	20	WPA-SB-48-20.0_04/27/2017
WPA-SB-51-30.0		WPA-SB-51-30.0_04/25/2017	4/25/2017	30	30	WPA-SB-51-30.0_04/25/2017
WPA-SB-52-30.0		WPA-SB-52-30.0_04/27/2017	4/27/2017	30	30	WPA-SB-52-30.0_04/27/2017
WPA-SB-53-20.0		WPA-SB-53-20.0_04/27/2017	4/27/2017	20	20	WPA-SB-53-20.0_04/27/2017
WPA-SB-54-30.0		WPA-SB-54-30.0_04/27/2017	4/27/2017	30	30	WPA-SB-54-30.0_04/27/2017
WPA-SB-54-10.0-D	WPA-SB-54-30.0	WPA-SB-54-10.0_04/27/2017	4/27/2017	30	30	WPA-SB-54-10.0-D_04/27/2017
WPA-SB-20-22.0		WPA-SB-20-22.0_04/19/2017	4/19/2017	22	22	WPA-SB-20-22.0_04/19/2017

Appendix A.
Samples Evaluated in the HHRA
East Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
Surface Soil						
ETF-SB-01-2.0		ETF-SB-01-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-01-2.0_11/02/2016
ETF-SB-01-0.5		ETF-SB-01-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-01-0.5_11/02/2016
ETF-SB01-13-0.5-D	ETF-SB01-13-0.5	ETF-SB01-13-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-13-0.5-D_10/30/2017
ETF-SB01-13-0.5		ETF-SB01-13-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-13-0.5_10/30/2017
ETF-SB01-13-2.0		ETF-SB01-13-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-13-2.0_10/30/2017
ETF-SB01-13-2.0-D	ETF-SB01-13-2.0	ETF-SB01-13-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-13-2.0-D_10/30/2017
ETF-SB01-14-0.5		ETF-SB01-14-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-14-0.5_10/30/2017
ETF-SB01-14-2.0		ETF-SB01-14-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-14-2.0_10/30/2017
ETF-SB01-16-0.5		ETF-SB01-16-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-16-0.5_10/30/2017
ETF-SB01-16-2.0		ETF-SB01-16-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-16-2.0_10/30/2017
ETF-SB-02-0.5		ETF-SB-02-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-02-0.5_11/02/2016
ETF-SB-02-2.0		ETF-SB-02-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-02-2.0_11/02/2016
ETF-SB-03-2.0		ETF-SB-03-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-03-2.0_11/02/2016
ETF-SB-03-0.5		ETF-SB-03-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-03-0.5_11/02/2016
ETF-SB-04-0.5		ETF-SB-04-0.5_11/01/2016	11/1/2016	0.5	0.5	ETF-SB-04-0.5_11/01/2016
ETF-SB-04-2.0		ETF-SB-04-2.0_11/01/2016	11/1/2016	2	2	ETF-SB-04-2.0_11/01/2016
ETF-SB04-18-0.5		ETF-SB04-18-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB04-18-0.5_10/30/2017
ETF-SB04-18-2.0		ETF-SB04-18-2.0_10/30/2017	10/30/2017	2	2	ETF-SB04-18-2.0_10/30/2017
ETF-SB04-19-0.5		ETF-SB04-19-0.5_10/31/2017	10/31/2017	0.5	0.5	ETF-SB04-19-0.5_10/31/2017
ETF-SB04-19-2.0		ETF-SB04-19-2.0_10/31/2017	10/31/2017	2	2	ETF-SB04-19-2.0_10/31/2017
ETF-SB04-19-0.5-D	ETF-SB04-19-0.5-D	ETF-SB04-19-0.5_10/31/2017	10/31/2017	0.5	0.5	ETF-SB04-19-0.5-D_10/31/2017
ETF-SB04-21-2.0		ETF-SB04-21-2.0_10/30/2017	10/30/2017	2	2	ETF-SB04-21-2.0_10/30/2017
ETF-SB04-21-0.5		ETF-SB04-21-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB04-21-0.5_10/30/2017
ETF-SB-05-0.5		ETF-SB-05-0.5_11/01/2016	11/1/2016	0.5	0.5	ETF-SB-05-0.5_11/01/2016
ETF-SB-05-2.0		ETF-SB-05-2.0_11/01/2016	11/1/2016	2	2	ETF-SB-05-2.0_11/01/2016
ETF-SB06-113-0.5		ETF-SB06-113-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB06-113-0.5_11/06/2017
ETF-SB06-113-2.0		ETF-SB06-113-2.0_11/06/2017	11/6/2017	2	2	ETF-SB06-113-2.0_11/06/2017
ETF-SB06-114-2.0		ETF-SB06-114-2.0_11/06/2017	11/6/2017	2	2	ETF-SB06-114-2.0_11/06/2017
ETF-SB06-114-0.5		ETF-SB06-114-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB06-114-0.5_11/06/2017
ETF-SB06-115-0.5		ETF-SB06-115-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB06-115-0.5_11/06/2017
ETF-SB06-115-2.0		ETF-SB06-115-2.0_11/06/2017	11/6/2017	2	2	ETF-SB06-115-2.0_11/06/2017
ETF-SB07-139-2.0		ETF-SB07-139-2.0_11/07/2017	11/7/2017	2	2	ETF-SB07-139-2.0_11/07/2017
ETF-SB07-139-0.5		ETF-SB07-139-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-139-0.5_11/07/2017
ETF-SB07-119-2.0		ETF-SB07-119-2.0_11/07/2017	11/7/2017	2	2	ETF-SB07-119-2.0_11/07/2017
ETF-SB07-118-2.0		ETF-SB07-118-2.0_11/07/2017	11/7/2017	2	2	ETF-SB07-118-2.0_11/07/2017
ETF-SB07-118-0.5		ETF-SB07-118-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-118-0.5_11/07/2017
ETF-SB07-116-0.5		ETF-SB07-116-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-116-0.5_11/07/2017
ETF-SB07-119-0.5		ETF-SB07-119-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-119-0.5_11/07/2017
ETF-SB07-116-1.0		ETF-SB07-116-1.0_11/07/2017	11/7/2017	1	1	ETF-SB07-116-1.0_11/07/2017
ETF-SB08-121-0.5-D	ETF-SB08-121-0.5	ETF-SB08-121-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-121-0.5-D_11/02/2017
ETF-SB08-121-2.0		ETF-SB08-121-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-121-2.0_11/02/2017
ETF-SB08-121-0.5		ETF-SB08-121-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-121-0.5_11/02/2017
ETF-SB08-122-2.0-D	ETF-SB08-122-2.0	ETF-SB08-122-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-122-2.0-D_11/02/2017
ETF-SB08-122-2.0		ETF-SB08-122-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-122-2.0_11/02/2017
ETF-SB08-122-0.5		ETF-SB08-122-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-122-0.5_11/02/2017
ETF-SB08-123-2.0		ETF-SB08-123-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-123-2.0_11/02/2017
ETF-SB08-123-2.0-D	ETF-SB08-123-2.0	ETF-SB08-123-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-123-2.0-D_11/02/2017
ETF-SB08-123-0.5		ETF-SB08-123-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-123-0.5_11/02/2017
ETF-SB09-129-0.5		ETF-SB09-129-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB09-129-0.5_11/06/2017
ETF-SB-09-2.0		ETF-SB-09-2.0_11/03/2016	11/3/2016	2	2	ETF-SB-09-2.0_11/03/2016
ETF-SB09-127-0.5		ETF-SB09-127-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB09-127-0.5_11/02/2017
ETF-SB09-128-0.5		ETF-SB09-128-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB09-128-0.5_11/02/2017
ETF-SB09-128-2.0		ETF-SB09-128-2.0_11/02/2017	11/2/2017	2	2	ETF-SB09-128-2.0_11/02/2017
ETF-SB-10-0.5		ETF-SB-10-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-10-0.5_11/02/2016
ETF-SB-10-2.0		ETF-SB-10-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-10-2.0_11/02/2016
ETF-SB-124-2.0		ETF-SB-124-2.0_11/06/2017	11/6/2017	2	2	ETF-SB-124-2.0_11/06/2017
ETF-SB-124-0.5		ETF-SB-124-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB-124-0.5_11/06/2017
ETF-SB-125-0.5		ETF-SB-125-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB-125-0.5_11/06/2017
ETF-SB-125-2.0		ETF-SB-125-2.0_11/06/2017	11/6/2017	2	2	ETF-SB-125-2.0_11/06/2017
ETF-SB-126-0.5		ETF-SB-126-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB-126-0.5_11/06/2017
ETF-SB-126-2.0		ETF-SB-126-2.0_11/06/2017	11/6/2017	2	2	ETF-SB-126-2.0_11/06/2017
ETF-SB-130-0.5		ETF-SB-130-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-130-0.5_11/07/2017
ETF-SB-130-2.0		ETF-SB-130-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-130-2.0_11/07/2017
ETF-SB-131-0.5		ETF-SB-131-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-131-0.5_11/07/2017
ETF-SB-131-2.0		ETF-SB-131-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-131-2.0_11/07/2017
ETF-SB13-120-2.0		ETF-SB13-120-2.0_11/07/2017	11/7/2017	2	2	ETF-SB13-120-2.0_11/07/2017
ETF-SB13-120-0.5		ETF-SB13-120-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB13-120-0.5_11/07/2017

Appendix A.
Samples Evaluated in the HHRA
East Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
ETF-SB-136-0.5		ETF-SB-136-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-136-0.5_11/07/2017
ETF-SB-136-2.0		ETF-SB-136-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-136-2.0_11/07/2017
ETF-SB-137-0.5		ETF-SB-137-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-137-0.5_11/07/2017
ETF-SB-137-2.0		ETF-SB-137-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-137-2.0_11/07/2017
ETF-SB-141-0.5		ETF-SB-141-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-141-0.5_12/03/2018
ETF-SB-141-2.0		ETF-SB-141-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-141-2.0_12/03/2018
ETF-SB-142-2.0		ETF-SB-142-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-142-2.0_12/03/2018
ETF-SB-142-0.5		ETF-SB-142-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-142-0.5_12/03/2018
ETF-SB-143-0.5		ETF-SB-143-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-143-0.5_12/03/2018
ETF-SB-143-2.0		ETF-SB-143-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-143-2.0_12/03/2018
ETF-SB-144-0.5		ETF-SB-144-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-144-0.5_12/03/2018
ETF-SB-144-2.0		ETF-SB-144-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-144-2.0_12/03/2018
ETF-SB-145-0.5		ETF-SB-145-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-145-0.5_12/03/2018
ETF-SB-145-2.0		ETF-SB-145-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-145-2.0_12/03/2018
ETF-SB-146-0.5		ETF-SB-146-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-146-0.5_12/03/2018
ETF-SB-146-2.0		ETF-SB-146-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-146-2.0_12/03/2018
ETF-SB-147-0.5		ETF-SB-147-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-147-0.5_12/03/2018
ETF-SB-147-2.0		ETF-SB-147-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-147-2.0_12/03/2018
ETF-SB-148-0.5		ETF-SB-148-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-148-0.5_12/03/2018
ETF-SB-148-2.0		ETF-SB-148-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-148-2.0_12/03/2018
ETF-SB-149-0.5		ETF-SB-149-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-149-0.5_12/03/2018
ETF-SB-149-2.0		ETF-SB-149-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-149-2.0_12/03/2018
ETF-SB-150-0.5		ETF-SB-150-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-150-0.5_12/03/2018
ETF-SB-150-0.5-DUP	ETF-SB-150-0.5	ETF-SB-150-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-150-0.5-DUP_12/03/2018
ETF-SB-150-2.0		ETF-SB-150-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-150-2.0_12/03/2018
ETF-SB-151-2.0-DUP	ETF-SB-151-2.0	ETF-SB-151-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-151-2.0-DUP_12/03/2018
ETF-SB-151-0.5		ETF-SB-151-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-151-0.5_12/03/2018
ETF-SB-151-0.5-DUP	ETF-SB-151-0.5	ETF-SB-151-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-151-0.5-DUP_12/03/2018
ETF-SB-151-2.0		ETF-SB-151-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-151-2.0_12/03/2018
ETF-SB-152-0.5		ETF-SB-152-0.5_12/06/2018	12/6/2018	0.5	0.5	ETF-SB-152-0.5_12/06/2018
ETF-SB-153-0.5		ETF-SB-153-0.5_12/04/2018	12/4/2018	0.5	0.5	ETF-SB-153-0.5_12/04/2018
ETF-SB-154-0.5		ETF-SB-154-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-154-0.5_12/03/2018
ETF-SB-154-2.0		ETF-SB-154-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-154-2.0_12/03/2018
ETF-SB-155-0.5		ETF-SB-155-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-155-0.5_12/03/2018
ETF-SB-155-2.0		ETF-SB-155-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-155-2.0_12/03/2018
ETF-SB-156-0.5		ETF-SB-156-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-156-0.5_12/03/2018
ETF-SB-156-2.0		ETF-SB-156-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-156-2.0_12/03/2018
ETF-SB-157-0.5		ETF-SB-157-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-157-0.5_12/03/2018
ETF-SB-158-0.5		ETF-SB-158-0.5_12/04/2018	12/4/2018	0.5	0.5	ETF-SB-158-0.5_12/04/2018
ETF-SB-158-2.0		ETF-SB-158-2.0_12/04/2018	12/4/2018	2	2	ETF-SB-158-2.0_12/04/2018
ETF-SB-159-0.5		ETF-SB-159-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-159-0.5_12/03/2018
ETF-SB-159-2.0		ETF-SB-159-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-159-2.0_12/03/2018
ETF-SB-160-0.5		ETF-SB-160-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-160-0.5_12/03/2018
ETF-SB-160-2.0		ETF-SB-160-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-160-2.0_12/03/2018
ETF-SB-161-0.5		ETF-SB-161-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-161-0.5_12/03/2018
ETF-SB-161-2.0		ETF-SB-161-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-161-2.0_12/03/2018
ETF-SB-162-0.5		ETF-SB-162-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-162-0.5_12/03/2018
ETF-SB-162-2.0		ETF-SB-162-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-162-2.0_12/03/2018
ETF-SB-163-0.5		ETF-SB-163-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-163-0.5_12/03/2018
ETF-SB-163-2.0		ETF-SB-163-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-163-2.0_12/03/2018
Subsurface Soil						
ETF-SB-01-6.0		ETF-SB-01-6.0_11/02/2016	12:15:00 PM	6	6	ETF-SB-01-6.0_11/02/2016
ETF-SB01-13-6.0-D	ETF-SB01-13-6.0	ETF-SB01-13-6.0_10/30/2017	10/30/2017	6	6	ETF-SB01-13-6.0-D_10/30/2017
ETF-SB01-13-6.0		ETF-SB01-13-6.0_10/30/2017	10/30/2017	6	6	ETF-SB01-13-6.0_10/30/2017
ETF-SB01-13-10.0-D	ETF-SB01-13-10.0	ETF-SB01-13-10.0_10/30/2017	10/30/2017	10	10	ETF-SB01-13-10.0-D_10/30/2017
ETF-SB01-13-10.0		ETF-SB01-13-10.0_10/30/2017	10/30/2017	10	10	ETF-SB01-13-10.0_10/30/2017
ETF-SB01-14-6.0		ETF-SB01-14-6.0_10/30/2017	10/30/2017	6	6	ETF-SB01-14-6.0_10/30/2017
ETF-SB01-14-10.0		ETF-SB01-14-10.0_10/30/2017	10/30/2017	10	10	ETF-SB01-14-10.0_10/30/2017
ETF-SB01-16-10		ETF-SB01-16-10_10/30/2017	10/30/2017	10	10	ETF-SB01-16-10_10/30/2017
ETF-SB01-16-6.0		ETF-SB01-16-6.0_10/30/2017	10/30/2017	6	6	ETF-SB01-16-6.0_10/30/2017
ETF-SB-02-6.0-D	ETF-SB-02-6.0	ETF-SB-02-6.0_11/02/2016	11/2/2016	6	6	ETF-SB-02-6.0-D_11/02/2016
ETF-SB-02-6.0		ETF-SB-02-6.0_11/02/2016	11/2/2016	6	6	ETF-SB-02-6.0_11/02/2016
ETF-SB-03-10.0-D	ETF-SB-03-10.0	ETF-SB-03-10.0_11/02/2016	11/2/2016	10	10	ETF-SB-03-10.0-D_11/02/2016
ETF-SB-03-12.5		ETF-SB-03-12.5_11/02/2016	11/2/2016	12.5	12.5	ETF-SB-03-12.5_11/02/2016
ETF-SB-03-6.0		ETF-SB-03-6.0_11/02/2016	11/2/2016	6	6	ETF-SB-03-6.0_11/02/2016
ETF-SB-03-10.0		ETF-SB-03-10.0_11/02/2016	11/2/2016	10	10	ETF-SB-03-10.0_11/02/2016
ETF-SB-04-6.0		ETF-SB-04-6.0_11/01/2016	11/1/2016	6	6	ETF-SB-04-6.0_11/01/2016
ETF-SB04-18-10.0		ETF-SB04-18-10.0_10/30/2017	10/30/2017	10	10	ETF-SB04-18-10.0_10/30/2017

Appendix A.
Samples Evaluated in the HHRA
East Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
ETF-SB04-18-6.0		ETF-SB04-18-6.0_10/30/2017	10/30/2017	6	6	ETF-SB04-18-6.0_10/30/2017
ETF-SB04-19-4.5		ETF-SB04-19-4.5_10/31/2017	10/31/2017	4.5	4.5	ETF-SB04-19-4.5_10/31/2017
ETF-SB04-21-10.0		ETF-SB04-21-10.0_10/30/2017	10/30/2017	10	10	ETF-SB04-21-10.0_10/30/2017
ETF-SB04-21-6.0		ETF-SB04-21-6.0_10/30/2017	10/30/2017	6	6	ETF-SB04-21-6.0_10/30/2017
ETF-SB-05-10.0		ETF-SB-05-10.0_11/01/2016	11/1/2016	10	10	ETF-SB-05-10.0_11/01/2016
ETF-SB-05-6.0		ETF-SB-05-6.0_11/01/2016	11/1/2016	6	6	ETF-SB-05-6.0_11/01/2016
ETF-SB06-113-6.5		ETF-SB06-113-6.5_11/06/2017	11/6/2017	6.5	6.5	ETF-SB06-113-6.5_11/06/2017
ETF-SB06-114-5.0-D	ETF-SB06-114-5.0	ETF-SB06-114-5.0_11/06/2017	11/6/2017	5	5	ETF-SB06-114-5.0-D_11/06/2017
ETF-SB06-114-5.0		ETF-SB06-114-5.0_11/06/2017	11/6/2017	5	5	ETF-SB06-114-5.0_11/06/2017
ETF-SB06-115-3.5		ETF-SB06-115-3.5_11/06/2017	11/6/2017	3.5	3.5	ETF-SB06-115-3.5_11/06/2017
ETF-SB07-139-5.0		ETF-SB07-139-5.0_11/07/2017	11/7/2017	5	5	ETF-SB07-139-5.0_11/07/2017
ETF-SB07-119-10.0		ETF-SB07-119-10.0_11/07/2017	11/7/2017	10	10	ETF-SB07-119-10.0_11/07/2017
ETF-SB07-119-6.0		ETF-SB07-119-6.0_11/07/2017	11/7/2017	6	6	ETF-SB07-119-6.0_11/07/2017
ETF-SB08-121-10.0		ETF-SB08-121-10.0_11/02/2017	11/2/2017	10	10	ETF-SB08-121-10.0_11/02/2017
ETF-SB08-121-6.0		ETF-SB08-121-6.0_11/02/2017	11/2/2017	6	6	ETF-SB08-121-6.0_11/02/2017
ETF-SB08-122-5.0		ETF-SB08-122-5.0_11/02/2017	11/2/2017	5	5	ETF-SB08-122-5.0_11/02/2017
ETF-SB08-123-10.0		ETF-SB08-123-10.0_11/02/2017	11/2/2017	10	10	ETF-SB08-123-10.0_11/02/2017
ETF-SB08-123-6.0		ETF-SB08-123-6.0_11/02/2017	11/2/2017	6	6	ETF-SB08-123-6.0_11/02/2017
ETF-SB09-129-2.5		ETF-SB09-129-2.5_11/06/2017	11/6/2017	2.5	2.5	ETF-SB09-129-2.5_11/06/2017
ETF-SB09-127-3.0		ETF-SB09-127-3.0_11/02/2017	11/2/2017	3	3	ETF-SB09-127-3.0_11/02/2017
ETF-SB09-128-7.0		ETF-SB09-128-7.0_11/02/2017	11/2/2017	7	7	ETF-SB09-128-7.0_11/02/2017
ETF-SB09-128-7.0-D	ETF-SB09-128-7.0	ETF-SB09-128-7.0-D_11/02/2017	11/2/2017	7	7	ETF-SB09-128-7.0-D_11/02/2017
ETF-SB-124-6.0		ETF-SB-124-6.0_11/06/2017	11/6/2017	6	6	ETF-SB-124-6.0_11/06/2017
ETF-SB-125-6.5		ETF-SB-125-6.5_11/06/2017	11/6/2017	6.5	6.5	ETF-SB-125-6.5_11/06/2017
ETF-SB-126-5.0		ETF-SB-126-5.0_11/06/2017	11/6/2017	5	5	ETF-SB-126-5.0_11/06/2017
ETF-SB-130-7.0		ETF-SB-130-7.0_11/07/2017	11/7/2017	7	7	ETF-SB-130-7.0_11/07/2017
ETF-SB-131-6.0		ETF-SB-131-6.0_11/07/2017	11/7/2017	6	6	ETF-SB-131-6.0_11/07/2017
ETF-SB-131-7.5		ETF-SB-131-7.5_11/07/2017	11/7/2017	7.5	7.5	ETF-SB-131-7.5_11/07/2017
ETF-SB13-120-4.0		ETF-SB13-120-4.0_11/07/2017	11/7/2017	4	4	ETF-SB13-120-4.0_11/07/2017
ETF-SB-136-10.0		ETF-SB-136-10.0_11/07/2017	11/7/2017	10	10	ETF-SB-136-10.0_11/07/2017
ETF-SB-136-6.0		ETF-SB-136-6.0_11/07/2017	11/7/2017	6	6	ETF-SB-136-6.0_11/07/2017
ETF-SB-137-6.0		ETF-SB-137-6.0_11/07/2017	11/7/2017	6	6	ETF-SB-137-6.0_11/07/2017
ETF-SB-137-10.0		ETF-SB-137-10.0_11/07/2017	11/7/2017	10	10	ETF-SB-137-10.0_11/07/2017
ETF-SB-01-2.0		ETF-SB-01-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-01-2.0_11/02/2016
ETF-SB-01-0.5		ETF-SB-01-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-01-0.5_11/02/2016
ETF-SB01-13-0.5-D	ETF-SB01-13-0.5	ETF-SB01-13-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-13-0.5-D_10/30/2017
ETF-SB01-13-0.5		ETF-SB01-13-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-13-0.5_10/30/2017
ETF-SB01-13-2.0		ETF-SB01-13-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-13-2.0_10/30/2017
ETF-SB01-13-2.0-D	ETF-SB01-13-2.0	ETF-SB01-13-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-13-2.0-D_10/30/2017
ETF-SB01-14-0.5		ETF-SB01-14-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-14-0.5_10/30/2017
ETF-SB01-14-2.0		ETF-SB01-14-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-14-2.0_10/30/2017
ETF-SB01-16-0.5		ETF-SB01-16-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB01-16-0.5_10/30/2017
ETF-SB01-16-2.0		ETF-SB01-16-2.0_10/30/2017	10/30/2017	2	2	ETF-SB01-16-2.0_10/30/2017
ETF-SB-02-0.5		ETF-SB-02-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-02-0.5_11/02/2016
ETF-SB-02-2.0		ETF-SB-02-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-02-2.0_11/02/2016
ETF-SB-03-2.0		ETF-SB-03-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-03-2.0_11/02/2016
ETF-SB-03-0.5		ETF-SB-03-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-03-0.5_11/02/2016
ETF-SB-04-0.5		ETF-SB-04-0.5_11/01/2016	11/1/2016	0.5	0.5	ETF-SB-04-0.5_11/01/2016
ETF-SB-04-2.0		ETF-SB-04-2.0_11/01/2016	11/1/2016	2	2	ETF-SB-04-2.0_11/01/2016
ETF-SB04-18-0.5		ETF-SB04-18-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB04-18-0.5_10/30/2017
ETF-SB04-18-2.0		ETF-SB04-18-2.0_10/30/2017	10/30/2017	2	2	ETF-SB04-18-2.0_10/30/2017
ETF-SB04-19-0.5		ETF-SB04-19-0.5_10/31/2017	10/31/2017	0.5	0.5	ETF-SB04-19-0.5_10/31/2017
ETF-SB04-19-2.0		ETF-SB04-19-2.0_10/31/2017	10/31/2017	2	2	ETF-SB04-19-2.0_10/31/2017
ETF-SB04-19-0.5-D	ETF-SB04-19-0.5-D	ETF-SB04-19-0.5_10/31/2017	10/31/2017	0.5	0.5	ETF-SB04-19-0.5-D_10/31/2017
ETF-SB04-21-2.0		ETF-SB04-21-2.0_10/30/2017	10/30/2017	2	2	ETF-SB04-21-2.0_10/30/2017
ETF-SB04-21-0.5		ETF-SB04-21-0.5_10/30/2017	10/30/2017	0.5	0.5	ETF-SB04-21-0.5_10/30/2017
ETF-SB-05-0.5		ETF-SB-05-0.5_11/01/2016	11/1/2016	0.5	0.5	ETF-SB-05-0.5_11/01/2016
ETF-SB-05-2.0		ETF-SB-05-2.0_11/01/2016	11/1/2016	2	2	ETF-SB-05-2.0_11/01/2016
ETF-SB06-113-0.5		ETF-SB06-113-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB06-113-0.5_11/06/2017
ETF-SB06-113-2.0		ETF-SB06-113-2.0_11/06/2017	11/6/2017	2	2	ETF-SB06-113-2.0_11/06/2017
ETF-SB06-114-2.0		ETF-SB06-114-2.0_11/06/2017	11/6/2017	2	2	ETF-SB06-114-2.0_11/06/2017
ETF-SB06-114-0.5		ETF-SB06-114-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB06-114-0.5_11/06/2017
ETF-SB06-115-0.5		ETF-SB06-115-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB06-115-0.5_11/06/2017
ETF-SB06-115-2.0		ETF-SB06-115-2.0_11/06/2017	11/6/2017	2	2	ETF-SB06-115-2.0_11/06/2017
ETF-SB07-139-2.0		ETF-SB07-139-2.0_11/07/2017	11/7/2017	2	2	ETF-SB07-139-2.0_11/07/2017
ETF-SB07-139-0.5		ETF-SB07-139-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-139-0.5_11/07/2017
ETF-SB07-119-2.0		ETF-SB07-119-2.0_11/07/2017	11/7/2017	2	2	ETF-SB07-119-2.0_11/07/2017
ETF-SB07-118-2.0		ETF-SB07-118-2.0_11/07/2017	11/7/2017	2	2	ETF-SB07-118-2.0_11/07/2017

Appendix A.
Samples Evaluated in the HHRA
East Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
ETF-SB07-118-0.5		ETF-SB07-118-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-118-0.5_11/07/2017
ETF-SB07-116-0.5		ETF-SB07-116-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-116-0.5_11/07/2017
ETF-SB07-119-0.5		ETF-SB07-119-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB07-119-0.5_11/07/2017
ETF-SB07-116-1.0		ETF-SB07-116-1.0_11/07/2017	11/7/2017	1	1	ETF-SB07-116-1.0_11/07/2017
ETF-SB08-121-0.5-D	ETF-SB08-121-0.5	ETF-SB08-121-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-121-0.5-D_11/02/2017
ETF-SB08-121-2.0		ETF-SB08-121-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-121-2.0_11/02/2017
ETF-SB08-121-0.5		ETF-SB08-121-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-121-0.5_11/02/2017
ETF-SB08-122-2.0-D	ETF-SB08-122-2.0	ETF-SB08-122-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-122-2.0-D_11/02/2017
ETF-SB08-122-2.0		ETF-SB08-122-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-122-2.0_11/02/2017
ETF-SB08-122-0.5		ETF-SB08-122-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-122-0.5_11/02/2017
ETF-SB08-123-2.0		ETF-SB08-123-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-123-2.0_11/02/2017
ETF-SB08-123-2.0-D	ETF-SB08-123-2.0	ETF-SB08-123-2.0_11/02/2017	11/2/2017	2	2	ETF-SB08-123-2.0-D_11/02/2017
ETF-SB08-123-0.5		ETF-SB08-123-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB08-123-0.5_11/02/2017
ETF-SB09-129-0.5		ETF-SB09-129-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB09-129-0.5_11/06/2017
ETF-SB-09-2.0		ETF-SB-09-2.0_11/03/2016	11/3/2016	2	2	ETF-SB-09-2.0_11/03/2016
ETF-SB09-127-0.5		ETF-SB09-127-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB09-127-0.5_11/02/2017
ETF-SB09-128-0.5		ETF-SB09-128-0.5_11/02/2017	11/2/2017	0.5	0.5	ETF-SB09-128-0.5_11/02/2017
ETF-SB09-128-2.0		ETF-SB09-128-2.0_11/02/2017	11/2/2017	2	2	ETF-SB09-128-2.0_11/02/2017
ETF-SB-10-0.5		ETF-SB-10-0.5_11/02/2016	11/2/2016	0.5	0.5	ETF-SB-10-0.5_11/02/2016
ETF-SB-10-2.0		ETF-SB-10-2.0_11/02/2016	11/2/2016	2	2	ETF-SB-10-2.0_11/02/2016
ETF-SB-124-2.0		ETF-SB-124-2.0_11/06/2017	11/6/2017	2	2	ETF-SB-124-2.0_11/06/2017
ETF-SB-124-0.5		ETF-SB-124-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB-124-0.5_11/06/2017
ETF-SB-125-0.5		ETF-SB-125-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB-125-0.5_11/06/2017
ETF-SB-125-2.0		ETF-SB-125-2.0_11/06/2017	11/6/2017	2	2	ETF-SB-125-2.0_11/06/2017
ETF-SB-126-0.5		ETF-SB-126-0.5_11/06/2017	11/6/2017	0.5	0.5	ETF-SB-126-0.5_11/06/2017
ETF-SB-126-2.0		ETF-SB-126-2.0_11/06/2017	11/6/2017	2	2	ETF-SB-126-2.0_11/06/2017
ETF-SB-130-0.5		ETF-SB-130-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-130-0.5_11/07/2017
ETF-SB-130-2.0		ETF-SB-130-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-130-2.0_11/07/2017
ETF-SB-131-0.5		ETF-SB-131-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-131-0.5_11/07/2017
ETF-SB-131-2.0		ETF-SB-131-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-131-2.0_11/07/2017
ETF-SB13-120-2.0		ETF-SB13-120-2.0_11/07/2017	11/7/2017	2	2	ETF-SB13-120-2.0_11/07/2017
ETF-SB13-120-0.5		ETF-SB13-120-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB13-120-0.5_11/07/2017
ETF-SB-136-0.5		ETF-SB-136-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-136-0.5_11/07/2017
ETF-SB-136-2.0		ETF-SB-136-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-136-2.0_11/07/2017
ETF-SB-137-0.5		ETF-SB-137-0.5_11/07/2017	11/7/2017	0.5	0.5	ETF-SB-137-0.5_11/07/2017
ETF-SB-137-2.0		ETF-SB-137-2.0_11/07/2017	11/7/2017	2	2	ETF-SB-137-2.0_11/07/2017
ETF-SB-141-0.5		ETF-SB-141-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-141-0.5_12/03/2018
ETF-SB-141-2.0		ETF-SB-141-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-141-2.0_12/03/2018
ETF-SB-142-2.0		ETF-SB-142-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-142-2.0_12/03/2018
ETF-SB-142-0.5		ETF-SB-142-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-142-0.5_12/03/2018
ETF-SB-143-0.5		ETF-SB-143-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-143-0.5_12/03/2018
ETF-SB-143-2.0		ETF-SB-143-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-143-2.0_12/03/2018
ETF-SB-144-0.5		ETF-SB-144-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-144-0.5_12/03/2018
ETF-SB-144-2.0		ETF-SB-144-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-144-2.0_12/03/2018
ETF-SB-145-0.5		ETF-SB-145-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-145-0.5_12/03/2018
ETF-SB-145-2.0		ETF-SB-145-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-145-2.0_12/03/2018
ETF-SB-146-0.5		ETF-SB-146-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-146-0.5_12/03/2018
ETF-SB-146-2.0		ETF-SB-146-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-146-2.0_12/03/2018
ETF-SB-147-0.5		ETF-SB-147-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-147-0.5_12/03/2018
ETF-SB-147-2.0		ETF-SB-147-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-147-2.0_12/03/2018
ETF-SB-148-0.5		ETF-SB-148-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-148-0.5_12/03/2018
ETF-SB-148-2.0		ETF-SB-148-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-148-2.0_12/03/2018
ETF-SB-149-0.5		ETF-SB-149-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-149-0.5_12/03/2018
ETF-SB-149-2.0		ETF-SB-149-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-149-2.0_12/03/2018
ETF-SB-150-0.5		ETF-SB-150-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-150-0.5_12/03/2018
ETF-SB-150-0.5-DUP	ETF-SB-150-0.5	ETF-SB-150-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-150-0.5-DUP_12/03/2018
ETF-SB-150-2.0		ETF-SB-150-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-150-2.0_12/03/2018
ETF-SB-151-2.0-DUP	ETF-SB-151-2.0	ETF-SB-151-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-151-2.0-DUP_12/03/2018
ETF-SB-151-0.5		ETF-SB-151-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-151-0.5_12/03/2018
ETF-SB-151-0.5-DUP	ETF-SB-151-0.5	ETF-SB-151-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-151-0.5-DUP_12/03/2018
ETF-SB-151-2.0		ETF-SB-151-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-151-2.0_12/03/2018
ETF-SB-152-0.5		ETF-SB-152-0.5_12/06/2018	12/6/2018	0.5	0.5	ETF-SB-152-0.5_12/06/2018
ETF-SB-153-0.5		ETF-SB-153-0.5_12/04/2018	12/4/2018	0.5	0.5	ETF-SB-153-0.5_12/04/2018
ETF-SB-154-0.5		ETF-SB-154-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-154-0.5_12/03/2018
ETF-SB-154-2.0		ETF-SB-154-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-154-2.0_12/03/2018
ETF-SB-155-0.5		ETF-SB-155-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-155-0.5_12/03/2018
ETF-SB-155-2.0		ETF-SB-155-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-155-2.0_12/03/2018
ETF-SB-156-0.5		ETF-SB-156-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-156-0.5_12/03/2018

Appendix A.
Samples Evaluated in the HHRA
East Tank Farm - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
ETF-SB-156-2.0		ETF-SB-156-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-156-2.0_12/03/2018
ETF-SB-157-0.5		ETF-SB-157-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-157-0.5_12/03/2018
ETF-SB-158-0.5		ETF-SB-158-0.5_12/04/2018	12/4/2018	0.5	0.5	ETF-SB-158-0.5_12/04/2018
ETF-SB-158-2.0		ETF-SB-158-2.0_12/04/2018	12/4/2018	2	2	ETF-SB-158-2.0_12/04/2018
ETF-SB-159-0.5		ETF-SB-159-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-159-0.5_12/03/2018
ETF-SB-159-2.0		ETF-SB-159-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-159-2.0_12/03/2018
ETF-SB-160-0.5		ETF-SB-160-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-160-0.5_12/03/2018
ETF-SB-160-2.0		ETF-SB-160-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-160-2.0_12/03/2018
ETF-SB-161-0.5		ETF-SB-161-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-161-0.5_12/03/2018
ETF-SB-161-2.0		ETF-SB-161-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-161-2.0_12/03/2018
ETF-SB-162-0.5		ETF-SB-162-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-162-0.5_12/03/2018
ETF-SB-162-2.0		ETF-SB-162-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-162-2.0_12/03/2018
ETF-SB-163-0.5		ETF-SB-163-0.5_12/03/2018	12/3/2018	0.5	0.5	ETF-SB-163-0.5_12/03/2018
ETF-SB-163-2.0		ETF-SB-163-2.0_12/03/2018	12/3/2018	2	2	ETF-SB-163-2.0_12/03/2018

Appendix A.
Samples Evaluated in the HHRA
Residential Yards - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)
R101-001-12.0		R101-001-12.0 12/05/2018	12/5/2018	12	12
R101-001-2.0		R101-001-2.0 12/05/2018	12/5/2018	2	2
R101-001-6.0		R101-001-6.0 12/05/2018	12/5/2018	6	6
R101-002-12.0		R101-002-12.0 12/05/2018	12/5/2018	12	12
R101-002-2.0		R101-002-2.0 12/05/2018	12/5/2018	2	2
R101-002-6.0		R101-002-6.0 12/05/2018	12/5/2018	6	6
R101-003-12.0		R101-003-12.0 12/05/2018	12/5/2018	12	12
R101-003-2.0		R101-003-2.0 12/05/2018	12/5/2018	2	2
R101-003-6.0		R101-003-6.0 12/05/2018	12/5/2018	6	6
R101-004-12.0		R101-004-12.0 12/05/2018	12/5/2018	12	12
R101-004-2.0		R101-004-2.0 12/05/2018	12/5/2018	2	2
R101-004-6.0		R101-004-6.0 12/05/2018	12/5/2018	6	6
R101-005-12.0		R101-005-12.0 12/05/2018	12/5/2018	12	12
R101-005-2.0		R101-005-2.0 12/05/2018	12/5/2018	2	2
R101-005-6.0		R101-005-6.0 12/05/2018	12/5/2018	6	6
R101-006-12.0		R101-006-12.0 12/05/2018	12/5/2018	12	12
R101-006-2.0		R101-006-2.0 12/05/2018	12/5/2018	2	2
R101-006-6.0		R101-006-6.0 12/05/2018	12/5/2018	6	6
R102-001-12.0		R102-001-12.0 12/06/2018	12/6/2018	12	12
R102-001-2.0		R102-001-2.0 12/06/2018	12/6/2018	2	2
R102-001-2.0-DUP	R102-001-2.0	R102-001-2.0 12/06/2018	12/6/2018	2	2
R102-001-6.0		R102-001-6.0 12/06/2018	12/6/2018	6	6
R102-001-6.0-DUP	R102-001-6.0	R102-001-6.0 12/06/2018	12/6/2018	6	6
R102-002-12.0		R102-002-12.0 12/06/2018	12/6/2018	12	12
R102-002-2.0-DUP	R102-002-2.0	R102-002-2.0 12/06/2018	12/6/2018	2	2
R102-002-2.0		R102-002-2.0 12/06/2018	12/6/2018	2	2
R102-002-6.0		R102-002-6.0 12/06/2018	12/6/2018	6	6
R102-002-6.0-DUP	R102-002-6.0	R102-002-6.0 12/06/2018	12/6/2018	6	6
R102-003-12.0		R102-003-12.0 12/06/2018	12/6/2018	12	12
R102-003-2.0		R102-003-2.0 12/06/2018	12/6/2018	2	2
R102-003-6.0		R102-003-6.0 12/06/2018	12/6/2018	6	6
R102-004-12.0		R102-004-12.0 12/06/2018	12/6/2018	12	12
R102-004-2.0		R102-004-2.0 12/06/2018	12/6/2018	2	2
R102-004-2.0-DUP	R102-004-2.0	R102-004-2.0 12/06/2018	12/6/2018	2	2
R102-004-6.0		R102-004-6.0 12/06/2018	12/6/2018	6	6
R102-004-6.0-DUP	R102-004-6.0	R102-004-6.0 12/06/2018	12/6/2018	6	6
R102-005-12.0		R102-005-12.0 12/06/2018	12/6/2018	12	12
R102-005-2.0		R102-005-2.0 12/06/2018	12/6/2018	2	2
R102-005-6.0		R102-005-6.0 12/06/2018	12/6/2018	6	6
R102-006-12.0		R102-006-12.0 12/06/2018	12/6/2018	12	12
R102-006-2.0		R102-006-2.0 12/06/2018	12/6/2018	2	2
R102-006-2.0-DUP	R102-006-2.0	R102-006-2.0 12/06/2018	12/6/2018	2	2
R102-006-6.0-DUP	R102-006-6.0	R102-006-6.0 12/06/2018	12/6/2018	6	6
R102-006-6.0		R102-006-6.0 12/06/2018	12/6/2018	6	6
WO-002-001-00-51		WO-002-001-00-51 06/02/2015	6/2/2015 11:20:00 AM	0	1
WO-002-001-00-52	WO-002-001-00-51	WO-002-001-00-52 06/02/2015	6/2/2015 11:25:00 AM	0	1
WO-002-001-06-51		WO-002-001-06-51 06/02/2015	6/2/2015 2:30:00 PM	0	6
WO-002-001-12-51		WO-002-001-12-51 06/02/2015	6/2/2015 2:35:00 PM	6	12
WO-002-002-00-51		WO-002-002-00-51 06/02/2015	6/2/2015 11:45:00 AM	0	1
WO-002-002-06-51		WO-002-002-06-51 06/02/2015	6/2/2015 4:30:00 PM	0	6
WO-002-003-00-51		WO-002-003-00-51 06/02/2015	6/2/2015 1:30:00 PM	0	1
WO-002-003-06-51		WO-002-003-06-51 06/02/2015	6/2/2015 1:40:00 PM	0	6
WO-002-003-12-51		WO-002-003-12-51 06/02/2015	6/2/2015 1:45:00 PM	6	12

Appendix A.
Samples Evaluated in the HHRA
Residential Yards - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)
WO-002-004-00-51		WO-002-004-00-51 06/02/2015	6/2/2015 1:05:00 PM	0	1
WO-002-004-00-52	WO-002-004-00-51	WO-002-004-00-52 06/02/2015	6/2/2015 1:10:00 PM	0	1
WO-002-004-06-51		WO-002-004-06-51 06/02/2015	6/2/2015 4:45:00 PM	0	6
WO-005-001-00-51		WO-005-001-00-51 05/19/2015	5/19/2015 2:45:00 PM	0	1
WO-005-001-00-52	WO-005-001-00-51	WO-005-001-00-52 05/19/2015	5/19/2015 2:50:00 PM	0	1
WO-005-001-06-51		WO-005-001-06-51 05/21/2015	5/21/2015 11:05:00 AM	0	6
WO-005-001-12-51		WO-005-001-12-51 05/21/2015	5/21/2015 11:10:00 AM	6	12
WO-005-001-24-51		WO-005-001-24-51 05/21/2015	5/21/2015 11:15:00 AM	12	24
WO-005-001-24-52	WO-005-001-24-51	WO-005-001-24-52 05/21/2015	5/21/2015 11:20:00 AM	12	24
WO-005-002-00-51		WO-005-002-00-51 05/19/2015	5/19/2015 3:30:00 PM	0	1
WO-005-002-06-51		WO-005-002-06-51 05/21/2015	5/21/2015 2:30:00 PM	0	6
WO-005-002-12-51		WO-005-002-12-51 05/21/2015	5/21/2015 2:35:00 PM	6	12
WO-005-002-24-51		WO-005-002-24-51 05/21/2015	5/21/2015 2:40:00 PM	12	24
WO-005-002-24-52	WO-005-002-24-51	WO-005-002-24-52 05/21/2015	5/21/2015 2:45:00 PM	12	24
WO-005-003-00-51		WO-005-003-00-51 05/20/2015	5/20/2015 7:30:00 AM	0	1
WO-005-003-06-51		WO-005-003-06-51 05/21/2015	5/21/2015 2:00:00 PM	0	6
WO-005-003-12-51		WO-005-003-12-51 05/21/2015	5/21/2015 2:05:00 PM	6	12
WO-005-003-24-51		WO-005-003-24-51 05/21/2015	5/21/2015 2:10:00 PM	12	24
WO-005-004-00-51		WO-005-004-00-51 05/20/2015	5/20/2015 8:00:00 AM	0	1
WO-005-004-00-52	WO-005-004-00-51	WO-005-004-00-52 05/20/2015	5/20/2015 8:05:00 AM	0	1
WO-005-004-06-51		WO-005-004-06-51 05/21/2015	5/21/2015 3:10:00 PM	0	6
WO-005-004-12-51		WO-005-004-12-51 05/21/2015	5/21/2015 3:15:00 PM	6	12
WO-005-004-24-51		WO-005-004-24-51 05/21/2015	5/21/2015 3:15:00 PM	12	24
WO-005-005-00-51		WO-005-005-00-51 05/20/2015	5/20/2015 8:15:00 AM	0	1
WO-005-005-06-51		WO-005-005-06-51 05/21/2015	5/21/2015 4:20:00 PM	0	6
WO-005-005-12-51		WO-005-005-12-51 05/21/2015	5/21/2015 4:25:00 PM	6	12
WO-005-006-00-51		WO-005-006-00-51 05/20/2015	5/20/2015 8:40:00 AM	0	1
WO-005-006-06-51		WO-005-006-06-51 05/21/2015	5/21/2015 3:30:00 PM	0	6
WO-005-006-12-51		WO-005-006-12-51 05/21/2015	5/21/2015 3:35:00 PM	6	12
WO-005-006-24-51		WO-005-006-24-51 05/21/2015	5/21/2015 3:40:00 PM	12	24
WO-006-001-00-51		WO-006-001-00-51 05/18/2015	5/18/2015 3:15:00 PM	0	1
WO-006-001-06-51		WO-006-001-06-51 05/19/2015	5/19/2015 8:15:00 AM	0	6
WO-006-001-06-51_R		WO-006-001-06-51_R 05/22/2015	5/22/2015 8:00:00 AM	0	6
WO-006-001-12-51		WO-006-001-12-51 05/19/2015	5/19/2015 8:20:00 AM	6	12
WO-006-001-12-51_R		WO-006-001-12-51_R 05/22/2015	5/22/2015 8:05:00 AM	6	12
WO-006-001-24-51		WO-006-001-24-51 05/19/2015	5/19/2015 8:25:00 AM	12	24
WO-006-001-24-51_R		WO-006-001-24-51_R 05/22/2015	5/22/2015 8:10:00 AM	12	24
WO-006-002-00-51		WO-006-002-00-51 05/18/2015	5/18/2015 3:30:00 PM	0	1
WO-006-002-06-51		WO-006-002-06-51 05/19/2015	5/19/2015 8:40:00 AM	0	6
WO-006-002-06-51_R		WO-006-002-06-51_R 05/22/2015	5/22/2015 8:15:00 AM	0	6
WO-006-002-12-51		WO-006-002-12-51 05/19/2015	5/19/2015 8:45:00 AM	6	12
WO-006-002-12-51_R		WO-006-002-12-51_R 05/22/2015	5/22/2015 8:20:00 AM	6	12
WO-006-002-24-51		WO-006-002-24-51 05/19/2015	5/19/2015 8:50:00 AM	12	24
WO-006-003-00-51		WO-006-003-00-51 05/18/2015	5/18/2015 3:40:00 PM	0	1
WO-006-003-06-51		WO-006-003-06-51 05/19/2015	5/19/2015 10:15:00 AM	0	6
WO-006-003-12-51		WO-006-003-12-51 05/19/2015	5/19/2015 10:20:00 AM	6	12
WO-006-003-24-51		WO-006-003-24-51 05/19/2015	5/19/2015 10:25:00 AM	12	24
WO-006-003-24-52	WO-006-003-24-51	WO-006-003-24-52 05/19/2015	5/19/2015 10:30:00 AM	12	24
WO-006-004-00-51		WO-006-004-00-51 05/18/2015	5/18/2015 4:00:00 PM	0	1
WO-006-004-00-52	WO-006-004-00-51	WO-006-004-00-52 05/18/2015	5/18/2015 4:05:00 PM	0	1
WO-006-004-06-51		WO-006-004-06-51 05/19/2015	5/19/2015 9:20:00 AM	0	6
WO-006-004-12-51		WO-006-004-12-51 05/19/2015	5/19/2015 9:25:00 AM	6	12
WO-006-004-24-51		WO-006-004-24-51 05/19/2015	5/19/2015 9:30:00 AM	12	24

Appendix A.
Samples Evaluated in the HHRA
Residential Yards - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)
WO-006-005-00-51		WO-006-005-00-51 05/18/2015	5/18/2015 4:20:00 PM	0	1
WO-006-005-06-51		WO-006-005-06-51 05/19/2015	5/19/2015 10:45:00 AM	0	6
WO-006-005-12-51		WO-006-005-12-51 05/19/2015	5/19/2015 10:50:00 AM	6	12
WO-006-005-24-51		WO-006-005-24-51 05/19/2015	5/19/2015 10:55:00 AM	12	24
WO-006-006-00-51		WO-006-006-00-51 05/18/2015	5/18/2015 4:40:00 PM	0	1
WO-006-006-06-51		WO-006-006-06-51 05/19/2015	5/19/2015 11:45:00 AM	0	6
WO-006-006-12-51		WO-006-006-12-51 05/19/2015	5/19/2015 11:50:00 AM	6	12
WO-006-006-12-52	WO-006-006-12-51	WO-006-006-12-52 05/19/2015	5/19/2015 11:55:00 AM	6	12
WO-006-006-24-51		WO-006-006-24-51 05/19/2015	5/19/2015 12:00:00 PM	12	24
WO-006-007-00-51		WO-006-007-00-51 05/18/2015	5/18/2015 5:20:00 PM	0	1
WO-006-007-06-51		WO-006-007-06-51 05/19/2015	5/19/2015 12:15:00 PM	0	6
WO-006-007-12-51		WO-006-007-12-51 05/19/2015	5/19/2015 12:20:00 PM	6	12
WO-006-007-24-51		WO-006-007-24-51 05/19/2015	5/19/2015 12:25:00 PM	12	24
WO-006-008-00-51		WO-006-008-00-51 05/18/2015	5/18/2015 5:25:00 PM	0	1
WO-006-008-06-51		WO-006-008-06-51 05/19/2015	5/19/2015 12:40:00 PM	0	6
WO-006-008-12-51		WO-006-008-12-51 05/19/2015	5/19/2015 12:45:00 PM	6	12
WO-006-008-24-51		WO-006-008-24-51 05/19/2015	5/19/2015 12:50:00 PM	12	24
WO-008-001-00-51		WO-008-001-00-51 06/01/2015	6/1/2015 9:00:00 AM	0	1
WO-008-001-06-51		WO-008-001-06-51 06/01/2015	6/1/2015 9:50:00 AM	0	6
WO-008-001-12-51		WO-008-001-12-51 06/01/2015	6/1/2015 9:55:00 AM	6	12
WO-008-001-24-51		WO-008-001-24-51 06/01/2015	6/1/2015 10:00:00 AM	12	24
WO-008-002-00-51		WO-008-002-00-51 06/01/2015	6/1/2015 9:05:00 AM	0	1
WO-008-002-00-52	WO-008-002-00-51	WO-008-002-00-52 06/01/2015	6/1/2015 9:10:00 AM	0	1
WO-008-002-06-51		WO-008-002-06-51 06/01/2015	6/1/2015 10:25:00 AM	0	6
WO-008-002-12-51		WO-008-002-12-51 06/01/2015	6/1/2015 10:35:00 AM	6	12
WO-008-002-24-51		WO-008-002-24-51 06/01/2015	6/1/2015 10:40:00 AM	12	24
WO-008-003-00-51		WO-008-003-00-51 06/01/2015	6/1/2015 9:10:00 AM	0	1
WO-008-003-06-51		WO-008-003-06-51 06/01/2015	6/1/2015 11:50:00 AM	0	6
WO-008-003-12-51		WO-008-003-12-51 06/01/2015	6/1/2015 11:55:00 AM	6	12
WO-008-003-24-51		WO-008-003-24-51 06/01/2015	6/1/2015 11:55:00 AM	12	24
WO-008-004-00-51		WO-008-004-00-51 06/01/2015	6/1/2015 9:20:00 AM	0	1
WO-008-004-06-51		WO-008-004-06-51 06/01/2015	6/1/2015 11:10:00 AM	0	6
WO-008-004-12-51		WO-008-004-12-51 06/01/2015	6/1/2015 11:15:00 AM	6	12
WO-008-004-24-51		WO-008-004-24-51 06/01/2015	6/1/2015 11:20:00 AM	12	24
WO-008-004-24-52	WO-008-004-24-51	WO-008-004-24-52 06/01/2015	6/1/2015 11:25:00 AM	12	24
WO-011-001-00-51		WO-011-001-00-51 06/01/2015	6/1/2015 3:50:00 PM	0	1
WO-011-001-06-51		WO-011-001-06-51 06/02/2015	6/2/2015 8:55:00 AM	0	6
WO-011-001-12-51		WO-011-001-12-51 06/02/2015	6/2/2015 9:00:00 AM	6	12
WO-011-001-24-51		WO-011-001-24-51 06/02/2015	6/2/2015 9:05:00 AM	12	24
WO-011-002-00-51		WO-011-002-00-51 06/01/2015	6/1/2015 3:40:00 PM	0	1
WO-011-002-06-51		WO-011-002-06-51 06/02/2015	6/2/2015 8:15:00 AM	0	6
WO-011-002-12-51		WO-011-002-12-51 06/02/2015	6/2/2015 8:20:00 AM	6	12
WO-011-002-24-51		WO-011-002-24-51 06/02/2015	6/2/2015 8:25:00 AM	12	24
WO-011-002-24-52	WO-011-002-24-51	WO-011-002-24-52 06/02/2015	6/2/2015 8:30:00 AM	12	24
WO-011-003-00-51		WO-011-003-00-51 06/01/2015	6/1/2015 4:15:00 PM	0	1
WO-011-003-06-51		WO-011-003-06-51 06/02/2015	6/2/2015 9:10:00 AM	0	6
WO-011-003-12-51		WO-011-003-12-51 06/02/2015	6/2/2015 9:15:00 AM	6	12
WO-011-003-24-51		WO-011-003-24-51 06/02/2015	6/2/2015 9:20:00 AM	12	24
WO-011-004-00-51		WO-011-004-00-51 06/01/2015	6/1/2015 4:30:00 PM	0	1
WO-011-004-06-51		WO-011-004-06-51 06/02/2015	6/2/2015 9:50:00 AM	0	6
WO-011-004-12-51		WO-011-004-12-51 06/02/2015	6/2/2015 9:55:00 AM	6	12
WO-011-004-24-51		WO-011-004-24-51 06/02/2015	6/2/2015 10:00:00 AM	12	24
WO-017-001-00-51		WO-017-001-00-51 05/20/2015	5/20/2015 9:15:00 AM	0	1

Appendix A.
Samples Evaluated in the HHRA
Residential Yards - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)
WO-017-001-00-51S		WO-017-001-00-51S 06/08/2015	6/8/2015 11:00:00 AM	0	1
WO-017-001-06-51		WO-017-001-06-51 05/21/2015	5/21/2015 8:20:00 AM	0	6
WO-017-001-06-51S		WO-017-001-06-51S 06/09/2015	6/9/2015 4:00:00 PM	0	6
WO-017-001-06-52S	WO-017-001-06-51S	WO-017-001-06-52S 06/09/2015	6/9/2015 4:05:00 PM	0	6
WO-017-001-12-51		WO-017-001-12-51 05/21/2015	5/21/2015 8:25:00 AM	6	12
WO-017-002-00-51		WO-017-002-00-51 05/20/2015	5/20/2015 9:20:00 AM	0	1
WO-017-002-00-51S		WO-017-002-00-51S 06/10/2015	6/10/2015 9:43:00 AM	0	1
WO-017-002-06-51		WO-017-002-06-51 05/21/2015	5/21/2015 8:45:00 AM	0	6
WO-017-002-06-51S		WO-017-002-06-51S 06/08/2015	6/8/2015 1:51:00 PM	0	6
WO-017-002-12-51		WO-017-002-12-51 05/21/2015	5/21/2015 8:50:00 AM	6	12
WO-017-002-24-51		WO-017-002-24-51 05/21/2015	5/21/2015 8:55:00 AM	12	24
WO-017-003-00-51		WO-017-003-00-51 05/20/2015	5/20/2015 9:45:00 AM	0	1
WO-017-003-00-51S		WO-017-003-00-51S 06/10/2015	6/10/2015 11:00:00 AM	0	1
WO-017-003-00-52	WO-017-003-00-51	WO-017-003-00-52 05/20/2015	5/20/2015 9:50:00 AM	0	1
WO-017-003-06-51		WO-017-003-06-51 05/21/2015	5/21/2015 9:30:00 AM	0	6
WO-017-003-06-51S		WO-017-003-06-51S 06/10/2015	6/10/2015 3:18:00 PM	0	6
WO-017-003-12-51		WO-017-003-12-51 05/21/2015	5/21/2015 9:35:00 AM	6	12
WO-017-003-12-52	WO-017-003-12-51	WO-017-003-12-52 05/21/2015	5/21/2015 9:40:00 AM	6	12
WO-017-003-24-51		WO-017-003-24-51 05/21/2015	5/21/2015 9:45:00 AM	12	24
WO-017-004-00-51		WO-017-004-00-51 05/20/2015	5/20/2015 9:40:00 AM	0	1
WO-017-004-00-51S		WO-017-004-00-51S 06/09/2015	6/9/2015 11:26:00 AM	0	1
WO-017-004-06-51		WO-017-004-06-51 05/21/2015	5/21/2015 10:05:00 AM	0	6
WO-017-004-06-51S		WO-017-004-06-51S 06/10/2015	6/10/2015 4:00:00 PM	0	6
WO-017-004-12-51		WO-017-004-12-51 05/21/2015	5/21/2015 10:10:00 AM	6	12
WO-017-004-24-51		WO-017-004-24-51 05/21/2015	5/21/2015 10:15:00 AM	12	24
WO-017-005-00-51		WO-017-005-00-51 05/20/2015	5/20/2015 8:10:00 AM	0	1
WO-017-005-00-51S		WO-017-005-00-51S 06/11/2015	6/11/2015 9:00:00 AM	0	1
WO-017-005-06-51		WO-017-005-06-51 05/20/2015	5/20/2015 10:20:00 AM	0	6
WO-017-005-06-51S		WO-017-005-06-51S 06/10/2015	6/10/2015 2:33:00 PM	0	6
WO-017-005-12-51		WO-017-005-12-51 05/20/2015	5/20/2015 10:25:00 AM	6	12
WO-017-005-24-51		WO-017-005-24-51 05/20/2015	5/20/2015 10:30:00 AM	12	24
WO-017-006-00-51		WO-017-006-00-51 05/20/2015	5/20/2015 8:55:00 AM	0	1
WO-017-006-00-51S		WO-017-006-00-51S 06/11/2015	6/11/2015 10:40:00 AM	0	1
WO-017-006-06-51		WO-017-006-06-51 05/20/2015	5/20/2015 2:50:00 PM	0	6
WO-017-006-06-51S		WO-017-006-06-51S 06/10/2015	6/10/2015 11:50:00 AM	0	6
WO-017-006-12-51		WO-017-006-12-51 05/20/2015	5/20/2015 2:55:00 PM	6	12
WO-019-001-00-51		WO-019-001-00-51 06/03/2015	6/3/2015 2:40:00 PM	0	1
WO-019-001-00-52	WO-019-001-00-51	WO-019-001-00-52 06/03/2015	6/3/2015 2:45:00 PM	0	1
WO-019-001-06-51		WO-019-001-06-51 06/03/2015	6/3/2015 3:15:00 PM	0	6
WO-019-002-00-51		WO-019-002-00-51 06/03/2015	6/3/2015 3:00:00 PM	0	1
WO-019-002-06-51		WO-019-002-06-51 06/03/2015	6/3/2015 3:40:00 PM	0	6
WO-019-003-00-51		WO-019-003-00-51 06/04/2015	6/4/2015 8:10:00 AM	0	1
WO-019-003-00-52	WO-019-003-00-51	WO-019-003-00-52 06/04/2015	6/4/2015 8:15:00 AM	0	1
WO-019-003-06-51		WO-019-003-06-51 06/04/2015	6/4/2015 8:30:00 AM	0	6
WO-019-004-00-51		WO-019-004-00-51 06/04/2015	6/4/2015 9:40:00 AM	0	1
WO-019-004-06-51		WO-019-004-06-51 06/04/2015	6/4/2015 11:00:00 AM	0	6
WO-019-005-00-51		WO-019-005-00-51 06/04/2015	6/4/2015 8:35:00 AM	0	1
WO-019-005-00-52	WO-019-005-00-51	WO-019-005-00-52 06/04/2015	6/4/2015 8:40:00 AM	0	1
WO-019-005-06-51		WO-019-005-06-51 06/04/2015	6/4/2015 9:00:00 AM	0	6
WO-019-005-12-51		WO-019-005-12-51 06/04/2015	6/4/2015 9:05:00 AM	6	12
WO-019-005-24-51		WO-019-005-24-51 06/04/2015	6/4/2015 9:10:00 AM	12	24
WO-019-006-00-51		WO-019-006-00-51 06/04/2015	6/4/2015 9:35:00 AM	0	1
WO-019-006-06-51		WO-019-006-06-51 06/04/2015	6/4/2015 10:25:00 AM	0	6

Appendix A.
Samples Evaluated in the HHRA
Residential Yards - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)
WO-019-007-00-51		WO-019-007-00-51_06/04/2015	6/4/2015 9:05:00 AM	0	1
WO-019-007-06-51		WO-019-007-06-51_06/04/2015	6/4/2015 9:45:00 AM	0	6
WO-019-007-12-51		WO-019-007-12-51_06/04/2015	6/4/2015 9:50:00 AM	6	12
WO-019-007-24-51		WO-019-007-24-51_06/04/2015	6/4/2015 9:55:00 AM	12	24
WO-019-008-00-51		WO-019-008-00-51_06/04/2015	6/4/2015 9:30:00 AM	0	1
WO-019-008-06-51		WO-019-008-06-51_06/04/2015	6/4/2015 10:30:00 AM	0	6
WO-019-008-12-51		WO-019-008-12-51_06/04/2015	6/4/2015 10:35:00 AM	6	12
WO-020-001-00-51		WO-020-001-00-51_05/18/2015	5/18/2015 2:00:00 PM	0	1
WO-020-001-00-51S		WO-020-001-00-51S_06/11/2015	6/11/2015 9:53:00 AM	0	1
WO-020-001-06-51		WO-020-001-06-51_05/18/2015	5/18/2015 2:05:00 PM	0	6
WO-020-001-06-51S		WO-020-001-06-51S_06/11/2015	6/11/2015 2:12:00 PM	0	6
WO-020-001-12-51		WO-020-001-12-51_05/18/2015	5/18/2015 2:10:00 PM	6	12
WO-020-001-24-51		WO-020-001-24-51_05/18/2015	5/18/2015 2:15:00 PM	12	24
WO-020-001-24-52	WO-020-001-24-51	WO-020-001-24-52_05/18/2015	5/18/2015 2:20:00 PM	12	24
WO-020-002-00-51		WO-020-002-00-51_05/18/2015	5/18/2015 1:15:00 PM	0	1
WO-020-002-00-51S		WO-020-002-00-51S_06/11/2015	6/11/2015 3:06:00 PM	0	1
WO-020-002-06-51		WO-020-002-06-51_05/18/2015	5/18/2015 1:20:00 PM	0	6
WO-020-002-06-51S		WO-020-002-06-51S_06/08/2015	6/8/2015 3:00:00 PM	0	6
WO-020-002-06-52S	WO-020-002-06-51S	WO-020-002-06-52S_06/08/2015	6/8/2015 3:05:00 PM	0	6
WO-020-002-12-51		WO-020-002-12-51_05/18/2015	5/18/2015 1:25:00 PM	6	12
WO-020-002-24-51		WO-020-002-24-51_05/18/2015	5/18/2015 1:30:00 PM	12	24
WO-020-003-00-51		WO-020-003-00-51_05/18/2015	5/18/2015 10:15:00 AM	0	1
WO-020-003-00-51S		WO-020-003-00-51S_06/11/2015	6/11/2015 3:47:00 PM	0	1
WO-020-003-00-52	WO-020-003-00-51	WO-020-003-00-52_05/18/2015	5/18/2015 10:20:00 AM	0	1
WO-020-003-06-51		WO-020-003-06-51_05/18/2015	5/18/2015 10:25:00 AM	0	6
WO-020-003-06-51S		WO-020-003-06-51S_06/12/2015	6/12/2015 9:07:00 AM	0	6
WO-020-003-12-51		WO-020-003-12-51_05/18/2015	5/18/2015 10:30:00 AM	6	12
WO-020-003-24-51		WO-020-003-24-51_05/18/2015	5/18/2015 10:35:00 AM	12	24
WO-020-004-00-51		WO-020-004-00-51_05/18/2015	5/18/2015 9:45:00 AM	0	1
WO-020-004-00-51S		WO-020-004-00-51S_06/11/2015	6/11/2015 4:20:00 PM	0	1
WO-020-004-06-51		WO-020-004-06-51_05/18/2015	5/18/2015 9:50:00 AM	0	6
WO-020-004-06-51S		WO-020-004-06-51S_06/11/2015	6/11/2015 11:45:00 AM	0	6
WO-020-004-12-51		WO-020-004-12-51_05/18/2015	5/18/2015 9:55:00 AM	6	12
WO-020-004-24-51		WO-020-004-24-51_05/18/2015	5/18/2015 10:00:00 AM	12	24
WO-020-005-00-51		WO-020-005-00-51_05/18/2015	5/18/2015 8:05:00 AM	0	1
WO-020-005-00-51S		WO-020-005-00-51S_06/08/2015	6/8/2015 3:42:00 PM	0	1
WO-020-005-06-51		WO-020-005-06-51_05/18/2015	5/18/2015 8:10:00 AM	0	6
WO-020-005-06-51S		WO-020-005-06-51S_06/08/2015	6/8/2015 4:25:00 PM	0	6
WO-020-005-12-51		WO-020-005-12-51_05/18/2015	5/18/2015 8:15:00 AM	6	12
WO-020-005-24-51		WO-020-005-24-51_05/18/2015	5/18/2015 8:20:00 AM	12	24
WO-020-006-00-51		WO-020-006-00-51_05/18/2015	5/18/2015 9:15:00 AM	0	1
WO-020-006-00-51S		WO-020-006-00-51S_06/11/2015	6/11/2015 1:49:00 PM	0	1
WO-020-006-06-51		WO-020-006-06-51_05/18/2015	5/18/2015 9:20:00 AM	0	6
WO-020-006-06-51S		WO-020-006-06-51S_06/12/2015	6/12/2015 10:42:00 AM	0	6
WO-020-006-12-51		WO-020-006-12-51_05/18/2015	5/18/2015 9:25:00 AM	6	12
WO-020-006-24-51		WO-020-006-24-51_05/18/2015	5/18/2015 9:30:00 AM	12	24
WO-021-001-00-51		WO-021-001-00-51_06/03/2015	6/3/2015 7:55:00 AM	0	1
WO-021-001-06-51		WO-021-001-06-51_06/03/2015	6/3/2015 9:15:00 AM	0	6
WO-021-001-12-51		WO-021-001-12-51_06/03/2015	6/3/2015 9:20:00 AM	6	12
WO-021-001-24-51		WO-021-001-24-51_06/03/2015	6/3/2015 9:25:00 AM	12	24
WO-021-003-00-51		WO-021-003-00-51_06/03/2015	6/3/2015 8:05:00 AM	0	1
WO-021-003-00-52	WO-021-003-00-51	WO-021-003-00-52_06/03/2015	6/3/2015 8:10:00 AM	0	1
WO-021-003-06-51		WO-021-003-06-51_06/03/2015	6/3/2015 9:45:00 AM	0	6

Appendix A.
Samples Evaluated in the HHRA
Residential Yards - Surface and Subsurface Soil

Sample Name	Parent Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)
WO-021-003-12-51		WO-021-003-12-51_06/03/2015	6/3/2015 9:50:00 AM	6	12
WO-021-003-24-51		WO-021-003-24-51_06/03/2015	6/3/2015 9:55:00 AM	12	24
WO-021-004-00-51		WO-021-004-00-51_06/03/2015	6/3/2015 8:25:00 AM	0	1
WO-021-004-00-52	WO-021-004-00-51	WO-021-004-00-52_06/03/2015	6/3/2015 8:30:00 AM	0	1
WO-021-004-06-51		WO-021-004-06-51_06/03/2015	6/3/2015 11:20:00 AM	0	6
WO-021-004-12-51		WO-021-004-12-51_06/03/2015	6/3/2015 11:25:00 AM	6	12
WO-021-004-24-51		WO-021-004-24-51_06/03/2015	6/3/2015 11:30:00 AM	12	24
WO-021-005-00-51		WO-021-005-00-51_06/03/2015	6/3/2015 8:45:00 AM	0	1
WO-021-005-06-51		WO-021-005-06-51_06/03/2015	6/3/2015 10:20:00 AM	0	6
WO-021-005-12-51		WO-021-005-12-51_06/03/2015	6/3/2015 10:25:00 AM	6	12
WO-021-005-24-51		WO-021-005-24-51_06/03/2015	6/3/2015 10:30:00 AM	12	24
WO-021-006-00-51		WO-021-006-00-51_06/03/2015	6/3/2015 9:30:00 AM	0	1
WO-021-006-06-51		WO-021-006-06-51_06/03/2015	6/3/2015 11:05:00 AM	0	6
WO-021-006-12-51		WO-021-006-12-51_06/03/2015	6/3/2015 11:10:00 AM	6	12
WO-021-006-24-51		WO-021-006-24-51_06/03/2015	6/3/2015 11:15:00 AM	12	24
WO-021-007-00-51		WO-021-007-00-51_06/03/2015	6/3/2015 9:00:00 AM	0	1
WO-021-007-06-51		WO-021-007-06-51_06/03/2015	6/3/2015 11:40:00 AM	0	6
WO-021-007-12-51		WO-021-007-12-51_06/03/2015	6/3/2015 11:45:00 AM	6	12
WO-021-007-24-51		WO-021-007-24-51_06/03/2015	6/3/2015 11:50:00 AM	12	24

Appendix A.
Samples Evaluated in the HHRA
Background

Sample Name	Final Sample Name	Sample Date	Starting Depth (ft)	Ending Depth (ft)	Sample Code
ETUC-SD-0.5	ETUC-SD-0.5_10/23/2017	10/23/2017	0.5	0.5	ETUC-SD-0.5_10/23/2017
SCUC1a-SD-0.5	SCUC1A-SD-0.5_10/18/2017	10/18/2017	0.5	0.5	SCUC1A-SD-0.5_10/18/2017
SCUC1c-SD-0.5	SCUC1C-SD-0.5_10/17/2017	10/17/2017	0.5	0.5	SCUC1C-SD-0.5_10/17/2017
SCUC1-SD-0.5	SCUC1-SD-0.5_10/17/2017	10/17/2017	0.5	0.5	SCUC1-SD-0.5_10/17/2017
WTUC-SD-01-0.5	WTUC-SD-01-0.5_10/24/2017	10/24/2017	0.5	0.5	WTUC-SD-01-0.5_10/24/2017
WTUC-SD-0.5	WTUC-SD-0.5_10/24/2017	10/24/2017	0.5	0.5	WTUC-SD-0.5_10/24/2017
BKG-01-0.5	BKG-01-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-01-0.5_11/02/2017
BKG-02-0.5	BKG-02-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-02-0.5_11/02/2017
BKG-03-0.5	BKG-03-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-03-0.5_11/02/2017
BKG-04-0.5	BKG-04-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-04-0.5_11/02/2017
BKG-05-0.5	BKG-05-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-05-0.5_11/02/2017
BKG-06-0.5	BKG-06-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-06-0.5_11/02/2017
BKG-07-0.5	BKG-07-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-07-0.5_11/02/2017
BKG-08-0.5	BKG-08-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-08-0.5_11/02/2017
BKG-09-0.5	BKG-09-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-09-0.5_11/02/2017
BKG-10-0.5	BKG-10-0.5_11/02/2017	11/2/2017	0.5	0.5	BKG-10-0.5_11/02/2017
ETUC-SW-F	ETUC-SW-F_10/23/2017	10/23/2017	--	--	ETUC-SW-F_10/23/2017
ETUC-SW	ETUC-SW_10/23/2017	10/23/2017	--	--	ETUC-SW_10/23/2017
SCUC1a-SW	SCUC1A-SW_10/18/2017	10/18/2017	--	--	SCUC1A-SW_10/18/2017
SCUC1a-SW-F	SCUC1A-SW-F_10/18/2017	10/18/2017	--	--	SCUC1A-SW-F_10/18/2017
SCUC1c-SW	SCUC1C-SW_10/17/2017	10/17/2017	--	--	SCUC1C-SW_10/17/2017
SCUC1c-SW-F	SCUC1C-SW-F_10/17/2017	10/17/2017	--	--	SCUC1C-SW-F_10/17/2017
WTUC-SW	WTUC-SW_10/24/2017	10/24/2017	--	--	WTUC-SW_10/24/2017
WTUC-SW-F	WTUC-SW-F_10/24/2017	10/24/2017	--	--	WTUC-SW-F_10/24/2017

APPENDIX B

ProUCL Outputs

(electronic versions only)

Surface Soil Background ProUCL Outputs

Background Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/17/2019 6:12:12 PM
 From File ProUCL Inputs BKG SS.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Coverage 95%
 Different or Future K Observations 1
 Number of Bootstrap Operations 10000

1234678-HpCDF

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	1.7000E-7	First Quartile	3.4875E-7
Second Largest	5.3000E-6	Median	5.6700E-7
Maximum	8.6700E-6	Third Quartile	3.8750E-6
Mean	2.2906E-6	SD	2.9109E-6
Coefficient of Variation	N/A	Skewness	1.437
Mean of logged Data	-13.82	SD of logged Data	1.399

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.762	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.308	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	1.0764E-5	90% Percentile (z)	6.0211E-6
95% UPL (t)	7.8870E-6	95% Percentile (z)	7.0786E-6
95% USL	8.6249E-6	99% Percentile (z)	9.0624E-6

Gamma GOF Test

A-D Test Statistic	0.697	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.264	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.277	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.721	k star (bias corrected MLE)	0.571
Theta hat (MLE)	3.1776E-6	Theta star (bias corrected MLE)	4.0097E-6
nu hat (MLE)	14.42	nu star (bias corrected)	11.43
MLE Mean (bias corrected)	2.2906E-6	MLE Sd (bias corrected)	3.0306E-6

Background Statistics Assuming Gamma Distribution

Surface Soil Background ProUCL Outputs

95% Wilson Hilferty (WH) Approx. Gamma UPL	9.7405E-6	90% Percentile	6.0229E-6
95% Hawkins Wixley (HW) Approx. Gamma UPL	1.0400E-5	95% Percentile	8.3893E-6
95% WH Approx. Gamma UTL with 95% Coverage	1.8951E-5	99% Percentile	1.4138E-5
95% HW Approx. Gamma UTL with 95% Coverage	2.2413E-5		
95% WH USL	1.1723E-5	95% HW USL	1.2848E-5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.895	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.223	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	5.8378E-5	90% Percentile (z)	5.9715E-6
95% UPL (t)	1.4643E-5	95% Percentile (z)	9.9278E-6
95% USL	2.0876E-5	99% Percentile (z)	2.5762E-5

Nonparametric Distribution Free Background Statistics

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	8.6700E-6
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	8.6700E-6	95% BCA Bootstrap UTL with 95% Coverage	8.6700E-6
95% UPL	8.6700E-6	90% Percentile	5.6370E-6
90% Chebyshev UPL	1.1450E-5	95% Percentile	7.1535E-6
95% Chebyshev UPL	1.5598E-5	99% Percentile	8.3667E-6
95% USL	8.6700E-6		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

1234789-HpCDF

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	10		
Number of Detects	5	Number of Non-Detects	5
Number of Distinct Detects	5	Number of Distinct Non-Detects	5
Minimum Detect	5.1400E-8	Minimum Non-Detect	5.3100E-6
Maximum Detect	1.7700E-7	Maximum Non-Detect	5.4800E-6
Variance Detected	2.678E-15	Percent Non-Detects	50%
Mean Detected	8.7080E-8	SD Detected	5.1746E-8
Mean of Detected Logged Data	-16.37	SD of Detected Logged Data	0.494

Surface Soil Background ProUCL Outputs

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL) 2.911

d2max (for USL) 2.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.754	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.324	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level
Detected Data appear Approximate Normal at 5% Significance Level		

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	8.7080E-8	KM SD	4.6283E-8
95% UTL95% Coverage	2.2181E-7	95% KM UPL (t)	1.7606E-7
90% KM Percentile (z)	1.4639E-7	95% KM Percentile (z)	1.6321E-7
99% KM Percentile (z)	1.9475E-7	95% KM USL	1.8779E-7

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	1.3910E-6	SD	1.3751E-6
95% UTL95% Coverage	5.3940E-6	95% UPL (t)	4.0348E-6
90% Percentile (z)	3.1533E-6	95% Percentile (z)	3.6529E-6
99% Percentile (z)	4.5901E-6	95% USL	4.3834E-6

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.544	Anderson-Darling GOF Test
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	4.674	k star (bias corrected MLE)	2.003
Theta hat (MLE)	1.8632E-8	Theta star (bias corrected MLE)	4.3480E-8
nu hat (MLE)	46.74	nu star (bias corrected)	20.03
MLE Mean (bias corrected)	8.7080E-8		
MLE Sd (bias corrected)	6.1532E-8	95% Percentile of Chisquare (2kstar)	9.497

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	5.1400E-8	Mean	0.005
Maximum	0.01	Median	0.005
SD	0.00527	CV	1.054
k hat (MLE)	0.148	k star (bias corrected MLE)	0.171
Theta hat (MLE)	0.0337	Theta star (bias corrected MLE)	0.0293
nu hat (MLE)	2.968	nu star (bias corrected)	3.411
MLE Mean (bias corrected)	0.005	MLE Sd (bias corrected)	0.0121

Surface Soil Background ProUCL Outputs

95% Percentile of Chisquare (2kstar)	1.827	90% Percentile	0.015
95% Percentile	0.0268	99% Percentile	0.0601

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.0816	0.153	95% Approx. Gamma UPL	0.034	0.0488
95% Gamma USL	0.0436	0.0676			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	8.7080E-8	SD (KM)	4.6283E-8
Variance (KM)	2.142E-15	SE of Mean (KM)	2.3141E-8
k hat (KM)	3.54	k star (KM)	2.545
nu hat (KM)	70.8	nu star (KM)	50.89
theta hat (KM)	2.4599E-8	theta star (KM)	3.4221E-8
80% gamma percentile (KM)	1.2668E-7	90% gamma percentile (KM)	1.6022E-7
95% gamma percentile (KM)	1.9178E-7	99% gamma percentile (KM)	2.6082E-7

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	2.5139E-7	2.5745E-7	95% Approx. Gamma UPL	1.7896E-7	1.7961E-7
95% KM Gamma Percentile	1.6147E-7	1.6134E-7	95% Gamma USL	1.9599E-7	1.9760E-7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.856	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.24	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	8.2514E-8	Mean in Log Scale	-16.37
SD in Original Scale	3.4831E-8	SD in Log Scale	0.329
95% UTL95% Coverage	2.0319E-7	95% BCA UTL95% Coverage	1.7700E-7
95% Bootstrap (%) UTL95% Coverage	1.7700E-7	95% UPL (t)	1.4676E-7
90% Percentile (z)	1.1885E-7	95% Percentile (z)	1.3394E-7
99% Percentile (z)	1.6762E-7	95% USL	1.5953E-7

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-16.37	95% KM UTL (Lognormal)95% Coverage	2.8188E-7
KM SD of Logged Data	0.442	95% KM UPL (Lognormal)	1.8218E-7
95% KM Percentile Lognormal (z)	1.6116E-7	95% KM USL (Lognormal)	2.0376E-7

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	1.3910E-6	Mean in Log Scale	-14.6
SD in Original Scale	1.3751E-6	SD in Log Scale	1.896
95% UTL95% Coverage	1.1438E-4	95% UPL (t)	1.7555E-5
90% Percentile (z)	5.2061E-6	95% Percentile (z)	1.0368E-5
99% Percentile (z)	3.7747E-5	95% USL	2.8388E-5

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Surface Soil Background ProUCL Outputs

Nonparametric Distribution Free Background Statistics

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

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with 95% Coverage	5.4800E-6
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	5.4800E-6
95% USL	5.4800E-6	95% KM Chebyshev UPL	2.9867E-7

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

123789-HxCDF

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	9		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	8
Minimum Detect	1.2400E-7	Minimum Non-Detect	5.2300E-6
Maximum Detect	1.2400E-7	Maximum Non-Detect	5.4800E-6
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	1.2400E-7	SD Detected	N/A
Mean of Detected Logged Data	-15.9	SD of Detected Logged Data	N/A

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 123789-HxCDF was not processed!

12378-PeCDD

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	9		
Number of Detects	7	Number of Non-Detects	3
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	1.8700E-8	Minimum Non-Detect	5.3300E-6
Maximum Detect	2.0200E-7	Maximum Non-Detect	5.4200E-6
Variance Detected	4.251E-15	Percent Non-Detects	30%
Mean Detected	7.7871E-8	SD Detected	6.5199E-8
Mean of Detected Logged Data	-16.69	SD of Detected Logged Data	0.906

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Surface Soil Background ProUCL Outputs

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.876	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.185	Lilliefors GOF Test
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	7.7871E-8	KM SD	6.0362E-8	
95% UTL	95% Coverage	2.5359E-7	95% KM UPL (t)	1.9392E-7
90% KM Percentile (z)	1.5523E-7	95% KM Percentile (z)	1.7716E-7	
99% KM Percentile (z)	2.1830E-7	95% KM USL	2.0922E-7	

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	8.6301E-7	SD	1.2654E-6	
95% UTL	95% Coverage	4.5465E-6	95% UPL (t)	3.2958E-6
90% Percentile (z)	2.4847E-6	95% Percentile (z)	2.9444E-6	
99% Percentile (z)	3.8067E-6	95% USL	3.6165E-6	

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.273	Anderson-Darling GOF Test
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.17	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.316	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.681	k star (bias corrected MLE)	1.056
Theta hat (MLE)	4.6335E-8	Theta star (bias corrected MLE)	7.3770E-8
nu hat (MLE)	23.53	nu star (bias corrected)	14.78
MLE Mean (bias corrected)	7.7871E-8		
MLE Sd (bias corrected)	7.5793E-8	95% Percentile of Chisquare (2kstar)	6.205

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.8700E-8	Mean	0.003
Maximum	0.01	Median	1.0245E-7
SD	0.00483	CV	1.61
k hat (MLE)	0.11	k star (bias corrected MLE)	0.144
Theta hat (MLE)	0.0272	Theta star (bias corrected MLE)	0.0208
nu hat (MLE)	2.209	nu star (bias corrected)	2.88
MLE Mean (bias corrected)	0.003	MLE Sd (bias corrected)	0.00791
95% Percentile of Chisquare (2kstar)	1.597	90% Percentile	0.00884
95% Percentile	0.0166	99% Percentile	0.0395

Surface Soil Background ProUCL Outputs

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.0485	0.078	95% Approx. Gamma UPL	0.0184	0.022
95% Gamma USL	0.0243	0.0317			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	7.7871E-8	SD (KM)	6.0362E-8
Variance (KM)	3.644E-15	SE of Mean (KM)	2.4643E-8
k hat (KM)	1.664	k star (KM)	1.232
nu hat (KM)	33.29	nu star (KM)	24.63
theta hat (KM)	4.6790E-8	theta star (KM)	6.3225E-8
80% gamma percentile (KM)	1.2299E-7	90% gamma percentile (KM)	1.7031E-7
95% gamma percentile (KM)	2.1690E-7	99% gamma percentile (KM)	3.2349E-7

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	3.6969E-7	4.0707E-7	95% Approx. Gamma UPL	2.2609E-7	2.3536E-7
95% KM Gamma Percentile	1.9381E-7	1.9886E-7	95% Gamma USL	2.5851E-7	2.7285E-7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.932	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.168	Lilliefors GOF Test
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	7.2704E-8	Mean in Log Scale	-16.69
SD in Original Scale	5.5523E-8	SD in Log Scale	0.774
95% UTL95% Coverage	5.3456E-7	95% BCA UTL95% Coverage	2.0200E-7
95% Bootstrap (%) UTL95% Coverage	2.0200E-7	95% UPL (t)	2.4879E-7
90% Percentile (z)	1.5150E-7	95% Percentile (z)	2.0068E-7
99% Percentile (z)	3.4003E-7	95% USL	3.0271E-7

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-16.69	95% KM UTL (Lognormal)95% Coverage	6.4567E-7
KM SD of Logged Data	0.839	95% KM UPL (Lognormal)	2.8184E-7
95% KM Percentile Lognormal (z)	2.2328E-7	95% KM USL (Lognormal)	3.4860E-7

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	8.6301E-7	Mean in Log Scale	-15.53
SD in Original Scale	1.2654E-6	SD in Log Scale	2.01
95% UTL95% Coverage	6.2472E-5	95% UPL (t)	8.5638E-6
90% Percentile (z)	2.3602E-6	95% Percentile (z)	4.8997E-6
99% Percentile (z)	1.9284E-5	95% USL	1.4256E-5

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Surface Soil Background ProUCL Outputs

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

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with 95% Coverage	5.4200E-6
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	5.4200E-6
95% USL	5.4200E-6	95% KM Chebyshev UPL	3.5383E-7

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Aluminum

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	1890	First Quartile	2170
Second Largest	3550	Median	2635
Maximum	4170	Third Quartile	3415
Mean	2804	SD	758.9
Coefficient of Variation	0.271	Skewness	0.564
Mean of logged Data	7.907	SD of logged Data	0.266

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.923
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.187
5% Lilliefors Critical Value	0.262

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	5013	90% Percentile (z)	3777
95% UPL (t)	4263	95% Percentile (z)	4052
95% USL	4455	99% Percentile (z)	4569

Gamma GOF Test

A-D Test Statistic	0.363
5% A-D Critical Value	0.725
K-S Test Statistic	0.199
5% K-S Critical Value	0.266

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	15.73	k star (bias corrected MLE)	11.08
Theta hat (MLE)	178.2	Theta star (bias corrected MLE)	253.1

Surface Soil Background ProUCL Outputs

nu hat (MLE)	314.6	nu star (bias corrected)	221.6
MLE Mean (bias corrected)	2804	MLE Sd (bias corrected)	842.4

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	4414	90% Percentile	3923
95% Hawkins Wixley (HW) Approx. Gamma UPL	4439	95% Percentile	4318
95% WH Approx. Gamma UTL with 95% Coverage	5489	99% Percentile	5125
95% HW Approx. Gamma UTL with 95% Coverage	5574		
95% WH USL	4675	95% HW USL	4712

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	5884	90% Percentile (z)	3817
95% UPL (t)	4525	95% Percentile (z)	4203
95% USL	4841	99% Percentile (z)	5038

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	4170
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	4170	95% BCA Bootstrap UTL with 95% Coverage	4170
95% UPL	4170	90% Percentile	3612
90% Chebyshev UPL	5192	95% Percentile	3891
95% Chebyshev UPL	6273	99% Percentile	4114
95% USL	4170		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Arsenic

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Minimum	0.64	First Quartile	0.805
Second Largest	1.3	Median	1
Maximum	2.1	Third Quartile	1.275
Mean	1.08	SD	0.434
Coefficient of Variation	0.402	Skewness	1.481

Surface Soil Background ProUCL Outputs

Mean of logged Data	0.0135	SD of logged Data	0.366

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with	95% Coverage	2.344	90% Percentile (z)	1.637
	95% UPL (t)	1.915	95% Percentile (z)	1.794
	95% USL	2.025	99% Percentile (z)	2.09

Gamma GOF Test

A-D Test Statistic	0.331	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.155	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.04	k star (bias corrected MLE)	5.694
Theta hat (MLE)	0.134	Theta star (bias corrected MLE)	0.19
nu hat (MLE)	160.8	nu star (bias corrected)	113.9
MLE Mean (bias corrected)	1.08	MLE Sd (bias corrected)	0.453

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	1.981	90% Percentile	1.685
95% Hawkins Wixley (HW) Approx. Gamma UPL	1.995	95% Percentile	1.916
95% WH Approx. Gamma UTL with	95% Coverage	2.637	99% Percentile
95% HW Approx. Gamma UTL with	95% Coverage	2.698	
	95% WH USL	2.137	95% HW USL
			2.16

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.148	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with	95% Coverage	2.943	90% Percentile (z)	1.621
	95% UPL (t)	2.049	95% Percentile (z)	1.851
	95% USL	2.249	99% Percentile (z)	2.376

Nonparametric Distribution Free Background Statistics

Surface Soil Background ProUCL Outputs

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	2.1
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	2.1	95% BCA Bootstrap UTL with 95% Coverage	2.1
95% UPL	2.1	90% Percentile	1.38
90% Chebyshev UPL	2.447	95% Percentile	1.74
95% Chebyshev UPL	3.065	99% Percentile	2.028
95% USL	2.1		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Barium

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	15.5	First Quartile	18.73
Second Largest	37.3	Median	21.55
Maximum	58.6	Third Quartile	26.15
Mean	25.98	SD	13.08
Coefficient of Variation	0.503	Skewness	2.058
Mean of logged Data	3.172	SD of logged Data	0.407

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.755	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.272	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	64.06	90% Percentile (z)	42.74
95% UPL (t)	51.13	95% Percentile (z)	47.5
95% USL	54.44	99% Percentile (z)	56.41

Gamma GOF Test

A-D Test Statistic	0.657	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.226	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Surface Soil Background ProUCL Outputs

Gamma Statistics

k hat (MLE)	6.027	k star (bias corrected MLE)	4.285
Theta hat (MLE)	4.311	Theta star (bias corrected MLE)	6.063
nu hat (MLE)	120.5	nu star (bias corrected)	85.71
MLE Mean (bias corrected)	25.98	MLE Sd (bias corrected)	12.55

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	51.4	90% Percentile	42.8
95% Hawkins Wixley (HW) Approx. Gamma UPL	51.54	95% Percentile	49.46
95% WH Approx. Gamma UTL with 95% Coverage	70.8	99% Percentile	63.64
95% HW Approx. Gamma UTL with 95% Coverage	72.22		
95% WH USL	55.99	95% HW USL	56.35

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.885	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.198	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	77.98	90% Percentile (z)	40.19
95% UPL (t)	52.16	95% Percentile (z)	46.59
95% USL	57.83	99% Percentile (z)	61.47

Nonparametric Distribution Free Background Statistics

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	58.6
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	58.6	95% BCA Bootstrap UTL with 95% Coverage	58.6
95% UPL	58.6	90% Percentile	39.43
90% Chebyshev UPL	67.14	95% Percentile	49.02
95% Chebyshev UPL	85.78	99% Percentile	56.68
95% USL	58.6		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers

and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data

represents a background data set and when many onsite observations need to be compared with the BTV.

Benzo (a) anthracene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	4		

Surface Soil Background ProUCL Outputs

Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	3
Minimum Detect	0.0033	Minimum Non-Detect	0.0035
Maximum Detect	0.0033	Maximum Non-Detect	0.0038
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	0.0033	SD Detected	N/A
Mean of Detected Logged Data	-5.714	SD of Detected Logged Data	N/A

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 Benzo (a) anthracene was not processed!

Benzo (a) pyrene

General Statistics			
Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	4		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	3
Minimum Detect	0.0025	Minimum Non-Detect	0.0035
Maximum Detect	0.0025	Maximum Non-Detect	0.0038
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	0.0025	SD Detected	N/A
Mean of Detected Logged Data	-5.991	SD of Detected Logged Data	N/A

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 Benzo (a) pyrene was not processed!

Benzo (b) fluoranthene

General Statistics			
Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	5		
Number of Detects	2	Number of Non-Detects	8
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.0011	Minimum Non-Detect	0.0035
Maximum Detect	0.0032	Maximum Non-Detect	0.0038
Variance Detected	2.2050E-6	Percent Non-Detects	80%
Mean Detected	0.00215	SD Detected	0.00148
Mean of Detected Logged Data	-6.279	SD of Detected Logged Data	0.755

Warning: Data set has only 2 Detected Values.

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

Surface Soil Background ProUCL Outputs

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL) 2.911

d2max (for USL) 2.176

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.00215	KM SD	0.00105
95% UTL95% Coverage	0.00521	95% KM UPL (t)	0.00417
90% KM Percentile (z)	0.0035	95% KM Percentile (z)	0.00388
99% KM Percentile (z)	0.00459	95% KM USL	0.00443

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.00188	SD	5.1707E-4
95% UTL95% Coverage	0.00338	95% UPL (t)	0.00287
90% Percentile (z)	0.00254	95% Percentile (z)	0.00273
99% Percentile (z)	0.00308	95% USL	0.003

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	3.829	k star (bias corrected MLE)	N/A
Theta hat (MLE)	5.6154E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	15.32	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A		
MLE Sd (bias corrected)	N/A	95% Percentile of Chisquare (2kstar)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00215	SD (KM)	0.00105
Variance (KM)	1.1025E-6	SE of Mean (KM)	0.00105
k hat (KM)	4.193	k star (KM)	3.002
nu hat (KM)	83.85	nu star (KM)	60.03
theta hat (KM)	5.1279E-4	theta star (KM)	7.1629E-4
80% gamma percentile (KM)	0.00307	90% gamma percentile (KM)	0.00381
95% gamma percentile (KM)	0.00451	99% gamma percentile (KM)	0.00602

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.00681	0.00718	95% Approx. Gamma UPL	0.00472	0.00482
95% KM Gamma Percentile	0.00422	0.00428	95% Gamma USL	0.00521	0.00536

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.00242	Mean in Log Scale	-6.279
SD in Original Scale	0.00191	SD in Log Scale	0.757

Surface Soil Background ProUCL Outputs

95% UTL95% Coverage	0.017	95% BCA UTL95% Coverage	0.00705
95% Bootstrap (%) UTL95% Coverage	0.00705	95% UPL (t)	0.00804
90% Percentile (z)	0.00495	95% Percentile (z)	0.00652
99% Percentile (z)	0.0109	95% USL	0.00974

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-6.279	95% KM UTL (Lognormal)95% Coverage	0.00888
KM SD of Logged Data	0.534	95% KM UPL (Lognormal)	0.00524
95% KM Percentile Lognormal (z)	0.00452	95% KM USL (Lognormal)	0.006

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.00188	Mean in Log Scale	-6.309
SD in Original Scale	5.1707E-4	SD in Log Scale	0.253
95% UTL95% Coverage	0.0038	95% UPL (t)	0.00296
90% Percentile (z)	0.00252	95% Percentile (z)	0.00276
99% Percentile (z)	0.00328	95% USL	0.00316

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with95% Coverage	0.0038
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	0.0038
95% USL	0.0038	95% KM Chebyshev UPL	0.00695

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Benzo (g,h,i) perylene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	4		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	3
Minimum Detect	0.0016	Minimum Non-Detect	0.0035
Maximum Detect	0.0016	Maximum Non-Detect	0.0038
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	0.0016	SD Detected	N/A
Mean of Detected Logged Data	-6.438	SD of Detected Logged Data	N/A

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 Benzo (g,h,i) perylene was not processed!

Surface Soil Background ProUCL Outputs

Beryllium

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	9		
Number of Detects	4	Number of Non-Detects	6
Number of Distinct Detects	3	Number of Distinct Non-Detects	6
Minimum Detect	0.17	Minimum Non-Detect	0.44
Maximum Detect	0.21	Maximum Non-Detect	0.55
Variance Detected	4.2500E-4	Percent Non-Detects	60%
Mean Detected	0.188	SD Detected	0.0206
Mean of Detected Logged Data	-1.678	SD of Detected Logged Data	0.11

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.829	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.302	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.188	KM SD	0.0179
95% UTL95% Coverage	0.239	95% KM UPL (t)	0.222
90% KM Percentile (z)	0.21	95% KM Percentile (z)	0.217
99% KM Percentile (z)	0.229	95% KM USL	0.226

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.225	SD	0.0378
95% UTL95% Coverage	0.335	95% UPL (t)	0.298
90% Percentile (z)	0.273	95% Percentile (z)	0.287
99% Percentile (z)	0.313	95% USL	0.307

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.524	Anderson-Darling GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.337	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	110.7	k star (bias corrected MLE)	27.84
Theta hat (MLE)	0.00169	Theta star (bias corrected MLE)	0.00673
nu hat (MLE)	885.6	nu star (bias corrected)	222.7
MLE Mean (bias corrected)	0.188		

MLE Sd (bias corrected)	0.0355	95% Percentile of Chisquare (2kstar)	74.1

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

Estimates of Gamma Parameters using KM Estimates

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

Lognormal GOF Test on Detected Observations Only

Detected Data appear Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

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Surface Soil Background ProUCL Outputs

90% Percentile (z)	0.202	95% Percentile (z)	0.207
99% Percentile (z)	0.216	95% USL	0.214

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-1.678	95% KM UTL (Lognormal)	95% Coverage	0.246
KM SD of Logged Data	0.095	95% KM UPL (Lognormal)		0.224
95% KM Percentile Lognormal (z)	0.218	95% KM USL (Lognormal)		0.23

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.225	Mean in Log Scale	-1.505
SD in Original Scale	0.0378	SD in Log Scale	0.174
95% UTL	95% Coverage	95% UPL (t)	0.31
90% Percentile (z)	0.278	95% Percentile (z)	0.296
99% Percentile (z)	0.333	95% USL	0.324

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

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

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with 95% Coverage	0.55
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	0.55
95% USL	0.55	95% KM Chebyshev UPL	0.269

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers

and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data

represents a background data set and when many onsite observations need to be compared with the BTV.

Calcium

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	10		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	9
Minimum Detect	366	Minimum Non-Detect	443
Maximum Detect	366	Maximum Non-Detect	549
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	366	SD Detected	N/A
Mean of Detected Logged Data	5.903	SD of Detected Logged Data	N/A

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 Calcium was not processed!

Surface Soil Background ProUCL Outputs

Chromium

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	9		
Number of Detects	3	Number of Non-Detects	7
Number of Distinct Detects	3	Number of Distinct Non-Detects	6
Minimum Detect	5.9	Minimum Non-Detect	0.88
Maximum Detect	7.1	Maximum Non-Detect	1.1
Variance Detected	0.363	Percent Non-Detects	70%
Mean Detected	6.467	SD Detected	0.603
Mean of Detected Logged Data	1.864	SD of Detected Logged Data	0.0928

Warning: Data set has only 3 Detected Values.

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

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.991	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	2.556	KM SD	2.574
95% UTL95% Coverage	10.05	95% KM UPL (t)	7.505
90% KM Percentile (z)	5.855	95% KM Percentile (z)	6.79
99% KM Percentile (z)	8.545	95% KM USL	8.158

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	2.285	SD	2.9
95% UTL95% Coverage	10.73	95% UPL (t)	7.86
90% Percentile (z)	6.001	95% Percentile (z)	7.055
99% Percentile (z)	9.031	95% USL	8.595

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	173.8	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0372	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1043	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A		
MLE Sd (bias corrected)	N/A	95% Percentile of Chisquare (2kstar)	N/A

Surface Soil Background ProUCL Outputs

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.442	Mean	4.73
Maximum	7.1	Median	3.995
SD	1.256	CV	0.265
k hat (MLE)	17.63	k star (bias corrected MLE)	12.4
Theta hat (MLE)	0.268	Theta star (bias corrected MLE)	0.381
nu hat (MLE)	352.5	nu star (bias corrected)	248.1
MLE Mean (bias corrected)	4.73	MLE Sd (bias corrected)	1.343
95% Percentile of Chisquare (2kstar)	37.42	90% Percentile	6.512
95% Percentile	7.134	99% Percentile	8.401

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	8.96	9.058	95% Approx. Gamma UPL	7.28	7.301
95% Gamma USL	7.689	7.725			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.556	SD (KM)	2.574
Variance (KM)	6.627	SE of Mean (KM)	0.997
k hat (KM)	0.986	k star (KM)	0.757
nu hat (KM)	19.72	nu star (KM)	15.14
theta hat (KM)	2.593	theta star (KM)	3.378
80% gamma percentile (KM)	4.189	90% gamma percentile (KM)	6.299
95% gamma percentile (KM)	8.459	99% gamma percentile (KM)	13.58

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	14.47	15.73	95% Approx. Gamma UPL	8.328	8.509
95% KM Gamma Percentile	6.987	7.028	95% Gamma USL	9.693	10.05

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.995	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.199	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	4.981	Mean in Log Scale	1.587
SD in Original Scale	1.079	SD in Log Scale	0.2
95% UTL95% Coverage	8.76	95% BCA UTL95% Coverage	7.1
95% Bootstrap (%) UTL95% Coverage	7.1	95% UPL (t)	7.185
90% Percentile (z)	6.319	95% Percentile (z)	6.796
99% Percentile (z)	7.791	95% USL	7.56

Surface Soil Background ProUCL Outputs

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	0.47	95% KM UTL (Lognormal)	95% Coverage	22.86
KM SD of Logged Data	0.914		95% KM UPL (Lognormal)	9.264
95% KM Percentile Lognormal (z)	7.188		95% KM USL (Lognormal)	11.68

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	2.285	Mean in Log Scale	0.0614
SD in Original Scale	2.9	SD in Log Scale	1.247
95% UTL	95% Coverage	95% UPL (t)	11.69
90% Percentile (z)	5.255	95% Percentile (z)	8.266
99% Percentile (z)	19.33	95% USL	16.03

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

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

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with 95% Coverage	7.1
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	7.1
95% USL	7.1	95% KM Chebyshev UPL	14.32

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Chrysene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	6		
Number of Detects	5	Number of Non-Detects	5
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.0036
Maximum Detect	0.004	Maximum Non-Detect	0.0036
Variance Detected	1.5250E-6	Percent Non-Detects	50%
Mean Detected	0.0018	SD Detected	0.00123
Mean of Detected Logged Data	-6.455	SD of Detected Logged Data	0.53

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.64	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.427	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.343	Data Not Normal at 5% Significance Level	

Surface Soil Background ProUCL Outputs

Data Not Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.00153	KM SD	8.3179E-4
95% UTL95% Coverage	0.00395	95% KM UPL (t)	0.00312
90% KM Percentile (z)	0.00259	95% KM Percentile (z)	0.00289
99% KM Percentile (z)	0.00346	95% KM USL	0.00334

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.0018	SD	8.2327E-4
95% UTL95% Coverage	0.0042	95% UPL (t)	0.00338
90% Percentile (z)	0.00286	95% Percentile (z)	0.00315
99% Percentile (z)	0.00372	95% USL	0.00359

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.923	Anderson-Darling GOF Test
5% A-D Critical Value	0.681	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.418	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.359	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.856	k star (bias corrected MLE)	1.676
Theta hat (MLE)	4.6680E-4	Theta star (bias corrected MLE)	0.00107
nu hat (MLE)	38.56	nu star (bias corrected)	16.76
MLE Mean (bias corrected)	0.0018		
MLE Sd (bias corrected)	0.00139	95% Percentile of Chisquare (2kstar)	8.416

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.0059
Maximum	0.01	Median	0.007
SD	0.0044	CV	0.746
k hat (MLE)	1.402	k star (bias corrected MLE)	1.048
Theta hat (MLE)	0.00421	Theta star (bias corrected MLE)	0.00563
nu hat (MLE)	28.03	nu star (bias corrected)	20.95
MLE Mean (bias corrected)	0.0059	MLE Sd (bias corrected)	0.00576
95% Percentile of Chisquare (2kstar)	6.175	90% Percentile	0.0134
95% Percentile	0.0174	99% Percentile	0.0265

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.0337	0.039	95% Approx. Gamma UPL	0.0197	0.0211
95% Gamma USL	0.0228	0.0249			

Surface Soil Background ProUCL Outputs

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00153	SD (KM)	8.3179E-4
Variance (KM)	6.9188E-7	SE of Mean (KM)	2.9706E-4
k hat (KM)	3.361	k star (KM)	2.42
nu hat (KM)	67.23	nu star (KM)	48.39
theta hat (KM)	4.5369E-4	theta star (KM)	6.3027E-4
80% gamma percentile (KM)	0.00223	90% gamma percentile (KM)	0.00284
95% gamma percentile (KM)	0.00341	99% gamma percentile (KM)	0.00466

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.00396	0.00397	95% Approx. Gamma UPL	0.00291	0.00288
95% KM Gamma Percentile	0.00265	0.00262	95% Gamma USL	0.00316	0.00314

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.714	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.387	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.00159	Mean in Log Scale	-6.545
SD in Original Scale	9.0242E-4	SD in Log Scale	0.426
95% UTL95% Coverage	0.00497	95% BCA UTL95% Coverage	0.004
95% Bootstrap (%) UTL95% Coverage	0.004	95% UPL (t)	0.00326
90% Percentile (z)	0.00248	95% Percentile (z)	0.0029
99% Percentile (z)	0.00387	95% USL	0.00363

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-6.572	95% KM UTL (Lognormal)95% Coverage	0.00399
KM SD of Logged Data	0.36	95% KM UPL (Lognormal)	0.0028
95% KM Percentile Lognormal (z)	0.00253	95% KM USL (Lognormal)	0.00307

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.0018	Mean in Log Scale	-6.388
SD in Original Scale	8.2327E-4	SD in Log Scale	0.36
95% UTL95% Coverage	0.0048	95% UPL (t)	0.00336
90% Percentile (z)	0.00267	95% Percentile (z)	0.00304
99% Percentile (z)	0.00389	95% USL	0.00368

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with95% Coverage	0.004
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	0.004

Surface Soil Background ProUCL Outputs

95% USL 0.004

95% KM Chebyshev UPL 0.00533

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Cobalt

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Minimum	1.1	First Quartile	1.45
Second Largest	9.5	Median	2.05
Maximum	10.8	Third Quartile	2.975
Mean	3.53	SD	3.561
Coefficient of Variation	1.009	Skewness	1.672
Mean of logged Data	0.914	SD of logged Data	0.814

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.684
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.348
5% Lilliefors Critical Value	0.262

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	13.9	90% Percentile (z)	8.093
95% UPL (t)	10.38	95% Percentile (z)	9.387
95% USL	11.28	99% Percentile (z)	11.81

Gamma GOF Test

A-D Test Statistic	0.932
5% A-D Critical Value	0.739
K-S Test Statistic	0.256
5% K-S Critical Value	0.271

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	1.584	k star (bias corrected MLE)	1.175
Theta hat (MLE)	2.229	Theta star (bias corrected MLE)	3.003
nu hat (MLE)	31.68	nu star (bias corrected)	23.51
MLE Mean (bias corrected)	3.53	MLE Sd (bias corrected)	3.256

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	10.95	90% Percentile	7.81
95% Hawkins Wixley (HW) Approx. Gamma UPL	11.12	95% Percentile	9.993

Surface Soil Background ProUCL Outputs

95% WH Approx. Gamma UTL with 95% Coverage	18.39	99% Percentile	15
95% HW Approx. Gamma UTL with 95% Coverage	19.67		
95% WH USL	12.62	95% HW USL	12.97

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.856	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	26.69	90% Percentile (z)	7.08
95% UPL (t)	11.93	95% Percentile (z)	9.518
95% USL	14.67	99% Percentile (z)	16.58

Nonparametric Distribution Free Background Statistics

Data appear Approximate Gamma Distribution at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	10.8
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	10.8	95% BCA Bootstrap UTL with 95% Coverage	10.8
95% UPL	10.8	90% Percentile	9.63
90% Chebyshev UPL	14.73	95% Percentile	10.22
95% Chebyshev UPL	19.81	99% Percentile	10.68
95% USL	10.8		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Copper

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Minimum	1.8	First Quartile	1.9
Second Largest	2.6	Median	2.05
Maximum	3	Third Quartile	2.175
Mean	2.15	SD	0.375
Coefficient of Variation	0.174	Skewness	1.613
Mean of logged Data	0.753	SD of logged Data	0.16

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Surface Soil Background ProUCL Outputs

Shapiro Wilk Test Statistic	0.809	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	3.241	90% Percentile (z)	2.63
95% UPL (t)	2.871	95% Percentile (z)	2.767
95% USL	2.966	99% Percentile (z)	3.022

Gamma GOF Test

A-D Test Statistic	0.749	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.724	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.239	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	41.24	k star (bias corrected MLE)	28.94
Theta hat (MLE)	0.0521	Theta star (bias corrected MLE)	0.0743
nu hat (MLE)	824.8	nu star (bias corrected)	578.7
MLE Mean (bias corrected)	2.15	MLE Sd (bias corrected)	0.4

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	2.881	90% Percentile	2.675
95% Hawkins Wixley (HW) Approx. Gamma UPL	2.882	95% Percentile	2.847
95% WH Approx. Gamma UTL with 95% Coverage	3.326	99% Percentile	3.187
95% HW Approx. Gamma UTL with 95% Coverage	3.339		
95% WH USL	2.991	95% HW USL	2.995

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.85	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	3.382	90% Percentile (z)	2.607
95% UPL (t)	2.888	95% Percentile (z)	2.763
95% USL	3.007	99% Percentile (z)	3.081

Nonparametric Distribution Free Background Statistics

Data appear Approximate Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	3
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59

Surface Soil Background ProUCL Outputs

95% Percentile Bootstrap UTL with 95% Coverage	3	95% BCA Bootstrap UTL with 95% Coverage	3
95% UPL	3	90% Percentile	2.64
90% Chebyshev UPL	3.33	95% Percentile	2.82
95% Chebyshev UPL	3.864	99% Percentile	2.964
95% USL	3		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Cyanide

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Minimum	0.045	First Quartile	0.06
Second Largest	0.12	Median	0.0665
Maximum	0.14	Third Quartile	0.0858
Mean	0.0776	SD	0.0312
Coefficient of Variation	0.402	Skewness	1.092
Mean of logged Data	-2.622	SD of logged Data	0.376

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.881	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.221	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	0.168	90% Percentile (z)	0.118
95% UPL (t)	0.138	95% Percentile (z)	0.129
95% USL	0.145	99% Percentile (z)	0.15

Gamma GOF Test

A-D Test Statistic	0.371	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.72	k star (bias corrected MLE)	5.47
Theta hat (MLE)	0.0101	Theta star (bias corrected MLE)	0.0142
nu hat (MLE)	154.4	nu star (bias corrected)	109.4
MLE Mean (bias corrected)	0.0776	MLE Sd (bias corrected)	0.0332

Surface Soil Background ProUCL Outputs

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	0.144	90% Percentile	0.122
95% Hawkins Wixley (HW) Approx. Gamma UPL	0.145	95% Percentile	0.139
95% WH Approx. Gamma UTL with 95% Coverage	0.192	99% Percentile	0.175
95% HW Approx. Gamma UTL with 95% Coverage	0.197		
95% WH USL	0.155	95% HW USL	0.157

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.17	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	0.217	90% Percentile (z)	0.118
95% UPL (t)	0.15	95% Percentile (z)	0.135
95% USL	0.165	99% Percentile (z)	0.174

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	0.14
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	0.14	95% BCA Bootstrap UTL with 95% Coverage	0.14
95% UPL	0.14	90% Percentile	0.122
90% Chebyshev UPL	0.176	95% Percentile	0.131
95% Chebyshev UPL	0.22	99% Percentile	0.138
95% USL	0.14		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Fluoranthene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	5		
Number of Detects	2	Number of Non-Detects	8
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.0012	Minimum Non-Detect	0.0035
Maximum Detect	0.0046	Maximum Non-Detect	0.0038
Variance Detected	5.7800E-6	Percent Non-Detects	80%
Mean Detected	0.0029	SD Detected	0.0024

Surface Soil Background ProUCL Outputs

Mean of Detected Logged Data -6.054

SD of Detected Logged Data 0.95

Warning: Data set has only 2 Detected Values.

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

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL) 2.911

d2max (for USL) 2.176

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.00154	KM SD	0.00102
95% UTL95% Coverage	0.00451	95% KM UPL (t)	0.0035
90% KM Percentile (z)	0.00285	95% KM Percentile (z)	0.00322
99% KM Percentile (z)	0.00391	95% KM USL	0.00376

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.00203	SD	9.2534E-4
95% UTL95% Coverage	0.00472	95% UPL (t)	0.0038
90% Percentile (z)	0.00321	95% Percentile (z)	0.00355
99% Percentile (z)	0.00418	95% USL	0.00404

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.529	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00115	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	10.12	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A		
MLE Sd (bias corrected)	N/A	95% Percentile of Chisquare (2kstar)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00154	SD (KM)	0.00102
Variance (KM)	1.0404E-6	SE of Mean (KM)	4.5616E-4
k hat (KM)	2.28	k star (KM)	1.662
nu hat (KM)	45.59	nu star (KM)	33.25
theta hat (KM)	6.7558E-4	theta star (KM)	9.2641E-4
80% gamma percentile (KM)	0.00236	90% gamma percentile (KM)	0.00313
95% gamma percentile (KM)	0.00388	99% gamma percentile (KM)	0.00555

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.00447	0.00446	95% Approx. Gamma UPL	0.00317	0.00312
95% KM Gamma Percentile	0.00286	0.00281	95% Gamma USL	0.00348	0.00343

Surface Soil Background ProUCL Outputs
Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.0016	Mean in Log Scale	-6.604
SD in Original Scale	0.00116	SD in Log Scale	0.578
95% UTL95% Coverage	0.00729	95% BCA UTL95% Coverage	0.0046
95% Bootstrap (%) UTL95% Coverage	0.0046	95% UPL (t)	0.00412
90% Percentile (z)	0.00284	95% Percentile (z)	0.00351
99% Percentile (z)	0.0052	95% USL	0.00477

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-6.591	95% KM UTL (Lognormal)95% Coverage	0.00444
KM SD of Logged Data	0.403	95% KM UPL (Lognormal)	0.00298
95% KM Percentile Lognormal (z)	0.00266	95% KM USL (Lognormal)	0.0033

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.00203	Mean in Log Scale	-6.264
SD in Original Scale	9.2534E-4	SD in Log Scale	0.336
95% UTL95% Coverage	0.00506	95% UPL (t)	0.00363
90% Percentile (z)	0.00293	95% Percentile (z)	0.00331
99% Percentile (z)	0.00416	95% USL	0.00396

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with95% Coverage	0.0046
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	0.0046
95% USL	0.0046	95% KM Chebyshev UPL	0.0062

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Indeno (1,2,3-cd) pyrene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	4		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	3
Minimum Detect	0.0017	Minimum Non-Detect	0.0035
Maximum Detect	0.0017	Maximum Non-Detect	0.0038
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	0.0017	SD Detected	N/A

Surface Soil Background ProUCL Outputs

Mean of Detected Logged Data -6.377

SD of Detected Logged Data N/A

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 Indeno (1,2,3-cd) pyrene was not processed!

Iron

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	2710	First Quartile	3698
Second Largest	7730	Median	4085
Maximum	14700	Third Quartile	5000
Mean	5411	SD	3540
Coefficient of Variation	0.654	Skewness	2.412
Mean of logged Data	8.468	SD of logged Data	0.486

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.683
5% Shapiro Wilk Critical Value	0.842
Lilliefors Test Statistic	0.344
5% Lilliefors Critical Value	0.262

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	15717	90% Percentile (z)	9948
95% UPL (t)	12217	95% Percentile (z)	11234
95% USL	13115	99% Percentile (z)	13647

Gamma GOF Test

A-D Test Statistic	0.875
5% A-D Critical Value	0.729
K-S Test Statistic	0.293
5% K-S Critical Value	0.268

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.051	k star (bias corrected MLE)	2.902
Theta hat (MLE)	1336	Theta star (bias corrected MLE)	1864
nu hat (MLE)	81.02	nu star (bias corrected)	58.05
MLE Mean (bias corrected)	5411	MLE Sd (bias corrected)	3176

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	12028	90% Percentile	9669
95% Hawkins Wixley (HW) Approx. Gamma UPL	12033	95% Percentile	11464

Surface Soil Background ProUCL Outputs

95% WH Approx. Gamma UTL with 95% Coverage	17443	99% Percentile	15363
95% HW Approx. Gamma UTL with 95% Coverage	17847		
95% WH USL	13290	95% HW USL	13363

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.256	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	19594	90% Percentile (z)	8873
95% UPL (t)	12118	95% Percentile (z)	10587
95% USL	13707	99% Percentile (z)	14746

Nonparametric Distribution Free Background Statistics

Data appear Lognormal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	14700
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	14700	95% BCA Bootstrap UTL with 95% Coverage	14700
95% UPL	14700	90% Percentile	8427
90% Chebyshev UPL	16550	95% Percentile	11564
95% Chebyshev UPL	21596	99% Percentile	14073
95% USL	14700		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Lead

General Statistics

Total Number of Observations	10	Number of Distinct Observations	8
Minimum	2.8	First Quartile	3.925
Second Largest	6.9	Median	4
Maximum	7.8	Third Quartile	4.8
Mean	4.6	SD	1.578
Coefficient of Variation	0.343	Skewness	1.252
Mean of logged Data	1.479	SD of logged Data	0.314

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Surface Soil Background ProUCL Outputs

Shapiro Wilk Test Statistic	0.85	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.248	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	9.192	90% Percentile (z)	6.622
95% UPL (t)	7.633	95% Percentile (z)	7.195
95% USL	8.033	99% Percentile (z)	8.27

Gamma GOF Test

A-D Test Statistic	0.57	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.236	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	10.83	k star (bias corrected MLE)	7.645
Theta hat (MLE)	0.425	Theta star (bias corrected MLE)	0.602
nu hat (MLE)	216.5	nu star (bias corrected)	152.9
MLE Mean (bias corrected)	4.6	MLE Sd (bias corrected)	1.664

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	7.847	90% Percentile	6.819
95% Hawkins Wixley (HW) Approx. Gamma UPL	7.887	95% Percentile	7.634
95% WH Approx. Gamma UTL with 95% Coverage	10.12	99% Percentile	9.324
95% HW Approx. Gamma UTL with 95% Coverage	10.29		
95% WH USL	8.392	95% HW USL	8.458

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.216	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	10.96	90% Percentile (z)	6.567
95% UPL (t)	8.034	95% Percentile (z)	7.362
95% USL	8.7	99% Percentile (z)	9.121

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	7.8
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59

Surface Soil Background ProUCL Outputs

95% Percentile Bootstrap UTL with 95% Coverage	7.8	95% BCA Bootstrap UTL with 95% Coverage	7.8
95% UPL	7.8	90% Percentile	6.99
90% Chebyshev UPL	9.564	95% Percentile	7.395
95% Chebyshev UPL	11.81	99% Percentile	7.719
95% USL	7.8		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Magnesium

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	180	First Quartile	223.3
Second Largest	289	Median	236.5
Maximum	369	Third Quartile	257
Mean	246.2	SD	53.46
Coefficient of Variation	0.217	Skewness	1.311
Mean of logged Data	5.487	SD of logged Data	0.204

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.896	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.205	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	401.8	90% Percentile (z)	314.7
95% UPL (t)	349	95% Percentile (z)	334.1
95% USL	362.5	99% Percentile (z)	370.6

Gamma GOF Test

A-D Test Statistic	0.344	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.172	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	25.96	k star (bias corrected MLE)	18.24
Theta hat (MLE)	9.483	Theta star (bias corrected MLE)	13.5
nu hat (MLE)	519.2	nu star (bias corrected)	364.8
MLE Mean (bias corrected)	246.2	MLE Sd (bias corrected)	57.65

Surface Soil Background ProUCL Outputs

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	353.6	90% Percentile	322.4
95% Hawkins Wixley (HW) Approx. Gamma UPL	354.4	95% Percentile	348.1
95% WH Approx. Gamma UTL with 95% Coverage	421.6	99% Percentile	399.7
95% HW Approx. Gamma UTL with 95% Coverage	425		
95% WH USL	370.2	95% HW USL	371.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.165	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	436.9	90% Percentile (z)	313.5
95% UPL (t)	357.2	95% Percentile (z)	337.6
95% USL	376.2	99% Percentile (z)	387.8

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	369
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	369	95% BCA Bootstrap UTL with 95% Coverage	369
95% UPL	369	90% Percentile	297
90% Chebyshev UPL	414.4	95% Percentile	333
95% Chebyshev UPL	490.6	99% Percentile	361.8
95% USL	369		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Manganese

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	137	First Quartile	188.5
Second Largest	384	Median	226.5
Maximum	545	Third Quartile	264
Mean	260.8	SD	120
Coefficient of Variation	0.46	Skewness	1.744
Mean of logged Data	5.487	SD of logged Data	0.396

Surface Soil Background ProUCL Outputs

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL) 2.911 d2max (for USL) 2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.819	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.279	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	610	90% Percentile (z)	414.5
95% UPL (t)	491.4	95% Percentile (z)	458.1
95% USL	521.8	99% Percentile (z)	539.9

Gamma GOF Test

A-D Test Statistic	0.485	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.645	k star (bias corrected MLE)	4.718
Theta hat (MLE)	39.25	Theta star (bias corrected MLE)	55.27
nu hat (MLE)	132.9	nu star (bias corrected)	94.37
MLE Mean (bias corrected)	260.8	MLE Sd (bias corrected)	120.1

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	502.7	90% Percentile	421.6
95% Hawkins Wixley (HW) Approx. Gamma UPL	505.5	95% Percentile	484.4
95% WH Approx. Gamma UTL with 95% Coverage	684.2	99% Percentile	617.5
95% HW Approx. Gamma UTL with 95% Coverage	700		
95% WH USL	545.7	95% HW USL	550.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.2	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	764.5	90% Percentile (z)	401
95% UPL (t)	516.9	95% Percentile (z)	463.1
95% USL	571.5	99% Percentile (z)	606.5

Nonparametric Distribution Free Background Statistics

Data appear Gamma Distributed at 5% Significance Level

Surface Soil Background ProUCL Outputs

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	545
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	545	95% BCA Bootstrap UTL with 95% Coverage	545
95% UPL	545	90% Percentile	400.1
90% Chebyshev UPL	638.2	95% Percentile	472.6
95% Chebyshev UPL	809.2	99% Percentile	530.5
95% USL	545		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Mercury

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	3		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	2
Minimum Detect	0.038	Minimum Non-Detect	0.12
Maximum Detect	0.038	Maximum Non-Detect	0.13
Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	0.038	SD Detected	N/A
Mean of Detected Logged Data	-3.27	SD of Detected Logged Data	N/A

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 Mercury was not processed!

Nickel

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Minimum	1.8	First Quartile	1.925
Second Largest	3.2	Median	2.15
Maximum	5.6	Third Quartile	2.6
Mean	2.56	SD	1.156
Coefficient of Variation	0.452	Skewness	2.411
Mean of logged Data	0.875	SD of logged Data	0.35

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Surface Soil Background ProUCL Outputs

Shapiro Wilk Test Statistic	0.681	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.289	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	5.925	90% Percentile (z)	4.041
95% UPL (t)	4.782	95% Percentile (z)	4.461
95% USL	5.075	99% Percentile (z)	5.249

Gamma GOF Test

A-D Test Statistic	0.961	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.727	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.267	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.839	k star (bias corrected MLE)	5.554
Theta hat (MLE)	0.327	Theta star (bias corrected MLE)	0.461
nu hat (MLE)	156.8	nu star (bias corrected)	111.1
MLE Mean (bias corrected)	2.56	MLE Sd (bias corrected)	1.086

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	4.715	90% Percentile	4.013
95% Hawkins Wixley (HW) Approx. Gamma UPL	4.711	95% Percentile	4.568
95% WH Approx. Gamma UTL with 95% Coverage	6.294	99% Percentile	5.736
95% HW Approx. Gamma UTL with 95% Coverage	6.368		
95% WH USL	5.091	95% HW USL	5.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.798	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.248	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	6.651	90% Percentile (z)	3.758
95% UPL (t)	4.704	95% Percentile (z)	4.268
95% USL	5.141	99% Percentile (z)	5.419

Nonparametric Distribution Free Background Statistics

Data appear Approximate Lognormal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	5.6
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59

Surface Soil Background ProUCL Outputs

95% Percentile Bootstrap UTL with 95% Coverage	5.6	95% BCA Bootstrap UTL with 95% Coverage	5.6
95% UPL	5.6	90% Percentile	3.44
90% Chebyshev UPL	6.197	95% Percentile	4.52
95% Chebyshev UPL	7.844	99% Percentile	5.384
95% USL	5.6		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers

and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data

represents a background data set and when many onsite observations need to be compared with the BTV.

OCDD

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	9		
Number of Detects	6	Number of Non-Detects	4
Number of Distinct Detects	6	Number of Distinct Non-Detects	3
Minimum Detect	1.0900E-5	Minimum Non-Detect	1.0700E-5
Maximum Detect	1.9100E-5	Maximum Non-Detect	1.1000E-5
Variance Detected	8.098E-12	Percent Non-Detects	40%
Mean Detected	1.4883E-5	SD Detected	2.8456E-6
Mean of Detected Logged Data	-11.13	SD of Detected Logged Data	0.194

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.983	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.192	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	1.3215E-5	KM SD	2.8679E-6
95% UTL95% Coverage	2.1563E-5	95% KM UPL (t)	1.8729E-5
90% KM Percentile (z)	1.6890E-5	95% KM Percentile (z)	1.7932E-5
99% KM Percentile (z)	1.9887E-5	95% KM USL	1.9456E-5

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	1.1095E-5	SD	5.3310E-6
95% UTL95% Coverage	2.6613E-5	95% UPL (t)	2.1344E-5
90% Percentile (z)	1.7927E-5	95% Percentile (z)	1.9864E-5
99% Percentile (z)	2.3497E-5	95% USL	2.2696E-5

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.187	Anderson-Darling GOF Test

Surface Soil Background ProUCL Outputs

5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	32.48	k star (bias corrected MLE)	16.35
Theta hat (MLE)	4.5828E-7	Theta star (bias corrected MLE)	9.1032E-7
nu hat (MLE)	389.7	nu star (bias corrected)	196.2
MLE Mean (bias corrected)	1.4883E-5		
MLE Sd (bias corrected)	3.6808E-6	95% Percentile of Chisquare (2kstar)	47.04

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.0900E-5	Mean	0.00401
Maximum	0.01	Median	1.8000E-5
SD	0.00516	CV	1.286
k hat (MLE)	0.238	k star (bias corrected MLE)	0.234
Theta hat (MLE)	0.0168	Theta star (bias corrected MLE)	0.0172
nu hat (MLE)	4.769	nu star (bias corrected)	4.672
MLE Mean (bias corrected)	0.00401	MLE Sd (bias corrected)	0.00829
95% Percentile of Chisquare (2kstar)	2.307	90% Percentile	0.0121
95% Percentile	0.0198	99% Percentile	0.0405

The following statistics are computed using Gamma ROS Statistics on Imputed Data

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.0584	0.0889	95% Approx. Gamma UPL	0.0245	0.03
95% Gamma USL	0.0314	0.0408			

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.3215E-5	SD (KM)	2.8679E-6
Variance (KM)	8.225E-12	SE of Mean (KM)	9.9352E-7
k hat (KM)	21.23	k star (KM)	14.93
nu hat (KM)	424.7	nu star (KM)	298.6
theta hat (KM)	6.2238E-7	theta star (KM)	8.8515E-7
80% gamma percentile (KM)	1.5974E-5	90% gamma percentile (KM)	1.7744E-5
95% gamma percentile (KM)	1.9297E-5	99% gamma percentile (KM)	2.2443E-5

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	2.2702E-5	2.2889E-5	95% Approx. Gamma UPL	1.9011E-5	1.9055E-5
95% KM Gamma Percentile	1.8051E-5	1.8071E-5	95% Gamma USL	1.9916E-5	1.9989E-5

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.983	Shapiro Wilk GOF Test

Surface Soil Background ProUCL Outputs

5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.16	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level
Detected Data appear Lognormal at 5% Significance Level		

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	1.2498E-5	Mean in Log Scale	-11.33
SD in Original Scale	3.7607E-6	SD in Log Scale	0.299
95% UTL95% Coverage	2.8650E-5	95% BCA UTL95% Coverage	1.9100E-5
95% Bootstrap (%) UTL95% Coverage	1.9100E-5	95% UPL (t)	2.1323E-5
90% Percentile (z)	1.7605E-5	95% Percentile (z)	1.9624E-5
99% Percentile (z)	2.4057E-5	95% USL	2.3001E-5

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-11.26	95% KM UTL (Lognormal)95% Coverage	2.3537E-5
KM SD of Logged Data	0.206	95% KM UPL (Lognormal)	1.9204E-5
95% KM Percentile Lognormal (z)	1.8137E-5	95% KM USL (Lognormal)	2.0233E-5

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	1.1095E-5	Mean in Log Scale	-11.53
SD in Original Scale	5.3310E-6	SD in Log Scale	0.534
95% UTL95% Coverage	4.6608E-5	95% UPL (t)	2.7485E-5
90% Percentile (z)	1.9513E-5	95% Percentile (z)	2.3694E-5
99% Percentile (z)	3.4102E-5	95% USL	3.1471E-5

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

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

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with95% Coverage	1.9100E-5
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	1.9100E-5
95% USL	1.9100E-5	95% KM Chebyshev UPL	2.6326E-5

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Phenanthrene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	4		
Number of Detects	1	Number of Non-Detects	9
Number of Distinct Detects	1	Number of Distinct Non-Detects	3
Minimum Detect	0.0015	Minimum Non-Detect	0.0035
Maximum Detect	0.0015	Maximum Non-Detect	0.0038

Surface Soil Background ProUCL Outputs

Variance Detected	N/A	Percent Non-Detects	90%
Mean Detected	0.0015	SD Detected	N/A
Mean of Detected Logged Data	-6.502	SD of Detected Logged Data	N/A

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 Phenanthrene was not processed!

Potassium

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Minimum	294	First Quartile	375
Second Largest	494	Median	406.5
Maximum	526	Third Quartile	475.8
Mean	412.8	SD	78.71
Coefficient of Variation	0.191	Skewness	-0.168
Mean of logged Data	6.006	SD of logged Data	0.198

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.15	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	641.9	90% Percentile (z)	513.7
95% UPL (t)	564.1	95% Percentile (z)	542.3
95% USL	584.1	99% Percentile (z)	595.9

Gamma GOF Test

A-D Test Statistic	0.308	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.167	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	29.27	k star (bias corrected MLE)	20.56
Theta hat (MLE)	14.1	Theta star (bias corrected MLE)	20.08
nu hat (MLE)	585.4	nu star (bias corrected)	411.1
MLE Mean (bias corrected)	412.8	MLE Sd (bias corrected)	91.05

Background Statistics Assuming Gamma Distribution

Surface Soil Background ProUCL Outputs

95% Wilson Hilferty (WH) Approx. Gamma UPL	581.7	90% Percentile	532.9
95% Hawkins Wixley (HW) Approx. Gamma UPL	584.5	95% Percentile	573.1
95% WH Approx. Gamma UTL with 95% Coverage	687.5	99% Percentile	653.6
95% HW Approx. Gamma UTL with 95% Coverage	695.1		
95% WH USL	607.7	95% HW USL	611.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.158	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	722.1	90% Percentile (z)	523
95% UPL (t)	593.7	95% Percentile (z)	562
95% USL	624.3	99% Percentile (z)	643.1

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	526
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	526	95% BCA Bootstrap UTL with 95% Coverage	526
95% UPL	526	90% Percentile	497.2
90% Chebyshev UPL	660.5	95% Percentile	511.6
95% Chebyshev UPL	772.6	99% Percentile	523.1
95% USL	526		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Pyrene

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	5		
Number of Detects	2	Number of Non-Detects	8
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.0012	Minimum Non-Detect	0.0035
Maximum Detect	0.0064	Maximum Non-Detect	0.0038
Variance Detected	1.3520E-5	Percent Non-Detects	80%
Mean Detected	0.0038	SD Detected	0.00368
Mean of Detected Logged Data	-5.888	SD of Detected Logged Data	1.184

Surface Soil Background ProUCL Outputs

Warning: Data set has only 2 Detected Values.

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

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	0.00172	KM SD	0.00156
95% UTL95% Coverage	0.00626	95% KM UPL (t)	0.00472
90% KM Percentile (z)	0.00372	95% KM Percentile (z)	0.00429
99% KM Percentile (z)	0.00535	95% KM USL	0.00511

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	0.00221	SD	0.00149
95% UTL95% Coverage	0.00653	95% UPL (t)	0.00506
90% Percentile (z)	0.00411	95% Percentile (z)	0.00465
99% Percentile (z)	0.00566	95% USL	0.00544

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.732	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00219	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.927	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A		
MLE Sd (bias corrected)	N/A	95% Percentile of Chisquare (2kstar)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00172	SD (KM)	0.00156
Variance (KM)	2.4336E-6	SE of Mean (KM)	6.9765E-4
k hat (KM)	1.216	k star (KM)	0.918
nu hat (KM)	24.31	nu star (KM)	18.35
theta hat (KM)	0.00141	theta star (KM)	0.00187
80% gamma percentile (KM)	0.00279	90% gamma percentile (KM)	0.00405
95% gamma percentile (KM)	0.00531	99% gamma percentile (KM)	0.00827

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	0.00618	0.00617	95% Approx. Gamma UPL	0.0041	0.00401
95% KM Gamma Percentile	0.00361	0.00352	95% Gamma USL	0.00458	0.0045

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Surface Soil Background ProUCL Outputs

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	0.00183	Mean in Log Scale	-6.575
SD in Original Scale	0.00173	SD in Log Scale	0.72
95% UTL95% Coverage	0.0114	95% BCA UTL95% Coverage	0.0064
95% Bootstrap (%) UTL95% Coverage	0.0064	95% UPL (t)	0.00557
90% Percentile (z)	0.00351	95% Percentile (z)	0.00456
99% Percentile (z)	0.00745	95% USL	0.00669

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	-6.558	95% KM UTL (Lognormal)95% Coverage	0.00612
KM SD of Logged Data	0.502	95% KM UPL (Lognormal)	0.00373
95% KM Percentile Lognormal (z)	0.00324	95% KM USL (Lognormal)	0.00423

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	0.00221	Mean in Log Scale	-6.231
SD in Original Scale	0.00149	SD in Log Scale	0.434
95% UTL95% Coverage	0.00697	95% UPL (t)	0.00453
90% Percentile (z)	0.00343	95% Percentile (z)	0.00402
99% Percentile (z)	0.0054	95% USL	0.00506

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with95% Coverage	0.0064
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	0.0064
95% USL	0.0064	95% KM Chebyshev UPL	0.00885

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Sodium

General Statistics

Total Number of Observations	10	Number of Missing Observations	0
Number of Distinct Observations	10		
Number of Detects	2	Number of Non-Detects	8
Number of Distinct Detects	2	Number of Distinct Non-Detects	8
Minimum Detect	10.7	Minimum Non-Detect	443
Maximum Detect	11.6	Maximum Non-Detect	549
Variance Detected	0.405	Percent Non-Detects	80%
Mean Detected	11.15	SD Detected	0.636
Mean of Detected Logged Data	2.411	SD of Detected Logged Data	0.0571

Surface Soil Background ProUCL Outputs

Warning: Data set has only 2 Detected Values.

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

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan Meier (KM) Background Statistics Assuming Normal Distribution

KM Mean	11.15	KM SD	0.45
95% UTL95% Coverage	12.46	95% KM UPL (t)	12.02
90% KM Percentile (z)	11.73	95% KM Percentile (z)	11.89
99% KM Percentile (z)	12.2	95% KM USL	12.13

DL/2 Substitution Background Statistics Assuming Normal Distribution

Mean	201.3	SD	102.1
95% UTL95% Coverage	498.5	95% UPL (t)	397.6
90% Percentile (z)	332.2	95% Percentile (z)	369.3
99% Percentile (z)	438.8	95% USL	423.5

DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	613.6	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0182	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2454	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A		
MLE Sd (bias corrected)	N/A	95% Percentile of Chisquare (2kstar)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	11.15	SD (KM)	0.45
Variance (KM)	0.203	SE of Mean (KM)	0.45
k hat (KM)	613.9	k star (KM)	429.8
nu hat (KM)	12279	nu star (KM)	8596
theta hat (KM)	0.0182	theta star (KM)	0.0259
80% gamma percentile (KM)	11.6	90% gamma percentile (KM)	11.84
95% gamma percentile (KM)	12.05	99% gamma percentile (KM)	12.44

The following statistics are computed using gamma distribution and KM estimates

Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods

	WH	HW		WH	HW
95% Approx. Gamma UTL with 95% Coverage	12.51	12.51	95% Approx. Gamma UPL	12.03	12.03
95% KM Gamma Percentile	11.9	11.9	95% Gamma USL	12.15	12.16

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Surface Soil Background ProUCL Outputs

Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects

Mean in Original Scale	11.14	Mean in Log Scale	2.411
SD in Original Scale	0.212	SD in Log Scale	0.019
95% UTL95% Coverage	11.78	95% BCA UTL95% Coverage	N/A
95% Bootstrap (%) UTL95% Coverage	N/A	95% UPL (t)	11.56
90% Percentile (z)	11.42	95% Percentile (z)	11.5
99% Percentile (z)	11.65	95% USL	11.61

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean of Logged Data	2.411	95% KM UTL (Lognormal)95% Coverage	12.53
KM SD of Logged Data	0.0404	95% KM UPL (Lognormal)	12.04
95% KM Percentile Lognormal (z)	11.91	95% KM USL (Lognormal)	12.16

Background DL/2 Statistics Assuming Lognormal Distribution

Mean in Original Scale	201.3	Mean in Log Scale	4.893
SD in Original Scale	102.1	SD in Log Scale	1.311
95% UTL95% Coverage	6055	95% UPL (t)	1657
90% Percentile (z)	715.3	95% Percentile (z)	1152
99% Percentile (z)	2814	95% USL	2311

DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)

Order of Statistic, r	10	95% UTL with95% Coverage	549
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
Approximate Sample Size needed to achieve specified CC	59	95% UPL	549
95% USL	549	95% KM Chebyshev UPL	13.21

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Vanadium

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Minimum	3.9	First Quartile	5.175
Second Largest	7.7	Median	6.15
Maximum	9.7	Third Quartile	7.1
Mean	6.29	SD	1.676
Coefficient of Variation	0.266	Skewness	0.702
Mean of logged Data	1.808	SD of logged Data	0.263

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Surface Soil Background ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.138	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	11.17	90% Percentile (z)	8.438
95% UPL (t)	9.513	95% Percentile (z)	9.047
95% USL	9.938	99% Percentile (z)	10.19

Gamma GOF Test

A-D Test Statistic	0.153	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	16.17	k star (bias corrected MLE)	11.38
Theta hat (MLE)	0.389	Theta star (bias corrected MLE)	0.553
nu hat (MLE)	323.3	nu star (bias corrected)	227.6
MLE Mean (bias corrected)	6.29	MLE Sd (bias corrected)	1.864

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	9.847	90% Percentile	8.766
95% Hawkins Wixley (HW) Approx. Gamma UPL	9.906	95% Percentile	9.637
95% WH Approx. Gamma UTL with 95% Coverage	12.21	99% Percentile	11.42
95% HW Approx. Gamma UTL with 95% Coverage	12.4		
95% WH USL	10.42	95% HW USL	10.51

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.991	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.118	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	13.12	90% Percentile (z)	8.543
95% UPL (t)	10.11	95% Percentile (z)	9.401
95% USL	10.81	99% Percentile (z)	11.25

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	9.7

Surface Soil Background ProUCL Outputs

Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	9.7	95% BCA Bootstrap UTL with 95% Coverage	9.7
95% UPL	9.7	90% Percentile	7.9
90% Chebyshev UPL	11.56	95% Percentile	8.8
95% Chebyshev UPL	13.95	99% Percentile	9.52
95% USL	9.7		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Zinc

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Minimum	3.6	First Quartile	5.55
Second Largest	9.6	Median	5.95
Maximum	12.3	Third Quartile	7.75
Mean	6.91	SD	2.503
Coefficient of Variation	0.362	Skewness	1.151
Mean of logged Data	1.878	SD of logged Data	0.344

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	2.911	d2max (for USL)	2.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.212	Lilliefors GOF Test
5% Lilliefors Critical Value	0.262	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	14.2	90% Percentile (z)	10.12
95% UPL (t)	11.72	95% Percentile (z)	11.03
95% USL	12.36	99% Percentile (z)	12.73

Gamma GOF Test

A-D Test Statistic	0.353	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.726	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.185	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.342	k star (bias corrected MLE)	6.606
Theta hat (MLE)	0.74	Theta star (bias corrected MLE)	1.046

Surface Soil Background ProUCL Outputs

nu hat (MLE)	186.8	nu star (bias corrected)	132.1
MLE Mean (bias corrected)	6.91	MLE Sd (bias corrected)	2.688

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	12.21	90% Percentile	10.5
95% Hawkins Wixley (HW) Approx. Gamma UPL	12.31	95% Percentile	11.84
95% WH Approx. Gamma UTL with 95% Coverage	15.99	99% Percentile	14.64
95% HW Approx. Gamma UTL with 95% Coverage	16.35		
95% WH USL	13.11	95% HW USL	13.26

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.17	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	17.81	90% Percentile (z)	10.17
95% UPL (t)	12.68	95% Percentile (z)	11.52
95% USL	13.83	99% Percentile (z)	14.57

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	10	95% UTL with 95% Coverage	12.3
Approx, f used to compute achieved CC	0.526	Approximate Actual Confidence Coefficient achieved by UTL	0.401
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	12.3	95% BCA Bootstrap UTL with 95% Coverage	12.3
95% UPL	12.3	90% Percentile	9.87
90% Chebyshev UPL	14.79	95% Percentile	11.09
95% Chebyshev UPL	18.35	99% Percentile	12.06
95% USL	12.3		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Surface Soil North Tank Farm ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 1:06:20 PM
 From File ProUCL Inputs HHRA NTF SS.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	58	Number of Distinct Observations	56
		Number of Missing Observations	0
Minimum	528	Mean	5481
Maximum	18500	Median	4200
SD	4070	Std. Error of Mean	534.4
Coefficient of Variation	0.743	Skewness	1.617

Normal GOF Test

Shapiro Wilk Test Statistic 0.822
 5% Shapiro Wilk P Value 3.5328E-9
 Lilliefors Test Statistic 0.197
 5% Lilliefors Critical Value 0.116

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 6374

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 6481
 95% Modified-t UCL (Johnson-1978) 6393

Gamma GOF Test

A-D Test Statistic 0.812
 5% A-D Critical Value 0.761
 K-S Test Statistic 0.124
 5% K-S Critical Value 0.118

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.275	k star (bias corrected MLE)	2.169
Theta hat (MLE)	2409	Theta star (bias corrected MLE)	2527
nu hat (MLE)	263.9	nu star (bias corrected)	251.6
MLE Mean (bias corrected)	5481	MLE Sd (bias corrected)	3722
		Approximate Chi Square Value (0.05)	215.9
Adjusted Level of Significance	0.0459	Adjusted Chi Square Value	215

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 6388

95% Adjusted Gamma UCL (use when $n < 50$) 6413

Surface Soil North Tank Farm ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.728	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0777	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.116	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	6.269	Mean of logged Data	8.373
Maximum of Logged Data	9.826	SD of logged Data	0.698

Assuming Lognormal Distribution

95% H-UCL	6672	90% Chebyshev (MVUE) UCL	7156
95% Chebyshev (MVUE) UCL	7907	97.5% Chebyshev (MVUE) UCL	8950
99% Chebyshev (MVUE) UCL	10998		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6360	95% Jackknife UCL	6374
95% Standard Bootstrap UCL	6350	95% Bootstrap-t UCL	6549
95% Hall's Bootstrap UCL	6481	95% Percentile Bootstrap UCL	6414
95% BCA Bootstrap UCL	6514		
90% Chebyshev(Mean, Sd) UCL	7084	95% Chebyshev(Mean, Sd) UCL	7810
97.5% Chebyshev(Mean, Sd) UCL	8818	99% Chebyshev(Mean, Sd) UCL	10798

Suggested UCL to Use

95% H-UCL	6672

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Antimony

General Statistics

Total Number of Observations	58	Number of Distinct Observations	23
Number of Detects	6	Number of Non-Detects	52
Number of Distinct Detects	5	Number of Distinct Non-Detects	18
Minimum Detect	0.14	Minimum Non-Detect	0.76
Maximum Detect	4.1	Maximum Non-Detect	1.2
Variance Detects	2.545	Percent Non-Detects	89.66%
Mean Detects	0.845	SD Detects	1.595

Surface Soil North Tank Farm ProUCL Outputs

Median Detects	0.19	CV Detects	1.888
Skewness Detects	2.445	Kurtosis Detects	5.982
Mean of Logged Detects	-1.154	SD of Logged Detects	1.277

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.522	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.472	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.261	KM Standard Error of Mean	0.0765
KM SD	0.511	95% KM (BCA) UCL	0.399
95% KM (t) UCL	0.389	95% KM (Percentile Bootstrap) UCL	0.4
95% KM (z) UCL	0.387	95% KM Bootstrap t UCL	1.044
90% KM Chebyshev UCL	0.491	95% KM Chebyshev UCL	0.595
97.5% KM Chebyshev UCL	0.739	99% KM Chebyshev UCL	1.023

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.351	Anderson-Darling GOF Test
5% A-D Critical Value	0.729	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.447	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.346	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.624	k star (bias corrected MLE)	0.423
Theta hat (MLE)	1.355	Theta star (bias corrected MLE)	1.998
nu hat (MLE)	7.484	nu star (bias corrected)	5.075
Mean (detects)	0.845		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.334
Maximum	4.1	Median	0.103
SD	0.627	CV	1.875
k hat (MLE)	0.503	k star (bias corrected MLE)	0.488
Theta hat (MLE)	0.665	Theta star (bias corrected MLE)	0.685
nu hat (MLE)	58.34	nu star (bias corrected)	56.66
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (56.66, α)	40.36	Adjusted Chi Square Value (56.66, β)	40.01
95% Gamma Approximate UCL (use when $n \geq 50$)	0.469	95% Gamma Adjusted UCL (use when $n < 50$)	0.474

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.261	SD (KM)	0.511

Surface Soil North Tank Farm ProUCL Outputs

Variance (KM)	0.261	SE of Mean (KM)	0.0765
k hat (KM)	0.262	k star (KM)	0.26
nu hat (KM)	30.4	nu star (KM)	30.16
theta hat (KM)	0.997	theta star (KM)	1.005
80% gamma percentile (KM)	0.385	90% gamma percentile (KM)	0.782
95% gamma percentile (KM)	1.25	99% gamma percentile (KM)	2.49

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (30.16, α)	18.62	Adjusted Chi Square Value (30.16, β)	18.38
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.423	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.429

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.656	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.371	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.318	Mean in Log Scale	-1.509
SD in Original Scale	0.532	SD in Log Scale	0.719
95% t UCL (assumes normality of ROS data)	0.435	95% Percentile Bootstrap UCL	0.45
95% BCA Bootstrap UCL	0.534	95% Bootstrap t UCL	0.661
95% H-UCL (Log ROS)	0.348		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.613	KM Geo Mean	0.199
KM SD (logged)	0.459	95% Critical H Value (KM-Log)	1.867
KM Standard Error of Mean (logged)	0.123	95% H-UCL (KM -Log)	0.248
KM SD (logged)	0.459	95% Critical H Value (KM-Log)	1.867
KM Standard Error of Mean (logged)	0.123		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.515	Mean in Log Scale	-0.79
SD in Original Scale	0.489	SD in Log Scale	0.416
95% t UCL (Assumes normality)	0.623	95% H-Stat UCL	0.548

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.595

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

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

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

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

Surface Soil North Tank Farm ProUCL Outputs

Arsenic

General Statistics

Total Number of Observations	58	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	0.44	Mean	2.005
Maximum	6.2	Median	1.6
SD	1.225	Std. Error of Mean	0.161
Coefficient of Variation	0.611	Skewness	1.499

Normal GOF Test

Shapiro Wilk Test Statistic	0.858
5% Shapiro Wilk P Value	2.7675E-7
Lilliefors Test Statistic	0.191
5% Lilliefors Critical Value	0.116

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	2.274

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	2.304
95% Modified-t UCL (Johnson-1978)	2.28

Gamma GOF Test

A-D Test Statistic	0.785
5% A-D Critical Value	0.757
K-S Test Statistic	0.127
5% K-S Critical Value	0.118

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.269	k star (bias corrected MLE)	3.112
Theta hat (MLE)	0.613	Theta star (bias corrected MLE)	0.644
nu hat (MLE)	379.3	nu star (bias corrected)	361
MLE Mean (bias corrected)	2.005	MLE Sd (bias corrected)	1.137
		Approximate Chi Square Value (0.05)	317.9
Adjusted Level of Significance	0.0459	Adjusted Chi Square Value	316.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.277	95% Adjusted Gamma UCL (use when n<50)	2.284

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979
5% Shapiro Wilk P Value	0.666
Lilliefors Test Statistic	0.0894
5% Lilliefors Critical Value	0.116

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.821	Mean of logged Data	0.535

Surface Soil North Tank Farm ProUCL Outputs

Maximum of Logged Data	1.825	SD of logged Data	0.57

Assuming Lognormal Distribution

95% H-UCL	2.325	90% Chebyshev (MVUE) UCL	2.482
95% Chebyshev (MVUE) UCL	2.699	97.5% Chebyshev (MVUE) UCL	3
99% Chebyshev (MVUE) UCL	3.592		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.27	95% Jackknife UCL	2.274
95% Standard Bootstrap UCL	2.267	95% Bootstrap-t UCL	2.318
95% Hall's Bootstrap UCL	2.316	95% Percentile Bootstrap UCL	2.274
95% BCA Bootstrap UCL	2.293		
90% Chebyshev(Mean, Sd) UCL	2.488	95% Chebyshev(Mean, Sd) UCL	2.706
97.5% Chebyshev(Mean, Sd) UCL	3.01	99% Chebyshev(Mean, Sd) UCL	3.605

Suggested UCL to Use

95% H-UCL	2.325

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Cobalt

General Statistics

Total Number of Observations	58	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	0.59	Mean	4.271
Maximum	17.8	Median	3.1
SD	3.172	Std. Error of Mean	0.416
Coefficient of Variation	0.743	Skewness	2.172

Normal GOF Test

Shapiro Wilk Test Statistic	0.765
5% Shapiro Wilk P Value	4.770E-12
Lilliefors Test Statistic	0.249
5% Lilliefors Critical Value	0.116

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

Surface Soil North Tank Farm ProUCL Outputs

95% Normal UCL

95% Student's-t UCL 4.967

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 5.083

95% Modified-t UCL (Johnson-1978) 4.987

Gamma GOF Test

A-D Test Statistic 2.089

5% A-D Critical Value 0.76

K-S Test Statistic 0.181

5% K-S Critical Value 0.118

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 2.652

Theta hat (MLE) 1.61

nu hat (MLE) 307.6

MLE Mean (bias corrected) 4.271

Adjusted Level of Significance 0.0459

k star (bias corrected MLE) 2.526

Theta star (bias corrected MLE) 1.69

nu star (bias corrected) 293.1

MLE Sd (bias corrected) 2.687

Approximate Chi Square Value (0.05) 254.4

Adjusted Chi Square Value 253.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 4.919

95% Adjusted Gamma UCL (use when $n < 50$) 4.937

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.956

5% Shapiro Wilk P Value 0.074

Lilliefors Test Statistic 0.136

5% Lilliefors Critical Value 0.116

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data -0.528

Maximum of Logged Data 2.879

Mean of logged Data 1.252

SD of logged Data 0.617

Assuming Lognormal Distribution

95% H-UCL 4.968

95% Chebyshev (MVUE) UCL 5.814

99% Chebyshev (MVUE) UCL 7.869

90% Chebyshev (MVUE) UCL 5.315

97.5% Chebyshev (MVUE) UCL 6.508

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 4.956

95% Standard Bootstrap UCL 4.949

95% Hall's Bootstrap UCL 5.167

95% BCA Bootstrap UCL 5.09

90% Chebyshev(Mean, Sd) UCL 5.52

97.5% Chebyshev(Mean, Sd) UCL 6.872

95% Jackknife UCL 4.967

95% Bootstrap-t UCL 5.17

95% Percentile Bootstrap UCL 4.971

95% Chebyshev(Mean, Sd) UCL 6.086

99% Chebyshev(Mean, Sd) UCL 8.415

Suggested UCL to Use

Surface Soil North Tank Farm ProUCL Outputs

95% H-UCL 4.968

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Iron

General Statistics

Total Number of Observations	58	Number of Distinct Observations	57
		Number of Missing Observations	0
Minimum	1980	Mean	10225
Maximum	35100	Median	8520
SD	6269	Std. Error of Mean	823.2
Coefficient of Variation	0.613	Skewness	1.653

Normal GOF Test

Shapiro Wilk Test Statistic	0.86
5% Shapiro Wilk P Value	3.5794E-7
Lilliefors Test Statistic	0.183
5% Lilliefors Critical Value	0.116

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 11602

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 11770

95% Modified-t UCL (Johnson-1978) 11631

Gamma GOF Test

A-D Test Statistic	0.633
5% A-D Critical Value	0.757
K-S Test Statistic	0.115
5% K-S Critical Value	0.118

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.294	k star (bias corrected MLE)	3.135
Theta hat (MLE)	3104	Theta star (bias corrected MLE)	3262
nu hat (MLE)	382.1	nu star (bias corrected)	363.7
MLE Mean (bias corrected)	10225	MLE Sd (bias corrected)	5775
		Approximate Chi Square Value (0.05)	320.5
Adjusted Level of Significance	0.0459	Adjusted Chi Square Value	319.4

Surface Soil North Tank Farm ProUCL Outputs

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 11603

95% Adjusted Gamma UCL (use when $n < 50$) 11641

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.99
 5% Shapiro Wilk P Value 0.972
 Lilliefors Test Statistic 0.0763
 5% Lilliefors Critical Value 0.116

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 7.591
 Maximum of Logged Data 10.47

Mean of logged Data 9.073
 SD of logged Data 0.567

Assuming Lognormal Distribution

95% H-UCL 11835
 95% Chebyshev (MVUE) UCL 13730
 99% Chebyshev (MVUE) UCL 18252

90% Chebyshev (MVUE) UCL 12631
 97.5% Chebyshev (MVUE) UCL 15255

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 11579
 95% Standard Bootstrap UCL 11569
 95% Hall's Bootstrap UCL 11874
 95% BCA Bootstrap UCL 11756
 90% Chebyshev(Mean, Sd) UCL 12695
 97.5% Chebyshev(Mean, Sd) UCL 15366

95% Jackknife UCL 11602
 95% Bootstrap-t UCL 11830
 95% Percentile Bootstrap UCL 11570
 95% Chebyshev(Mean, Sd) UCL 13813
 99% Chebyshev(Mean, Sd) UCL 18416

Suggested UCL to Use

95% Approximate Gamma UCL 11603

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

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

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

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

Manganese

General Statistics

Total Number of Observations 58
 Minimum 20.8
 Maximum 7400
 SD 994.8
 Coefficient of Variation 2.248

Number of Distinct Observations 58
 Number of Missing Observations 0
 Mean 442.5
 Median 238.5
 Std. Error of Mean 130.6
 Skewness 6.328

Normal GOF Test

Surface Soil North Tank Farm ProUCL Outputs

Shapiro Wilk Test Statistic	0.355	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	Lilliefors GOF Test
5% Lilliefors Critical Value	0.116	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 660.9

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 773.3

95% Modified-t UCL (Johnson-1978) 679

Gamma GOF Test

A-D Test Statistic	2.25
5% A-D Critical Value	0.787
K-S Test Statistic	0.174
5% K-S Critical Value	0.121

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.845	k star (bias corrected MLE)	0.813
Theta hat (MLE)	523.6	Theta star (bias corrected MLE)	544.3
nu hat (MLE)	98.04	nu star (bias corrected)	94.3
MLE Mean (bias corrected)	442.5	MLE Sd (bias corrected)	490.8
		Approximate Chi Square Value (0.05)	72.9
Adjusted Level of Significance	0.0459	Adjusted Chi Square Value	72.42

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 572.4

95% Adjusted Gamma UCL (use when $n < 50$) 576.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98
5% Shapiro Wilk P Value	0.677
Lilliefors Test Statistic	0.0737
5% Lilliefors Critical Value	0.116

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.035	Mean of logged Data	5.395
Maximum of Logged Data	8.909	SD of logged Data	1.073

Assuming Lognormal Distribution

95% H-UCL	555.2	90% Chebyshev (MVUE) UCL	582.5
95% Chebyshev (MVUE) UCL	671.5	97.5% Chebyshev (MVUE) UCL	795.1
99% Chebyshev (MVUE) UCL	1038		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 657.4

95% Jackknife UCL 660.9

Surface Soil North Tank Farm ProUCL Outputs

95% Standard Bootstrap UCL	654.1	95% Bootstrap-t UCL	1182
95% Hall's Bootstrap UCL	1536	95% Percentile Bootstrap UCL	683.1
95% BCA Bootstrap UCL	870.3		
90% Chebyshev(Mean, Sd) UCL	834.4	95% Chebyshev(Mean, Sd) UCL	1012
97.5% Chebyshev(Mean, Sd) UCL	1258	99% Chebyshev(Mean, Sd) UCL	1742

Suggested UCL to Use

95% H-UCL 555.2

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Benzo (a) anthracene

General Statistics

Total Number of Observations	58	Number of Distinct Observations	44
Number of Detects	42	Number of Non-Detects	16
Number of Distinct Detects	38	Number of Distinct Non-Detects	8
Minimum Detect	0.0012	Minimum Non-Detect	0.0036
Maximum Detect	2.26	Maximum Non-Detect	0.2
Variance Detects	0.153	Percent Non-Detects	27.59%
Mean Detects	0.107	SD Detects	0.391
Median Detects	0.0061	CV Detects	3.666
Skewness Detects	4.84	Kurtosis Detects	24.53
Mean of Logged Detects	-4.549	SD of Logged Detects	1.71

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.301	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.942	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.44	Lilliefors GOF Test
5% Lilliefors Critical Value	0.135	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0798	KM Standard Error of Mean	0.0441
KM SD	0.332	95% KM (BCA) UCL	0.161
95% KM (t) UCL	0.154	95% KM (Percentile Bootstrap) UCL	0.157
95% KM (z) UCL	0.152	95% KM Bootstrap t UCL	0.486
90% KM Chebyshev UCL	0.212	95% KM Chebyshev UCL	0.272
97.5% KM Chebyshev UCL	0.355	99% KM Chebyshev UCL	0.518

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.527	Anderson-Darling GOF Test

Surface Soil North Tank Farm ProUCL Outputs

5% A-D Critical Value	0.86	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.31	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.148	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	0.299	k star (bias corrected MLE)	0.293
Theta hat (MLE)	0.357	Theta star (bias corrected MLE)	0.364
nu hat (MLE)	25.09	nu star (bias corrected)	24.63
Mean (detects)	0.107		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0012	Mean	0.0817
Maximum	2.26	Median	0.01
SD	0.334	CV	4.089
k hat (MLE)	0.335	k star (bias corrected MLE)	0.33
Theta hat (MLE)	0.244	Theta star (bias corrected MLE)	0.248
nu hat (MLE)	38.91	nu star (bias corrected)	38.23
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (38.23, α)	25.07	Adjusted Chi Square Value (38.23, β)	24.8
95% Gamma Approximate UCL (use when $n \geq 50$)	0.125	95% Gamma Adjusted UCL (use when $n < 50$)	0.126

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0798	SD (KM)	0.332
Variance (KM)	0.11	SE of Mean (KM)	0.0441
k hat (KM)	0.0579	k star (KM)	0.0664
nu hat (KM)	6.715	nu star (KM)	7.701
theta hat (KM)	1.378	theta star (KM)	1.202
80% gamma percentile (KM)	0.0252	90% gamma percentile (KM)	0.165
95% gamma percentile (KM)	0.456	99% gamma percentile (KM)	1.54

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.70, α)	2.563	Adjusted Chi Square Value (7.70, β)	2.488
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.24	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.247

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.942	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	Lilliefors GOF Test
5% Lilliefors Critical Value	0.135	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.079	Mean in Log Scale	-4.812
SD in Original Scale	0.335	SD in Log Scale	1.593

Surface Soil North Tank Farm ProUCL Outputs

95% t UCL (assumes normality of ROS data)	0.152	95% Percentile Bootstrap UCL	0.158
95% BCA Bootstrap UCL	0.206	95% Bootstrap t UCL	0.48
95% H-UCL (Log ROS)	0.0574		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.798	KM Geo Mean	0.00825
KM SD (logged)	1.588	95% Critical H Value (KM-Log)	3.24
KM Standard Error of Mean (logged)	0.223	95% H-UCL (KM -Log)	0.0576
KM SD (logged)	1.588	95% Critical H Value (KM-Log)	3.24
KM Standard Error of Mean (logged)	0.223		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0926	Mean in Log Scale	-4.368
SD in Original Scale	0.333	SD in Log Scale	1.78
95% t UCL (Assumes normality)	0.166	95% H-Stat UCL	0.141

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.272

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	58	Number of Distinct Observations	48
Number of Detects	44	Number of Non-Detects	14
Number of Distinct Detects	41	Number of Distinct Non-Detects	8
Minimum Detect	0.0011	Minimum Non-Detect	0.0036
Maximum Detect	2.02	Maximum Non-Detect	0.2
Variance Detects	0.114	Percent Non-Detects	24.14%
Mean Detects	0.0991	SD Detects	0.338
Median Detects	0.0072	CV Detects	3.409
Skewness Detects	4.901	Kurtosis Detects	25.89
Mean of Logged Detects	-4.491	SD of Logged Detects	1.752

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.329	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.944	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.433	Lilliefors GOF Test
5% Lilliefors Critical Value	0.132	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Surface Soil North Tank Farm ProUCL Outputs

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

KM Mean	0.0772	KM Standard Error of Mean	0.039
KM SD	0.294	95% KM (BCA) UCL	0.152
95% KM (t) UCL	0.142	95% KM (Percentile Bootstrap) UCL	0.149
95% KM (z) UCL	0.141	95% KM Bootstrap t UCL	0.329
90% KM Chebyshev UCL	0.194	95% KM Chebyshev UCL	0.247
97.5% KM Chebyshev UCL	0.321	99% KM Chebyshev UCL	0.466

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.753	Anderson-Darling GOF Test
5% A-D Critical Value	0.858	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.297	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.145	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.314	k star (bias corrected MLE)	0.308
Theta hat (MLE)	0.316	Theta star (bias corrected MLE)	0.322
nu hat (MLE)	27.63	nu star (bias corrected)	27.08
Mean (detects)	0.0991		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.0784
Maximum	2.02	Median	0.01
SD	0.296	CV	3.776
k hat (MLE)	0.347	k star (bias corrected MLE)	0.34
Theta hat (MLE)	0.226	Theta star (bias corrected MLE)	0.23
nu hat (MLE)	40.21	nu star (bias corrected)	39.46
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (39.46, α)	26.07	Adjusted Chi Square Value (39.46, β)	25.79
95% Gamma Approximate UCL (use when $n \geq 50$)	0.119	95% Gamma Adjusted UCL (use when $n < 50$)	0.12

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0772	SD (KM)	0.294
Variance (KM)	0.0863	SE of Mean (KM)	0.039
k hat (KM)	0.0691	k star (KM)	0.0771
nu hat (KM)	8.02	nu star (KM)	8.939
theta hat (KM)	1.117	theta star (KM)	1.002
80% gamma percentile (KM)	0.0341	90% gamma percentile (KM)	0.179
95% gamma percentile (KM)	0.448	99% gamma percentile (KM)	1.392

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.94, α)	3.29	Adjusted Chi Square Value (8.94, β)	3.203
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.21	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.216

Surface Soil North Tank Farm ProUCL Outputs

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.944	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.154	Lilliefors GOF Test
5% Lilliefors Critical Value	0.132	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0766	Mean in Log Scale	-4.753
SD in Original Scale	0.296	SD in Log Scale	1.655
95% t UCL (assumes normality of ROS data)	0.142	95% Percentile Bootstrap UCL	0.146
95% BCA Bootstrap UCL	0.194	95% Bootstrap t UCL	0.34
95% H-UCL (Log ROS)	0.0704		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.747	KM Geo Mean	0.00867
KM SD (logged)	1.657	95% Critical H Value (KM-Log)	3.333
KM Standard Error of Mean (logged)	0.229	95% H-UCL (KM -Log)	0.0711
KM SD (logged)	1.657	95% Critical H Value (KM-Log)	3.333
KM Standard Error of Mean (logged)	0.229		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0874	Mean in Log Scale	-4.399
SD in Original Scale	0.295	SD in Log Scale	1.797
95% t UCL (Assumes normality)	0.152	95% H-Stat UCL	0.143

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.247

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

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

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

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

Benzo (b) fluoranthene

General Statistics

Total Number of Observations	58	Number of Distinct Observations	44
Number of Detects	44	Number of Non-Detects	14
Number of Distinct Detects	37	Number of Distinct Non-Detects	7
Minimum Detect	0.0018	Minimum Non-Detect	0.0036
Maximum Detect	2.7	Maximum Non-Detect	0.2
Variance Detects	0.201	Percent Non-Detects	24.14%
Mean Detects	0.119	SD Detects	0.448
Median Detects	0.0099	CV Detects	3.762

Surface Soil North Tank Farm ProUCL Outputs

Skewness Detects	5.09	Kurtosis Detects	27.42
Mean of Logged Detects	-4.321	SD of Logged Detects	1.607

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.293	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.944	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.438	Lilliefors GOF Test
5% Lilliefors Critical Value	0.132	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0926	KM Standard Error of Mean	0.0517
KM SD	0.389	95% KM (BCA) UCL	0.189
95% KM (t) UCL	0.179	95% KM (Percentile Bootstrap) UCL	0.183
95% KM (z) UCL	0.178	95% KM Bootstrap t UCL	0.649
90% KM Chebyshev UCL	0.248	95% KM Chebyshev UCL	0.318
97.5% KM Chebyshev UCL	0.415	99% KM Chebyshev UCL	0.607

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	7.265	Anderson-Darling GOF Test
5% A-D Critical Value	0.858	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.363	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.145	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.312	k star (bias corrected MLE)	0.306
Theta hat (MLE)	0.382	Theta star (bias corrected MLE)	0.389
nu hat (MLE)	27.48	nu star (bias corrected)	26.94
Mean (detects)	0.119		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0018	Mean	0.0939
Maximum	2.7	Median	0.01
SD	0.392	CV	4.175
k hat (MLE)	0.34	k star (bias corrected MLE)	0.334
Theta hat (MLE)	0.277	Theta star (bias corrected MLE)	0.282
nu hat (MLE)	39.4	nu star (bias corrected)	38.69
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (38.69, α)	25.45	Adjusted Chi Square Value (38.69, β)	25.17
95% Gamma Approximate UCL (use when $n \geq 50$)	0.143	95% Gamma Adjusted UCL (use when $n < 50$)	0.144

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0926	SD (KM)	0.389
Variance (KM)	0.151	SE of Mean (KM)	0.0517

Surface Soil North Tank Farm ProUCL Outputs

k hat (KM)	0.0566	k star (KM)	0.0652
nu hat (KM)	6.568	nu star (KM)	7.561
theta hat (KM)	1.635	theta star (KM)	1.42
80% gamma percentile (KM)	0.0279	90% gamma percentile (KM)	0.188
95% gamma percentile (KM)	0.527	99% gamma percentile (KM)	1.801

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.56, α)	2.484	Adjusted Chi Square Value (7.56, β)	2.41
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.282	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.29

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.85	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.944	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	Lilliefors GOF Test
5% Lilliefors Critical Value	0.132	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0918	Mean in Log Scale	-4.655
SD in Original Scale	0.393	SD in Log Scale	1.606
95% t UCL (assumes normality of ROS data)	0.178	95% Percentile Bootstrap UCL	0.183
95% BCA Bootstrap UCL	0.244	95% Bootstrap t UCL	0.539
95% H-UCL (Log ROS)	0.0692		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.596	KM Geo Mean	0.0101
KM SD (logged)	1.543	95% Critical H Value (KM-Log)	3.179
KM Standard Error of Mean (logged)	0.212	95% H-UCL (KM -Log)	0.0636
KM SD (logged)	1.543	95% Critical H Value (KM-Log)	3.179
KM Standard Error of Mean (logged)	0.212		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.102	Mean in Log Scale	-4.323
SD in Original Scale	0.391	SD in Log Scale	1.698
95% t UCL (Assumes normality)	0.188	95% H-Stat UCL	0.12

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.318

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

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

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

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

Surface Soil North Tank Farm ProUCL Outputs

General Statistics

Total Number of Observations	58	Number of Distinct Observations	36
Number of Detects	27	Number of Non-Detects	31
Number of Distinct Detects	22	Number of Distinct Non-Detects	14
Minimum Detect	0.0011	Minimum Non-Detect	0.0036
Maximum Detect	0.364	Maximum Non-Detect	0.21
Variance Detects	0.00689	Percent Non-Detects	53.45%
Mean Detects	0.0302	SD Detects	0.083
Median Detects	0.0026	CV Detects	2.749
Skewness Detects	3.458	Kurtosis Detects	11.72
Mean of Logged Detects	-5.316	SD of Logged Detects	1.602

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.395	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.453	Lilliefors GOF Test
5% Lilliefors Critical Value	0.167	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0163	KM Standard Error of Mean	0.00778
KM SD	0.0575	95% KM (BCA) UCL	0.0304
95% KM (t) UCL	0.0293	95% KM (Percentile Bootstrap) UCL	0.0301
95% KM (z) UCL	0.0291	95% KM Bootstrap t UCL	0.0602
90% KM Chebyshev UCL	0.0396	95% KM Chebyshev UCL	0.0502
97.5% KM Chebyshev UCL	0.0649	99% KM Chebyshev UCL	0.0937

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.885	Anderson-Darling GOF Test
5% A-D Critical Value	0.838	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.296	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.181	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.368	k star (bias corrected MLE)	0.351
Theta hat (MLE)	0.0821	Theta star (bias corrected MLE)	0.0859
nu hat (MLE)	19.85	nu star (bias corrected)	18.97
Mean (detects)	0.0302		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.0204
Maximum	0.364	Median	0.01
SD	0.0571	CV	2.797

Surface Soil North Tank Farm ProUCL Outputs

k hat (MLE)	0.618	k star (bias corrected MLE)	0.597
Theta hat (MLE)	0.033	Theta star (bias corrected MLE)	0.0342
nu hat (MLE)	71.67	nu star (bias corrected)	69.29
Adjusted Level of Significance (β)	0.0459		
Approximate Chi Square Value (69.29, α)	51.13	Adjusted Chi Square Value (69.29, β)	50.73
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0277	95% Gamma Adjusted UCL (use when $n < 50$)	0.0279

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0163	SD (KM)	0.0575
Variance (KM)	0.00331	SE of Mean (KM)	0.00778
k hat (KM)	0.0802	k star (KM)	0.0876
nu hat (KM)	9.309	nu star (KM)	10.16
theta hat (KM)	0.203	theta star (KM)	0.186
80% gamma percentile (KM)	0.00916	90% gamma percentile (KM)	0.0407
95% gamma percentile (KM)	0.095	99% gamma percentile (KM)	0.276

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.16, α)	4.042	Adjusted Chi Square Value (10.16, β)	3.944
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.041	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.042

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.823	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	Lilliefors GOF Test
5% Lilliefors Critical Value	0.167	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0159	Mean in Log Scale	-5.644
SD in Original Scale	0.0577	SD in Log Scale	1.237
95% t UCL (assumes normality of ROS data)	0.0285	95% Percentile Bootstrap UCL	0.0296
95% BCA Bootstrap UCL	0.0359	95% Bootstrap t UCL	0.0718
95% H-UCL (Log ROS)	0.012		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.712	KM Geo Mean	0.00331
KM SD (logged)	1.283	95% Critical H Value (KM-Log)	2.844
KM Standard Error of Mean (logged)	0.199	95% H-UCL (KM -Log)	0.0122
KM SD (logged)	1.283	95% Critical H Value (KM-Log)	2.844
KM Standard Error of Mean (logged)	0.199		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0427	Mean in Log Scale	-4.548
SD in Original Scale	0.0655	SD in Log Scale	1.861
95% t UCL (Assumes normality)	0.0571	95% H-Stat UCL	0.146

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Surface Soil North Tank Farm ProUCL Outputs

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.0502

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

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

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

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

Surface Soil Lorraine Process Area ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 10:54:08 AM
 From File ProUCL Inputs Hhra LPA SS.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	64	Number of Distinct Observations	60
		Number of Missing Observations	0
Minimum	910	Mean	4383
Maximum	22700	Median	2905
SD	3999	Std. Error of Mean	499.9
Coefficient of Variation	0.912	Skewness	2.376

Normal GOF Test

Shapiro Wilk Test Statistic 0.748
 5% Shapiro Wilk P Value 1.454E-14
 Lilliefors Test Statistic 0.22
 5% Lilliefors Critical Value 0.111

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 5218

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 5364
 95% Modified-t UCL (Johnson-1978) 5243

Gamma GOF Test

A-D Test Statistic 1.465
 5% A-D Critical Value 0.765
 K-S Test Statistic 0.119
 5% K-S Critical Value 0.113

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.851	k star (bias corrected MLE)	1.774
Theta hat (MLE)	2369	Theta star (bias corrected MLE)	2470
nu hat (MLE)	236.9	nu star (bias corrected)	227.1
MLE Mean (bias corrected)	4383	MLE Sd (bias corrected)	3291
		Approximate Chi Square Value (0.05)	193.2
Adjusted Level of Significance	0.0463	Adjusted Chi Square Value	192.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50) 5152

95% Adjusted Gamma UCL (use when n<50) 5171

Surface Soil Lorraine Process Area ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.139	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.076	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.111	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.813	Mean of logged Data	8.092
Maximum of Logged Data	10.03	SD of logged Data	0.74

Assuming Lognormal Distribution

95% H-UCL	5196	90% Chebyshev (MVUE) UCL	5587
95% Chebyshev (MVUE) UCL	6183	97.5% Chebyshev (MVUE) UCL	7009
99% Chebyshev (MVUE) UCL	8633		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5206	95% Jackknife UCL	5218
95% Standard Bootstrap UCL	5210	95% Bootstrap-t UCL	5459
95% Hall's Bootstrap UCL	5518	95% Percentile Bootstrap UCL	5246
95% BCA Bootstrap UCL	5375		
90% Chebyshev(Mean, Sd) UCL	5883	95% Chebyshev(Mean, Sd) UCL	6562
97.5% Chebyshev(Mean, Sd) UCL	7505	99% Chebyshev(Mean, Sd) UCL	9357

Suggested UCL to Use

95% H-UCL	5196

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Arsenic

General Statistics

Total Number of Observations	64	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.5	Mean	2.195
Maximum	4.6	Median	2
SD	1.169	Std. Error of Mean	0.146
Coefficient of Variation	0.533	Skewness	0.501

Surface Soil Lorraine Process Area ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic 0.92
 5% Shapiro Wilk P Value 3.6599E-4
 Lilliefors Test Statistic 0.148
 5% Lilliefors Critical Value 0.111

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 2.439

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 2.446

95% Modified-t UCL (Johnson-1978) 2.441

Gamma GOF Test

A-D Test Statistic 0.599
 5% A-D Critical Value 0.757
 K-S Test Statistic 0.102
 5% K-S Critical Value 0.112

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 3.359
 Theta hat (MLE) 0.654
 nu hat (MLE) 430
 MLE Mean (bias corrected) 2.195
 Adjusted Level of Significance 0.0463

k star (bias corrected MLE) 3.212
 Theta star (bias corrected MLE) 0.683
 nu star (bias corrected) 411.2
 MLE Sd (bias corrected) 1.225
 Approximate Chi Square Value (0.05) 365.2
 Adjusted Chi Square Value 364.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 2.472

95% Adjusted Gamma UCL (use when $n < 50$) 2.479

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.946
 5% Shapiro Wilk P Value 0.0144
 Lilliefors Test Statistic 0.0993
 5% Lilliefors Critical Value 0.111

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data -0.693
 Maximum of Logged Data 1.526

Mean of logged Data 0.63
 SD of logged Data 0.588

Assuming Lognormal Distribution

95% H-UCL 2.574
 95% Chebyshev (MVUE) UCL 2.988
 99% Chebyshev (MVUE) UCL 3.968

90% Chebyshev (MVUE) UCL 2.75
 97.5% Chebyshev (MVUE) UCL 3.319

Nonparametric Distribution Free UCL Statistics

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

Surface Soil Lorraine Process Area ProUCL Outputs

Nonparametric Distribution Free UCLs

95% CLT UCL	2.436	95% Jackknife UCL	2.439
95% Standard Bootstrap UCL	2.433	95% Bootstrap-t UCL	2.447
95% Hall's Bootstrap UCL	2.444	95% Percentile Bootstrap UCL	2.436
95% BCA Bootstrap UCL	2.453		
90% Chebyshev(Mean, Sd) UCL	2.634	95% Chebyshev(Mean, Sd) UCL	2.833
97.5% Chebyshev(Mean, Sd) UCL	3.108	99% Chebyshev(Mean, Sd) UCL	3.65

Suggested UCL to Use

95% Approximate Gamma UCL	2.472

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	64	Number of Distinct Observations	30
Number of Detects	59	Number of Non-Detects	5
Number of Distinct Detects	30	Number of Distinct Non-Detects	1
Minimum Detect	0.27	Minimum Non-Detect	2.1
Maximum Detect	13.3	Maximum Non-Detect	2.1
Variance Detects	4.086	Percent Non-Detects	7.813%
Mean Detects	3.245	SD Detects	2.021
Median Detects	2.7	CV Detects	0.623
Skewness Detects	3.361	Kurtosis Detects	14.35
Mean of Logged Detects	1.045	SD of Logged Detects	0.525

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.679
5% Shapiro Wilk P Value	2.220E-16
Lilliefors Test Statistic	0.202
5% Lilliefors Critical Value	0.115

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	3.119	KM Standard Error of Mean	0.25
KM SD	1.976	95% KM (BCA) UCL	3.559
95% KM (t) UCL	3.536	95% KM (Percentile Bootstrap) UCL	3.548
95% KM (z) UCL	3.53	95% KM Bootstrap t UCL	3.768
90% KM Chebyshev UCL	3.869	95% KM Chebyshev UCL	4.208
97.5% KM Chebyshev UCL	4.68	99% KM Chebyshev UCL	5.605

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.705
5% A-D Critical Value	0.754
K-S Test Statistic	0.123
5% K-S Critical Value	0.116

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Surface Soil Lorraine Process Area ProUCL Outputs

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.949	k star (bias corrected MLE)	3.76
Theta hat (MLE)	0.822	Theta star (bias corrected MLE)	0.863
nu hat (MLE)	466	nu star (bias corrected)	443.7
Mean (detects)	3.245		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.27	Mean	3.081
Maximum	13.3	Median	2.65
SD	2.024	CV	0.657
k hat (MLE)	3.372	k star (bias corrected MLE)	3.224
Theta hat (MLE)	0.914	Theta star (bias corrected MLE)	0.956
nu hat (MLE)	431.6	nu star (bias corrected)	412.7
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (412.72, α)	366.6	Adjusted Chi Square Value (412.72, β)	365.6
95% Gamma Approximate UCL (use when $n \geq 50$)	3.469	95% Gamma Adjusted UCL (use when $n < 50$)	3.478

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.119	SD (KM)	1.976
Variance (KM)	3.906	SE of Mean (KM)	0.25
k hat (KM)	2.491	k star (KM)	2.384
nu hat (KM)	318.8	nu star (KM)	305.2
theta hat (KM)	1.252	theta star (KM)	1.308
80% gamma percentile (KM)	4.573	90% gamma percentile (KM)	5.824
95% gamma percentile (KM)	7.006	99% gamma percentile (KM)	9.6

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (305.19, α)	265.7	Adjusted Chi Square Value (305.19, β)	264.9
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	3.582	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.594

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.892
5% Shapiro Wilk P Value	1.6668E-5
Lilliefors Test Statistic	0.108
5% Lilliefors Critical Value	0.115

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.107	Mean in Log Scale	0.993
SD in Original Scale	1.999	SD in Log Scale	0.538
95% t UCL (assumes normality of ROS data)	3.524	95% Percentile Bootstrap UCL	3.557
95% BCA Bootstrap UCL	3.655	95% Bootstrap t UCL	3.758
95% H-UCL (Log ROS)	3.545		

Surface Soil Lorraine Process Area ProUCL Outputs

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.995	KM Geo Mean	2.705
KM SD (logged)	0.549	95% Critical H Value (KM-Log)	1.897
KM Standard Error of Mean (logged)	0.0726	95% H-UCL (KM -Log)	3.586
KM SD (logged)	0.549	95% Critical H Value (KM-Log)	1.897
KM Standard Error of Mean (logged)	0.0726		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.074	Mean in Log Scale	0.967
SD in Original Scale	2.028	SD in Log Scale	0.572
95% t UCL (Assumes normality)	3.497	95% H-Stat UCL	3.555

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 3.586

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

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

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

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

Iron

General Statistics

Total Number of Observations	64	Number of Distinct Observations	60
		Number of Missing Observations	0
Minimum	2210	Mean	8960
Maximum	40200	Median	7810
SD	6304	Std. Error of Mean	788
Coefficient of Variation	0.704	Skewness	2.465

Normal GOF Test

Shapiro Wilk Test Statistic	0.804
5% Shapiro Wilk P Value	2.320E-11
Lilliefors Test Statistic	0.142
5% Lilliefors Critical Value	0.111

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 10275

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 10515

95% Modified-t UCL (Johnson-1978) 10315

Gamma GOF Test

Surface Soil Lorraine Process Area ProUCL Outputs

A-D Test Statistic	0.376	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.062	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.112	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	2.74	k star (bias corrected MLE)	2.622
Theta hat (MLE)	3270	Theta star (bias corrected MLE)	3417
nu hat (MLE)	350.7	nu star (bias corrected)	335.6
MLE Mean (bias corrected)	8960	MLE Sd (bias corrected)	5533
		Approximate Chi Square Value (0.05)	294.2
Adjusted Level of Significance	0.0463	Adjusted Chi Square Value	293.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	10222	95% Adjusted Gamma UCL (use when $n < 50$)	10253

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.543	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0567	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.111	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.701	Mean of logged Data	8.907
Maximum of Logged Data	10.6	SD of logged Data	0.623

Assuming Lognormal Distribution

95% H-UCL	10448	90% Chebyshev (MVUE) UCL	11186
95% Chebyshev (MVUE) UCL	12207	97.5% Chebyshev (MVUE) UCL	13624
99% Chebyshev (MVUE) UCL	16406		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	10256	95% Jackknife UCL	10275
95% Standard Bootstrap UCL	10220	95% Bootstrap-t UCL	10663
95% Hall's Bootstrap UCL	10882	95% Percentile Bootstrap UCL	10325
95% BCA Bootstrap UCL	10549		
90% Chebyshev(Mean, Sd) UCL	11324	95% Chebyshev(Mean, Sd) UCL	12394
97.5% Chebyshev(Mean, Sd) UCL	13881	99% Chebyshev(Mean, Sd) UCL	16800

Suggested UCL to Use

95% Approximate Gamma UCL	10222

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

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

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

Surface Soil Lorraine Process Area ProUCL Outputs

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

Lead

General Statistics

Total Number of Observations	64	Number of Distinct Observations	58
		Number of Missing Observations	0
Minimum	0.5	Mean	532.7
Maximum	20800	Median	28.95
SD	2784	Std. Error of Mean	348
Coefficient of Variation	5.227	Skewness	6.684

Normal GOF Test

Shapiro Wilk Test Statistic	0.206
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.488
5% Lilliefors Critical Value	0.111

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	1114

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	1416
95% Modified-t UCL (Johnson-1978)	1162

Gamma GOF Test

A-D Test Statistic	10.93
5% A-D Critical Value	0.887
K-S Test Statistic	0.343
5% K-S Critical Value	0.122

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.254	k star (bias corrected MLE)	0.253
Theta hat (MLE)	2095	Theta star (bias corrected MLE)	2108
nu hat (MLE)	32.54	nu star (bias corrected)	32.35
MLE Mean (bias corrected)	532.7	MLE Sd (bias corrected)	1060
		Approximate Chi Square Value (0.05)	20.35
Adjusted Level of Significance	0.0463	Adjusted Chi Square Value	20.13

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	846.8	95% Adjusted Gamma UCL (use when $n < 50$)	856

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923
5% Shapiro Wilk P Value	5.5427E-4
Lilliefors Test Statistic	0.0973
5% Lilliefors Critical Value	0.111

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Surface Soil Lorraine Process Area ProUCL Outputs

Lognormal Statistics

Minimum of Logged Data	-0.693	Mean of logged Data	3.491
Maximum of Logged Data	9.943	SD of logged Data	1.753

Assuming Lognormal Distribution

95% H-UCL	280.3	90% Chebyshev (MVUE) UCL	279.9
95% Chebyshev (MVUE) UCL	341.4	97.5% Chebyshev (MVUE) UCL	426.8
99% Chebyshev (MVUE) UCL	594.6		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	1105	95% Jackknife UCL	1114
95% Standard Bootstrap UCL	1107	95% Bootstrap-t UCL	6361
95% Hall's Bootstrap UCL	6949	95% Percentile Bootstrap UCL	1170
95% BCA Bootstrap UCL	1673		
90% Chebyshev(Mean, Sd) UCL	1577	95% Chebyshev(Mean, Sd) UCL	2050
97.5% Chebyshev(Mean, Sd) UCL	2706	99% Chebyshev(Mean, Sd) UCL	3996

Suggested UCL to Use

95% H-UCL	280.3

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Manganese

General Statistics

Total Number of Observations	64	Number of Distinct Observations	61
		Number of Missing Observations	0
Minimum	16.7	Mean	188.4
Maximum	1430	Median	150
SD	193.9	Std. Error of Mean	24.24
Coefficient of Variation	1.029	Skewness	4.532

Normal GOF Test

Shapiro Wilk Test Statistic	0.608
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.243
5% Lilliefors Critical Value	0.111

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Surface Soil Lorraine Process Area ProUCL Outputs

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 228.9

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 243

95% Modified-t UCL (Johnson-1978) 231.2

Gamma GOF Test

A-D Test Statistic 0.932

5% A-D Critical Value 0.765

K-S Test Statistic 0.127

5% K-S Critical Value 0.113

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 1.87

Theta hat (MLE) 100.8

nu hat (MLE) 239.4

MLE Mean (bias corrected) 188.4

Adjusted Level of Significance 0.0463

k star (bias corrected MLE) 1.793

Theta star (bias corrected MLE) 105.1

nu star (bias corrected) 229.5

MLE Sd (bias corrected) 140.7

Approximate Chi Square Value (0.05) 195.4

Adjusted Chi Square Value 194.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)) 221.3

95% Adjusted Gamma UCL (use when n<50) 222.1

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.984

5% Shapiro Wilk P Value 0.835

Lilliefors Test Statistic 0.0879

5% Lilliefors Critical Value 0.111

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 2.815

Maximum of Logged Data 7.265

Mean of logged Data 4.948

SD of logged Data 0.751

Assuming Lognormal Distribution

95% H-UCL 227

95% Chebyshev (MVUE) UCL 270.5

99% Chebyshev (MVUE) UCL 379.1

90% Chebyshev (MVUE) UCL 244.1

97.5% Chebyshev (MVUE) UCL 307.1

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 228.3

95% Standard Bootstrap UCL 228.1

95% Hall's Bootstrap UCL 409.8

95% BCA Bootstrap UCL 246.9

90% Chebyshev(Mean, Sd) UCL 261.2

97.5% Chebyshev(Mean, Sd) UCL 339.8

95% Jackknife UCL 228.9

95% Bootstrap-t UCL 258.4

95% Percentile Bootstrap UCL 231.6

95% Chebyshev(Mean, Sd) UCL 294.1

99% Chebyshev(Mean, Sd) UCL 429.6

Surface Soil Lorraine Process Area ProUCL Outputs

Suggested UCL to Use

95% H-UCL 227

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Benzo (a) anthracene

General Statistics

Total Number of Observations	64	Number of Distinct Observations	49
Number of Detects	49	Number of Non-Detects	15
Number of Distinct Detects	42	Number of Distinct Non-Detects	8
Minimum Detect	0.0013	Minimum Non-Detect	0.0018
Maximum Detect	2.1	Maximum Non-Detect	0.36
Variance Detects	0.149	Percent Non-Detects	23.44%
Mean Detects	0.132	SD Detects	0.385
Median Detects	0.019	CV Detects	2.925
Skewness Detects	4.077	Kurtosis Detects	17.15
Mean of Logged Detects	-3.916	SD of Logged Detects	1.738

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.378	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.444	Lilliefors GOF Test
5% Lilliefors Critical Value	0.126	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.103	KM Standard Error of Mean	0.0427
KM SD	0.338	95% KM (BCA) UCL	0.183
95% KM (t) UCL	0.174	95% KM (Percentile Bootstrap) UCL	0.18
95% KM (z) UCL	0.173	95% KM Bootstrap t UCL	0.286
90% KM Chebyshev UCL	0.231	95% KM Chebyshev UCL	0.289
97.5% KM Chebyshev UCL	0.37	99% KM Chebyshev UCL	0.528

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.972	Anderson-Darling GOF Test
5% A-D Critical Value	0.849	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.298	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.136	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Surface Soil Lorraine Process Area ProUCL Outputs

Gamma Statistics on Detected Data Only

k hat (MLE)	0.355	k star (bias corrected MLE)	0.347
Theta hat (MLE)	0.371	Theta star (bias corrected MLE)	0.38
nu hat (MLE)	34.8	nu star (bias corrected)	34
Mean (detects)	0.132		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0013	Mean	0.104
Maximum	2.1	Median	0.01
SD	0.34	CV	3.27
k hat (MLE)	0.373	k star (bias corrected MLE)	0.366
Theta hat (MLE)	0.279	Theta star (bias corrected MLE)	0.285
nu hat (MLE)	47.7	nu star (bias corrected)	46.8
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (46.80, α)	32.1	Adjusted Chi Square Value (46.80, β)	31.82
95% Gamma Approximate UCL (use when $n \geq 50$)	0.152	95% Gamma Adjusted UCL (use when $n < 50$)	0.153

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.103	SD (KM)	0.338
Variance (KM)	0.114	SE of Mean (KM)	0.0427
k hat (KM)	0.0929	k star (KM)	0.099
nu hat (KM)	11.9	nu star (KM)	12.67
theta hat (KM)	1.109	theta star (KM)	1.041
80% gamma percentile (KM)	0.0704	90% gamma percentile (KM)	0.273
95% gamma percentile (KM)	0.598	99% gamma percentile (KM)	1.645

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.67, α)	5.673	Adjusted Chi Square Value (12.67, β)	5.565
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.23	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.235

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.127	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.126	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.102	Mean in Log Scale	-4.38
SD in Original Scale	0.341	SD in Log Scale	1.849
95% t UCL (assumes normality of ROS data)	0.173	95% Percentile Bootstrap UCL	0.178
95% BCA Bootstrap UCL	0.211	95% Bootstrap t UCL	0.285
95% H-UCL (Log ROS)	0.135		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

Surface Soil Lorraine Process Area ProUCL Outputs

KM Mean (logged)	-4.315	KM Geo Mean	0.0134
KM SD (logged)	1.764	95% Critical H Value (KM-Log)	2.767
KM Standard Error of Mean (logged)	0.23	95% H-UCL (KM -Log)	0.117
KM SD (logged)	1.764	95% Critical H Value (KM-Log)	2.767
KM Standard Error of Mean (logged)	0.23		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.112	Mean in Log Scale	-4.087
SD in Original Scale	0.34	SD in Log Scale	1.857
95% t UCL (Assumes normality)	0.183	95% H-Stat UCL	0.185

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.289

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	64	Number of Distinct Observations	49
Number of Detects	50	Number of Non-Detects	14
Number of Distinct Detects	45	Number of Distinct Non-Detects	8
Minimum Detect	4.4000E-4	Minimum Non-Detect	0.0018
Maximum Detect	3.7	Maximum Non-Detect	0.36
Variance Detects	0.407	Percent Non-Detects	21.88%
Mean Detects	0.198	SD Detects	0.638
Median Detects	0.022	CV Detects	3.226
Skewness Detects	4.4	Kurtosis Detects	20.49
Mean of Logged Detects	-3.824	SD of Logged Detects	1.901

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.348	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.424	Lilliefors GOF Test
5% Lilliefors Critical Value	0.125	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.157	KM Standard Error of Mean	0.0712
KM SD	0.564	95% KM (BCA) UCL	0.288
95% KM (t) UCL	0.276	95% KM (Percentile Bootstrap) UCL	0.281
95% KM (z) UCL	0.274	95% KM Bootstrap t UCL	0.416

Surface Soil Lorraine Process Area ProUCL Outputs

90% KM Chebyshev UCL	0.37	95% KM Chebyshev UCL	0.467
97.5% KM Chebyshev UCL	0.601	99% KM Chebyshev UCL	0.865

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.17	Anderson-Darling GOF Test	
5% A-D Critical Value	0.86	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.255	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.136	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.311	k star (bias corrected MLE)	0.306
Theta hat (MLE)	0.636	Theta star (bias corrected MLE)	0.647
nu hat (MLE)	31.1	nu star (bias corrected)	30.57
Mean (detects)	0.198		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.4000E-4	Mean	0.157
Maximum	3.7	Median	0.01
SD	0.568	CV	3.625
k hat (MLE)	0.319	k star (bias corrected MLE)	0.314
Theta hat (MLE)	0.492	Theta star (bias corrected MLE)	0.499
nu hat (MLE)	40.8	nu star (bias corrected)	40.22
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (40.22, α)	26.69	Adjusted Chi Square Value (40.22, β)	26.44
95% Gamma Approximate UCL (use when $n \geq 50$)	0.236	95% Gamma Adjusted UCL (use when $n < 50$)	0.238

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.157	SD (KM)	0.564
Variance (KM)	0.318	SE of Mean (KM)	0.0712
k hat (KM)	0.0774	k star (KM)	0.0842
nu hat (KM)	9.905	nu star (KM)	10.77
theta hat (KM)	2.027	theta star (KM)	1.863
80% gamma percentile (KM)	0.0822	90% gamma percentile (KM)	0.383
95% gamma percentile (KM)	0.913	99% gamma percentile (KM)	2.711

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.77, α)	4.431	Adjusted Chi Square Value (10.77, β)	4.337
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.381	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.39

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.947	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.102	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.125	Detected Data appear Lognormal at 5% Significance Level	

Surface Soil Lorraine Process Area ProUCL Outputs

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.156	Mean in Log Scale	-4.32
SD in Original Scale	0.568	SD in Log Scale	2.038
95% t UCL (assumes normality of ROS data)	0.274	95% Percentile Bootstrap UCL	0.281
95% BCA Bootstrap UCL	0.335	95% Bootstrap t UCL	0.405
95% H-UCL (Log ROS)	0.235		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.287	KM Geo Mean	0.0137
KM SD (logged)	2.01	95% Critical H Value (KM-Log)	3.066
KM Standard Error of Mean (logged)	0.267	95% H-UCL (KM -Log)	0.226
KM SD (logged)	2.01	95% Critical H Value (KM-Log)	3.066
KM Standard Error of Mean (logged)	0.267		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.164	Mean in Log Scale	-4.041
SD in Original Scale	0.567	SD in Log Scale	1.985
95% t UCL (Assumes normality)	0.282	95% H-Stat UCL	0.269

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.226

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

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

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

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

Benzo (b) fluoranthene

General Statistics

Total Number of Observations	64	Number of Distinct Observations	50
Number of Detects	53	Number of Non-Detects	11
Number of Distinct Detects	45	Number of Distinct Non-Detects	7
Minimum Detect	7.3000E-4	Minimum Non-Detect	0.0018
Maximum Detect	7.9	Maximum Non-Detect	0.36
Variance Detects	1.566	Percent Non-Detects	17.19%
Mean Detects	0.35	SD Detects	1.251
Median Detects	0.03	CV Detects	3.575
Skewness Detects	5.053	Kurtosis Detects	27.52
Mean of Logged Detects	-3.334	SD of Logged Detects	1.881

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.313

Normal GOF Test on Detected Observations Only

Surface Soil Lorraine Process Area ProUCL Outputs

5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.434	Lilliefors GOF Test
5% Lilliefors Critical Value	0.121	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

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

KM Mean	0.292	KM Standard Error of Mean	0.143
KM SD	1.135	95% KM (BCA) UCL	0.555
95% KM (t) UCL	0.532	95% KM (Percentile Bootstrap) UCL	0.547
95% KM (z) UCL	0.528	95% KM Bootstrap t UCL	1.076
90% KM Chebyshev UCL	0.722	95% KM Chebyshev UCL	0.917
97.5% KM Chebyshev UCL	1.187	99% KM Chebyshev UCL	1.718

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.909	Anderson-Darling GOF Test
5% A-D Critical Value	0.862	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.275	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.133	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.302	k star (bias corrected MLE)	0.297
Theta hat (MLE)	1.16	Theta star (bias corrected MLE)	1.178
nu hat (MLE)	31.98	nu star (bias corrected)	31.5
Mean (detects)	0.35		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	7.3000E-4	Mean	0.292
Maximum	7.9	Median	0.017
SD	1.144	CV	3.924
k hat (MLE)	0.298	k star (bias corrected MLE)	0.294
Theta hat (MLE)	0.98	Theta star (bias corrected MLE)	0.991
nu hat (MLE)	38.1	nu star (bias corrected)	37.65
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (37.65, α)	24.6	Adjusted Chi Square Value (37.65, β)	24.35
95% Gamma Approximate UCL (use when $n \geq 50$)	0.446	95% Gamma Adjusted UCL (use when $n < 50$)	0.451

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.292	SD (KM)	1.135
Variance (KM)	1.289	SE of Mean (KM)	0.143
k hat (KM)	0.0664	k star (KM)	0.0737
nu hat (KM)	8.495	nu star (KM)	9.43
theta hat (KM)	4.406	theta star (KM)	3.969
80% gamma percentile (KM)	0.117	90% gamma percentile (KM)	0.656
95% gamma percentile (KM)	1.691	99% gamma percentile (KM)	5.383

Surface Soil Lorraine Process Area ProUCL Outputs

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.43, α)	3.589	Adjusted Chi Square Value (9.43, β)	3.506
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.768	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.787

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.958	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.114	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.086	Lilliefors GOF Test
5% Lilliefors Critical Value	0.121	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.291	Mean in Log Scale	-3.773
SD in Original Scale	1.144	SD in Log Scale	2.07
95% t UCL (assumes normality of ROS data)	0.53	95% Percentile Bootstrap UCL	0.552
95% BCA Bootstrap UCL	0.675	95% Bootstrap t UCL	1.066
95% H-UCL (Log ROS)	0.442		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.776	KM Geo Mean	0.0229
KM SD (logged)	2.08	95% Critical H Value (KM-Log)	3.126
KM Standard Error of Mean (logged)	0.269	95% H-UCL (KM -Log)	0.452
KM SD (logged)	2.08	95% Critical H Value (KM-Log)	3.126
KM Standard Error of Mean (logged)	0.269		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.298	Mean in Log Scale	-3.604
SD in Original Scale	1.143	SD in Log Scale	2.026
95% t UCL (Assumes normality)	0.536	95% H-Stat UCL	0.465

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.452

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

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

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

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

Dibenz (a,h) anthracene

General Statistics

Total Number of Observations	64	Number of Distinct Observations	29
Number of Detects	9	Number of Non-Detects	55
Number of Distinct Detects	9	Number of Distinct Non-Detects	21

Surface Soil Lorraine Process Area ProUCL Outputs

Minimum Detect	7.9000E-4	Minimum Non-Detect	0.0017
Maximum Detect	0.22	Maximum Non-Detect	0.94
Variance Detects	0.00516	Percent Non-Detects	85.94%
Mean Detects	0.0286	SD Detects	0.0719
Median Detects	0.0043	CV Detects	2.512
Skewness Detects	2.988	Kurtosis Detects	8.946
Mean of Logged Detects	-5.172	SD of Logged Detects	1.575

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.43	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.48	Lilliefors GOF Test
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0056	KM Standard Error of Mean	0.00391
KM SD	0.0282	95% KM (BCA) UCL	0.0165
95% KM (t) UCL	0.0121	95% KM (Percentile Bootstrap) UCL	0.0132
95% KM (z) UCL	0.012	95% KM Bootstrap t UCL	0.056
90% KM Chebyshev UCL	0.0173	95% KM Chebyshev UCL	0.0227
97.5% KM Chebyshev UCL	0.03	99% KM Chebyshev UCL	0.0445

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.485	Anderson-Darling GOF Test
5% A-D Critical Value	0.788	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.365	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.298	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.406	k star (bias corrected MLE)	0.345
Theta hat (MLE)	0.0705	Theta star (bias corrected MLE)	0.083
nu hat (MLE)	7.306	nu star (bias corrected)	6.204
Mean (detects)	0.0286		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	7.9000E-4	Mean	0.0128
Maximum	0.22	Median	0.01
SD	0.0264	CV	2.063
k hat (MLE)	1.75	k star (bias corrected MLE)	1.679
Theta hat (MLE)	0.00732	Theta star (bias corrected MLE)	0.00763
nu hat (MLE)	224	nu star (bias corrected)	214.9
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (214.85, α)	181.9	Adjusted Chi Square Value (214.85, β)	181.2

Surface Soil Lorraine Process Area ProUCL Outputs

95% Gamma Approximate UCL (use when $n \geq 50$) 0.0151 95% Gamma Adjusted UCL (use when $n < 50$) 0.0152

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0056	SD (KM)	0.0282
Variance (KM)	7.9794E-4	SE of Mean (KM)	0.00391
k hat (KM)	0.0393	k star (KM)	0.0478
nu hat (KM)	5.027	nu star (KM)	6.124
theta hat (KM)	0.143	theta star (KM)	0.117
80% gamma percentile (KM)	6.4727E-4	90% gamma percentile (KM)	0.00805
95% gamma percentile (KM)	0.0293	99% gamma percentile (KM)	0.124

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.12, α)	1.704	Adjusted Chi Square Value (6.12, β)	1.651
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0201	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0208

Lognormal GOF Test on Detected Observations Only

		Shapiro Wilk GOF Test
Shapiro Wilk Test Statistic	0.856	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.24	
5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00485	Mean in Log Scale	-7.172
SD in Original Scale	0.0274	SD in Log Scale	1.402
95% t UCL (assumes normality of ROS data)	0.0106	95% Percentile Bootstrap UCL	0.0116
95% BCA Bootstrap UCL	0.0154	95% Bootstrap t UCL	0.0721
95% H-UCL (Log ROS)	0.00309		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.596	KM Geo Mean	0.00137
KM SD (logged)	1.03	95% Critical H Value (KM-Log)	2.263
KM Standard Error of Mean (logged)	0.185	95% H-UCL (KM -Log)	0.00311
KM SD (logged)	1.03	95% Critical H Value (KM-Log)	2.263
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0452	Mean in Log Scale	-4.747
SD in Original Scale	0.0796	SD in Log Scale	1.957
95% t UCL (Assumes normality)	0.0618	95% H-Stat UCL	0.123

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 0.00311

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

Surface Soil Lorraine Process Area ProUCL Outputs

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

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

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

Indeno (1,2,3-cd) pyrene

General Statistics

Total Number of Observations	64	Number of Distinct Observations	47
Number of Detects	49	Number of Non-Detects	15
Number of Distinct Detects	40	Number of Distinct Non-Detects	8
Minimum Detect	4.0000E-4	Minimum Non-Detect	0.0018
Maximum Detect	1.6	Maximum Non-Detect	0.36
Variance Detects	0.056	Percent Non-Detects	23.44%
Mean Detects	0.063	SD Detects	0.237
Median Detects	0.0094	CV Detects	3.757
Skewness Detects	6.053	Kurtosis Detects	38.96
Mean of Logged Detects	-4.615	SD of Logged Detects	1.655

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.279	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.401	Lilliefors GOF Test
5% Lilliefors Critical Value	0.126	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0502	KM Standard Error of Mean	0.0261
KM SD	0.207	95% KM (BCA) UCL	0.103
95% KM (t) UCL	0.0937	95% KM (Percentile Bootstrap) UCL	0.0992
95% KM (z) UCL	0.0931	95% KM Bootstrap t UCL	0.254
90% KM Chebyshev UCL	0.128	95% KM Chebyshev UCL	0.164
97.5% KM Chebyshev UCL	0.213	99% KM Chebyshev UCL	0.31

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.94	Anderson-Darling GOF Test
5% A-D Critical Value	0.847	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.272	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.136	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.362	k star (bias corrected MLE)	0.353
Theta hat (MLE)	0.174	Theta star (bias corrected MLE)	0.179
nu hat (MLE)	35.43	nu star (bias corrected)	34.59
Mean (detects)	0.063		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

Surface Soil Lorraine Process Area ProUCL Outputs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.0000E-4	Mean	0.0517
Maximum	1.6	Median	0.01
SD	0.208	CV	4.02
k hat (MLE)	0.406	k star (bias corrected MLE)	0.397
Theta hat (MLE)	0.127	Theta star (bias corrected MLE)	0.13
nu hat (MLE)	51.98	nu star (bias corrected)	50.88
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (50.88, α)	35.5	Adjusted Chi Square Value (50.88, β)	35.2
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0741	95% Gamma Adjusted UCL (use when $n < 50$)	0.0747

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0502	SD (KM)	0.207
Variance (KM)	0.0426	SE of Mean (KM)	0.0261
k hat (KM)	0.059	k star (KM)	0.0667
nu hat (KM)	7.555	nu star (KM)	8.534
theta hat (KM)	0.85	theta star (KM)	0.752
80% gamma percentile (KM)	0.016	90% gamma percentile (KM)	0.104
95% gamma percentile (KM)	0.287	99% gamma percentile (KM)	0.966

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.53, α)	3.048	Adjusted Chi Square Value (8.53, β)	2.973
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.14	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.144

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.947	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.132	Lilliefors GOF Test
5% Lilliefors Critical Value	0.126	Detected Data Not Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0495	Mean in Log Scale	-4.903
SD in Original Scale	0.208	SD in Log Scale	1.631
95% t UCL (assumes normality of ROS data)	0.0929	95% Percentile Bootstrap UCL	0.0984
95% BCA Bootstrap UCL	0.134	95% Bootstrap t UCL	0.248
95% H-UCL (Log ROS)	0.048		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.901	KM Geo Mean	0.00744
KM SD (logged)	1.655	95% Critical H Value (KM-Log)	2.637
KM Standard Error of Mean (logged)	0.222	95% H-UCL (KM -Log)	0.0507
KM SD (logged)	1.655	95% Critical H Value (KM-Log)	2.637
KM Standard Error of Mean (logged)	0.222		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0607
SD in Original Scale	0.209

DL/2 Log-Transformed

Mean in Log Scale	-4.549
SD in Log Scale	1.768

Surface Soil Lorraine Process Area ProUCL Outputs

95% t UCL (Assumes normality) 0.104

95% H-Stat UCL 0.0937

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 0.0507

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

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

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

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

Surface Soil Loading Dock Area ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/11/2019 11:59:08 AM
 From File LDA_input file.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	1620	Mean	3636
Maximum	8300	Median	2615
SD	2093	Std. Error of Mean	468
Coefficient of Variation	0.576	Skewness	1.173

Normal GOF Test

Shapiro Wilk Test Statistic 0.824
 5% Shapiro Wilk Critical Value 0.905
 Lilliefors Test Statistic 0.229
 5% Lilliefors Critical Value 0.192

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 4445

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 4536
 95% Modified-t UCL (Johnson-1978) 4465

Gamma GOF Test

A-D Test Statistic 0.945
 5% A-D Critical Value 0.746
 K-S Test Statistic 0.207
 5% K-S Critical Value 0.195

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.826	k star (bias corrected MLE)	3.285
Theta hat (MLE)	950.3	Theta star (bias corrected MLE)	1107
nu hat (MLE)	153	nu star (bias corrected)	131.4
MLE Mean (bias corrected)	3636	MLE Sd (bias corrected)	2006
		Approximate Chi Square Value (0.05)	105.9
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	104.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 4510

95% Adjusted Gamma UCL (use when $n < 50$) 4588

Surface Soil Loading Dock Area ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.907	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.183	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.39	Mean of logged Data	8.062
Maximum of Logged Data	9.024	SD of logged Data	0.518

Assuming Lognormal Distribution

95% H-UCL	4620	90% Chebyshev (MVUE) UCL	4900
95% Chebyshev (MVUE) UCL	5489	97.5% Chebyshev (MVUE) UCL	6306
99% Chebyshev (MVUE) UCL	7911		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4405	95% Jackknife UCL	4445
95% Standard Bootstrap UCL	4385	95% Bootstrap-t UCL	4646
95% Hall's Bootstrap UCL	4501	95% Percentile Bootstrap UCL	4417
95% BCA Bootstrap UCL	4556		
90% Chebyshev(Mean, Sd) UCL	5039	95% Chebyshev(Mean, Sd) UCL	5675
97.5% Chebyshev(Mean, Sd) UCL	6558	99% Chebyshev(Mean, Sd) UCL	8292

Suggested UCL to Use

95% H-UCL	4620

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Antimony

General Statistics

Total Number of Observations	20	Number of Distinct Observations	10
Number of Detects	2	Number of Non-Detects	18
Number of Distinct Detects	2	Number of Distinct Non-Detects	8
Minimum Detect	1.7	Minimum Non-Detect	0.85
Maximum Detect	6.8	Maximum Non-Detect	1.1
Variance Detects	13.01	Percent Non-Detects	90%
Mean Detects	4.25	SD Detects	3.606

Surface Soil Loading Dock Area ProUCL Outputs

Median Detects	4.25	CV Detects	0.849
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.224	SD of Logged Detects	0.98

Warning: Data set has only 2 Detected Values.

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

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

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

KM Mean	1.19	KM Standard Error of Mean	0.411
KM SD	1.3	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.901	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.866	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.424	95% KM Chebyshev UCL	2.982
97.5% KM Chebyshev UCL	3.758	99% KM Chebyshev UCL	5.281

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.394	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.775	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	9.577	nu star (bias corrected)	N/A
Mean (detects)	4.25		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.19	SD (KM)	1.3
Variance (KM)	1.691	SE of Mean (KM)	0.411
k hat (KM)	0.838	k star (KM)	0.745
nu hat (KM)	33.5	nu star (KM)	29.81
theta hat (KM)	1.421	theta star (KM)	1.597
80% gamma percentile (KM)	1.951	90% gamma percentile (KM)	2.943
95% gamma percentile (KM)	3.96	99% gamma percentile (KM)	6.375

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (29.81, α)	18.35	Adjusted Chi Square Value (29.81, β)	17.63
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.934	95% Gamma Adjusted KM-UCL (use when $n < 50$)	2.012

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.435	Mean in Log Scale	-5.574
SD in Original Scale	1.545	SD in Log Scale	3.132
95% t UCL (assumes normality of ROS data)	1.033	95% Percentile Bootstrap UCL	1.11
95% BCA Bootstrap UCL	1.537	95% Bootstrap t UCL	27.07

Surface Soil Loading Dock Area ProUCL Outputs
95% H-UCL (Log ROS) 51.23

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0239	KM Geo Mean	0.976
KM SD (logged)	0.47	95% Critical H Value (KM-Log)	1.991
KM Standard Error of Mean (logged)	0.149	95% H-UCL (KM -Log)	1.352
KM SD (logged)	0.47	95% Critical H Value (KM-Log)	1.991
KM Standard Error of Mean (logged)	0.149		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.872	Mean in Log Scale	-0.511
SD in Original Scale	1.421	SD in Log Scale	0.639
95% t UCL (Assumes normality)	1.421	95% H-Stat UCL	1.011

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 2.982

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

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

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

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

Arsenic

General Statistics

Total Number of Observations	20	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	0.88	Mean	3.049
Maximum	9.4	Median	2.65
SD	2.121	Std. Error of Mean	0.474
Coefficient of Variation	0.696	Skewness	1.898

Normal GOF Test

Shapiro Wilk Test Statistic	0.797
5% Shapiro Wilk Critical Value	0.905
Lilliefors Test Statistic	0.228
5% Lilliefors Critical Value	0.192

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.869	95% Adjusted-CLT UCL (Chen-1995)	4.044
		95% Modified-t UCL (Johnson-1978)	3.903

Surface Soil Loading Dock Area ProUCL Outputs

Gamma GOF Test

A-D Test Statistic	0.49	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.155	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	2.901	k star (bias corrected MLE)	2.499
Theta hat (MLE)	1.051	Theta star (bias corrected MLE)	1.22
nu hat (MLE)	116	nu star (bias corrected)	99.97
MLE Mean (bias corrected)	3.049	MLE Sd (bias corrected)	1.929
		Approximate Chi Square Value (0.05)	77.91
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	76.37

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	3.913	95% Adjusted Gamma UCL (use when n<50)	3.991

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.115	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	-0.128	Mean of logged Data	0.933
Maximum of Logged Data	2.241	SD of logged Data	0.601

Assuming Lognormal Distribution

95% H-UCL	4.078	90% Chebyshev (MVUE) UCL	4.288
95% Chebyshev (MVUE) UCL	4.866	97.5% Chebyshev (MVUE) UCL	5.668
99% Chebyshev (MVUE) UCL	7.244		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	3.829	95% Jackknife UCL	3.869
95% Standard Bootstrap UCL	3.816	95% Bootstrap-t UCL	4.401
95% Hall's Bootstrap UCL	7.771	95% Percentile Bootstrap UCL	3.857
95% BCA Bootstrap UCL	4.034		
90% Chebyshev(Mean, Sd) UCL	4.472	95% Chebyshev(Mean, Sd) UCL	5.116
97.5% Chebyshev(Mean, Sd) UCL	6.011	99% Chebyshev(Mean, Sd) UCL	7.767

Suggested UCL to Use

95% Adjusted Gamma UCL	3.991

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.

Surface Soil Loading Dock Area ProUCL Outputs

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cobalt

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	0.53	Mean	5.747
Maximum	43.2	Median	2.25
SD	9.74	Std. Error of Mean	2.178
Coefficient of Variation	1.695	Skewness	3.394

Normal GOF Test		
Shapiro Wilk Test Statistic	0.505	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.376	Lilliefors GOF Test
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.512	95% Adjusted-CLT UCL (Chen-1995)	11.1
		95% Modified-t UCL (Johnson-1978)	9.788

Gamma GOF Test		
A-D Test Statistic	1.94	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.772	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.256	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.2	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	0.904	k star (bias corrected MLE)	0.801
Theta hat (MLE)	6.359	Theta star (bias corrected MLE)	7.17
nu hat (MLE)	36.15	nu star (bias corrected)	32.06
MLE Mean (bias corrected)	5.747	MLE Sd (bias corrected)	6.419
		Approximate Chi Square Value (0.05)	20.12
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	19.37

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	9.157	95% Adjusted Gamma UCL (use when n<50)	9.51

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.896	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	
		Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.192	
		Data Not Lognormal at 5% Significance Level
Data Not Lognormal at 5% Significance Level		

Surface Soil Loading Dock Area ProUCL Outputs

Lognormal Statistics

Minimum of Logged Data	-0.635	Mean of logged Data	1.102
Maximum of Logged Data	3.766	SD of logged Data	1.007

Assuming Lognormal Distribution

95% H-UCL	9.215	90% Chebyshev (MVUE) UCL	8.476
95% Chebyshev (MVUE) UCL	10.13	97.5% Chebyshev (MVUE) UCL	12.43
99% Chebyshev (MVUE) UCL	16.94		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	9.329	95% Jackknife UCL	9.512
95% Standard Bootstrap UCL	9.252	95% Bootstrap-t UCL	16.44
95% Hall's Bootstrap UCL	20.24	95% Percentile Bootstrap UCL	9.69
95% BCA Bootstrap UCL	11.67		
90% Chebyshev(Mean, Sd) UCL	12.28	95% Chebyshev(Mean, Sd) UCL	15.24
97.5% Chebyshev(Mean, Sd) UCL	19.35	99% Chebyshev(Mean, Sd) UCL	27.42

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	15.24

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

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

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

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

Iron

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	4010	Mean	11510
Maximum	57300	Median	7360
SD	12021	Std. Error of Mean	2688
Coefficient of Variation	1.044	Skewness	3.25

Normal GOF Test

Shapiro Wilk Test Statistic	0.586
5% Shapiro Wilk Critical Value	0.905
Lilliefors Test Statistic	0.29
5% Lilliefors Critical Value	0.192

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	16158

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	18019

Surface Soil Loading Dock Area ProUCL Outputs

95% Modified-t UCL (Johnson-1978) 16483

Gamma GOF Test

A-D Test Statistic 1.281
5% A-D Critical Value 0.752
K-S Test Statistic 0.216
5% K-S Critical Value 0.196

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 2
Theta hat (MLE) 5755
nu hat (MLE) 79.99
MLE Mean (bias corrected) 11510
Adjusted Level of Significance 0.038

k star (bias corrected MLE) 1.733
Theta star (bias corrected MLE) 6641
nu star (bias corrected) 69.33
MLE Sd (bias corrected) 8743
Approximate Chi Square Value (0.05) 51.16
Adjusted Chi Square Value 49.93

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 15597

95% Adjusted Gamma UCL (use when $n < 50$) 15982

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.891
5% Shapiro Wilk Critical Value 0.905
Lilliefors Test Statistic 0.173
5% Lilliefors Critical Value 0.192

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 8.297
Maximum of Logged Data 10.96

Mean of logged Data 9.081
SD of logged Data 0.662

Assuming Lognormal Distribution

95% H-UCL 15263
95% Chebyshev (MVUE) UCL 18193
99% Chebyshev (MVUE) UCL 27679

90% Chebyshev (MVUE) UCL 15887
97.5% Chebyshev (MVUE) UCL 21393

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 15931
95% Standard Bootstrap UCL 15806
95% Hall's Bootstrap UCL 33228
95% BCA Bootstrap UCL 18706
90% Chebyshev(Mean, Sd) UCL 19574
97.5% Chebyshev(Mean, Sd) UCL 28296

95% Jackknife UCL 16158
95% Bootstrap-t UCL 23134
95% Percentile Bootstrap UCL 16260
95% Chebyshev(Mean, Sd) UCL 23227
99% Chebyshev(Mean, Sd) UCL 38255

Suggested UCL to Use

95% H-UCL 15263

Surface Soil Loading Dock Area ProUCL Outputs

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Manganese

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	26.9	Mean	262.7
Maximum	1810	Median	152.5
SD	394.6	Std. Error of Mean	88.23
Coefficient of Variation	1.502	Skewness	3.537
Normal GOF Test			
Shapiro Wilk Test Statistic	0.538	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.326	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	415.2	95% Adjusted-CLT UCL (Chen-1995)	482.4
		95% Modified-t UCL (Johnson-1978)	426.9
Gamma GOF Test			
A-D Test Statistic	0.808	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.179	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.199	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.036	k star (bias corrected MLE)	0.914
Theta hat (MLE)	253.6	Theta star (bias corrected MLE)	287.4
nu hat (MLE)	41.43	nu star (bias corrected)	36.55
MLE Mean (bias corrected)	262.7	MLE Sd (bias corrected)	274.8
		Approximate Chi Square Value (0.05)	23.71
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	22.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	404.9	95% Adjusted Gamma UCL (use when n<50)	419.3

Surface Soil Loading Dock Area ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.972	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.113	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.292	Mean of logged Data	5.016
Maximum of Logged Data	7.501	SD of logged Data	1.006

Assuming Lognormal Distribution

95% H-UCL	460.4	90% Chebyshev (MVUE) UCL	423.8
95% Chebyshev (MVUE) UCL	506.4	97.5% Chebyshev (MVUE) UCL	621.1
99% Chebyshev (MVUE) UCL	846.4		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	407.8	95% Jackknife UCL	415.2
95% Standard Bootstrap UCL	403.3	95% Bootstrap-t UCL	755.9
95% Hall's Bootstrap UCL	1046	95% Percentile Bootstrap UCL	420.4
95% BCA Bootstrap UCL	514.1		
90% Chebyshev(Mean, Sd) UCL	527.4	95% Chebyshev(Mean, Sd) UCL	647.3
97.5% Chebyshev(Mean, Sd) UCL	813.7	99% Chebyshev(Mean, Sd) UCL	1141

Suggested UCL to Use

95% Adjusted Gamma UCL	419.3

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
Number of Detects	16	Number of Non-Detects	4
Number of Distinct Detects	16	Number of Distinct Non-Detects	3
Minimum Detect	0.0052	Minimum Non-Detect	0.19
Maximum Detect	0.77	Maximum Non-Detect	3.8
Variance Detects	0.0469	Percent Non-Detects	20%
Mean Detects	0.15	SD Detects	0.217
Median Detects	0.0545	CV Detects	1.442

Surface Soil Loading Dock Area ProUCL Outputs

Skewness Detects	2.027	Kurtosis Detects	3.733
Mean of Logged Detects	-2.801	SD of Logged Detects	1.442

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.685	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.324	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.138	KM Standard Error of Mean	0.0489
KM SD	0.201	95% KM (BCA) UCL	0.23
95% KM (t) UCL	0.223	95% KM (Percentile Bootstrap) UCL	0.224
95% KM (z) UCL	0.219	95% KM Bootstrap t UCL	0.293
90% KM Chebyshev UCL	0.285	95% KM Chebyshev UCL	0.352
97.5% KM Chebyshev UCL	0.444	99% KM Chebyshev UCL	0.625

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.626	Anderson-Darling GOF Test
5% A-D Critical Value	0.781	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.224	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.672	k star (bias corrected MLE)	0.588
Theta hat (MLE)	0.223	Theta star (bias corrected MLE)	0.256
nu hat (MLE)	21.5	nu star (bias corrected)	18.8
Mean (detects)	0.15		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0052	Mean	0.131
Maximum	0.77	Median	0.059
SD	0.197	CV	1.5
k hat (MLE)	0.718	k star (bias corrected MLE)	0.644
Theta hat (MLE)	0.183	Theta star (bias corrected MLE)	0.204
nu hat (MLE)	28.74	nu star (bias corrected)	25.76
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (25.76, α)	15.2	Adjusted Chi Square Value (25.76, β)	14.56
95% Gamma Approximate UCL (use when $n \geq 50$)	0.222	95% Gamma Adjusted UCL (use when $n < 50$)	0.232

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.138	SD (KM)	0.201
Variance (KM)	0.0403	SE of Mean (KM)	0.0489

Surface Soil Loading Dock Area ProUCL Outputs

k hat (KM)	0.475	k star (KM)	0.437
nu hat (KM)	19.02	nu star (KM)	17.5
theta hat (KM)	0.291	theta star (KM)	0.316
80% gamma percentile (KM)	0.225	90% gamma percentile (KM)	0.385
95% gamma percentile (KM)	0.557	99% gamma percentile (KM)	0.988

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (17.50, α)	9.029	Adjusted Chi Square Value (17.50, β)	8.55
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.268	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.283

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.968	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.115	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.13	Mean in Log Scale	-2.864
SD in Original Scale	0.197	SD in Log Scale	1.304
95% t UCL (assumes normality of ROS data)	0.206	95% Percentile Bootstrap UCL	0.206
95% BCA Bootstrap UCL	0.233	95% Bootstrap t UCL	0.267
95% H-UCL (Log ROS)	0.337		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.873	KM Geo Mean	0.0566
KM SD (logged)	1.367	95% Critical H Value (KM-Log)	3.203
KM Standard Error of Mean (logged)	0.342	95% H-UCL (KM -Log)	0.393
KM SD (logged)	1.367	95% Critical H Value (KM-Log)	3.203
KM Standard Error of Mean (logged)	0.342		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.27	Mean in Log Scale	-2.449
SD in Original Scale	0.462	SD in Log Scale	1.593
95% t UCL (Assumes normality)	0.448	95% H-Stat UCL	1.14

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$ but $k \leq 1$)	0.283

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

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

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

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

Surface Soil Wilcox Process Area ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 1:18:28 PM
 From File ProUCL Inputs HHRA WPA SS.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	108	Number of Distinct Observations	103
		Number of Missing Observations	0
Minimum	914	Mean	4792
Maximum	19000	Median	3695
SD	3385	Std. Error of Mean	325.7
Coefficient of Variation	0.706	Skewness	1.503

Normal GOF Test

Shapiro Wilk Test Statistic 0.85
 5% Shapiro Wilk P Value 1.110E-16
 Lilliefors Test Statistic 0.183
 5% Lilliefors Critical Value 0.0855

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 5332

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 5378
 95% Modified-t UCL (Johnson-1978) 5340

Gamma GOF Test

A-D Test Statistic 1.456
 5% A-D Critical Value 0.762
 K-S Test Statistic 0.102
 5% K-S Critical Value 0.0883

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.442	k star (bias corrected MLE)	2.38
Theta hat (MLE)	1963	Theta star (bias corrected MLE)	2013
nu hat (MLE)	527.4	nu star (bias corrected)	514.1
MLE Mean (bias corrected)	4792	MLE Sd (bias corrected)	3106
		Approximate Chi Square Value (0.05)	462.5
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	461.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50) 5326

95% Adjusted Gamma UCL (use when n<50) 5334

Surface Soil Wilcox Process Area ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.153	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0654	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0855	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	6.818	Mean of logged Data	8.256
Maximum of Logged Data	9.852	SD of logged Data	0.661

Assuming Lognormal Distribution

95% H-UCL	5421	90% Chebyshev (MVUE) UCL	5777
95% Chebyshev (MVUE) UCL	6229	97.5% Chebyshev (MVUE) UCL	6856
99% Chebyshev (MVUE) UCL	8089		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5328	95% Jackknife UCL	5332
95% Standard Bootstrap UCL	5328	95% Bootstrap-t UCL	5389
95% Hall's Bootstrap UCL	5377	95% Percentile Bootstrap UCL	5332
95% BCA Bootstrap UCL	5392		
90% Chebyshev(Mean, Sd) UCL	5769	95% Chebyshev(Mean, Sd) UCL	6212
97.5% Chebyshev(Mean, Sd) UCL	6826	99% Chebyshev(Mean, Sd) UCL	8032

Suggested UCL to Use

95% H-UCL	5421

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Arsenic

General Statistics

Total Number of Observations	108	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	0.64	Mean	2.742
Maximum	20.9	Median	2.1
SD	2.373	Std. Error of Mean	0.228
Coefficient of Variation	0.865	Skewness	5.015

Surface Soil Wilcox Process Area ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic	0.58
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.24
5% Lilliefors Critical Value	0.0855

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	3.121

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	3.235
95% Modified-t UCL (Johnson-1978)	3.139

Gamma GOF Test

A-D Test Statistic	3.405
5% A-D Critical Value	0.759
K-S Test Statistic	0.134
5% K-S Critical Value	0.088

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.005	k star (bias corrected MLE)	2.927
Theta hat (MLE)	0.913	Theta star (bias corrected MLE)	0.937
nu hat (MLE)	649	nu star (bias corrected)	632.3
MLE Mean (bias corrected)	2.742	MLE Sd (bias corrected)	1.603
		Approximate Chi Square Value (0.05)	575
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	574.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.015	95% Adjusted Gamma UCL (use when n<50)	3.019

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955
5% Shapiro Wilk P Value	0.00542
Lilliefors Test Statistic	0.0956
5% Lilliefors Critical Value	0.0855

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.446	Mean of logged Data	0.833
Maximum of Logged Data	3.04	SD of logged Data	0.534

Assuming Lognormal Distribution

95% H-UCL	2.919	90% Chebyshev (MVUE) UCL	3.082
95% Chebyshev (MVUE) UCL	3.279	97.5% Chebyshev (MVUE) UCL	3.552
99% Chebyshev (MVUE) UCL	4.087		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Surface Soil Wilcox Process Area ProUCL Outputs

Nonparametric Distribution Free UCLs

95% CLT UCL	3.118	95% Jackknife UCL	3.121
95% Standard Bootstrap UCL	3.113	95% Bootstrap-t UCL	3.351
95% Hall's Bootstrap UCL	4.613	95% Percentile Bootstrap UCL	3.151
95% BCA Bootstrap UCL	3.27		
90% Chebyshev(Mean, Sd) UCL	3.427	95% Chebyshev(Mean, Sd) UCL	3.737
97.5% Chebyshev(Mean, Sd) UCL	4.168	99% Chebyshev(Mean, Sd) UCL	5.014

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	3.737

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

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

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

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

Cadmium

General Statistics

Total Number of Observations	108	Number of Distinct Observations	68
Number of Detects	81	Number of Non-Detects	27
Number of Distinct Detects	57	Number of Distinct Non-Detects	14
Minimum Detect	0.044	Minimum Non-Detect	0.39
Maximum Detect	13	Maximum Non-Detect	0.58
Variance Detects	2.757	Percent Non-Detects	25%
Mean Detects	0.927	SD Detects	1.66
Median Detects	0.44	CV Detects	1.791
Skewness Detects	5.264	Kurtosis Detects	35.39
Mean of Logged Detects	-0.941	SD of Logged Detects	1.35

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.519
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.297
5% Lilliefors Critical Value	0.0985

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.737	KM Standard Error of Mean	0.142
KM SD	1.468	95% KM (BCA) UCL	1.002
95% KM (t) UCL	0.973	95% KM (Percentile Bootstrap) UCL	0.994
95% KM (z) UCL	0.971	95% KM Bootstrap t UCL	1.161
90% KM Chebyshev UCL	1.164	95% KM Chebyshev UCL	1.357
97.5% KM Chebyshev UCL	1.625	99% KM Chebyshev UCL	2.153

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.554
5% A-D Critical Value	0.798
K-S Test Statistic	0.1
5% K-S Critical Value	0.103

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Surface Soil Wilcox Process Area ProUCL Outputs
Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.699	k star (bias corrected MLE)	0.681
Theta hat (MLE)	1.327	Theta star (bias corrected MLE)	1.361
nu hat (MLE)	113.2	nu star (bias corrected)	110.4
Mean (detects)	0.927		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.704
Maximum	13	Median	0.205
SD	1.488	CV	2.115
k hat (MLE)	0.465	k star (bias corrected MLE)	0.459
Theta hat (MLE)	1.512	Theta star (bias corrected MLE)	1.534
nu hat (MLE)	100.5	nu star (bias corrected)	99.06
Adjusted Level of Significance (β)	0.0478		
Approximate Chi Square Value (99.06, α)	77.1	Adjusted Chi Square Value (99.06, β)	76.83
95% Gamma Approximate UCL (use when $n \geq 50$)	0.904	95% Gamma Adjusted UCL (use when $n < 50$)	0.907

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.737	SD (KM)	1.468
Variance (KM)	2.155	SE of Mean (KM)	0.142
k hat (KM)	0.252	k star (KM)	0.251
nu hat (KM)	54.41	nu star (KM)	54.23
theta hat (KM)	2.925	theta star (KM)	2.934
80% gamma percentile (KM)	1.072	90% gamma percentile (KM)	2.211
95% gamma percentile (KM)	3.562	99% gamma percentile (KM)	7.155

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (54.23, α)	38.31	Adjusted Chi Square Value (54.23, β)	38.13
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.043	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.048

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.949
5% Shapiro Wilk P Value	0.00718
Lilliefors Test Statistic	0.105
5% Lilliefors Critical Value	0.0985

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.736	Mean in Log Scale	-1.18
SD in Original Scale	1.474	SD in Log Scale	1.258
95% t UCL (assumes normality of ROS data)	0.972	95% Percentile Bootstrap UCL	0.993
95% BCA Bootstrap UCL	1.106	95% Bootstrap t UCL	1.168
95% H-UCL (Log ROS)	0.916		

Surface Soil Wilcox Process Area ProUCL Outputs

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.221	KM Geo Mean	0.295
KM SD (logged)	1.31	95% Critical H Value (KM-Log)	2.518
KM Standard Error of Mean (logged)	0.134	95% H-UCL (KM -Log)	0.957
KM SD (logged)	1.31	95% Critical H Value (KM-Log)	2.518
KM Standard Error of Mean (logged)	0.134		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.755	Mean in Log Scale	-1.064
SD in Original Scale	1.467	SD in Log Scale	1.189
95% t UCL (Assumes normality)	0.99	95% H-Stat UCL	0.921

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL 1.043

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Chromium, Hexavalent

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	84
Number of Detects	5	Number of Non-Detects	2
Number of Distinct Detects	5	Number of Distinct Non-Detects	2
Minimum Detect	0.54	Minimum Non-Detect	0.45
Maximum Detect	1.3	Maximum Non-Detect	0.47
Variance Detects	0.132	Percent Non-Detects	28.57%
Mean Detects	0.94	SD Detects	0.363
Median Detects	1.1	CV Detects	0.386
Skewness Detects	-0.44	Kurtosis Detects	-3.073
Mean of Logged Detects	-0.131	SD of Logged Detects	0.43

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Surface Soil Wilcox Process Area ProUCL Outputs

Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level
Detected Data appear Normal at 5% Significance Level		

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

KM Mean	0.8	KM Standard Error of Mean	0.149
KM SD	0.353	95% KM (BCA) UCL	1.029
95% KM (t) UCL	1.09	95% KM (Percentile Bootstrap) UCL	1.019
95% KM (z) UCL	1.045	95% KM Bootstrap t UCL	1.069
90% KM Chebyshev UCL	1.247	95% KM Chebyshev UCL	1.449
97.5% KM Chebyshev UCL	1.73	99% KM Chebyshev UCL	2.282

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.619	Anderson-Darling GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.312	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	7.375	k star (bias corrected MLE)	3.083
Theta hat (MLE)	0.127	Theta star (bias corrected MLE)	0.305
nu hat (MLE)	73.75	nu star (bias corrected)	30.83
Mean (detects)	0.94		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.2	Mean	0.729
Maximum	1.3	Median	0.56
SD	0.467	CV	0.641
k hat (MLE)	2.268	k star (bias corrected MLE)	1.391
Theta hat (MLE)	0.321	Theta star (bias corrected MLE)	0.524
nu hat (MLE)	31.75	nu star (bias corrected)	19.48
Adjusted Level of Significance (β)	0.0158		
Approximate Chi Square Value (19.48, α)	10.47	Adjusted Chi Square Value (19.48, β)	8.545
95% Gamma Approximate UCL (use when $n \geq 50$)	1.356	95% Gamma Adjusted UCL (use when $n < 50$)	1.661

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.8	SD (KM)	0.353
Variance (KM)	0.124	SE of Mean (KM)	0.149
k hat (KM)	5.148	k star (KM)	3.037
nu hat (KM)	72.08	nu star (KM)	42.52
theta hat (KM)	0.155	theta star (KM)	0.263
80% gamma percentile (KM)	1.139	90% gamma percentile (KM)	1.416

Surface Soil Wilcox Process Area ProUCL Outputs

95% gamma percentile (KM)	1.673	99% gamma percentile (KM)	2.231

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (42.52, α)	28.57	Adjusted Chi Square Value (42.52, β)	25.17
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.191	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.351

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.796	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.301	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.76	Mean in Log Scale	-0.427
SD in Original Scale	0.427	SD in Log Scale	0.616
95% t UCL (assumes normality of ROS data)	1.074	95% Percentile Bootstrap UCL	1.01
95% BCA Bootstrap UCL	1.01	95% Bootstrap t UCL	1.093
95% H-UCL (Log ROS)	1.557		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.322	KM Geo Mean	0.725
KM SD (logged)	0.444	95% Critical H Value (KM-Log)	2.347
KM Standard Error of Mean (logged)	0.187	95% H-UCL (KM -Log)	1.223
KM SD (logged)	0.444	95% Critical H Value (KM-Log)	2.347
KM Standard Error of Mean (logged)	0.187		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.737	Mean in Log Scale	-0.514
SD in Original Scale	0.456	SD in Log Scale	0.742
95% t UCL (Assumes normality)	1.072	95% H-Stat UCL	1.958

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 1.09

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	108	Number of Distinct Observations	46
Number of Detects	97	Number of Non-Detects	11

Surface Soil Wilcox Process Area ProUCL Outputs

Number of Distinct Detects	46	Number of Distinct Non-Detects	2
Minimum Detect	0.81	Minimum Non-Detect	2
Maximum Detect	22.5	Maximum Non-Detect	2.1
Variance Detects	6.471	Percent Non-Detects	10.19%
Mean Detects	3.784	SD Detects	2.544
Median Detects	3.1	CV Detects	0.672
Skewness Detects	4.446	Kurtosis Detects	30.08
Mean of Logged Detects	1.197	SD of Logged Detects	0.492

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.681
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.166
5% Lilliefors Critical Value	0.0902

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	3.565	KM Standard Error of Mean	0.241
KM SD	2.487	95% KM (BCA) UCL	3.985
95% KM (t) UCL	3.965	95% KM (Percentile Bootstrap) UCL	3.984
95% KM (z) UCL	3.961	95% KM Bootstrap t UCL	4.123
90% KM Chebyshev UCL	4.288	95% KM Chebyshev UCL	4.615
97.5% KM Chebyshev UCL	5.07	99% KM Chebyshev UCL	5.963

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.466
5% A-D Critical Value	0.756
K-S Test Statistic	0.108
5% K-S Critical Value	0.0912

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.886	k star (bias corrected MLE)	3.773
Theta hat (MLE)	0.974	Theta star (bias corrected MLE)	1.003
nu hat (MLE)	754	nu star (bias corrected)	732
Mean (detects)	3.784		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.165	Mean	3.481
Maximum	22.5	Median	2.85
SD	2.577	CV	0.74
k hat (MLE)	2.492	k star (bias corrected MLE)	2.429
Theta hat (MLE)	1.397	Theta star (bias corrected MLE)	1.433
nu hat (MLE)	538.3	nu star (bias corrected)	524.7
Adjusted Level of Significance (β)	0.0478		

Surface Soil Wilcox Process Area ProUCL Outputs

Approximate Chi Square Value (524.68, α)	472.6	Adjusted Chi Square Value (524.68, β)	471.9
95% Gamma Approximate UCL (use when $n \geq 50$)	3.865	95% Gamma Adjusted UCL (use when $n < 50$)	3.87

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.565	SD (KM)	2.487
Variance (KM)	6.185	SE of Mean (KM)	0.241
k hat (KM)	2.055	k star (KM)	2.004
nu hat (KM)	443.9	nu star (KM)	432.9
theta hat (KM)	1.735	theta star (KM)	1.779
80% gamma percentile (KM)	5.336	90% gamma percentile (KM)	6.93
95% gamma percentile (KM)	8.451	99% gamma percentile (KM)	11.82

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (432.87, α)	385.6	Adjusted Chi Square Value (432.87, β)	385
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	4.002	95% Gamma Adjusted KM-UCL (use when $n < 50$)	4.008

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.982	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.654	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0799	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0902	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.551	Mean in Log Scale	1.115
SD in Original Scale	2.509	SD in Log Scale	0.529
95% t UCL (assumes normality of ROS data)	3.952	95% Percentile Bootstrap UCL	3.978
95% BCA Bootstrap UCL	4.101	95% Bootstrap t UCL	4.122
95% H-UCL (Log ROS)	3.854		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.122	KM Geo Mean	3.071
KM SD (logged)	0.52	95% Critical H Value (KM-Log)	1.844
KM Standard Error of Mean (logged)	0.0514	95% H-UCL (KM -Log)	3.857
KM SD (logged)	0.52	95% Critical H Value (KM-Log)	1.844
KM Standard Error of Mean (logged)	0.0514		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.503	Mean in Log Scale	1.077
SD in Original Scale	2.551	SD in Log Scale	0.586
95% t UCL (Assumes normality)	3.91	95% H-Stat UCL	3.88

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM Student's t	3.446	KM H-UCL	3.857

Surface Soil Wilcox Process Area ProUCL Outputs

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

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

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

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

Copper

General Statistics

Total Number of Observations	108	Number of Distinct Observations	91
Number of Detects	107	Number of Non-Detects	1
Number of Distinct Detects	90	Number of Distinct Non-Detects	1
Minimum Detect	1.9	Minimum Non-Detect	2.1
Maximum Detect	7490	Maximum Non-Detect	2.1
Variance Detects	522306	Percent Non-Detects	0.926%
Mean Detects	86.96	SD Detects	722.7
Median Detects	9	CV Detects	8.311
Skewness Detects	10.33	Kurtosis Detects	106.8
Mean of Logged Detects	2.468	SD of Logged Detects	1.072

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.11
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.483
5% Lilliefors Critical Value	0.0859

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	86.17	KM Standard Error of Mean	69.22
KM SD	716	95% KM (BCA) UCL	226.4
95% KM (t) UCL	201	95% KM (Percentile Bootstrap) UCL	224.5
95% KM (z) UCL	200	95% KM Bootstrap t UCL	3228
90% KM Chebyshev UCL	293.8	95% KM Chebyshev UCL	387.9
97.5% KM Chebyshev UCL	518.5	99% KM Chebyshev UCL	774.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	22.66
5% A-D Critical Value	0.858
K-S Test Statistic	0.339
5% K-S Critical Value	0.0947

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.339	k star (bias corrected MLE)	0.335
Theta hat (MLE)	256.9	Theta star (bias corrected MLE)	259.4
nu hat (MLE)	72.44	nu star (bias corrected)	71.75
Mean (detects)	86.96		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

Surface Soil Wilcox Process Area ProUCL Outputs

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	86.15
Maximum	7490	Median	8.9
SD	719.4	CV	8.35
k hat (MLE)	0.331	k star (bias corrected MLE)	0.328
Theta hat (MLE)	260.6	Theta star (bias corrected MLE)	263
nu hat (MLE)	71.4	nu star (bias corrected)	70.75
Adjusted Level of Significance (β)	0.0478		
Approximate Chi Square Value (70.75, α)	52.38	Adjusted Chi Square Value (70.75, β)	52.17
95% Gamma Approximate UCL (use when $n \geq 50$)	116.4	95% Gamma Adjusted UCL (use when $n < 50$)	116.8

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	86.17	SD (KM)	716
Variance (KM)	512700	SE of Mean (KM)	69.22
k hat (KM)	0.0145	k star (KM)	0.0203
nu hat (KM)	3.128	nu star (KM)	4.375
theta hat (KM)	5950	theta star (KM)	4255
80% gamma percentile (KM)	0.0399	90% gamma percentile (KM)	13.41
95% gamma percentile (KM)	202.1	99% gamma percentile (KM)	2404

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.37, α)	0.875	Adjusted Chi Square Value (4.37, β)	0.855
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	430.8	95% Gamma Adjusted KM-UCL (use when $n < 50$)	440.9

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.86	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	4.330E-15	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.139	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0859	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	86.17	Mean in Log Scale	2.447
SD in Original Scale	719.4	SD in Log Scale	1.089
95% t UCL (assumes normality of ROS data)	201	95% Percentile Bootstrap UCL	224.3
95% BCA Bootstrap UCL	298.3	95% Bootstrap t UCL	3191
95% H-UCL (Log ROS)	26.62		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.451	KM Geo Mean	11.6
KM SD (logged)	1.076	95% Critical H Value (KM-Log)	2.283
KM Standard Error of Mean (logged)	0.104	95% H-UCL (KM -Log)	26.26
KM SD (logged)	1.076	95% Critical H Value (KM-Log)	2.283
KM Standard Error of Mean (logged)	0.104		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	86.16	Mean in Log Scale	2.446

Surface Soil Wilcox Process Area ProUCL Outputs

SD in Original Scale	719.4	SD in Log Scale	1.092
95% t UCL (Assumes normality)	201	95% H-Stat UCL	26.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 387.9

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

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

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

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

Iron

General Statistics

Total Number of Observations	108	Number of Distinct Observations	93
		Number of Missing Observations	0
Minimum	3580	Mean	11130
Maximum	47500	Median	9660
SD	6610	Std. Error of Mean	636.1
Coefficient of Variation	0.594	Skewness	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.794
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.177
5% Lilliefors Critical Value	0.0855

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 12186

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 12340

95% Modified-t UCL (Johnson-1978) 12211

Gamma GOF Test

A-D Test Statistic	1.257
5% A-D Critical Value	0.756
K-S Test Statistic	0.103
5% K-S Critical Value	0.0877

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.023	k star (bias corrected MLE)	3.917
Theta hat (MLE)	2767	Theta star (bias corrected MLE)	2841
nu hat (MLE)	868.9	nu star (bias corrected)	846.1
MLE Mean (bias corrected)	11130	MLE Sd (bias corrected)	5624

Surface Soil Wilcox Process Area ProUCL Outputs

	Approximate Chi Square Value (0.05)	779.6
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value
		778.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12080
	95% Adjusted Gamma UCL (use when n<50) 12093

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.286	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0683	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0855	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	8.183	Mean of logged Data	9.188
Maximum of Logged Data	10.77	SD of logged Data	0.492

Assuming Lognormal Distribution

95% H-UCL	12043
95% Chebyshev (MVUE) UCL	13426
99% Chebyshev (MVUE) UCL	16505
	90% Chebyshev (MVUE) UCL 12678
	97.5% Chebyshev (MVUE) UCL 14465

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	12177
95% Standard Bootstrap UCL	12181
95% Hall's Bootstrap UCL	12465
95% BCA Bootstrap UCL	12353
90% Chebyshev(Mean, Sd) UCL	13039
97.5% Chebyshev(Mean, Sd) UCL	15103
	95% Jackknife UCL 12186
	95% Bootstrap-t UCL 12422
	95% Percentile Bootstrap UCL 12193
	95% Chebyshev(Mean, Sd) UCL 13903
	99% Chebyshev(Mean, Sd) UCL 17459

Suggested UCL to Use

95% Student's-t UCL	12186
or 95% H-UCL	12043
	or 95% Modified-t UCL 12211

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Lead

General Statistics

Surface Soil Wilcox Process Area ProUCL Outputs

Total Number of Observations	108	Number of Distinct Observations	103
Number of Detects	107	Number of Non-Detects	1
Number of Distinct Detects	102	Number of Distinct Non-Detects	1
Minimum Detect	3	Minimum Non-Detect	0.5
Maximum Detect	19000	Maximum Non-Detect	0.5
Variance Detects	3596649	Percent Non-Detects	0.926%
Mean Detects	453.9	SD Detects	1896
Median Detects	76.9	CV Detects	4.178
Skewness Detects	9.059	Kurtosis Detects	88.32
Mean of Logged Detects	4.256	SD of Logged Detects	1.872

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.24
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.406
5% Lilliefors Critical Value	0.0859

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	449.7	KM Standard Error of Mean	181.7
KM SD	1879	95% KM (BCA) UCL	833.3
95% KM (t) UCL	751.2	95% KM (Percentile Bootstrap) UCL	784.3
95% KM (z) UCL	748.6	95% KM Bootstrap t UCL	1458
90% KM Chebyshev UCL	994.8	95% KM Chebyshev UCL	1242
97.5% KM Chebyshev UCL	1584	99% KM Chebyshev UCL	2258

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.587
5% A-D Critical Value	0.853
K-S Test Statistic	0.184
5% K-S Critical Value	0.0944

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.36	k star (bias corrected MLE)	0.356
Theta hat (MLE)	1262	Theta star (bias corrected MLE)	1276
nu hat (MLE)	76.96	nu star (bias corrected)	76.13
Mean (detects)	453.9		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	449.7
Maximum	19000	Median	74.3
SD	1888	CV	4.198
k hat (MLE)	0.348	k star (bias corrected MLE)	0.344
Theta hat (MLE)	1293	Theta star (bias corrected MLE)	1306

Surface Soil Wilcox Process Area ProUCL Outputs

nu hat (MLE)	75.16	nu star (bias corrected)	74.4
Adjusted Level of Significance (β)	0.0478		
Approximate Chi Square Value (74.40, α)	55.54	Adjusted Chi Square Value (74.40, β)	55.32
95% Gamma Approximate UCL (use when $n \geq 50$)	602.5	95% Gamma Adjusted UCL (use when $n < 50$)	604.9

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	449.7	SD (KM)	1879
Variance (KM)	3531931	SE of Mean (KM)	181.7
k hat (KM)	0.0573	k star (KM)	0.0618
nu hat (KM)	12.37	nu star (KM)	13.36
theta hat (KM)	7853	theta star (KM)	7271
80% gamma percentile (KM)	118.1	90% gamma percentile (KM)	871.5
95% gamma percentile (KM)	2537	99% gamma percentile (KM)	8955

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (13.36, α)	6.135	Adjusted Chi Square Value (13.36, β)	6.069
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	979.3	95% Gamma Adjusted KM-UCL (use when $n < 50$)	990

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.963
5% Shapiro Wilk P Value	0.0338
Lilliefors Test Statistic	0.0711
5% Lilliefors Critical Value	0.0859

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	449.7	Mean in Log Scale	4.208
SD in Original Scale	1888	SD in Log Scale	1.928
95% t UCL (assumes normality of ROS data)	751.2	95% Percentile Bootstrap UCL	786.7
95% BCA Bootstrap UCL	1044	95% Bootstrap t UCL	1445
95% H-UCL (Log ROS)	787.2		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.21	KM Geo Mean	67.39
KM SD (logged)	1.914	95% Critical H Value (KM-Log)	3.206
KM Standard Error of Mean (logged)	0.185	95% H-UCL (KM -Log)	761.9
KM SD (logged)	1.914	95% Critical H Value (KM-Log)	3.206
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	449.7
SD in Original Scale	1888
95% t UCL (Assumes normality)	751.2

DL/2 Log-Transformed

Mean in Log Scale	4.204
SD in Log Scale	1.941
95% H-Stat UCL	808.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Surface Soil Wilcox Process Area ProUCL Outputs

KM H-UCL 761.9

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

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

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

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

Manganese

General Statistics

Total Number of Observations	108	Number of Distinct Observations	96
		Number of Missing Observations	0
Minimum	31.6	Mean	266.2
Maximum	1420	Median	225
SD	225.2	Std. Error of Mean	21.67
Coefficient of Variation	0.846	Skewness	2.829

Normal GOF Test

Shapiro Wilk Test Statistic	0.725
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.198
5% Lilliefors Critical Value	0.0855

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	302.1

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	308.1
95% Modified-t UCL (Johnson-1978)	303.1

Gamma GOF Test

A-D Test Statistic	1.374
5% A-D Critical Value	0.765
K-S Test Statistic	0.107
5% K-S Critical Value	0.0885

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.069	k star (bias corrected MLE)	2.018
Theta hat (MLE)	128.6	Theta star (bias corrected MLE)	131.9
nu hat (MLE)	447	nu star (bias corrected)	435.9
MLE Mean (bias corrected)	266.2	MLE Sd (bias corrected)	187.4
		Approximate Chi Square Value (0.05)	388.5
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	387.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	298.6	95% Adjusted Gamma UCL (use when $n < 50$)	299.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.967

Shapiro Wilk Lognormal GOF Test

Surface Soil Wilcox Process Area ProUCL Outputs

5% Shapiro Wilk P Value	0.07	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0837	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0855	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	3.453	Mean of logged Data	5.323
Maximum of Logged Data	7.258	SD of logged Data	0.732

Assuming Lognormal Distribution

95% H-UCL	308.5	90% Chebyshev (MVUE) UCL	330.1
95% Chebyshev (MVUE) UCL	358.6	97.5% Chebyshev (MVUE) UCL	398.1
99% Chebyshev (MVUE) UCL	475.8		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	301.8	95% Jackknife UCL	302.1
95% Standard Bootstrap UCL	301.3	95% Bootstrap-t UCL	310.2
95% Hall's Bootstrap UCL	312.1	95% Percentile Bootstrap UCL	302.4
95% BCA Bootstrap UCL	309.7		
90% Chebyshev(Mean, Sd) UCL	331.2	95% Chebyshev(Mean, Sd) UCL	360.6
97.5% Chebyshev(Mean, Sd) UCL	401.5	99% Chebyshev(Mean, Sd) UCL	481.8

Suggested UCL to Use

95% H-UCL	308.5

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Mercury

General Statistics

Total Number of Observations	108	Number of Distinct Observations	63
Number of Detects	55	Number of Non-Detects	53
Number of Distinct Detects	49	Number of Distinct Non-Detects	16
Minimum Detect	0.012	Minimum Non-Detect	0.059
Maximum Detect	2	Maximum Non-Detect	0.13
Variance Detects	0.233	Percent Non-Detects	49.07%
Mean Detects	0.404	SD Detects	0.483
Median Detects	0.2	CV Detects	1.197
Skewness Detects	1.818	Kurtosis Detects	2.771

Surface Soil Wilcox Process Area ProUCL Outputs

Mean of Logged Detects -1.632

SD of Logged Detects 1.337

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.747
5% Shapiro Wilk P Value 4.257E-12
Lilliefors Test Statistic 0.241
5% Lilliefors Critical Value 0.119

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.223	KM Standard Error of Mean	0.0378
KM SD	0.389	95% KM (BCA) UCL	0.287
95% KM (t) UCL	0.285	95% KM (Percentile Bootstrap) UCL	0.287
95% KM (z) UCL	0.285	95% KM Bootstrap t UCL	0.302
90% KM Chebyshev UCL	0.336	95% KM Chebyshev UCL	0.388
97.5% KM Chebyshev UCL	0.459	99% KM Chebyshev UCL	0.599

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 0.635
5% A-D Critical Value 0.789
K-S Test Statistic 0.113
5% K-S Critical Value 0.124

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.817	k star (bias corrected MLE)	0.785
Theta hat (MLE)	0.494	Theta star (bias corrected MLE)	0.514
nu hat (MLE)	89.9	nu star (bias corrected)	86.33
Mean (detects)	0.404		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.214
Maximum	2	Median	0.0258
SD	0.395	CV	1.847
k hat (MLE)	0.447	k star (bias corrected MLE)	0.441
Theta hat (MLE)	0.478	Theta star (bias corrected MLE)	0.485
nu hat (MLE)	96.55	nu star (bias corrected)	95.2
Adjusted Level of Significance (β)	0.0478		
Approximate Chi Square Value (95.20, α)	73.69	Adjusted Chi Square Value (95.20, β)	73.44
95% Gamma Approximate UCL (use when $n \geq 50$)	0.276	95% Gamma Adjusted UCL (use when $n < 50$)	0.277

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.223	SD (KM)	0.389
Variance (KM)	0.151	SE of Mean (KM)	0.0378
k hat (KM)	0.329	k star (KM)	0.326

Surface Soil Wilcox Process Area ProUCL Outputs

nu hat (KM)	70.98	nu star (KM)	70.34
theta hat (KM)	0.678	theta star (KM)	0.684
80% gamma percentile (KM)	0.348	90% gamma percentile (KM)	0.65
95% gamma percentile (KM)	0.992	99% gamma percentile (KM)	1.872

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (70.34, α)	52.03	Adjusted Chi Square Value (70.34, β)	51.82
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.301	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.302

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.955	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.0721	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0948	Lilliefors GOF Test
5% Lilliefors Critical Value	0.119	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.225	Mean in Log Scale	-2.544
SD in Original Scale	0.389	SD in Log Scale	1.428
95% t UCL (assumes normality of ROS data)	0.287	95% Percentile Bootstrap UCL	0.289
95% BCA Bootstrap UCL	0.298	95% Bootstrap t UCL	0.303
95% H-UCL (Log ROS)	0.314		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.584	KM Geo Mean	0.0755
KM SD (logged)	1.428	95% Critical H Value (KM-Log)	2.645
KM Standard Error of Mean (logged)	0.162	95% H-UCL (KM -Log)	0.302
KM SD (logged)	1.428	95% Critical H Value (KM-Log)	2.645
KM Standard Error of Mean (logged)	0.162		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.229	Mean in Log Scale	-2.326
SD in Original Scale	0.387	SD in Log Scale	1.199
95% t UCL (Assumes normality)	0.291	95% H-Stat UCL	0.265

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.301

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

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

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

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

Surface Soil Wilcox Process Area ProUCL Outputs

General Statistics

Total Number of Observations	108	Number of Distinct Observations	41
Number of Detects	32	Number of Non-Detects	76
Number of Distinct Detects	24	Number of Distinct Non-Detects	19
Minimum Detect	0.015	Minimum Non-Detect	0.37
Maximum Detect	0.48	Maximum Non-Detect	0.58
Variance Detects	0.0111	Percent Non-Detects	70.37%
Mean Detects	0.0636	SD Detects	0.105
Median Detects	0.0355	CV Detects	1.658
Skewness Detects	3.656	Kurtosis Detects	12.61
Mean of Logged Detects	-3.231	SD of Logged Detects	0.784

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.409	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.391	Lilliefors GOF Test
5% Lilliefors Critical Value	0.154	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0548	KM Standard Error of Mean	0.0128
KM SD	0.0862	95% KM (BCA) UCL	0.0796
95% KM (t) UCL	0.0761	95% KM (Percentile Bootstrap) UCL	0.0778
95% KM (z) UCL	0.0759	95% KM Bootstrap t UCL	0.137
90% KM Chebyshev UCL	0.0933	95% KM Chebyshev UCL	0.111
97.5% KM Chebyshev UCL	0.135	99% KM Chebyshev UCL	0.182

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.758	Anderson-Darling GOF Test
5% A-D Critical Value	0.771	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.264	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.159	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.191	k star (bias corrected MLE)	1.1
Theta hat (MLE)	0.0534	Theta star (bias corrected MLE)	0.0578
nu hat (MLE)	76.23	nu star (bias corrected)	70.42
Mean (detects)	0.0636		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0559
Maximum	0.48	Median	0.035
SD	0.0724	CV	1.294
k hat (MLE)	1.195	k star (bias corrected MLE)	1.168

Surface Soil Wilcox Process Area ProUCL Outputs

Theta hat (MLE)	0.0468	Theta star (bias corrected MLE)	0.0479
nu hat (MLE)	258.2	nu star (bias corrected)	252.3
Adjusted Level of Significance (β)	0.0478		
Approximate Chi Square Value (252.34, α)	216.6	Adjusted Chi Square Value (252.34, β)	216.1
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0652	95% Gamma Adjusted UCL (use when $n < 50$)	0.0653

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0548	SD (KM)	0.0862
Variance (KM)	0.00743	SE of Mean (KM)	0.0128
k hat (KM)	0.405	k star (KM)	0.4
nu hat (KM)	87.46	nu star (KM)	86.36
theta hat (KM)	0.135	theta star (KM)	0.137
80% gamma percentile (KM)	0.0885	90% gamma percentile (KM)	0.155
95% gamma percentile (KM)	0.228	99% gamma percentile (KM)	0.411

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (86.36, α)	65.94	Adjusted Chi Square Value (86.36, β)	65.7
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0718	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0721

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.816	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors GOF Test
5% Lilliefors Critical Value	0.154	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0494	Mean in Log Scale	-3.266
SD in Original Scale	0.0613	SD in Log Scale	0.619
95% t UCL (assumes normality of ROS data)	0.0592	95% Percentile Bootstrap UCL	0.0597
95% BCA Bootstrap UCL	0.0641	95% Bootstrap t UCL	0.0728
95% H-UCL (Log ROS)	0.0518		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.285	KM Geo Mean	0.0375
KM SD (logged)	0.689	95% Critical H Value (KM-Log)	1.956
KM Standard Error of Mean (logged)	0.112	95% H-UCL (KM -Log)	0.0541
KM SD (logged)	0.689	95% Critical H Value (KM-Log)	1.956
KM Standard Error of Mean (logged)	0.112		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.192	Mean in Log Scale	-1.948
SD in Original Scale	0.103	SD in Log Scale	0.94
95% t UCL (Assumes normality)	0.208	95% H-Stat UCL	0.27

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Surface Soil Wilcox Process Area ProUCL Outputs

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.111

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

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

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

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

Vanadium

General Statistics

Total Number of Observations	108	Number of Distinct Observations	72
		Number of Missing Observations	0
Minimum	4.5	Mean	11.95
Maximum	79.2	Median	10.5
SD	7.97	Std. Error of Mean	0.767
Coefficient of Variation	0.667	Skewness	5.985

Normal GOF Test

Shapiro Wilk Test Statistic	0.559
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.236
5% Lilliefors Critical Value	0.0855

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	13.23

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	13.69
95% Modified-t UCL (Johnson-1978)	13.3

Gamma GOF Test

A-D Test Statistic	2.923
5% A-D Critical Value	0.755
K-S Test Statistic	0.142
5% K-S Critical Value	0.0875

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.983	k star (bias corrected MLE)	4.85
Theta hat (MLE)	2.399	Theta star (bias corrected MLE)	2.465
nu hat (MLE)	1076	nu star (bias corrected)	1048
MLE Mean (bias corrected)	11.95	MLE Sd (bias corrected)	5.428
		Approximate Chi Square Value (0.05)	973.5
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	972.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.86	95% Adjusted Gamma UCL (use when n<50)	12.88

Lognormal GOF Test

Surface Soil Wilcox Process Area ProUCL Outputs

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	2.9335E-4	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0989	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0855	Data Not Lognormal at 5% Significance Level
Data Not Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	1.504	Mean of logged Data	2.377
Maximum of Logged Data	4.372	SD of logged Data	0.411

Assuming Lognormal Distribution

95% H-UCL	12.58	90% Chebyshev (MVUE) UCL	13.15
95% Chebyshev (MVUE) UCL	13.81	97.5% Chebyshev (MVUE) UCL	14.71
99% Chebyshev (MVUE) UCL	16.49		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	13.22	95% Jackknife UCL	13.23
95% Standard Bootstrap UCL	13.2	95% Bootstrap-t UCL	14.19
95% Hall's Bootstrap UCL	19.01	95% Percentile Bootstrap UCL	13.32
95% BCA Bootstrap UCL	13.85		
90% Chebyshev(Mean, Sd) UCL	14.25	95% Chebyshev(Mean, Sd) UCL	15.3
97.5% Chebyshev(Mean, Sd) UCL	16.74	99% Chebyshev(Mean, Sd) UCL	19.58

Suggested UCL to Use

95% Student's-t UCL	13.23	or 95% Modified-t UCL	13.3

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

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

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

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

Zinc

General Statistics

Total Number of Observations	108	Number of Distinct Observations	101
		Number of Missing Observations	0
Minimum	3.8	Mean	120.6
Maximum	3960	Median	28.55
SD	412.5	Std. Error of Mean	39.69
Coefficient of Variation	3.42	Skewness	8.119

Normal GOF Test

Shapiro Wilk Test Statistic	0.278	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.389	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0855	Data Not Normal at 5% Significance Level

Surface Soil Wilcox Process Area ProUCL Outputs

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 186.5

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 219

95% Modified-t UCL (Johnson-1978) 191.6

Gamma GOF Test

A-D Test Statistic 6.585

5% A-D Critical Value 0.818

K-S Test Statistic 0.158

5% K-S Critical Value 0.0924

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 0.502

Theta hat (MLE) 240.3

nu hat (MLE) 108.4

MLE Mean (bias corrected) 120.6

Adjusted Level of Significance 0.0478

k star (bias corrected MLE) 0.494

Theta star (bias corrected MLE) 244.1

nu star (bias corrected) 106.7

MLE Sd (bias corrected) 171.6

Approximate Chi Square Value (0.05) 83.88

Adjusted Chi Square Value 83.61

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 153.5

95% Adjusted Gamma UCL (use when $n < 50$) 154

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.941

5% Shapiro Wilk P Value 1.3822E-4

Lilliefors Test Statistic 0.139

5% Lilliefors Critical Value 0.0855

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 1.335

Maximum of Logged Data 8.284

Mean of logged Data 3.528

SD of logged Data 1.401

Assuming Lognormal Distribution

95% H-UCL 129.5

95% Chebyshev (MVUE) UCL 160.3

99% Chebyshev (MVUE) UCL 251.3

90% Chebyshev (MVUE) UCL 138.2

97.5% Chebyshev (MVUE) UCL 191

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL 185.9

95% Standard Bootstrap UCL 184.8

95% Hall's Bootstrap UCL 458.4

95% BCA Bootstrap UCL 239.3

90% Chebyshev(Mean, Sd) UCL 239.7

95% Jackknife UCL 186.5

95% Bootstrap-t UCL 356.8

95% Percentile Bootstrap UCL 194.2

95% Chebyshev(Mean, Sd) UCL 293.6

Surface Soil Wilcox Process Area ProUCL Outputs

97.5% Chebyshev(Mean, Sd) UCL 368.5

99% Chebyshev(Mean, Sd) UCL 515.5

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 293.6

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

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

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

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

2-Methylnaphthalene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	67
		Number of Missing Observations	8
Number of Detects	68	Number of Non-Detects	32
Number of Distinct Detects	56	Number of Distinct Non-Detects	15
Minimum Detect	0.002	Minimum Non-Detect	0.0019
Maximum Detect	30	Maximum Non-Detect	2
Variance Detects	19.01	Percent Non-Detects	32%
Mean Detects	1.509	SD Detects	4.36
Median Detects	0.15	CV Detects	2.89
Skewness Detects	5.023	Kurtosis Detects	28.82
Mean of Logged Detects	-1.849	SD of Logged Detects	2.362

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.39
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.365
5% Lilliefors Critical Value	0.107

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	1.047	KM Standard Error of Mean	0.366
KM SD	3.633	95% KM (BCA) UCL	1.735
95% KM (t) UCL	1.654	95% KM (Percentile Bootstrap) UCL	1.71
95% KM (z) UCL	1.649	95% KM Bootstrap t UCL	2.367
90% KM Chebyshev UCL	2.145	95% KM Chebyshev UCL	2.642
97.5% KM Chebyshev UCL	3.333	99% KM Chebyshev UCL	4.689

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.559
5% A-D Critical Value	0.864
K-S Test Statistic	0.148
5% K-S Critical Value	0.117

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.304	k star (bias corrected MLE)	0.301
Theta hat (MLE)	4.957	Theta star (bias corrected MLE)	5.017

Surface Soil Wilcox Process Area ProUCL Outputs

nu hat (MLE)	41.39	nu star (bias corrected)	40.9
Mean (detects)	1.509		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.002	Mean	1.029
Maximum	30	Median	0.0295
SD	3.655	CV	3.552
k hat (MLE)	0.256	k star (bias corrected MLE)	0.255
Theta hat (MLE)	4.015	Theta star (bias corrected MLE)	4.031
nu hat (MLE)	51.27	nu star (bias corrected)	51.06
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (51.06, α)	35.65	Adjusted Chi Square Value (51.06, β)	35.46
95% Gamma Approximate UCL (use when $n \geq 50$)	1.474	95% Gamma Adjusted UCL (use when $n < 50$)	1.482

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.047	SD (KM)	3.633
Variance (KM)	13.2	SE of Mean (KM)	0.366
k hat (KM)	0.083	k star (KM)	0.0872
nu hat (KM)	16.6	nu star (KM)	17.43
theta hat (KM)	12.61	theta star (KM)	12.01
80% gamma percentile (KM)	0.583	90% gamma percentile (KM)	2.609
95% gamma percentile (KM)	6.098	99% gamma percentile (KM)	17.79

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (17.43, α)	8.982	Adjusted Chi Square Value (17.43, β)	8.893
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	2.031	95% Gamma Adjusted KM-UCL (use when $n < 50$)	2.051

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.966	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.154	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0827	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.107	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.036	Mean in Log Scale	-2.676
SD in Original Scale	3.653	SD in Log Scale	2.483
95% t UCL (assumes normality of ROS data)	1.643	95% Percentile Bootstrap UCL	1.703
95% BCA Bootstrap UCL	1.972	95% Bootstrap t UCL	2.334
95% H-UCL (Log ROS)	4.136		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.635	KM Geo Mean	0.0717
KM SD (logged)	2.453	95% Critical H Value (KM-Log)	4.018
KM Standard Error of Mean (logged)	0.267	95% H-UCL (KM -Log)	3.913

Surface Soil Wilcox Process Area ProUCL Outputs

KM SD (logged)	2.453	95% Critical H Value (KM-Log)	4.018
KM Standard Error of Mean (logged)	0.267		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.091	Mean in Log Scale	-2.13
SD in Original Scale	3.642	SD in Log Scale	2.27
95% t UCL (Assumes normality)	1.696	95% H-Stat UCL	3.699

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 3.913

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

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

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

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

Benzo (a) anthracene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	73
		Number of Missing Observations	8
Number of Detects	77	Number of Non-Detects	23
Number of Distinct Detects	70	Number of Distinct Non-Detects	10
Minimum Detect	8.6000E-4	Minimum Non-Detect	0.0019
Maximum Detect	44	Maximum Non-Detect	1.8
Variance Detects	33.31	Percent Non-Detects	23%
Mean Detects	1.531	SD Detects	5.771
Median Detects	0.16	CV Detects	3.771
Skewness Detects	6.005	Kurtosis Detects	40.51
Mean of Logged Detects	-2.332	SD of Logged Detects	2.448

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.3
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.426
5% Lilliefors Critical Value	0.101

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	1.19	KM Standard Error of Mean	0.51
KM SD	5.07	95% KM (BCA) UCL	2.146
95% KM (t) UCL	2.038	95% KM (Percentile Bootstrap) UCL	2.114
95% KM (z) UCL	2.03	95% KM Bootstrap t UCL	3.526
90% KM Chebyshev UCL	2.721	95% KM Chebyshev UCL	3.415
97.5% KM Chebyshev UCL	4.377	99% KM Chebyshev UCL	6.268

Surface Soil Wilcox Process Area ProUCL Outputs

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.114	Anderson-Darling GOF Test
5% A-D Critical Value	0.887	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.226	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.112	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.256	k star (bias corrected MLE)	0.255
Theta hat (MLE)	5.967	Theta star (bias corrected MLE)	5.998
nu hat (MLE)	39.5	nu star (bias corrected)	39.3
Mean (detects)	1.531		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.6000E-4	Mean	1.182
Maximum	44	Median	0.0365
SD	5.097	CV	4.311
k hat (MLE)	0.239	k star (bias corrected MLE)	0.238
Theta hat (MLE)	4.949	Theta star (bias corrected MLE)	4.959
nu hat (MLE)	47.79	nu star (bias corrected)	47.69
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (47.69, α)	32.84	Adjusted Chi Square Value (47.69, β)	32.66
95% Gamma Approximate UCL (use when $n \geq 50$)	1.717	95% Gamma Adjusted UCL (use when $n < 50$)	1.726

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.19	SD (KM)	5.07
Variance (KM)	25.7	SE of Mean (KM)	0.51
k hat (KM)	0.0551	k star (KM)	0.0601
nu hat (KM)	11.03	nu star (KM)	12.03
theta hat (KM)	21.59	theta star (KM)	19.79
80% gamma percentile (KM)	0.289	90% gamma percentile (KM)	2.245
95% gamma percentile (KM)	6.675	99% gamma percentile (KM)	23.99

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.03, α)	5.245	Adjusted Chi Square Value (12.03, β)	5.18
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	2.73	95% Gamma Adjusted KM-UCL (use when $n < 50$)	2.764

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.966	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.135	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0873	Lilliefors GOF Test
5% Lilliefors Critical Value	0.101	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Surface Soil Wilcox Process Area ProUCL Outputs

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.184	Mean in Log Scale	-2.891
SD in Original Scale	5.097	SD in Log Scale	2.514
95% t UCL (assumes normality of ROS data)	2.031	95% Percentile Bootstrap UCL	2.135
95% BCA Bootstrap UCL	2.603	95% Bootstrap t UCL	3.288
95% H-UCL (Log ROS)	3.682		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.878	KM Geo Mean	0.0562
KM SD (logged)	2.521	95% Critical H Value (KM-Log)	4.11
KM Standard Error of Mean (logged)	0.267	95% H-UCL (KM -Log)	3.82
KM SD (logged)	2.521	95% Critical H Value (KM-Log)	4.11
KM Standard Error of Mean (logged)	0.267		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.217	Mean in Log Scale	-2.495
SD in Original Scale	5.09	SD in Log Scale	2.403
95% t UCL (Assumes normality)	2.062	95% H-Stat UCL	3.843

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 3.82

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	74
		Number of Missing Observations	8
Number of Detects	77	Number of Non-Detects	23
Number of Distinct Detects	67	Number of Distinct Non-Detects	10
Minimum Detect	0.0012	Minimum Non-Detect	0.0019
Maximum Detect	31	Maximum Non-Detect	1.8
Variance Detects	20.16	Percent Non-Detects	23%
Mean Detects	1.151	SD Detects	4.49
Median Detects	0.1	CV Detects	3.899
Skewness Detects	5.61	Kurtosis Detects	32.85
Mean of Logged Detects	-2.547	SD of Logged Detects	2.338

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.282
5% Shapiro Wilk P Value	0

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Surface Soil Wilcox Process Area ProUCL Outputs

Lilliefors Test Statistic	0.444	Lilliefors GOF Test
5% Lilliefors Critical Value	0.101	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.899	KM Standard Error of Mean	0.397
KM SD	3.941	95% KM (BCA) UCL	1.693
95% KM (t) UCL	1.558	95% KM (Percentile Bootstrap) UCL	1.611
95% KM (z) UCL	1.552	95% KM Bootstrap t UCL	3.221
90% KM Chebyshev UCL	2.089	95% KM Chebyshev UCL	2.629
97.5% KM Chebyshev UCL	3.377	99% KM Chebyshev UCL	4.847

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.607	Anderson-Darling GOF Test
5% A-D Critical Value	0.884	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.235	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.112	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.262	k star (bias corrected MLE)	0.261
Theta hat (MLE)	4.391	Theta star (bias corrected MLE)	4.417
nu hat (MLE)	40.38	nu star (bias corrected)	40.14
Mean (detects)	1.151		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0012	Mean	0.892
Maximum	31	Median	0.027
SD	3.962	CV	4.441
k hat (MLE)	0.248	k star (bias corrected MLE)	0.247
Theta hat (MLE)	3.601	Theta star (bias corrected MLE)	3.612
nu hat (MLE)	49.55	nu star (bias corrected)	49.4
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (49.40, α)	34.26	Adjusted Chi Square Value (49.40, β)	34.08
95% Gamma Approximate UCL (use when $n \geq 50$)	1.286	95% Gamma Adjusted UCL (use when $n < 50$)	1.293

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.899	SD (KM)	3.941
Variance (KM)	15.53	SE of Mean (KM)	0.397
k hat (KM)	0.052	k star (KM)	0.0571
nu hat (KM)	10.41	nu star (KM)	11.43
theta hat (KM)	17.28	theta star (KM)	15.73
80% gamma percentile (KM)	0.188	90% gamma percentile (KM)	1.608
95% gamma percentile (KM)	4.981	99% gamma percentile (KM)	18.52

Surface Soil Wilcox Process Area ProUCL Outputs

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.43, α)	4.853	Adjusted Chi Square Value (11.43, β)	4.791
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	2.117	95% Gamma Adjusted KM-UCL (use when $n < 50$)	2.145

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.964	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.0969	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.075	Lilliefors GOF Test
5% Lilliefors Critical Value	0.101	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.893	Mean in Log Scale	-2.984
SD in Original Scale	3.962	SD in Log Scale	2.321
95% t UCL (assumes normality of ROS data)	1.551	95% Percentile Bootstrap UCL	1.598
95% BCA Bootstrap UCL	1.913	95% Bootstrap t UCL	3.24
95% H-UCL (Log ROS)	1.833		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.991	KM Geo Mean	0.0502
KM SD (logged)	2.365	95% Critical H Value (KM-Log)	3.9
KM Standard Error of Mean (logged)	0.252	95% H-UCL (KM -Log)	2.082
KM SD (logged)	2.365	95% Critical H Value (KM-Log)	3.9
KM Standard Error of Mean (logged)	0.252		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.926	Mean in Log Scale	-2.615
SD in Original Scale	3.957	SD in Log Scale	2.267
95% t UCL (Assumes normality)	1.583	95% H-Stat UCL	2.257

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	2.082

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

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

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

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

Benzo (b) fluoranthene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	78
		Number of Missing Observations	8
Number of Detects	78	Number of Non-Detects	22
Number of Distinct Detects	72	Number of Distinct Non-Detects	10

Surface Soil Wilcox Process Area ProUCL Outputs

Minimum Detect	0.0012	Minimum Non-Detect	0.0019
Maximum Detect	35	Maximum Non-Detect	1.8
Variance Detects	22.3	Percent Non-Detects	22%
Mean Detects	1.114	SD Detects	4.722
Median Detects	0.086	CV Detects	4.238
Skewness Detects	6.115	Kurtosis Detects	39.54
Mean of Logged Detects	-2.548	SD of Logged Detects	2.215

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.258	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.444	Lilliefors GOF Test
5% Lilliefors Critical Value	0.1	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.879	KM Standard Error of Mean	0.419
KM SD	4.168	95% KM (BCA) UCL	1.691
95% KM (t) UCL	1.576	95% KM (Percentile Bootstrap) UCL	1.642
95% KM (z) UCL	1.569	95% KM Bootstrap t UCL	3.968
90% KM Chebyshev UCL	2.138	95% KM Chebyshev UCL	2.708
97.5% KM Chebyshev UCL	3.499	99% KM Chebyshev UCL	5.053

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.613	Anderson-Darling GOF Test
5% A-D Critical Value	0.883	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.243	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.111	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.265	k star (bias corrected MLE)	0.263
Theta hat (MLE)	4.206	Theta star (bias corrected MLE)	4.233
nu hat (MLE)	41.32	nu star (bias corrected)	41.07
Mean (detects)	1.114		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0012	Mean	0.871
Maximum	35	Median	0.03
SD	4.19	CV	4.809
k hat (MLE)	0.248	k star (bias corrected MLE)	0.248
Theta hat (MLE)	3.508	Theta star (bias corrected MLE)	3.519
nu hat (MLE)	49.67	nu star (bias corrected)	49.51
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (49.51, α)	34.36	Adjusted Chi Square Value (49.51, β)	34.17

Surface Soil Wilcox Process Area ProUCL Outputs

95% Gamma Approximate UCL (use when n>=50)	1.256	95% Gamma Adjusted UCL (use when n<50)	1.262

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.879	SD (KM)	4.168
Variance (KM)	17.37	SE of Mean (KM)	0.419
k hat (KM)	0.0445	k star (KM)	0.0498
nu hat (KM)	8.9	nu star (KM)	9.966
theta hat (KM)	19.76	theta star (KM)	17.64
80% gamma percentile (KM)	0.118	90% gamma percentile (KM)	1.336
95% gamma percentile (KM)	4.67	99% gamma percentile (KM)	19.15

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.97, α)	3.921	Adjusted Chi Square Value (9.97, β)	3.865
95% Gamma Approximate KM-UCL (use when n>=50)	2.235	95% Gamma Adjusted KM-UCL (use when n<50)	2.267

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.971	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.238	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0699	Lilliefors GOF Test
5% Lilliefors Critical Value	0.1	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.875	Mean in Log Scale	-3.003
SD in Original Scale	4.189	SD in Log Scale	2.26
95% t UCL (assumes normality of ROS data)	1.57	95% Percentile Bootstrap UCL	1.641
95% BCA Bootstrap UCL	2.069	95% Bootstrap t UCL	3.756
95% H-UCL (Log ROS)	1.5		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.004	KM Geo Mean	0.0496
KM SD (logged)	2.292	95% Critical H Value (KM-Log)	3.801
KM Standard Error of Mean (logged)	0.243	95% H-UCL (KM -Log)	1.644
KM SD (logged)	2.292	95% Critical H Value (KM-Log)	3.801
KM Standard Error of Mean (logged)	0.243		

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed		
Mean in Original Scale	0.902	Mean in Log Scale	-2.68
SD in Original Scale	4.185	SD in Log Scale	2.214
95% t UCL (Assumes normality)	1.597	95% H-Stat UCL	1.813

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 1.644

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

Surface Soil Wilcox Process Area ProUCL Outputs

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

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

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

Chrysene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	77
		Number of Missing Observations	8
Number of Detects	85	Number of Non-Detects	15
Number of Distinct Detects	71	Number of Distinct Non-Detects	8
Minimum Detect	0.0015	Minimum Non-Detect	0.0019
Maximum Detect	120	Maximum Non-Detect	1.8
Variance Detects	214.6	Percent Non-Detects	15%
Mean Detects	3.437	SD Detects	14.65
Median Detects	0.15	CV Detects	4.262
Skewness Detects	6.718	Kurtosis Detects	50.03
Mean of Logged Detects	-1.819	SD of Logged Detects	2.577

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.264
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.425
5% Lilliefors Critical Value	0.0962

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	2.932	KM Standard Error of Mean	1.356
KM SD	13.48	95% KM (BCA) UCL	5.677
95% KM (t) UCL	5.183	95% KM (Percentile Bootstrap) UCL	5.346
95% KM (z) UCL	5.162	95% KM Bootstrap t UCL	10.49
90% KM Chebyshev UCL	6.999	95% KM Chebyshev UCL	8.842
97.5% KM Chebyshev UCL	11.4	99% KM Chebyshev UCL	16.42

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.1
5% A-D Critical Value	0.898
K-S Test Statistic	0.227
5% K-S Critical Value	0.107

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.235	k star (bias corrected MLE)	0.234
Theta hat (MLE)	14.63	Theta star (bias corrected MLE)	14.66
nu hat (MLE)	39.94	nu star (bias corrected)	39.86
Mean (detects)	3.437		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

Surface Soil Wilcox Process Area ProUCL Outputs

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0015	Mean	2.923
Maximum	120	Median	0.078
SD	13.55	CV	4.636
k hat (MLE)	0.219	k star (bias corrected MLE)	0.219
Theta hat (MLE)	13.33	Theta star (bias corrected MLE)	13.33
nu hat (MLE)	43.84	nu star (bias corrected)	43.85
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (43.85, α)	29.67	Adjusted Chi Square Value (43.85, β)	29.5
95% Gamma Approximate UCL (use when $n \geq 50$)	4.32	95% Gamma Adjusted UCL (use when $n < 50$)	4.345

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.932	SD (KM)	13.48
Variance (KM)	181.7	SE of Mean (KM)	1.356
k hat (KM)	0.0473	k star (KM)	0.0526
nu hat (KM)	9.462	nu star (KM)	10.51
theta hat (KM)	61.97	theta star (KM)	55.78
80% gamma percentile (KM)	0.472	90% gamma percentile (KM)	4.765
95% gamma percentile (KM)	15.86	99% gamma percentile (KM)	62.51

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.51, α)	4.264	Adjusted Chi Square Value (10.51, β)	4.205
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	7.227	95% Gamma Adjusted KM-UCL (use when $n < 50$)	7.327

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.966	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.11	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0844	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0962	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.926	Mean in Log Scale	-2.182
SD in Original Scale	13.55	SD in Log Scale	2.606
95% t UCL (assumes normality of ROS data)	5.176	95% Percentile Bootstrap UCL	5.435
95% BCA Bootstrap UCL	6.771	95% Bootstrap t UCL	9.571
95% H-UCL (Log ROS)	10.17		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.193	KM Geo Mean	0.112
KM SD (logged)	2.628	95% Critical H Value (KM-Log)	4.255
KM Standard Error of Mean (logged)	0.272	95% H-UCL (KM -Log)	10.85
KM SD (logged)	2.628	95% Critical H Value (KM-Log)	4.255
KM Standard Error of Mean (logged)	0.272		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	2.95

DL/2 Log-Transformed

Mean in Log Scale	-1.974

Surface Soil Wilcox Process Area ProUCL Outputs

SD in Original Scale	13.54	SD in Log Scale	2.546
95% t UCL (Assumes normality)	5.198	95% H-Stat UCL	10.27

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 10.85

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

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

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

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

Dibenz (a,h) anthracene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	64
		Number of Missing Observations	8
Number of Detects	47	Number of Non-Detects	53
Number of Distinct Detects	43	Number of Distinct Non-Detects	24
Minimum Detect	0.0013	Minimum Non-Detect	0.0019
Maximum Detect	5.9	Maximum Non-Detect	2
Variance Detects	1.427	Percent Non-Detects	53%
Mean Detects	0.353	SD Detects	1.194
Median Detects	0.032	CV Detects	3.379
Skewness Detects	4.323	Kurtosis Detects	18.29
Mean of Logged Detects	-3.542	SD of Logged Detects	2.15

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.317	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.946	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.459	Lilliefors GOF Test
5% Lilliefors Critical Value	0.128	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.183	KM Standard Error of Mean	0.084
KM SD	0.828	95% KM (BCA) UCL	0.343
95% KM (t) UCL	0.323	95% KM (Percentile Bootstrap) UCL	0.334
95% KM (z) UCL	0.321	95% KM Bootstrap t UCL	0.765
90% KM Chebyshev UCL	0.435	95% KM Chebyshev UCL	0.549
97.5% KM Chebyshev UCL	0.708	99% KM Chebyshev UCL	1.019

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.287	Anderson-Darling GOF Test
5% A-D Critical Value	0.873	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.26	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.141	Detected Data Not Gamma Distributed at 5% Significance Level

Surface Soil Wilcox Process Area ProUCL Outputs

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.279	k star (bias corrected MLE)	0.275
Theta hat (MLE)	1.267	Theta star (bias corrected MLE)	1.284
nu hat (MLE)	26.22	nu star (bias corrected)	25.88
Mean (detects)	0.353		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0013	Mean	0.188
Maximum	5.9	Median	0.01
SD	0.833	CV	4.432
k hat (MLE)	0.308	k star (bias corrected MLE)	0.305
Theta hat (MLE)	0.61	Theta star (bias corrected MLE)	0.615
nu hat (MLE)	61.6	nu star (bias corrected)	61.08
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (61.08, α)	44.11	Adjusted Chi Square Value (61.08, β)	43.9
95% Gamma Approximate UCL (use when $n \geq 50$)	0.26	95% Gamma Adjusted UCL (use when $n < 50$)	0.261

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.183	SD (KM)	0.828
Variance (KM)	0.686	SE of Mean (KM)	0.084
k hat (KM)	0.0489	k star (KM)	0.0541
nu hat (KM)	9.776	nu star (KM)	10.82
theta hat (KM)	3.746	theta star (KM)	3.386
80% gamma percentile (KM)	0.0323	90% gamma percentile (KM)	0.308
95% gamma percentile (KM)	0.999	99% gamma percentile (KM)	3.859

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.82, α)	4.458	Adjusted Chi Square Value (10.82, β)	4.398
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.444	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.45

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.938
5% Shapiro Wilk Critical Value	0.946
Lilliefors Test Statistic	0.0877
5% Lilliefors Critical Value	0.128

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.175	Mean in Log Scale	-4.246
SD in Original Scale	0.832	SD in Log Scale	1.874
95% t UCL (assumes normality of ROS data)	0.313	95% Percentile Bootstrap UCL	0.33
95% BCA Bootstrap UCL	0.399	95% Bootstrap t UCL	0.85
95% H-UCL (Log ROS)	0.153		

Surface Soil Wilcox Process Area ProUCL Outputs

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.262	KM Geo Mean	0.0141
KM SD (logged)	2.026	95% Critical H Value (KM-Log)	3.453
KM Standard Error of Mean (logged)	0.255	95% H-UCL (KM -Log)	0.222
KM SD (logged)	2.026	95% Critical H Value (KM-Log)	3.453
KM Standard Error of Mean (logged)	0.255		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.3	Mean in Log Scale	-3.004
SD in Original Scale	0.846	SD in Log Scale	2.127
95% t UCL (Assumes normality)	0.441	95% H-Stat UCL	1.025

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.222

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

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

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

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

Indeno (1,2,3-cd) pyrene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	67
		Number of Missing Observations	8
Number of Detects	73	Number of Non-Detects	27
Number of Distinct Detects	59	Number of Distinct Non-Detects	12
Minimum Detect	4.1000E-4	Minimum Non-Detect	0.0019
Maximum Detect	5.7	Maximum Non-Detect	1.9
Variance Detects	0.735	Percent Non-Detects	27%
Mean Detects	0.24	SD Detects	0.857
Median Detects	0.028	CV Detects	3.568
Skewness Detects	5.404	Kurtosis Detects	30.26
Mean of Logged Detects	-3.6	SD of Logged Detects	2.061

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.297
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.417
5% Lilliefors Critical Value	0.104

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.186	KM Standard Error of Mean	0.0741

Surface Soil Wilcox Process Area ProUCL Outputs

KM SD	0.734	95% KM (BCA) UCL	0.322
95% KM (t) UCL	0.309	95% KM (Percentile Bootstrap) UCL	0.316
95% KM (z) UCL	0.308	95% KM Bootstrap t UCL	0.634
90% KM Chebyshev UCL	0.409	95% KM Chebyshev UCL	0.509
97.5% KM Chebyshev UCL	0.649	99% KM Chebyshev UCL	0.923

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.74	Anderson-Darling GOF Test
5% A-D Critical Value	0.862	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.189	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.113	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.315	k star (bias corrected MLE)	0.311
Theta hat (MLE)	0.763	Theta star (bias corrected MLE)	0.773
nu hat (MLE)	45.95	nu star (bias corrected)	45.4
Mean (detects)	0.24		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.1000E-4	Mean	0.184
Maximum	5.7	Median	0.0125
SD	0.737	CV	4.007
k hat (MLE)	0.329	k star (bias corrected MLE)	0.326
Theta hat (MLE)	0.559	Theta star (bias corrected MLE)	0.564
nu hat (MLE)	65.86	nu star (bias corrected)	65.22
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (65.22, α)	47.63	Adjusted Chi Square Value (65.22, β)	47.41
95% Gamma Approximate UCL (use when $n \geq 50$)	0.252	95% Gamma Adjusted UCL (use when $n < 50$)	0.253

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.186	SD (KM)	0.734
Variance (KM)	0.539	SE of Mean (KM)	0.0741
k hat (KM)	0.0644	k star (KM)	0.0692
nu hat (KM)	12.89	nu star (KM)	13.83
theta hat (KM)	2.892	theta star (KM)	2.694
80% gamma percentile (KM)	0.0649	90% gamma percentile (KM)	0.398
95% gamma percentile (KM)	1.07	99% gamma percentile (KM)	3.531

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (13.83, α)	6.458	Adjusted Chi Square Value (13.83, β)	6.384
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.399	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.404

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.97	Shapiro Wilk GOF Test

Surface Soil Wilcox Process Area ProUCL Outputs

5% Shapiro Wilk P Value 0.236 Detected Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic 0.0679 **Lilliefors GOF Test**

5% Lilliefors Critical Value 0.104 Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.181	Mean in Log Scale	-3.858
SD in Original Scale	0.738	SD in Log Scale	1.94
95% t UCL (assumes normality of ROS data)	0.303	95% Percentile Bootstrap UCL	0.317
95% BCA Bootstrap UCL	0.378	95% Bootstrap t UCL	0.635
95% H-UCL (Log ROS)	0.266		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.872	KM Geo Mean	0.0208
KM SD (logged)	2.045	95% Critical H Value (KM-Log)	3.478
KM Standard Error of Mean (logged)	0.228	95% H-UCL (KM -Log)	0.344
KM SD (logged)	2.045	95% Critical H Value (KM-Log)	3.478
KM Standard Error of Mean (logged)	0.228		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.239
SD in Original Scale	0.745
95% t UCL (Assumes normality)	0.362

DL/2 Log-Transformed

Mean in Log Scale	-3.269
SD in Log Scale	2.07
95% H-Stat UCL	0.673

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 0.344

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

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

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

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

Naphthalene

General Statistics

Total Number of Observations	100	Number of Distinct Observations	64
		Number of Missing Observations	8
Number of Detects	56	Number of Non-Detects	44
Number of Distinct Detects	45	Number of Distinct Non-Detects	21
Minimum Detect	8.6000E-4	Minimum Non-Detect	0.0019
Maximum Detect	8.5	Maximum Non-Detect	2
Variance Detects	1.941	Percent Non-Detects	44%
Mean Detects	0.583	SD Detects	1.393
Median Detects	0.0915	CV Detects	2.387
Skewness Detects	4.275	Kurtosis Detects	20.83

Surface Soil Wilcox Process Area ProUCL Outputs

Mean of Logged Detects	-2.463	SD of Logged Detects	2.195

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.467	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.338	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.118	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.349	KM Standard Error of Mean	0.108
KM SD	1.07	95% KM (BCA) UCL	0.548
95% KM (t) UCL	0.529	95% KM (Percentile Bootstrap) UCL	0.544
95% KM (z) UCL	0.527	95% KM Bootstrap t UCL	0.722
90% KM Chebyshev UCL	0.674	95% KM Chebyshev UCL	0.822
97.5% KM Chebyshev UCL	1.026	99% KM Chebyshev UCL	1.427

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.724	Anderson-Darling GOF Test	
5% A-D Critical Value	0.851	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.139	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.128	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.35	k star (bias corrected MLE)	0.343
Theta hat (MLE)	1.669	Theta star (bias corrected MLE)	1.702
nu hat (MLE)	39.15	nu star (bias corrected)	38.39
Mean (detects)	0.583		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.6000E-4	Mean	0.335
Maximum	8.5	Median	0.011
SD	1.076	CV	3.213
k hat (MLE)	0.309	k star (bias corrected MLE)	0.307
Theta hat (MLE)	1.083	Theta star (bias corrected MLE)	1.092
nu hat (MLE)	61.87	nu star (bias corrected)	61.35
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (61.35, α)	44.34	Adjusted Chi Square Value (61.35, β)	44.12
95% Gamma Approximate UCL (use when $n \geq 50$)	0.463	95% Gamma Adjusted UCL (use when $n < 50$)	0.466

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.349	SD (KM)	1.07
Variance (KM)	1.145	SE of Mean (KM)	0.108
k hat (KM)	0.106	k star (KM)	0.11

Surface Soil Wilcox Process Area ProUCL Outputs

nu hat (KM)	21.28	nu star (KM)	21.98
theta hat (KM)	3.281	theta star (KM)	3.177
80% gamma percentile (KM)	0.275	90% gamma percentile (KM)	0.963
95% gamma percentile (KM)	2.012	99% gamma percentile (KM)	5.288

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (21.98, α)	12.32	Adjusted Chi Square Value (21.98, β)	12.22
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.623	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.628

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.976	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.543	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0647	Lilliefors GOF Test
5% Lilliefors Critical Value	0.118	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.337	Mean in Log Scale	-3.404
SD in Original Scale	1.075	SD in Log Scale	2.183
95% t UCL (assumes normality of ROS data)	0.515	95% Percentile Bootstrap UCL	0.532
95% BCA Bootstrap UCL	0.608	95% Bootstrap t UCL	0.706
95% H-UCL (Log ROS)	0.803		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.416	KM Geo Mean	0.0329
KM SD (logged)	2.304	95% Critical H Value (KM-Log)	3.817
KM Standard Error of Mean (logged)	0.272	95% H-UCL (KM -Log)	1.129
KM SD (logged)	2.304	95% Critical H Value (KM-Log)	3.817
KM Standard Error of Mean (logged)	0.272		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.43	Mean in Log Scale	-2.514
SD in Original Scale	1.071	SD in Log Scale	2.111
95% t UCL (Assumes normality)	0.607	95% H-Stat UCL	1.599

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	1.129

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

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

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

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

Surface Soil East Tank Farm ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/11/2019 11:57:06 AM

From File ETF_input file.xls

Full Precision OFF

Confidence Coefficient 95%

Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	102	Number of Distinct Observations	93
		Number of Missing Observations	0
Minimum	1550	Mean	7461
Maximum	24200	Median	6485
SD	4971	Std. Error of Mean	492.2
Coefficient of Variation	0.666	Skewness	1.443

Normal GOF Test

Shapiro Wilk Test Statistic	0.85
5% Shapiro Wilk P Value	2.442E-15
Lilliefors Test Statistic	0.143
5% Lilliefors Critical Value	0.088

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8278

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8346

95% Modified-t UCL (Johnson-1978) 8290

Gamma GOF Test

A-D Test Statistic	0.944
5% A-D Critical Value	0.76
K-S Test Statistic	0.0878
5% K-S Critical Value	0.0897

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	2.711	k star (bias corrected MLE)	2.638
Theta hat (MLE)	2752	Theta star (bias corrected MLE)	2828
nu hat (MLE)	553.1	nu star (bias corrected)	538.1
MLE Mean (bias corrected)	7461	MLE Sd (bias corrected)	4594
		Approximate Chi Square Value (0.05)	485.3
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	484.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 8273

95% Adjusted Gamma UCL (use when $n < 50$) 8285

Surface Soil East Tank Farm ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973
5% Shapiro Wilk P Value	0.231
Lilliefors Test Statistic	0.0615
5% Lilliefors Critical Value	0.088

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.346	Mean of logged Data	8.722
Maximum of Logged Data	10.09	SD of logged Data	0.627

Assuming Lognormal Distribution

95% H-UCL	8415	90% Chebyshev (MVUE) UCL	8960
95% Chebyshev (MVUE) UCL	9643	97.5% Chebyshev (MVUE) UCL	10590
99% Chebyshev (MVUE) UCL	12452		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	8271	95% Jackknife UCL	8278
95% Standard Bootstrap UCL	8263	95% Bootstrap-t UCL	8354
95% Hall's Bootstrap UCL	8364	95% Percentile Bootstrap UCL	8288
95% BCA Bootstrap UCL	8337		
90% Chebyshev(Mean, Sd) UCL	8938	95% Chebyshev(Mean, Sd) UCL	9606
97.5% Chebyshev(Mean, Sd) UCL	10535	99% Chebyshev(Mean, Sd) UCL	12358

Suggested UCL to Use

95% Approximate Gamma UCL	8273

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Arsenic

General Statistics

Total Number of Observations	102	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	0.5	Mean	2.676
Maximum	11.3	Median	2.2
SD	1.729	Std. Error of Mean	0.171
Coefficient of Variation	0.646	Skewness	2.12

Normal GOF Test

Surface Soil East Tank Farm ProUCL Outputs

Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.174	Lilliefors GOF Test
5% Lilliefors Critical Value	0.088	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.96	95% Adjusted-CLT UCL (Chen-1995)	2.996
		95% Modified-t UCL (Johnson-1978)	2.966

Gamma GOF Test

A-D Test Statistic	0.954	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0953	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0895	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.15	k star (bias corrected MLE)	3.064
Theta hat (MLE)	0.85	Theta star (bias corrected MLE)	0.873
nu hat (MLE)	642.5	nu star (bias corrected)	625
MLE Mean (bias corrected)	2.676	MLE Sd (bias corrected)	1.529
		Approximate Chi Square Value (0.05)	568
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	567.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.944	95% Adjusted Gamma UCL (use when n<50)	2.948

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.899	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0607	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.088	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.693	Mean of logged Data	0.817
Maximum of Logged Data	2.425	SD of logged Data	0.575

Assuming Lognormal Distribution

95% H-UCL	2.974	90% Chebyshev (MVUE) UCL	3.155
95% Chebyshev (MVUE) UCL	3.377	97.5% Chebyshev (MVUE) UCL	3.684
99% Chebyshev (MVUE) UCL	4.288		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.958	95% Jackknife UCL	2.96

Surface Soil East Tank Farm ProUCL Outputs

95% Standard Bootstrap UCL	2.954	95% Bootstrap-t UCL	3.001
95% Hall's Bootstrap UCL	3.021	95% Percentile Bootstrap UCL	2.956
95% BCA Bootstrap UCL	2.994		
90% Chebyshev(Mean, Sd) UCL	3.19	95% Chebyshev(Mean, Sd) UCL	3.422
97.5% Chebyshev(Mean, Sd) UCL	3.745	99% Chebyshev(Mean, Sd) UCL	4.38

Suggested UCL to Use

95% H-UCL 2.974

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Benzo (a) anthracene

General Statistics

Total Number of Observations	102	Number of Distinct Observations	56
Number of Detects	53	Number of Non-Detects	49
Number of Distinct Detects	45	Number of Distinct Non-Detects	16
Minimum Detect	8.3000E-4	Minimum Non-Detect	0.0021
Maximum Detect	11	Maximum Non-Detect	0.25
Variance Detects	2.279	Percent Non-Detects	48.04%
Mean Detects	0.247	SD Detects	1.51
Median Detects	0.0038	CV Detects	6.11
Skewness Detects	7.219	Kurtosis Detects	52.38
Mean of Logged Detects	-4.858	SD of Logged Detects	1.939

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.169
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.454
5% Lilliefors Critical Value	0.121

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.132	KM Standard Error of Mean	0.108
KM SD	1.085	95% KM (BCA) UCL	0.349
95% KM (t) UCL	0.312	95% KM (Percentile Bootstrap) UCL	0.347
95% KM (z) UCL	0.31	95% KM Bootstrap t UCL	2.934
90% KM Chebyshev UCL	0.457	95% KM Chebyshev UCL	0.605
97.5% KM Chebyshev UCL	0.809	99% KM Chebyshev UCL	1.211

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 9.839

Anderson-Darling GOF Test

Surface Soil East Tank Farm ProUCL Outputs

5% A-D Critical Value	0.907	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.31	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.135	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	0.211	k star (bias corrected MLE)	0.212
Theta hat (MLE)	1.171	Theta star (bias corrected MLE)	1.168
nu hat (MLE)	22.36	nu star (bias corrected)	22.43
Mean (detects)	0.247		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.3000E-4	Mean	0.147
Maximum	11	Median	0.01
SD	1.091	CV	7.44
k hat (MLE)	0.263	k star (bias corrected MLE)	0.262
Theta hat (MLE)	0.557	Theta star (bias corrected MLE)	0.56
nu hat (MLE)	53.64	nu star (bias corrected)	53.4
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (53.40, α)	37.61	Adjusted Chi Square Value (53.40, β)	37.42
95% Gamma Approximate UCL (use when $n \geq 50$)	0.208	95% Gamma Adjusted UCL (use when $n < 50$)	0.209

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.132	SD (KM)	1.085
Variance (KM)	1.176	SE of Mean (KM)	0.108
k hat (KM)	0.0148	k star (KM)	0.0209
nu hat (KM)	3.017	nu star (KM)	4.262
theta hat (KM)	8.918	theta star (KM)	6.314
80% gamma percentile (KM)	8.2811E-5	90% gamma percentile (KM)	0.0233
95% gamma percentile (KM)	0.325	99% gamma percentile (KM)	3.666

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.26, α)	0.828	Adjusted Chi Square Value (4.26, β)	0.807
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.679	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.696

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.851	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	6.0001E-7	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.194	Lilliefors GOF Test
5% Lilliefors Critical Value	0.121	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.131	Mean in Log Scale	-5.297
SD in Original Scale	1.09	SD in Log Scale	1.644

Surface Soil East Tank Farm ProUCL Outputs

95% t UCL (assumes normality of ROS data)	0.31	95% Percentile Bootstrap UCL	0.345
95% BCA Bootstrap UCL	0.554	95% Bootstrap t UCL	3.238
95% H-UCL (Log ROS)	0.0309		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.322	KM Geo Mean	0.00489
KM SD (logged)	1.632	95% Critical H Value (KM-Log)	2.863
KM Standard Error of Mean (logged)	0.184	95% H-UCL (KM -Log)	0.0295
KM SD (logged)	1.632	95% Critical H Value (KM-Log)	2.863
KM Standard Error of Mean (logged)	0.184		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.158	Mean in Log Scale	-4.325
SD in Original Scale	1.088	SD in Log Scale	1.979
95% t UCL (Assumes normality)	0.337	95% H-Stat UCL	0.179

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.605

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	102	Number of Distinct Observations	56
Number of Detects	53	Number of Non-Detects	49
Number of Distinct Detects	44	Number of Distinct Non-Detects	16
Minimum Detect	9.9000E-4	Minimum Non-Detect	0.0021
Maximum Detect	12	Maximum Non-Detect	0.25
Variance Detects	2.707	Percent Non-Detects	48.04%
Mean Detects	0.265	SD Detects	1.645
Median Detects	0.0045	CV Detects	6.198
Skewness Detects	7.248	Kurtosis Detects	52.67
Mean of Logged Detects	-4.722	SD of Logged Detects	1.952

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.164
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.45
5% Lilliefors Critical Value	0.121

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Surface Soil East Tank Farm ProUCL Outputs

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

KM Mean	0.142	KM Standard Error of Mean	0.118
KM SD	1.182	95% KM (BCA) UCL	0.381
95% KM (t) UCL	0.338	95% KM (Percentile Bootstrap) UCL	0.376
95% KM (z) UCL	0.337	95% KM Bootstrap t UCL	3.011
90% KM Chebyshev UCL	0.497	95% KM Chebyshev UCL	0.657
97.5% KM Chebyshev UCL	0.88	99% KM Chebyshev UCL	1.318

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	9.323	Anderson-Darling GOF Test
5% A-D Critical Value	0.906	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.321	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.135	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.214	k star (bias corrected MLE)	0.215
Theta hat (MLE)	1.238	Theta star (bias corrected MLE)	1.236
nu hat (MLE)	22.72	nu star (bias corrected)	22.77
Mean (detects)	0.265		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	9.9000E-4	Mean	0.157
Maximum	12	Median	0.01
SD	1.189	CV	7.565
k hat (MLE)	0.263	k star (bias corrected MLE)	0.262
Theta hat (MLE)	0.598	Theta star (bias corrected MLE)	0.6
nu hat (MLE)	53.63	nu star (bias corrected)	53.38
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (53.38, α)	37.6	Adjusted Chi Square Value (53.38, β)	37.41
95% Gamma Approximate UCL (use when $n \geq 50$)	0.223	95% Gamma Adjusted UCL (use when $n < 50$)	0.224

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.142	SD (KM)	1.182
Variance (KM)	1.397	SE of Mean (KM)	0.118
k hat (KM)	0.0145	k star (KM)	0.0206
nu hat (KM)	2.955	nu star (KM)	4.201
theta hat (KM)	9.82	theta star (KM)	6.906
80% gamma percentile (KM)	7.7635E-5	90% gamma percentile (KM)	0.0237
95% gamma percentile (KM)	0.343	99% gamma percentile (KM)	3.96

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.20, α)	0.803	Adjusted Chi Square Value (4.20, β)	0.783
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.744	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.763

Surface Soil East Tank Farm ProUCL Outputs

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.858	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	1.2656E-6	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.196	Lilliefors GOF Test
5% Lilliefors Critical Value	0.121	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.141	Mean in Log Scale	-5.236
SD in Original Scale	1.188	SD in Log Scale	1.68
95% t UCL (assumes normality of ROS data)	0.336	95% Percentile Bootstrap UCL	0.375
95% BCA Bootstrap UCL	0.501	95% Bootstrap t UCL	3.353
95% H-UCL (Log ROS)	0.0356		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.246	KM Geo Mean	0.00527
KM SD (logged)	1.672	95% Critical H Value (KM-Log)	2.909
KM Standard Error of Mean (logged)	0.187	95% H-UCL (KM -Log)	0.0346
KM SD (logged)	1.672	95% Critical H Value (KM-Log)	2.909
KM Standard Error of Mean (logged)	0.187		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.164	Mean in Log Scale	-4.42
SD in Original Scale	1.186	SD in Log Scale	1.985
95% t UCL (Assumes normality)	0.359	95% H-Stat UCL	0.165

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.657

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

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

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

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

Benzo (b) fluoranthene

General Statistics

Total Number of Observations	102	Number of Distinct Observations	56
Number of Detects	60	Number of Non-Detects	42
Number of Distinct Detects	49	Number of Distinct Non-Detects	14
Minimum Detect	8.3000E-4	Minimum Non-Detect	0.0021
Maximum Detect	20	Maximum Non-Detect	0.25
Variance Detects	6.649	Percent Non-Detects	41.18%
Mean Detects	0.38	SD Detects	2.579
Median Detects	0.00415	CV Detects	6.788

Surface Soil East Tank Farm ProUCL Outputs

Skewness Detects	7.721	Kurtosis Detects	59.73
Mean of Logged Detects	-4.718	SD of Logged Detects	2.005

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.15
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.461
5% Lilliefors Critical Value	0.114

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.228	KM Standard Error of Mean	0.197
KM SD	1.97	95% KM (BCA) UCL	0.623
95% KM (t) UCL	0.554	95% KM (Percentile Bootstrap) UCL	0.619
95% KM (z) UCL	0.551	95% KM Bootstrap t UCL	6.362
90% KM Chebyshev UCL	0.818	95% KM Chebyshev UCL	1.085
97.5% KM Chebyshev UCL	1.456	99% KM Chebyshev UCL	2.185

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	11.27
5% A-D Critical Value	0.917
K-S Test Statistic	0.316
5% K-S Critical Value	0.128

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.197	k star (bias corrected MLE)	0.198
Theta hat (MLE)	1.93	Theta star (bias corrected MLE)	1.918
nu hat (MLE)	23.61	nu star (bias corrected)	23.76
Mean (detects)	0.38		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.3000E-4	Mean	0.246
Maximum	20	Median	0.01
SD	1.98	CV	8.037
k hat (MLE)	0.23	k star (bias corrected MLE)	0.23
Theta hat (MLE)	1.07	Theta star (bias corrected MLE)	1.071
nu hat (MLE)	46.97	nu star (bias corrected)	46.92
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (46.92, α)	32.2	Adjusted Chi Square Value (46.92, β)	32.03
95% Gamma Approximate UCL (use when $n \geq 50$)	0.359	95% Gamma Adjusted UCL (use when $n < 50$)	0.361

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.228	SD (KM)	1.97
Variance (KM)	3.879	SE of Mean (KM)	0.197

Surface Soil East Tank Farm ProUCL Outputs

k hat (KM)	0.0134	k star (KM)	0.0195
nu hat (KM)	2.728	nu star (KM)	3.981
theta hat (KM)	17.03	theta star (KM)	11.67
80% gamma percentile (KM)	7.2091E-5	90% gamma percentile (KM)	0.0302
95% gamma percentile (KM)	0.501	99% gamma percentile (KM)	6.382

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (3.98, α)	0.714	Adjusted Chi Square Value (3.98, β)	0.696
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.27	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.303

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.864	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	3.1088E-7	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.114	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.226	Mean in Log Scale	-5.137
SD in Original Scale	1.979	SD in Log Scale	1.784
95% t UCL (assumes normality of ROS data)	0.552	95% Percentile Bootstrap UCL	0.617
95% BCA Bootstrap UCL	1.003	95% Bootstrap t UCL	6.989
95% H-UCL (Log ROS)	0.0495		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.136	KM Geo Mean	0.00588
KM SD (logged)	1.78	95% Critical H Value (KM-Log)	3.035
KM Standard Error of Mean (logged)	0.198	95% H-UCL (KM -Log)	0.0491
KM SD (logged)	1.78	95% Critical H Value (KM-Log)	3.035
KM Standard Error of Mean (logged)	0.198		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.249	Mean in Log Scale	-4.349
SD in Original Scale	1.977	SD in Log Scale	2.019
95% t UCL (Assumes normality)	0.574	95% H-Stat UCL	0.193

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	1.085

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

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

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

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

Surface Soil East Tank Farm ProUCL Outputs

General Statistics

Total Number of Observations	102	Number of Distinct Observations	63
Number of Detects	101	Number of Non-Detects	1
Number of Distinct Detects	63	Number of Distinct Non-Detects	1
Minimum Detect	0.35	Minimum Non-Detect	1.9
Maximum Detect	30.5	Maximum Non-Detect	1.9
Variance Detects	20.19	Percent Non-Detects	0.98%
Mean Detects	4.805	SD Detects	4.493
Median Detects	3.4	CV Detects	0.935
Skewness Detects	3.627	Kurtosis Detects	17.57
Mean of Logged Detects	1.29	SD of Logged Detects	0.748

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.671
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.187
5% Lilliefors Critical Value	0.0884

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	4.77	KM Standard Error of Mean	0.444
KM SD	4.463	95% KM (BCA) UCL	5.574
95% KM (t) UCL	5.507	95% KM (Percentile Bootstrap) UCL	5.537
95% KM (z) UCL	5.5	95% KM Bootstrap t UCL	5.812
90% KM Chebyshev UCL	6.102	95% KM Chebyshev UCL	6.706
97.5% KM Chebyshev UCL	7.543	99% KM Chebyshev UCL	9.189

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.266
5% A-D Critical Value	0.766
K-S Test Statistic	0.109
5% K-S Critical Value	0.0904

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.94	k star (bias corrected MLE)	1.889
Theta hat (MLE)	2.476	Theta star (bias corrected MLE)	2.543
nu hat (MLE)	391.9	nu star (bias corrected)	381.6
Mean (detects)	4.805		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.142	Mean	4.759
Maximum	30.5	Median	3.4
SD	4.494	CV	0.944

Surface Soil East Tank Farm ProUCL Outputs

k hat (MLE)	1.807	k star (bias corrected MLE)	1.76
Theta hat (MLE)	2.634	Theta star (bias corrected MLE)	2.703
nu hat (MLE)	368.6	nu star (bias corrected)	359.1
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (359.13, α)	316.2	Adjusted Chi Square Value (359.13, β)	315.6
95% Gamma Approximate UCL (use when $n \geq 50$)	5.405	95% Gamma Adjusted UCL (use when $n < 50$)	5.415

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.77	SD (KM)	4.463
Variance (KM)	19.92	SE of Mean (KM)	0.444
k hat (KM)	1.142	k star (KM)	1.115
nu hat (KM)	233	nu star (KM)	227.5
theta hat (KM)	4.176	theta star (KM)	4.277
80% gamma percentile (KM)	7.605	90% gamma percentile (KM)	10.69
95% gamma percentile (KM)	13.75	99% gamma percentile (KM)	20.8

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (227.51, α)	193.6	Adjusted Chi Square Value (227.51, β)	193.1
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	5.605	95% Gamma Adjusted KM-UCL (use when $n < 50$)	5.618

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.98	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.525	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.057	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0884	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.769	Mean in Log Scale	1.279
SD in Original Scale	4.485	SD in Log Scale	0.752
95% t UCL (assumes normality of ROS data)	5.506	95% Percentile Bootstrap UCL	5.547
95% BCA Bootstrap UCL	5.712	95% Bootstrap t UCL	5.76
95% H-UCL (Log ROS)	5.538		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.279	KM Geo Mean	3.592
KM SD (logged)	0.751	95% Critical H Value (KM-Log)	1.998
KM Standard Error of Mean (logged)	0.0749	95% H-UCL (KM -Log)	5.529
KM SD (logged)	0.751	95% Critical H Value (KM-Log)	1.998
KM Standard Error of Mean (logged)	0.0749		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.767	Mean in Log Scale	1.277
SD in Original Scale	4.487	SD in Log Scale	0.756
95% t UCL (Assumes normality)	5.504	95% H-Stat UCL	5.546

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Surface Soil East Tank Farm ProUCL Outputs

Suggested UCL to Use

KM H-UCL 5.529

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

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

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

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

Indeno (1,2,3-cd) pyrene

General Statistics

Total Number of Observations	102	Number of Distinct Observations	51
Number of Detects	48	Number of Non-Detects	54
Number of Distinct Detects	37	Number of Distinct Non-Detects	17
Minimum Detect	9.1000E-4	Minimum Non-Detect	0.0021
Maximum Detect	3.1	Maximum Non-Detect	0.25
Variance Detects	0.2	Percent Non-Detects	52.94%
Mean Detects	0.0905	SD Detects	0.447
Median Detects	0.0036	CV Detects	4.937
Skewness Detects	6.778	Kurtosis Detects	46.54
Mean of Logged Detects	-4.928	SD of Logged Detects	1.825

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.207	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.421	Lilliefors GOF Test
5% Lilliefors Critical Value	0.127	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0468	KM Standard Error of Mean	0.0307
KM SD	0.307	95% KM (BCA) UCL	0.11
95% KM (t) UCL	0.0978	95% KM (Percentile Bootstrap) UCL	0.107
95% KM (z) UCL	0.0974	95% KM Bootstrap t UCL	0.371
90% KM Chebyshev UCL	0.139	95% KM Chebyshev UCL	0.181
97.5% KM Chebyshev UCL	0.239	99% KM Chebyshev UCL	0.353

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.427	Anderson-Darling GOF Test
5% A-D Critical Value	0.874	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.14	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.277	k star (bias corrected MLE)	0.273
Theta hat (MLE)	0.327	Theta star (bias corrected MLE)	0.331
nu hat (MLE)	26.56	nu star (bias corrected)	26.23
Mean (detects)	0.0905		

Surface Soil East Tank Farm ProUCL Outputs

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	9.1000E-4	Mean	0.0548
Maximum	3.1	Median	0.01
SD	0.309	CV	5.626
k hat (MLE)	0.384	k star (bias corrected MLE)	0.38
Theta hat (MLE)	0.143	Theta star (bias corrected MLE)	0.144
nu hat (MLE)	78.43	nu star (bias corrected)	77.46
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (77.46, α)	58.19	Adjusted Chi Square Value (77.46, β)	57.95
95% Gamma Approximate UCL (use when $n \geq 50$)	0.073	95% Gamma Adjusted UCL (use when $n < 50$)	0.0733

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0468	SD (KM)	0.307
Variance (KM)	0.094	SE of Mean (KM)	0.0307
k hat (KM)	0.0233	k star (KM)	0.0292
nu hat (KM)	4.763	nu star (KM)	5.956
theta hat (KM)	2.006	theta star (KM)	1.604
80% gamma percentile (KM)	4.4225E-4	90% gamma percentile (KM)	0.0254
95% gamma percentile (KM)	0.177	99% gamma percentile (KM)	1.218

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.96, α)	1.617	Adjusted Chi Square Value (5.96, β)	1.586
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.172	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.176

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.871	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.947	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors GOF Test
5% Lilliefors Critical Value	0.127	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0453	Mean in Log Scale	-5.402
SD in Original Scale	0.308	SD in Log Scale	1.522
95% t UCL (assumes normality of ROS data)	0.0959	95% Percentile Bootstrap UCL	0.105
95% BCA Bootstrap UCL	0.146	95% Bootstrap t UCL	0.438
95% H-UCL (Log ROS)	0.0217		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.447	KM Geo Mean	0.00431
KM SD (logged)	1.552	95% Critical H Value (KM-Log)	2.773
KM Standard Error of Mean (logged)	0.182	95% H-UCL (KM -Log)	0.0221
KM SD (logged)	1.552	95% Critical H Value (KM-Log)	2.773
KM Standard Error of Mean (logged)	0.182		

Surface Soil East Tank Farm ProUCL Outputs

DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0731	Mean in Log Scale	-4.407
SD in Original Scale	0.307	SD in Log Scale	1.947
95% t UCL (Assumes normality)	0.124	95% H-Stat UCL	0.152
DL/2 is not a recommended method, provided for comparisons and historical reasons			

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
95% KM (Chebyshev) UCL 0.181

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

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

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

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

Iron

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	96
		Number of Missing Observations	0
Minimum	2030	Mean	13487
Maximum	77600	Median	9620
SD	12123	Std. Error of Mean	1200
Coefficient of Variation	0.899	Skewness	2.523

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.758	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk P Value	0		
Lilliefors Test Statistic	0.199	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.088	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15479	95% Adjusted-CLT UCL (Chen-1995)	15782
		95% Modified-t UCL (Johnson-1978)	15529

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.496	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.766		
K-S Test Statistic	0.104	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0903	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

Surface Soil East Tank Farm ProUCL Outputs

k hat (MLE)	1.852	k star (bias corrected MLE)	1.804
Theta hat (MLE)	7282	Theta star (bias corrected MLE)	7475
nu hat (MLE)	377.8	nu star (bias corrected)	368.1
MLE Mean (bias corrected)	13487	MLE Sd (bias corrected)	10041
		Approximate Chi Square Value (0.05)	324.6
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	324

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	15293	95% Adjusted Gamma UCL (use when n<50)	15320

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978
5% Shapiro Wilk P Value	0.433
Lilliefors Test Statistic	0.0485
5% Lilliefors Critical Value	0.088

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.616	Mean of logged Data	9.216
Maximum of Logged Data	11.26	SD of logged Data	0.75

Assuming Lognormal Distribution

95% H-UCL	15469	90% Chebyshev (MVUE) UCL	16592
95% Chebyshev (MVUE) UCL	18093	97.5% Chebyshev (MVUE) UCL	20176
99% Chebyshev (MVUE) UCL	24267		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	15461	95% Jackknife UCL	15479
95% Standard Bootstrap UCL	15456	95% Bootstrap-t UCL	15850
95% Hall's Bootstrap UCL	15969	95% Percentile Bootstrap UCL	15566
95% BCA Bootstrap UCL	15811		
90% Chebyshev(Mean, Sd) UCL	17088	95% Chebyshev(Mean, Sd) UCL	18719
97.5% Chebyshev(Mean, Sd) UCL	20983	99% Chebyshev(Mean, Sd) UCL	25430

Suggested UCL to Use

95% H-UCL	15469

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Surface Soil East Tank Farm ProUCL Outputs

Lead

General Statistics

Total Number of Observations	102	Number of Distinct Observations	82
Number of Detects	101	Number of Non-Detects	1
Number of Distinct Detects	81	Number of Distinct Non-Detects	1
Minimum Detect	1	Minimum Non-Detect	0.48
Maximum Detect	2730	Maximum Non-Detect	0.48
Variance Detects	126999	Percent Non-Detects	0.98%
Mean Detects	85.22	SD Detects	356.4
Median Detects	7.1	CV Detects	4.182
Skewness Detects	6.144	Kurtosis Detects	40.21
Mean of Logged Detects	2.341	SD of Logged Detects	1.492

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.259
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.446
5% Lilliefors Critical Value	0.0884

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	84.39	KM Standard Error of Mean	35.12
KM SD	353	95% KM (BCA) UCL	150.1
95% KM (t) UCL	142.7	95% KM (Percentile Bootstrap) UCL	146.3
95% KM (z) UCL	142.2	95% KM Bootstrap t UCL	251.5
90% KM Chebyshev UCL	189.8	95% KM Chebyshev UCL	237.5
97.5% KM Chebyshev UCL	303.7	99% KM Chebyshev UCL	433.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	17.9
5% A-D Critical Value	0.862
K-S Test Statistic	0.327
5% K-S Critical Value	0.0965

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.324	k star (bias corrected MLE)	0.321
Theta hat (MLE)	263.3	Theta star (bias corrected MLE)	265.8
nu hat (MLE)	65.38	nu star (bias corrected)	64.77
Mean (detects)	85.22		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	84.38
Maximum	2730	Median	7.05

Surface Soil East Tank Farm ProUCL Outputs

SD	354.7	CV	4.204
k hat (MLE)	0.316	k star (bias corrected MLE)	0.313
Theta hat (MLE)	266.9	Theta star (bias corrected MLE)	269.2
nu hat (MLE)	64.5	nu star (bias corrected)	63.93
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (63.93, α)	46.54	Adjusted Chi Square Value (63.93, β)	46.33
95% Gamma Approximate UCL (use when $n \geq 50$)	115.9	95% Gamma Adjusted UCL (use when $n < 50$)	116.5

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	84.39	SD (KM)	353
Variance (KM)	124579	SE of Mean (KM)	35.12
k hat (KM)	0.0572	k star (KM)	0.062
nu hat (KM)	11.66	nu star (KM)	12.65
theta hat (KM)	1476	theta star (KM)	1361
80% gamma percentile (KM)	22.32	90% gamma percentile (KM)	163.9
95% gamma percentile (KM)	476.2	99% gamma percentile (KM)	1678

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.65, α)	5.659	Adjusted Chi Square Value (12.65, β)	5.592
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	188.7	95% Gamma Adjusted KM-UCL (use when $n < 50$)	190.9

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.836
5% Shapiro Wilk P Value	1.110E-16
Lilliefors Test Statistic	0.173
5% Lilliefors Critical Value	0.0884

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	84.38	Mean in Log Scale	2.304
SD in Original Scale	354.7	SD in Log Scale	1.531
95% t UCL (assumes normality of ROS data)	142.7	95% Percentile Bootstrap UCL	148.3
95% BCA Bootstrap UCL	174.6	95% Bootstrap t UCL	250.7
95% H-UCL (Log ROS)	49.16		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.311	KM Geo Mean	10.08
KM SD (logged)	1.508	95% Critical H Value (KM-Log)	2.724
KM Standard Error of Mean (logged)	0.15	95% H-UCL (KM -Log)	47.31
KM SD (logged)	1.508	95% Critical H Value (KM-Log)	2.724
KM Standard Error of Mean (logged)	0.15		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	84.38
SD in Original Scale	354.7
95% t UCL (Assumes normality)	142.7

DL/2 Log-Transformed

Mean in Log Scale	2.304
SD in Log Scale	1.531
95% H-Stat UCL	49.13

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Surface Soil East Tank Farm ProUCL Outputs
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 237.5

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

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

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

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

Manganese

General Statistics

Total Number of Observations	102	Number of Distinct Observations	89
		Number of Missing Observations	0
Minimum	14	Mean	329
Maximum	6060	Median	159.5
SD	787.7	Std. Error of Mean	78
Coefficient of Variation	2.394	Skewness	6.423

Normal GOF Test

Shapiro Wilk Test Statistic	0.313
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.345
5% Lilliefors Critical Value	0.088

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 458.5

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	510.3
95% Modified-t UCL (Johnson-1978)	466.7

Gamma GOF Test

A-D Test Statistic	6.018
5% A-D Critical Value	0.788
K-S Test Statistic	0.202
5% K-S Critical Value	0.0919

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.896	k star (bias corrected MLE)	0.876
Theta hat (MLE)	367.3	Theta star (bias corrected MLE)	375.6
nu hat (MLE)	182.7	nu star (bias corrected)	178.7
MLE Mean (bias corrected)	329	MLE Sd (bias corrected)	351.5
		Approximate Chi Square Value (0.05)	148.8
Adjusted Level of Significance	0.0476	Adjusted Chi Square Value	148.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 395.1

95% Adjusted Gamma UCL (use when $n < 50$) 396.2

Surface Soil East Tank Farm ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959
5% Shapiro Wilk P Value	0.0167
Lilliefors Test Statistic	0.0959
5% Lilliefors Critical Value	0.088

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.639	Mean of logged Data	5.143
Maximum of Logged Data	8.709	SD of logged Data	0.967

Assuming Lognormal Distribution

95% H-UCL	337.1	90% Chebyshev (MVUE) UCL	364.3
95% Chebyshev (MVUE) UCL	406.3	97.5% Chebyshev (MVUE) UCL	464.6
99% Chebyshev (MVUE) UCL	579.1		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	457.3	95% Jackknife UCL	458.5
95% Standard Bootstrap UCL	456.8	95% Bootstrap-t UCL	793.5
95% Hall's Bootstrap UCL	1093	95% Percentile Bootstrap UCL	472
95% BCA Bootstrap UCL	527.1		
90% Chebyshev(Mean, Sd) UCL	563	95% Chebyshev(Mean, Sd) UCL	669
97.5% Chebyshev(Mean, Sd) UCL	816.1	99% Chebyshev(Mean, Sd) UCL	1105

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 669

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

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

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

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

Thallium

General Statistics

Total Number of Observations	102	Number of Distinct Observations	24
Number of Detects	3	Number of Non-Detects	99
Number of Distinct Detects	3	Number of Distinct Non-Detects	21
Minimum Detect	0.076	Minimum Non-Detect	0.42
Maximum Detect	0.21	Maximum Non-Detect	0.64
Variance Detects	0.00511	Percent Non-Detects	97.06%
Mean Detects	0.129	SD Detects	0.0715
Median Detects	0.1	CV Detects	0.555
Skewness Detects	1.515	Kurtosis Detects	N/A
Mean of Logged Detects	-2.147	SD of Logged Detects	0.526

Surface Soil East Tank Farm ProUCL Outputs

Warning: Data set has only 3 Detected Values.

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

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.323	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	0.129	KM Standard Error of Mean	0.0413
KM SD	0.0583	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.197	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.197	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.252	95% KM Chebyshev UCL	0.308
97.5% KM Chebyshev UCL	0.386	99% KM Chebyshev UCL	0.539

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	5.357	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.024	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	32.14	nu star (bias corrected)	N/A
Mean (detects)	0.129		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.132
Maximum	0.306	Median	0.124
SD	0.0732	CV	0.555
k hat (MLE)	2.546	k star (bias corrected MLE)	2.478
Theta hat (MLE)	0.0518	Theta star (bias corrected MLE)	0.0532
nu hat (MLE)	519.4	nu star (bias corrected)	505.5
Adjusted Level of Significance (β)	0.0476		
Approximate Chi Square Value (505.48, α)	454.3	Adjusted Chi Square Value (505.48, β)	453.7
95% Gamma Approximate UCL (use when $n \geq 50$)	0.147	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.129	SD (KM)	0.0583
Variance (KM)	0.0034	SE of Mean (KM)	0.0413
k hat (KM)	4.864	k star (KM)	4.728
nu hat (KM)	992.3	nu star (KM)	964.4
theta hat (KM)	0.0265	theta star (KM)	0.0272

Surface Soil East Tank Farm ProUCL Outputs

80% gamma percentile (KM)	0.174	90% gamma percentile (KM)	0.208
95% gamma percentile (KM)	0.239	99% gamma percentile (KM)	0.304

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (964.42, α)	893.3	Adjusted Chi Square Value (964.42, β)	892.4
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.139	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.139

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.135	Mean in Log Scale	-2.147
SD in Original Scale	0.0739	SD in Log Scale	0.54
95% t UCL (assumes normality of ROS data)	0.147	95% Percentile Bootstrap UCL	0.147
95% BCA Bootstrap UCL	0.147	95% Bootstrap t UCL	0.148
95% H-UCL (Log ROS)	0.149		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.147	KM Geo Mean	0.117
KM SD (logged)	0.429	95% Critical H Value (KM-Log)	1.792
KM Standard Error of Mean (logged)	0.304	95% H-UCL (KM -Log)	0.138
KM SD (logged)	0.429	95% Critical H Value (KM-Log)	1.792
KM Standard Error of Mean (logged)	0.304		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.255	Mean in Log Scale	-1.377
SD in Original Scale	0.0316	SD in Log Scale	0.172
95% t UCL (Assumes normality)	0.26	95% H-Stat UCL	0.264

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.197

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

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

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

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

Subsurface Soil North Tank Farm ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 1:08:19 PM
 From File ProUCL Inputs HHRA NTF SB.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	27	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	1570	Mean	6389
Maximum	16700	Median	4610
SD	4100	Std. Error of Mean	789
Coefficient of Variation	0.642	Skewness	0.852

Normal GOF Test

Shapiro Wilk Test Statistic 0.898
 5% Shapiro Wilk Critical Value 0.923
 Lilliefors Test Statistic 0.186
 5% Lilliefors Critical Value 0.167

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 7735

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 7825

95% Modified-t UCL (Johnson-1978) 7757

Gamma GOF Test

A-D Test Statistic 0.475
 5% A-D Critical Value 0.754
 K-S Test Statistic 0.131
 5% K-S Critical Value 0.17

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.592	k star (bias corrected MLE)	2.329
Theta hat (MLE)	2465	Theta star (bias corrected MLE)	2743
nu hat (MLE)	140	nu star (bias corrected)	125.8
MLE Mean (bias corrected)	6389	MLE Sd (bias corrected)	4187
		Approximate Chi Square Value (0.05)	100.9
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	99.44

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50) 7967

95% Adjusted Gamma UCL (use when n<50) 8081

Subsurface Soil North Tank Farm ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.96	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.127	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	7.359	Mean of logged Data	8.557
Maximum of Logged Data	9.723	SD of logged Data	0.667

Assuming Lognormal Distribution

95% H-UCL	8588	90% Chebyshev (MVUE) UCL	9095
95% Chebyshev (MVUE) UCL	10299	97.5% Chebyshev (MVUE) UCL	11970
99% Chebyshev (MVUE) UCL	15252		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	7687	95% Jackknife UCL	7735
95% Standard Bootstrap UCL	7678	95% Bootstrap-t UCL	7950
95% Hall's Bootstrap UCL	7798	95% Percentile Bootstrap UCL	7703
95% BCA Bootstrap UCL	7823		
90% Chebyshev(Mean, Sd) UCL	8756	95% Chebyshev(Mean, Sd) UCL	9828
97.5% Chebyshev(Mean, Sd) UCL	11316	99% Chebyshev(Mean, Sd) UCL	14240

Suggested UCL to Use

95% Adjusted Gamma UCL	8081

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

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

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

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

Arsenic

General Statistics

Total Number of Observations	27	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	0.36	Mean	2.463
Maximum	12.9	Median	1.7
SD	2.697	Std. Error of Mean	0.519
Coefficient of Variation	1.095	Skewness	2.69

Normal GOF Test

Shapiro Wilk Test Statistic	0.687	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.923	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.257	Lilliefors GOF Test

Subsurface Soil North Tank Farm ProUCL Outputs

5% Lilliefors Critical Value 0.167

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 3.348

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 3.604

95% Modified-t UCL (Johnson-1978) 3.393

Gamma GOF Test

A-D Test Statistic 0.632

5% A-D Critical Value 0.765

K-S Test Statistic 0.162

5% K-S Critical Value 0.172

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 1.399

Theta hat (MLE) 1.76

nu hat (MLE) 75.57

MLE Mean (bias corrected) 2.463

Adjusted Level of Significance 0.0401

k star (bias corrected MLE) 1.269

Theta star (bias corrected MLE) 1.941

nu star (bias corrected) 68.51

MLE Sd (bias corrected) 2.187

Approximate Chi Square Value (0.05) 50.46

Adjusted Chi Square Value 49.47

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 3.344

95% Adjusted Gamma UCL (use when $n < 50$) 3.411

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.977

5% Shapiro Wilk Critical Value 0.923

Lilliefors Test Statistic 0.0973

5% Lilliefors Critical Value 0.167

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data -1.022

Maximum of Logged Data 2.557

Mean of logged Data 0.503

SD of logged Data 0.884

Assuming Lognormal Distribution

95% H-UCL 3.688

95% Chebyshev (MVUE) UCL 4.381

99% Chebyshev (MVUE) UCL 6.926

90% Chebyshev (MVUE) UCL 3.763

97.5% Chebyshev (MVUE) UCL 5.24

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 3.317

95% Standard Bootstrap UCL 3.303

95% Hall's Bootstrap UCL 4.618

95% BCA Bootstrap UCL 3.688

95% Jackknife UCL 3.348

95% Bootstrap-t UCL 4.018

95% Percentile Bootstrap UCL 3.36

Subsurface Soil North Tank Farm ProUCL Outputs

90% Chebyshev(Mean, Sd) UCL	4.02	95% Chebyshev(Mean, Sd) UCL	4.725
97.5% Chebyshev(Mean, Sd) UCL	5.704	99% Chebyshev(Mean, Sd) UCL	7.627

Suggested UCL to Use

95% Adjusted Gamma UCL	3.411

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	27	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	1.1	Mean	5.519
Maximum	29.3	Median	2.3
SD	6.92	Std. Error of Mean	1.332
Coefficient of Variation	1.254	Skewness	2.194

Normal GOF Test

Shapiro Wilk Test Statistic	0.664
5% Shapiro Wilk Critical Value	0.923
Lilliefors Test Statistic	0.294
5% Lilliefors Critical Value	0.167

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	7.79

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	8.31
95% Modified-t UCL (Johnson-1978)	7.884

Gamma GOF Test

A-D Test Statistic	1.986
5% A-D Critical Value	0.771
K-S Test Statistic	0.222
5% K-S Critical Value	0.173

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.093	k star (bias corrected MLE)	0.996
Theta hat (MLE)	5.049	Theta star (bias corrected MLE)	5.539
nu hat (MLE)	59.02	nu star (bias corrected)	53.8
MLE Mean (bias corrected)	5.519	MLE Sd (bias corrected)	5.529
		Approximate Chi Square Value (0.05)	37.95
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	37.09

Assuming Gamma Distribution

Subsurface Soil North Tank Farm ProUCL Outputs

95% Approximate Gamma UCL (use when $n \geq 50$) 7.824 95% Adjusted Gamma UCL (use when $n < 50$) 8.003

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.923	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.172	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.167	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.0953	Mean of logged Data	1.185
Maximum of Logged Data	3.378	SD of logged Data	0.957

Assuming Lognormal Distribution

95% H-UCL	8.214	90% Chebyshev (MVUE) UCL	8.211
95% Chebyshev (MVUE) UCL	9.642	97.5% Chebyshev (MVUE) UCL	11.63
99% Chebyshev (MVUE) UCL	15.53		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	7.709	95% Jackknife UCL	7.79
95% Standard Bootstrap UCL	7.668	95% Bootstrap-t UCL	9.032
95% Hall's Bootstrap UCL	8.45	95% Percentile Bootstrap UCL	7.77
95% BCA Bootstrap UCL	8.293		
90% Chebyshev(Mean, Sd) UCL	9.514	95% Chebyshev(Mean, Sd) UCL	11.32
97.5% Chebyshev(Mean, Sd) UCL	13.84	99% Chebyshev(Mean, Sd) UCL	18.77

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 11.32

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

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

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

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

Iron

General Statistics

Total Number of Observations	27	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	2690	Mean	14026
Maximum	46900	Median	10400
SD	10205	Std. Error of Mean	1964
Coefficient of Variation	0.728	Skewness	1.888

Normal GOF Test

Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test

Subsurface Soil North Tank Farm ProUCL Outputs

5% Shapiro Wilk Critical Value	0.923	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.226	Lilliefors GOF Test
5% Lilliefors Critical Value	0.167	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 17375

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 18018

95% Modified-t UCL (Johnson-1978) 17494

Gamma GOF Test

A-D Test Statistic	0.497	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.17	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	2.5	k star (bias corrected MLE)	2.247
Theta hat (MLE)	5609	Theta star (bias corrected MLE)	6241
nu hat (MLE)	135	nu star (bias corrected)	121.4
MLE Mean (bias corrected)	14026	MLE Sd (bias corrected)	9356
		Approximate Chi Square Value (0.05)	96.91
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	95.52

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 17562

95% Adjusted Gamma UCL (use when $n < 50$) 17819

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.115	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	7.897	Mean of logged Data	9.336
Maximum of Logged Data	10.76	SD of logged Data	0.666

Assuming Lognormal Distribution

95% H-UCL	18680	90% Chebyshev (MVUE) UCL	19785
95% Chebyshev (MVUE) UCL	22401	97.5% Chebyshev (MVUE) UCL	26031
99% Chebyshev (MVUE) UCL	33163		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	17256	95% Jackknife UCL	17375
95% Standard Bootstrap UCL	17195	95% Bootstrap-t UCL	18878

Subsurface Soil North Tank Farm ProUCL Outputs

95% Hall's Bootstrap UCL	19806	95% Percentile Bootstrap UCL	17309
95% BCA Bootstrap UCL	18166		
90% Chebyshev(Mean, Sd) UCL	19917	95% Chebyshev(Mean, Sd) UCL	22586
97.5% Chebyshev(Mean, Sd) UCL	26290	99% Chebyshev(Mean, Sd) UCL	33567

Suggested UCL to Use

95% Adjusted Gamma UCL 17819

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

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

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

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

Manganese

General Statistics

Total Number of Observations	27	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	13.7	Mean	165.4
Maximum	614	Median	106
SD	141.4	Std. Error of Mean	27.22
Coefficient of Variation	0.855	Skewness	1.5

Normal GOF Test

Shapiro Wilk Test Statistic	0.852
5% Shapiro Wilk Critical Value	0.923
Lilliefors Test Statistic	0.181
5% Lilliefors Critical Value	0.167

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 211.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 218.6

95% Modified-t UCL (Johnson-1978) 213.1

Gamma GOF Test

A-D Test Statistic	0.324
5% A-D Critical Value	0.763
K-S Test Statistic	0.121
5% K-S Critical Value	0.171

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.537	k star (bias corrected MLE)	1.391
Theta hat (MLE)	107.6	Theta star (bias corrected MLE)	118.9
nu hat (MLE)	82.99	nu star (bias corrected)	75.11
MLE Mean (bias corrected)	165.4	MLE Sd (bias corrected)	140.2
		Approximate Chi Square Value (0.05)	56.15
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	55.1

Subsurface Soil North Tank Farm ProUCL Outputs

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	221.2	95% Adjusted Gamma UCL (use when $n < 50$)	225.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0802	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.617	Mean of logged Data	4.749
Maximum of Logged Data	6.42	SD of logged Data	0.914

Assuming Lognormal Distribution

95% H-UCL	270.2	90% Chebyshev (MVUE) UCL	273.5
95% Chebyshev (MVUE) UCL	319.6	97.5% Chebyshev (MVUE) UCL	383.6
99% Chebyshev (MVUE) UCL	509.3		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	210.2	95% Jackknife UCL	211.8
95% Standard Bootstrap UCL	209.5	95% Bootstrap-t UCL	224.4
95% Hall's Bootstrap UCL	228.3	95% Percentile Bootstrap UCL	211.3
95% BCA Bootstrap UCL	217.9		
90% Chebyshev(Mean, Sd) UCL	247	95% Chebyshev(Mean, Sd) UCL	284
97.5% Chebyshev(Mean, Sd) UCL	335.4	99% Chebyshev(Mean, Sd) UCL	436.2

Suggested UCL to Use

95% Adjusted Gamma UCL 225.5

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

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

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

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

Subsurface Soil Lorraine Process Area ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 10:55:45 AM
 From File ProUCL Inputs HHRA LPA SB.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	86	Number of Distinct Observations	83
		Number of Missing Observations	0
Minimum	812	Mean	5648
Maximum	21900	Median	4955
SD	3780	Std. Error of Mean	407.7
Coefficient of Variation	0.669	Skewness	1.998

Normal GOF Test

Shapiro Wilk Test Statistic 0.823
 5% Shapiro Wilk P Value 8.216E-15
 Lilliefors Test Statistic 0.145
 5% Lilliefors Critical Value 0.0957

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 6326

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 6412
 95% Modified-t UCL (Johnson-1978) 6340

Gamma GOF Test

A-D Test Statistic 0.654
 5% A-D Critical Value 0.76
 K-S Test Statistic 0.0672
 5% K-S Critical Value 0.0972

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.893	k star (bias corrected MLE)	2.8
Theta hat (MLE)	1952	Theta star (bias corrected MLE)	2017
nu hat (MLE)	497.6	nu star (bias corrected)	481.6
MLE Mean (bias corrected)	5648	MLE Sd (bias corrected)	3375
		Approximate Chi Square Value (0.05)	431.7
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	430.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50) 6300

95% Adjusted Gamma UCL (use when n<50) 6312

Subsurface Soil Lorraine Process Area ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.989	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.935	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.054	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0957	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	6.7	Mean of logged Data	8.456
Maximum of Logged Data	9.994	SD of logged Data	0.607

Assuming Lognormal Distribution

95% H-UCL	6415	90% Chebyshev (MVUE) UCL	6835
95% Chebyshev (MVUE) UCL	7376	97.5% Chebyshev (MVUE) UCL	8127
99% Chebyshev (MVUE) UCL	9601		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6318	95% Jackknife UCL	6326
95% Standard Bootstrap UCL	6312	95% Bootstrap-t UCL	6440
95% Hall's Bootstrap UCL	6464	95% Percentile Bootstrap UCL	6316
95% BCA Bootstrap UCL	6427		
90% Chebyshev(Mean, Sd) UCL	6871	95% Chebyshev(Mean, Sd) UCL	7425
97.5% Chebyshev(Mean, Sd) UCL	8193	99% Chebyshev(Mean, Sd) UCL	9704

Suggested UCL to Use

95% Approximate Gamma UCL	6300

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

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

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

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

Arsenic

General Statistics

Total Number of Observations	86	Number of Distinct Observations	47
Number of Detects	82	Number of Non-Detects	4
Number of Distinct Detects	45	Number of Distinct Non-Detects	2
Minimum Detect	0.39	Minimum Non-Detect	0.5
Maximum Detect	9.4	Maximum Non-Detect	0.6
Variance Detects	2.251	Percent Non-Detects	4.651%
Mean Detects	2.404	SD Detects	1.5
Median Detects	2	CV Detects	0.624
Skewness Detects	1.857	Kurtosis Detects	5.384
Mean of Logged Detects	0.708	SD of Logged Detects	0.592

Normal GOF Test on Detects Only

Subsurface Soil Lorraine Process Area ProUCL Outputs

Shapiro Wilk Test Statistic	0.864	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	2.589E-10	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.143	Lilliefors GOF Test
5% Lilliefors Critical Value	0.098	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

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

KM Mean	2.312	KM Standard Error of Mean	0.164
KM SD	1.515	95% KM (BCA) UCL	2.59
95% KM (t) UCL	2.585	95% KM (Percentile Bootstrap) UCL	2.598
95% KM (z) UCL	2.582	95% KM Bootstrap t UCL	2.627
90% KM Chebyshev UCL	2.805	95% KM Chebyshev UCL	3.028
97.5% KM Chebyshev UCL	3.338	99% KM Chebyshev UCL	3.947

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.44	Anderson-Darling GOF Test
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0909	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0993	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	3.114	k star (bias corrected MLE)	3.009
Theta hat (MLE)	0.772	Theta star (bias corrected MLE)	0.799
nu hat (MLE)	510.8	nu star (bias corrected)	493.4
Mean (detects)	2.404		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0508	Mean	2.302
Maximum	9.4	Median	1.85
SD	1.537	CV	0.668
k hat (MLE)	2.215	k star (bias corrected MLE)	2.146
Theta hat (MLE)	1.039	Theta star (bias corrected MLE)	1.073
nu hat (MLE)	381.1	nu star (bias corrected)	369.1
Adjusted Level of Significance (β)	0.0472		
Approximate Chi Square Value (369.09, α)	325.6	Adjusted Chi Square Value (369.09, β)	324.9
95% Gamma Approximate UCL (use when $n \geq 50$)	2.61	95% Gamma Adjusted UCL (use when $n < 50$)	2.615

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.312	SD (KM)	1.515
Variance (KM)	2.295	SE of Mean (KM)	0.164
k hat (KM)	2.328	k star (KM)	2.255
nu hat (KM)	400.5	nu star (KM)	387.9
theta hat (KM)	0.993	theta star (KM)	1.025
80% gamma percentile (KM)	3.412	90% gamma percentile (KM)	4.372

Subsurface Soil Lorraine Process Area ProUCL Outputs

95% gamma percentile (KM)	5.282	99% gamma percentile (KM)	7.285

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (387.85, α)	343.2	Adjusted Chi Square Value (387.85, β)	342.5
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	2.613	95% Gamma Adjusted KM-UCL (use when $n < 50$)	2.618

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.989	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.951	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0563	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.098	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.319	Mean in Log Scale	0.649
SD in Original Scale	1.515	SD in Log Scale	0.638
95% t UCL (assumes normality of ROS data)	2.591	95% Percentile Bootstrap UCL	2.595
95% BCA Bootstrap UCL	2.62	95% Bootstrap t UCL	2.626
95% H-UCL (Log ROS)	2.683		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.634	KM Geo Mean	1.886
KM SD (logged)	0.665	95% Critical H Value (KM-Log)	1.969
KM Standard Error of Mean (logged)	0.0722	95% H-UCL (KM -Log)	2.711
KM SD (logged)	0.665	95% Critical H Value (KM-Log)	1.969
KM Standard Error of Mean (logged)	0.0722		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.305	Mean in Log Scale	0.613
SD in Original Scale	1.533	SD in Log Scale	0.723
95% t UCL (Assumes normality)	2.58	95% H-Stat UCL	2.809

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	2.613	95% GROS Approximate Gamma UCL	2.61

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	86	Number of Distinct Observations	47
Number of Detects	78	Number of Non-Detects	8

Subsurface Soil Lorraine Process Area ProUCL Outputs

Number of Distinct Detects	46	Number of Distinct Non-Detects	3
Minimum Detect	1.5	Minimum Non-Detect	2
Maximum Detect	19.1	Maximum Non-Detect	2.2
Variance Detects	6.753	Percent Non-Detects	9.302%
Mean Detects	4.54	SD Detects	2.599
Median Detects	3.95	CV Detects	0.572
Skewness Detects	2.554	Kurtosis Detects	11.72
Mean of Logged Detects	1.385	SD of Logged Detects	0.499

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.822
5% Shapiro Wilk P Value	3.751E-13
Lilliefors Test Statistic	0.121
5% Lilliefors Critical Value	0.1

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	4.28	KM Standard Error of Mean	0.281
KM SD	2.59	95% KM (BCA) UCL	4.773
95% KM (t) UCL	4.748	95% KM (Percentile Bootstrap) UCL	4.746
95% KM (z) UCL	4.743	95% KM Bootstrap t UCL	4.842
90% KM Chebyshev UCL	5.124	95% KM Chebyshev UCL	5.506
97.5% KM Chebyshev UCL	6.036	99% KM Chebyshev UCL	7.077

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.446
5% A-D Critical Value	0.756
K-S Test Statistic	0.0819
5% K-S Critical Value	0.102

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.072	k star (bias corrected MLE)	3.924
Theta hat (MLE)	1.115	Theta star (bias corrected MLE)	1.157
nu hat (MLE)	635.3	nu star (bias corrected)	612.2
Mean (detects)	4.54		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.567	Mean	4.222
Maximum	19.1	Median	3.8
SD	2.669	CV	0.632
k hat (MLE)	2.969	k star (bias corrected MLE)	2.874
Theta hat (MLE)	1.422	Theta star (bias corrected MLE)	1.469
nu hat (MLE)	510.7	nu star (bias corrected)	494.2
Adjusted Level of Significance (β)	0.0472		

Subsurface Soil Lorraine Process Area ProUCL Outputs

Approximate Chi Square Value (494.24, α)	443.7	Adjusted Chi Square Value (494.24, β)	442.9
95% Gamma Approximate UCL (use when $n \geq 50$)	4.704	95% Gamma Adjusted UCL (use when $n < 50$)	4.712

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.28	SD (KM)	2.59
Variance (KM)	6.706	SE of Mean (KM)	0.281
k hat (KM)	2.732	k star (KM)	2.644
nu hat (KM)	469.9	nu star (KM)	454.8
theta hat (KM)	1.567	theta star (KM)	1.619
80% gamma percentile (KM)	6.198	90% gamma percentile (KM)	7.808
95% gamma percentile (KM)	9.319	99% gamma percentile (KM)	12.62

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (454.82, α)	406.4	Adjusted Chi Square Value (454.82, β)	405.6
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	4.79	95% Gamma Adjusted KM-UCL (use when $n < 50$)	4.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.979	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.568	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0728	Lilliefors GOF Test
5% Lilliefors Critical Value	0.1	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.278	Mean in Log Scale	1.306
SD in Original Scale	2.608	SD in Log Scale	0.538
95% t UCL (assumes normality of ROS data)	4.745	95% Percentile Bootstrap UCL	4.762
95% BCA Bootstrap UCL	4.829	95% Bootstrap t UCL	4.848
95% H-UCL (Log ROS)	4.757		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.308	KM Geo Mean	3.698
KM SD (logged)	0.531	95% Critical H Value (KM-Log)	1.864
KM Standard Error of Mean (logged)	0.0578	95% H-UCL (KM -Log)	4.741
KM SD (logged)	0.531	95% Critical H Value (KM-Log)	1.864
KM Standard Error of Mean (logged)	0.0578		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.216	Mean in Log Scale	1.262
SD in Original Scale	2.674	SD in Log Scale	0.613
95% t UCL (Assumes normality)	4.696	95% H-Stat UCL	4.843

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	4.79	95% GROS Approximate Gamma UCL	4.704

Subsurface Soil Lorraine Process Area ProUCL Outputs

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

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

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

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

Iron

General Statistics

Total Number of Observations	86	Number of Distinct Observations	81
		Number of Missing Observations	0
Minimum	2080	Mean	10239
Maximum	38700	Median	9600
SD	5667	Std. Error of Mean	611.1
Coefficient of Variation	0.553	Skewness	1.879

Normal GOF Test

Shapiro Wilk Test Statistic	0.885
5% Shapiro Wilk P Value	6.6026E-9
Lilliefors Test Statistic	0.101
5% Lilliefors Critical Value	0.0957

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 11255

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 11376

95% Modified-t UCL (Johnson-1978) 11276

Gamma GOF Test

A-D Test Statistic	0.258
5% A-D Critical Value	0.757
K-S Test Statistic	0.0471
5% K-S Critical Value	0.0969

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.714	k star (bias corrected MLE)	3.592
Theta hat (MLE)	2757	Theta star (bias corrected MLE)	2850
nu hat (MLE)	638.8	nu star (bias corrected)	617.9
MLE Mean (bias corrected)	10239	MLE Sd (bias corrected)	5402
		Approximate Chi Square Value (0.05)	561.2
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	560.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 11273

95% Adjusted Gamma UCL (use when $n < 50$) 11291

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977
5% Shapiro Wilk P Value	0.44
Lilliefors Test Statistic	0.0726

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Subsurface Soil Lorraine Process Area ProUCL Outputs

5% Lilliefors Critical Value 0.0957

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.64	Mean of logged Data	9.093
Maximum of Logged Data	10.56	SD of logged Data	0.549

Assuming Lognormal Distribution

95% H-UCL	11564	90% Chebyshev (MVUE) UCL	12274
95% Chebyshev (MVUE) UCL	13158	97.5% Chebyshev (MVUE) UCL	14386
99% Chebyshev (MVUE) UCL	16797		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	11244	95% Jackknife UCL	11255
95% Standard Bootstrap UCL	11230	95% Bootstrap-t UCL	11408
95% Hall's Bootstrap UCL	11527	95% Percentile Bootstrap UCL	11269
95% BCA Bootstrap UCL	11405		
90% Chebyshev(Mean, Sd) UCL	12072	95% Chebyshev(Mean, Sd) UCL	12903
97.5% Chebyshev(Mean, Sd) UCL	14055	99% Chebyshev(Mean, Sd) UCL	16319

Suggested UCL to Use

95% Approximate Gamma UCL 11273

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

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

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

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

Lead

General Statistics

Total Number of Observations	86	Number of Distinct Observations	54
Number of Detects	81	Number of Non-Detects	5
Number of Distinct Detects	52	Number of Distinct Non-Detects	2
Minimum Detect	0.95	Minimum Non-Detect	0.5
Maximum Detect	972	Maximum Non-Detect	0.6
Variance Detects	11751	Percent Non-Detects	5.814%
Mean Detects	19.5	SD Detects	108.4
Median Detects	4.2	CV Detects	5.559
Skewness Detects	8.705	Kurtosis Detects	77.21
Mean of Logged Detects	1.53	SD of Logged Detects	1.013

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.163
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.455
5% Lilliefors Critical Value	0.0985

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Subsurface Soil Lorraine Process Area ProUCL Outputs

Detected Data Not Normal at 5% Significance Level

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

KM Mean	18.39	KM Standard Error of Mean	11.35
KM SD	104.6	95% KM (BCA) UCL	41.39
95% KM (t) UCL	37.28	95% KM (Percentile Bootstrap) UCL	40.6
95% KM (z) UCL	37.07	95% KM Bootstrap t UCL	177.5
90% KM Chebyshev UCL	52.46	95% KM Chebyshev UCL	67.89
97.5% KM Chebyshev UCL	89.3	99% KM Chebyshev UCL	131.4

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	16.52	Anderson-Darling GOF Test
5% A-D Critical Value	0.831	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.377	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.106	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.449	k star (bias corrected MLE)	0.44
Theta hat (MLE)	43.47	Theta star (bias corrected MLE)	44.3
nu hat (MLE)	72.67	nu star (bias corrected)	71.31
Mean (detects)	19.5		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	18.37
Maximum	972	Median	4.15
SD	105.3	CV	5.731
k hat (MLE)	0.382	k star (bias corrected MLE)	0.376
Theta hat (MLE)	48.12	Theta star (bias corrected MLE)	48.83
nu hat (MLE)	65.65	nu star (bias corrected)	64.69
Adjusted Level of Significance (β)	0.0472		
Approximate Chi Square Value (64.69, α)	47.19	Adjusted Chi Square Value (64.69, β)	46.93
95% Gamma Approximate UCL (use when $n \geq 50$)	25.18	95% Gamma Adjusted UCL (use when $n < 50$)	25.32

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	18.39	SD (KM)	104.6
Variance (KM)	10951	SE of Mean (KM)	11.35
k hat (KM)	0.0309	k star (KM)	0.0376
nu hat (KM)	5.314	nu star (KM)	6.462
theta hat (KM)	595.3	theta star (KM)	489.6
80% gamma percentile (KM)	0.748	90% gamma percentile (KM)	17.76
95% gamma percentile (KM)	84.95	99% gamma percentile (KM)	444

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.46, α)	1.881	Adjusted Chi Square Value (6.46, β)	1.839

Subsurface Soil Lorraine Process Area ProUCL Outputs

95% Gamma Approximate KM-UCL (use when n>=50) 63.21 95% Gamma Adjusted KM-UCL (use when n<50) 64.64

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic 0.788	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value 1.110E-16	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic 0.195	Lilliefors GOF Test
5% Lilliefors Critical Value 0.0985	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale 18.4		Mean in Log Scale 1.407
SD in Original Scale 105.3		SD in Log Scale 1.102
95% t UCL (assumes normality of ROS data) 37.27		95% Percentile Bootstrap UCL 40.51
95% BCA Bootstrap UCL 54.39		95% Bootstrap t UCL 173
95% H-UCL (Log ROS) 9.916		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged) 1.401		KM Geo Mean 4.058
KM SD (logged) 1.107		95% Critical H Value (KM-Log) 2.343
KM Standard Error of Mean (logged) 0.12		95% H-UCL (KM -Log) 9.917
KM SD (logged) 1.107		95% Critical H Value (KM-Log) 2.343
KM Standard Error of Mean (logged) 0.12		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed
Mean in Original Scale 18.38		Mean in Log Scale 1.363
SD in Original Scale 105.3		SD in Log Scale 1.194
95% t UCL (Assumes normality) 37.26		95% H-Stat UCL 10.91

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 67.89

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

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

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

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

Manganese

General Statistics

Total Number of Observations 86		Number of Distinct Observations 82
		Number of Missing Observations 0
Minimum 11.1		Mean 127.6
Maximum 742		Median 75.25
SD 140		Std. Error of Mean 15.1

Subsurface Soil Lorraine Process Area ProUCL Outputs

Coefficient of Variation	1.097	Skewness	2.355

Normal GOF Test

Shapiro Wilk Test Statistic	0.725	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.203	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0957	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	152.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	156.6
95% Modified-t UCL (Johnson-1978)	153.4

Gamma GOF Test

A-D Test Statistic	1.367	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.777	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0992	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0988	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.234	k star (bias corrected MLE)	1.198
Theta hat (MLE)	103.5	Theta star (bias corrected MLE)	106.5
nu hat (MLE)	212.2	nu star (bias corrected)	206.1
MLE Mean (bias corrected)	127.6	MLE Sd (bias corrected)	116.6
		Approximate Chi Square Value (0.05)	173.9
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	173.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	151.3	95% Adjusted Gamma UCL (use when n<50)	151.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.317	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0524	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0957	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.407	Mean of logged Data	4.392
Maximum of Logged Data	6.609	SD of logged Data	0.962

Assuming Lognormal Distribution

95% H-UCL	161.5	90% Chebyshev (MVUE) UCL	174.2
95% Chebyshev (MVUE) UCL	195.4	97.5% Chebyshev (MVUE) UCL	224.8
99% Chebyshev (MVUE) UCL	282.7		

Nonparametric Distribution Free UCL Statistics

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

Subsurface Soil Lorraine Process Area ProUCL Outputs

Nonparametric Distribution Free UCLs

95% CLT UCL	152.5	95% Jackknife UCL	152.8
95% Standard Bootstrap UCL	152.4	95% Bootstrap-t UCL	158.4
95% Hall's Bootstrap UCL	157.6	95% Percentile Bootstrap UCL	152.9
95% BCA Bootstrap UCL	157		
90% Chebyshev(Mean, Sd) UCL	173	95% Chebyshev(Mean, Sd) UCL	193.5
97.5% Chebyshev(Mean, Sd) UCL	222	99% Chebyshev(Mean, Sd) UCL	277.9

Suggested UCL to Use

95% H-UCL 161.5

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Thallium

General Statistics

Total Number of Observations	84	Number of Distinct Observations	33
		Number of Missing Observations	2
Number of Detects	13	Number of Non-Detects	71
Number of Distinct Detects	13	Number of Distinct Non-Detects	21
Minimum Detect	0.012	Minimum Non-Detect	0.38
Maximum Detect	0.6	Maximum Non-Detect	0.63
Variance Detects	0.0246	Percent Non-Detects	84.52%
Mean Detects	0.0792	SD Detects	0.157
Median Detects	0.038	CV Detects	1.981
Skewness Detects	3.568	Kurtosis Detects	12.81
Mean of Logged Detects	-3.18	SD of Logged Detects	0.903

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.383	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.489	Lilliefors GOF Test
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0426	KM Standard Error of Mean	0.00788
KM SD	0.0627	95% KM (BCA) UCL	0.0579
95% KM (t) UCL	0.0557	95% KM (Percentile Bootstrap) UCL	0.0567
95% KM (z) UCL	0.0556	95% KM Bootstrap t UCL	0.0671
90% KM Chebyshev UCL	0.0663	95% KM Chebyshev UCL	0.077

Subsurface Soil Lorraine Process Area ProUCL Outputs

97.5% KM Chebyshev UCL 0.0918

99% KM Chebyshev UCL 0.121

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.338	Anderson-Darling GOF Test
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.421	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.244	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.906	k star (bias corrected MLE)	0.748
Theta hat (MLE)	0.0875	Theta star (bias corrected MLE)	0.106
nu hat (MLE)	23.55	nu star (bias corrected)	19.45
Mean (detects)	0.0792		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0522
Maximum	0.6	Median	0.0247
SD	0.0771	CV	1.478
k hat (MLE)	1.048	k star (bias corrected MLE)	1.018
Theta hat (MLE)	0.0498	Theta star (bias corrected MLE)	0.0512
nu hat (MLE)	176	nu star (bias corrected)	171
Adjusted Level of Significance (β)	0.0471		
Approximate Chi Square Value (171.03, α)	141.8	Adjusted Chi Square Value (171.03, β)	141.3
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0629	95% Gamma Adjusted UCL (use when $n < 50$)	0.0631

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0426	SD (KM)	0.0627
Variance (KM)	0.00393	SE of Mean (KM)	0.00788
k hat (KM)	0.462	k star (KM)	0.454
nu hat (KM)	77.68	nu star (KM)	76.24
theta hat (KM)	0.0922	theta star (KM)	0.0939
80% gamma percentile (KM)	0.0696	90% gamma percentile (KM)	0.118
95% gamma percentile (KM)	0.169	99% gamma percentile (KM)	0.298

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (76.24, α)	57.13	Adjusted Chi Square Value (76.24, β)	56.84
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0569	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0572

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.317	Lilliefors GOF Test
5% Lilliefors Critical Value	0.234	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Subsurface Soil Lorraine Process Area ProUCL Outputs

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0468	Mean in Log Scale	-3.306
SD in Original Scale	0.0646	SD in Log Scale	0.589
95% t UCL (assumes normality of ROS data)	0.0585	95% Percentile Bootstrap UCL	0.0599
95% BCA Bootstrap UCL	0.0681	95% Bootstrap t UCL	0.0788
95% H-UCL (Log ROS)	0.0493		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.368	KM Geo Mean	0.0345
KM SD (logged)	0.52	95% Critical H Value (KM-Log)	1.856
KM Standard Error of Mean (logged)	0.129	95% H-UCL (KM -Log)	0.0439
KM SD (logged)	0.52	95% Critical H Value (KM-Log)	1.856
KM Standard Error of Mean (logged)	0.129		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.219	Mean in Log Scale	-1.688
SD in Original Scale	0.0878	SD in Log Scale	0.735
95% t UCL (Assumes normality)	0.235	95% H-Stat UCL	0.285

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.077

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	86	Number of Distinct Observations	33
Number of Detects	15	Number of Non-Detects	71
Number of Distinct Detects	14	Number of Distinct Non-Detects	21
Minimum Detect	0.0014	Minimum Non-Detect	0.0018
Maximum Detect	0.22	Maximum Non-Detect	2
Variance Detects	0.00395	Percent Non-Detects	82.56%
Mean Detects	0.0415	SD Detects	0.0629
Median Detects	0.014	CV Detects	1.514
Skewness Detects	2.091	Kurtosis Detects	4.149
Mean of Logged Detects	-4.253	SD of Logged Detects	1.598

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.683	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level	

Subsurface Soil Lorraine Process Area ProUCL Outputs

Lilliefors Test Statistic	0.318	Lilliefors GOF Test
5% Lilliefors Critical Value	0.22	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

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

KM Mean	0.0113	KM Standard Error of Mean	0.00411
KM SD	0.0325	95% KM (BCA) UCL	0.019
95% KM (t) UCL	0.0181	95% KM (Percentile Bootstrap) UCL	0.0184
95% KM (z) UCL	0.018	95% KM Bootstrap t UCL	0.0248
90% KM Chebyshev UCL	0.0236	95% KM Chebyshev UCL	0.0292
97.5% KM Chebyshev UCL	0.0369	99% KM Chebyshev UCL	0.0521

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.579	Anderson-Darling GOF Test
5% A-D Critical Value	0.787	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.219	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.233	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	0.58	k star (bias corrected MLE)	0.508
Theta hat (MLE)	0.0717	Theta star (bias corrected MLE)	0.0817
nu hat (MLE)	17.39	nu star (bias corrected)	15.24
Mean (detects)	0.0415		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0014	Mean	0.0164
Maximum	0.22	Median	0.01
SD	0.0286	CV	1.743
k hat (MLE)	1.418	k star (bias corrected MLE)	1.376
Theta hat (MLE)	0.0116	Theta star (bias corrected MLE)	0.0119
nu hat (MLE)	243.8	nu star (bias corrected)	236.7
Adjusted Level of Significance (β)	0.0472		
Approximate Chi Square Value (236.66, α)	202	Adjusted Chi Square Value (236.66, β)	201.5
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0192	95% Gamma Adjusted UCL (use when $n < 50$)	0.0193

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0113	SD (KM)	0.0325
Variance (KM)	0.00106	SE of Mean (KM)	0.00411
k hat (KM)	0.12	k star (KM)	0.124
nu hat (KM)	20.64	nu star (KM)	21.26
theta hat (KM)	0.0938	theta star (KM)	0.0911
80% gamma percentile (KM)	0.0102	90% gamma percentile (KM)	0.0321
95% gamma percentile (KM)	0.064	99% gamma percentile (KM)	0.16

Subsurface Soil Lorraine Process Area ProUCL Outputs

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (21.26, α)	11.78	Adjusted Chi Square Value (21.26, β)	11.66
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0203	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0205

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.122	Lilliefors GOF Test
5% Lilliefors Critical Value	0.22	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00898	Mean in Log Scale	-6.544
SD in Original Scale	0.0298	SD in Log Scale	1.72
95% t UCL (assumes normality of ROS data)	0.0143	95% Percentile Bootstrap UCL	0.0148
95% BCA Bootstrap UCL	0.0168	95% Bootstrap t UCL	0.0214
95% H-UCL (Log ROS)	0.0111		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.876	KM Geo Mean	0.0028
KM SD (logged)	1.263	95% Critical H Value (KM-Log)	2.505
KM Standard Error of Mean (logged)	0.18	95% H-UCL (KM -Log)	0.00877
KM SD (logged)	1.263	95% Critical H Value (KM-Log)	2.505
KM Standard Error of Mean (logged)	0.18		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0837	Mean in Log Scale	-4.386
SD in Original Scale	0.202	SD in Log Scale	2.149
95% t UCL (Assumes normality)	0.12	95% H-Stat UCL	0.288

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0203

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

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

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

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

Subsurface Soil Loading Dock Area ProUCL Outputs

UCL Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 1:49:48 PM
 From File ProUCL Inputs HHRA LDA SB.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1710	Mean	4250
Maximum	9450	Median	2920
SD	3515	Std. Error of Mean	1758
Coefficient of Variation	0.827	Skewness	1.832

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.777
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.383
5% Lilliefors Critical Value	0.375

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8386

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8861

95% Modified-t UCL (Johnson-1978) 8655

Gamma GOF Test

A-D Test Statistic	0.468
5% A-D Critical Value	0.66
K-S Test Statistic	0.357
5% K-S Critical Value	0.397

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.468	k star (bias corrected MLE)	0.784
Theta hat (MLE)	1722	Theta star (bias corrected MLE)	5423
nu hat (MLE)	19.74	nu star (bias corrected)	6.269
MLE Mean (bias corrected)	4250	MLE Sd (bias corrected)	4801
		Approximate Chi Square Value (0.05)	1.779

Subsurface Soil Loading Dock Area ProUCL Outputs

Adjusted Level of Significance N/A

Adjusted Chi Square Value N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 14978

95% Adjusted Gamma UCL (use when $n < 50$) N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.904
5% Shapiro Wilk Critical Value 0.748
Lilliefors Test Statistic 0.312
5% Lilliefors Critical Value 0.375

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 7.444
Maximum of Logged Data 9.154

Mean of logged Data 8.139
SD of logged Data 0.723

Assuming Lognormal Distribution

95% H-UCL 34993
95% Chebyshev (MVUE) UCL 10405
99% Chebyshev (MVUE) UCL 18446

90% Chebyshev (MVUE) UCL 8451
97.5% Chebyshev (MVUE) UCL 13118

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 7141
95% Standard Bootstrap UCL N/A
95% Hall's Bootstrap UCL N/A
95% BCA Bootstrap UCL N/A
90% Chebyshev(Mean, Sd) UCL 9523
97.5% Chebyshev(Mean, Sd) UCL 15226

95% Jackknife UCL 8386
95% Bootstrap-t UCL N/A
95% Percentile Bootstrap UCL N/A
95% Chebyshev(Mean, Sd) UCL 11911
99% Chebyshev(Mean, Sd) UCL 21738

Suggested UCL to Use

95% Student's-t UCL 8386

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Arsenic

General Statistics

Total Number of Observations 4

Minimum 0.46

Number of Distinct Observations 4
Number of Missing Observations 0
Mean 1.84

Subsurface Soil Loading Dock Area ProUCL Outputs

Maximum	3.3	Median	1.8
SD	1.205	Std. Error of Mean	0.603
Coefficient of Variation	0.655	Skewness	0.17

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	3.258

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	2.886
95% Modified-t UCL (Johnson-1978)	3.267

Gamma GOF Test

A-D Test Statistic	0.232	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.191	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.384	k star (bias corrected MLE)	0.763
Theta hat (MLE)	0.772	Theta star (bias corrected MLE)	2.413
nu hat (MLE)	19.07	nu star (bias corrected)	6.101
MLE Mean (bias corrected)	1.84	MLE Sd (bias corrected)	2.107
		Approximate Chi Square Value (0.05)	1.692
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.636	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.777	Mean of logged Data	0.386
Maximum of Logged Data	1.194	SD of logged Data	0.85

Subsurface Soil Loading Dock Area ProUCL Outputs

Assuming Lognormal Distribution

95% H-UCL	35.09	90% Chebyshev (MVUE) UCL	4.202
95% Chebyshev (MVUE) UCL	5.244	97.5% Chebyshev (MVUE) UCL	6.69
99% Chebyshev (MVUE) UCL	9.529		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.831	95% Jackknife UCL	3.258
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.648	95% Chebyshev(Mean, Sd) UCL	4.467
97.5% Chebyshev(Mean, Sd) UCL	5.604	99% Chebyshev(Mean, Sd) UCL	7.837

Suggested UCL to Use

95% Student's-t UCL	3.258

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.36	Mean	8.14
Maximum	26.9	Median	2.65
SD	12.57	Std. Error of Mean	6.284
Coefficient of Variation	1.544	Skewness	1.942

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.721
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.397
5% Lilliefors Critical Value	0.375

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	22.93

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	25

Subsurface Soil Loading Dock Area ProUCL Outputs

95% Modified-t UCL (Johnson-1978) 23.95

Gamma GOF Test

A-D Test Statistic	0.336	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.677	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.299	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.408	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	0.584	k star (bias corrected MLE)	0.313
Theta hat (MLE)	13.94	Theta star (bias corrected MLE)	26.04
nu hat (MLE)	4.67	nu star (bias corrected)	2.501
MLE Mean (bias corrected)	8.14	MLE Sd (bias corrected)	14.56
		Approximate Chi Square Value (0.05)	0.241
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	84.35	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.985	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	-1.022	Mean of logged Data	1.034
Maximum of Logged Data	3.292	SD of logged Data	1.781

Assuming Lognormal Distribution

95% H-UCL	2279065	90% Chebyshev (MVUE) UCL	23.84
95% Chebyshev (MVUE) UCL	31.21	97.5% Chebyshev (MVUE) UCL	41.44
99% Chebyshev (MVUE) UCL	61.54		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	18.48	95% Jackknife UCL	22.93
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	26.99	95% Chebyshev(Mean, Sd) UCL	35.53
97.5% Chebyshev(Mean, Sd) UCL	47.38	99% Chebyshev(Mean, Sd) UCL	70.67

Suggested UCL to Use

95% Adjusted Gamma UCL	N/A

Subsurface Soil Loading Dock Area ProUCL Outputs

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

Iron

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3070	Mean	8510
Maximum	14400	Median	8285
SD	5493	Std. Error of Mean	2747
Coefficient of Variation	0.645	Skewness	0.103

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.894	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.258	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 14974

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 13179

95% Modified-t UCL (Johnson-1978) 14997

Gamma GOF Test

A-D Test Statistic	0.377	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.285	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.793	k star (bias corrected MLE)	0.865
Theta hat (MLE)	3047	Theta star (bias corrected MLE)	9840
nu hat (MLE)	22.34	nu star (bias corrected)	6.919
MLE Mean (bias corrected)	8510	MLE Sd (bias corrected)	9151
		Approximate Chi Square Value (0.05)	2.126
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Subsurface Soil Loading Dock Area ProUCL Outputs

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 27694

95% Adjusted Gamma UCL (use when $n < 50$) N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.903
5% Shapiro Wilk Critical Value 0.748
Lilliefors Test Statistic 0.261
5% Lilliefors Critical Value 0.375

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 8.029
Maximum of Logged Data 9.575

Mean of logged Data 8.859
SD of logged Data 0.74

Assuming Lognormal Distribution

95% H-UCL 80101
95% Chebyshev (MVUE) UCL 21871
99% Chebyshev (MVUE) UCL 38918

90% Chebyshev (MVUE) UCL 17727
97.5% Chebyshev (MVUE) UCL 27621

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 13028
95% Standard Bootstrap UCL N/A
95% Hall's Bootstrap UCL N/A
95% BCA Bootstrap UCL N/A
90% Chebyshev(Mean, Sd) UCL 16750
97.5% Chebyshev(Mean, Sd) UCL 25662

95% Jackknife UCL 14974
95% Bootstrap-t UCL N/A
95% Percentile Bootstrap UCL N/A
95% Chebyshev(Mean, Sd) UCL 20482
99% Chebyshev(Mean, Sd) UCL 35838

Suggested UCL to Use

95% Student's-t UCL 14974

Recommended UCL exceeds the maximum observation

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

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

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

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

Manganese

General Statistics

Total Number of Observations 4

Number of Distinct Observations 4

Number of Missing Observations 0

Minimum 33.5

Mean 155.7

Maximum 453

Median 68.2

SD 200

Std. Error of Mean 100

Coefficient of Variation 1.284

Skewness 1.895

Subsurface Soil Loading Dock Area ProUCL Outputs

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.735	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.37	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level
Data appear Approximate Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 391.1

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 421.5
95% Modified-t UCL (Johnson-1978) 406.9

Gamma GOF Test

A-D Test Statistic	0.477	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.667	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.297	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.402	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	1.011	k star (bias corrected MLE)	0.419
Theta hat (MLE)	154	Theta star (bias corrected MLE)	371.3
nu hat (MLE)	8.087	nu star (bias corrected)	3.355
MLE Mean (bias corrected)	155.7	MLE Sd (bias corrected)	240.5
		Approximate Chi Square Value (0.05)	0.485
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 1077 95% Adjusted Gamma UCL (use when $n < 50$) N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.236	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	3.512	Mean of logged Data	4.478
Maximum of Logged Data	6.116	SD of logged Data	1.179

Assuming Lognormal Distribution

95% H-UCL	36062	90% Chebyshev (MVUE) UCL	368.2
95% Chebyshev (MVUE) UCL	470.7	97.5% Chebyshev (MVUE) UCL	613.1

Subsurface Soil Loading Dock Area ProUCL Outputs

99% Chebyshev (MVUE) UCL 892.8

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	320.2	95% Jackknife UCL	391.1
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	455.7	95% Chebyshev(Mean, Sd) UCL	591.6
97.5% Chebyshev(Mean, Sd) UCL	780.3	99% Chebyshev(Mean, Sd) UCL	1151

Suggested UCL to Use

95% Student's-t UCL 391.1

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Subsurface Soil Wilcox Process Area ProUCLOutputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/13/2019 1:22:04 PM
 From File ProUCL Inputs HHRA WPA SB.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	115	Number of Distinct Observations	108
		Number of Missing Observations	3
Minimum	1190	Mean	7545
Maximum	20000	Median	6800
SD	3897	Std. Error of Mean	363.4
Coefficient of Variation	0.516	Skewness	0.964

Normal GOF Test

Shapiro Wilk Test Statistic 0.917
 5% Shapiro Wilk P Value 3.7053E-8
 Lilliefors Test Statistic 0.12
 5% Lilliefors Critical Value 0.0829

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8148

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8178
 95% Modified-t UCL (Johnson-1978) 8153

Gamma GOF Test

A-D Test Statistic 0.605
 5% A-D Critical Value 0.757
 K-S Test Statistic 0.0782
 5% K-S Critical Value 0.0859

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.926	k star (bias corrected MLE)	3.829
Theta hat (MLE)	1922	Theta star (bias corrected MLE)	1970
nu hat (MLE)	902.9	nu star (bias corrected)	880.7
MLE Mean (bias corrected)	7545	MLE Sd (bias corrected)	3856
		Approximate Chi Square Value (0.05)	812.8
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	812

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50) 8175

95% Adjusted Gamma UCL (use when n<50) 8183

Subsurface Soil Wilcox Process Area ProUCLOutputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.3	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0583	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0829	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.082	Mean of logged Data	8.796
Maximum of Logged Data	9.903	SD of logged Data	0.532

Assuming Lognormal Distribution

95% H-UCL	8351	90% Chebyshev (MVUE) UCL	8807
95% Chebyshev (MVUE) UCL	9352	97.5% Chebyshev (MVUE) UCL	10109
99% Chebyshev (MVUE) UCL	11596		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	8143	95% Jackknife UCL	8148
95% Standard Bootstrap UCL	8144	95% Bootstrap-t UCL	8176
95% Hall's Bootstrap UCL	8184	95% Percentile Bootstrap UCL	8159
95% BCA Bootstrap UCL	8169		
90% Chebyshev(Mean, Sd) UCL	8635	95% Chebyshev(Mean, Sd) UCL	9129
97.5% Chebyshev(Mean, Sd) UCL	9814	99% Chebyshev(Mean, Sd) UCL	11160

Suggested UCL to Use

95% Approximate Gamma UCL	8175

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

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

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

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

Arsenic

General Statistics

Total Number of Observations	115	Number of Distinct Observations	50
		Number of Missing Observations	3
Minimum	0.83	Mean	3.476
Maximum	20.3	Median	2.5
SD	3.337	Std. Error of Mean	0.311
Coefficient of Variation	0.96	Skewness	2.844

Normal GOF Test

Shapiro Wilk Test Statistic	0.638	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.281	Lilliefors GOF Test

Subsurface Soil Wilcox Process Area ProUCLOutputs

5% Lilliefors Critical Value 0.0829

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 3.992

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 4.076

95% Modified-t UCL (Johnson-1978) 4.006

Gamma GOF Test

A-D Test Statistic 6.385

5% A-D Critical Value 0.765

K-S Test Statistic 0.192

5% K-S Critical Value 0.0867

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 2.072

Theta hat (MLE) 1.677

nu hat (MLE) 476.7

MLE Mean (bias corrected) 3.476

Adjusted Level of Significance 0.0479

k star (bias corrected MLE) 2.024

Theta star (bias corrected MLE) 1.717

nu star (bias corrected) 465.6

MLE Sd (bias corrected) 2.443

Approximate Chi Square Value (0.05) 416.5

Adjusted Chi Square Value 416

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)) 3.886

95% Adjusted Gamma UCL (use when n<50) 3.891

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.913

5% Shapiro Wilk P Value 1.0512E-8

Lilliefors Test Statistic 0.132

5% Lilliefors Critical Value 0.0829

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data -0.186

Maximum of Logged Data 3.011

Mean of logged Data 0.986

SD of logged Data 0.651

Assuming Lognormal Distribution

95% H-UCL 3.728

95% Chebyshev (MVUE) UCL 4.263

99% Chebyshev (MVUE) UCL 5.49

90% Chebyshev (MVUE) UCL 3.964

97.5% Chebyshev (MVUE) UCL 4.677

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL 3.988

95% Standard Bootstrap UCL 3.987

95% Hall's Bootstrap UCL 4.093

95% BCA Bootstrap UCL 4.078

95% Jackknife UCL 3.992

95% Bootstrap-t UCL 4.115

95% Percentile Bootstrap UCL 4.013

Subsurface Soil Wilcox Process Area ProUCLOutputs

90% Chebyshev(Mean, Sd) UCL	4.41	95% Chebyshev(Mean, Sd) UCL	4.833
97.5% Chebyshev(Mean, Sd) UCL	5.42	99% Chebyshev(Mean, Sd) UCL	6.573

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	4.833

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	115	Number of Distinct Observations	72
		Number of Missing Observations	3
Number of Detects	111	Number of Non-Detects	4
Number of Distinct Detects	72	Number of Distinct Non-Detects	2
Minimum Detect	1.4	Minimum Non-Detect	2.1
Maximum Detect	32.6	Maximum Non-Detect	2.2
Variance Detects	17.07	Percent Non-Detects	3.478%
Mean Detects	6.216	SD Detects	4.132
Median Detects	5.8	CV Detects	0.665
Skewness Detects	3.243	Kurtosis Detects	16.54
Mean of Logged Detects	1.672	SD of Logged Detects	0.547

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.755
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.146
5% Lilliefors Critical Value	0.0844

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	6.061	KM Standard Error of Mean	0.386
KM SD	4.123	95% KM (BCA) UCL	6.737
95% KM (t) UCL	6.702	95% KM (Percentile Bootstrap) UCL	6.732
95% KM (z) UCL	6.697	95% KM Bootstrap t UCL	6.857
90% KM Chebyshev UCL	7.22	95% KM Chebyshev UCL	7.745
97.5% KM Chebyshev UCL	8.474	99% KM Chebyshev UCL	9.905

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.909
5% A-D Critical Value	0.758
K-S Test Statistic	0.0761
5% K-S Critical Value	0.0871

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics on Detected Data Only

k hat (MLE)	3.372	k star (bias corrected MLE)	3.287

Subsurface Soil Wilcox Process Area ProUCLOutputs

Theta hat (MLE)	1.844	Theta star (bias corrected MLE)	1.891
nu hat (MLE)	748.5	nu star (bias corrected)	729.6
Mean (detects)	6.216		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.185	Mean	6.019
Maximum	32.6	Median	5.6
SD	4.191	CV	0.696
k hat (MLE)	2.561	k star (bias corrected MLE)	2.5
Theta hat (MLE)	2.35	Theta star (bias corrected MLE)	2.408
nu hat (MLE)	589	nu star (bias corrected)	575
Adjusted Level of Significance (β)	0.0479		
Approximate Chi Square Value (574.98, α)	520.4	Adjusted Chi Square Value (574.98, β)	519.7
95% Gamma Approximate UCL (use when $n \geq 50$)	6.651	95% Gamma Adjusted UCL (use when $n < 50$)	6.659

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.061	SD (KM)	4.123
Variance (KM)	17	SE of Mean (KM)	0.386
k hat (KM)	2.161	k star (KM)	2.11
nu hat (KM)	497	nu star (KM)	485.4
theta hat (KM)	2.805	theta star (KM)	2.872
80% gamma percentile (KM)	9.017	90% gamma percentile (KM)	11.64
95% gamma percentile (KM)	14.14	99% gamma percentile (KM)	19.65

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (485.40, α)	435.3	Adjusted Chi Square Value (485.40, β)	434.7
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	6.759	95% Gamma Adjusted KM-UCL (use when $n < 50$)	6.768

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.981	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.536	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0735	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0844	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.06	Mean in Log Scale	1.632
SD in Original Scale	4.143	SD in Log Scale	0.577
95% t UCL (assumes normality of ROS data)	6.7	95% Percentile Bootstrap UCL	6.712
95% BCA Bootstrap UCL	6.839	95% Bootstrap t UCL	6.886
95% H-UCL (Log ROS)	6.686		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.633	KM Geo Mean	5.118
KM SD (logged)	0.573	95% Critical H Value (KM-Log)	1.881

Subsurface Soil Wilcox Process Area ProUCLOutputs

KM Standard Error of Mean (logged)	0.0538	95% H-UCL (KM -Log)	6.673
KM SD (logged)	0.573	95% Critical H Value (KM-Log)	1.881
KM Standard Error of Mean (logged)	0.0538		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	6.038
SD in Original Scale	4.167
95% t UCL (Assumes normality)	6.682

DL/2 Log-Transformed

Mean in Log Scale	1.616
SD in Log Scale	0.611
95% H-Stat UCL	6.769

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	6.759	95% GROS Approximate Gamma UCL	6.651

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Iron

General Statistics

Total Number of Observations	115	Number of Distinct Observations	97
		Number of Missing Observations	3
Minimum	2980	Mean	14083
Maximum	72300	Median	12400
SD	8890	Std. Error of Mean	829
Coefficient of Variation	0.631	Skewness	3.308

Normal GOF Test

Shapiro Wilk Test Statistic	0.745
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.203
5% Lilliefors Critical Value	0.0829

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	15457

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	15719
95% Modified-t UCL (Johnson-1978)	15500

Gamma GOF Test

A-D Test Statistic	1.821

Anderson-Darling Gamma GOF Test

Subsurface Soil Wilcox Process Area ProUCLOutputs

5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.128	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0859	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	3.885	k star (bias corrected MLE)	3.79
Theta hat (MLE)	3625	Theta star (bias corrected MLE)	3716
nu hat (MLE)	893.6	nu star (bias corrected)	871.6
MLE Mean (bias corrected)	14083	MLE Sd (bias corrected)	7234
		Approximate Chi Square Value (0.05)	804.1
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	803.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15265	95% Adjusted Gamma UCL (use when n<50)	15281

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.982	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.623	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0908	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0829	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8	Mean of logged Data	9.419
Maximum of Logged Data	11.19	SD of logged Data	0.501

Assuming Lognormal Distribution

95% H-UCL	15212	90% Chebyshev (MVUE) UCL	16002
95% Chebyshev (MVUE) UCL	16936	97.5% Chebyshev (MVUE) UCL	18232
99% Chebyshev (MVUE) UCL	20778		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	15446	95% Jackknife UCL	15457
95% Standard Bootstrap UCL	15428	95% Bootstrap-t UCL	15830
95% Hall's Bootstrap UCL	16127	95% Percentile Bootstrap UCL	15551
95% BCA Bootstrap UCL	15804		
90% Chebyshev(Mean, Sd) UCL	16570	95% Chebyshev(Mean, Sd) UCL	17696
97.5% Chebyshev(Mean, Sd) UCL	19260	99% Chebyshev(Mean, Sd) UCL	22331

Suggested UCL to Use

95% H-UCL	15212

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

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

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

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

Subsurface Soil Wilcox Process Area ProUCLOutputs

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Lead

General Statistics

Total Number of Observations	115	Number of Distinct Observations	81
		Number of Missing Observations	3
Minimum	1.9	Mean	26.47
Maximum	921	Median	6.2
SD	92.31	Std. Error of Mean	8.608
Coefficient of Variation	3.487	Skewness	8.342

Normal GOF Test

Shapiro Wilk Test Statistic	0.273
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.395
5% Lilliefors Critical Value	0.0829

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	40.75

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	47.79
95% Modified-t UCL (Johnson-1978)	41.87

Gamma GOF Test

A-D Test Statistic	13.97
5% A-D Critical Value	0.814
K-S Test Statistic	0.26
5% K-S Critical Value	0.0902

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.552	k star (bias corrected MLE)	0.544
Theta hat (MLE)	47.92	Theta star (bias corrected MLE)	48.68
nu hat (MLE)	127.1	nu star (bias corrected)	125.1
MLE Mean (bias corrected)	26.47	MLE Sd (bias corrected)	35.9
		Approximate Chi Square Value (0.05)	100.3
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	99.98

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	33.03	95% Adjusted Gamma UCL (use when $n < 50$)	33.12

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.865
5% Shapiro Wilk P Value	6.661E-16

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Subsurface Soil Wilcox Process Area ProUCLOutputs

Lilliefors Test Statistic	0.149	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0829	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.642	Mean of logged Data	2.144
Maximum of Logged Data	6.825	SD of logged Data	1.15

Assuming Lognormal Distribution

95% H-UCL	21.32	90% Chebyshev (MVUE) UCL	23
95% Chebyshev (MVUE) UCL	26	97.5% Chebyshev (MVUE) UCL	30.16
99% Chebyshev (MVUE) UCL	38.34		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	40.63	95% Jackknife UCL	40.75
95% Standard Bootstrap UCL	40.54	95% Bootstrap-t UCL	63.69
95% Hall's Bootstrap UCL	89.36	95% Percentile Bootstrap UCL	42.59
95% BCA Bootstrap UCL	51.86		
90% Chebyshev(Mean, Sd) UCL	52.3	95% Chebyshev(Mean, Sd) UCL	64
97.5% Chebyshev(Mean, Sd) UCL	80.23	99% Chebyshev(Mean, Sd) UCL	112.1

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 64

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

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

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

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

Manganese

General Statistics

Total Number of Observations	115	Number of Distinct Observations	103
		Number of Missing Observations	3
Minimum	26.5	Mean	263.8
Maximum	3770	Median	175
SD	406.4	Std. Error of Mean	37.89
Coefficient of Variation	1.541	Skewness	6.467

Normal GOF Test

Shapiro Wilk Test Statistic	0.438	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.28	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0829	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Subsurface Soil Wilcox Process Area ProUCLOutputs

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 326.6

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 350.5

95% Modified-t UCL (Johnson-1978) 330.4

Gamma GOF Test

A-D Test Statistic 3.662

5% A-D Critical Value 0.772

K-S Test Statistic 0.152

5% K-S Critical Value 0.0873

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 1.415

Theta hat (MLE) 186.5

nu hat (MLE) 325.4

MLE Mean (bias corrected) 263.8

Adjusted Level of Significance 0.0479

k star (bias corrected MLE) 1.384

Theta star (bias corrected MLE) 190.7

nu star (bias corrected) 318.2

MLE Sd (bias corrected) 224.3

Approximate Chi Square Value (0.05) 277.9

Adjusted Chi Square Value 277.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 302.1

95% Adjusted Gamma UCL (use when $n < 50$) 302.6

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.973

5% Shapiro Wilk P Value 0.194

Lilliefors Test Statistic 0.0742

5% Lilliefors Critical Value 0.0829

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 3.277

Maximum of Logged Data 8.235

Mean of logged Data 5.182

SD of logged Data 0.794

Assuming Lognormal Distribution

95% H-UCL 284

95% Chebyshev (MVUE) UCL 332.2

99% Chebyshev (MVUE) UCL 446.3

90% Chebyshev (MVUE) UCL 304.4

97.5% Chebyshev (MVUE) UCL 370.7

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 326.1

95% Standard Bootstrap UCL 325.5

95% Hall's Bootstrap UCL 591.9

95% BCA Bootstrap UCL 364.4

90% Chebyshev(Mean, Sd) UCL 377.5

97.5% Chebyshev(Mean, Sd) UCL 500.4

95% Jackknife UCL 326.6

95% Bootstrap-t UCL 386.9

95% Percentile Bootstrap UCL 330.9

95% Chebyshev(Mean, Sd) UCL 429

99% Chebyshev(Mean, Sd) UCL 640.8

Subsurface Soil Wilcoxon Process Area ProUCL Outputs

Suggested UCL to Use

95% H-UCL 284

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Thallium

General Statistics

Total Number of Observations	115	Number of Distinct Observations	48
		Number of Missing Observations	3
Number of Detects	46	Number of Non-Detects	69
Number of Distinct Detects	32	Number of Distinct Non-Detects	16
Minimum Detect	0.023	Minimum Non-Detect	0.39
Maximum Detect	0.11	Maximum Non-Detect	0.6
Variance Detects	3.5659E-4	Percent Non-Detects	60%
Mean Detects	0.0512	SD Detects	0.0189
Median Detects	0.0475	CV Detects	0.369
Skewness Detects	1.045	Kurtosis Detects	1.071
Mean of Logged Detects	-3.033	SD of Logged Detects	0.352

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.945	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors GOF Test
5% Lilliefors Critical Value	0.129	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0512	KM Standard Error of Mean	0.00278
KM SD	0.0187	95% KM (BCA) UCL	0.056
95% KM (t) UCL	0.0559	95% KM (Percentile Bootstrap) UCL	0.0558
95% KM (z) UCL	0.0558	95% KM Bootstrap t UCL	0.0565
90% KM Chebyshev UCL	0.0596	95% KM Chebyshev UCL	0.0634
97.5% KM Chebyshev UCL	0.0686	99% KM Chebyshev UCL	0.0789

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.514	Anderson-Darling GOF Test
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.135	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.131	Detected Data Not Gamma Distributed at 5% Significance Level
Detected data follow Appr. Gamma Distribution at 5% Significance Level		

Subsurface Soil Wilcox Process Area ProUCLOutputs

Gamma Statistics on Detected Data Only

k hat (MLE)	8.282	k star (bias corrected MLE)	7.756
Theta hat (MLE)	0.00619	Theta star (bias corrected MLE)	0.00661
nu hat (MLE)	761.9	nu star (bias corrected)	713.6
Mean (detects)	0.0512		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0199	Mean	0.0508
Maximum	0.11	Median	0.049
SD	0.0165	CV	0.325
k hat (MLE)	9.998	k star (bias corrected MLE)	9.743
Theta hat (MLE)	0.00508	Theta star (bias corrected MLE)	0.00522
nu hat (MLE)	2299	nu star (bias corrected)	2241
Adjusted Level of Significance (β)	0.0479		
Approximate Chi Square Value (N/A, α)	2132	Adjusted Chi Square Value (N/A, β)	2130
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0534	95% Gamma Adjusted UCL (use when $n < 50$)	0.0535

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0512	SD (KM)	0.0187
Variance (KM)	3.4883E-4	SE of Mean (KM)	0.00278
k hat (KM)	7.526	k star (KM)	7.336
nu hat (KM)	1731	nu star (KM)	1687
theta hat (KM)	0.00681	theta star (KM)	0.00698
80% gamma percentile (KM)	0.0661	90% gamma percentile (KM)	0.0765
95% gamma percentile (KM)	0.0858	99% gamma percentile (KM)	0.105

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1593	Adjusted Chi Square Value (N/A, β)	1592
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0543	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.0543

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.945	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.111	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.129	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0505	Mean in Log Scale	-3.033
SD in Original Scale	0.0162	SD in Log Scale	0.309
95% t UCL (assumes normality of ROS data)	0.053	95% Percentile Bootstrap UCL	0.053
95% BCA Bootstrap UCL	0.0531	95% Bootstrap t UCL	0.0532
95% H-UCL (Log ROS)	0.0531		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

Subsurface Soil Wilcox Process Area ProUCLOutputs

KM Mean (logged)	-3.033	KM Geo Mean	0.0482
KM SD (logged)	0.348	95% Critical H Value (KM-Log)	1.758
KM Standard Error of Mean (logged)	0.0519	95% H-UCL (KM -Log)	0.0542
KM SD (logged)	0.348	95% Critical H Value (KM-Log)	1.758
KM Standard Error of Mean (logged)	0.0519		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.174	Mean in Log Scale	-2.031
SD in Original Scale	0.103	SD in Log Scale	0.853
95% t UCL (Assumes normality)	0.19	95% H-Stat UCL	0.223

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0543	95% GROS Approximate Gamma UCL	0.0534

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Vanadium

General Statistics

Total Number of Observations	115	Number of Distinct Observations	90
		Number of Missing Observations	3
Minimum	4.7	Mean	16.2
Maximum	40.2	Median	15.6
SD	6.084	Std. Error of Mean	0.567
Coefficient of Variation	0.376	Skewness	0.838

Normal GOF Test

Shapiro Wilk Test Statistic	0.96
5% Shapiro Wilk P Value	0.0115
Lilliefors Test Statistic	0.107
5% Lilliefors Critical Value	0.0829

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	17.14

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	17.18
95% Modified-t UCL (Johnson-1978)	17.15

Subsurface Soil Wilcox Process Area ProUCLOutputs

Gamma GOF Test

A-D Test Statistic	0.362	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0598	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0856	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	7.121	k star (bias corrected MLE)	6.941
Theta hat (MLE)	2.275	Theta star (bias corrected MLE)	2.334
nu hat (MLE)	1638	nu star (bias corrected)	1596
MLE Mean (bias corrected)	16.2	MLE Sd (bias corrected)	6.15
		Approximate Chi Square Value (0.05)	1505
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	1504

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	17.19	95% Adjusted Gamma UCL (use when n<50)	17.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.199	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0613	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0829	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.548	Mean of logged Data	2.713
Maximum of Logged Data	3.694	SD of logged Data	0.392

Assuming Lognormal Distribution

95% H-UCL	17.38	90% Chebyshev (MVUE) UCL	18.12
95% Chebyshev (MVUE) UCL	18.95	97.5% Chebyshev (MVUE) UCL	20.11
99% Chebyshev (MVUE) UCL	22.39		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	17.14	95% Jackknife UCL	17.14
95% Standard Bootstrap UCL	17.13	95% Bootstrap-t UCL	17.2
95% Hall's Bootstrap UCL	17.21	95% Percentile Bootstrap UCL	17.14
95% BCA Bootstrap UCL	17.2		
90% Chebyshev(Mean, Sd) UCL	17.9	95% Chebyshev(Mean, Sd) UCL	18.68
97.5% Chebyshev(Mean, Sd) UCL	19.75	99% Chebyshev(Mean, Sd) UCL	21.85

Suggested UCL to Use

95% Approximate Gamma UCL	17.19

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

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

Subsurface Soil Wilcox Process Area ProUCLOutputs

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

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

2-Methylnaphthalene

General Statistics

Total Number of Observations	104	Number of Distinct Observations	66
		Number of Missing Observations	14
Number of Detects	62	Number of Non-Detects	42
Number of Distinct Detects	56	Number of Distinct Non-Detects	12
Minimum Detect	0.001	Minimum Non-Detect	0.0019
Maximum Detect	140	Maximum Non-Detect	1
Variance Detects	402.6	Percent Non-Detects	40.38%
Mean Detects	5.593	SD Detects	20.06
Median Detects	0.0475	CV Detects	3.587
Skewness Detects	5.659	Kurtosis Detects	35.21
Mean of Logged Detects	-2.272	SD of Logged Detects	3.079

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.322	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.39	Lilliefors GOF Test
5% Lilliefors Critical Value	0.112	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	3.345	KM Standard Error of Mean	1.543
KM SD	15.61	95% KM (BCA) UCL	6.192
95% KM (t) UCL	5.906	95% KM (Percentile Bootstrap) UCL	6.083
95% KM (z) UCL	5.883	95% KM Bootstrap t UCL	11.95
90% KM Chebyshev UCL	7.974	95% KM Chebyshev UCL	10.07
97.5% KM Chebyshev UCL	12.98	99% KM Chebyshev UCL	18.7

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.516	Anderson-Darling GOF Test
5% A-D Critical Value	0.928	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.248	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.126	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.186	k star (bias corrected MLE)	0.188
Theta hat (MLE)	30.02	Theta star (bias corrected MLE)	29.75
nu hat (MLE)	23.1	nu star (bias corrected)	23.32
Mean (detects)	5.593		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

Subsurface Soil Wilcox Process Area ProUCLOutputs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.001	Mean	3.343
Maximum	140	Median	0.01
SD	15.68	CV	4.691
k hat (MLE)	0.173	k star (bias corrected MLE)	0.174
Theta hat (MLE)	19.36	Theta star (bias corrected MLE)	19.2
nu hat (MLE)	35.92	nu star (bias corrected)	36.22
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (36.22, α)	23.44	Adjusted Chi Square Value (36.22, β)	23.3
95% Gamma Approximate UCL (use when $n \geq 50$)	5.165	95% Gamma Adjusted UCL (use when $n < 50$)	5.197

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.345	SD (KM)	15.61
Variance (KM)	243.6	SE of Mean (KM)	1.543
k hat (KM)	0.0459	k star (KM)	0.051
nu hat (KM)	9.553	nu star (KM)	10.61
theta hat (KM)	72.83	theta star (KM)	65.57
80% gamma percentile (KM)	0.487	90% gamma percentile (KM)	5.239
95% gamma percentile (KM)	17.92	99% gamma percentile (KM)	72.18

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.61, α)	4.327	Adjusted Chi Square Value (10.61, β)	4.271
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	8.202	95% Gamma Adjusted KM-UCL (use when $n < 50$)	8.311

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic 0.916

Shapiro Wilk GOF Test

5% Shapiro Wilk P Value 2.7297E-4

Detected Data Not Lognormal at 5% Significance Level

Lilliefors Test Statistic 0.118

Lilliefors GOF Test

5% Lilliefors Critical Value 0.112

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.348	Mean in Log Scale	-3.446
SD in Original Scale	15.68	SD in Log Scale	3.122
95% t UCL (assumes normality of ROS data)	5.9	95% Percentile Bootstrap UCL	6.179
95% BCA Bootstrap UCL	7.864	95% Bootstrap t UCL	11.82
95% H-UCL (Log ROS)	17.91		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.327	KM Geo Mean	0.0359
KM SD (logged)	2.864	95% Critical H Value (KM-Log)	4.401
KM Standard Error of Mean (logged)	0.306	95% H-UCL (KM -Log)	7.52
KM SD (logged)	2.864	95% Critical H Value (KM-Log)	4.401
KM Standard Error of Mean (logged)	0.306		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	3.374
SD in Original Scale	15.68

DL/2 Log-Transformed

Mean in Log Scale	-2.559
SD in Log Scale	2.632

Subsurface Soil Wilcoxon Process Area ProUCLOutputs

95% t UCL (Assumes normality) 5.926

95% H-Stat UCL 7.149

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 10.07

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

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

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

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

Benzo (a) anthracene

General Statistics

Total Number of Observations	104	Number of Distinct Observations	57
		Number of Missing Observations	14
Number of Detects	43	Number of Non-Detects	61
Number of Distinct Detects	40	Number of Distinct Non-Detects	19
Minimum Detect	8.9000E-4	Minimum Non-Detect	0.0019
Maximum Detect	22	Maximum Non-Detect	1.8
Variance Detects	19.72	Percent Non-Detects	58.65%
Mean Detects	1.434	SD Detects	4.441
Median Detects	0.031	CV Detects	3.096
Skewness Detects	3.68	Kurtosis Detects	13.48
Mean of Logged Detects	-3.146	SD of Logged Detects	2.749

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.376	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.447	Lilliefors GOF Test
5% Lilliefors Critical Value	0.134	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.608	KM Standard Error of Mean	0.288
KM SD	2.906	95% KM (BCA) UCL	1.175
95% KM (t) UCL	1.087	95% KM (Percentile Bootstrap) UCL	1.116
95% KM (z) UCL	1.083	95% KM Bootstrap t UCL	1.666
90% KM Chebyshev UCL	1.473	95% KM Chebyshev UCL	1.865
97.5% KM Chebyshev UCL	2.409	99% KM Chebyshev UCL	3.478

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.08	Anderson-Darling GOF Test
5% A-D Critical Value	0.906	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.266	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.15	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Subsurface Soil Wilcox Process Area ProUCLOutputs

Gamma Statistics on Detected Data Only

k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	6.88	Theta star (bias corrected MLE)	6.848
nu hat (MLE)	17.93	nu star (bias corrected)	18.01
Mean (detects)	1.434		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.9000E-4	Mean	0.632
Maximum	22	Median	0.01
SD	2.92	CV	4.617
k hat (MLE)	0.217	k star (bias corrected MLE)	0.217
Theta hat (MLE)	2.914	Theta star (bias corrected MLE)	2.912
nu hat (MLE)	45.15	nu star (bias corrected)	45.18
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (45.18, α)	30.76	Adjusted Chi Square Value (45.18, β)	30.59
95% Gamma Approximate UCL (use when $n \geq 50$)	0.929	95% Gamma Adjusted UCL (use when $n < 50$)	0.934

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.608	SD (KM)	2.906
Variance (KM)	8.447	SE of Mean (KM)	0.288
k hat (KM)	0.0438	k star (KM)	0.0489
nu hat (KM)	9.106	nu star (KM)	10.18
theta hat (KM)	13.89	theta star (KM)	12.43
80% gamma percentile (KM)	0.0763	90% gamma percentile (KM)	0.902
95% gamma percentile (KM)	3.209	99% gamma percentile (KM)	13.34

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.18, α)	4.052	Adjusted Chi Square Value (10.18, β)	3.998
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.527	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.548

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.936	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.134	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.603	Mean in Log Scale	-4.573
SD in Original Scale	2.921	SD in Log Scale	2.573
95% t UCL (assumes normality of ROS data)	1.078	95% Percentile Bootstrap UCL	1.111
95% BCA Bootstrap UCL	1.33	95% Bootstrap t UCL	1.688
95% H-UCL (Log ROS)	0.785		

Subsurface Soil Wilcox Process Area ProUCLOutputs

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.445	KM Geo Mean	0.0117
KM SD (logged)	2.455	95% Critical H Value (KM-Log)	3.871
KM Standard Error of Mean (logged)	0.3	95% H-UCL (KM -Log)	0.609
KM SD (logged)	2.455	95% Critical H Value (KM-Log)	3.871
KM Standard Error of Mean (logged)	0.3		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.664	Mean in Log Scale	-3.07
SD in Original Scale	2.912	SD in Log Scale	2.262
95% t UCL (Assumes normality)	1.137	95% H-Stat UCL	1.346

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 0.609

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	104	Number of Distinct Observations	53
		Number of Missing Observations	14
Number of Detects	39	Number of Non-Detects	65
Number of Distinct Detects	36	Number of Distinct Non-Detects	19
Minimum Detect	8.2000E-4	Minimum Non-Detect	0.0019
Maximum Detect	24	Maximum Non-Detect	1.8
Variance Detects	15.51	Percent Non-Detects	62.5%
Mean Detects	1.048	SD Detects	3.939
Median Detects	0.025	CV Detects	3.759
Skewness Detects	5.521	Kurtosis Detects	32.35
Mean of Logged Detects	-3.352	SD of Logged Detects	2.621

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.298	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.939	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.413	Lilliefors GOF Test
5% Lilliefors Critical Value	0.14	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.406	KM Standard Error of Mean	0.242
KM SD	2.432	95% KM (BCA) UCL	0.883

Subsurface Soil Wilcox Process Area ProUCLOutputs

95% KM (t) UCL	0.808	95% KM (Percentile Bootstrap) UCL	0.859
95% KM (z) UCL	0.804	95% KM Bootstrap t UCL	2.015
90% KM Chebyshev UCL	1.131	95% KM Chebyshev UCL	1.46
97.5% KM Chebyshev UCL	1.916	99% KM Chebyshev UCL	2.811

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.846	Anderson-Darling GOF Test
5% A-D Critical Value	0.902	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.295	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.156	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.214	k star (bias corrected MLE)	0.215
Theta hat (MLE)	4.891	Theta star (bias corrected MLE)	4.877
nu hat (MLE)	16.71	nu star (bias corrected)	16.76
Mean (detects)	1.048		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.2000E-4	Mean	0.448
Maximum	24	Median	0.01
SD	2.447	CV	5.466
k hat (MLE)	0.235	k star (bias corrected MLE)	0.234
Theta hat (MLE)	1.908	Theta star (bias corrected MLE)	1.911
nu hat (MLE)	48.81	nu star (bias corrected)	48.74
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (48.74, α)	33.71	Adjusted Chi Square Value (48.74, β)	33.54
95% Gamma Approximate UCL (use when $n \geq 50$)	0.647	95% Gamma Adjusted UCL (use when $n < 50$)	0.651

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.406	SD (KM)	2.432
Variance (KM)	5.916	SE of Mean (KM)	0.242
k hat (KM)	0.0279	k star (KM)	0.0335
nu hat (KM)	5.808	nu star (KM)	6.973
theta hat (KM)	14.56	theta star (KM)	12.12
80% gamma percentile (KM)	0.009	90% gamma percentile (KM)	0.309
95% gamma percentile (KM)	1.731	99% gamma percentile (KM)	10.17

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.97, α)	2.156	Adjusted Chi Square Value (6.97, β)	2.119
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.315	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.338

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.939	Detected Data Not Lognormal at 5% Significance Level

Subsurface Soil Wilcox Process Area ProUCLOutputs

Lilliefors Test Statistic	0.112	Lilliefors GOF Test
5% Lilliefors Critical Value	0.14	Detected Data appear Lognormal at 5% Significance Level
Detected Data appear Approximate Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.404	Mean in Log Scale	-4.697
SD in Original Scale	2.444	SD in Log Scale	2.413
95% t UCL (assumes normality of ROS data)	0.802	95% Percentile Bootstrap UCL	0.844
95% BCA Bootstrap UCL	1.185	95% Bootstrap t UCL	2.008
95% H-UCL (Log ROS)	0.416		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.562	KM Geo Mean	0.0104
KM SD (logged)	2.254	95% Critical H Value (KM-Log)	3.616
KM Standard Error of Mean (logged)	0.288	95% H-UCL (KM -Log)	0.296
KM SD (logged)	2.254	95% Critical H Value (KM-Log)	3.616
KM Standard Error of Mean (logged)	0.288		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.465	Mean in Log Scale	-3.12
SD in Original Scale	2.437	SD in Log Scale	2.144
95% t UCL (Assumes normality)	0.862	95% H-Stat UCL	0.918

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.296

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

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

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

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

Benzo (b) fluoranthene

General Statistics

Total Number of Observations	104	Number of Distinct Observations	50
		Number of Missing Observations	14
Number of Detects	35	Number of Non-Detects	69
Number of Distinct Detects	33	Number of Distinct Non-Detects	21
Minimum Detect	0.0015	Minimum Non-Detect	0.0019
Maximum Detect	27	Maximum Non-Detect	1.8
Variance Detects	21.48	Percent Non-Detects	66.35%
Mean Detects	1.216	SD Detects	4.634
Median Detects	0.023	CV Detects	3.811
Skewness Detects	5.384	Kurtosis Detects	30.37
Mean of Logged Detects	-3.272	SD of Logged Detects	2.587

Subsurface Soil Wilcox Process Area ProUCLOutputs

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.292	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.415	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.423	KM Standard Error of Mean	0.27
KM SD	2.71	95% KM (BCA) UCL	0.975
95% KM (t) UCL	0.871	95% KM (Percentile Bootstrap) UCL	0.938
95% KM (z) UCL	0.867	95% KM Bootstrap t UCL	2.421
90% KM Chebyshev UCL	1.232	95% KM Chebyshev UCL	1.599
97.5% KM Chebyshev UCL	2.107	99% KM Chebyshev UCL	3.106

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.845	Anderson-Darling GOF Test
5% A-D Critical Value	0.902	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.31	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.165	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.211	k star (bias corrected MLE)	0.212
Theta hat (MLE)	5.777	Theta star (bias corrected MLE)	5.749
nu hat (MLE)	14.74	nu star (bias corrected)	14.81
Mean (detects)	1.216		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0015	Mean	0.478
Maximum	27	Median	0.01
SD	2.728	CV	5.711
k hat (MLE)	0.23	k star (bias corrected MLE)	0.23
Theta hat (MLE)	2.076	Theta star (bias corrected MLE)	2.078
nu hat (MLE)	47.85	nu star (bias corrected)	47.8
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (47.80, α)	32.94	Adjusted Chi Square Value (47.80, β)	32.76
95% Gamma Approximate UCL (use when $n \geq 50$)	0.693	95% Gamma Adjusted UCL (use when $n < 50$)	0.697

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.423	SD (KM)	2.71
Variance (KM)	7.341	SE of Mean (KM)	0.27
k hat (KM)	0.0244	k star (KM)	0.0301
nu hat (KM)	5.078	nu star (KM)	6.265

Subsurface Soil Wilcox Process Area ProUCLOutputs

theta hat (KM)	17.34	theta star (KM)	14.06
80% gamma percentile (KM)	0.0049	90% gamma percentile (KM)	0.249
95% gamma percentile (KM)	1.645	99% gamma percentile (KM)	10.92

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.26, α)	1.777	Adjusted Chi Square Value (6.26, β)	1.744
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.493	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.521

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.915	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.934	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.135	Lilliefors GOF Test
5% Lilliefors Critical Value	0.148	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.422	Mean in Log Scale	-4.747
SD in Original Scale	2.723	SD in Log Scale	2.378
95% t UCL (assumes normality of ROS data)	0.865	95% Percentile Bootstrap UCL	0.93
95% BCA Bootstrap UCL	1.31	95% Bootstrap t UCL	2.443
95% H-UCL (Log ROS)	0.354		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.538	KM Geo Mean	0.0107
KM SD (logged)	2.132	95% Critical H Value (KM-Log)	3.464
KM Standard Error of Mean (logged)	0.277	95% H-UCL (KM -Log)	0.215
KM SD (logged)	2.132	95% Critical H Value (KM-Log)	3.464
KM Standard Error of Mean (logged)	0.277		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.49	Mean in Log Scale	-3.033
SD in Original Scale	2.715	SD in Log Scale	2.083
95% t UCL (Assumes normality)	0.932	95% H-Stat UCL	0.848

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	0.215

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

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

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

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

Dibenz (a,h) anthracene

General Statistics

Subsurface Soil Wilcox Process Area ProUCLOutputs

Total Number of Observations	104	Number of Distinct Observations	42
		Number of Missing Observations	14
Number of Detects	21	Number of Non-Detects	83
Number of Distinct Detects	21	Number of Distinct Non-Detects	24
Minimum Detect	9.3000E-4	Minimum Non-Detect	0.0019
Maximum Detect	4	Maximum Non-Detect	1.8
Variance Detects	0.818	Percent Non-Detects	79.81%
Mean Detects	0.339	SD Detects	0.904
Median Detects	0.0081	CV Detects	2.664
Skewness Detects	3.702	Kurtosis Detects	14.73
Mean of Logged Detects	-3.936	SD of Logged Detects	2.477

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.432	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.383	Lilliefors GOF Test
5% Lilliefors Critical Value	0.188	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0753	KM Standard Error of Mean	0.0424
KM SD	0.42	95% KM (BCA) UCL	0.151
95% KM (t) UCL	0.146	95% KM (Percentile Bootstrap) UCL	0.151
95% KM (z) UCL	0.145	95% KM Bootstrap t UCL	0.318
90% KM Chebyshev UCL	0.202	95% KM Chebyshev UCL	0.26
97.5% KM Chebyshev UCL	0.34	99% KM Chebyshev UCL	0.497

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.124	Anderson-Darling GOF Test
5% A-D Critical Value	0.871	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.287	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.208	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.249	k star (bias corrected MLE)	0.245
Theta hat (MLE)	1.364	Theta star (bias corrected MLE)	1.385
nu hat (MLE)	10.45	nu star (bias corrected)	10.29
Mean (detects)	0.339		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	9.3000E-4	Mean	0.0925
Maximum	4	Median	0.01
SD	0.423	CV	4.573
k hat (MLE)	0.359	k star (bias corrected MLE)	0.355

Subsurface Soil Wilcox Process Area ProUCLOutputs

Theta hat (MLE)	0.258	Theta star (bias corrected MLE)	0.261
nu hat (MLE)	74.6	nu star (bias corrected)	73.79
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (73.79, α)	55	Adjusted Chi Square Value (73.79, β)	54.78
95% Gamma Approximate UCL (use when $n \geq 50$)	0.124	95% Gamma Adjusted UCL (use when $n < 50$)	0.125

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0753	SD (KM)	0.42
Variance (KM)	0.176	SE of Mean (KM)	0.0424
k hat (KM)	0.0322	k star (KM)	0.0377
nu hat (KM)	6.7	nu star (KM)	7.84
theta hat (KM)	2.339	theta star (KM)	1.999
80% gamma percentile (KM)	0.00311	90% gamma percentile (KM)	0.0732
95% gamma percentile (KM)	0.349	99% gamma percentile (KM)	1.817

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.84, α)	2.643	Adjusted Chi Square Value (7.84, β)	2.6
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.223	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.227

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.188	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0735	Mean in Log Scale	-5.932
SD in Original Scale	0.421	SD in Log Scale	2.155
95% t UCL (assumes normality of ROS data)	0.142	95% Percentile Bootstrap UCL	0.15
95% BCA Bootstrap UCL	0.204	95% Bootstrap t UCL	0.348
95% H-UCL (Log ROS)	0.0568		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.556	KM Geo Mean	0.00387
KM SD (logged)	1.734	95% Critical H Value (KM-Log)	2.985
KM Standard Error of Mean (logged)	0.259	95% H-UCL (KM -Log)	0.029
KM SD (logged)	1.734	95% Critical H Value (KM-Log)	2.985
KM Standard Error of Mean (logged)	0.259		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.176	Mean in Log Scale	-3.002
SD in Original Scale	0.429	SD in Log Scale	1.93
95% t UCL (Assumes normality)	0.245	95% H-Stat UCL	0.59

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Subsurface Soil Wilcox Process Area ProUCLOutputs

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.26

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

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

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

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

Indeno (1,2,3-cd) pyrene

General Statistics

Total Number of Observations	104	Number of Distinct Observations	44
		Number of Missing Observations	14
Number of Detects	30	Number of Non-Detects	74
Number of Distinct Detects	23	Number of Distinct Non-Detects	23
Minimum Detect	4.8000E-4	Minimum Non-Detect	0.0019
Maximum Detect	4	Maximum Non-Detect	1.8
Variance Detects	0.589	Percent Non-Detects	71.15%
Mean Detects	0.244	SD Detects	0.768
Median Detects	0.009	CV Detects	3.147
Skewness Detects	4.428	Kurtosis Detects	21.18
Mean of Logged Detects	-4.434	SD of Logged Detects	2.404

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.366	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.417	Lilliefors GOF Test
5% Lilliefors Critical Value	0.159	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0777	KM Standard Error of Mean	0.0421
KM SD	0.42	95% KM (BCA) UCL	0.16
95% KM (t) UCL	0.148	95% KM (Percentile Bootstrap) UCL	0.154
95% KM (z) UCL	0.147	95% KM Bootstrap t UCL	0.31
90% KM Chebyshev UCL	0.204	95% KM Chebyshev UCL	0.261
97.5% KM Chebyshev UCL	0.341	99% KM Chebyshev UCL	0.497

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.279	Anderson-Darling GOF Test
5% A-D Critical Value	0.885	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.176	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.237	k star (bias corrected MLE)	0.236
Theta hat (MLE)	1.029	Theta star (bias corrected MLE)	1.036
nu hat (MLE)	14.22	nu star (bias corrected)	14.13
Mean (detects)	0.244		

Subsurface Soil Wilcox Process Area ProUCLOutputs

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.8000E-4	Mean	0.0938
Maximum	4	Median	0.01
SD	0.424	CV	4.519
k hat (MLE)	0.343	k star (bias corrected MLE)	0.34
Theta hat (MLE)	0.273	Theta star (bias corrected MLE)	0.276
nu hat (MLE)	71.41	nu star (bias corrected)	70.68
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (70.68, α)	52.32	Adjusted Chi Square Value (70.68, β)	52.1
95% Gamma Approximate UCL (use when $n \geq 50$)	0.127	95% Gamma Adjusted UCL (use when $n < 50$)	0.127

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0777	SD (KM)	0.42
Variance (KM)	0.177	SE of Mean (KM)	0.0421
k hat (KM)	0.0342	k star (KM)	0.0396
nu hat (KM)	7.112	nu star (KM)	8.241
theta hat (KM)	2.274	theta star (KM)	1.962
80% gamma percentile (KM)	0.00408	90% gamma percentile (KM)	0.0829
95% gamma percentile (KM)	0.371	99% gamma percentile (KM)	1.843

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.24, α)	2.875	Adjusted Chi Square Value (8.24, β)	2.831
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.223	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.226

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.146	Lilliefors GOF Test
5% Lilliefors Critical Value	0.159	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0754	Mean in Log Scale	-5.557
SD in Original Scale	0.421	SD in Log Scale	1.946
95% t UCL (assumes normality of ROS data)	0.144	95% Percentile Bootstrap UCL	0.149
95% BCA Bootstrap UCL	0.207	95% Bootstrap t UCL	0.344
95% H-UCL (Log ROS)	0.0477		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.497	KM Geo Mean	0.0041
KM SD (logged)	1.848	95% Critical H Value (KM-Log)	3.119
KM Standard Error of Mean (logged)	0.262	95% H-UCL (KM -Log)	0.0399
KM SD (logged)	1.848	95% Critical H Value (KM-Log)	3.119
KM Standard Error of Mean (logged)	0.262		

Subsurface Soil Wilcox Process Area ProUCLOutputs

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.17	Mean in Log Scale	-3.263
SD in Original Scale	0.431	SD in Log Scale	2.111
95% t UCL (Assumes normality)	0.24	95% H-Stat UCL	0.727

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 0.0399

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

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

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

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

Naphthalene

General Statistics

Total Number of Observations	104	Number of Distinct Observations	60
		Number of Missing Observations	14
Number of Detects	52	Number of Non-Detects	52
Number of Distinct Detects	47	Number of Distinct Non-Detects	15
Minimum Detect	0.0011	Minimum Non-Detect	0.0019
Maximum Detect	67	Maximum Non-Detect	1.8
Variance Detects	107.6	Percent Non-Detects	50%
Mean Detects	2.932	SD Detects	10.37
Median Detects	0.0515	CV Detects	3.537
Skewness Detects	5.347	Kurtosis Detects	30.72
Mean of Logged Detects	-2.434	SD of Logged Detects	2.887

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.322
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.389
5% Lilliefors Critical Value	0.122

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	1.479	KM Standard Error of Mean	0.733
KM SD	7.407	95% KM (BCA) UCL	2.885
95% KM (t) UCL	2.697	95% KM (Percentile Bootstrap) UCL	2.809
95% KM (z) UCL	2.686	95% KM Bootstrap t UCL	6.588
90% KM Chebyshev UCL	3.679	95% KM Chebyshev UCL	4.676
97.5% KM Chebyshev UCL	6.059	99% KM Chebyshev UCL	8.776

Gamma GOF Tests on Detected Observations Only

Subsurface Soil Wilcox Process Area ProUCLOutputs

A-D Test Statistic	3.865	Anderson-Darling GOF Test
5% A-D Critical Value	0.908	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.215	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.137	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	14.08	Theta star (bias corrected MLE)	14.02
nu hat (MLE)	21.66	nu star (bias corrected)	21.75
Mean (detects)	2.932		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	1.479
Maximum	67	Median	0.01
SD	7.443	CV	5.032
k hat (MLE)	0.193	k star (bias corrected MLE)	0.194
Theta hat (MLE)	7.674	Theta star (bias corrected MLE)	7.64
nu hat (MLE)	40.09	nu star (bias corrected)	40.27
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (40.27, α)	26.73	Adjusted Chi Square Value (40.27, β)	26.57
95% Gamma Approximate UCL (use when $n \geq 50$)	2.228	95% Gamma Adjusted UCL (use when $n < 50$)	2.241

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.479	SD (KM)	7.407
Variance (KM)	54.86	SE of Mean (KM)	0.733
k hat (KM)	0.0399	k star (KM)	0.0451
nu hat (KM)	8.297	nu star (KM)	9.391
theta hat (KM)	37.09	theta star (KM)	32.76
80% gamma percentile (KM)	0.137	90% gamma percentile (KM)	1.957
95% gamma percentile (KM)	7.549	99% gamma percentile (KM)	33.47

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.39, α)	3.565	Adjusted Chi Square Value (9.39, β)	3.514
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	3.897	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.953

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.941	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0.0192	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	Lilliefors GOF Test
5% Lilliefors Critical Value	0.122	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.478	Mean in Log Scale	-3.849

Subsurface Soil Wilcoxon Process Area ProUCLOutputs

SD in Original Scale	7.443	SD in Log Scale	2.86
95% t UCL (assumes normality of ROS data)	2.689	95% Percentile Bootstrap UCL	2.829
95% BCA Bootstrap UCL	3.541	95% Bootstrap t UCL	6.563
95% H-UCL (Log ROS)	4.386		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.713	KM Geo Mean	0.0244
KM SD (logged)	2.644	95% Critical H Value (KM-Log)	4.114
KM Standard Error of Mean (logged)	0.299	95% H-UCL (KM -Log)	2.352
KM SD (logged)	2.644	95% Critical H Value (KM-Log)	4.114
KM Standard Error of Mean (logged)	0.299		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	1.528
SD in Original Scale	7.434
95% t UCL (Assumes normality)	2.738

DL/2 Log-Transformed

Mean in Log Scale	-2.682
SD in Log Scale	2.422
95% H-Stat UCL	3.199

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL	2.352

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

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

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

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

Benzene

General Statistics

Total Number of Observations	40	Number of Distinct Observations	29
		Number of Missing Observations	63
Number of Detects	14	Number of Non-Detects	26
Number of Distinct Detects	14	Number of Distinct Non-Detects	15
Minimum Detect	0.0064	Minimum Non-Detect	0.0044
Maximum Detect	4.8	Maximum Non-Detect	18
Variance Detects	2.94	Percent Non-Detects	65%
Mean Detects	1.185	SD Detects	1.715
Median Detects	0.189	CV Detects	1.447
Skewness Detects	1.277	Kurtosis Detects	0.0418
Mean of Logged Detects	-1.443	SD of Logged Detects	2.218

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.714
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.328
5% Lilliefors Critical Value	0.226

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Subsurface Soil Wilcox Process Area ProUCLOutputs

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.444	KM Standard Error of Mean	0.195
KM SD	1.154	95% KM (BCA) UCL	0.777
95% KM (t) UCL	0.772	95% KM (Percentile Bootstrap) UCL	0.773
95% KM (z) UCL	0.764	95% KM Bootstrap t UCL	0.97
90% KM Chebyshev UCL	1.028	95% KM Chebyshev UCL	1.292
97.5% KM Chebyshev UCL	1.659	99% KM Chebyshev UCL	2.381

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.581	Anderson-Darling GOF Test
5% A-D Critical Value	0.811	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.184	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.245	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.407	k star (bias corrected MLE)	0.367
Theta hat (MLE)	2.913	Theta star (bias corrected MLE)	3.227
nu hat (MLE)	11.39	nu star (bias corrected)	10.29
Mean (detects)	1.185		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0064	Mean	0.421
Maximum	4.8	Median	0.01
SD	1.141	CV	2.709
k hat (MLE)	0.267	k star (bias corrected MLE)	0.263
Theta hat (MLE)	1.579	Theta star (bias corrected MLE)	1.599
nu hat (MLE)	21.35	nu star (bias corrected)	21.08
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (21.08, α)	11.65	Adjusted Chi Square Value (21.08, β)	11.39
95% Gamma Approximate UCL (use when $n \geq 50$)	0.762	95% Gamma Adjusted UCL (use when $n < 50$)	0.78

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.444	SD (KM)	1.154
Variance (KM)	1.332	SE of Mean (KM)	0.195
k hat (KM)	0.148	k star (KM)	0.153
nu hat (KM)	11.82	nu star (KM)	12.26
theta hat (KM)	3.003	theta star (KM)	2.894
80% gamma percentile (KM)	0.491	90% gamma percentile (KM)	1.319
95% gamma percentile (KM)	2.431	99% gamma percentile (KM)	5.643

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.26, α)	5.4	Adjusted Chi Square Value (12.26, β)	5.23

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95% Gamma Approximate KM-UCL (use when $n \geq 50$) 1.007 95% Gamma Adjusted KM-UCL (use when $n < 50$) 1.04

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.935	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.142	Lilliefors GOF Test
5% Lilliefors Critical Value	0.226	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.416	Mean in Log Scale	-5.181
SD in Original Scale	1.143	SD in Log Scale	3.264
95% t UCL (assumes normality of ROS data)	0.72	95% Percentile Bootstrap UCL	0.723
95% BCA Bootstrap UCL	0.804	95% Bootstrap t UCL	0.938
95% H-UCL (Log ROS)	23.38		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.901	KM Geo Mean	0.0202
KM SD (logged)	2.323	95% Critical H Value (KM-Log)	4.265
KM Standard Error of Mean (logged)	0.397	95% H-UCL (KM -Log)	1.466
KM SD (logged)	2.323	95% Critical H Value (KM-Log)	4.265
KM Standard Error of Mean (logged)	0.397		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.747	Mean in Log Scale	-3.633
SD in Original Scale	1.793	SD in Log Scale	2.866
95% t UCL (Assumes normality)	1.225	95% H-Stat UCL	16.8

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$ but $k \leq 1$) 1.04

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

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

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

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

Chloroform

General Statistics

Total Number of Observations	40	Number of Distinct Observations	25
		Number of Missing Observations	63
Number of Detects	2	Number of Non-Detects	38
Number of Distinct Detects	2	Number of Distinct Non-Detects	23
Minimum Detect	10	Minimum Non-Detect	0.0044
Maximum Detect	22	Maximum Non-Detect	18

Subsurface Soil Wilcox Process Area ProUCLOutputs

Variance Detects	72	Percent Non-Detects	95%
Mean Detects	16	SD Detects	8.485
Median Detects	16	CV Detects	0.53
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	2.697	SD of Logged Detects	0.558

Warning: Data set has only 2 Detected Values.

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

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

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

KM Mean	0.811	KM Standard Error of Mean	0.839
KM SD	3.743	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.224	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.191	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3.327	95% KM Chebyshev UCL	4.467
97.5% KM Chebyshev UCL	6.05	99% KM Chebyshev UCL	9.157

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	6.761	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.367	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	27.04	nu star (bias corrected)	N/A
Mean (detects)	16		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.811	SD (KM)	3.743
Variance (KM)	14.01	SE of Mean (KM)	0.839
k hat (KM)	0.0469	k star (KM)	0.0601
nu hat (KM)	3.754	nu star (KM)	4.806
theta hat (KM)	17.28	theta star (KM)	13.5
80% gamma percentile (KM)	0.196	90% gamma percentile (KM)	1.527
95% gamma percentile (KM)	4.545	99% gamma percentile (KM)	16.35

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.044
Approximate Chi Square Value (4.81, α)	1.063	Adjusted Chi Square Value (4.81, β)	1.001
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	3.664	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.894
95% Gamma Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$)			

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.325	Mean in Log Scale	-0.65

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SD in Original Scale	3.691	SD in Log Scale	1.039
95% t UCL (assumes normality of ROS data)	2.308	95% Percentile Bootstrap UCL	2.368
95% BCA Bootstrap UCL	3.135	95% Bootstrap t UCL	8.901
95% H-UCL (Log ROS)	1.346		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.015	KM Geo Mean	0.00664
KM SD (logged)	1.782	95% Critical H Value (KM-Log)	3.453
KM Standard Error of Mean (logged)	0.401	95% H-UCL (KM -Log)	0.0871
KM SD (logged)	1.782	95% Critical H Value (KM-Log)	3.453
KM Standard Error of Mean (logged)	0.401		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	1.14
SD in Original Scale	3.993
95% t UCL (Assumes normality)	2.204

DL/2 Log-Transformed

Mean in Log Scale	-4.331
SD in Log Scale	2.703
95% H-Stat UCL	4.147

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	4.467

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

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

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

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

Ethylbenzene

General Statistics

Total Number of Observations	40	Number of Distinct Observations	29
		Number of Missing Observations	63
Number of Detects	14	Number of Non-Detects	26
Number of Distinct Detects	14	Number of Distinct Non-Detects	15
Minimum Detect	0.0072	Minimum Non-Detect	0.0044
Maximum Detect	28	Maximum Non-Detect	5.3
Variance Detects	81.49	Percent Non-Detects	65%
Mean Detects	7.509	SD Detects	9.027
Median Detects	3.725	CV Detects	1.202
Skewness Detects	1.162	Kurtosis Detects	0.455
Mean of Logged Detects	0.418	SD of Logged Detects	2.645

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.827
5% Shapiro Wilk Critical Value	0.874
Lilliefors Test Statistic	0.238
5% Lilliefors Critical Value	0.226

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Subsurface Soil Wilcoxon Process Area ProUCLOutputs

Detected Data Not Normal at 5% Significance Level

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

KM Mean	2.638	KM Standard Error of Mean	1.028
KM SD	6.267	95% KM (BCA) UCL	4.456
95% KM (t) UCL	4.37	95% KM (Percentile Bootstrap) UCL	4.366
95% KM (z) UCL	4.329	95% KM Bootstrap t UCL	5.217
90% KM Chebyshev UCL	5.723	95% KM Chebyshev UCL	7.12
97.5% KM Chebyshev UCL	9.06	99% KM Chebyshev UCL	12.87

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.287	Anderson-Darling GOF Test
5% A-D Critical Value	0.811	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.244	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.41	k star (bias corrected MLE)	0.37
Theta hat (MLE)	18.31	Theta star (bias corrected MLE)	20.3
nu hat (MLE)	11.48	nu star (bias corrected)	10.36
Mean (detects)	7.509		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0072	Mean	2.635
Maximum	28	Median	0.01
SD	6.347	CV	2.409
k hat (MLE)	0.194	k star (bias corrected MLE)	0.196
Theta hat (MLE)	13.59	Theta star (bias corrected MLE)	13.45
nu hat (MLE)	15.5	nu star (bias corrected)	15.67
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (15.67, α)	7.733	Adjusted Chi Square Value (15.67, β)	7.524
95% Gamma Approximate UCL (use when $n \geq 50$)	5.34	95% Gamma Adjusted UCL (use when $n < 50$)	5.489

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.638	SD (KM)	6.267
Variance (KM)	39.27	SE of Mean (KM)	1.028
k hat (KM)	0.177	k star (KM)	0.181
nu hat (KM)	14.17	nu star (KM)	14.44
theta hat (KM)	14.89	theta star (KM)	14.61
80% gamma percentile (KM)	3.278	90% gamma percentile (KM)	7.956
95% gamma percentile (KM)	13.94	99% gamma percentile (KM)	30.72

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (14.44, α)	6.875	Adjusted Chi Square Value (14.44, β)	6.679

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95% Gamma Approximate KM-UCL (use when $n \geq 50$) 5.541 95% Gamma Adjusted KM-UCL (use when $n < 50$) 5.703

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.191	Lilliefors GOF Test
5% Lilliefors Critical Value	0.226	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.63	Mean in Log Scale	-4.251
SD in Original Scale	6.349	SD in Log Scale	3.994
95% t UCL (assumes normality of ROS data)	4.321	95% Percentile Bootstrap UCL	4.371
95% BCA Bootstrap UCL	4.76	95% Bootstrap t UCL	5.391
95% H-UCL (Log ROS)	3507		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.329	KM Geo Mean	0.0358
KM SD (logged)	3.17	95% Critical H Value (KM-Log)	5.598
KM Standard Error of Mean (logged)	0.525	95% H-UCL (KM -Log)	93.28
KM SD (logged)	3.17	95% Critical H Value (KM-Log)	5.598
KM Standard Error of Mean (logged)	0.525		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.735	Mean in Log Scale	-3.18
SD in Original Scale	6.321	SD in Log Scale	3.479
95% t UCL (Assumes normality)	4.419	95% H-Stat UCL	528.3

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$ but $k \leq 1$) 5.703

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

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

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

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

m, p-Xylene

General Statistics

Total Number of Observations	40	Number of Distinct Observations	34
		Number of Missing Observations	63
Number of Detects	14	Number of Non-Detects	26
Number of Distinct Detects	14	Number of Distinct Non-Detects	20
Minimum Detect	0.261	Minimum Non-Detect	0.0044
Maximum Detect	68	Maximum Non-Detect	5.3

Subsurface Soil Wilcox Process Area ProUCLOutputs

Variance Detects	390	Percent Non-Detects	65%
Mean Detects	12.86	SD Detects	19.75
Median Detects	3.375	CV Detects	1.535
Skewness Detects	1.97	Kurtosis Detects	3.959
Mean of Logged Detects	1.082	SD of Logged Detects	1.976

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.7	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.319	Lilliefors GOF Test
5% Lilliefors Critical Value	0.226	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	4.511	KM Standard Error of Mean	2.103
KM SD	12.82	95% KM (BCA) UCL	8.115
95% KM (t) UCL	8.055	95% KM (Percentile Bootstrap) UCL	8.131
95% KM (z) UCL	7.971	95% KM Bootstrap t UCL	11.51
90% KM Chebyshev UCL	10.82	95% KM Chebyshev UCL	13.68
97.5% KM Chebyshev UCL	17.65	99% KM Chebyshev UCL	25.44

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.924	Anderson-Darling GOF Test
5% A-D Critical Value	0.805	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.289	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.243	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.44	k star (bias corrected MLE)	0.393
Theta hat (MLE)	29.23	Theta star (bias corrected MLE)	32.7
nu hat (MLE)	12.32	nu star (bias corrected)	11.01
Mean (detects)	12.86		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.509
Maximum	68	Median	0.01
SD	12.98	CV	2.88
k hat (MLE)	0.181	k star (bias corrected MLE)	0.184
Theta hat (MLE)	24.87	Theta star (bias corrected MLE)	24.45
nu hat (MLE)	14.51	nu star (bias corrected)	14.75
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (14.75, α)	7.088	Adjusted Chi Square Value (14.75, β)	6.889
95% Gamma Approximate UCL (use when $n \geq 50$)	9.382	95% Gamma Adjusted UCL (use when $n < 50$)	9.654

Subsurface Soil Wilcox Process Area ProUCLOutputs

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.511	SD (KM)	12.82
Variance (KM)	164.3	SE of Mean (KM)	2.103
k hat (KM)	0.124	k star (KM)	0.131
nu hat (KM)	9.907	nu star (KM)	10.5
theta hat (KM)	36.43	theta star (KM)	34.38
80% gamma percentile (KM)	4.35	90% gamma percentile (KM)	13.06
95% gamma percentile (KM)	25.42	99% gamma percentile (KM)	62.33

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.50, α)	4.255	Adjusted Chi Square Value (10.50, β)	4.107
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	11.13	95% Gamma Adjusted KM-UCL (use when $n < 50$)	11.53

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.276	Lilliefors GOF Test
5% Lilliefors Critical Value	0.226	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.511	Mean in Log Scale	-2.689
SD in Original Scale	12.98	SD in Log Scale	3.122
95% t UCL (assumes normality of ROS data)	7.969	95% Percentile Bootstrap UCL	8.139
95% BCA Bootstrap UCL	9.477	95% Bootstrap t UCL	11.71
95% H-UCL (Log ROS)	140.4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.091	KM Geo Mean	0.0455
KM SD (logged)	3.303	95% Critical H Value (KM-Log)	5.812
KM Standard Error of Mean (logged)	0.548	95% H-UCL (KM -Log)	230
KM SD (logged)	3.303	95% Critical H Value (KM-Log)	5.812
KM Standard Error of Mean (logged)	0.548		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.613	Mean in Log Scale	-2.601
SD in Original Scale	12.95	SD in Log Scale	3.323
95% t UCL (Assumes normality)	8.064	95% H-Stat UCL	416.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	13.68

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

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

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

Subsurface Soil Wilcox Process Area ProUCLOutputs

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

Subsurface Soil East Tank Farm ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/11/2019 12:14:58 PM
 From File ProUCL Inputs Hhra ETF SB.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	41	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	1970	Mean	7164
Maximum	16400	Median	6470
SD	3559	Std. Error of Mean	555.9
Coefficient of Variation	0.497	Skewness	0.977

Normal GOF Test

Shapiro Wilk Test Statistic 0.916
 5% Shapiro Wilk Critical Value 0.941
 Lilliefors Test Statistic 0.166
 5% Lilliefors Critical Value 0.137

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8100

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8169

95% Modified-t UCL (Johnson-1978) 8114

Gamma GOF Test

A-D Test Statistic 0.27
 5% A-D Critical Value 0.752
 K-S Test Statistic 0.103
 5% K-S Critical Value 0.138

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.363	k star (bias corrected MLE)	4.06
Theta hat (MLE)	1642	Theta star (bias corrected MLE)	1765
nu hat (MLE)	357.7	nu star (bias corrected)	332.9
MLE Mean (bias corrected)	7164	MLE Sd (bias corrected)	3555
		Approximate Chi Square Value (0.05)	291.6
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	290.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50) 8178

95% Adjusted Gamma UCL (use when n<50) 8217

Subsurface Soil East Tank Farm ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0721	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	7.586	Mean of logged Data	8.758
Maximum of Logged Data	9.705	SD of logged Data	0.503

Assuming Lognormal Distribution

95% H-UCL	8393	90% Chebyshev (MVUE) UCL	8970
95% Chebyshev (MVUE) UCL	9775	97.5% Chebyshev (MVUE) UCL	10892
99% Chebyshev (MVUE) UCL	13087		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	8078	95% Jackknife UCL	8100
95% Standard Bootstrap UCL	8081	95% Bootstrap-t UCL	8236
95% Hall's Bootstrap UCL	8210	95% Percentile Bootstrap UCL	8082
95% BCA Bootstrap UCL	8155		
90% Chebyshev(Mean, Sd) UCL	8832	95% Chebyshev(Mean, Sd) UCL	9587
97.5% Chebyshev(Mean, Sd) UCL	10635	99% Chebyshev(Mean, Sd) UCL	12695

Suggested UCL to Use

95% Adjusted Gamma UCL	8217

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

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

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

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

Arsenic

General Statistics

Total Number of Observations	41	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	0.92	Mean	3.98
Maximum	14.4	Median	2.9
SD	3.41	Std. Error of Mean	0.533
Coefficient of Variation	0.857	Skewness	1.801

Normal GOF Test

Shapiro Wilk Test Statistic	0.77	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.228	Lilliefors GOF Test

Subsurface Soil East Tank Farm ProUCL Outputs

5% Lilliefors Critical Value 0.137

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 4.877

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 5.016

95% Modified-t UCL (Johnson-1978) 4.902

Gamma GOF Test

A-D Test Statistic 1.012

5% A-D Critical Value 0.76

K-S Test Statistic 0.136

5% K-S Critical Value 0.14

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE) 1.918

Theta hat (MLE) 2.075

nu hat (MLE) 157.3

MLE Mean (bias corrected) 3.98

Adjusted Level of Significance 0.0441

k star (bias corrected MLE) 1.794

Theta star (bias corrected MLE) 2.219

nu star (bias corrected) 147.1

MLE Sd (bias corrected) 2.972

Approximate Chi Square Value (0.05) 120.1

Adjusted Chi Square Value 119.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 4.876

95% Adjusted Gamma UCL (use when $n < 50$) 4.913

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.956

5% Shapiro Wilk Critical Value 0.941

Lilliefors Test Statistic 0.0815

5% Lilliefors Critical Value 0.137

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data -0.0834

Maximum of Logged Data 2.667

Mean of logged Data 1.099

SD of logged Data 0.737

Assuming Lognormal Distribution

95% H-UCL 5.02

95% Chebyshev (MVUE) UCL 6.055

99% Chebyshev (MVUE) UCL 8.815

90% Chebyshev (MVUE) UCL 5.384

97.5% Chebyshev (MVUE) UCL 6.986

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 4.856

95% Standard Bootstrap UCL 4.84

95% Hall's Bootstrap UCL 5.014

95% BCA Bootstrap UCL 5.001

95% Jackknife UCL 4.877

95% Bootstrap-t UCL 5.124

95% Percentile Bootstrap UCL 4.897

Subsurface Soil East Tank Farm ProUCL Outputs

90% Chebyshev(Mean, Sd) UCL	5.578	95% Chebyshev(Mean, Sd) UCL	6.302
97.5% Chebyshev(Mean, Sd) UCL	7.306	99% Chebyshev(Mean, Sd) UCL	9.279

Suggested UCL to Use

95% Adjusted Gamma UCL	4.913

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

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

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

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

Benzo (a) pyrene

General Statistics

Total Number of Observations	41	Number of Distinct Observations	18
Number of Detects	9	Number of Non-Detects	32
Number of Distinct Detects	8	Number of Distinct Non-Detects	10
Minimum Detect	0.0039	Minimum Non-Detect	0.0018
Maximum Detect	0.42	Maximum Non-Detect	0.21
Variance Detects	0.0174	Percent Non-Detects	78.05%
Mean Detects	0.0745	SD Detects	0.132
Median Detects	0.04	CV Detects	1.768
Skewness Detects	2.812	Kurtosis Detects	8.171
Mean of Logged Detects	-3.621	SD of Logged Detects	1.537

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.552	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.436	Lilliefors GOF Test
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0264	KM Standard Error of Mean	0.0118
KM SD	0.0661	95% KM (BCA) UCL	0.0488
95% KM (t) UCL	0.0463	95% KM (Percentile Bootstrap) UCL	0.0469
95% KM (z) UCL	0.0459	95% KM Bootstrap t UCL	0.0649
90% KM Chebyshev UCL	0.0619	95% KM Chebyshev UCL	0.078
97.5% KM Chebyshev UCL	0.1	99% KM Chebyshev UCL	0.144

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.604	Anderson-Darling GOF Test
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.284	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.292	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Subsurface Soil East Tank Farm ProUCL Outputs

Gamma Statistics on Detected Data Only

k hat (MLE)	0.603	k star (bias corrected MLE)	0.476
Theta hat (MLE)	0.124	Theta star (bias corrected MLE)	0.156
nu hat (MLE)	10.86	nu star (bias corrected)	8.571
Mean (detects)	0.0745		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0039	Mean	0.0304
Maximum	0.42	Median	0.01
SD	0.0669	CV	2.204
k hat (MLE)	0.837	k star (bias corrected MLE)	0.792
Theta hat (MLE)	0.0363	Theta star (bias corrected MLE)	0.0383
nu hat (MLE)	68.66	nu star (bias corrected)	64.97
Adjusted Level of Significance (β)	0.0441		
Approximate Chi Square Value (64.97, α)	47.42	Adjusted Chi Square Value (64.97, β)	46.88
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0416	95% Gamma Adjusted UCL (use when $n < 50$)	0.0421

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0264	SD (KM)	0.0661
Variance (KM)	0.00436	SE of Mean (KM)	0.0118
k hat (KM)	0.16	k star (KM)	0.164
nu hat (KM)	13.09	nu star (KM)	13.47
theta hat (KM)	0.165	theta star (KM)	0.161
80% gamma percentile (KM)	0.0308	90% gamma percentile (KM)	0.0791
95% gamma percentile (KM)	0.143	99% gamma percentile (KM)	0.324

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (13.47, α)	6.21	Adjusted Chi Square Value (13.47, β)	6.03
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.0573	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.059

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.192	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0224	Mean in Log Scale	-5.41
SD in Original Scale	0.0663	SD in Log Scale	1.75
95% t UCL (assumes normality of ROS data)	0.0398	95% Percentile Bootstrap UCL	0.0423
95% BCA Bootstrap UCL	0.0552	95% Bootstrap t UCL	0.0796
95% H-UCL (Log ROS)	0.0514		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

Subsurface Soil East Tank Farm ProUCL Outputs

KM Mean (logged)	-5.038	KM Geo Mean	0.00649
KM SD (logged)	1.556	95% Critical H Value (KM-Log)	3.029
KM Standard Error of Mean (logged)	0.385	95% H-UCL (KM -Log)	0.0458
KM SD (logged)	1.556	95% Critical H Value (KM-Log)	3.029
KM Standard Error of Mean (logged)	0.385		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0707	Mean in Log Scale	-3.483
SD in Original Scale	0.0699	SD in Log Scale	1.765
95% t UCL (Assumes normality)	0.0891	95% H-Stat UCL	0.367

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$ but $k \leq 1$) 0.059

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

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

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

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

Cobalt

General Statistics

Total Number of Observations	41	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	1.2	Mean	7.371
Maximum	29.7	Median	5.3
SD	6.507	Std. Error of Mean	1.016
Coefficient of Variation	0.883	Skewness	1.991

Normal GOF Test

Shapiro Wilk Test Statistic	0.771
5% Shapiro Wilk Critical Value	0.941
Lilliefors Test Statistic	0.218
5% Lilliefors Critical Value	0.137

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	9.082

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	9.38
95% Modified-t UCL (Johnson-1978)	9.135

Gamma GOF Test

A-D Test Statistic	0.749
5% A-D Critical Value	0.762

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Subsurface Soil East Tank Farm ProUCL Outputs

K-S Test Statistic	0.125	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	1.802	k star (bias corrected MLE)	1.686
Theta hat (MLE)	4.091	Theta star (bias corrected MLE)	4.371
nu hat (MLE)	147.7	nu star (bias corrected)	138.3
MLE Mean (bias corrected)	7.371	MLE Sd (bias corrected)	5.676
		Approximate Chi Square Value (0.05)	112.1
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	111.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	9.091	95% Adjusted Gamma UCL (use when n<50)	9.162

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0704	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.182	Mean of logged Data	1.695
Maximum of Logged Data	3.391	SD of logged Data	0.776

Assuming Lognormal Distribution

95% H-UCL	9.55	90% Chebyshev (MVUE) UCL	10.23
95% Chebyshev (MVUE) UCL	11.56	97.5% Chebyshev (MVUE) UCL	13.41
99% Chebyshev (MVUE) UCL	17.03		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	9.042	95% Jackknife UCL	9.082
95% Standard Bootstrap UCL	9.007	95% Bootstrap-t UCL	9.606
95% Hall's Bootstrap UCL	9.585	95% Percentile Bootstrap UCL	9.083
95% BCA Bootstrap UCL	9.441		
90% Chebyshev(Mean, Sd) UCL	10.42	95% Chebyshev(Mean, Sd) UCL	11.8
97.5% Chebyshev(Mean, Sd) UCL	13.72	99% Chebyshev(Mean, Sd) UCL	17.48

Suggested UCL to Use

95% Adjusted Gamma UCL	9.162

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

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

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

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

Subsurface Soil East Tank Farm ProUCL Outputs

Iron

General Statistics

Total Number of Observations	41	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	5470	Mean	16133
Maximum	65800	Median	13400
SD	10918	Std. Error of Mean	1705
Coefficient of Variation	0.677	Skewness	2.622

Normal GOF Test

Shapiro Wilk Test Statistic	0.765	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.941	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.186	Lilliefors GOF Test
5% Lilliefors Critical Value	0.137	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 19004

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 19683

95% Modified-t UCL (Johnson-1978) 19120

Gamma GOF Test

A-D Test Statistic	0.732	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.136	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.298	k star (bias corrected MLE)	3.073
Theta hat (MLE)	4892	Theta star (bias corrected MLE)	5250
nu hat (MLE)	270.4	nu star (bias corrected)	252
MLE Mean (bias corrected)	16133	MLE Sd (bias corrected)	9203
		Approximate Chi Square Value (0.05)	216.2
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	215

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 18800

95% Adjusted Gamma UCL (use when $n < 50$) 18906

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.969	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0993	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.607	Mean of logged Data	9.529

Subsurface Soil East Tank Farm ProUCL Outputs

Maximum of Logged Data 11.09

SD of logged Data 0.544

Assuming Lognormal Distribution

95% H-UCL 18835	90% Chebyshev (MVUE) UCL 20171
95% Chebyshev (MVUE) UCL 22110	97.5% Chebyshev (MVUE) UCL 24802
99% Chebyshev (MVUE) UCL 30090	

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 18937	95% Jackknife UCL 19004
95% Standard Bootstrap UCL 18927	95% Bootstrap-t UCL 20118
95% Hall's Bootstrap UCL 21800	95% Percentile Bootstrap UCL 19028
95% BCA Bootstrap UCL 19713	
90% Chebyshev(Mean, Sd) UCL 21248	95% Chebyshev(Mean, Sd) UCL 23565
97.5% Chebyshev(Mean, Sd) UCL 26781	99% Chebyshev(Mean, Sd) UCL 33098

Suggested UCL to Use

95% Adjusted Gamma UCL 18906

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

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

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

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

Manganese

General Statistics

Total Number of Observations 41	Number of Distinct Observations 41
	Number of Missing Observations 0
Minimum 16.8	Mean 195.6
Maximum 992	Median 103
SD 253.3	Std. Error of Mean 39.55
Coefficient of Variation 1.295	Skewness 2.365

Normal GOF Test

Shapiro Wilk Test Statistic 0.619	
5% Shapiro Wilk Critical Value 0.941	
Lilliefors Test Statistic 0.281	
5% Lilliefors Critical Value 0.137	

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 262.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 276.3

95% Modified-t UCL (Johnson-1978) 264.6

Gamma GOF Test

Subsurface Soil East Tank Farm ProUCL Outputs

A-D Test Statistic	1.943	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.776	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.142	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1.079	k star (bias corrected MLE)	1.017
Theta hat (MLE)	181.2	Theta star (bias corrected MLE)	192.4
nu hat (MLE)	88.51	nu star (bias corrected)	83.36
MLE Mean (bias corrected)	195.6	MLE Sd (bias corrected)	194
		Approximate Chi Square Value (0.05)	63.32
Adjusted Level of Significance	0.0441	Adjusted Chi Square Value	62.68

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	257.5	95% Adjusted Gamma UCL (use when $n < 50$)	260.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.941	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.107	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.821	Mean of logged Data	4.746
Maximum of Logged Data	6.9	SD of logged Data	0.977

Assuming Lognormal Distribution

95% H-UCL	265.9	90% Chebyshev (MVUE) UCL	279.5
95% Chebyshev (MVUE) UCL	323.5	97.5% Chebyshev (MVUE) UCL	384.5
99% Chebyshev (MVUE) UCL	504.3		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	260.6	95% Jackknife UCL	262.2
95% Standard Bootstrap UCL	259.5	95% Bootstrap-t UCL	292.3
95% Hall's Bootstrap UCL	263.6	95% Percentile Bootstrap UCL	263.1
95% BCA Bootstrap UCL	278.4		
90% Chebyshev(Mean, Sd) UCL	314.2	95% Chebyshev(Mean, Sd) UCL	368
97.5% Chebyshev(Mean, Sd) UCL	442.6	99% Chebyshev(Mean, Sd) UCL	589.1

Suggested UCL to Use

95% H-UCL	265.9

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

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

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

Subsurface Soil East Tank Farm ProUCL Outputs

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Groundwater (MW) ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.17/9/2019 11:18:18 AM
 From File GWMW ProUCL Inputs.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

ALUMINUM

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	50.4	Mean	3918
Maximum	12900	Median	787.5
SD	5571	Std. Error of Mean	2274
Coefficient of Variation	1.422	Skewness	1.153

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic 0.757
 5% Shapiro Wilk Critical Value 0.788
 Lilliefors Test Statistic 0.34
 5% Lilliefors Critical Value 0.325

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8501

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8803

95% Modified-t UCL (Johnson-1978) 8680

Gamma GOF Test

A-D Test Statistic 0.466
 5% A-D Critical Value 0.753
 K-S Test Statistic 0.274
 5% K-S Critical Value 0.353

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.389	k star (bias corrected MLE)	0.306
Theta hat (MLE)	10059	Theta star (bias corrected MLE)	12810
nu hat (MLE)	4.674	nu star (bias corrected)	3.67
MLE Mean (bias corrected)	3918	MLE Sd (bias corrected)	7084
		Approximate Chi Square Value (0.05)	0.596

Groundwater (MW) ProUCL Outputs

Adjusted Level of Significance 0.0122

Adjusted Chi Square Value 0.281

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 24131

95% Adjusted Gamma UCL (use when $n < 50$) 51214

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.891
5% Shapiro Wilk Critical Value 0.788
Lilliefors Test Statistic 0.232
5% Lilliefors Critical Value 0.325

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 3.92
Maximum of Logged Data 9.465

Mean of logged Data 6.576
SD of logged Data 2.373

Assuming Lognormal Distribution

95% H-UCL 1.824E+8
95% Chebyshev (MVUE) UCL 20633
99% Chebyshev (MVUE) UCL 41167

90% Chebyshev (MVUE) UCL 15642
97.5% Chebyshev (MVUE) UCL 27560

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL 7659
95% Standard Bootstrap UCL 7330
95% Hall's Bootstrap UCL 67317
95% BCA Bootstrap UCL 8098
90% Chebyshev(Mean, Sd) UCL 10741
97.5% Chebyshev(Mean, Sd) UCL 18122

95% Jackknife UCL 8501
95% Bootstrap-t UCL 32036
95% Percentile Bootstrap UCL 7523
95% Chebyshev(Mean, Sd) UCL 13832
99% Chebyshev(Mean, Sd) UCL 26548

Suggested UCL to Use

95% Adjusted Gamma UCL 51214

Recommended UCL exceeds the maximum observation

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

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

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

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

ARSENIC

General Statistics

Total Number of Observations 6
Number of Detects 5
Number of Distinct Detects 5
Minimum Detect 4.2
Maximum Detect 28.3

Number of Distinct Observations 6
Number of Non-Detects 1
Number of Distinct Non-Detects 1
Minimum Non-Detect 2
Maximum Non-Detect 2

Groundwater (MW) ProUCL Outputs

Variance Detects	91.39	Percent Non-Detects	16.67%
Mean Detects	13.54	SD Detects	9.56
Median Detects	10.4	CV Detects	0.706
Skewness Detects	1.05	Kurtosis Detects	0.485
Mean of Logged Detects	2.397	SD of Logged Detects	0.737

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.924	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.229	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	11.62	KM Standard Error of Mean	4.068
KM SD	8.912	95% KM (BCA) UCL	17.95
95% KM (t) UCL	19.81	95% KM (Percentile Bootstrap) UCL	17.95
95% KM (z) UCL	18.31	95% KM Bootstrap t UCL	25.91
90% KM Chebyshev UCL	23.82	95% KM Chebyshev UCL	29.35
97.5% KM Chebyshev UCL	37.02	99% KM Chebyshev UCL	52.09

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.188	Anderson-Darling GOF Test
5% A-D Critical Value	0.683	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.552	k star (bias corrected MLE)	1.154
Theta hat (MLE)	5.307	Theta star (bias corrected MLE)	11.73
nu hat (MLE)	25.52	nu star (bias corrected)	11.54
Mean (detects)	13.54		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	11.29
Maximum	28.3	Median	8.95
SD	10.18	CV	0.902
k hat (MLE)	0.528	k star (bias corrected MLE)	0.375
Theta hat (MLE)	21.38	Theta star (bias corrected MLE)	30.09

Groundwater (MW) ProUCL Outputs

nu hat (MLE)	6.334	nu star (bias corrected)	4.5
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (4.50, α)	0.929	Adjusted Chi Square Value (4.50, β)	0.477
95% Gamma Approximate UCL (use when $n \geq 50$)	54.68	95% Gamma Adjusted UCL (use when $n < 50$)	106.6

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	11.62	SD (KM)	8.912
Variance (KM)	79.42	SE of Mean (KM)	4.068
k hat (KM)	1.699	k star (KM)	0.961
nu hat (KM)	20.39	nu star (KM)	11.53
theta hat (KM)	6.837	theta star (KM)	12.09
80% gamma percentile (KM)	18.76	90% gamma percentile (KM)	27.01
95% gamma percentile (KM)	35.3	99% gamma percentile (KM)	54.59

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.53, α)	4.918	Adjusted Chi Square Value (11.53, β)	3.483
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	27.23	95% Gamma Adjusted KM-UCL (use when $n < 50$)	38.45

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.993	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	11.55	Mean in Log Scale	2.075
SD in Original Scale	9.843	SD in Log Scale	1.027
95% t UCL (assumes normality of ROS data)	19.65	95% Percentile Bootstrap UCL	17.88
95% BCA Bootstrap UCL	18.98	95% Bootstrap t UCL	26.79
95% H-UCL (Log ROS)	94.08		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.113	KM Geo Mean	8.274
KM SD (logged)	0.875	95% Critical H Value (KM-Log)	3.697
KM Standard Error of Mean (logged)	0.399	95% H-UCL (KM -Log)	51.57
KM SD (logged)	0.875	95% Critical H Value (KM-Log)	3.697
KM Standard Error of Mean (logged)	0.399		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	11.45	Mean in Log Scale	1.998
SD in Original Scale	9.966	SD in Log Scale	1.18
95% t UCL (Assumes normality)	19.65	95% H-Stat UCL	181.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Groundwater (MW) ProUCL Outputs

95% KM (t) UCL 19.81

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

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

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

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

COBALT

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.91	Mean	4.992
Maximum	10.8	Median	4.65
SD	4.439	Std. Error of Mean	1.812
Coefficient of Variation	0.889	Skewness	0.225

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.809	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.297	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8.644

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8.151
95% Modified-t UCL (Johnson-1978) 8.671

Gamma GOF Test

A-D Test Statistic	0.731	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.713	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.302	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.34	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	1.137	k star (bias corrected MLE)	0.68
Theta hat (MLE)	4.39	Theta star (bias corrected MLE)	7.345
nu hat (MLE)	13.64	nu star (bias corrected)	8.156
MLE Mean (bias corrected)	4.992	MLE Sd (bias corrected)	6.055
		Approximate Chi Square Value (0.05)	2.825
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	1.823

Groundwater (MW) ProUCL Outputs

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.41	95% Adjusted Gamma UCL (use when n<50)	22.33

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.786	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.294	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.0943	Mean of logged Data	1.107
Maximum of Logged Data	2.38	SD of logged Data	1.186

Assuming Lognormal Distribution

95% H-UCL	76.92	90% Chebyshev (MVUE) UCL	12.57
95% Chebyshev (MVUE) UCL	15.9	97.5% Chebyshev (MVUE) UCL	20.53
99% Chebyshev (MVUE) UCL	29.61		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	7.973	95% Jackknife UCL	8.644
95% Standard Bootstrap UCL	7.711	95% Bootstrap-t UCL	9.322
95% Hall's Bootstrap UCL	6.694	95% Percentile Bootstrap UCL	7.757
95% BCA Bootstrap UCL	7.757		
90% Chebyshev(Mean, Sd) UCL	10.43	95% Chebyshev(Mean, Sd) UCL	12.89
97.5% Chebyshev(Mean, Sd) UCL	16.31	99% Chebyshev(Mean, Sd) UCL	23.02

Suggested UCL to Use

95% Student's-t UCL	8.644

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

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

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

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

IRON

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	257	Mean	19263
Maximum	49400	Median	15850
SD	17242	Std. Error of Mean	7039
Coefficient of Variation	0.895	Skewness	1.11

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

Groundwater (MW) ProUCL Outputs

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 33447

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 34249

95% Modified-t UCL (Johnson-1978) 33978

Gamma GOF Test

A-D Test Statistic	0.377	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.259	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.343	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.813	k star (bias corrected MLE)	0.518
Theta hat (MLE)	23685	Theta star (bias corrected MLE)	37204
nu hat (MLE)	9.76	nu star (bias corrected)	6.213
MLE Mean (bias corrected)	19263	MLE Sd (bias corrected)	26770
		Approximate Chi Square Value (0.05)	1.75
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	1.028

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 68400

95% Adjusted Gamma UCL (use when $n < 50$) 116466

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.798	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.336	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.325	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.549	Mean of logged Data	9.138
Maximum of Logged Data	10.81	SD of logged Data	1.863

Assuming Lognormal Distribution

95% H-UCL 21156057
 95% Chebyshev (MVUE) UCL 126552
 99% Chebyshev (MVUE) UCL 247977

90% Chebyshev (MVUE) UCL 97039
 97.5% Chebyshev (MVUE) UCL 167514

Groundwater (MW) ProUCL Outputs

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	30841	95% Jackknife UCL	33447
95% Standard Bootstrap UCL	29776	95% Bootstrap-t UCL	42136
95% Hall's Bootstrap UCL	54615	95% Percentile Bootstrap UCL	30026
95% BCA Bootstrap UCL	33000		
90% Chebyshev(Mean, Sd) UCL	40380	95% Chebyshev(Mean, Sd) UCL	49945
97.5% Chebyshev(Mean, Sd) UCL	63221	99% Chebyshev(Mean, Sd) UCL	89300

Suggested UCL to Use

95% Student's-t UCL 33447

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

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

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

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

LEAD

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	2
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.27	Minimum Non-Detect	1
Maximum Detect	10	Maximum Non-Detect	1
Variance Detects	19.66	Percent Non-Detects	33.33%
Mean Detects	4.618	SD Detects	4.434
Median Detects	4.1	CV Detects	0.96
Skewness Detects	0.436	Kurtosis Detects	-2.553
Mean of Logged Detects	0.859	SD of Logged Detects	1.618

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.237	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	3.168	KM Standard Error of Mean	1.766
KM SD	3.746	95% KM (BCA) UCL	N/A
95% KM (t) UCL	6.727	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	6.073	95% KM Bootstrap t UCL	N/A

Groundwater (MW) ProUCL Outputs

90% KM Chebyshev UCL	8.466	95% KM Chebyshev UCL	10.87
97.5% KM Chebyshev UCL	14.2	99% KM Chebyshev UCL	20.74

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.261	Anderson-Darling GOF Test	
5% A-D Critical Value	0.668	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.25	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.404	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.875	k star (bias corrected MLE)	0.385
Theta hat (MLE)	5.277	Theta star (bias corrected MLE)	11.98
nu hat (MLE)	7	nu star (bias corrected)	3.083
Mean (detects)	4.618		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3.108
Maximum	10	Median	1.035
SD	4.155	CV	1.337
k hat (MLE)	0.404	k star (bias corrected MLE)	0.313
Theta hat (MLE)	7.686	Theta star (bias corrected MLE)	9.921
nu hat (MLE)	4.853	nu star (bias corrected)	3.76
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (3.76, α)	0.629	Adjusted Chi Square Value (3.76, β)	0.299
95% Gamma Approximate UCL (use when $n \geq 50$)	18.58	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.168	SD (KM)	3.746
Variance (KM)	14.03	SE of Mean (KM)	1.766
k hat (KM)	0.715	k star (KM)	0.469
nu hat (KM)	8.585	nu star (KM)	5.626
theta hat (KM)	4.429	theta star (KM)	6.758
80% gamma percentile (KM)	5.186	90% gamma percentile (KM)	8.685
95% gamma percentile (KM)	12.45	99% gamma percentile (KM)	21.77

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.63, α)	1.452	Adjusted Chi Square Value (5.63, β)	0.82
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	12.28	95% Gamma Adjusted KM-UCL (use when $n < 50$)	21.74

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.231	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level	

Groundwater (MW) ProUCL Outputs
Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.179	Mean in Log Scale	0.125
SD in Original Scale	4.095	SD in Log Scale	1.729
95% t UCL (assumes normality of ROS data)	6.548	95% Percentile Bootstrap UCL	5.842
95% BCA Bootstrap UCL	6.442	95% Bootstrap t UCL	15.99
95% H-UCL (Log ROS)	901.6		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.136	KM Geo Mean	1.146
KM SD (logged)	1.534	95% Critical H Value (KM-Log)	6.003
KM Standard Error of Mean (logged)	0.723	95% H-UCL (KM -Log)	228.8
KM SD (logged)	1.534	95% Critical H Value (KM-Log)	6.003
KM Standard Error of Mean (logged)	0.723		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.245	Mean in Log Scale	0.342
SD in Original Scale	4.04	SD in Log Scale	1.488
95% t UCL (Assumes normality)	6.568	95% H-Stat UCL	206.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	6.727

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

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

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

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

MANGANESE

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	183	Mean	657.7
Maximum	1400	Median	582
SD	465.4	Std. Error of Mean	190
Coefficient of Variation	0.708	Skewness	0.742

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Groundwater (MW) ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.157	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 1041

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 1032

95% Modified-t UCL (Johnson-1978) 1050

Gamma GOF Test

A-D Test Statistic	0.214	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.704	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.189	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.336	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.226	k star (bias corrected MLE)	1.224
Theta hat (MLE)	295.5	Theta star (bias corrected MLE)	537.3
nu hat (MLE)	26.71	nu star (bias corrected)	14.69
MLE Mean (bias corrected)	657.7	MLE Sd (bias corrected)	594.4
		Approximate Chi Square Value (0.05)	7.045
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	5.252

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 1371

95% Adjusted Gamma UCL (use when $n < 50$) 1839

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.17	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.209	Mean of logged Data	6.248
Maximum of Logged Data	7.244	SD of logged Data	0.795

Assuming Lognormal Distribution

95% H-UCL	2428	90% Chebyshev (MVUE) UCL	1310
95% Chebyshev (MVUE) UCL	1602	97.5% Chebyshev (MVUE) UCL	2007
99% Chebyshev (MVUE) UCL	2803		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

Groundwater (MW) ProUCL Outputs

95% CLT UCL	970.2	95% Jackknife UCL	1041
95% Standard Bootstrap UCL	945.6	95% Bootstrap-t UCL	1187
95% Hall's Bootstrap UCL	1233	95% Percentile Bootstrap UCL	943.7
95% BCA Bootstrap UCL	978		
90% Chebyshev(Mean, Sd) UCL	1228	95% Chebyshev(Mean, Sd) UCL	1486
97.5% Chebyshev(Mean, Sd) UCL	1844	99% Chebyshev(Mean, Sd) UCL	2548

Suggested UCL to Use

95% Student's-t UCL 1041

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

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

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

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

VANADIUM

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	2
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	1.8	Minimum Non-Detect	5
Maximum Detect	12.5	Maximum Non-Detect	10
Variance Detects	26.53	Percent Non-Detects	33.33%
Mean Detects	7.7	SD Detects	5.15
Median Detects	8.25	CV Detects	0.669
Skewness Detects	-0.291	Kurtosis Detects	-4.006
Mean of Logged Detects	1.791	SD of Logged Detects	0.903

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.896	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	5.911	KM Standard Error of Mean	2.142
KM SD	4.487	95% KM (BCA) UCL	N/A
95% KM (t) UCL	10.23	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	9.434	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	12.34	95% KM Chebyshev UCL	15.25
97.5% KM Chebyshev UCL	19.29	99% KM Chebyshev UCL	27.22

Gamma GOF Tests on Detected Observations Only

Groundwater (MW) ProUCL Outputs

A-D Test Statistic	0.371	Anderson-Darling GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.303	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	2.153	k star (bias corrected MLE)	0.705
Theta hat (MLE)	3.577	Theta star (bias corrected MLE)	10.92
nu hat (MLE)	17.22	nu star (bias corrected)	5.639
Mean (detects)	7.7		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1.8	Mean	5.944
Maximum	12.5	Median	4.029
SD	4.845	CV	0.815
k hat (MLE)	1.797	k star (bias corrected MLE)	1.01
Theta hat (MLE)	3.308	Theta star (bias corrected MLE)	5.887
nu hat (MLE)	21.56	nu star (bias corrected)	12.12
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (12.12, α)	5.303	Adjusted Chi Square Value (12.12, β)	3.799
95% Gamma Approximate UCL (use when $n \geq 50$)	13.58	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.911	SD (KM)	4.487
Variance (KM)	20.14	SE of Mean (KM)	2.142
k hat (KM)	1.735	k star (KM)	0.979
nu hat (KM)	20.82	nu star (KM)	11.74
theta hat (KM)	3.407	theta star (KM)	6.04
80% gamma percentile (KM)	9.53	90% gamma percentile (KM)	13.68
95% gamma percentile (KM)	17.84	99% gamma percentile (KM)	27.52

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.74, α)	5.059	Adjusted Chi Square Value (11.74, β)	3.598
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	13.72	95% Gamma Adjusted KM-UCL (use when $n < 50$)	19.29

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.886	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.265	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.904	Mean in Log Scale	1.468

Groundwater (MW) ProUCL Outputs

SD in Original Scale	4.871	SD in Log Scale	0.867
95% t UCL (assumes normality of ROS data)	9.91	95% Percentile Bootstrap UCL	9.084
95% BCA Bootstrap UCL	9.284	95% Bootstrap t UCL	15
95% H-UCL (Log ROS)	26.25		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.447	KM Geo Mean	4.25
KM SD (logged)	0.832	95% Critical H Value (KM-Log)	3.573
KM Standard Error of Mean (logged)	0.407	95% H-UCL (KM -Log)	22.73
KM SD (logged)	0.832	95% Critical H Value (KM-Log)	3.573
KM Standard Error of Mean (logged)	0.407		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.383	Mean in Log Scale	1.615
SD in Original Scale	4.55	SD in Log Scale	0.782
95% t UCL (Assumes normality)	10.13	95% H-Stat UCL	22.58

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	10.23

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

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

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

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

NAPHTHALENE

General Statistics

Total Number of Observations	6	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	2
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.06	Minimum Non-Detect	0.1
Maximum Detect	95	Maximum Non-Detect	0.1
Variance Detects	2091	Percent Non-Detects	33.33%
Mean Detects	36.58	SD Detects	45.73
Median Detects	25.63	CV Detects	1.25
Skewness Detects	0.737	Kurtosis Detects	-1.907
Mean of Logged Detects	1.071	SD of Logged Detects	3.717

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Groundwater (MW) ProUCL Outputs

Shapiro Wilk Test Statistic	0.867	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.287	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level
Detected Data appear Normal at 5% Significance Level		

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

KM Mean	24.41	KM Standard Error of Mean	17.27
KM SD	36.63	95% KM (BCA) UCL	N/A
95% KM (t) UCL	59.2	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	52.81	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	76.21	95% KM Chebyshev UCL	99.68
97.5% KM Chebyshev UCL	132.3	99% KM Chebyshev UCL	196.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.465	Anderson-Darling GOF Test
5% A-D Critical Value	0.711	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.304	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.42	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	0.276	k star (bias corrected MLE)	0.236
Theta hat (MLE)	132.3	Theta star (bias corrected MLE)	155.1
nu hat (MLE)	2.212	nu star (bias corrected)	1.886
Mean (detects)	36.58		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	24.39
Maximum	95	Median	0.155
SD	40.14	CV	1.646
k hat (MLE)	0.185	k star (bias corrected MLE)	0.204
Theta hat (MLE)	131.5	Theta star (bias corrected MLE)	119.6
nu hat (MLE)	2.225	nu star (bias corrected)	2.446
Adjusted Level of Significance (β)	0.0122		
Approximate Chi Square Value (2.45, α)	0.229	Adjusted Chi Square Value (2.45, β)	0.109
95% Gamma Approximate UCL (use when $n \geq 50$)	260.3	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	24.41	SD (KM)	36.63
Variance (KM)	1342	SE of Mean (KM)	17.27
k hat (KM)	0.444	k star (KM)	0.333
nu hat (KM)	5.326	nu star (KM)	3.996
theta hat (KM)	54.99	theta star (KM)	73.29
80% gamma percentile (KM)	38.29	90% gamma percentile (KM)	71

Groundwater (MW) ProUCL Outputs

95% gamma percentile (KM) 107.9

99% gamma percentile (KM) 202.6

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (4.00, α) 0.72

Adjusted Chi Square Value (4.00, β) 0.351

95% Gamma Approximate KM-UCL (use when $n \geq 50$) 135.4

95% Gamma Adjusted KM-UCL (use when $n < 50$) 277.9

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic 0.856

Shapiro Wilk GOF Test

5% Shapiro Wilk Critical Value 0.748

Detected Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic 0.279

Lilliefors GOF Test

5% Lilliefors Critical Value 0.375

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale 24.4

Mean in Log Scale -0.467

SD in Original Scale 40.13

SD in Log Scale 3.809

95% t UCL (assumes normality of ROS data) 57.42

95% Percentile Bootstrap UCL 48.71

95% BCA Bootstrap UCL 56.03

95% Bootstrap t UCL 10418

95% H-UCL (Log ROS) 4.194E+13

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged) -0.223

KM Geo Mean 0.8

KM SD (logged) 3.203

95% Critical H Value (KM-Log) 12.16

KM Standard Error of Mean (logged) 1.51

95% H-UCL (KM -Log) 4.957E+9

KM SD (logged) 3.203

95% Critical H Value (KM-Log) 12.16

KM Standard Error of Mean (logged) 1.51

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 24.4

SD in Original Scale 40.13

95% t UCL (Assumes normality) 57.42

DL/2 Log-Transformed

Mean in Log Scale -0.284

SD in Log Scale 3.564

95% H-Stat UCL 9.633E+11

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 59.2

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

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

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

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

Surface Water Background ProUCL Outputs

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation ProUCL 5.16/7/2019 12:48:03 PM
 From File \\lovetonfederal\agencies\Non Dod\USEPA R6\Wilcox Oil\HHRA\ProUCL\input files\ProUCL Inputs SW BKG.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Coverage 95%
 New or Future K Observations 1
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	204	First Quartile	307.5
Second Largest	728	Median	535
Maximum	757	Third Quartile	735.3
Mean	507.8	SD	277.1
Coefficient of Variation	0.546	Skewness	-0.201
Mean of logged Data	6.093	SD of logged Data	0.633

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.859	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.287	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	1933	90% Percentile (z)	862.9
95% UPL (t)	1237	95% Percentile (z)	963.6
95% USL	913	99% Percentile (z)	1152

Gamma GOF Test

A-D Test Statistic	0.422	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.32	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.813	k star (bias corrected MLE)	1.12
Theta hat (MLE)	133.2	Theta star (bias corrected MLE)	453.4
nu hat (MLE)	30.5	nu star (bias corrected)	8.958
MLE Mean (bias corrected)	507.8	MLE Sd (bias corrected)	479.8

Background Statistics Assuming Gamma Distribution

Surface Water Background ProUCL Outputs

95% Wilson Hilferty (WH) Approx. Gamma UPL	1683	90% Percentile	1137
95% Hawkins Wixley (HW) Approx. Gamma UPL	1795	95% Percentile	1462
95% WH Approx. Gamma UTL with 95% Coverage	3987	99% Percentile	2210
95% HW Approx. Gamma UTL with 95% Coverage	4752		
95% WH USL	1016	95% HW USL	1037

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.284	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	11491	90% Percentile (z)	996.6
95% UPL (t)	2342	95% Percentile (z)	1254
95% USL	1118	99% Percentile (z)	1931

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	757
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	757	90% Percentile	748.3
90% Chebyshev UPL	1437	95% Percentile	752.7
95% Chebyshev UPL	1858	99% Percentile	756.1
95% USL	757		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Barium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	47.1	First Quartile	50.03
Second Largest	51.1	Median	51.05
Maximum	73.6	Third Quartile	56.73
Mean	55.7	SD	12.08
Coefficient of Variation	0.217	Skewness	1.853
Mean of logged Data	4.004	SD of logged Data	0.2

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Surface Water Background ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic	0.759	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.398	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	117.8	90% Percentile (z)	71.18
95% UPL (t)	87.48	95% Percentile (z)	75.57
95% USL	73.36	99% Percentile (z)	83.8

Gamma GOF Test

A-D Test Statistic	0.644	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.412	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.394	Data Not Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	31.72	k star (bias corrected MLE)	8.095
Theta hat (MLE)	1.756	Theta star (bias corrected MLE)	6.88
nu hat (MLE)	253.7	nu star (bias corrected)	64.76
MLE Mean (bias corrected)	55.7	MLE Sd (bias corrected)	19.58

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	90.66	90% Percentile	81.8
95% Hawkins Wixley (HW) Approx. Gamma UPL	91.15	95% Percentile	91.31
95% WH Approx. Gamma UTL with 95% Coverage	136.5	99% Percentile	111
95% HW Approx. Gamma UTL with 95% Coverage	140		
95% WH USL	73.41	95% HW USL	73.42

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.786	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.387	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	153.4	90% Percentile (z)	70.84
95% UPL (t)	92.79	95% Percentile (z)	76.18
95% USL	73.45	99% Percentile (z)	87.3

Nonparametric Distribution Free Background Statistics

Data appear Approximate Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	73.6

Surface Water Background ProUCL Outputs

Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	73.6	90% Percentile	66.85
90% Chebyshev UPL	96.21	95% Percentile	70.23
95% Chebyshev UPL	114.6	99% Percentile	72.93
95% USL	73.6		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Calcium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	16000	First Quartile	16150
Second Largest	16400	Median	16300
Maximum	24200	Third Quartile	18350
Mean	18200	SD	4003
Coefficient of Variation	0.22	Skewness	1.99
Mean of logged Data	9.793	SD of logged Data	0.201

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.668
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.424
5% Lilliefors Critical Value	0.375

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	38793	90% Percentile (z)	23330
95% UPL (t)	28733	95% Percentile (z)	24785
95% USL	24055	99% Percentile (z)	27513

Gamma GOF Test

A-D Test Statistic	0.854
5% A-D Critical Value	0.657
K-S Test Statistic	0.446
5% K-S Critical Value	0.394

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	31.2	k star (bias corrected MLE)	7.966
Theta hat (MLE)	583.4	Theta star (bias corrected MLE)	2285

Surface Water Background ProUCL Outputs

nu hat (MLE)	249.6	nu star (bias corrected)	63.73
MLE Mean (bias corrected)	18200	MLE Sd (bias corrected)	6448

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	29730	90% Percentile	26798
95% Hawkins Wixley (HW) Approx. Gamma UPL	29882	95% Percentile	29939
95% WH Approx. Gamma UTL with 95% Coverage	44871	99% Percentile	36446
95% HW Approx. Gamma UTL with 95% Coverage	46008		
95% WH USL	24037	95% HW USL	24035

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.677	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.419	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	50350	90% Percentile (z)	23169
95% UPL (t)	30388	95% Percentile (z)	24924
95% USL	24027	99% Percentile (z)	28582

Nonparametric Distribution Free Background Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	24200
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	24200	90% Percentile	21860
90% Chebyshev UPL	31628	95% Percentile	23030
95% Chebyshev UPL	37710	99% Percentile	23966
95% USL	24200		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Iron

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	695	First Quartile	1681
Second Largest	2110	Median	2060
Maximum	2710	Third Quartile	2260
Mean	1881	SD	849.1
Coefficient of Variation	0.451	Skewness	-1.183

Surface Water Background ProUCL Outputs

Mean of logged Data 7.427

SD of logged Data 0.603

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL) 5.144

d2max (for USL) 1.462

Normal GOF Test

Shapiro Wilk Test Statistic 0.908
5% Shapiro Wilk Critical Value 0.748
Lilliefors Test Statistic 0.31
5% Lilliefors Critical Value 0.375

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage 6249
95% UPL (t) 4115
95% USL 3123

90% Percentile (z) 2969
95% Percentile (z) 3278
99% Percentile (z) 3857

Gamma GOF Test

A-D Test Statistic 0.501
5% A-D Critical Value 0.659
K-S Test Statistic 0.367
5% K-S Critical Value 0.396

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 4.606
Theta hat (MLE) 408.4
nu hat (MLE) 36.85
MLE Mean (bias corrected) 1881

k star (bias corrected MLE) 1.318
Theta star (bias corrected MLE) 1427
nu star (bias corrected) 10.55
MLE Sd (bias corrected) 1638

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL 5721
95% Hawkins Wixley (HW) Approx. Gamma UPL 6133
95% WH Approx. Gamma UTL with 95% Coverage 12890
95% HW Approx. Gamma UTL with 95% Coverage 15379
95% WH USL 3581

90% Percentile 4046
95% Percentile 5119
99% Percentile 7563
95% HW USL 3676

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.815
5% Shapiro Wilk Critical Value 0.748
Lilliefors Test Statistic 0.366
5% Lilliefors Critical Value 0.375

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage 37437
95% UPL (t) 8221
95% USL 4062

90% Percentile (z) 3642
95% Percentile (z) 4535
99% Percentile (z) 6841

Nonparametric Distribution Free Background Statistics

Surface Water Background ProUCL Outputs

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	2710
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	2710	90% Percentile	2530
90% Chebyshev UPL	4729	95% Percentile	2620
95% Chebyshev UPL	6019	99% Percentile	2692
95% USL	2710		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Magnesium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	4010	First Quartile	5458
Second Largest	6000	Median	5970
Maximum	8680	Third Quartile	6670
Mean	6158	SD	1919
Coefficient of Variation	0.312	Skewness	0.579
Mean of logged Data	8.689	SD of logged Data	0.315

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.938	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	16028	90% Percentile (z)	8617
95% UPL (t)	11206	95% Percentile (z)	9314
95% USL	8964	99% Percentile (z)	10622

Gamma GOF Test

A-D Test Statistic	0.317	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Surface Water Background ProUCL Outputs

Gamma Statistics

k hat (MLE)	13.73	k star (bias corrected MLE)	3.6
Theta hat (MLE)	448.4	Theta star (bias corrected MLE)	1710
nu hat (MLE)	109.9	nu star (bias corrected)	28.8
MLE Mean (bias corrected)	6158	MLE Sd (bias corrected)	3245

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	12474	90% Percentile	10509
95% Hawkins Wixley (HW) Approx. Gamma UPL	12711	95% Percentile	12279
95% WH Approx. Gamma UTL with 95% Coverage	21901	99% Percentile	16080
95% HW Approx. Gamma UTL with 95% Coverage	23315		
95% WH USL	9216	95% HW USL	9259

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.251	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	30055	90% Percentile (z)	8890
95% UPL (t)	13607	95% Percentile (z)	9970
95% USL	9412	99% Percentile (z)	12360

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	8680
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
	95% UPL 8680	90% Percentile	7876
90% Chebyshev UPL	12594	95% Percentile	8278
95% Chebyshev UPL	15509	99% Percentile	8600
95% USL	8680		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers

and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data

represents a background data set and when many onsite observations need to be compared with the BTV.

Manganese

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	7.7	First Quartile	73.33

Surface Water Background ProUCL Outputs

Second Largest	112	Median	103.6
Maximum	690	Third Quartile	256.5
Mean	226.2	SD	312.5
Coefficient of Variation	1.382	Skewness	1.869
Mean of logged Data	4.463	SD of logged Data	1.847

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.759	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.393	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	1834	90% Percentile (z)	626.8
95% UPL (t)	1049	95% Percentile (z)	740.3
95% USL	683.3	99% Percentile (z)	953.3

Gamma GOF Test

A-D Test Statistic	0.307	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.675	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.276	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.407	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.639	k star (bias corrected MLE)	0.326
Theta hat (MLE)	354.1	Theta star (bias corrected MLE)	693.2
nu hat (MLE)	5.11	nu star (bias corrected)	2.611
MLE Mean (bias corrected)	226.2	MLE Sd (bias corrected)	396

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	1955	90% Percentile	660
95% Hawkins Wixley (HW) Approx. Gamma UPL	2434	95% Percentile	1007
95% WH Approx. Gamma UTL with 95% Coverage	7557	99% Percentile	1899
95% HW Approx. Gamma UTL with 95% Coverage	12567		
95% WH USL	776.9	95% HW USL	829.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.27	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	1162804	90% Percentile (z)	925.8

Surface Water Background ProUCL Outputs

95% UPL (t) 11203

95% Percentile (z) 1811

95% USL 1293

99% Percentile (z) 6380

Nonparametric Distribution Free Background Statistics

Data appear Approximate Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	690
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	690	90% Percentile	516.6
90% Chebyshev UPL	1275	95% Percentile	603.3
95% Chebyshev UPL	1749	99% Percentile	672.7
95% USL	690		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers

and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data

represents a background data set and when many onsite observations need to be compared with the BTV.

Potassium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	4380	First Quartile	4448
Second Largest	4560	Median	4515
Maximum	4830	Third Quartile	4628
Mean	4560	SD	194.4
Coefficient of Variation	0.0426	Skewness	1.19
Mean of logged Data	8.424	SD of logged Data	0.0421

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.928
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.25
5% Lilliefors Critical Value	0.375

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	5560	90% Percentile (z)	4809
95% UPL (t)	5072	95% Percentile (z)	4880
95% USL	4844	99% Percentile (z)	5012

Gamma GOF Test

A-D Test Statistic	0.311

Anderson-Darling Gamma GOF Test

Surface Water Background ProUCL Outputs

5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.245	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	745.2	k star (bias corrected MLE)	186.5
Theta hat (MLE)	6.119	Theta star (bias corrected MLE)	24.45
nu hat (MLE)	5962	nu star (bias corrected)	1492
MLE Mean (bias corrected)	4560	MLE Sd (bias corrected)	333.9

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	5084	90% Percentile	4993
95% Hawkins Wixley (HW) Approx. Gamma UPL	5086	95% Percentile	5123
95% WH Approx. Gamma UTL with 95% Coverage	5624	99% Percentile	5373
95% HW Approx. Gamma UTL with 95% Coverage	5632		
95% WH USL	4846	95% HW USL	4846

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.244	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	5660	90% Percentile (z)	4810
95% UPL (t)	5091	95% Percentile (z)	4884
95% USL	4847	99% Percentile (z)	5026

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	4830
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	4830	90% Percentile	4749
90% Chebyshev UPL	5212	95% Percentile	4790
95% Chebyshev UPL	5507	99% Percentile	4822
95% USL	4830		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Surface Water Background ProUCL Outputs

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	7160	First Quartile	9815
Second Largest	11100	Median	10900
Maximum	18200	Third Quartile	12875
Mean	11790	SD	4626
Coefficient of Variation	0.392	Skewness	1.095
Mean of logged Data	9.32	SD of logged Data	0.382

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	35584	90% Percentile (z)	17718
95% UPL (t)	23961	95% Percentile (z)	19398
95% USL	18555	99% Percentile (z)	22551

Gamma GOF Test

A-D Test Statistic	0.316	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.278	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.177	k star (bias corrected MLE)	2.461
Theta hat (MLE)	1285	Theta star (bias corrected MLE)	4791
nu hat (MLE)	73.42	nu star (bias corrected)	19.69
MLE Mean (bias corrected)	11790	MLE Sd (bias corrected)	7516

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	27258	90% Percentile	21857
95% Hawkins Wixley (HW) Approx. Gamma UPL	27911	95% Percentile	26228
95% WH Approx. Gamma UTL with 95% Coverage	52180	99% Percentile	35807
95% HW Approx. Gamma UTL with 95% Coverage	56555		
95% WH USL	19062	95% HW USL	19157

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Surface Water Background ProUCL Outputs

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	79620	90% Percentile (z)	18201
95% UPL (t)	30482	95% Percentile (z)	20911
95% USL	19503	99% Percentile (z)	27131

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	18200
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	18200	90% Percentile	16070
90% Chebyshev UPL	27305	95% Percentile	17135
95% Chebyshev UPL	34333	99% Percentile	17987
95% USL	18200		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Surface Water ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/7/2019 12:06:07 PM
 From File ProUCL Inputs Hhra SW ALL.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Arsenic

General Statistics

Total Number of Observations	47	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	42
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	1.2	Minimum Non-Detect	2.5
Maximum Detect	5.4	Maximum Non-Detect	5
Variance Detects	2.82	Percent Non-Detects	89.36%
Mean Detects	3	SD Detects	1.679
Median Detects	3.4	CV Detects	0.56
Skewness Detects	0.473	Kurtosis Detects	-0.523
Mean of Logged Detects	0.957	SD of Logged Detects	0.615

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.922	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	1.594	KM Standard Error of Mean	0.192
KM SD	0.747	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.916	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.909	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.169	95% KM Chebyshev UCL	2.429
97.5% KM Chebyshev UCL	2.79	99% KM Chebyshev UCL	3.5

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.339	Anderson-Darling GOF Test
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.262	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.696	k star (bias corrected MLE)	1.612
Theta hat (MLE)	0.812	Theta star (bias corrected MLE)	1.862
nu hat (MLE)	36.96	nu star (bias corrected)	16.12
Mean (detects)	3		

Surface Water ProUCL Outputs

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0206	Mean	1.569
Maximum	5.4	Median	1.411
SD	1.036	CV	0.66
k hat (MLE)	1.916	k star (bias corrected MLE)	1.808
Theta hat (MLE)	0.819	Theta star (bias corrected MLE)	0.867
nu hat (MLE)	180.1	nu star (bias corrected)	170
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (169.97, α)	140.8	Adjusted Chi Square Value (169.97, β)	140
95% Gamma Approximate UCL (use when $n \geq 50$)	1.893	95% Gamma Adjusted UCL (use when $n < 50$)	1.905

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.594	SD (KM)	0.747
Variance (KM)	0.557	SE of Mean (KM)	0.192
k hat (KM)	4.558	k star (KM)	4.281
nu hat (KM)	428.5	nu star (KM)	402.5
theta hat (KM)	0.35	theta star (KM)	0.372
80% gamma percentile (KM)	2.18	90% gamma percentile (KM)	2.626
95% gamma percentile (KM)	3.035	99% gamma percentile (KM)	3.905

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (402.46, α)	357	Adjusted Chi Square Value (402.46, β)	355.6
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	1.797	95% Gamma Adjusted KM-UCL (use when $n < 50$)	1.804

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.268	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.661	Mean in Log Scale	0.389
SD in Original Scale	0.894	SD in Log Scale	0.483
95% t UCL (assumes normality of ROS data)	1.88	95% Percentile Bootstrap UCL	1.88
95% BCA Bootstrap UCL	1.921	95% Bootstrap t UCL	1.938
95% H-UCL (Log ROS)	1.896		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.404	KM Geo Mean	1.498
KM SD (logged)	0.31	95% Critical H Value (KM-Log)	1.778
KM Standard Error of Mean (logged)	0.116	95% H-UCL (KM -Log)	1.705
KM SD (logged)	0.31	95% Critical H Value (KM-Log)	1.778
KM Standard Error of Mean (logged)	0.116		

Surface Water ProUCL Outputs

DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.702	Mean in Log Scale	0.449
SD in Original Scale	0.842	SD in Log Scale	0.379
95% t UCL (Assumes normality)	1.908	95% H-Stat UCL	1.862
DL/2 is not a recommended method, provided for comparisons and historical reasons			

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use	
95% KM (t) UCL	1.916

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

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

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

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

Cadmium

General Statistics			
Total Number of Observations	47	Number of Distinct Observations	6
Number of Detects	4	Number of Non-Detects	43
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	7.9	Minimum Non-Detect	1
Maximum Detect	25	Maximum Non-Detect	5
Variance Detects	63.7	Percent Non-Detects	91.49%
Mean Detects	14.6	SD Detects	7.981
Median Detects	12.75	CV Detects	0.547
Skewness Detects	0.837	Kurtosis Detects	-1.289
Mean of Logged Detects	2.569	SD of Logged Detects	0.545

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.895
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.266
5% Lilliefors Critical Value	0.375

Shapiro Wilk GOF Test

Detected Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	2.157	KM Standard Error of Mean	0.724
KM SD	4.297	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.372	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.348	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.329	95% KM Chebyshev UCL	5.312
97.5% KM Chebyshev UCL	6.678	99% KM Chebyshev UCL	9.359

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.359

Anderson-Darling GOF Test

Surface Water ProUCL Outputs

5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.3	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.623	k star (bias corrected MLE)	1.322
Theta hat (MLE)	3.158	Theta star (bias corrected MLE)	11.04
nu hat (MLE)	36.98	nu star (bias corrected)	10.58
Mean (detects)	14.6		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.258
Maximum	25	Median	0.01
SD	4.591	CV	3.648
k hat (MLE)	0.18	k star (bias corrected MLE)	0.183
Theta hat (MLE)	6.983	Theta star (bias corrected MLE)	6.881
nu hat (MLE)	16.94	nu star (bias corrected)	17.19
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (17.19, α)	8.808	Adjusted Chi Square Value (17.19, β)	8.617
95% Gamma Approximate UCL (use when $n \geq 50$)	2.456	95% Gamma Adjusted UCL (use when $n < 50$)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.157	SD (KM)	4.297
Variance (KM)	18.47	SE of Mean (KM)	0.724
k hat (KM)	0.252	k star (KM)	0.25
nu hat (KM)	23.69	nu star (KM)	23.51
theta hat (KM)	8.56	theta star (KM)	8.625
80% gamma percentile (KM)	3.134	90% gamma percentile (KM)	6.475
95% gamma percentile (KM)	10.44	99% gamma percentile (KM)	21

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (23.51, α)	13.48	Adjusted Chi Square Value (23.51, β)	13.24
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	3.764	95% Gamma Adjusted KM-UCL (use when $n < 50$)	3.832

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.265	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.958	Mean in Log Scale	-0.879
SD in Original Scale	4.515	SD in Log Scale	1.843

Surface Water ProUCL Outputs

95% t UCL (assumes normality of ROS data)	3.064	95% Percentile Bootstrap UCL	3.16
95% BCA Bootstrap UCL	3.543	95% Bootstrap t UCL	4.476
95% H-UCL (Log ROS)	5.677		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.219	KM Geo Mean	1.244
KM SD (logged)	0.73	95% Critical H Value (KM-Log)	2.06
KM Standard Error of Mean (logged)	0.123	95% H-UCL (KM -Log)	2.027
KM SD (logged)	0.73	95% Critical H Value (KM-Log)	2.06
KM Standard Error of Mean (logged)	0.123		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.445	Mean in Log Scale	0.988
SD in Original Scale	4.018	SD in Log Scale	0.603
95% t UCL (Assumes normality)	4.429	95% H-Stat UCL	3.839

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.372

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

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

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

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

Iron

General Statistics

Total Number of Observations	47	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	101	Mean	2170
Maximum	19400	Median	1130
SD	4216	Std. Error of Mean	614.9
Coefficient of Variation	1.943	Skewness	3.424

Normal GOF Test

Shapiro Wilk Test Statistic	0.451
5% Shapiro Wilk Critical Value	0.946
Lilliefors Test Statistic	0.4
5% Lilliefors Critical Value	0.128

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	3203

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	3510

Surface Water ProUCL Outputs

95% Modified-t UCL (Johnson-1978) 3254

Gamma GOF Test

A-D Test Statistic 3.483
5% A-D Critical Value 0.796
K-S Test Statistic 0.254
5% K-S Critical Value 0.135

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 0.699
Theta hat (MLE) 3106
nu hat (MLE) 65.69
MLE Mean (bias corrected) 2170
Adjusted Level of Significance 0.0449

k star (bias corrected MLE) 0.668
Theta star (bias corrected MLE) 3247
nu star (bias corrected) 62.83
MLE Sd (bias corrected) 2655
Approximate Chi Square Value (0.05) 45.59
Adjusted Chi Square Value 45.13

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 2991

95% Adjusted Gamma UCL (use when $n < 50$) 3021

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.916
5% Shapiro Wilk Critical Value 0.946
Lilliefors Test Statistic 0.156
5% Lilliefors Critical Value 0.128

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 4.615
Maximum of Logged Data 9.873

Mean of logged Data 6.818
SD of logged Data 1.229

Assuming Lognormal Distribution

95% H-UCL 3106
95% Chebyshev (MVUE) UCL 3726
99% Chebyshev (MVUE) UCL 6079

90% Chebyshev (MVUE) UCL 3155
97.5% Chebyshev (MVUE) UCL 4520

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL 3182
95% Standard Bootstrap UCL 3169
95% Hall's Bootstrap UCL 3342
95% BCA Bootstrap UCL 3558
90% Chebyshev(Mean, Sd) UCL 4015
97.5% Chebyshev(Mean, Sd) UCL 6011

95% Jackknife UCL 3203
95% Bootstrap-t UCL 4335
95% Percentile Bootstrap UCL 3241
95% Chebyshev(Mean, Sd) UCL 4851
99% Chebyshev(Mean, Sd) UCL 8289

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 4851

Surface Water ProUCL Outputs

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

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

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

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

Lead

General Statistics

Total Number of Observations	47	Number of Distinct Observations	15
Number of Detects	13	Number of Non-Detects	34
Number of Distinct Detects	13	Number of Distinct Non-Detects	2
Minimum Detect	0.71	Minimum Non-Detect	2.5
Maximum Detect	181	Maximum Non-Detect	5
Variance Detects	5227	Percent Non-Detects	72.34%
Mean Detects	48.49	SD Detects	72.3
Median Detects	10.5	CV Detects	1.491
Skewness Detects	1.419	Kurtosis Detects	0.0681
Mean of Logged Detects	2.646	SD of Logged Detects	1.799

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.625	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.412	Lilliefors GOF Test
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	14.01	KM Standard Error of Mean	6.422
KM SD	42.3	95% KM (BCA) UCL	25.88
95% KM (t) UCL	24.79	95% KM (Percentile Bootstrap) UCL	25.14
95% KM (z) UCL	24.57	95% KM Bootstrap t UCL	28.34
90% KM Chebyshev UCL	33.27	95% KM Chebyshev UCL	42
97.5% KM Chebyshev UCL	54.11	99% KM Chebyshev UCL	77.91

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.887	Anderson-Darling GOF Test
5% A-D Critical Value	0.789	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.274	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.25	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.512	k star (bias corrected MLE)	0.445
Theta hat (MLE)	94.63	Theta star (bias corrected MLE)	108.9
nu hat (MLE)	13.32	nu star (bias corrected)	11.58
Mean (detects)	48.49		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

Surface Water ProUCL Outputs

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	13.42
Maximum	181	Median	0.01
SD	42.94	CV	3.2
k hat (MLE)	0.148	k star (bias corrected MLE)	0.153
Theta hat (MLE)	90.56	Theta star (bias corrected MLE)	87.76
nu hat (MLE)	13.93	nu star (bias corrected)	14.37
Adjusted Level of Significance (β)	0.0449		
Approximate Chi Square Value (14.37, α)	6.827	Adjusted Chi Square Value (14.37, β)	6.662
95% Gamma Approximate UCL (use when $n \geq 50$)	28.25	95% Gamma Adjusted UCL (use when $n < 50$)	28.95

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	14.01	SD (KM)	42.3
Variance (KM)	1789	SE of Mean (KM)	6.422
k hat (KM)	0.11	k star (KM)	0.117
nu hat (KM)	10.31	nu star (KM)	10.98
theta hat (KM)	127.7	theta star (KM)	119.9
80% gamma percentile (KM)	11.91	90% gamma percentile (KM)	39.38
95% gamma percentile (KM)	80.19	99% gamma percentile (KM)	205.6

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.98, α)	4.565	Adjusted Chi Square Value (10.98, β)	4.434
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	33.7	95% Gamma Adjusted KM-UCL (use when $n < 50$)	34.69

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.171	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.234	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	14.32	Mean in Log Scale	0.268
SD in Original Scale	42.68	SD in Log Scale	2.186
95% t UCL (assumes normality of ROS data)	24.77	95% Percentile Bootstrap UCL	25.29
95% BCA Bootstrap UCL	29.34	95% Bootstrap t UCL	29.2
95% H-UCL (Log ROS)	49.41		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.571	KM Geo Mean	1.769
KM SD (logged)	1.581	95% Critical H Value (KM-Log)	3.026
KM Standard Error of Mean (logged)	0.247	95% H-UCL (KM -Log)	12.5
KM SD (logged)	1.581	95% Critical H Value (KM-Log)	3.026
KM Standard Error of Mean (logged)	0.247		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	14.61	Mean in Log Scale	1.056

Surface Water ProUCL Outputs

SD in Original Scale	42.57	SD in Log Scale	1.382
95% t UCL (Assumes normality)	25.03	95% H-Stat UCL	13.14

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 42

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

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

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

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

Manganese

General Statistics

Total Number of Observations	47	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	6.9	Mean	244.1
Maximum	1080	Median	144
SD	262.1	Std. Error of Mean	38.23
Coefficient of Variation	1.074	Skewness	1.954

Normal GOF Test

Shapiro Wilk Test Statistic	0.739
5% Shapiro Wilk Critical Value	0.946
Lilliefors Test Statistic	0.265
5% Lilliefors Critical Value	0.128

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 308.3

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 318.7

95% Modified-t UCL (Johnson-1978) 310.1

Gamma GOF Test

A-D Test Statistic	0.817
5% A-D Critical Value	0.776
K-S Test Statistic	0.139
5% K-S Critical Value	0.133

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.088	k star (bias corrected MLE)	1.033
Theta hat (MLE)	224.3	Theta star (bias corrected MLE)	236.3
nu hat (MLE)	102.3	nu star (bias corrected)	97.1
MLE Mean (bias corrected)	244.1	MLE Sd (bias corrected)	240.2

Surface Water ProUCL Outputs

Adjusted Level of Significance	0.0449	Approximate Chi Square Value (0.05)	75.37
		Adjusted Chi Square Value	74.77

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	314.5	95% Adjusted Gamma UCL (use when $n < 50$)	317.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.946	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.162	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.128	Data Not Lognormal at 5% Significance Level
Data appear Approximate Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	1.932	Mean of logged Data	4.972
Maximum of Logged Data	6.985	SD of logged Data	1.135

Assuming Lognormal Distribution

95% H-UCL	416.5	90% Chebyshev (MVUE) UCL	431.3
95% Chebyshev (MVUE) UCL	504.7	97.5% Chebyshev (MVUE) UCL	606.7
99% Chebyshev (MVUE) UCL	806.9		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	307	95% Jackknife UCL	308.3
95% Standard Bootstrap UCL	306.4	95% Bootstrap-t UCL	325.6
95% Hall's Bootstrap UCL	318.1	95% Percentile Bootstrap UCL	308.7
95% BCA Bootstrap UCL	320.2		
90% Chebyshev(Mean, Sd) UCL	358.8	95% Chebyshev(Mean, Sd) UCL	410.8
97.5% Chebyshev(Mean, Sd) UCL	482.9	99% Chebyshev(Mean, Sd) UCL	624.5

Suggested UCL to Use

95% H-UCL	416.5

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Sediment Background ProUCL Outputs

Background Statistics for Uncensored Full Data Sets

User Selected Options

Date/Time of Computation ProUCL 5.16/7/2019 11:10:24 AM
 From File \\lovetonfederal\agencies\Non Dod\USEPA R6\Wilcox Oil\HHRA\ProUCL\input files\ProUCL Input SD BKG.xlsx
 Full Precision OFF
 Confidence Coefficient 95%
 Coverage 95%
 New or Future K Observations 1
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	1050	First Quartile	1095
Second Largest	3840	Median	2475
Maximum	5790	Third Quartile	4328
Mean	2948	SD	2299
Coefficient of Variation	0.78	Skewness	0.584
Mean of logged Data	7.721	SD of logged Data	0.868

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.871	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.288	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	14772	90% Percentile (z)	5894
95% UPL (t)	8996	95% Percentile (z)	6729
95% USL	6309	99% Percentile (z)	8295

Gamma GOF Test

A-D Test Statistic	0.459	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.328	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.022	k star (bias corrected MLE)	0.672
Theta hat (MLE)	1458	Theta star (bias corrected MLE)	4386
nu hat (MLE)	16.17	nu star (bias corrected)	5.377
MLE Mean (bias corrected)	2948	MLE Sd (bias corrected)	3595

Background Statistics Assuming Gamma Distribution

Sediment Background ProUCL Outputs

95% Wilson Hilferty (WH) Approx. Gamma UPL	13457	90% Percentile	7470
95% Hawkins Wixley (HW) Approx. Gamma UPL	14740	95% Percentile	10181
95% WH Approx. Gamma UTL with 95% Coverage	37855	99% Percentile	16676
95% HW Approx. Gamma UTL with 95% Coverage	48527		
95% WH USL	7113	95% HW USL	7290

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.845	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.293	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	195905	90% Percentile (z)	6861
95% UPL (t)	22131	95% Percentile (z)	9404
95% USL	8027	99% Percentile (z)	16988

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	5790
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	5790	90% Percentile	5205
90% Chebyshev UPL	10658	95% Percentile	5498
95% Chebyshev UPL	14150	99% Percentile	5732
95% USL	5790		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Arsenic

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	0.25	First Quartile	1.113
Second Largest	1.8	Median	1.6
Maximum	1.9	Third Quartile	1.825
Mean	1.338	SD	0.756
Coefficient of Variation	0.566	Skewness	-1.554
Mean of logged Data	0.045	SD of logged Data	0.963

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Sediment Background ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic	0.84	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	5.229	90% Percentile (z)	2.307
95% UPL (t)	3.328	95% Percentile (z)	2.582
95% USL	2.444	99% Percentile (z)	3.097

Gamma GOF Test

A-D Test Statistic	0.632	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.366	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.186	k star (bias corrected MLE)	0.713
Theta hat (MLE)	0.612	Theta star (bias corrected MLE)	1.876
nu hat (MLE)	17.49	nu star (bias corrected)	5.705
MLE Mean (bias corrected)	1.338	MLE Sd (bias corrected)	1.584

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	5.851	90% Percentile	3.343
95% Hawkins Wixley (HW) Approx. Gamma UPL	6.716	95% Percentile	4.522
95% WH Approx. Gamma UTL with 95% Coverage	15.99	99% Percentile	7.333
95% HW Approx. Gamma UTL with 95% Coverage	21.84		
95% WH USL	3.166	95% HW USL	3.352

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.74	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.369	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	148.5	90% Percentile (z)	3.595
95% UPL (t)	13.19	95% Percentile (z)	5.102
95% USL	4.28	99% Percentile (z)	9.837

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	1.9

Sediment Background ProUCL Outputs

Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	1.9	90% Percentile	1.87
90% Chebyshev UPL	3.875	95% Percentile	1.885
95% Chebyshev UPL	5.024	99% Percentile	1.897
95% USL	1.9		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Calcium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	178	First Quartile	503.5
Second Largest	639	Median	625.5
Maximum	1540	Third Quartile	864.3
Mean	742.3	SD	572.2
Coefficient of Variation	0.771	Skewness	1.155
Mean of logged Data	6.349	SD of logged Data	0.887

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.9	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.322	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	3686	90% Percentile (z)	1476
95% UPL (t)	2248	95% Percentile (z)	1684
95% USL	1579	99% Percentile (z)	2074

Gamma GOF Test

A-D Test Statistic	0.308	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.073	k star (bias corrected MLE)	0.685
Theta hat (MLE)	358.1	Theta star (bias corrected MLE)	1084

Sediment Background ProUCL Outputs

nu hat (MLE)	16.58	nu star (bias corrected)	5.479
MLE Mean (bias corrected)	742.3	MLE Sd (bias corrected)	896.9

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	3330	90% Percentile	1873
95% Hawkins Wixley (HW) Approx. Gamma UPL	3676	95% Percentile	2546
95% WH Approx. Gamma UTL with 95% Coverage	9275	99% Percentile	4157
95% HW Approx. Gamma UTL with 95% Coverage	12003		
95% WH USL	1774	95% HW USL	1829

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.28
5% Lilliefors Critical Value	0.375

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	54850	90% Percentile (z)	1783
95% UPL (t)	5904	95% Percentile (z)	2461
95% USL	2094	99% Percentile (z)	4505

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	1540
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	1540	90% Percentile	1270
90% Chebyshev UPL	2662	95% Percentile	1405
95% Chebyshev UPL	3531	99% Percentile	1513
95% USL	1540		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Chromium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	2.2	First Quartile	4.975
Second Largest	6.2	Median	6.05
Maximum	6.7	Third Quartile	6.325
Mean	5.25	SD	2.06
Coefficient of Variation	0.392	Skewness	-1.845

Sediment Background ProUCL Outputs

Mean of logged Data	1.573	SD of logged Data	0.525

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.776	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.374	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with	95% Coverage	15.85	90% Percentile (z)	7.89
	95% UPL (t)	10.67	95% Percentile (z)	8.638
	95% USL	8.263	99% Percentile (z)	10.04

Gamma GOF Test

A-D Test Statistic	0.712	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.415	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.396	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.995	k star (bias corrected MLE)	1.665
Theta hat (MLE)	0.876	Theta star (bias corrected MLE)	3.152
nu hat (MLE)	47.96	nu star (bias corrected)	13.32
MLE Mean (bias corrected)	5.25	MLE Sd (bias corrected)	4.068

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	14.28	90% Percentile	10.67
95% Hawkins Wixley (HW) Approx. Gamma UPL	15.14	95% Percentile	13.21
95% WH Approx. Gamma UTL with	95% Coverage	30.15	99% Percentile
95% HW Approx. Gamma UTL with	95% Coverage	35.03	
	95% WH USL	9.353	95% HW USL
			9.565

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.723	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.4	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.375	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with	95% Coverage	71.86	90% Percentile (z)	9.447
	95% UPL (t)	19.2	95% Percentile (z)	11.43
	95% USL	10.39	99% Percentile (z)	16.36

Nonparametric Distribution Free Background Statistics

Sediment Background ProUCL Outputs

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	6.7
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	6.7	90% Percentile	6.55
90% Chebyshev UPL	12.16	95% Percentile	6.625
95% Chebyshev UPL	15.29	99% Percentile	6.685
95% USL	6.7		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Copper

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	1.1	First Quartile	1.475
Second Largest	4.4	Median	3
Maximum	5	Third Quartile	4.55
Mean	3.025	SD	1.96
Coefficient of Variation	0.648	Skewness	0.0245
Mean of logged Data	0.914	SD of logged Data	0.747

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.266	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	13.11	90% Percentile (z)	5.537
95% UPL (t)	8.183	95% Percentile (z)	6.249
95% USL	5.892	99% Percentile (z)	7.585

Gamma GOF Test

A-D Test Statistic	0.438	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Sediment Background ProUCL Outputs

Gamma Statistics

k hat (MLE)	2.748	k star (bias corrected MLE)	0.854
Theta hat (MLE)	1.101	Theta star (bias corrected MLE)	3.543
nu hat (MLE)	21.99	nu star (bias corrected)	6.83
MLE Mean (bias corrected)	3.025	MLE Sd (bias corrected)	3.274

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	11.76	90% Percentile	7.241
95% Hawkins Wixley (HW) Approx. Gamma UPL	12.72	95% Percentile	9.587
95% WH Approx. Gamma UTL with 95% Coverage	30.41	99% Percentile	15.1
95% HW Approx. Gamma UTL with 95% Coverage	37.6		
95% WH USL	6.65	95% HW USL	6.806

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.276	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	116.2	90% Percentile (z)	6.496
95% UPL (t)	17.8	95% Percentile (z)	8.521
95% USL	7.436	99% Percentile (z)	14.17

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	5
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	5	90% Percentile	4.82
90% Chebyshev UPL	9.6	95% Percentile	4.91
95% Chebyshev UPL	12.58	99% Percentile	4.982
95% USL	5		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers

and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data

represents a background data set and when many onsite observations need to be compared with the BTV.

Iron

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	1540	First Quartile	5140

Sediment Background ProUCL Outputs

Second Largest	6660	Median	6500
Maximum	8010	Third Quartile	6998
Mean	5638	SD	2826
Coefficient of Variation	0.501	Skewness	-1.596
Mean of logged Data	8.472	SD of logged Data	0.761

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.845	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.348	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	20174	90% Percentile (z)	9259
95% UPL (t)	13073	95% Percentile (z)	10286
95% USL	9770	99% Percentile (z)	12212

Gamma GOF Test

A-D Test Statistic	0.639	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.405	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.396	Data Not Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	3.177	k star (bias corrected MLE)	0.961
Theta hat (MLE)	1775	Theta star (bias corrected MLE)	5867
nu hat (MLE)	25.41	nu star (bias corrected)	7.687
MLE Mean (bias corrected)	5638	MLE Sd (bias corrected)	5751

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	20376	90% Percentile	13109
95% Hawkins Wixley (HW) Approx. Gamma UPL	22527	95% Percentile	17129
95% WH Approx. Gamma UTL with 95% Coverage	50460	99% Percentile	26490
95% HW Approx. Gamma UTL with 95% Coverage	64067		
95% WH USL	11899	95% HW USL	12387

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.749	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.395	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	239974	90% Percentile (z)	12675

Sediment Background ProUCL Outputs

95% UPL (t) 35418

95% Percentile (z) 16714

95% USL 14548

99% Percentile (z) 28083

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	8010
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	8010	90% Percentile	7605
90% Chebyshev UPL	15116	95% Percentile	7808
95% Chebyshev UPL	19409	99% Percentile	7970
95% USL	8010		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Lead

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	3.6	First Quartile	4.875
Second Largest	12.4	Median	8.85
Maximum	12.8	Third Quartile	12.5
Mean	8.525	SD	4.759
Coefficient of Variation	0.558	Skewness	-0.103
Mean of logged Data	2.004	SD of logged Data	0.632

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.831
5% Shapiro Wilk Critical Value	0.748
Lilliefors Test Statistic	0.292
5% Lilliefors Critical Value	0.375

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	33.01	90% Percentile (z)	14.62
95% UPL (t)	21.05	95% Percentile (z)	16.35
95% USL	15.49	99% Percentile (z)	19.6

Gamma GOF Test

A-D Test Statistic	0.473

Anderson-Darling Gamma GOF Test

Sediment Background ProUCL Outputs

5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.327	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.754	k star (bias corrected MLE)	1.105
Theta hat (MLE)	2.271	Theta star (bias corrected MLE)	7.713
nu hat (MLE)	30.03	nu star (bias corrected)	8.842
MLE Mean (bias corrected)	8.525	MLE Sd (bias corrected)	8.109

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	28.47	90% Percentile	19.15
95% Hawkins Wixley (HW) Approx. Gamma UPL	30.29	95% Percentile	24.66
95% WH Approx. Gamma UTL with 95% Coverage	67.73	99% Percentile	37.35
95% HW Approx. Gamma UTL with 95% Coverage	80.53		
95% WH USL	17.13	95% HW USL	17.45

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.859	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.292	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	191.3	90% Percentile (z)	16.67
95% UPL (t)	39.1	95% Percentile (z)	20.97
95% USL	18.69	99% Percentile (z)	32.25

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	12.8
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	12.8	90% Percentile	12.68
90% Chebyshev UPL	24.49	95% Percentile	12.74
95% Chebyshev UPL	31.72	99% Percentile	12.79
95% USL	12.8		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Sediment Background ProUCL Outputs

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	104	First Quartile	212.8
Second Largest	497	Median	373
Maximum	972	Third Quartile	615.8
Mean	455.5	SD	380.7
Coefficient of Variation	0.836	Skewness	1.035
Mean of logged Data	5.812	SD of logged Data	0.957

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	2414	90% Percentile (z)	943.3
95% UPL (t)	1457	95% Percentile (z)	1082
95% USL	1012	99% Percentile (z)	1341

Gamma GOF Test

A-D Test Statistic	0.198	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.179	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.767	k star (bias corrected MLE)	0.608
Theta hat (MLE)	257.8	Theta star (bias corrected MLE)	748.7
nu hat (MLE)	14.13	nu star (bias corrected)	4.867
MLE Mean (bias corrected)	455.5	MLE Sd (bias corrected)	584

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	2233	90% Percentile	1181
95% Hawkins Wixley (HW) Approx. Gamma UPL	2483	95% Percentile	1631
95% WH Approx. Gamma UTL with 95% Coverage	6508	99% Percentile	2718
95% HW Approx. Gamma UTL with 95% Coverage	8598		
95% WH USL	1146	95% HW USL	1182

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.993	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.161	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Sediment Background ProUCL Outputs

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	45909	90% Percentile (z)	1140
95% UPL (t)	4146	95% Percentile (z)	1614
95% USL	1355	99% Percentile (z)	3098

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	972
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	972	90% Percentile	829.5
90% Chebyshev UPL	1732	95% Percentile	900.8
95% Chebyshev UPL	2311	99% Percentile	957.8
95% USL	972		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Manganese

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	17	First Quartile	78.43
Second Largest	123	Median	111
Maximum	261	Third Quartile	157.5
Mean	125	SD	101.4
Coefficient of Variation	0.811	Skewness	0.793
Mean of logged Data	4.451	SD of logged Data	1.156

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	646.6	90% Percentile (z)	254.9
95% UPL (t)	391.8	95% Percentile (z)	291.8

Sediment Background ProUCL Outputs

95% USL 273.3

99% Percentile (z) 360.9

Gamma GOF Test

A-D Test Statistic	0.278	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.663	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.254	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.4	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	1.47	k star (bias corrected MLE)	0.534
Theta hat (MLE)	85	Theta star (bias corrected MLE)	233.9
nu hat (MLE)	11.76	nu star (bias corrected)	4.274
MLE Mean (bias corrected)	125	MLE Sd (bias corrected)	171

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	678.6	90% Percentile	333.4
95% Hawkins Wixley (HW) Approx. Gamma UPL	791	95% Percentile	468.9
95% WH Approx. Gamma UTL with 95% Coverage	2072	99% Percentile	799.8
95% HW Approx. Gamma UTL with 95% Coverage	2960		
95% WH USL	335	95% HW USL	354.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.299	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	32754	90% Percentile (z)	377
95% UPL (t)	1794	95% Percentile (z)	573.8
95% USL	464.7	99% Percentile (z)	1261

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	261
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	261	90% Percentile	219.6
90% Chebyshev UPL	465.1	95% Percentile	240.3
95% Chebyshev UPL	619.1	99% Percentile	256.9
95% USL	261		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

Sediment Background ProUCL Outputs

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Nickel

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	0.86	First Quartile	1.64
Second Largest	5.8	Median	3.85
Maximum	6.2	Third Quartile	5.9
Mean	3.69	SD	2.706
Coefficient of Variation	0.733	Skewness	-0.107
Mean of logged Data	1.018	SD of logged Data	0.95

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.282	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	17.61	90% Percentile (z)	7.158
95% UPL (t)	10.81	95% Percentile (z)	8.141
95% USL	7.647	99% Percentile (z)	9.985

Gamma GOF Test

A-D Test Statistic	0.419	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.318	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.89	k star (bias corrected MLE)	0.639
Theta hat (MLE)	1.952	Theta star (bias corrected MLE)	5.773
nu hat (MLE)	15.12	nu star (bias corrected)	5.114
MLE Mean (bias corrected)	3.69	MLE Sd (bias corrected)	4.615

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	17.5	90% Percentile	9.46
95% Hawkins Wixley (HW) Approx. Gamma UPL	19.62	95% Percentile	12.98
95% WH Approx. Gamma UTL with 95% Coverage	50.06	99% Percentile	21.44
95% HW Approx. Gamma UTL with 95% Coverage	66.64		
95% WH USL	9.126	95% HW USL	9.48

Lognormal GOF Test

Sediment Background ProUCL Outputs

Shapiro Wilk Test Statistic	0.882	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.282	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	366.3	90% Percentile (z)	9.35
95% UPL (t)	33.68	95% Percentile (z)	13.2
95% USL	11.1	99% Percentile (z)	25.22

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	6.2
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	6.2	90% Percentile	6.08
90% Chebyshev UPL	12.77	95% Percentile	6.14
95% Chebyshev UPL	16.88	99% Percentile	6.188
95% USL	6.2		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Potassium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	138	First Quartile	186.8
Second Largest	649	Median	426
Maximum	987	Third Quartile	733.5
Mean	494.3	SD	399.4
Coefficient of Variation	0.808	Skewness	0.559
Mean of logged Data	5.903	SD of logged Data	0.933

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.905	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Sediment Background ProUCL Outputs

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	2549	90% Percentile (z)	1006
95% UPL (t)	1545	95% Percentile (z)	1151
95% USL	1078	99% Percentile (z)	1423

Gamma GOF Test

A-D Test Statistic	0.346	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	1.813	k star (bias corrected MLE)	0.62
Theta hat (MLE)	272.6	Theta star (bias corrected MLE)	797.2
nu hat (MLE)	14.51	nu star (bias corrected)	4.96
MLE Mean (bias corrected)	494.3	MLE Sd (bias corrected)	627.7

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	2395	90% Percentile	1276
95% Hawkins Wixley (HW) Approx. Gamma UPL	2654	95% Percentile	1758
95% WH Approx. Gamma UTL with 95% Coverage	6943	99% Percentile	2919
95% HW Approx. Gamma UTL with 95% Coverage	9110		
95% WH USL	1236	95% HW USL	1272

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.916	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.236	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	44426	90% Percentile (z)	1210
95% UPL (t)	4261	95% Percentile (z)	1698
95% USL	1432	99% Percentile (z)	3207

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	987
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	987	90% Percentile	885.6
90% Chebyshev UPL	1834	95% Percentile	936.3
95% Chebyshev UPL	2441	99% Percentile	976.9
95% USL	987		

Sediment Background ProUCL Outputs

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20. Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Vanadium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	2.1	First Quartile	5.475
Second Largest	9.2	Median	7.9
Maximum	10.8	Third Quartile	9.6
Mean	7.175	SD	3.8
Coefficient of Variation	0.53	Skewness	-0.911
Mean of logged Data	1.807	SD of logged Data	0.739

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.203	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	26.72	90% Percentile (z)	12.05
95% UPL (t)	17.17	95% Percentile (z)	13.43
95% USL	12.73	99% Percentile (z)	16.02

Gamma GOF Test

A-D Test Statistic	0.393	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.266	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.212	k star (bias corrected MLE)	0.97
Theta hat (MLE)	2.234	Theta star (bias corrected MLE)	7.399
nu hat (MLE)	25.7	nu star (bias corrected)	7.758
MLE Mean (bias corrected)	7.175	MLE Sd (bias corrected)	7.286

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	25.79	90% Percentile	16.65
95% Hawkins Wixley (HW) Approx. Gamma UPL	28.27	95% Percentile	21.73
95% WH Approx. Gamma UTL with 95% Coverage	63.75	99% Percentile	33.56

Sediment Background ProUCL Outputs

95% HW Approx. Gamma UTL with 95% Coverage	79.86		
95% WH USL	15.09	95% HW USL	15.62

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.293	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	272.7	90% Percentile (z)	15.71
95% UPL (t)	42.58	95% Percentile (z)	20.54
95% USL	17.95	99% Percentile (z)	33.99

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	10.8
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A
95% UPL	10.8	90% Percentile	10.32
90% Chebyshev UPL	19.92	95% Percentile	10.56
95% Chebyshev UPL	25.7	99% Percentile	10.75
95% USL	10.8		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Zinc

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Minimum	5	First Quartile	5.225
Second Largest	20.8	Median	13.05
Maximum	36	Third Quartile	24.6
Mean	16.78	SD	14.79
Coefficient of Variation	0.882	Skewness	0.83
Mean of logged Data	2.474	SD of logged Data	0.991

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	5.144	d2max (for USL)	1.462

Normal GOF Test

Shapiro Wilk Test Statistic	0.871	Shapiro Wilk GOF Test

Sediment Background ProUCL Outputs

5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.281	Lilliefors GOF Test
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Background Statistics Assuming Normal Distribution

95% UTL with 95% Coverage	92.85	90% Percentile (z)	35.73
95% UPL (t)	55.69	95% Percentile (z)	41.1
95% USL	38.4	99% Percentile (z)	51.18

Gamma GOF Test

A-D Test Statistic	0.436	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.662	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.325	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	1.591	k star (bias corrected MLE)	0.565
Theta hat (MLE)	10.54	Theta star (bias corrected MLE)	29.72
nu hat (MLE)	12.73	nu star (bias corrected)	4.516
MLE Mean (bias corrected)	16.78	MLE Sd (bias corrected)	22.33

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	87.38	90% Percentile	44.22
95% Hawkins Wixley (HW) Approx. Gamma UPL	97.29	95% Percentile	61.7
95% WH Approx. Gamma UTL with 95% Coverage	262.9	99% Percentile	104.2
95% HW Approx. Gamma UTL with 95% Coverage	350.3		
95% WH USL	43.69	95% HW USL	44.95

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.854	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.292	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Background Statistics assuming Lognormal Distribution

95% UTL with 95% Coverage	1937	90% Percentile (z)	42.24
95% UPL (t)	160.8	95% Percentile (z)	60.53
95% USL	50.53	99% Percentile (z)	118.9

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	4	95% UTL with 95% Coverage	36
Approx, f used to compute achieved CC	0.211	Approximate Actual Confidence Coefficient achieved by UTL	0.185
		Approximate Sample Size needed to achieve specified CC	59
95% Percentile Bootstrap UTL with 95% Coverage	N/A	95% BCA Bootstrap UTL with 95% Coverage	N/A

Sediment Background ProUCL Outputs

95% UPL	36	90% Percentile	31.44
90% Chebyshev UPL	66.38	95% Percentile	33.72
95% Chebyshev UPL	88.85	99% Percentile	35.54
95% USL	36		

Note: The use of USL tends to yield a conservative estimate of BTV, especially when the sample size starts exceeding 20.

Therefore, one may use USL to estimate a BTV only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.

The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

Sediment ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/6/2019 1:13:19 PM
 From File ProUCL Input SD.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

ARSENIC

General Statistics

Total Number of Observations	40	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	0.46	Mean	1.862
Maximum	7.2	Median	1.4
SD	1.432	Std. Error of Mean	0.226
Coefficient of Variation	0.769	Skewness	2.133

Normal GOF Test

Shapiro Wilk Test Statistic 0.779
 5% Shapiro Wilk Critical Value 0.94
 Lilliefors Test Statistic 0.192
 5% Lilliefors Critical Value 0.139

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 2.244

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 2.316
 95% Modified-t UCL (Johnson-1978) 2.256

Gamma GOF Test

A-D Test Statistic 0.7
 5% A-D Critical Value 0.757
 K-S Test Statistic 0.11
 5% K-S Critical Value 0.141

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.445	k star (bias corrected MLE)	2.278
Theta hat (MLE)	0.762	Theta star (bias corrected MLE)	0.818
nu hat (MLE)	195.6	nu star (bias corrected)	182.2
MLE Mean (bias corrected)	1.862	MLE Sd (bias corrected)	1.234
		Approximate Chi Square Value (0.05)	152
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	151

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 2.233 95% Adjusted Gamma UCL (use when $n < 50$) 2.248

Sediment ProUCL Outputs

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.94	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0663	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.139	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.777	Mean of logged Data	0.404
Maximum of Logged Data	1.974	SD of logged Data	0.649

Assuming Lognormal Distribution

95% H-UCL	2.284	90% Chebyshev (MVUE) UCL	2.445
95% Chebyshev (MVUE) UCL	2.72	97.5% Chebyshev (MVUE) UCL	3.103
99% Chebyshev (MVUE) UCL	3.855		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2.235	95% Jackknife UCL	2.244
95% Standard Bootstrap UCL	2.232	95% Bootstrap-t UCL	2.376
95% Hall's Bootstrap UCL	2.381	95% Percentile Bootstrap UCL	2.255
95% BCA Bootstrap UCL	2.313		
90% Chebyshev(Mean, Sd) UCL	2.542	95% Chebyshev(Mean, Sd) UCL	2.849
97.5% Chebyshev(Mean, Sd) UCL	3.276	99% Chebyshev(Mean, Sd) UCL	4.115

Suggested UCL to Use

95% Adjusted Gamma UCL	2.248

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

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

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

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

CHROMIUM HEXAVALENT

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.81	Mean	2.642
Maximum	4.8	Median	2.2
SD	1.631	Std. Error of Mean	0.729
Coefficient of Variation	0.617	Skewness	0.407

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Sediment ProUCL Outputs

Normal GOF Test

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 4.197

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 3.983
95% Modified-t UCL (Johnson-1978) 4.219

Gamma GOF Test

A-D Test Statistic	0.212	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.683	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.203	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.914	k star (bias corrected MLE)	1.299
Theta hat (MLE)	0.907	Theta star (bias corrected MLE)	2.034
nu hat (MLE)	29.14	nu star (bias corrected)	12.99
MLE Mean (bias corrected)	2.642	MLE Sd (bias corrected)	2.318
		Approximate Chi Square Value (0.05)	5.887
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	3.978

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 5.831 95% Adjusted Gamma UCL (use when $n < 50$) 8.628

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.211	Mean of logged Data	0.79
Maximum of Logged Data	1.569	SD of logged Data	0.708

Assuming Lognormal Distribution

95% H-UCL	10.48	90% Chebyshev (MVUE) UCL	5.172
95% Chebyshev (MVUE) UCL	6.302	97.5% Chebyshev (MVUE) UCL	7.871
99% Chebyshev (MVUE) UCL	10.95		

Nonparametric Distribution Free UCL Statistics

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

Sediment ProUCL Outputs

Nonparametric Distribution Free UCLs

95% CLT UCL	3.841	95% Jackknife UCL	4.197
95% Standard Bootstrap UCL	3.713	95% Bootstrap-t UCL	5.377
95% Hall's Bootstrap UCL	6.7	95% Percentile Bootstrap UCL	3.76
95% BCA Bootstrap UCL	3.68		
90% Chebyshev(Mean, Sd) UCL	4.83	95% Chebyshev(Mean, Sd) UCL	5.821
97.5% Chebyshev(Mean, Sd) UCL	7.196	99% Chebyshev(Mean, Sd) UCL	9.898

Suggested UCL to Use

95% Student's-t UCL	4.197

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

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

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

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

BENZO(A)PYRENE

General Statistics

Total Number of Observations	40	Number of Distinct Observations	32
Number of Detects	32	Number of Non-Detects	8
Number of Distinct Detects	27	Number of Distinct Non-Detects	6
Minimum Detect	0.0015	Minimum Non-Detect	0.0037
Maximum Detect	1.2	Maximum Non-Detect	0.27
Variance Detects	0.0455	Percent Non-Detects	20%
Mean Detects	0.0677	SD Detects	0.213
Median Detects	0.013	CV Detects	3.153
Skewness Detects	5.143	Kurtosis Detects	27.74
Mean of Logged Detects	-4.35	SD of Logged Detects	1.636

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.325
5% Shapiro Wilk Critical Value	0.93
Lilliefors Test Statistic	0.401
5% Lilliefors Critical Value	0.154

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0578	KM Standard Error of Mean	0.0306
KM SD	0.19	95% KM (BCA) UCL	0.118
95% KM (t) UCL	0.109	95% KM (Percentile Bootstrap) UCL	0.115
95% KM (z) UCL	0.108	95% KM Bootstrap t UCL	0.258
90% KM Chebyshev UCL	0.15	95% KM Chebyshev UCL	0.191
97.5% KM Chebyshev UCL	0.249	99% KM Chebyshev UCL	0.362

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.716
5% A-D Critical Value	0.833
K-S Test Statistic	0.234
5% K-S Critical Value	0.167

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Sediment ProUCL Outputs

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.397	k star (bias corrected MLE)	0.381
Theta hat (MLE)	0.17	Theta star (bias corrected MLE)	0.178
nu hat (MLE)	25.44	nu star (bias corrected)	24.39
Mean (detects)	0.0677		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0015	Mean	0.0573
Maximum	1.2	Median	0.0105
SD	0.192	CV	3.346
k hat (MLE)	0.433	k star (bias corrected MLE)	0.418
Theta hat (MLE)	0.132	Theta star (bias corrected MLE)	0.137
nu hat (MLE)	34.68	nu star (bias corrected)	33.41
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (33.41, α)	21.19	Adjusted Chi Square Value (33.41, β)	20.83
95% Gamma Approximate UCL (use when $n \geq 50$)	0.0903	95% Gamma Adjusted UCL (use when $n < 50$)	0.0918

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0578	SD (KM)	0.19
Variance (KM)	0.036	SE of Mean (KM)	0.0306
k hat (KM)	0.0928	k star (KM)	0.103
nu hat (KM)	7.424	nu star (KM)	8.2
theta hat (KM)	0.622	theta star (KM)	0.564
80% gamma percentile (KM)	0.0415	90% gamma percentile (KM)	0.155
95% gamma percentile (KM)	0.335	99% gamma percentile (KM)	0.906

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (8.20, α)	2.851	Adjusted Chi Square Value (8.20, β)	2.734
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.166	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.173
95% Gamma Adjusted KM-UCL (use when $k \leq 1$ and $15 < n < 50$)			

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.93	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.112	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.154	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.056	Mean in Log Scale	-4.472
SD in Original Scale	0.192	SD in Log Scale	1.521
95% t UCL (assumes normality of ROS data)	0.107	95% Percentile Bootstrap UCL	0.114
95% BCA Bootstrap UCL	0.153	95% Bootstrap t UCL	0.278

Sediment ProUCL Outputs

95% H-UCL (Log ROS) 0.0769

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.487	KM Geo Mean	0.0113
KM SD (logged)	1.577	95% Critical H Value (KM-Log)	3.156
KM Standard Error of Mean (logged)	0.269	95% H-UCL (KM -Log)	0.0865
KM SD (logged)	1.577	95% Critical H Value (KM-Log)	3.156
KM Standard Error of Mean (logged)	0.269		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0715
SD in Original Scale	0.192
95% t UCL (Assumes normality)	0.123

DL/2 Log-Transformed

Mean in Log Scale	-4.117
SD in Log Scale	1.728
95% H-Stat UCL	0.184

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.191

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

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

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

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

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APPENDIX C

**CONSTRUCTION WORKER PARTICULATE EMISSION
FACTOR**

(electronic versions only)

Site-specific**Construction Worker Equation Inputs for Soil - Other Construction Activities**

Variable	Value
TR (target cancer risk) unitless	0.000001
THQ (target hazard quotient) unitless	1
EF _{cw} (exposure frequency - construction worker) day/yr	250
ED _{cw} (exposure duration - construction worker) yr	1
ET _{cw} (exposure time - construction worker) hr/day	8
LT (lifetime) yr	70
BW _{cw} (body weight - construction worker) kg	80
IR _{cw} (soil ingestion rate - construction worker) mg/day	330
SA _{cw} (surface area - construction worker) cm ² /day	3527
AF _{cw} (skin adherence factor - construction worker) mg/cm ²	0.3
AT _{cw} (averaging time - construction worker)	365
EW _{cw} (overall duration of construction) weeks/year	50
DW _{cw} (days worked - construction worker) days/week	5
A _c (acres)	5
A _{till} (areal extent of tilling) acres	5
A _{excav} (area of excavation site) m ²	5
A _{c-grade} (areal extent of grading) acres	5
A _{c-doz} (areal extent of dozing) acres	5
M _{m-doz} (Gravimetric soil moisture content) %	7.9
M _{m-excav} (Gravimetric soil moisture content) %	12
p _{soil} (density) g/cm ³ - chemical-specific	1.68
N _{A-dump} (number of times soil is dumped)	2
N _{A-till} (number of times soil is tilled)	2
S _{till} (soil silt content) %	18
S _{doz} (soil silt content) %	6.9
B _l (dozing blade length) m	2.4
B _l (grading blade length) m	2.4
N _{A-doz} (number of times site was dozed)	2
N _{A-grade} (number of times site was graded)	2
S _{doz} (dozing speed) kph	11.4
S _{grade} (dozing speed) kph	11.4
d _{excav} (average depth of excavation site) m	1.5
V (fraction of vegetative cover)	0
U _m (mean annual wind speed) m/s	4.69
U _t (equivalent threshold value) m/s	11.32
t _c (overall duration of construction) hours	8400
F _D Unitless Dispersion Correction Factor	0.185837208
T (time over which traffic occurs) s	7200000
J _T (g/m ² s)	8.31394E-07
F(x) (function dependant on U _m /U _t derived using Cowherd et al. (1985))	0.194

Site-specific**Construction Worker Equation Inputs for Soil - Other Construction Activities**

Variable	Value
M_{wind} (dust emitted by wind erosion) g	88039.13546
M_{doz} (dust emitted from dozing operations) g	501.0563805
M_{till} (dust emitted from tilling operations) g	25216.76624
M_{grade} (dust emitted from grading operations) g	7363.27368
M_{excav} (dust emitted from excavation soil dumping) g	3.072925474
VKT_{doz} (sum of fleet vehicle km traveled) km	16.8625
VKT_{grade} (sum of fleet vehicle km traveled) km	16.8625
Q/C_{sa} (inverse of the ratio of the geometric mean air concentration to the emission flu	9.435574229
PEF_{sc} (particulate emission factor) m^3/kg	61070100.28
A (PEF Dispersion Constant)	2.4538
B (PEF Dispersion Constant)	17.566
C (PEF Dispersion Constant)	189.0426
A_{surf} (areal extent of site) m^2	20234.3
A_s ($VF_{ulim-sc}$ acres)	0.5
T (temperature) C	25
foc (fraction organic carbon in soil) g/g	0.006
p_b (dry soil bulk density) g/cm^3	1.5
p_s (soil particle density) g/cm^3	2.65
w (water-filled soil porosity) L_{water}/L_{soil}	0.15
A (VF Dispersion Constant)	2.4538
B (VF Dispersion Constant)	17.566
C (VF Dispersion Constant)	189.0426
Q/C_{sa} (inverse of the ratio of the geometric mean air concentration to the emission flu	14.31407
n (total soil porosity) L_{pore}/L_{soil}	0.43396
a (air-filled soil porosity) L_{air}/L_{soil}	0.28396
A_s ($VF_{mlim-sc}$ acres)	0.5
p_b (dry soil bulk density) g/cm^3	1.5
d_s (average source depth) m	.
Q/C_{vol} (inverse of the ratio of the geometric mean air concentration to the emission fl	14.31407
$VF_{mlim-sc}$ (volitization factor) m^3_{air}/kg_{soil}	0

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APPENDIX D

BLOOD-LEAD MODELING

(electronic versions only)

LEAD MODEL FOR WINDOWS Version 1.1

Model Version: 1.1 Build11

User Name:

Date:

Site Name:

Operable Unit: East Tank Farm, Surface Soil

Run Mode: Research

***** Air *****

Indoor Air Pb Concentration: 30.000 percent of outdoor.

Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m ³ /day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m ³)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

***** Diet *****

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

***** Drinking Water *****

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

***** Soil & Dust *****

Multiple Source Analysis Used

Average multiple source concentration: 167.500 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	225.000	167.500
1-2	225.000	167.500
2-3	225.000	167.500
3-4	225.000	167.500
4-5	225.000	167.500
5-6	225.000	167.500
6-7	225.000	167.500

***** Alternate Intake *****

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

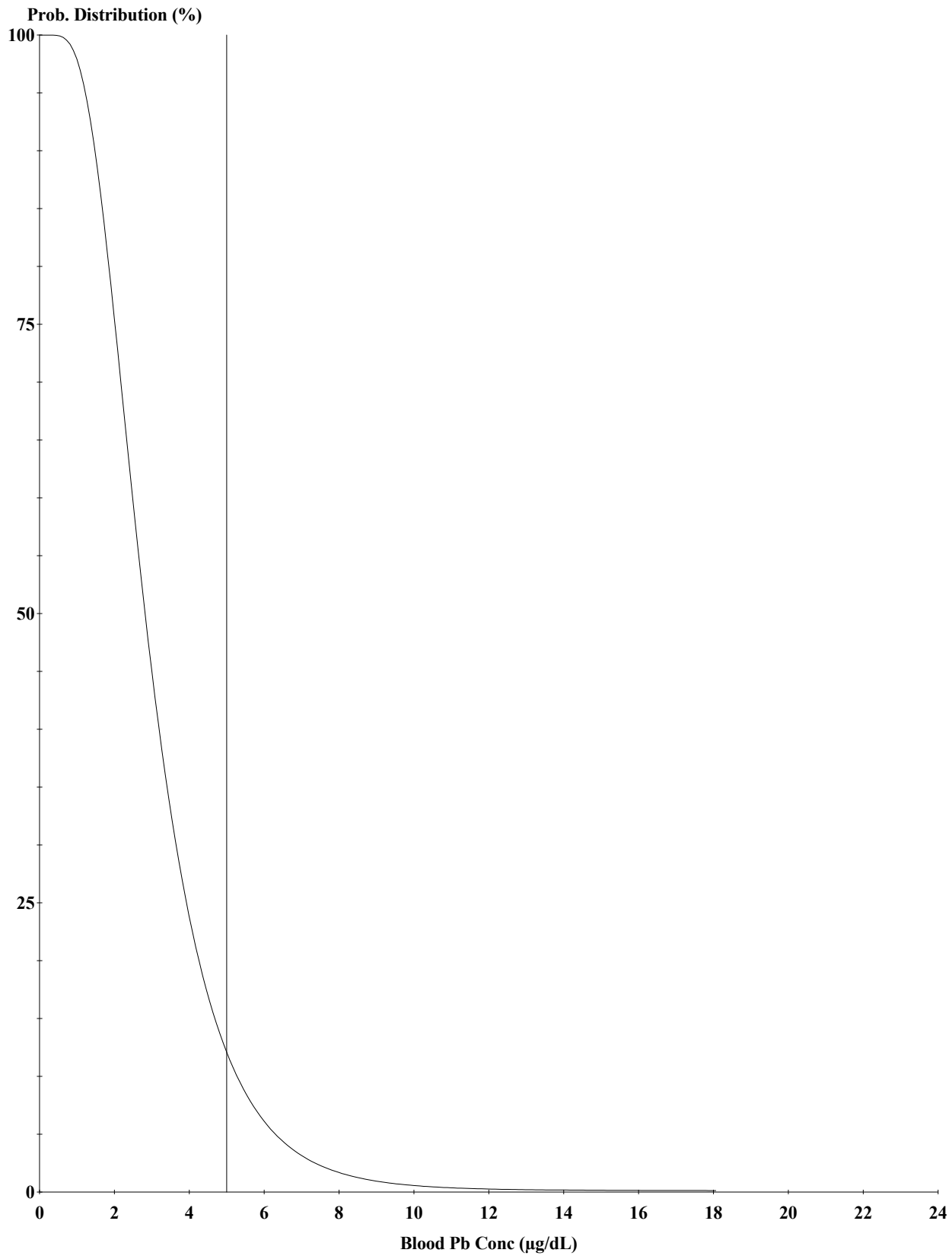
***** Maternal Contribution: Infant Model *****

Maternal Blood Concentration: 1.000 µg Pb/dL

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.055	0.000	0.373
1-2	0.034	0.905	0.000	0.923
2-3	0.062	0.994	0.000	0.970
3-4	0.067	0.961	0.000	0.999
4-5	0.067	0.936	0.000	1.055
5-6	0.093	0.990	0.000	1.120
6-7	0.093	1.076	0.000	1.144

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	4.603	6.053	3.3
1-2	7.232	9.095	3.8
2-3	7.308	9.334	3.5
3-4	7.380	9.406	3.3
4-5	5.566	7.624	2.7
5-6	5.043	7.247	2.3
6-7	4.780	7.093	2.1

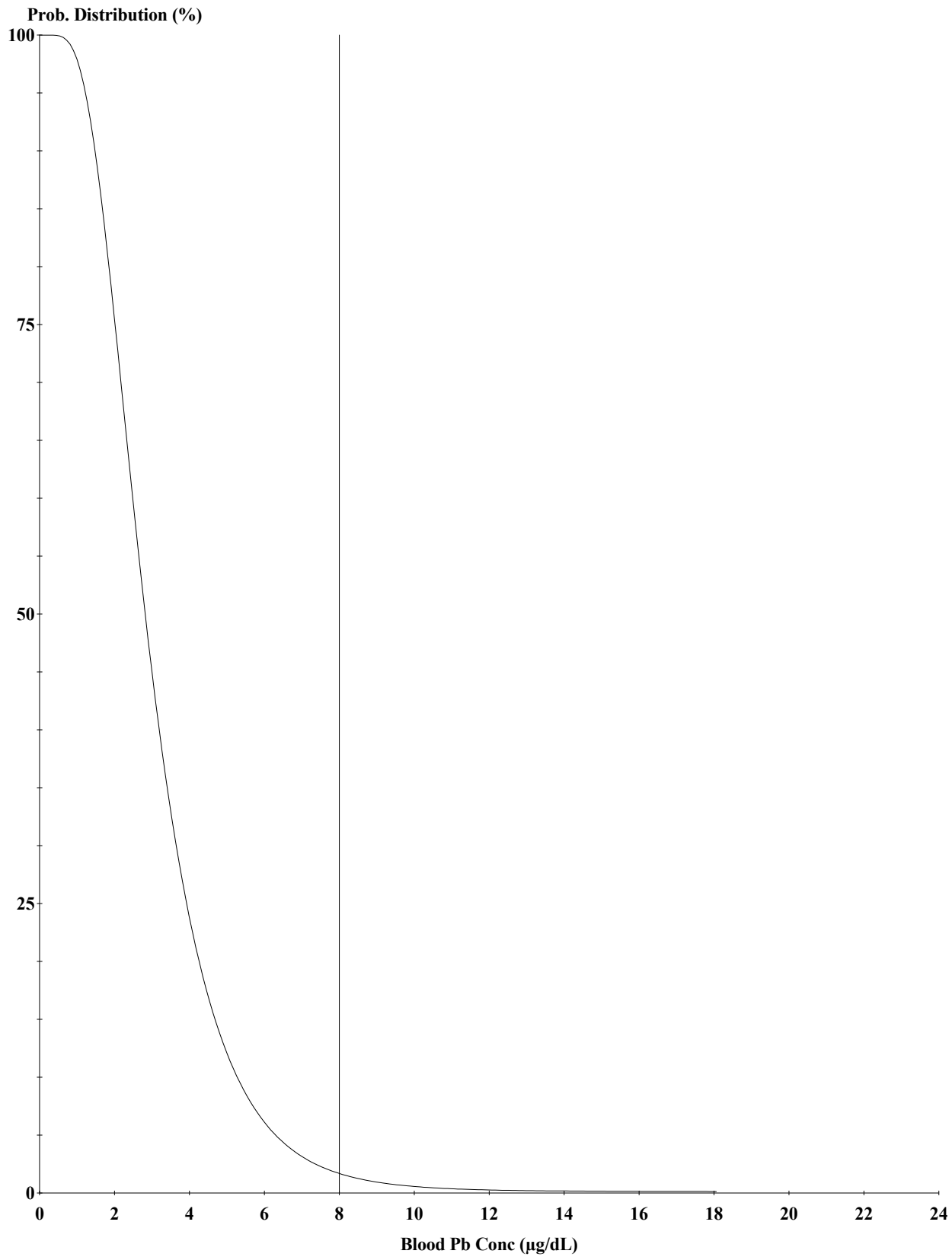


Cutoff = 5.000 µg/dl
Geo Mean = 2.955
GSD = 1.600
% Above = 13.154

Age Range = 0 to 84 months

Run Mode = Research

East Tank Farm, Surface Soil

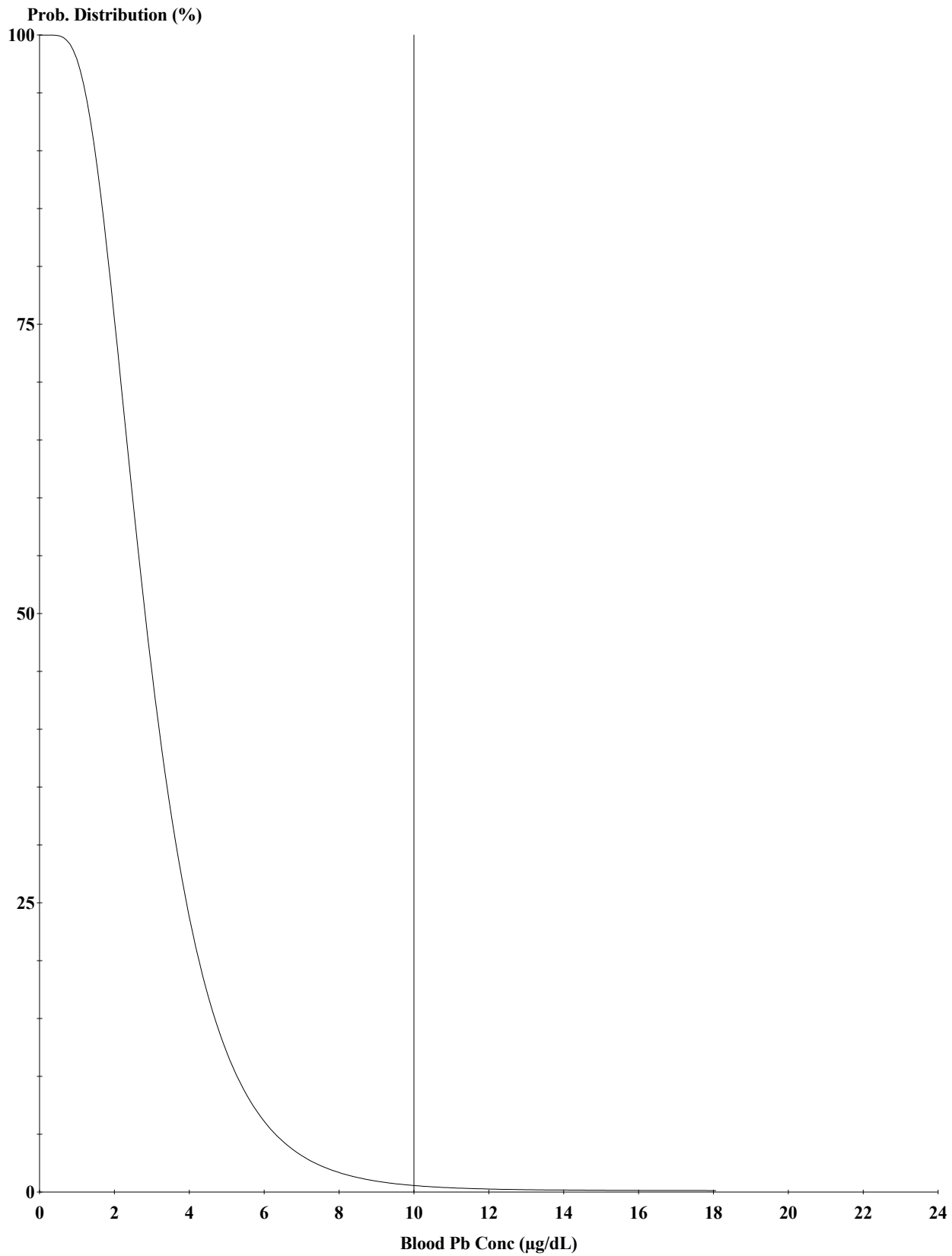


Cutoff = 8.000 µg/dl
Geo Mean = 2.955
GSD = 1.600
% Above = 1.704

Age Range = 0 to 84 months

Run Mode = Research

East Tank Farm, Surface Soil



Cutoff = 10.000 µg/dl
Geo Mean = 2.955
GSD = 1.600
% Above = 0.474

Age Range = 0 to 84 months

Run Mode = Research

East Tank Farm, Surface Soil

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead

Version date 06/14/2017

Edit Red Cells

Variable	Description of Variable	Units	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	225	225	225
R _{fetal/maternal}	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD _i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB ₀	Baseline PbB	µg/dL	0.6	0.6	0.6
IR _s	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	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	0.12	0.12
EF _{S, D}	Exposure frequency (same for soil and dust)	days/yr	250	250	250
AT _{S, D}	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB _{adult}	PbB of adult worker, geometric mean	µg/dL	1.3	1.3	1.3
PbB _{fetal, 0.95}	95th percentile PbB among fetuses of adult workers	µg/dL	3.2	3.2	3.2
PbB _t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	5.0	8.0	10.0
P(PbB _{fetal} > PbB _t)	Probability that fetal PbB exceeds target PbB, assuming lognormal distribution	%	0.8%	0.064%	0.016%

LEAD MODEL FOR WINDOWS Version 1.1

Model Version: 1.1 Build11

User Name:

Date:

Site Name:

Operable Unit: Lorraine Process Area, Surface Soil

Run Mode: Research

***** Air *****

Indoor Air Pb Concentration: 30.000 percent of outdoor.

Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m ³ /day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m ³)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

***** Diet *****

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

***** Drinking Water *****

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

***** Soil & Dust *****

Multiple Source Analysis Used

Average multiple source concentration: 385.900 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	537.000	385.900
1-2	537.000	385.900
2-3	537.000	385.900
3-4	537.000	385.900
4-5	537.000	385.900
5-6	537.000	385.900
6-7	537.000	385.900

***** Alternate Intake *****

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

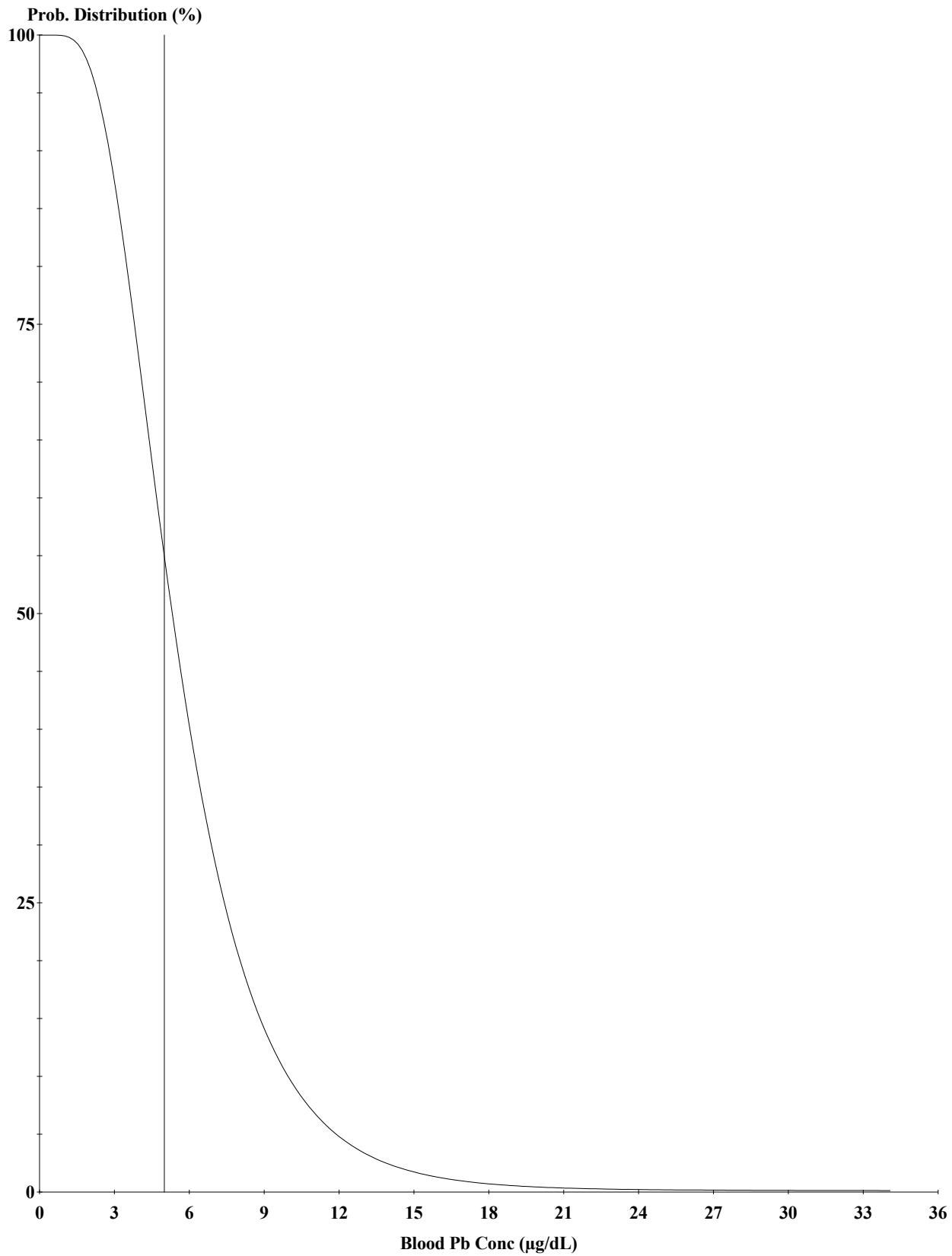
***** Maternal Contribution: Infant Model *****

Maternal Blood Concentration: 1.000 µg Pb/dL

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	0.990	0.000	0.350
1-2	0.034	0.839	0.000	0.856
2-3	0.062	0.930	0.000	0.908
3-4	0.067	0.907	0.000	0.943
4-5	0.067	0.900	0.000	1.015
5-6	0.093	0.960	0.000	1.086
6-7	0.093	1.047	0.000	1.113

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	10.138	11.499	6.1
1-2	15.734	17.463	7.1
2-3	16.056	17.957	6.7
3-4	16.349	18.266	6.3
4-5	12.571	14.553	5.2
5-6	11.472	13.611	4.4
6-7	10.917	13.170	3.8

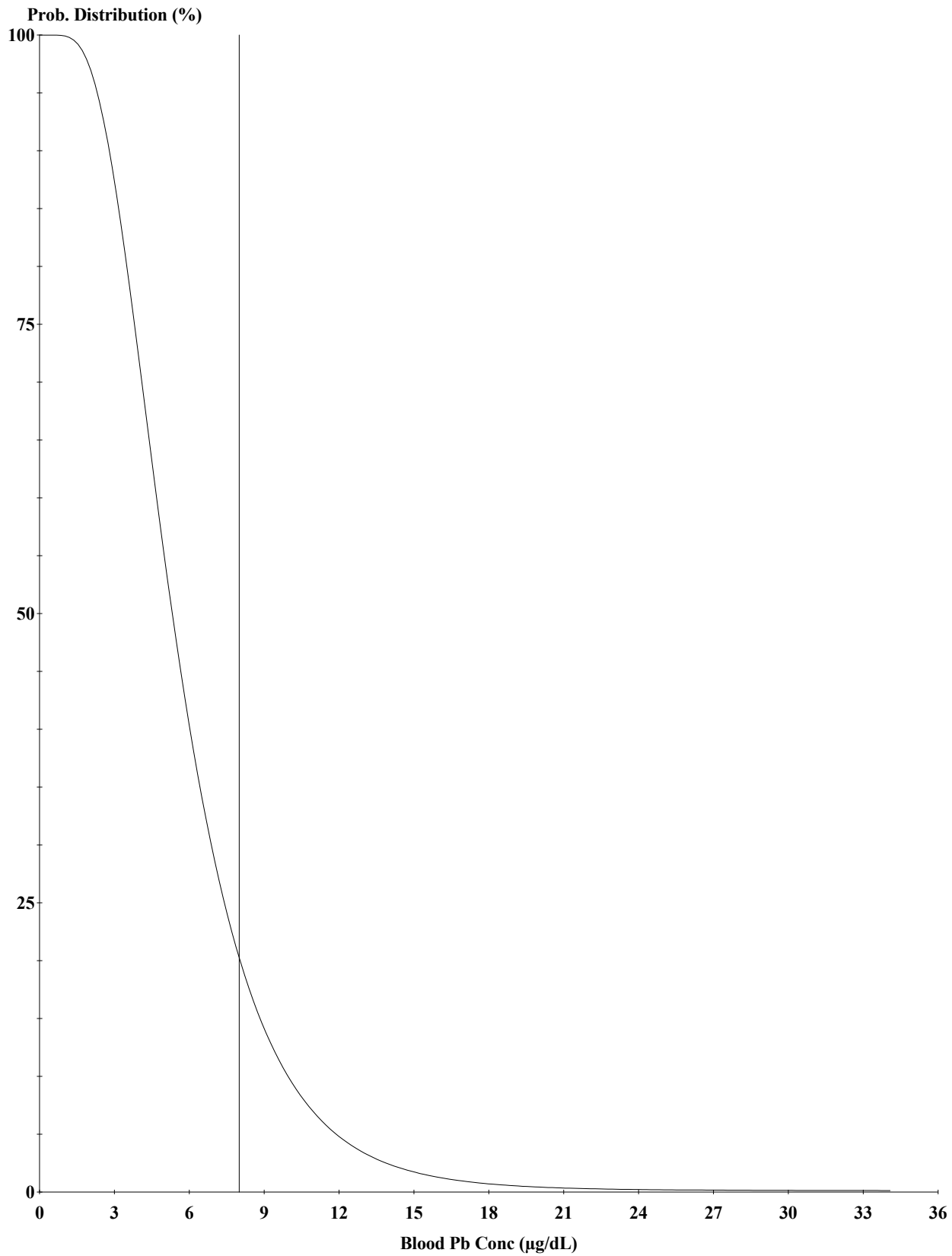


Cutoff = 5.000 µg/dl
Geo Mean = 5.575
GSD = 1.600
% Above = 59.157

Age Range = 0 to 84 months

Run Mode = Research

Lorraine Process Area, Surface Soil

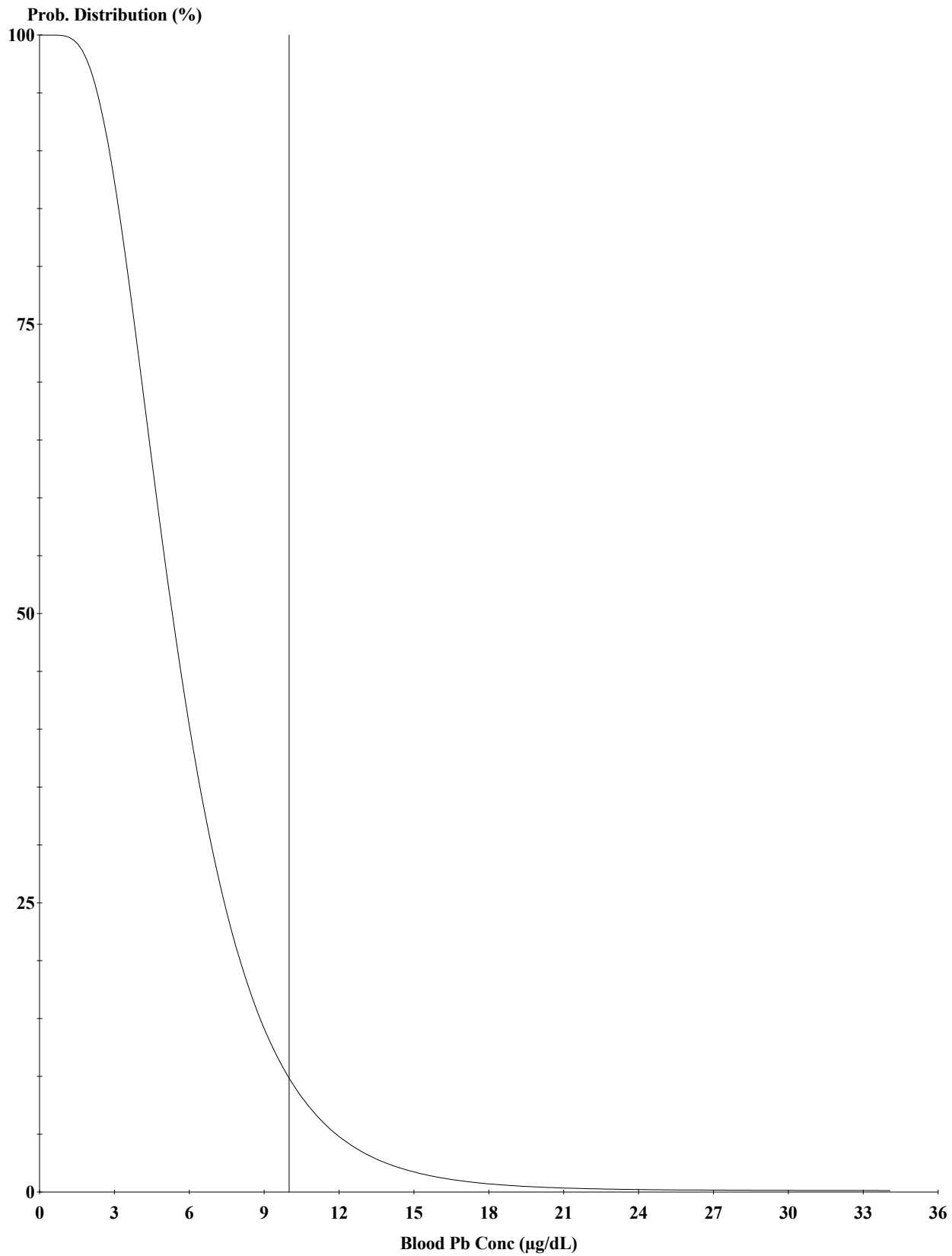


Cutoff = 8.000 µg/dl
Geo Mean = 5.575
GSD = 1.600
% Above = 22.112

Age Range = 0 to 84 months

Run Mode = Research

Lorraine Process Area, Surface Soil



Cutoff = 10.000 µg/dl

Geo Mean = 5.575

GSD = 1.600

% Above = 10.690

Age Range = 0 to 84 months

Run Mode = Research

Lorraine Process Area, Surface Soil

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead

Version date 06/14/2017

Edit Red Cells

Variable	Description of Variable	Units	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	537	537	537
$R_{\text{fetal/maternal}}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6
IR_s	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	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	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	250	250	250
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	2.4	2.4	2.4
$PbB_{\text{fetal}, 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	5.6	5.6	5.6
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	5.0	8.0	10.0
$P(PbB_{\text{fetal}} > PbB_t)$	Probability that fetal PbB exceeds target PbB, assuming lognormal distribution	%	7.3%	1.2%	0.4%

LEAD MODEL FOR WINDOWS Version 1.1

Model Version: 1.1 Build11

User Name:

Date:

Site Name:

Operable Unit: Lorraine Process Area, Subsurface Soil

Run Mode: Research

***** Air *****

Indoor Air Pb Concentration: 30.000 percent of outdoor.

Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m ³ /day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m ³)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

***** Diet *****

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

***** Drinking Water *****

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

***** Soil & Dust *****

Multiple Source Analysis Used

Average multiple source concentration: 63.270 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	76.100	63.270
1-2	76.100	63.270
2-3	76.100	63.270
3-4	76.100	63.270
4-5	76.100	63.270
5-6	76.100	63.270
6-7	76.100	63.270

***** Alternate Intake *****

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

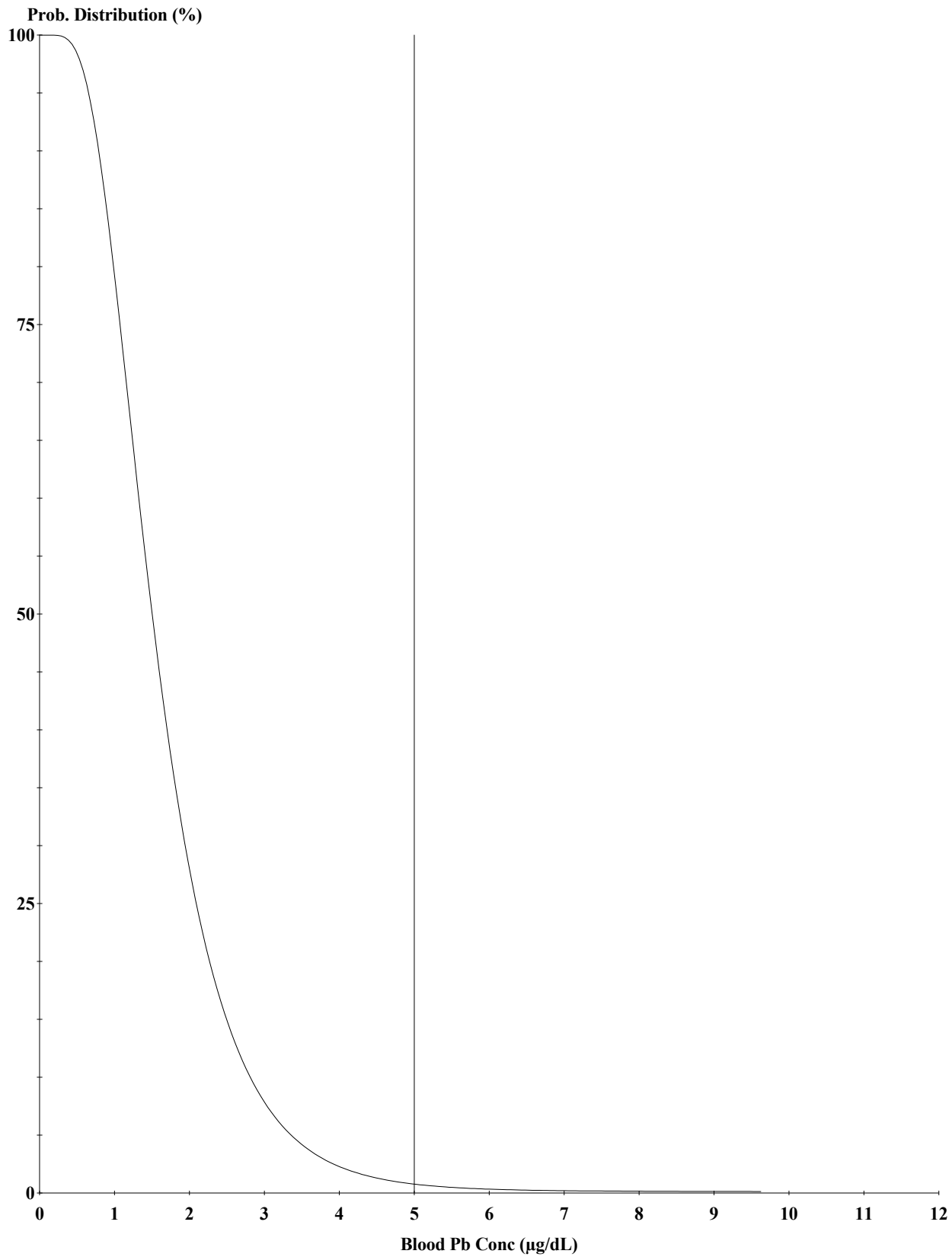
***** Maternal Contribution: Infant Model *****

Maternal Blood Concentration: 1.000 µg Pb/dL

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.090	0.000	0.386
1-2	0.034	0.942	0.000	0.961
2-3	0.062	1.028	0.000	1.004
3-4	0.067	0.990	0.000	1.029
4-5	0.067	0.954	0.000	1.076
5-6	0.093	1.006	0.000	1.138
6-7	0.093	1.091	0.000	1.159

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	1.698	3.195	1.8
1-2	2.687	4.623	1.9
2-3	2.700	4.795	1.8
3-4	2.714	4.799	1.7
4-5	2.026	4.122	1.4
5-6	1.829	4.066	1.3
6-7	1.730	4.073	1.2

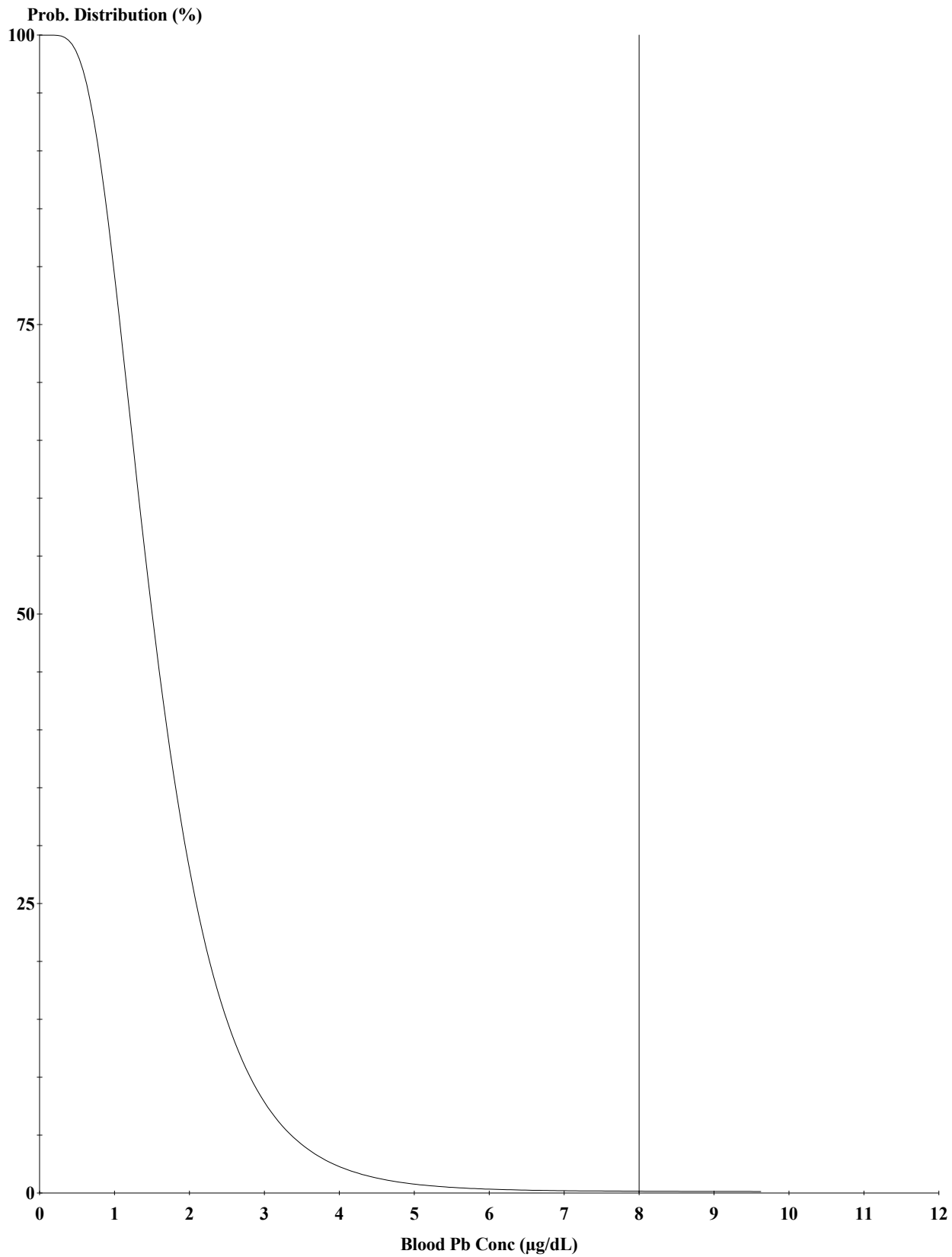


Cutoff = 5.000 µg/dl
Geo Mean = 1.574
GSD = 1.600
% Above = 0.697

Age Range = 0 to 84 months

Run Mode = Research

Lorraine Process Area, Subsurface Soil



Cutoff = 8.000 µg/dl

Geo Mean = 1.574

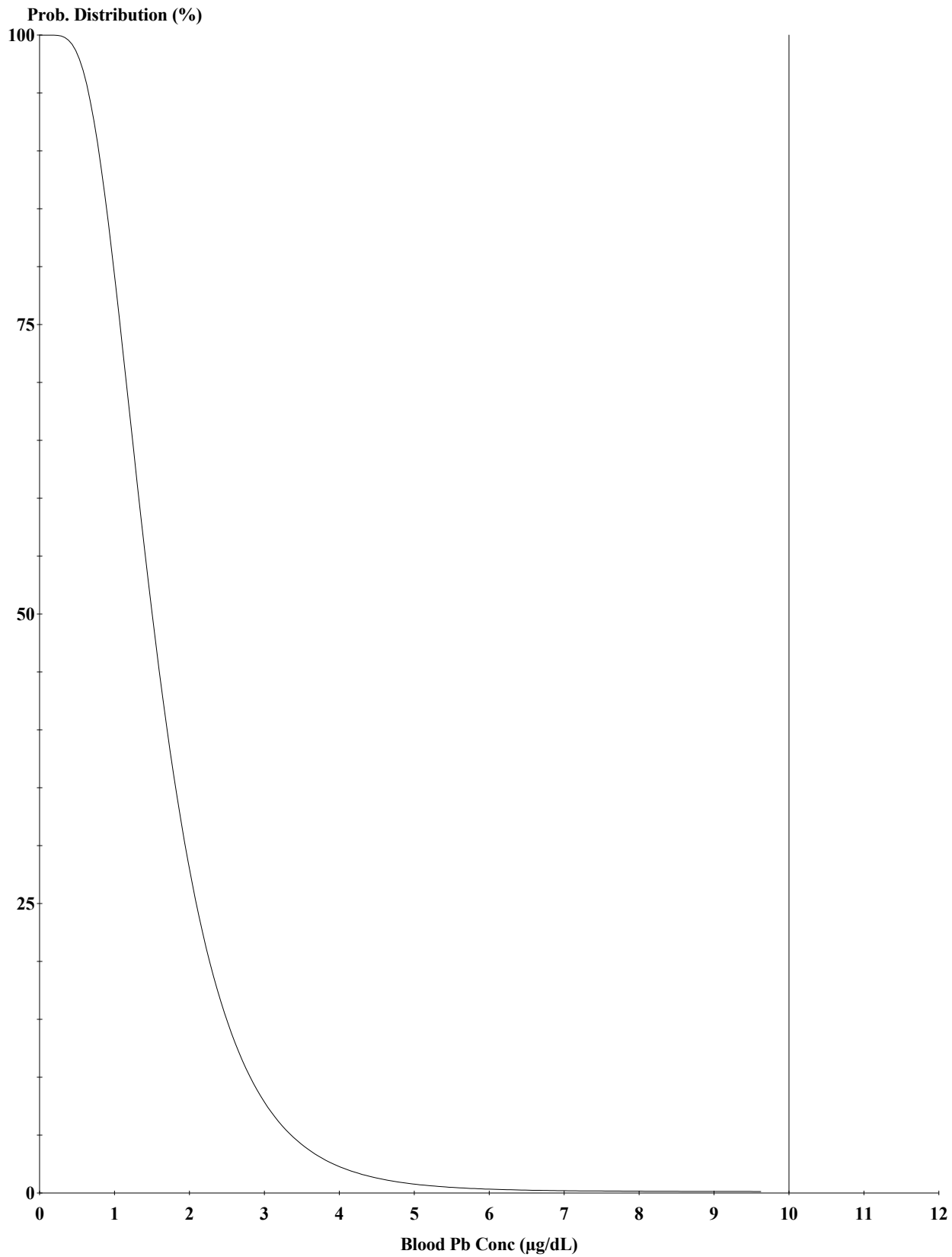
GSD = 1.600

% Above = 0.027

Age Range = 0 to 84 months

Run Mode = Research

Lorraine Process Area, Subsurface Soil



Cutoff = 10.000 µg/dl
Geo Mean = 1.574
GSD = 1.600
% Above = 0.004

Age Range = 0 to 84 months

Run Mode = Research

Lorraine Process Area, Subsurface Soil

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead

Version date 06/14/2017

Edit Red Cells

Variable	Description of Variable	Units	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	76.9	76.9	76.9
R _{fetal/maternal}	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD _i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB ₀	Baseline PbB	µg/dL	0.6	0.6	0.6
IR _s	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	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	0.12	0.12
EF _{S, D}	Exposure frequency (same for soil and dust)	days/yr	250	250	250
AT _{S, D}	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB _{adult}	PbB of adult worker, geometric mean	µg/dL	0.9	0.9	0.9
PbB _{fetal, 0.95}	95th percentile PbB among fetuses of adult workers	µg/dL	2.0	2.0	2.0
PbB _t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	5.0	8.0	10.0
P(PbB _{fetal} > PbB _t)	Probability that fetal PbB exceeds target PbB, assuming lognormal distribution	%	0.07%	0.0033%	0.00063%

LEAD MODEL FOR WINDOWS Version 1.1

Model Version: 1.1 Build11

User Name:

Date:

Site Name:

Operable Unit: Wilcox Process Area, Surface Soil

Run Mode: Research

***** Air *****

Indoor Air Pb Concentration: 30.000 percent of outdoor.

Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m ³ /day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m ³)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

***** Diet *****

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

***** Drinking Water *****

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

***** Soil & Dust *****

Multiple Source Analysis Used

Average multiple source concentration: 514.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	720.000	514.000
1-2	720.000	514.000
2-3	720.000	514.000
3-4	720.000	514.000
4-5	720.000	514.000
5-6	720.000	514.000
6-7	720.000	514.000

***** Alternate Intake *****

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

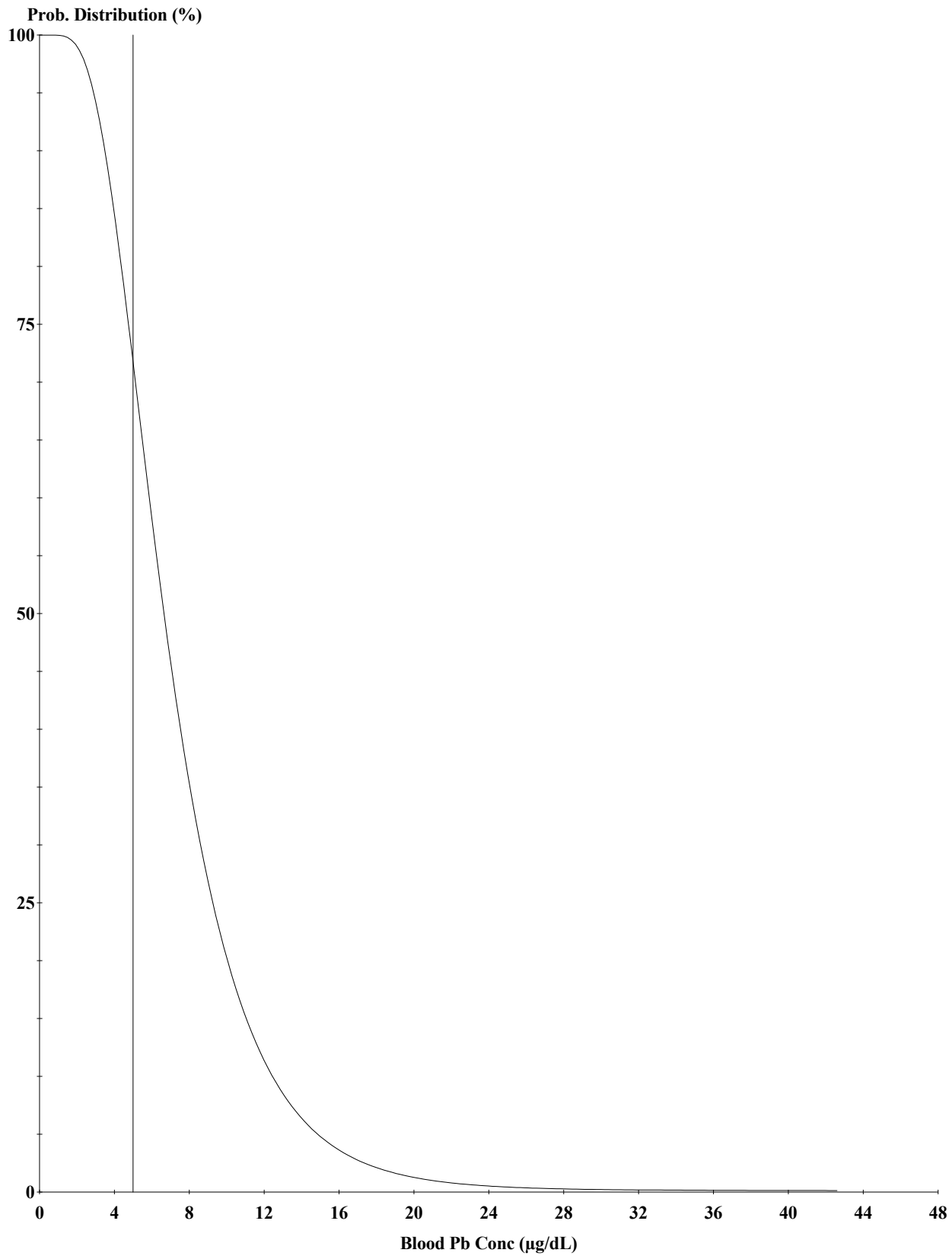
***** Maternal Contribution: Infant Model *****

Maternal Blood Concentration: 1.000 µg Pb/dL

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	0.956	0.000	0.338
1-2	0.034	0.805	0.000	0.822
2-3	0.062	0.897	0.000	0.876
3-4	0.067	0.879	0.000	0.913
4-5	0.067	0.881	0.000	0.994
5-6	0.093	0.943	0.000	1.067
6-7	0.093	1.031	0.000	1.096

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	13.090	14.406	7.6
1-2	20.195	21.856	8.9
2-3	20.707	22.543	8.3
3-4	21.174	23.033	8.0
4-5	16.443	18.385	6.6
5-6	15.066	17.168	5.5
6-7	14.367	16.587	4.8

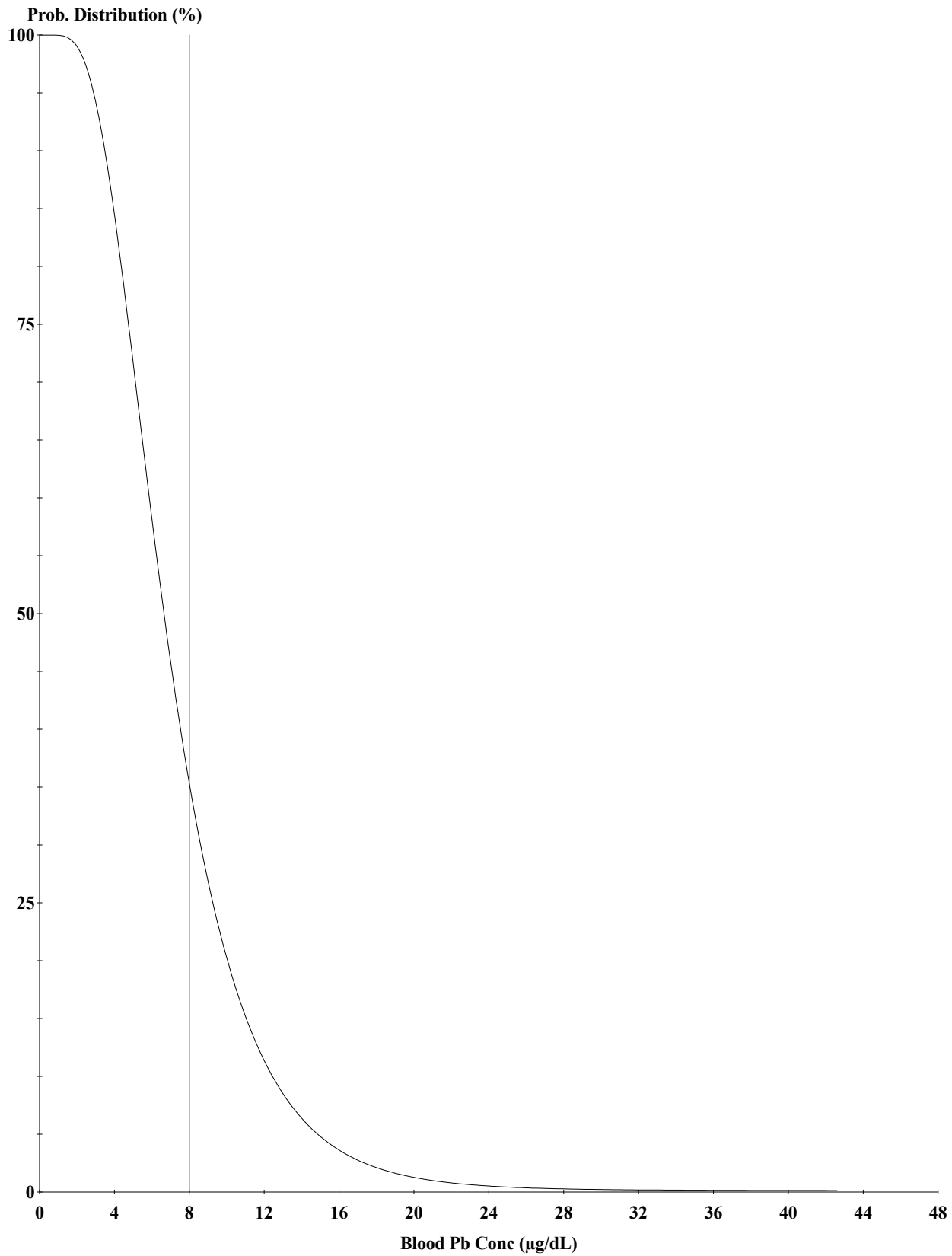


Cutoff = 5.000 µg/dl
Geo Mean = 6.969
GSD = 1.600
% Above = 76.004

Age Range = 0 to 84 months

Run Mode = Research

Wilcox Process Area, Surface Soil

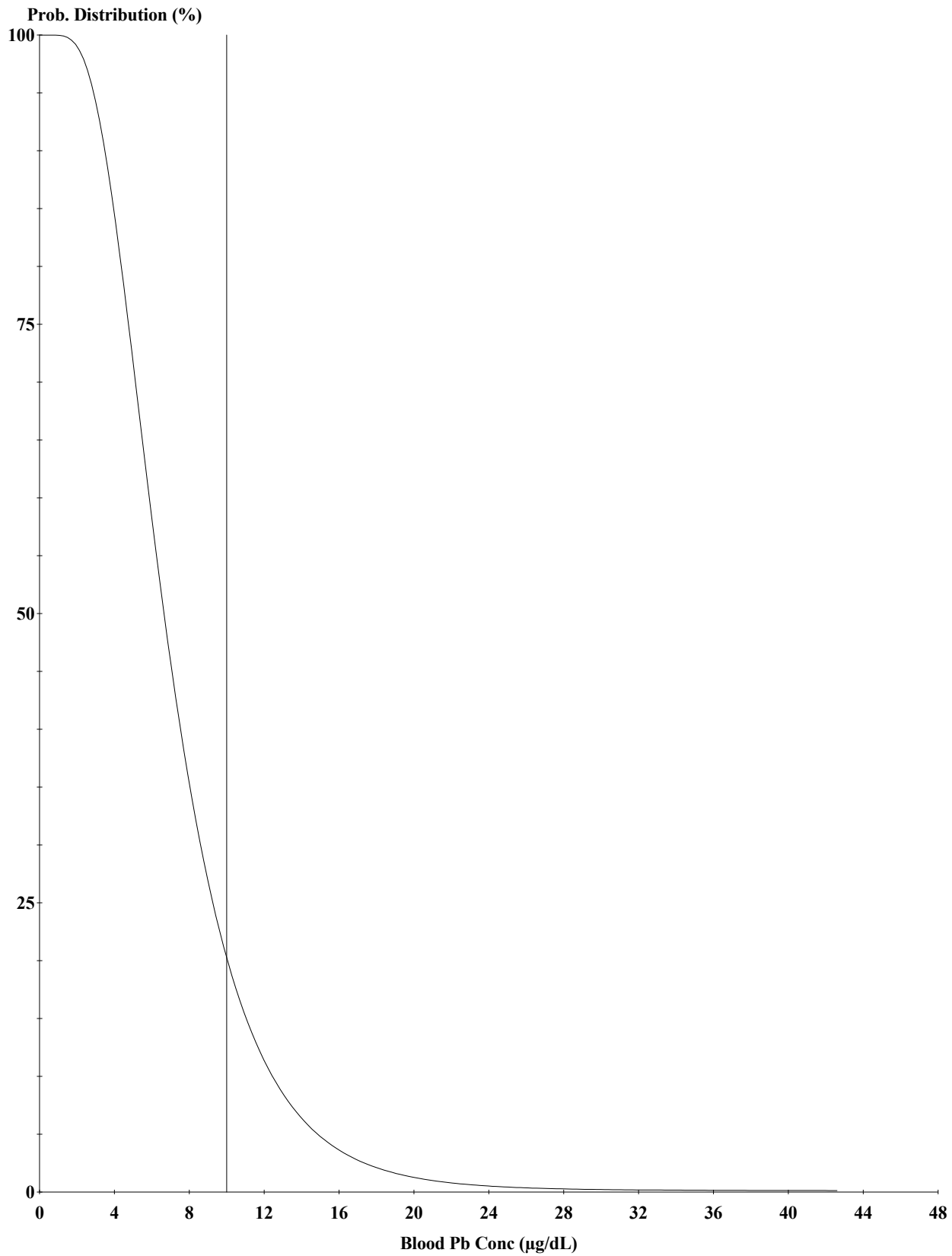


Cutoff = 8.000 µg/dl
Geo Mean = 6.969
GSD = 1.600
% Above = 38.454

Age Range = 0 to 84 months

Run Mode = Research

Wilcox Process Area, Surface Soil



Cutoff = 10.000 µg/dl
Geo Mean = 6.969
GSD = 1.600
% Above = 22.114

Age Range = 0 to 84 months

Run Mode = Research

Wilcox Process Area, Surface Soil

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead

Version date 06/14/2017

Edit Red Cells

Variable	Description of Variable	Units	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	720	720	720
$R_{\text{fetal/maternal}}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6
IR_s	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	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	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	250	250	250
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	3.0	3.0	3.0
$PbB_{\text{fetal}, 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	7.0	7.0	7.0
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	5.0	8.0	10.0
$P(PbB_{\text{fetal}} > PbB_t)$	Probability that fetal PbB exceeds target PbB, assuming lognormal distribution	%	14.3%	3.1%	1.2%

LEAD MODEL FOR WINDOWS Version 1.1

Model Version: 1.1 Build11

User Name:

Date:

Site Name:

Operable Unit: Wilcox Process Area, Subsurface Soil

Run Mode: Research

***** Air *****

Indoor Air Pb Concentration: 30.000 percent of outdoor.

Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m ³ /day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m ³)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

***** Diet *****

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

***** Drinking Water *****

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

***** Soil & Dust *****

Multiple Source Analysis Used

Average multiple source concentration: 61.520 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700

Outdoor airborne lead to indoor household dust lead concentration: 100.000

Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	73.600	61.520
1-2	73.600	61.520
2-3	73.600	61.520
3-4	73.600	61.520
4-5	73.600	61.520
5-6	73.600	61.520
6-7	73.600	61.520

***** Alternate Intake *****

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

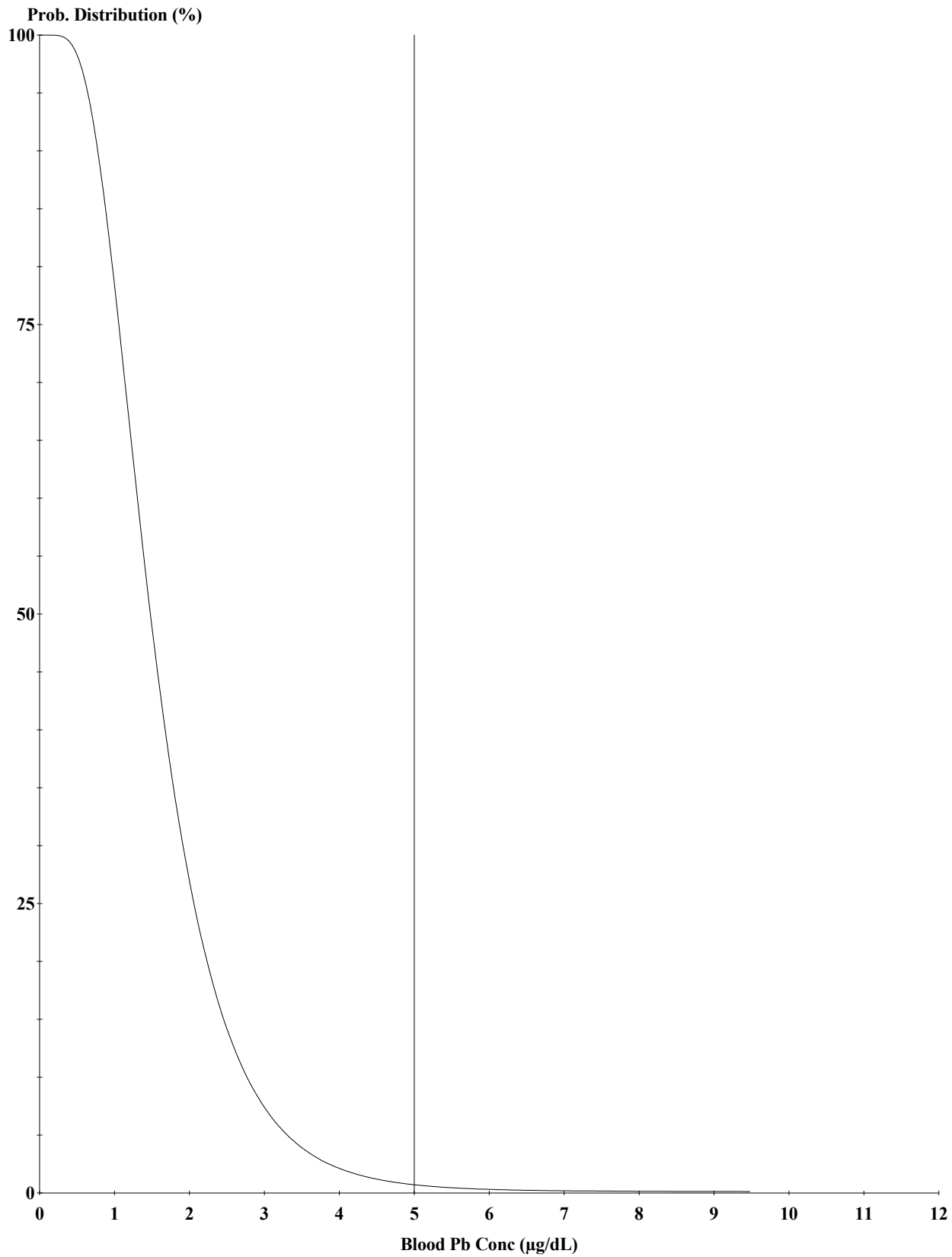
***** Maternal Contribution: Infant Model *****

Maternal Blood Concentration: 1.000 µg Pb/dL

CALCULATED BLOOD LEAD AND LEAD UPTAKES:

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.091	0.000	0.386
1-2	0.034	0.942	0.000	0.961
2-3	0.062	1.029	0.000	1.005
3-4	0.067	0.990	0.000	1.029
4-5	0.067	0.954	0.000	1.076
5-6	0.093	1.006	0.000	1.138
6-7	0.093	1.091	0.000	1.160

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	1.648	3.146	1.7
1-2	2.607	4.545	1.9
2-3	2.620	4.716	1.8
3-4	2.633	4.720	1.7
4-5	1.965	4.062	1.4
5-6	1.774	4.011	1.3
6-7	1.678	4.022	1.2

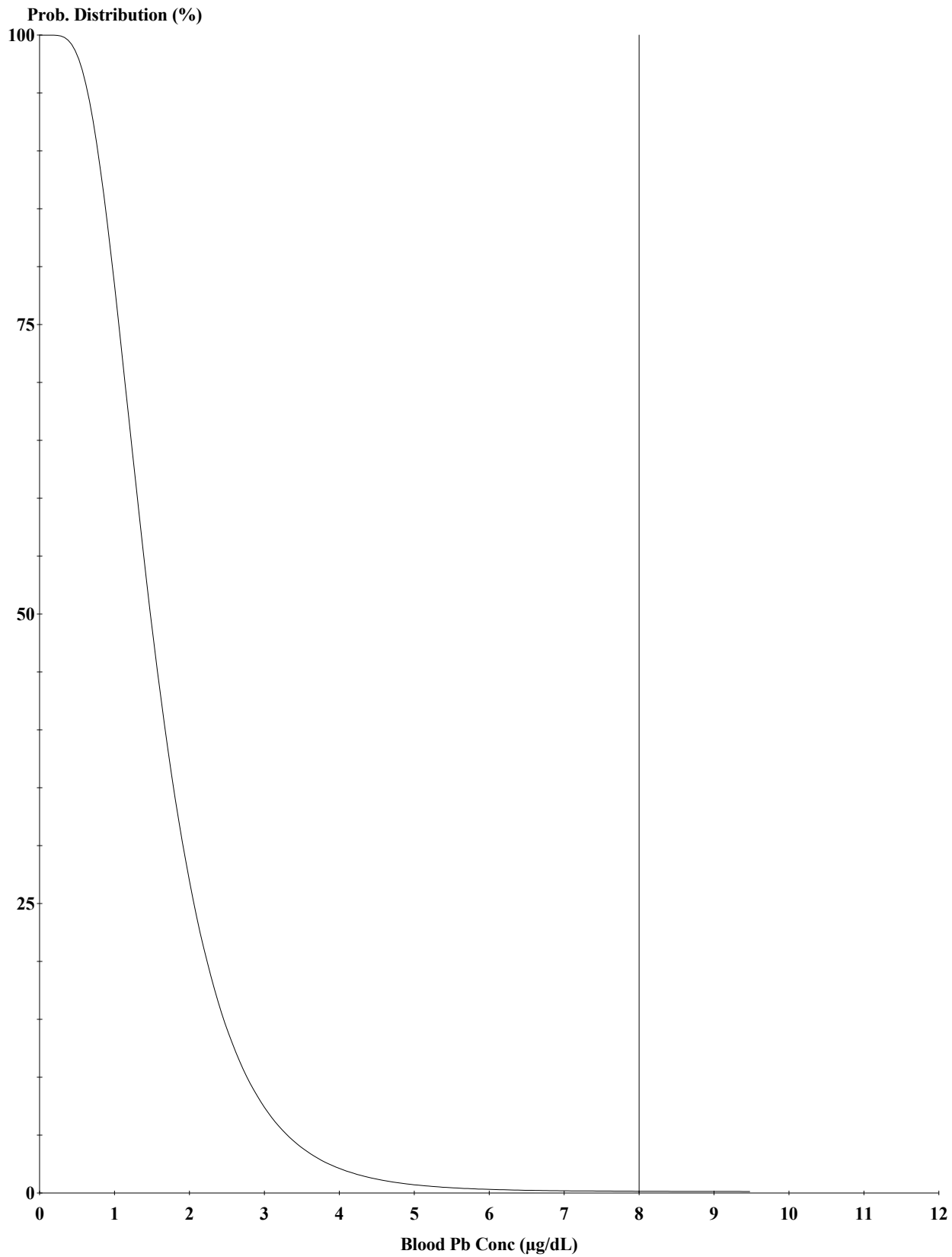


Cutoff = 5.000 µg/dl
Geo Mean = 1.550
GSD = 1.600
% Above = 0.636

Age Range = 0 to 84 months

Run Mode = Research

Wilcox Process Area, Subsurface Soil

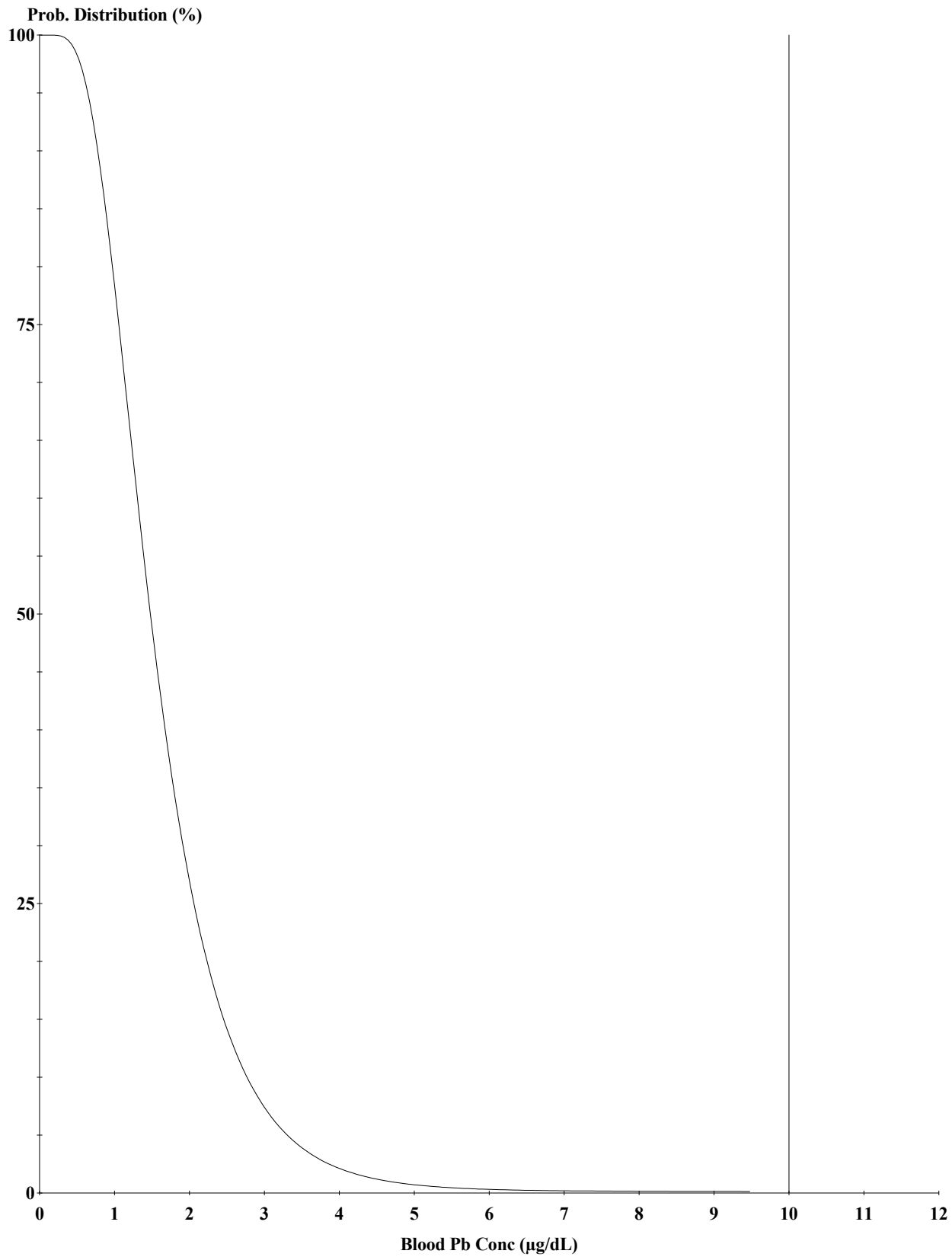


Cutoff = 8.000 µg/dl
Geo Mean = 1.550
GSD = 1.600
% Above = 0.024

Age Range = 0 to 84 months

Run Mode = Research

Wilcox Process Area, Subsurface Soil



Cutoff = 10.000 µg/dl
Geo Mean = 1.550
GSD = 1.600
% Above = 0.004

Age Range = 0 to 84 months

Run Mode = Research

Wilcox Process Area, Subsurface Soil

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead

Version date 06/14/2017

Edit Red Cells

Variable	Description of Variable	Units	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014	GSDI and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	73.6	73.6	73.6
$R_{\text{fetal/maternal}}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6
IR_s	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	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	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	250	250	250
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	0.8	0.8	0.8
$PbB_{\text{fetal}, 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	2.0	2.0	2.0
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	5.0	8.0	10.0
$P(PbB_{\text{fetal}} > PbB_t)$	Probability that fetal PbB exceeds target PbB, assuming lognormal distribution	%	0.07%	0.0030%	0.0006%

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