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Colonel Richard W. Gibbs
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2000 Wyoming Blvd SE
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Mr. John Kieling
Hazardous Waste Bureau Chief
New Mexico Environment Department (NMED)
2905 Rodeo Park Drive East, Building 1
Santa Fe NM 87505-6303

Dear Mr. Kieling

Please find attached the *Risk Assessment Report, Bulk Fuels Facility Spill; Solid Waste Management Unit ST-106/SS-111,* Kirtland Air Force Base, New Mexico, dated July 2017. This report is submitted in response to NMED's Notice of Deficiency dated May 24, 2017 and approval of extension request dated July 5, 2017.

If you have any questions or concerns, please contact Mrs. Holly O'Grady at (505) 853-3484 or at holly.ogrady@us.af.mil or Mr. Scott Clark at (505) 846-9017 or at scott.clark@us.af.mil.

Sincerely

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, USAF
Commander

Attachment:
Risk Assessment Report, July 2017, Bulk Fuels Facility Spill, Solid Waste Management Unit ST-106/SS-111.

cc:
NMED, Deputy Secretary (Borrego), letter
NMED-GWQB (Agnew, Hunter), letter
EPA Region 6 (Ellinger, King), letter
SAF-IEE (Lynnes), electronic only
AFCEC/CZ (Bodour, Clark, O'Grady), electronic only
USACE-ABQ District Office (Dreeland, Phaneuf, Salazar, Sanchez, Simpler), electronic only
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KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

RISK ASSESSMENT
BULK FUELS FACILITY RELEASE
SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

July 2017

377 MSG/CEI
2050 Wyoming Boulevard SE
Kirtland Air Force Base, New Mexico 87117-5270

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Risk Assessment
Bulk Fuels Facility Release
Solid Waste Management Unit ST-106/SS-111

July 2017

Prepared for

U.S. Army Corps of Engineers
Albuquerque District
Albuquerque, New Mexico 87109

USACE Contract No. W912PP-16-C-0002

Prepared by

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with support from

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NOTICE

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This Risk Assessment (RA) was prepared by Kirtland Air Force Base (AFB) to evaluate the potential for human and ecological exposure to contaminants of potential concern (COPC) and any associated potential human health effects and ecological risks related to fuel releases at the Bulk Fuels Facility (BFF) site (Site). Kirtland AFB, located in Albuquerque, New Mexico, discovered the release in November 1999 at the Former Fuel Offloading Rack at the BFF and determined through environmental investigations that subsurface fuel releases occurred over a period of decades, as described in Section 2 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (United States Army Corps of Engineers [USACE], 2017a). Resulting from these investigations, two solid waste management units (SWMU) identified as ST-106 and SS-111 were created. These SWMUs are comprised of the source area at the Site (ST-106) and the light non-aqueous phase liquid identified in the groundwater (SS-111), and are discussed in greater detail in the RFI Report (USACE, 2017a). Site investigations and interim measures have been ongoing since 1999. This RA uses Site data for soil, soil gas, and groundwater collected between 2014 and 2016 to evaluate the potential for exposure and associated risk to COPCs.

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DOCUMENT CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Richard W. Gibbs

RICHARD W. GIBBS, Colonel, U.S. Air Force
Commander, 377th Air Base Wing

16 Jul 17
Date

This document has been approved for public release.

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

12 JUL 17
Date

PREFACE

This Risk Assessment (RA) Report was prepared by Sundance, Consulting, Inc. (Sundance) for the U.S. Army Corps of Engineers (USACE) under contract number W912PP-16-C-0002. It pertains to the Kirtland Air Force Base (AFB) Bulk Fuels Facility Site at Solid Waste Management Unit (SWMU) ST-106/SS-111, located in Albuquerque, New Mexico. This RA Report was prepared in accordance with the permit issued to Kirtland AFB under the Resource Conservation and Recovery Act (RCRA) and applicable federal, state, and local laws and regulations.

This RA Report presents and describes data from the RCRA Facility Investigation performed at SWMU ST-106/SS-111, which has been used to characterize risks to human and ecological receptors. Ms. Amy Sanchez is the Contracting Officer's Representative for the USACE Albuquerque District, and Mr. Trent Simpler, Professional Engineer, is the Project Manager. Mr. Scott Clark is the Kirtland AFB Restoration Interim Section Chief. This Report was prepared by Rachel Hobbs, Professional Geologist (P.G.) the Sundance Project Manager, and Ryan Wortman, Sundance project geologist with assistance from Cynthia Cheatwood and Dan Hinckley of EA Engineering, Science, and Technology, Inc., PBC.

Rachel Hobbs

Rachel Hobbs, P.G.
Sundance Consulting, Inc.
Project Manager

TABLE OF CONTENTS

FIGURES

TABLES

TABLES (CONCLUDED)

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

%	percent
1,2-DCA	1,2-dichloroethane
1,2,4-TMB	1,2,4-trimethylbenzene
95UCL	95^{th} percentile upper confidence limit of the mean
AFB	Air Force Base
AOC	area of concern
AvGas	aviation gas
BFF	Bulk Fuels Facility
bgs	below ground surface
CARB	California Air Resources Board
COPC	contaminant of potential concern
CSEM	conceptual site exposure model
CSM	conceptual site model
DL	detection limit
DQO	data quality objective
DTIC	Defense Technical Information Center
EDB	ethylene dibromide
e.g.	for example
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ERP	Environmental Restoration Program
ESL	ecological screening level
etc.	etcetera
FFOR	Former Fuel Offloading Rack
GWM	groundwater monitoring
HC	hydrocarbon
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
HWB	Hazardous Waste Bureau

ACRONYMS AND ABBREVIATIONS (CONTINUED)

i.e.	in other words
INRMP	Integrated Natural Resources Management Plan
JP-4	jet propellant 4
JP-8	jet propellant 8
KAFB	Kirtland Air Force Base
LANL	Los Alamos National Laboratory
LNAPL	light non-aqueous phase liquid
LUC	land use control
MEK	methyl ethyl ketone
$\mu g/m^3$	microgram per cubic meter
µg/L	microgram per Liter
mg/kg	milligram per kilogram
NM	New Mexico
NMED	New Mexico Environment Department
No.	number
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
Permit	Permit identification number NM9570024423 (NMED, 2010)
P.G.	Professional Geologist
PVC	polyvinyl chloride
Q	Quarter
QAPjP	Quality Assurance Project Plan
RA	Risk Assessment
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Ridgecrest	Ridgecrest Drive
RL	reporting limit
RSL	Regional Screening Level
SDWA	Safe Drinking Water Act
Site	SWMU ST-106/SS-111
SL	screening level
SLERA	screening level ecological risk assessment
SLRA	screening level risk assessment
SSL	soil screening level
Sundance	Sundance Consulting, Inc.
SVE	soil vapor extraction

ACRONYMS AND ABBREVIATIONS (CONCLUDED)

SVM	soil vapor monitoring
SVMP	soil vapor monitoring point
SWMU	solid waste management unit
TSL	tapwater screening level
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VA	Veterans Affairs
VISL	Vapor Intrusion Screening Level
VOC	volatile organic compounds
Water Authority	Albuquerque Bernalillo County Water Utility Authority

EXECUTIVE SUMMARY

This Risk Assessment (RA) was prepared by Kirtland Air Force Base (AFB) to evaluate the potential for human and ecological exposure to, and potential risks from such exposures to, contaminants of potential concern (COPCs) related to the historical fuel leak at the Bulk Fuels Facility (BFF) site (Site). Kirtland AFB, which is located in Albuquerque, New Mexico, discovered the fuel release in November 1999 at the Former Fuel Offloading Rack at the BFF and determined through environmental investigations that subsurface fuel releases occurred over a period of decades. Site investigations and interim measures have been ongoing since 1999. This RA uses Site data for soil, soil gas, and groundwater from the Resource Conservation and Recovery Act (RCReA) Facility Investigation (RFI) Report (United States Army Corps of Engineers [USACE], 2017a) to evaluate the potential for exposure and associated risk to identified COPCs.

The investigation and remediation activities at the Site and this RA are being implemented pursuant to the RCRA corrective action provisions in Part 6 of Kirtland AFB's Hazardous Waste Treatment Facility Operating Permit (Permit Number NM9570024423—"Permit"). The Permit identified two BFF-related solid waste management units (SWMUs): ST-106 and SS-111. These SWMUs are comprised of the source area at the Site (ST-106) and the light non-aqueous phase liquid that was identified in the groundwater (SS-111), which are discussed in greater detail in the RFI Report.

The RCRA Permit requires the performance of a RA using the current version of New Mexico Environment Department (NMED) Risk Assessment Guidance for Site Investigations and Remediation (NMED, 2017). This guidance, which was developed by NMED, provides generic screening levels for soil, tapwater, and vapor intrusion for chemicals commonly found at contaminated sites based upon conservative default exposure assumptions for both residential and non-residential land use scenarios. The objective of this RA is to evaluate the potential human health and ecological risks associated with COPCs detected in environmental samples related to the Site.

There are two parts to this RA, the Human Health Risk Assessment (HHRA), and the Ecological Risk Assessment (ERA). The HHRA investigates whether there is any risk to human receptors from contamination at the Site, and the ERA examines whether there is any risk to ecological receptors, such as plants, birds, or mammals, from Site contaminants. For the purposes of the RFI Report, a list of fuel-related analytes was developed for soil, soil gas, and groundwater which are referred to in this RA as COPCs. In total, there are 20 COPCs across all three media. The list of COPCs differs slightly for soil, soil gas, and groundwater; however, ethylene dibromide; benzene, toluene, ethylbenzene, and xylenes constituents; naphthalene; 1,2,4-trimethylbenzene; and 1,2-dichloroethane are common to all three media.

Both the HHRA and the ERA ask two questions to determine whether unacceptable risk exists. The first question is whether there is an exposure pathway for contaminated media to come in contact with human or ecological receptors. For example, if subsurface soil is contaminated, and construction workers disturb the soil while performing their work, they could be exposed to contaminated soil by skin contact, accidental ingestion, or inhalation while they are working.

In this RA, existing land use controls (LUCs) are incorporated in the conceptual site exposure model for current receptors, in that ongoing institutional, engineering, and administrative practices may prevent exposure to current human receptors. However, future exposure scenarios are also considered in the RA, in the case that land use may change, or LUCs may change or be removed in the future. For example, current land use at the BFF is industrial, and is expected to remain industrial for the foreseeable future.

However, in the absence of LUCs, if land use were to change in the future, the BFF could become a residential area. Hypothetical future on-Site residential receptors are evaluated in the RA to inform risk management decisions, and assess unrestricted site use.

Once the complete and potentially complete exposure pathways are identified, the next question is whether the contamination is present at levels that could cause an unacceptable risk to human or ecological receptors, thus not protecting human health and the environment.

To evaluate potential risk to human receptors, both carcinogenic and non-carcinogenic COPCs are evaluated in the HHRA. NMED Guidance (2017) sets the target level for carcinogenic risk equal to or less than $1x10^{-5}$, meaning that the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen at the BFF is less than one in 100,000. For non-carcinogenic contaminants, NMED sets a hazard quotient (HQ) target of 1.0, below which, it is unlikely sensitive populations would experience adverse health effects (NMED, 2017).

To evaluate potential risk to ecological receptors, maximum concentrations of COPCs are evaluated in comparison to ecological screening levels (SLs). Similar to the HHRA, NMED sets a HQ target of 1.0, below which, it is unlikely sensitive populations would experience adverse ecological effects (NMED, 2017). If the HQ exceeds 1, additional evaluation is warranted.

ES-1 Human Health Risk Assessment Results

The HHRA concludes there are no estimated unacceptable risks to current human receptors from contaminated soil, soil gas, or groundwater either on-Site (in other words, within the area of investigation on-Site) or off-Base as summarized in Table ES-1.

The HHRA identified potential unacceptable risks for exposure to groundwater under a future domestic use scenario both on-Site and off-Base, and for on-Site soil gas via vapor intrusion to indoor air under a future hypothetical on-Site residential scenario. However, current interim measures prevent exposure to impacted groundwater, and residential use is prevented on-Site. As a result, no additional interim measures are recommended. Consideration of a LUC in any final remedy may be warranted to prevent residential use on-Site until soil gas concentrations have reached acceptable levels.

ES-1.1 Soil

Complete and potentially complete soil exposure pathways were identified for the on-Site current/future commercial/industrial workers at the BFF, future construction workers at the BFF, and future hypothetical residents at the BFF. No contaminated surface or mixed zone soil is present off-Base, therefore, there are no complete or potentially complete exposure pathways for impacted soil for off-Base receptors. Maximum detected concentrations in soil from 0 to 10 feet below ground surface (bgs) were below NMED soil screening levels (SSLs) for commercial/industrial, construction worker, and residential receptors. Total soil risks based on the maximum detected concentrations were at or below NMED target risk levels. No unacceptable risk was identified based on exposure to on-Site surface or mixed zone soil within the BFF. The maximum detected concentration of lead in soil (0 to 10 feet bgs) was below the NMED SSL. No additional interim measures for soils (0 to 10 feet bgs) are recommended to address human health risks.

ES-1.2 Soil Gas

Fuel contaminants can volatilize from contaminated soil into soil gas, which may migrate into indoor air spaces if buildings are present, or may be released to ambient air. The migration of vapors from subsurface sources to indoor air within buildings is defined as vapor intrusion. NMED has developed Vapor Intrusion Screening Levels (VISLs) for areas where buildings currently exist or may be built in the future above contaminated soil gas.

On-Site Soil Gas

The soil gas exposure pathway via vapor intrusion is potentially complete for current/future commercial/industrial workers at the BFF. Although unlikely, a future hypothetical on-Site residential scenario was evaluated to inform risk management decisions. Only four buildings (Buildings 1044, 1049, 2426, and 1055) at, or adjacent to, the BFF are regularly occupied during business hours. Results of the risk characterization based on exposure point concentrations indicate that no unacceptable risk exists for current/future commercial/industrial workers at the BFF via the vapor intrusion pathway. Under the hypothetical future on-Site resident scenario, the total carcinogenic risk slightly exceeded NMED's target cancer risk level of $1x10^{-5}$.

Off-Base Soil Gas

There are currently no buildings in the area where soil gas has been detected off-Base, and as a result the exposure pathway to current receptors is incomplete. However, because COPCs in soil gas have been detected in the off-Base area within and adjacent to Bullhead Park, vapor intrusion was considered a potentially complete pathway under a future hypothetical off-Base residential scenario in the park area. Evaluating a future hypothetical residential receptor in Bullhead Park provides a conservative assessment of any current/future recreational visitors to the park, current/future commercial/industrial workers at the Veterans Affairs complex, or current/future residents beyond Ridgecrest Drive. Maximum detected concentrations in off-Base soil gas were below NMED residential soil gas VISLs. Total risks based on maximum detected concentrations in soil gas were below NMED target levels for the off-Base resident via the vapor intrusion pathway. No interim measures for off-Base soil gas are recommended.

Soil Gas to Ambient (Outdoor) Air

In addition to the vapor intrusion pathway, the HHRA also looked at potential risks from releases of soil gas to ambient air and potential uptake of soil gas by plants off-Base. Any release of soil gas COPCs into the atmosphere would be immediately diluted by ambient outdoor air movement. In addition, there is no risk to receptors from uptake by plants (gardening). The amount of soil gas at the shallow depths where garden plant roots would be found is negligible, therefore uptake of COPCs in soil gas via plant was considered an incomplete pathway.

ES-1.3 Groundwater

Impacted groundwater at the BFF is not currently used as a drinking water source and LUCs are in place to prevent exposure. Therefore, there are currently no complete exposure pathways for groundwater on-Site or off-Base. In order to inform risk management decisions and evaluate an unrestricted use scenario, domestic use of groundwater was evaluated on-Site and off-Base. Total risks calculated using NMED tapwater regional screening levels exceeded NMED target levels.

The New Mexico Office of the State Engineer issued a well drilling moratorium associated with BFF corrective action activities on February 9, 2017. The intent of this moratorium is to protect human health and prevent interference with ongoing corrective action activities by restricting the drilling of new wells and the transfer of water rights within the boundaries specified by NMED. COPCs have not been detected in off-Base water supply sentinel wells at concentrations exceeding drinking water standards. In addition, Kirtland AFB drinking water supply wells are sampled monthly and no COPCs exceeding SLs have been detected.

Based on the results of the HHRA, the interim measures and LUCs are needed to prevent direct contact with groundwater.

ES-2 Ecological Risk Assessment Results

The ERA concluded there is no risk to ecological receptors from soil, soil gas, or groundwater at the Site. There is no exposure pathway to ecological receptors from contaminated groundwater because groundwater is approximately 480 feet bgs. The potential exposure pathways to ecological receptors are through surface soil (0 to 1 foot bgs), mixed zone soil (0 to 10 feet bgs), and soil gas.

Plants and animals at the Site may be exposed to COPCs in surface soil through direct contact, accidental ingestion of soil, or ingestion of food items contaminated through bioaccumulation. Burrowing animals, such as prairie dogs and burrowing owls, could also contact mixed zone soil. Contaminants released to soil could volatilize into air voids in the soil column such as animal burrows created by burrowing mammals, birds, and reptiles. Soil gas is evaluated as a complete exposure pathway through burrow air; specifically, for the burrowing owl, which is listed as a federal species of concern.

Review of concentrations in the contaminated soil remaining on-Site indicates only lead concentrations exceeded ecological SSLs in soil. Although maximum concentrations of lead exceeded no-effects-based SLs, evaluation of other parameters such as mean and median concentrations within the Site suggest exceedances are limited in extent, or within background concentrations. In addition, the maintenance of the BFF for Site operations limits the amount and quality of ecological habitat present, and ecological exposures are expected to be minimal for this reason. The mean and median concentrations at the Site are at background concentrations, indicating the lead concentrations are naturally occurring. Given the limited extent of concentrations exceeding no-effects SLs and the limited ecological exposure potential, no unacceptable ecological risk exists at the Site due to COPCs in soils.

The ERA concluded there is no unacceptable ecological risk from soil gas when burrowing owls are considered as ecological receptors. Concentrations of COPCs in on-Site soil gas were less than available ecological SLs. Maximum HQs for the eight volatile organic compounds with SLs were less than 0.3, indicating concentrations are low compared to effect levels. In addition, evaluating soil gas concentrations at the 15 to 25 feet bgs depth interval is conservative when compared to the typical maximum burrow depth of the burrowing owl (3 feet bgs). Soil gas concentrations at typical shallow burrow depths are expected to be less due to attenuation. Therefore, no further action is proposed for soil gas concentrations in on-Site soils for protection of ecological receptors.

1 INTRODUCTION

This Risk Assessment (RA) was prepared by Kirtland Air Force Base (AFB) to evaluate the potential for human and ecological exposure to contaminants of potential concern (COPC) and any associated potential human health effects and ecological risks related to fuel releases at the Bulk Fuels Facility (BFF) site (Site). Kirtland AFB, located in Albuquerque, New Mexico, discovered the release in November 1999 at the Former Fuel Offloading Rack (FFOR) at the BFF and determined through environmental investigations that subsurface fuel releases occurred over a period of decades, as described in Section 2 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report (United States Army Corps of Engineers [USACE], 2017a). Resulting from these investigations, two solid waste management units (SWMU) identified as ST-106 and SS-111 were created. These SWMUs are comprised of the source area at the Site (ST-106) and the light non-aqueous phase liquid (LNAPL) identified in the groundwater (SS-111), and are discussed in greater detail in the RFI Report (USACE, 2017a). Site investigations and interim measures have been ongoing since 1999. This RA uses Site data for soil, soil gas, and groundwater collected between 2014 and 2016 to evaluate the potential for exposure and associated risk to COPCs.

Part 6.2.4.5 of Kirtland AFB's Hazardous Waste Treatment Facility Operating Permit (Permit Number [No.] NM9570024423—"Permit") allows the Permittee to submit a RA report during the investigation stage or with the Corrective Measures Evaluation Report. Kirtland AFB chose to submit this RA at the investigation stage to identify any potential human health or ecological risks at this phase of the Site cleanup (that is, near the end of the investigation stage and while interim measures are being implemented).

1.1 Risk Assessment Objectives

As stated above, the objectives of this RA are to evaluate the potential human health and ecological risks associated with COPCs detected in environmental samples related to the Site. It is noted that the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) represent a site-specific RA for the BFF and only evaluate chemicals associated with the BFF. This site-specific RA includes samples collected on-Site (in other words [i.e.], within the area of investigation on-Site) and off-Base. The results of the RA will inform regulators and the public regarding present-day exposures and potential risks, and will guide future corrective action activities at the Site, if necessary, to reduce risks.

1.2 Regulatory Context

The investigation and remediation of the Site are being implemented pursuant to the RCRA corrective action provisions in Part 6 of Kirtland AFB's Permit. The Permit is enforced by the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB), which is authorized to administer RCRA by the United States Environmental Protection Agency (EPA). Part 6 of the Permit provides requirements for investigating the nature and extent of contamination from SWMUs and areas of concern (AOC), establishes cleanup criteria, provides for the implementation of interim measures, details RA requirements, and establishes procedures for identifying and implementing any necessary corrective measures.

The RFI Report covers activities conducted under Part 6.2.2.1 of the Permit, which sets forth requirements for site investigations. The RFI Report provides the results from 16 years of investigation activities into the nature and extent of environmental media contaminated by the Site releases and describes the interim measures that have been implemented to-date at the Site. The RFI Report was submitted to the NMED HWB on January 31, 2017 (USACE, 2017a). This RA uses data collected in support of the RFI and the interim measures, and demonstrates sufficient data have been collected to assess potential risk to human health and the environment.

This RA follows NMED's *Risk Assessment Guidance for Site Investigations and Remediation* (NMED, 2017). Typically, RAs are performed to determine risks under "baseline" or non-remediated conditions. However, appreciable removal of contamination and contaminated media has already occurred and is ongoing in the form of interim measures. Part 6.2.2.2.12 of the Permit explains that interim measures can be implemented if it is determined "such measures are necessary to reduce or prevent migration of hazardous wastes or hazardous constituents that have, or may result in, an unacceptable human or ecological receptor exposure to hazardous waste or hazardous constituents while long-term corrective action remedies are being evaluated and implemented." An interim measure is an important tool for protecting human health and the environment while other parts of the RCRA process are ongoing.

The following three community water systems, which are near the footprint of the Site groundwater plumes shown in Figure 1-1, are regulated under the Safe Drinking Water Act (SDWA):

- The Albuquerque Bernalillo County Water Utility Authority (Water Authority) provides drinking water to Bernalillo County and residential housing on-Site. The Water Authority operates the Ridgecrest Drive (Ridgecrest) well field, the closest municipal drinking water supply wells to the Site.

- The Veterans Affairs (VA) Medical Center owns and operates a drinking water supply well that serves the Medical Center and associated buildings. This well is located to the east of the Site.

- Kirtland AFB provides drinking water for on-Site industrial and office uses, the off-Base Maxwell housing complex, and the Child Development Center.

New Mexico (NM) sought and was granted primary authority for public water systems and has adopted state drinking water rules (NM Code R. §§ 20.7.10.1 – 2017.10.704). These rules are enforced by the NMED Drinking Water Bureau. All three community water systems are subject to SDWA requirements. Current and future water use is discussed in more detail in the RFI Report (USACE, 2017a; Section 7).

1.3 Summary of Site Contamination and Contaminant Transport

The RFI Report provides a detailed account of the past and current nature and extent of contamination and a Conceptual Site Model (CSM) detailing the movement of contaminants (USACE, 2017a). The following summary of the source of Site contamination and subsequent contaminant transport provides important context for the RA.

The source of contamination for the Site is historical fuel releases from the Kirtland AFB FFOR delivery infrastructure, specifically underground pipelines. These below-grade releases at the Site moved downwards through the soil until reaching groundwater located approximately 480 feet below ground surface (bgs). As discussed in RFI Report Section 7, and illustrated in the RFI Report as well as Figure 1-2 of this report, LNAPL migrated downward via a tortuous pathway, with lateral spreading occurring when less-permeable strata were reached (USACE, 2017a).

Fuel that leaked from the underground pipeline included aviation gasoline (AvGas), jet propellant 4 (JP-4), and jet propellant 8 (JP-8; USACE, 2017a). As outlined in the RFI Report, AvGas was the primary fuel stored and used at Kirtland AFB until 1975. Ethylene dibromide (EDB) was an additive used only in AvGas, so its presence is limited to before 1975 (USACE, 2017a). After 1975, Kirtland AFB transitioned to jet propellant fuels. Collectively, these types of fuel are referred to as LNAPL because they have a lower density than water and are comprised of compounds that are largely insoluble in water. In other words, if LNAPL infiltrates into the ground and reaches the water table, it will form a layer on top of the water table while the more soluble constituents dissolve into the groundwater. In addition, the volatile constituents of LNAPL can exist in vapor form in the air-filled pore space of soil (referred to as soil vapor in the RFI Report). The term “soil gas” is used by NMED in reference to this pore space in defining risk-based screening level concentrations, and the term is used in this report.

The releases of LNAPL from the fuel delivery infrastructure resulted in fuel-related contamination of environmental media in the vadose zone (the area from the ground surface to the water table) and in groundwater. Once released into this environment, fuel and constituents of fuel may exist in four phases:

1. Adsorbed (fuel constituents attached to soil particles)

2. LNAPL residual fuel (free product)

3. Soil gas (volatile fuel constituents as vapor in soil air pockets)

4. Dissolved (fuel constituents in groundwater and pore water in the vadose zone).

Dispersion, diffusion, and other transport mechanisms discussed in the RFI Report have been the factors responsible for the migration of fuel and its constituents (including EDB, benzene, and other fuel constituents) through the vadose zone and subsequently off-Base (USACE, 2017a). A distinct layer of floating LNAPL on the water table has not been consistently measured at the Site since 2012. Interim measures (for example [e.g.], soil removal at the source in 1999, and skimmer system and bioslurping from about 2008 through 2011) were implemented early on and reduced the amount of free product contributing to contamination in the environment. A significant factor impeding measurement of LNAPL has been a rising water table that has been documented from the early 20th century to the end of 2015 (USACE, 2017a; Section 5). Thus, present-day contamination is limited to dissolved constituents in groundwater (e.g., EDB, benzene, and other dissolved fuel constituents; see Figure 1-1), LNAPL that has moved into soil at the boundary of the water table, and soil gas generated from LNAPL, soil, and groundwater which exists at a depth of approximately 500 feet bgs.

The RFI Report describes the nature and extent of each form of contamination in the vadose zone and groundwater (USACE, 2017a). Table 1-1 summarizes the results of the RFI Report (USACE, 2017a) and describes the types of contamination present at the Site, both on-Site and off-Base.

Describing the nature and extent of contamination at the Site requires an understanding of possible chemical and biological transformations of LNAPL constituents, and of the relevant transport processes related to constituent migration. That is, it is important to understand the degradation of organic contaminant(s) through inorganic and biological chemical processes in the environment, and the processes by which contaminant(s) move away from the source area. For example, volatile hydrocarbon (HC) components of LNAPL are biologically degraded in soil pore spaces by indigenous bacteria under both aerobic and anaerobic conditions. This is especially true at the Site, where results of quarterly soil gas monitoring events and the rebound and respiration testing (USACE, 2017a; Section 4) indicate that aerobic biodegradation is active in many areas of the vadose zone. Biodegradation has played a substantial role in remediating fuel constituents at the Site before, during, and after soil vapor extraction (SVE) operation. The SVE systems generally have the effect of oxygenating areas of high soil vapor concentrations to promote aerobic biodegradation. However, the SVE system has also had a drying effect on the vadose zone that might have limited biodegradation in certain areas (USACE, 2017a; Section 4). Microbial analyses performed on groundwater samples at the Site in 2013 and 2015 (USACE, 2017a; Section 6) indicate that microbial-remediated reductive debromination of EDB is occurring in-situ in groundwater, and that benzene is also being microbially degraded in groundwater.

Additionally, as some fuel HCs are metabolized, enzymes are produced that can facilitate the degradation of halogenated HC additives, such as EDB, that are commonly more resistant to biodegradation. This process is known as co-metabolism. The agreement between independent measures of anaerobic EDB degradation (excess bromide and ethene/ethane) at the Site suggest that large quantities of EDB may have degraded at the Site, possibly aided by the co-metabolism of benzene while microorganisms degraded fuel HCs within the source area and just downgradient of the benzene plume. The fate and transport properties of LNAPL and the specific constituents of LNAPL are discussed in more detail in Sections 5 and 7 of the RFI Report (USACE, 2017a).

1.4 Interim Measures

As mentioned earlier and discussed in detail in the RFI Report, Kirtland AFB has completed a number of interim measures in the source area and is continuing to implement interim measures to address COPCs in soil, soil gas, and groundwater (USACE, 2017a). Interim measures as defined in the Permit include, "actions necessary to minimize or prevent the further migration of contaminants and limit actual or potential human and environmental exposure to contaminants while long-term corrective action remedies are evaluated." These measures are important for the RA because of their role in reducing or eliminating exposure to some of the contaminated media. The following interim measures have been implemented:

- **Soil Removal:** Three separate excavation events removed a total of 4,822 tons (3,027 cubic yards) of contaminated soil to achieve NMED's residential screening levels (SL; USACE, 2017a; Section 4).

- **Removal of Source Infrastructure:** Removal of the source area pipelines and replacement of fueling infrastructure eliminated the source of the release (USACE, 2017a; Section 2).

- **Soil Vapor Extraction:** SVE systems operated at the Site from 2003 through 2015. These systems disrupted the transport pathway for soil gas by reducing the mass of volatile contaminants. These SVE systems removed approximately 775,000 equivalent-gallons of jet fuel. Subsequent to deactivation of the SVE system in Quarter (Q) 2 2015, vadose zone soil gas HC concentrations have been returning to spatial patterns reflecting non-flow conditions (USACE, 2017a; Section 4).

- **LNAPL Skimmer System and Bioslurping:** The LNAPL skimmer system and bioslurping removed most of the floating LNAPL from the water table. This removal limited LNAPL constituents from volatilizing into soil gas or dissolving into groundwater (USACE, 2017a; Section 5). The skimmer system, used from 2007 to 2008, removed approximately 280-gallons of LNAPL. Bioslurping, used from early 2008 until late 2011, removed 225,000 equivalent-gallons of fuel (this number is included in the total amount removed by SVE).

- **Groundwater Treatment System:** The only interim measure operating at the time of this RA is the groundwater treatment system. This system currently includes three off-Base extraction wells which pump groundwater from the dissolved-phase EDB plume to an on-Site treatment facility. This interim measure is designed to collapse, treat, and hydraulically-control the downgradient dissolved-phase EDB plume (USACE, 2017a: Section 6).

- **Groundwater Monitoring:** Continual monitoring of on-Site and off-Base groundwater monitoring wells, and drinking water supply wells prevents exposure to current receptors. This monitoring includes several different types of wells listed below:

    - ***Groundwater Monitoring Program:*** One-hundred thirty four groundwater monitoring wells are monitored regulary to delineate the nature and extent of contaminants in groundwater as described in the RFI Report (USACE, 2017a). Shallow and deep sentinel groundwater monitoring wells on-Site and off-Base are sampled quarterly to ensure early detection of potential dissolved COPCs prior to reaching drinking water supply wells. The majority of off-Base public drinking water supply wells are operated by the Water Authority. The two Water Authority wells closest to the dissolved-phase EDB plume are Ridgecrest-3 and Ridgecrest-5 (Figure 1-1). In addition, the United States Geological Survey (USGS) performs monitoring of sentinel wells on a quarterly basis (Figure 1-1).

    - ***Kirtland AFB Water Supply Wells:*** There are three Kirtland AFB drinking water supply wells AFB (KAFB-003, KAFB-015, and KAFB-016) near the EDB plume, which are monitored monthly when operational to ensure COPCs have not reached the on-Site drinking water supply system (Figure 1-1). All analytical results have been below project SLs. In addition, sentinel groundwater monitoring wells are located between the groundwater contaminant plume and the Kirtland AFB supply wells to provide early detection of contaminants.

    - ***VA Medical Center Supply Well:*** The VA Medical Center abuts Kirtland AFB to the north and has one drinking water supply well, which is sampled monthly (Figure 1-1). Analytical results at this location have historically been nondetect or below project SLs for project COPCs. Additionally, there are sentinel groundwater monitoring wells located between the groundwater contaminant plume and the VA Medical center supply well to provide early detection of contaminants.

    - ***Privately-owned Irrigation Wells:*** There are two privately-owned water supply wells in the vicinity of the plume, which are used primarily for irrigation (Figure 1-1). One of these is sampled quarterly, and results are reported to NMED. All analytical results have been below project SLs. In addition, groundwater monitoring wells are located between these irrigation wells and the EDB plume to provide early detection of contaminants.

- **Land Use Controls:** Current land use controls (LUC) include general access restrictions for Kirtland AFB and the BFF, and restrictions on intrusive activities within the Site in accordance with the Air Force Work Clearance Request review process. At the direction of NMED, the Office of the State Engineer has restricted the installation of private water supply wells within a 500-foot buffer around the footprint of the dissolved-phase EDB plume. LUCs considered in this RA are discussed in more detail in Section 4.2.

1.5 Organization of this Document

The remainder of this document includes the following:

- **Section 2 Overview of the Risk Assessment Process**
  A description of NMED's HHRA and ERA methodologies, including information related to the human health and ecological SLs applied in the RA.

- **Section 3 Environmental Data and Data Quality**
  A description of the environmental sampling by which the soil, soil gas, and groundwater data used in the RA were acquired, and how the data were incorporated in the RA.

- **Section 4 Human Health Risk Assessment Exposure Assessment**
  This section provides includes identification of potentially complete exposure pathways for soil, soil gas, and groundwater for on-Site and off-Base locations.

- **Section 5 Human Health Risk Assessment Risk Characterization**
  This section includes a detailed risk characterization and uncertainty analysis, and presents the conclusions and recommendations of the HHRA.

- **Section 6 Ecological Risk Assessment**
  This section provides the results of the ERA, consisting of Phase I, Phase II Tier 1, and Phase II Tier 2 assessments.

2 OVERVIEW OF THE RISK ASSESSMENT PROCESS

The HHRA and ERA are conducted in accordance with NMED's *Risk Assessment Guidance for Site Investigations and Remediation* (NMED, 2017). NMED's Guidance incorporates readily obtainable Site data and utilizes methods from various EPA RA Guidances. The NMED Guidance is divided into two volumes:

- "Volume 1—Tier I Soil Screening Guidance Technical Background Document" discusses the methodology used to derive chemical-specific soil SLs (SSLs), tapwater SLs (TSLs), and vapor intrusion SLs (VISLs). In addition, guidance is provided to assist in identifying and evaluating appropriate exposure pathways and human or ecological receptors. Finally, it provides generic SSLs, TSLs, and VISLs for chemicals commonly found at contaminated sites based on default exposure parameters under residential and non-residential land use scenarios.

- "Volume 2—Screening Level Ecological Risk Assessments" describes NMED's procedure for the evaluation of ecological risk.

This RA is a screening level RA (SLRA) for both human and ecological receptors. As such, the focus of this SLRA is to evaluate whether 1) potentially complete exposure pathways could exist now or in the future for human or ecological receptors, and 2) to determine whether concentrations of analytes measured in environmental media present a risk to those receptors by comparison to NMED SLs and target risk values (NMED, 2017). SLs are media-specific and scenario-specific contaminant concentrations at or below which exposure would not be expected to result in an unacceptable risk. This SLRA answers the following questions:

- What are the sources, distribution, and concentrations of contaminants in soil, soil gas, and groundwater?

- Who could potentially come in contact with the contaminated soil, water, or air?

- Are the contaminant concentrations high enough to potentially cause an unacceptable risk to humans or ecological receptors (e.g., plants and wildlife)?

- Is further action needed to prevent exposure or cleanup the contamination?

As stated previously, this SLRA has been performed near the end of the investigation stage and while interim measures are being implemented. The objective of a SLRA is simply to indicate whether further evaluation, sampling, or other actions may be necessary (e.g., use of institutional or engineering controls to prevent exposure).

The Permit cites NMED Guidance, which specifies the steps that must be followed to perform a SLRA for both human and ecological receptors. These steps and their location in this RA include:

- Data quality assessment for SLRA (see Section 3)

- Development of human and ecological Conceptual Site Exposure Models (CSEM) to determine complete and incomplete exposure pathways (see Sections 4 and 6)

- Comparison of Site data with SLs and calculation of cumulative risk estimates to determine whether an unacceptable risk to human or ecological receptors from complete or potentially complete exposure pathways exists (see Sections 5 and 6)

- Assessment of uncertainties (see Sections 5.2 and 6.4).

NMED SLs incorporate a number of assumptions. Therefore, it is important to understand how the SLs are used in the SLRA, how they were developed, and why they are protective of human health and the environment. These topics are discussed in the following sections.

2.1 Human Health Risk Assessment

NMED uses a two-step approach for a HHRA. Step 1 involves comparing maximum COPC concentrations to the appropriate NMED-developed SLs. NMED SLs for soil, soil gas, and groundwater have been developed using conservative exposure assumptions. The exposure assumptions used in SL development are more likely to overestimate than underestimate potential risk (NMED, 2017). NMED SLs were derived from equations combining exposure assumptions with toxicity criteria following EPA's preferred hierarchy of toxicological data. NMED also considered different exposure scenarios, such as residential and commercial/industrial, and developed receptor-specific SLs for the different exposure scenarios. Figure 2-1 summarizes NMED's overall HHRA process. Step 1 of the NMED HHRA process uses maximum COPC concentrations and the appropriate media- and receptor-specific SL to calculate cumulative risks to human receptors. These cumulative risk estimates are compared to NMED target risk levels for carcinogenic and non-carcinogenic risks.

If the risk calculations performed using maximum concentrations of each COPC exceed NMED's target risk levels, the next step (Step 2) in the risk evaluation involves development of statistical estimates of average exposure point concentrations (EPCs). Section 3 includes a detailed analysis of the Site data to support calculation of EPCs.

The chemical-specific NMED SLs are based on a 1×10^{-5} target risk for carcinogens (risk of cancer occurrence is 1 in 100,000), or a hazard quotient (HQ) of 1.0 for non-carcinogens. A HQ is the ratio between an estimated exposure concentration (based on site data and exposure assumptions) and a concentration that is not expected to result in an adverse health effect.

2.1.1 Summary of NMED Human Health Screening Levels

NMED SLs are developed for residential, commercial/industrial, and construction exposure scenarios. Routes of exposure include dermal (absorption through skin contact with contaminants in soil or water), inhalation (absorption through the lungs from breathing), and ingestion (absorption through the gastrointestinal tract) exposures as appropriate to the exposure scenario (NMED, 2017). The assumptions NMED used to develop SLs for various exposure scenarios are described below. Section 2 in NMED's Guidance (NMED, 2017) has more detailed descriptions of the methods used to develop NMED SLs. NMED has also developed SSLs related to protection of groundwater from residual contamination in soil. Because near-surface soil remediation is complete and groundwater contamination from historical releases is directly evaluated in the HHRA, the groundwater protection SLs are not employed in the HHRA.

2.1.1.1 Soil Screening Levels for Residential Exposure Scenarios

Residential exposures are assessed with SSLs based on child and adult human receptors. The child receptor is used as the basis for calculating SSLs for non-carcinogenic effects, and both child and adult exposures are used to assess cancer risk over an individual's lifetime. Residential exposure includes three soil exposure pathways: direct ingestion, dermal absorption, and inhalation of volatiles and dust at soil depths ranging from ground surface to 10 feet bgs. A resident is assumed to occupy a home at a site 24 hours per day for 350 days per year for 26 years (NMED, 2017; Section 2). Residential SSLs are incorporated in this HHRA to evaluate exposure to future hypothetical on-site residents and assess the unrestricted use scenario.

2.1.1.2 Soil Screening Levels for Commercial/Industrial and Construction Exposure Scenarios

Non-residential land use exposures include all industrial and commercial land uses and focuses on two types of human receptors: a commercial/industrial worker and a construction worker. These types of workers are representative of on-Site workers. These SSLs are based on adult exposure only. The commercial/industrial worker is assumed to be a long-term (i.e., 25 years) receptor exposed to surface soil (0 to 1 foot bgs) on a regular basis during the work week. The construction worker is assumed to perform instrusive operations (i.e., excavation, trenching, etcetera [etc.]) and be exposed to surface and subsurface soil (i.e., 0 to 10 feet bgs) during the entire workday for a single project of one year's duration (NMED, 2017; Section 2). The application of commercial/industrial and construction scenarios allows for appropriate screening of potential soil exposures for both surface and subsurface soils, respectively, consistent with NMED's Guidance (NMED, 2017).

2.1.1.3 Tapwater Screening Levels

NMED TSLs are used in this HHRA to evaluate risk from exposure to contaminated groundwater. The TSLs are for domestic use (as tapwater) and assume ingestion and dermal contact with contaminants in domestic/household water and inhalation of volatiles through showering or dish washing (NMED, 2017; Section 2). TSLs are used in this HHRA because the fuel contamination is in an aquifer that is currently used by public drinking water systems, although any public supply wells and privately-owned irrigation wells are located outside the impacted area of the aquifer.

2.1.1.4 Vapor Intrusion Screening Levels

Vapor intrusion occurs when soil gas migrates from subsurface media (i.e., soil and/or groundwater) through pore spaces in the vadose zone and building foundations into indoor air, potentially exposing residential and commercial/industrial receptors to volatile COPCs. VISLs have been developed by NMED to address areas where buildings may exist above contaminated soil gas. The VISLs were developed for both soil gas (when the vapor is still in the ground beneath a building) and indoor air (vapor in a building). VISLs are evaluated if 1) there are compounds present in subsurface media that are sufficiently volatile and toxic, and 2) there are existing or planned buildings where exposure could occur. A chemical is considered to be sufficiently volatile if its Henry's Law Constant is 1×10^{-5} units of moles per cubic meter for air to moles per cubic meter for water or greater and its molecular weight is approximately 200 grams per mole or less. Section 7 of the RFI Report lists the physical properties of contaminants evaluated in the RFI Report and shows that most of the COPCs evaluated in this HHRA are sufficiently volatile (USACE, 2017a). Commercial/industrial and residential soil gas VISLs are used in this HHRA to evaluate exposure to COPCs in soil gas.

2.1.2 Ecological Risk Assessment

Part 6.2.3.7 of the RCRA Permit requires the evaluation of potential ecological risk for any SWMU or AOC where there has been a release of contaminants. As required by the Permit, the ERA follows Volume 2 of NMED's Guidance (NMED, 2017), with additional documents as cited in Section 6. The purpose of the ERA is to evaluate the potential adverse effects that chemical contamination could have on plants and animals on or near the site. Furthermore, it provides a means to organize and present scientific information in a logical format for risk managers (NMED, 2017).

NMED's ERA process includes a Phase I Qualitative Assessment, and a Phase II Quantitative Assessment. Phase II consists of Tier 1 and Tier 2 screening level ERA (SLERA). The Tier 1 SLERA determines whether the site needs to have the toxicity data and risk characterization assessed in more detail. The Tier 2 SLERA findings are used to determine whether the site requires a Quantitative Site-specific Risk Assessment (NMED, 2017).

The Phase I Qualitative Assessment begins with a scoping assessment that reviews the biological and physical properties of the site, including environmental setting, land use, contaminant fate and transport mechanisms, and the area's habitats, ecological receptors, and exposure pathways. This information is used to support development of a preliminary CSEM to determine if ecological risk is possible. If it is, then a Phase II, Tier 1 SLERA is implemented by selecting representative screening ecological receptors and exposure pathways to determine exposure estimates for effects assessment and risk characterization. If warranted, a Phase II, Tier 2 SLERA is implemented, which refines the toxicity assessment using more realistic estimates of exposure, such as maximum, mean and median concentration values, as well as using area use factors to provide a refined risk characterization.

3 ENVIRONMENTAL DATA AND DATA QUALITY

The foundation for any RA is the quality and quantity of data available to determine potential risk. The specific analytes evaluated in this RA are identified in Section 3.1. The data used in the RA include soil data collected on-Site and groundwater and soil gas data collected both on-Site and off-Base; these data are discussed in Section 3.2. Data quality attributes are discussed in Section 3.3, Data Evaluation.

3.1 Selection of Contaminants of Potential Concern

Section 3 of the RFI Report examined the list of sampled analytes throughout the history of Site investigations. NMED's RA Guidance states, "…*identification of contaminants of potential concern should begin with existing knowledge of the process, product, or waste from which the release originated*" (NMED, 2017). Since the sources of contamination at the Site are AvGas, JP-4, and JP-8; the list of fuel-related constituents is known. For the purposes of the RFI Report, a list of fuel-related analytes was developed for soil, soil gas, and groundwater, and referred to in this RA as COPCs (see Table 3-1). It should be noted that not all COPCs were sampled in every medium (e.g., lead is not volatile within the expected temperature and pressure ranges at the Site, and was not analyzed in soil gas samples). In total, there are 20 COPCs across all three media. The list of COPCs differs slightly for soil, soil gas, and groundwater; however, EDB; benzene, toluene, ethylbenzene, and xylenes; naphthalene; 1,2,4-trimethylbenzene (1,2,4-TMB); and 1,2-dichloroethane (1,2-DCA) are common to all three media. Analytes previously removed from sampling suites during optimization of the groundwater monitoring program were not included as COPCs (e.g., the 97 analytes removed from the groundwater monitoring program in 2015 [USACE, 2017a]).These analytes were nondetect and/or below SLs for the previous eight quarters of analysis.

3.2 Environmental Data Evaluated in the Risk Assessment

The following sections describes the environmental data in each media that were evaluated as part of this RA.

3.2.1 Soil

Several separate on-Site soil investigations have been conducted between 2000 and 2014, as described in Section 4 of the RFI Report (USACE, 2017a). Of the different soil samples acquired during this period, two sets of soil data are relevant for assessing potential risk from present-day exposure to soil on-Site: 1) soil data from unexcavated (non-removal) areas proximal to the release area, and 2) post-excavation soil confirmation data collected after the 2014 soil removal (USACE, 2017a). The 2014 post-excavation soil data are particularly relevant to the RA because they provide the most recent shallow soil data within 20 feet of the ground surface. Soil samples collected as part of well installation were not included in this RA because they were collected from soil at depths not relevant for RA, or were part of earlier sample events and represent soil that has been removed.

The soil dataset includes samples from 14 soil boring locations that contained exceedances of the NMED 2012 SSLs, but were not excavated or were only partially excavated during the 2014 excavation activities (USACE, 2017a) and post-excavation confirmation samples collected between 0 to 10 feet bgs. Figures 3-1 and 3-2 illustrate the 14 soil sample locations where excavation was not possible due to existing underground utilities and infrastructure. Sixty-three samples were collected from the sidewalls and floor of the excavation. Twelve additional step-out confirmation samples were collected for semi-volatile organic compounds, 2-methylnaphthalene and naphthalene, when concentrations exceeded the NMED 2012 SSLs (75 samples total were analyzed for 2-methylnaphthalene and naphthalene). 1-Methylnaphthalene was not included in the analysis for the original 63 confirmation samples, but was included in the method used to analyze the step-out confirmation samples (12 samples total analyzed for 1-methylnaphthalene). The post-excavation sample locations are presented in Figures 3-1 and 3-2 and sample results are summarized in Table 3-4.

Concentrations of COPCs in surface soil collected from 0 to 1 foot bgs are summarized in Table 3-2 and are compared to commercial/industrial worker SSLs in Section 5 per NMED RA Guidance (NMED, 2017).

Concentrations of COPCs in mixed zone soil (i.e., 0 to 10 feet bgs) are summarized in Table 3-3 and were compared to the residential or construction worker SSLs in Section 5 per NMED RA Guidance (NMED, 2017).

3.2.2 Soil Gas

Soil gas data from Q1 through Q3 2016 were used to evaluate the potential risk on-Site and off-Base from exposure to COPCs in soil gas. Soil gas data from three quarters were used in this RA to minimize the effect of the vadose zone stabilizing to natural flow conditions after the shutdown of the approximately 1,800 standard cubic feet per minute catalytic oxidizer SVE system, which occurred in Q2 2015 (USACE, 2017a). Analytical data for Q1 through Q3 2016 is included in the Q4 2016 monitoring report (USACE, 2017b).

Currently, there are 51 soil vapor monitoring (SVM) locations on-Site and five off-Base, as illustrated in Figure 3-3. Sample depth intervals at each location commonly range from a shallow interval with a well screen at 15 to 25 feet bgs to intervals at a depth of approximately 450 feet bgs. Soil gas data from all depth intervals are presented in the RFI Report (USACE, 2017a). However, for the RA, the most relevant data are the on-Site and off-Base shallow soil gas data collected at 15 to 25 feet bgs because these data best represent a potential source term for vapor intrusion into a building.

Of the 56 total locations, 35 have sample intervals at the 15 to 25-foot interval, 31 on-Site and four off-Base. Table 3-4 summarizes on-Site samples evaluated from Q1 through Q3 2016 (93 samples). Table 3-5 summarizes off-Base samples collected from Q1 through Q3 2016 (12 samples). Note that the RFI Report presents soil gas data with units of parts per million by volume, while the RA employs the units used by NMED for VISLs (i.e., micrograms per cubic meter [$\mu g/m^3$]). Soil gas data were converted to $\mu g/m^3$ from parts per billion by volume using the molecular weight of each chemical and a conversion factor of 24.45, which assumes a standard atmospheric pressure of 1 atmosphere and a standard temperature of 25 degrees Celsius. This conversion was performed to facilitate the HHRA by matching NMED soil gas VISL units.

3.2.3 Groundwater

Groundwater data from Q3 and Q4 2015, as presented in the RFI Report, were used to evaluate potential on-Site and off-Base risks from exposure to groundwater (USACE, 2017a). Section 6 of the RFI Report presents the details of the groundwater monitoring program along with the results from the beginning of monitoring in 2000 to the end of 2015 (USACE, 2017a). Tables 3-6 and 3-7 summarize the on-Base and off-Base groundwater datasets used in the HHRA. Thirty-four on-Site wells were sampled in Q3 and Q4 2015 (68 samples). Ninety-seven off-Base wells were sampled in Q3 and Q4 2015 with an additional three off-Site wells installed and sampled in Q4 2015 (197 samples; Figure 1-1).

3.3 Data Quality Evaluation

Data validation reports for soil data collected between Q1 2011 and Q4 2015, soil gas data collected from Q3 2015 through Q3 2016, and groundwater data collected from Q3 through Q4 2015 were completed in accordance with the *Quality Assurance Project Plan (QAPjP) for the Vadose Zone Investigation and Groundwater Investigation Work Plans* (USACE, 2011), and the *Soil Vapor and Drinking Water Monitoring Work Plan* (USACE, 2016), and have been presented in the associated Quarterly Pre-remedy Monitoring Reports. The requirements for data quality, quantity, and usability for the analytical data used in the RFI Report and this RA were specified in the QAPjP associated with each Work Plan. Therefore, these data have been determined to meet the data quality objectives (DQO) requirements in NMED's RA Guidance (NMED, 2017). The foundation for any RA is the quality of data available to determine potential risk. The RFI Report, which was submitted to NMED on January 31, 2017, summarizes all investigation activities and interim measures performed between November 11, 1999 and December 31, 2015. These data were collected during the multiple project investigations, which were performed in accordance with Site-specific Work Plans for each separate sampling event.

This RA uses validated data for the identified COPCs that was collected to support the RFI. Laboratory data flags are included in the project database, and no rejected data were used to evaluate the nature and extent of fuel-related contamination in the RFI Report or in this RA. The inclusion or exclusion of data within the RA, on the basis of analytical qualifiers, was performed in accordance with NMED Guidance (NMED, 2017). 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 dataset and considered nondetects at the given RL.
- Analytical results 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), "+" qualifiers (indicating the inorganic reported value may be biased high), and "-" qualifier indicating the reported value may be biased low) were retained at the reported concentration.

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 two results were averaged.
- If both samples show nondetect values, the two nondetect RLs were averaged.
- If only one sample indicated that the analyte was present, it was retained in the dataset and the nondetect value was discarded.

If all results for a COPC were nondetect, the COPC was not carried forward for risk characterization in Sections 5 or 6 (See Tables 3-2 through 3-7).

3.3.1 Soil Gas Data Quality Evaluation

The following issues were identified for soil gas data collected from the SVM locations:

- EDB was measured by two analytical methods (EPA method TO-15 and method California Air Resources Board [CARB] 422) and the results were not in agreement.
- Elevated concentrations of acetone and methyl ethyl ketone (MEK) were found in a number of samples.

To ensure the soil gas data used to assess risk met DQOs, each of these potential issues was evaluated further and the results of this evaluation are provided below. Detailed data evaluation reports are included in quarterly data quality evaluation reports. As summarized below and detailed in Attachment 1, these issues were evaluated and the analytical data were determined to be acceptable relative to the data quality indicators.

3.3.1.1 Evaluation of Soil Gas Analytical Methods for EDB

EDB in soil gas was measured in samples collected during SVM by two analytical methods: EPA method TO-15, which is a mass spectrometry detection method, and method CARB 422, which is an electron capture detection method. The TO-15 method has been used for SVM since 2010. The CARB 422 method was added in 2014 with the goal of having a method with a lower EDB detection limit in soil gas than the TO-15 method. However, a detailed assessment of soil gas data by both methods indicates the CARB 422 EDB results are not accurate; therefore, only TO-15 EDB results are used in this RA.

An investigation into the two soil gas methods for EDB is described in Attachment 1. Comparisons of the detection limits for EDB in soil gas by TO-15 and by CARB 422 are documented in a summary memo submitted to NMED in April 2017 (Kirtland AFB [KAFB], 2017). Level IV soil gas data packages and data analyses for EDB revealed a systematic difference in the magnitude of the detected values between the two methods, as well as an increase in the analytical detection limit by CARB 422 method. The following lines of evidence provide the basis for using the TO-15 EDB data in the RA rather than the CARB 422 EDB data:

- Comparison of 408 sample pairs of detected EDB results by CARB 422 and TO-15 showed a very consistent pattern of CARB 422 results two to five times higher than TO-15 results.
- Based on two laboratory control sample analyses performed by the laboratory, it appears the CARB 422 EDB results are biased approximately 1.7 times higher than the TO-15 results.
- Results of an investigation by the analytical laboratory indicate that this bias is at least partly due to improper preparation of the CARB 422 calibration standard prepared in March 2015 and used through November 2016.
- Review of 16 TO-15 analytical data packages confirms the ability of the TO-15 method to detect EDB in the presence of high concentration of other COPCs. TO-15 mass spectra with straight-chain HC mass up to 1,000 times larger than EDB mass were reviewed and determined not to impact EDB identification and quantitation.

- Mass spectrometry (i.e., TO-15) is considered a more definitive identification technique than electron capture detection (i.e., CARB 422) because the generally unique mass fragmentation patterns evaluated by mass spectrometry greatly reduce the chances for misidentification of an analyte and TO-15 is not affected by interference from other halogenated compounds.

- Review of detection limits for EDB in soil gas by TO-15 and CARB 422 indicate that approximately 70 percent (%) of the time, the detection limit (DL) for EDB by TO-15 is lower than that of CARB 422, demonstrating that for most sample locations, TO-15 is the more effective method (KAFB, 2017).

3.3.1.2 Evaluation of Acetone and MEK in Soil Gas

High levels of acetone and MEK were observed in some of the soil gas samples. The presence of these analytes is believed to be related to two sources 1) the polyvinyl chloride (PVC) glue (i.e., Oatey low volatile organic compound [VOC] purple primer) that was used to seal the SVM ports during Q1 2015 and 2) as a byproduct of biodegradation of fuel-related constituents. Acetone and MEK were not evaluated in the RA due to their relationship with these sources.

In the source area (e.g., SVMW-10-250), acetone, and MEK concentrations are similar in pattern to COPCs such as EDB and benzene. Transient production of acetone is generally correlative to sub-oxic, methanogenic environments. It is assumed that acetone production happens before the system becomes fully anaerobic (Mueller, 2011). The Q4 2016 Report (USACE, 2017b), indicates that this process may be occurring in groundwater. Thus, the report concludes persistence of the compound would indicate an active, continuing bioremediation signature. Concentrations of acetone and MEK in anaerobic areas of the vadose zone indicate this process may also be ongoing in the source area of the vadose zone.

In locations outside of the source area (e.g., KAFB-106141-250), the presence of acetone is consistent with the use of a PVC glue used to seal the sample ports in Q1 2015. This conclusion is supported by the presence of acetone and MEK in the primer and the temporal patterns of these constituents in the soil vapor monitoring points (SVMPs) data from this period. The highest concentrations of acetone and MEK were detected in the Q3 2015 soil gas data, which was the first quarter of data collected after the SVM locations were sealed. Review of chromatograms provided by the analytical laboratory demonstrates identification and quantification of the COPCs by EPA Method TO-15 was not otherwise affected by high concentrations of acetone and MEK. Soil gas data from Q1 through Q3 2016 were used in this RA.

4 HUMAN HEALTH EXPOSURE ASSESSMENT

The exposure assessment evaluates the magnitude, frequency, and duration of exposure of human receptors to contaminated media affected by site activities. A key component of the exposure assessment is the CSEM, which is based on the CSM (Section 7) described in the RFI Report (USACE, 2017a). The HHRA CSEM illustrates the potential exposure pathways by which humans could be exposed to contaminants at a site. As discussed in Section 3.1, this exposure assessment focuses on COPCs identified in the RFI Report that are related to the fuel released at the Site (USACE, 2017a).

Exposure pathways begin at source areas and progress through the environment via various fate and transport processes to potential human receptors. Schematic renderings of the on-Site and off-Base human health CSEMs are shown in Figures 4-1 and 4-2, respectively. The RFI CSM (USACE, 2017a; Section 7) sets forth the potential source areas and contaminant migration pathways. The following section details the site exposure setting and potential human receptors. 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 uptake route at the point of exposure.

All four components must exist for an exposure pathway to be complete (or potentially complete in the future) and for exposure to occur. Incomplete exposure pathways do not result in actual exposure and are not evaluated in the risk characterization. If the exposure pathway is incomplete, there is no risk to human receptors. Complete and potentially complete exposure pathways are carried forward and evaluated in the HHRA (Section 5, Human Health Risk Characterization) to determine whether there is a potential unacceptable risk to human health.

4.1 Land Use

NMED Guidance (NMED, 2017) requires plausible exposure under both current and future land use be evaluated in the HHRA. Therefore, an understanding of current and future land use is important to accurately determine the human receptors that may be present at the Site currently or in the future. Both on-Site and off-Base land use are evaluated in the vicinity of the BFF. Human receptors are discussed in Sections 4.3 and 4.4.

4.1.1 On-Site Land Use

Kirtland AFB is an active military installation, and is expected to remain active for the foreseeable future. According to the current Kirtland AFB's Installation Development Plan, the Site is located within the "Flightline District." The Flightline District is primarily industrial, with facilities and land use dedicated to the support of airfield operations. This includes the BFF, which is where the Site source area is located on-Site. As a result, current and anticipated future land use is primarily industrial for the Site, with limited, restricted administrative use (KAFB, 2016). No transfer of military property to the public is anticipated near the Site. Twelve buildings have been identified within and adjacent to the BFF (Table 4-1). Of these 12, only four are occupied on a regular basis. Only three of those four (Buildings 1044, 1049, and 1055) are occupied full time, and consistent with the NMED commercial/industrial exposure scenario, which assumes exposure to workers eight hours a day, five days a week, 45 weeks a year for 25 years (NMED, 2017).

4.1.2 Off-Base Land Use

Figure 1-1 shows the delineation of the benzene and EDB groundwater plumes off-Base. Current land use and expected future land use above the impacted groundwater plume north of the Kirtland AFB property line (Figure 1-1) is zoned majority residential with limited commercial zoning (City of Albuquerque, 2017a).

Off-Base soil gas contamination has been measured in a smaller area than the footprint of the off-Base groundwater plume, and includes the area of Bullhead Park, the VA Medical Center parking lot, and the Air Force-owned open space. Land use in the off-Base area adjacent to the Site and overlying the vapor plume is not expected to change in the future. Land use above the area of the off-Base soil gas plume includes areas zoned as residential. It is important to note there are currently no residential or industrial buildings in the area of the off-Base soil gas plume; the majority of the area is comprised of Bullhead Park. Since the area adjacent to Bullhead Park is already established and densely developed, it is unlikely land use will change significantly in the foreseeable future. Per the City of Albuquerque, the area is zoned RA-1, which requires a minimum of 20,000 square feet of open space per dwelling unit (City of Albuquerque, 2017a). In addition, although the City of Albuquerque websites show plans for redevelopment of commercial areas north of Bullhead Park, there are no planned changes to Bullhead Park or to the residential areas (City of Albuquerque, 2017b). The large open area to the northeast, between Bullhead Park and the residential areas (Figure 3-3), is owned by the Air Force and the Air National Guard.

4.1.3 Groundwater Use

Groundwater used by on-Site workers, and on-Site residents originates from two sources as discussed in the RFI Reprt (USACE, 2017). Kirtland AFB groundwater drinking water supply wells are used for offices, irrigation, and industrial purposes, and 2) the Water Authority supplies potable water for on-Site residential housing (USACE, 2017a). There are seven Kirtland AFB drinking water supply wells in the Albuquerque Basin screened at depths of 450 to 1,000 feet bgs. The three Kirtland AFB drinking water supply wells (KAFB-003, KAFB-015, and KAFB-016) closest to the groundwater plume are monitored monthly for potential groundwater contamination. KAFB-016 has not been operational for the last few years due to ongoing repairs; however, it is scheduled to resume operation in the summer of 2017. All analytical results have been below project SLs. In addition, sentinel groundwater monitoring wells are located between the groundwater contaminant plume and the Kirtland AFB supply wells to provide early detection of contaminants.

Off-Base groundwater in the vicinity of the Site originates from three sources: Water Authority supply wells, one VA Medical Center water supply well, and two privately-owned irrigation wells. The majority of off-Base public drinking water supply wells are operated by the Water Authority. The two Water Authority wells closest to the dissolved-phase EDB plume are Ridgecrest-3 and Ridgecrest-5 (Figure 1-1). Drinking water wells used by the Water Authority for its customers are screened at a depth of approximately 1,000 feet, which is significantly deeper in the aquifer than the contaminant plume. Shallow and deep sentinel groundwater monitoring wells on-Site and off-Base, and USGS sentinel wells are sampled quarterly to ensure early detection of potential dissolved COPCs prior to reaching drinking water supply wells (Figure 1-1).

The VA Medical Center drinking water well, located approximately 750 feet west of the estimated plume boundary, is also screened at a depth of approximately 1,000 feet bgs. This VA Medical Center drinking water well has not had any contaminant detections above SLs to-date and is sampled monthly. Additionally, there are sentinel groundwater monitoring wells located between the groundwater contaminant plume and the VA Medical Center supply well to provide early detection of contaminants.

The two privately-owned water supply wells in the vicinity of the plume are used primarily for irrigation (Figure 1-1). One of these wells is sampled quarterly, and concentrations of all analytes have been below SLs since sampling began in 2008. Results of the sampling events are reported quarterly to NMED.

4.2 Land Use Controls

Knowledge of the existing LUCs is important to develop the CSEM because LUCs can limit exposure of current human receptors to contamination. LUCs include physical, legal, or administrative mechanisms restricting the use of, or limiting access to, real property to prevent or reduce risks to human health and the environment. This HHRA incorporates current LUCs to evaluate current/future industrial exposure; however future residential scenarios assume an unrestricted scenario, to include the removal of all LUCs.

Access to Kirtland AFB (and the Site) is restricted by control gates manned by security forces 24 hours per day. All qualifying unescorted personnel are required to be registered in the defense identification system using REAL ID (REAL ID Act of 2005) criteria. In addition, the BFF itself has limited access and egress. The Kirtland AFB BFF enclosure includes a fenced area with signage and an automated gate, which limits access to authorized personnel with an appropriate code. Personnel must have approval from the Base Wing Commander to work inside the BFF. Additionally, there is on-Site signage, and utilities in the BFF are marked to prevent potential damage during digging and subsurface access is limited.

Administrative procedures are in place to manage activities to prevent exposure to contaminants. All work performed on-Site, including within the BFF, must have prior approval on an Air Force Form 332. If the proposed work requires digging or other land disturbance, it must be further reviewed through the Air Force Form 103, Base Civil Engineering Work Clearance Request. As part of this land disturbance review process, the location of buried utility lines and areas of contamination are identified and steps are outlined to control the disturbance of contaminated soils.

Off-Base institutional controls include City of Albuquerque zoning as discussed in Section 4.1. In addition, at the direction of NMED, the Office of the State Engineer has restricted the installation of private water supply wells within a 500-foot buffer around the footprint of the dissolved-phase EDB plume. This restriction ensures contaminated groundwater exposure pathways to private well owners remain incomplete.

4.3 On-Site CSEM

The on-Site CSEM is shown in Figure 4-1. The LUCs discussed in Section 4.2 are incorporated in the CSEM to determine whether exposure pathways are complete or potentially complete under the current/future commercial/industrial and construction worker scenarios. The future hypothetical residential scenario, although unlikely, assumes no action (to include any LUCs) will be performed to reduce exposure.

4.3.1 On-Site Human Receptors

Based on the Kirtland AFB land uses discussed in Section 4.1, the following receptors were identified on-Site who may be exposed to contaminated media:

- Current/future commercial/industrial workers who support daily activities at the BFF. Since the replacement and automation of the fueling infrastructure in 2011, operational activities at the BFF are greatly reduced.

- Future construction workers who may engage in intrusive construction or excavation activities at the BFF. Although there is no current active construction at the BFF, construction may occur in the future to repair or replace existing infrastructure.

- Future hypothetical residents within the BFF. Although unlikely, this scenario addresses changes in on-Site land use at the BFF to include future on-Site housing. This scenario informs risk management decisions for consideration of unrestricted use and assumes no actions (to include LUCs) will be taken to reduce exposure.

4.3.2 On-Site Exposure Pathways

The following sections describe the complete, potentially complete, and incomplete exposure pathways to contaminated media on-Site for receptors evaluated quantitatively in the HHRA. As illustrated in Figure 4-1, exposure pathways to both current and future human receptors are evaluated. The current LUCs in place on-Site restrict or reduce exposure to contaminated media in some cases.

4.3.2.1 On-Site Soil Exposure Pathways

As discussed in Section 3, contaminated soil was removed to 20 feet bgs during the 2014 excavation event. Contaminated soil deeper than 20 feet bgs is considered inaccessible to human receptors. However, contaminated soil at 14 locations in the BFF was not removed due to existing infrastructure and utilities.

Runoff and erosion from contaminated surface soil to surface water is not expected to result in any complete exposure pathways for human receptors. It is highly unlikely surface water is introducing appreciable amounts of contaminated surface soil into the storm water system because 1) topography at the Site is relatively flat and 2) the majority of surface water at the Site either evaporates or infiltrates into the soil (USACE, 2017a). The amount of unexcavated surface soil (approximately 700 square feet) would have a negligible contribution to surface water runoff at the BFF.

Current/Future Commercial/Industrial Worker – Surface Soil (0 to 1 foot bgs): A complete exposure pathway exists for surface soil and dust to both current and future commercial/industrial workers at the BFF (Figure 4-1). As discussed in Section 2, the commercial/industrial worker is assumed to be a long-term receptor exposed to surface soil (0 to 1 feet bgs) on a regular basis during the work week. A limited amount of impacted surface soil was left in place following the 2014 excavation. The commercial/industrial worker is not expected to perform intrusive activities in these areas but may visit these areas during regular work activities. Currently, there are no LUCs in place to prevent commercial/industrial workers from encountering contaminated surface soil, or dust blown from surface soil by wind, therefore, direct contact with surface soil for the commercial/industrial worker is considered a complete exposure pathway. The current/future commercial/industrial worker was evaluated for exposure to surface soil via ingestion, dermal contact, and inhalation of volatiles and particulates in dust.

Future Construction Worker – Mixed Zone Soil (0 to 10 feet bgs): The construction worker is assumed to be exposed to mixed zone soil (0 to 10 feet bgs) during the entire workday for a single project of one year's duration (NMED, 2017; Section 2). As described in Section 4.2, LUCs at Kirtland AFB currently prevent intrusive work without prior review and approval. However, under a future unrestricted use scenario, construction activities may be performed to repair or replace existing infrastructure or for redevelopment. Therefore, exposure pathways from mixed zone soil and dust to future construction workers are potentially complete. The future construction worker was evaluated for exposure to mixed zone soil via ingestion, dermal contact, and inhalation of volatiles and particulates in dust.

Future Hypothetical Residents – Mixed Zone Soil (0 to 10 feet bgs): There are currently no residential homes on-Site. However, the future on-Site residential scenario is evaluated to inform risk management decisions and assumes unrestricted use. The future residents are assumed to be adults and children in contact with soil at depths from 0 to 10 feet bgs. A resident is assumed to occupy a home on-Site 24 hours per day for 350 days per year for 26 years (Section 2). Under this scenario, exposure pathways from mixed zone soil and dust to future residential homeowners are potentially complete (Figure 4-1). The future hypothetical resident was evaluated for exposure to mixed zone soil via ingestion, dermal contact, and inhalation of volatiles and particulates in dust.

Concentrations of COPCs in on-Site soil are evaluated in Section 5 to determine whether there is an unacceptable risk to current or future receptors at the BFF from complete or potentially complete exposure pathways.

4.3.2.2 On-Site Soil Gas (Vapor Intrusion) Exposure Pathways

COPCs can volatilize from on-Site contaminated soil or groundwater into soil gas, which can migrate into indoor air spaces if buildings are present. The migration of vapors from subsurface sources to indoor air within buildings is defined as vapor intrusion. As shown in Figure 4-1, COPCs could volatilize from contaminated groundwater or subsurface soil. However, the water table is located at 480 feet bgs and vapors from groundwater are not expected to migrate from the top of the water table upwards to ground surface (EPA, 2012). The primary soil gas exposure pathway is the volatilization of COPCs in impacted subsurface soil to indoor air vai vapor intrusion.

Inhalation of VOCs released from soil gas to ambient (outdoor) air was considered a potentially complete but insignificant exposure pathway for all human receptors. It is unlikely appreciable amounts of contaminated soil gas are being released into the ambient air from subsurface soil on-Site because 1) almost no contaminated soil remains near the ground surface (i.e., within 20 feet of ground surface) to provide a continual source and 2) any such releases would be immediately diluted. The leaking underground pipes were decommissioned in 1999 and removed in 2010; the majority of the impacted soil has been excavated to 20 feet bgs. Volatile COPCs in soil at 0 to 10 feet were addressed as a soil exposure pathway as described in Section 4.3.2.1.

Soil gas exposure pathways for human receptors evaluated in the RA are discussed below.

Current/Future Commercial/Industrial Worker: A potentially complete vapor intrusion exposure pathway exists from soil gas to indoor air within existing buildings for current/future commercial/industrial workers at the BFF. Although there is a limited number of occupied buildings at and adjacent to the BFF (Section 4.1), there are currently no actions or LUCs in place addressing vapor intrusion specifically. The current/future commercial/industrial worker was evaluated for exposure via inhalation to COPCs in soil gas, which could be present in indoor air due to vapor intrusion.

Future Construction Worker: Because construction workers are assumed to perform all work outside, no complete exposure pathway exists for future construction workers for indoor air via vapor intrusion. Construction workers are assumed to be outdoor workers. A potentially complete exposure pathway may exist for soil gas to outdoor air within a trench. Concerns about construction worker exposure to soil gas within a trench will be captured qualitatively through the evaluation of the vapor intrusion to indoor air pathway for the current/future commercial/industrial workers in Section 5.

Future Hypothetical Resident: There are no current on-Site residential receptors within the BFF. However, should land use change in the future, residential homes could be constructed on-Site. Therefore, a potentially complete vapor intrusion exposure pathway exists from soil gas to indoor air within future residential buildings at the BFF (Figure 4-1). The future hypothetical on-Site resident was evaluated for exposure via inhalation to COPCs in soil gas, which could be present in indoor air due to vapor intrusion.

Concentrations of COPCs in on-Site soil gas are evaluated in Section 5 to determine whether there is an unacceptable risk to current or future receptors at the BFF from complete or potentially complete exposure pathways.

4.3.2.3 On-Site Groundwater Exposure Pathways

As shown in Figure 4-1, released LNAPL migrated through contaminated soil to groundwater underlying the Site. As discussed in Section 1.4, and Section 4.1.3, the active interim measures in place cause the exposure pathway to current groundwater receptors to be incomplete.

Future Users of Groundwater On-Site: To inform risk management decisions the HHRA assumed that a drinking water supply well could be installed within the on-Site portion of the contaminant plume. Therefore, direct contact pathways for groundwater were considered potentially complete, to include ingestion, dermal contact, and inhalation of volatiles during household use (such as showering or dishwashing). A second hypothetical future scenario is a future industrial worker. However, the NMED TSLs are developed to evaluate residential receptors, and assume higher exposure than that of a worker. Thus the TSLs are suffiently protective of workers.

Concentrations of COPCs in groundwater are evaluated in Section 5 to determine whether there is an unacceptable risk to future receptors should water supply wells be installed in the contaminated portion of the aquifer based on complete or potentially complete exposure pathways.

4.4 Off-Base CSEM

The off-Base CSEM is shown in Figure 4-2. The land use and LUCs discussed in Sections 4.1 and 4.2 are incorporated in the CSEM to determine where exposure pathways are complete, potentially complete, or incomplete for the identified human receptors.

4.4.1 Off-Base Human Receptors

Based on the off-Base land uses discussed in Section 4.1, there are three types of human receptors that may be exposed to contaminated media:

1. Current/future recreational users at Bullhead Park or the Air Force-owned open space.

2. Future hypothetical off-Base residents in the footprint of Bullhead Park or the Air Force-owned open space, should land use change in the future. The City of Albuquerque has no plans to change the use of Bullhead Park, and there are currently no residential buildings present, however consideration of a future residential scenario provides information for consideration of unrestricted use.

3. Future users of groundwater Off-Base: Although interim measures are in place to prevent exposure to contaminated groundwater, the HHRA assumed a a drinking water supply well could be installed within the off-Base portion of the contaminant plume. Therefore, direct contact pathways for groundwater were considered potentially complete, to include ingestion, dermal contact, and inhalation of volatiles during household use (such as showering or dishwashing).

Although current/future residents north of Ridgecrest and current/future commercial/industrial workers (i.e., VA complex) were not evaluated quantitatively in the RA, consideration of the future hypothetical residents at Bullhead Park conservatively assesses these scenarios. Bullhead Park is located nearest to the contamination and is expected to have higher concentrations compared to the Ridgecrest area or the VA complex, thus estimated exposure is maximized with consideration of the future hypothetical resident at Bullhead Park.

4.4.2 Off-Base Exposure Pathways

The following sections describe the complete, potentially complete, and incomplete exposure pathways to contaminated media off-Base for receptors evaluated quantitatively in the HHRA. As illustrated in Figure 4-2, the exposure media present off-Base are limited in comparison to the on-Site exposure media. There is no contaminated surface (0 to 1 feet bgs) or mixed zone (0 to 10 feet bgs) soil off-Base. All soil exposure pathways were considered incomplete for off-Base receptors.

4.4.2.1 Off-Base Soil Gas (Vapor Intrusion) Exposure Pathways

Contaminated groundwater has migrated off-B. COPCs in groundwater could volatilize and migrate upward through the subsurface to indoor air if buildings are present. However, the water table is located at 480 feet bgs, therefore vapors from groundwater are not expected to migrate from the top of the water table upwards to the ground surface over this distance (EPA, 2012). The primary vapor intrusion exposure pathway is the volatilization of COPCs from impacted subsurface soil remaining on-Site in the area adjacent to the Base (i.e., Bullhead Park).

Current/Future Recreational Users: There are no occupied buildings in Bullhead Park or in the Air Force-owned open space. The vapor intrusion pathway from soil gas to indoor air is incomplete for current/future recreational users.

Future Hypothetical Off-Base Residents: While the City of Albuquerque has no plans to change the use of Bullhead Park, it is possible that this area could become residential in the future. If Bullhead Park was converted to residential use in the future, the exposure pathway from soil gas to indoor air could be potentially complete due to horizontal soil gas migration. The future hypothetical resident at Bullhead Park was evaluated for exposure via inhalation to COPCs in soil gas, which could be present in indoor air due to vapor intrusion. The amount of soil gas at the shallow depths where garden plant roots would be found is negligible, therefore uptake of COPCs in soil gas via plant was considered an incomplete pathway.

The concentrations of COPCs in off-Base soil gas are evaluated in Section 5 to determine whether there is an unacceptable risk to future residents from this potentially complete exposure pathway.

4.4.2.2 Off-Base Groundwater Exposure Pathways

As shown in Figure 1-1, contaminated groundwater has migrated off-Base in the direction of groundwater flow resulting in a plume that extends off-Base. Figure 4-2 illustrates the complete, potentially complete, and incomplete exposure pathways for groundwater for each human receptor.

Current/Future Recreational Users: The depth to groundwater is approximately 480 feet bgs, therefore, there is no potential for contact with groundwater at Bullhead Park. Water for drinking fountains and landscape irrigation at the park is provided by the Water Authority (City of Albuquerque, 2015). As a result, the exposure pathways for a current/future recreational user at Bullhead Park is considered incomplete for groundwater.

Future Users of Groundwater Off-Base: Although interim measures are in place to prevent exposure to contaminated groundwater, the HHRA assumed a a drinking water supply well could be installed within the off-Base portion of the contaminant plume. Therefore, direct contact pathways for groundwater were considered potentially complete, to include ingestion, dermal contact, and inhalation of volatiles during household use (such as showering or dishwashing).

There are no Water Authority drinking water supply wells installed in the impacted portion of the off-Base groundwater plume. Therefore, groundwater exposure pathways are incomplete for current off-Base receptors.

Concentrations of COPCs in groundwater are evaluated in Section 5 to determine whether there is an unacceptable risk to future receptors should water supply wells be installed in the contaminated portion of the aquifer based on complete or potentially complete exposure pathways.

5 HUMAN HEALTH RISK CHARACTERIZATION

Risk characterization evaluates information pertaining to potential exposures of human receptors to contamination and the health effects for the COPCs identified in soil, soil gas, and groundwater (Section 3.1). Exposure pathways for these media are described in Section 4; complete or potentially complete exposure pathways for current and future human receptors were evaluated quantitatively. The risk characterization for the complete and potentially complete exposure pathways is provided in Section 5.1. Key uncertainties related to the risk characterization are discussed in Section 5.2. Conclusions of the human health risk characterization are discussed in Section 5.3.

5.1 Human Health Risk Assessment

Human health risks were estimated for the receptors and exposure pathways identified as complete or potentially complete in Section 4. Risk characterization was performed using the following steps:

1. Appropriate NMED SLs based on exposure media (e.g., soil, soil gas, groundwater) and appropriate receptor (e.g., residential, commercial/industrial, or construction worker) were identified:

    - On-site soil concentrations for COPCs were compared to commercial/industrial, construction worker, and residential SSLs.

    - On-Site soil gas concentrations for COPCs were compared to commercial/industrial and residential soil gas VISLs.

    - Off-Base soil gas concentrations were compared to residential soil gas VISLs.

    - Both On-Site and Off-Base groundwater concentrations were compared to residential TSLs.

    If NMED screening levels were not available, EPA regional screening levels (RSLs; EPA, 2016) were used. Carcinogenic RSLs were adjusted to NMED's target cancer risk of one in 100,000 (10^{-5}). As noted in Section 2, NMED SLs represent environmental concentrations at or below which further action is not warranted under the indicated land use.

    Maximum detected concentrations in each media were screened against the appropriate COPCs.

2. COPC-specific and cumulative cancer risks and hazard indices (HI) were calculated using the maximum concentration of each COPC as described in NMED, 2017.

    - For carcinogenic COPCs, the maximum concentration was divided by the appropriate SL and multiplied by 1×10^{-5} to derive a COPC-specific cancer risk. The cancer risks for each COPC in an exposure media were then summed for each receptor to provide the total estimated cancer risk. The sum was compared to the NMED target cancer risk level of 1×10^{-5} (NMED, 2017).

- For a non-carcinogenic COPC, a COPC-specific HQ was calculated by dividing the maximum concentration by the appropriate SL. The HQs for each COPC in an exposure media were summed for each receptor to obtain a total estimated HI. The HI was compared with the NMED target HI of 1 (NMED, 2017).

- If a COPC had both carcinogenic and non-carcinogenic effects, it was included in both the carcinogenic and non-carcinogenic risk calculations.

3. If the total cancer risk estimate or the total HI calculated using the maximum concentrations in an exposure medium the NMED target values, then further risk characterization was performed. In accordance with NMED Guidance (2017), EPCs were calculated in these cases. The total cancer risk and the total HI were then recalculated using the EPCs in place of the maximum concentration as described in Step 2 above.

   Statistic-based EPCs were derived to quantify concentrations of COPCs in media. For the HHRA, the EPC represents the COPC concentration in a media that a potential receptor is expected to contact over a designated exposure period (NMED, 2017). COPCs concentrations, as discussed in Section 3.3, were used to calculate the 95th percentile upper confidence limit of the mean (95UCL) when the total cancer risk and HI for an exposure medium exceeded the NMED target levels.

   In accordance with NMED Guidance (2017) EPCs were only calculated if the dataset for a COPC contained at least eight results with at least five detections. If a dataset contained nondetects, each nondetect was assigned a numerical value equal to its reporting limit. If an analyte was not detected in any samples, then it was not carried forward in the risk calculations. 95UCLs were calculated using the EPA's ProUCL 5.1 software. ProUCL performs distributional tests on the dataset for each COPC and calculates the most appropriate UCL based on the distribution of the dataset. The ProUCL program recommends a distribution and a value for the 95UCL, or the 99UCL as appropriate. The input and output data files for ProUCL calculations for each site are provided as Attachment 2.

5.1.1 Soil

Complete or potentially complete soil exposure pathways were identified in Section 4 for current/future on-Site industrial workers, future construction workers, and future hypothetical on-Site residents. No complete or potentially complete exposure pathways were identified for off-Base receptors for soil, as no contaminated soil exists off-Base at 0 to 10 feet bgs.

5.1.1.1 On-Site Soil Risks

As discussed in Section 3, both surface (0 to 1 foot bgs) and mixed zone soil (0 to 10 feet bgs) datasets were evaluated in this RA. The maximum detected concentrations of COPCs in surface soil and subsurface soil did not exceed NMED commercial/industrial, construction worker, or residential SSLs. Benzene and ethylbenzene were the only carcinogenic COPCs detected in soil samples collected from 0 to 10 feet bgs.

The maximum detected concentration of lead in soil at 0 to 10 feet bgs was 71 milligrams per kilogram (mg/kg), which is below the NMED SSL of 400 mg/kg.

Current/Future Commercial/Industrial Worker - Surface Soil (0 to 1 foot bgs): The total cancer risk and HI was calculated using the maximum concentrations for each COPC as shown in Tables 5-1 and 5-2, respectively. The total cancer risk was 2 x 10^{-10}, which is below NMED's target cancer risk level of 1 x 10^{-5} (Table 5-1). The total non-carcinogenic HI was 4 x 10^{-5}, which is below NMED's target HI of 1 (Table 5-2). The risk estimates indicate there is no unacceptable risk to current/future commercial/industrial workers at the BFF based on exposure to surface soil. No further risk evaluation was performed.

Future Hypothetical On-Site Resident – Mixed Zone Soil (0 to 10 feet bgs): Currently no residential homes exist at the BFF, and there are no plans to change land use from industrial to residential. However, should land use change in the future, a residential scenario was considered to inform the risk management process (Section 4). The total cancer risk and HI was calculated using the maximum concentrations for each COPC as shown in Tables 5-3 and Table 5-4, respectively. The total cancer risk was 8 x 10^{-8}, which is below NMED's target cancer risk level of 1 x 10^{-5} (Table 5-3). The total non-carcinogenic HI was 0.2, which is below NMED's target HI of 1 (Table 5-4). The risk estimates indicate there is no unacceptable risk to future hypothetical on-Site residents at the BFF based on exposure to mixed zone soil at 0 to 10 feet bgs. No further risk evaluation was performed.

Future Construction Worker – Mixed Zone Soil (0 to 10 feet bgs): Current LUCs prevent intrusive work at the BFF without prior review and approval. The future construction worker scenario evaluates the case where the existing LUCs are removed. The total cancer risk and HI was calculated using the maximum concentrations for each COPC as shown in Tables 5-5 and Table 5-6, respectively. The total cancer risk was 3 x 10^{-9}, which is below NMED's target cancer risk level of 1 x 10^{-5} (Table 5-5). The total non-carcinogenic HI was 0.04, which is below NMED's target HI of 1 (Table 5-6). The risk estimates indicate there is no unacceptable risk to future construction workers at the BFF based on exposure to mixed zone soil at 0 to 10 feet bgs. No further risk evaluation was performed.

5.1.1.2 Off-Base Soil Risk

No contaminated soil is present off-Base at depths of 0 to 10 feet bgs. Contaminated soil is confimed to the on-Site portion of the BFF. There are no complete exposure pathways for soil for any off-Base receptor.

5.1.2 Soil Gas

Complete and potentially complete soil gas exposure pathways via vapor intrusion to indoor air were identified in Section 4 for current/future on-Site commercial/industrial workers and future hypothetical on-Site residents - via vapor intrusion to indoor air.

No occupied buildings exist off-Base in the area of soil gas contamination, therefore there are currently no complete exposure pathways for soil gas. Although no residences are located in the area of soil gas contamination, in order to address potential changes in land use in the future, vapor intrusion to indoor air was considered a potentially complete pathway for a future hypothetical off-Base resident at Bullhead Park.

5.1.2.1 On-Site Soil Gas

Maximum detected concentrations in soil gas were compared to the NMED commercial/industrial or residential soil gas VISLs as appropriate. The cancer risk and noncancer HI were calculated using maximum detected concentrations and EPCs based on 95UCLs for the current/future commercial/industrial worker and the future hypothetical on-Site resident as described below.

Current/Future Commercial/Industrial Worker: The total cancer risk was calculated using the maximum detected concentrations for each COPC as shown in Table 5-7. The calculated total cancer risk was 6 x 10^{-5}, which exceeds NMED's target cancer risk level of 1 x 10^{-5}. Primary contributors to the total cancer risk were EDB and naphthalene, which had maximum detected concentrations that exceeded the commercial/industrial soil gas VISLs. Based on the exceedance of the NMED target cancer risk level, total cancer risk was further evaluated using EPCs based on the 95UCL. As shown in Table 5-8, the calculated total cancer risk based on the EPCs is 4 x 10^{-6}, which is below NMED's target cancer risk level of 1 x 10^{-5}.

The EPC represents the COPC concentration in a media that a potential receptor is expected to contact over a designated exposure period (NMED, 2017). To ensure that the calculated EPC was appropriately conservative,concentrations of EDB and naphthalene were evaluated in comparison to the commercial/industrial soil gas VISLs and occupied buildings. Figure 5-1 illustrates EDB concentrations in soil gas at 25 feet bgs in 2016. Only one detection from Q1 through Q3 2016 exceeded the EDB commercial/industrial soil gas VISL of 7.65 µg/m^3. This was a detection of 24 µg/m^3 at KAFB-106119-25 in Q2 2016. All other detected concentrations were below the SL. Figure 5-2 illustrates naphthalene concentrations in soil gas at 25 feet bgs in 2016. Similarly to EDB, only one detected concentration from Q1 through Q3 2016 exceeded the commercial/industrial soil gas VISL of 135 µg/m^3. This was a detection of 257 µg/m^3 at KAFB-106128-25 in Q2 2016. Neither of the detections exceeding screening criteria were located within 100 feet of occupied buildings. The soil gas results indicate that employing the EPCs is appropriately conservative to evaluate potential risk from on-Site soil gas.

As shown on Table 5-9, the calculated HI based on the maximum detected COPC concentrations was 0.2, which is below NMED's target HI of 1.

Based on the total cancer risk estimate and HI, there is no unacceptable risk for current/future on-Site commercial/industrial workers due to exposure to soil gas via vapor intrusion to indoor air.

Future Hypothetical On-Site Resident: The total cancer risk was calculated using the maximum detected concentrations for each COPC as shown in Table 5-10. The calculated total cancer risk was 3 x 10^{-4}, which exceeds NMED's target cancer risk of 1 x 10^{-5}. Primary contributors to the total cancer risk were EDB, benzene, and naphthalene, which had maximum detected concentrations that exceeded the residental soil gas VISLs. Based on the exceedance of the NMED target cancer risk level, total cancer risk was further evaluated using EPCs based on the 95UCL. As shown in Table 5-11, the calculated total cancer risk based on the EPC is 2 x 10^{-5}, which slightly exceeds NMED's target cancer risk level of 1 x 10^{-5}.

As shown in Table 5-12, the calculated HI based on the maxium detected COPC concentrations was 0.9, which is below NMED's target HI of 1.

No residents are located on-Site at the BFF and land use is not expected to change from industrial in the foreseeable future. Estimated cancer risks for a future hypothetical resident exceed the NMED cancer risk target level.

5.1.2.2 Off-Base Soil Gas

Currently no residences are located near the off-Base soil gas contamination, which mainly underlies Bullhead Park, the VA Medical Center parking lot, and the Air Force-owned open space. However, if future land use were to change, consideration of a residential scenario provides information for risk management decisions and unrestricted use considerations. Maximum detected concentrations of COPCs in off-Base soil gas were compared to residential soil gas VISLs. The maximum detected concentrations of COPCs in off-Base soil gas did not exceed residential soil gas VISLs.

Future Hypothetical Off-Base Resident (Bullhead Park): The total cancer risk and HI was calculated using the maximum concentrations for each COPC as shown in Tables 5-13 and 5-14, respectively. The calculated total cancer risk based on the maximum detected concentrations was 2×10^{-6}, which is below NMED's target cancer risk level of 1×10^{-5}. The calculated total HI from the maximum COPC concentrations was 0.04, which is below NMED's target HI of 1.

Therefore, there is no unacceptable risk to a future hypothetical off-Base resident at Bullhead Park from the vapor intrusion pathway (soil gas to indoor air). Consideration of a residential scenario is conservative and protective of current receptors located farther from the areas of contamination, such as residents north of Ridgecrest, and visitors and workers at the VA Complex. Under the residential scenario, exposure is assumed to be 24 hours per day at the site, 350 days per year, for 26 years.

5.1.3 Groundwater

As discussed in Section 4, there are no current complete exposure pathways for contaminated groundwater. The Kirtland AFB water supply wells, Water Authority wells, VA Complex well,and private irrigation wells are located in areas outside the affected portion of the aquifer. LUCs are in place to prevent installation of new wells within the affected portion of the aquifer. However, in order to inform risk management decisions, a future on-Site and off-Base residential scenario was evaluated which assumes a drinking water well was installed in the affected portion of the aquifer.

Maximum detected concentrations in groundwater were compared to the NMED TSLs for residential use. The cancer risk and noncancer HI were calculated using maximum detected concentrations and EPCs based on 95UCLs for the future hypothetical on-Site and off-Base residents as described below.

The maximum detected concentration of lead in groundwater was 5.3 micrograms per Liter (µg/L), which is below the EPA non-carcinogenic residential RSL of 15 µg/L.

5.1.3.1 On-Site Groundwater

The total cancer risk was calculated using the maximum detected concentrations in on-Site groundwater for each carcinogenic COPC as shown in Table 5-15. The calculated total cancer risk was 5×10^{-2}, which exceeds NMED's target cancer risk level of 1×10^{-5}. Based on the exceedance of the NMED target cancer risk level, total cancer risk was further evaluated using EPCs based on the 95UCL. As shown in Table 5-16, the calculated total cancer risk based on the EPC is 5×10^{-3}, which exceeds NMED's target cancer risk level of 1×10^{-5}. Primary contributors to the cancer risk were EDB, benzene, ethylbenzene, and naphthalene.

The total HI was calculated using the maximum detected concentrations for each non-carcinogenic COPC as shown on Table 5-17. The calculated total HI was 600, which exceeds NMED's target HI of 1. Based on the exceedance of the NMED target HI, the total HI was further evaluated using EPCs based on the 95UCL. As shown in Table 5-18, the calculated total cancer risk based on the EPC is 60, which exceeds NMED's target HI of 1. The primary contributors to the HI were benzene, naphthalene, toluene, and xylenes, which each had HQs exceeding 1.

Based on the calculated total cancer risk and HI, exposure to on-Site groundwater for domestic purposes under the hypothetical future residential scenario results in an unacceptable risk.

5.1.3.2 Off-Base Groundwater

The total cancer risk was calculated using the maximum detected concentrations in off-Base groundwater for each carcinogenic COPC as shown in Table 5-19. The calculated total cancer risk was 8 x 10^{-3}, which exceeds NMED's target cancer risk level of 1 x 10^{-5}. Based on the exceedance of the NMED target cancer risk level, total cancer risk was futher evaluated using EPCs based on the 95UCL. As shown in Table 5-20, the calculated total cancer risk based on the EPC is $1x10^{-4}$, which exceeds NMED's target cancer risk level. Primary contributors to the cancer risk were EDB and ethylbenzene.

The total HI was calculated using the maximum detected concentrations for each non-carcinogenic COPCs as shown on Table 5-21. The calculated total HI was 80, which exceeds NMED's target HI of 1. Primary contributors to the total HI were benzene, naphthalene, toluene, xylenes, and 1,2,4-TMB. Based on the exceedance of the NMED target HI of 1, the total HI was further evaluated using EPCs based on the 95UCL. As shown in Table 5-22 the calculated total HI based on the EPC is 0.8, which is less than the NMED target HI of 1.

Based on the calculated total cancer risk, exposure to off-Base groundwater for domestic purposes under the hypothetical future residential scenario results in an unacceptable risk.

5.2 Uncertainty Analysis

The human health risk-screening assessments are subject to varying degrees and types of uncertainty.

Aspects of data evaluation and COPC identification, exposure assessment, toxicity assessment, and the additive approach for risk characterization contribute to uncertainties in the RA process. Each or all of these uncertainties may affect the evaluation results. Specific uncertainties related to this RA are discussed in the following sections.

5.2.1 Uncertainty Related to Analytical Data Quality

The analytical data quality was evaluated for uncertainties related to the quantitation limits and it was determined that the sensitivity of DLs for COPCs in all environmental media with a low or no detection frequency (majority of samples were nondetect) were less than the analyte-specific SLs, except for three analytes in groundwater (1-methylnaphthalene; 2-methylnaphthalene; and 1,2-DCA) and one analyte in soil gas (EDB). For the three groundwater analytes (as compared to the TSL) and for EDB in soil gas
(as compared to commercial/industrial soil gas VISL), the majority (over 80%) of the nondetect samples had DLs lower than the analyte-specific SLs. With respect to DLs for EDB in soil gas compared to the residential soil gas VISL of 1.56 µg/m^3, the DLs ranged from 1.23 to 10.76 µg/m^3).

However, all four of the analytes were identified as COPCs, and were included in the RA with risk estimated using maximum detected concentrations. There is a low potential for underestimation of risk for these analytes.

Other uncertainties in analytical data quality may include errors in sampling, laboratory analysis, and data analysis. However, using both maximum detected concentrations and statisticallybased EPCs is intended to provide upper-bound estimates of exposure and risks.

5.2.2 Uncertainty in Risks Related to Soil Gas Exposure

An uncertainty related to soil gas exposure was identified in the RA. NMED soil gas VISLs were developed to screen soil gas samples collected at shallow depths below a building slab. In this RA, the NMED soil gas VISLs were applied to soil gas data measured from SVMPs at 15 to 25 feet bgs. Even in cases where a COPC is detected above the soil gas VISL at a SVMP located at 15 to 25 feet bgs below a building slab, there is uncertainty whether the COPC will be detected from a shallow sub-slab sample. Fick's First Law of diffusion states that diffusive flux from a source at 25 feet bgs below a building slab will be 15 to 25 times lower than if the source were present at 1 foot from the slab. In principle, concentration gradients are affected by the presence of a slab (EPA, 2012). However, the accumulation of VOCs below a slab based on diffusion from a deep vapor source, as shown by EPA, is only possible if soil gas advection into the building is negligible. The application of soil gas VISLs to the soil gas data collected at 15 to 25 feet bgs most likely results in an overestimation of risks.

5.3 Human Health Risk Assessment Conclusions

The HHRA concludes there are no estimated unacceptable risks to current human receptors from contaminated soil, soil gas, or groundwater either on-Site or off-Base.

The HHRA identified potential unacceptable risks for exposure to on-Site soil gas under a future hypothetical residential scenario, and exposure to groundwater under a future domestic use scenario. However, there are no current complete exposure pathways for groundwater.

Interim measures are in place to prevent exposure to impacted groundwater. An additional LUC may be warranted as part of a final remedy to prevent residential use at the BFF until concentrations of COPCs in soil gas have a level that do not present an unacceptable risk.

5.3.1 Soil

Maximum detected concentations of COPCs in soil at 0 to 10 feet bgs were below NMED SSLs. The total cancer risk and HI based on maximum detected concentrations were below NMED target levels for all receptors. No impacted soil is located off-Base. No unacceptable risk was identified based on exposure to surface or mixed zone soil for any receptor on-Site at the BFF.

Recommendation: No additional interim measures are recommended for soils at 0 to 10 feet bgs.

5.3.2 Soil Gas

Twelve industrial/administrative buildings are located at the BFF or in close proximity; three of these buildings are continuously occupied. For the current/future on-Site commercial/industrial worker at the BFF, although the total cancer risk based on maximum detected concentrations in soil gas exceeded the

NMED target cancer risk level, the total cancer risk calculated using the EPCs was below 1 x 10^{-5}. The total HI based on the maximum detected concentration was below the NMED target HI of 1. No unacceptable risks were identified for the current/future on-Site commercial/industrial worker at the BFF based on exposure to soil gas via vapor intrusion to indoor air.

No residential buildings are located at the BFF and residential use is not planned for the foreable future. However, in order to evaluated an unrestricted use scenario, risk for a hypothetical future on-Site resident was evaluated. Total cancer risks exceeded NMED's target cancer risk level. The total HI based on the maximum detected soil gas concentration was below the NMED target HI of 1.

No occupied buildings are currently located within the area of the off-Base soil gas plume. However, should land use change in the future, a hypothetical future off-Base resident scenario at Bullhead Park was evaluated. Based on the maximum detected concentrations in soil gas, the total cancer risk and HI were below NMED target levels. No unacceptable risk was identified based on exposure to soil gas via vapor intrusion to indoor air. Consideration of a future hypothetical off-Base resident at Bullhead Park is conservative and protective for current/future recreational uses at Bullhead Park. This scenario is also protective for residents north of Ridgecrest and visitors to the VA Complex, which are located farther from the impacted off-Base soil gas area.

Recommendation: Current interim measures prevent residential use at the BFF. A LUC may be needed in a future final remedy to prevent residential reuse in the BFF until concentrations of COPCs in soil gas allow unrestricted use and unlimited exposure. No additional interim measures for off-Base soil gas are recommended.

5.3.3 Groundwater

The calculated total cancer risks and HI for domestic use of on-Site and off-Base groundwater exceed NMED's target cancer risk level of 1 x 10^{-5} and target HI of 1. However, interim measures are in place to prevent exposure to impacted groundwater on and off-Base. There are no current complete exposure pathways to impacted groundwater.

Recommendation: No additional interim measures are recommended to prevent exposure to impacted groundwater on-Site or off-Base.

6 ECOLOGICAL RISK ASSESSMENT

This ERA follows the NMED ERA process described in Section 2.1.2 (NMED, 2017). This process determines whether unacceptable adverse risks are present or might accrue to ecological receptors as a result of hazardous substances released at the Site.

6.1 Phase I Qualitative Assessment

The primary objective of the Phase I Qualitative Assessment is to assess whether enough information is available to determine the potential for unacceptable risks to ecological receptors as a result of hazardous substance releases. Characterizing the ecological communities in the vicinity of the Site (Sections 6.1.1 to 6.1.5), assessing the particular hazardous substances released and likelihood of potential unacceptable risk to identified ecological receptors (Section 6.1.6), identifying potential exposure pathways for ecological receptors (Section 6.1.7), and developing ecological assessment endpoints (Section 6.1.8) meet this objective.

6.1.1 General Site Characteristics

The Site is located in the Arizona/New Mexico Plateau Ecoregion (Omernik, 1986). Based on information contained in the Integrated Natural Resources Management Plan (INRMP) for Kirtland AFB (2007 and 2012 update), no designated or identified critical habitats exist at Kirtland AFB. Surveys and literature indicate important habitats on Kirtland AFB include wetlands that provide water to wildlife in an otherwise arid environment, and are rare in the region. None of these wetlands are near the Site. Other important habitats on Kirtland AFB include prairie dog towns, which provide nesting habitats for the burrowing owl, and open juniper woodlands between 5,900 and 6,600 feet in elevation, which are nesting habitat for the gray vireo. The Site lies between 5,314 and 5,364 feet in elevation. Nesting habitat for gray vireo is primarily on the far eastern side of Kirtland AFB in the foothills of the Manzano Mountains and does not currently exist on the Site. Prairie dog burrows and burrowing owls have been observed on-Site inside the BFF.

6.1.2 Surface Water, Sediment, and Wetlands

No surface water, sediment, or wetlands are located at the Site. Groundwater at the Site is approximately 480 feet bgs, and would not be expressed as surface water.

6.1.3 Vegetative Communities

Vegetation of the Arizona/New Mexico Plateau Ecoregion includes grama/galleta steppe, Great Basin sagebrush, and saltbush/greasewood plants (Omernik, 1986). Before the acquisition of land for what is now Kirtland AFB, the area was rangeland used for livestock grazing and typical ranching as well as mining operations. These operations ceased, for the most part, when Kirtland AFB occupied the land in the mid-1940s. Since then, some of the vegetation has been cleared for operational developments, while the eastern half of the Base has remained primarily undisturbed.

Vegetation on-Site is sparse as shown in on-Site photographs presented in Section 2 of the RFI and in Figure 6-1 (USACE, 2017a). This is primarily due to the generally disturbed nature of the on-Site area, which is largely an industrial area that is kept clear for vehicles and equipment, and characterized by poor soils and low precipitation. From January 2010 to December 2016, the average yearly precipitation ranged from 4.7 to 11.5 inches, with an average of 7.86 inches (National Oceanic and Atmospheric

Administration [NOAA], 2017). Snowfall is not uncommon in winter months, but seldom exceeds 3 inches. The summer monsoon season from July through September accounts for one-half of the annual rainfall.

The following four plant communities on Kirtland AFB constitute the major types of vegetation:

- Grassland (includes sagebrush steppe and juniper woodlands)
- Pinyon-Juniper Woodlands
- Ponderosa Pine Woodlands
- Riparian/Wetland/Arroyo.

The BFF area is industrial, and has been disturbed during construction activities, such as the updates to the fueling infrastructure. However, based on the recorded soil types at the Site (Latene sandy loam and Wink fine sandy loam; USDA, 2013), native vegetation would typically include mesa dropseed, blue grama, broom snakeweed, and sands dropseed (Kirtland AFB, 2007 and 2012 update). These two soil types have poor to very poor potential for supporting habitat elements including grain and seed crops, domestic grasses and legumes, wild herbaceous plants, shrubs, and wetland plants (USDA, 1977). As the on-Site area is primarily industrial, vegetation consists mostly of open sandy and gravel areas with sparsely distributed grasses. The habitat surrounding the on-Site area is also sparsely vegetated with shrub/scrub, grasses, and small trees, which is typical of the Albuquerque, New Mexico area. The very low productivity of the soil is also supported by the finding that the average organic carbon in surface soil is 0.49 mg/kg (based on detected results in soil samples collected on-Site ST105 SB0524 [7]; ST105-SB0525 [7]; and ST105-SB0524 [2]).

6.1.4 Wildlife

The INRMP (Kirtland AFB, 2012) lists 55 species of mammals, 141 species of birds, 34 species of reptiles and amphibians, and three species of fish that may occur on the 52,287-acre Base. Based on the industrial nature and sparse vegetative communities on-Site (Section 6.1.3), few of these bird, mammal, and reptile species would be expected to occur on-Site. However, rabbits, coyotes, and birds, as well as evidence of prairie dogs, have been observed on-Site. No amphibians or fish would be present due to the lack of surface water at on-Site.

6.1.5 Threatened, Rare, and Endangered Species

Threatened, rare, or endangered species in the general area of Kirtland AFB include the following:

- Gray vireo — state-threatened species
- Western burrowing owl — federal species of concern
- Loggerhead shrike — federal species of concern
- Mountain plover — federal species of concern
- Texas-horned lizard — federal species of concern.

Except for the Western burrowing owl, none of these species are expected on-Site. Gray vireo territories have been documented on-Site throughout the juniper woodland community between 5,850 and 6,600 feet elevation on the far eastern side of Kirtland AFB. These species occupy areas with an open canopy (i.e., less than 25%). The Loggerhead shrike has been observed on Base in grassland, pinyon-juniper woodlands, and riparian habitats. Mountain plovers are not known to occur on-Site; however, limited sightings have been documented just south of the Base on the Isleta Pueblo Indian Reservation. Appropriate nesting habitat for the Mountain plover is limited on-Site; however, the southern grasslands on-Site may potentially be used as brood-rearing habitat or during migration. The Texas-horned lizard has not been documented on-Site.

The Western burrowing owl, a federal species of concern, is a common resident at Kirtland AFB and has been monitored on-Site for more than 10 years. The Kirtland AFB INRMP (KAFB, 2012) includes a Burrowing Owl Management Plan (Appendix O). Figure 6-2 illustrates locations of Western burrowing owl nests documented in 2015. Western burrowing owls are very closely associated with the prairie dog colonies on-Site, as they use abandoned prairie dog burrows for nesting. As of 2015 there are no active nests in the vicinity of the BFF; however, prairie dog burrows are present in the BFF, and a burrowing owl was documented at a burrow in the BFF in May of 2017. Thus, the Western burrowing owl is evaluated as an ecological receptor in this RA.

In summary, there are multiple threatened, rare, or endangered species in the general area of Kirtland AFB; however, except for the Western burrowing owl, none of these species are expected on-Site.

6.1.6 Ecological Problem Formulation

The ecological problem formulation for the Site starts with the same list of analytes as the HHRA and compares those analytes to ecological screening values. This formulation process then identifies the exposure pathways, the ecological values (or receptors) to be protected, and the measures of effect used to quantify potential risk to ecological receptors at the Site.

The list of chemicals evaluated in the ERA are listed in Table 3-1 for soil and soil gas. Groundwater was not evaluated as part of the SLERA due to lack of exposure pathways to groundwater.

6.1.7 Conceptual Site Exposure Model

The CSEM identifies complete and potentially complete exposure pathways between physical media affected by Site-related contamination and potential ecological receptors. Identifying relevant exposure pathways is a critical element of the CSEM. Only exposure pathways that are complete or potentially complete are quantitatively evaluated in a Phase II Quantitative Assessment. If, under current and expected future land use scenarios, there are no potential exposure pathways for ecological receptors at the Site, there is no potential for risk, and the exposure pathway is not evaluated in Phase II. A CSEM for ecological receptors is presented in Figure 6-3.

The primary exposure medium on Base for ecological receptors is considered to be surface soil. Mixed zone soil (0 to 10 feet bgs) was considered an exposure medium for the burrowing owl and prairie dogs. NMED Guidance (NMED, 2017) states that, “For all non-burrowing ecological receptors and for shallow-rooted plants, the soil exposure intervals typical of surface conditions and is considered to be between 0 and 1 foot bgs). For all burrowing ecological receptors (and receptors that may use burrows) and deep rooted plants, the soil interval to be evaluated is 0 to 10 feet bgs.”

Plants and animals on-Site may be exposed to COPCs in surface soil through direct contact, incidental ingestion of soil, or ingestion of food items that have become contaminated through bioaccumulation. Burrowing animals (i.e., burrowing owls and prairie dogs) may be exposed to mixed zone soil (0 to 10 feet bgs) via these same exposure pathways. Direct contact exposure pathways are considered complete for plants, terrestrial invertebrates, and terrestrial vertebrates, while bioaccumulation exposure pathways are complete for terrestrial invertebrates and vertebrates.

COPCs released to surface soil or mixed zone soil could volatilize into air voids in the soil column such as animal burrows created by burrowing mammals and reptiles. Because several VOCs are listed as COPCs at the Site, inhalation of soil gas in soil burrows is considered a complete exposure pathway for burrowing animals on-Site.

Exposure pathways to surface water and sediment are incomplete for all ecological receptors because there are no permanent surface water features on the Site. In addition, ecological receptors at the Site are not exposed to Site groundwater because groundwater does not reach the surface via any seeps or wetlands. Therefore, groundwater exposure pathways are considered incomplete.

6.1.8 Assessment Endpoints

Assessment endpoints identify the particular ecological resources (e.g., plants and animals, habitats, etc.) to be protected at a site. At the Site, terrestrial fauna potentially includes invertebrates, reptiles, birds, small mammals (e.g., rodents), and larger carnivorous, omnivorous, and/or browsing mammals (e.g., mule deer). The assessment endpoints used for screening are:

1. Protection of terrestrial plant populations and communities
2. Protection of soil invertebrate populations and communities
3. Protection of populations of herbivorous birds
4. Protection of populations of omnivorous birds
5. Protection of populations of insectivorous birds
6. Protection of populations of carnivorous birds
7. Protection of populations of herbivorous mammals
8. Protection of populations of omnivorous mammals
9. Protection of populations of insectivorous mammals
10. Protection of populations of carnivorous mammals.

In addition, because exposure to volatile chemicals in soil burrows is potentially a complete exposure pathway, the following is an assessment endpoint based on the inhalation exposure pathway:

1. Protection of populations of burrowing mammals.

A lack of toxicity data for Site COPCs precludes adequate quantitative evaluation of risks to reptiles at the Site; therefore, they were not included as ecological receptors for the Phase II Quantitative Assessment. The uncertainties associated with eliminating ecological receptors from quantitative evaluation because of a lack of toxicity (or other) data is considered in the uncertainty discussion in Section 6.4.

6.2 Phase II, Tier 1 Quantitative Assessment

Based on this Phase I Qualitative Assessment, it was determined that a Phase II Quantitative Assessment was warranted because ecological receptors are potentially present at the Site, and Site-related chemicals have been documented in soil and soil gas.

NMED's Phase II Quantitative Assessment starts with a Tier 1 SLERA. The Tier 1 SLERA uses conservative SLs based on concentrations demonstrated to cause no adverse effects in ecological receptors and conservative exposure assumptions based on maximum detected concentrations. The Tier 1 utilizes the initial ecological problem formulation and ecological CSEM, and identifies COPCs for further evaluation in the Tier 2 Quantitative Assessment.

6.2.1 Assessment Endpoints and Measures of Effect

Potential adverse effects to assessment endpoints listed in Section 6.1.8 are inferred from one or more measurement endpoints. The measurement endpoint is a measurable response to a stressor, in this case chemical concentration in soil, that is related to the valued attribute of the chosen assessment endpoint, in this case protection of populations of plants, invertebrates, mammals, and birds. The measurement endpoint serves as a surrogate that can be used to draw a predictive conclusion about the potential for effects of the COPC to the assessment endpoint. For the Tier 1 SLERA, the measurement endpoint for all identified assessment endpoints is comparison of chemical concentrations in soil and soil gas to conservative toxicological benchmarks based on no-observed-adverse-effect levels (NOAEL).

NOAEL toxicity values were obtained from literature sources as indicated below. SLs were obtained for as many of the assessment endpoint ecological receptor categories as possible, and the screening comparisons were conducted using the most sensitive ecological receptor category, i.e., the ecological receptor category with the lowest SL.

For inorganic constituents in soil, ecological screening levels (ESL) derived by NMED (NMED, 2017) were used preferentially over other sources of information for organics. If no SLs were available from NMED, other sources of SLs such as the Los Alamos National Laboratory (LANL; LANL, 2014) ESLs and the National Oceanic and Atmospheric Administration Screening Quick Reference Tables (Buchman, 2008) were used to identify appropriate SLs.

Screening values of soil gas concentrations of COPCs were obtained from the LANL EcoRisk Database V 3.3 (LANL, 2014). If no soil gas SL was available for a constituent in the LANL database, soil gas SLs were obtained from MWH Americas, Inc. (2011).

6.2.2 Exposure Estimation

The Tier 1 SLERA exposure estimation utilizes conservative assumptions, including use of maximum detected values and assumption of 100% bioavailability of COPCs.

The initial screening of COPCs in soil and soil gas was conducted using the maximum measured concentration in the media of interest. For surface soil, the maximum concentration in soil samples collected from 0 to 1 foot bgs were used as the screening EPC for all assessment endpoints. For mixed zone soil, the maximum concentration in soil samples collected from 0 to 10 feet bgs were used as the screening EPC for all assessment endpoints. For soil gas, the maximum measured concentration in the shallowest depth interval (15 to 25 feet bgs) of all on-Site soil gas samples from sampling conducted between Q1 2016 and Q3 2016 were used as the EPC for burrowing mammals. Use of the measured soil gas concentration at 15 to 25 feet bgs is a conservative exposure estimate, because burrowing mammals do not burrow that deeply (typically less than 3 feet bgs), and soil gas concentrations would be lower at 3 feet bgs then 15 to 25 feet bgs.

6.2.3 Ecological Risk Characterization

The Tier 1 SLERA ecological risk characterization compares conservative measures of effect with exposure estimates based on maximum detected concentrations.

6.2.3.1 Surface Soil

Eight of the 12 COPCs analyzed in the surface soil were detected in surface soil (0 to 1 foot bgs). Results of the initial screening of surface soil concentrations are presented in Table 6-1. Maximum detected concentrations of lead exceeded SLs, and therefore the analyte is retained for further evaluation in the Phase II, Tier 2 Quantitative Assessment for surface soil in the suface soil on-Site. In addition to calculating HQs for individual chemical constituents, NMED Guidance requires that the ecological screening assessment calculate a HI for each of the screening ecological receptors evaluated (NMED, 2017). The HI represents the sum of the HQ values across chemical constituents for each ecological receptor, and is intended to account for additive toxicological effects that might be missed if looking solely at individual HQs. The HI calculations for surface soil on-Site are presented in Table 6-2. Three of the 10 ecological receptors had total HIs greater than 1. Table 6-2 shows how each COPC contributes to the total HI for each ecological receptor. Lead was the only COPC that contributed significantly to HI values greater than one.

6.2.3.2 Mixed Zone Soil from Confirmation Samples

Ten of the 13 COPCs analyzed in the mixed zone soil were detected in mixed zone soil (0 to 10 feet bgs). Results of the initial screening of mixed zone soil concentrations on-Site are presented in Table 6-3. Complete exposure pathways exist for mixed zone soil to two ecological receptors evaluated in Table 6-3, prairie dogs and burrowing owls. Maximum detected concentrations of lead in confirmation samples exceeded SLs, and therefore the analyte is retained for further evaluation in the Phase II, Tier 2 Quantitative Assessment for mixed zone soil in the confirmation samples. The HI represents the sum of the HQ values across COPCs for each ecological receptor, and is intended to account for additive toxicological effects that might be missed if looking solely at individual HQs. The HI calculations for mixed zone soil on-Site are presented in Table 6-4. Both ecological receptors had total HIs greater than 1. Table 6-4 shows how each COPC contributes to the total HI for each ecological receptor. Lead was the only constituent that contributed significantly to HI values greater than 1.

6.2.3.3 Soil Gas

Twelve of the 14 potential soil gas COPCs were detected in the shallowest soil gas sampling interval of 15 to 25 feet bgs. Soil gas ESLs were available for eight of the 12 detected constituents. HQs for all eight of these constituents were less than 0.3, indicating no potential unacceptable ecological risk from soil gas concentrations for these COPCs in mammal burrows. Soil gas SLs were not available for 1,2-dibromoethane, cyclohexane, n-heptane, or n-hexane, therefore a quantitative evaluation of risk from these COPCs is not possible. Results of the soil gas are screening are presented in Table 6-5. Potential risk from COPCs without soil gas SLs is discussed further in the uncertainty analysis in Section 6.4.

6.3 Phase II, Tier 2 Quantitative Assessment

A Tier 2 SLERA includes a re-evaluation of the conservative assumptions used in the Tier 1 SLERA. Results of the Tier 2 SLERA indicate that although some detections of lead exceeded the most conservative SLs for a limited number of ecological receptors, no unacceptable risk is posed by any fuel-related constituents at the Site.

For the on-Site surface soil dataset, only lead was carried forward to the Tier 2 assessment. The maximum lead concentration (39.1 mg/kg) exceeded SLs for insectivorous birds, omnivorous birds, and herbivorous birds. Insectivorous, omnivorous, and herbivorous birds forage over defined ranges, and are not exposed to single point concentrations in the way that sessile organisms such as plants are exposed, thus use of an estimator of central tendency exposure is relevant for calculating risk to mammals and birds. Table 6-6 presents summary statistics for lead at the 0 to 1 foot bgs depth. Lead background concentrations at Kirtland AFB are 21.4 mg/kg in surface soil, and 11.8 mg/kg in subsurface soil (NMED, 2007). The lead surface soil background concentration also exceeds the SLs for insectivorous, omnivorous, and herbivorous birds. Mean and median lead concentrations of the on-Site surface soil dataset are 11 mg/kg and 8 mg/kg respectively and the dection frequency is 100%. The mean, median, and detection frequency of lead concentrations support that on-Site surface soils are within the range of background conditions at Kirtland AFB. Thus, potential risk to ecological receptors from lead cannot be differentiated from background conditions.

For mixed zone soil (0 to 10 feet bgs) only lead, based on detections in confirmation samples, was carried forward to the Tier 2 assessment for burrowing owls. The maximum lead concentration in confirmation samples (71 mg/kg) exceed SLs for small omnivorous mammals and carnivorous birds. These receptors forage over defined ranges, and are not exposed to single point concentrations in the way that sessile organisms such as plants are exposed, thus similar to surface soil an estimator of central tendency exposure is relevant to calculating risk to mammals and birds. Table 6-6 present the summary statistics for lead in the confirmation samples from 0 to 10 feet bgs. Mean and median lead concentrations of the on-Site surface soil data are 9.6 mg/kg and 4.1 mg/kg respectively, which is below the SLs for omnivorous mammals and carnivorous birds and the dection frequency is 100%. The mean, median, and detection frequency of lead concentrations support that on-Site mixed zone soils are within the range of background conditions at Kirtland AFB. Thus, potential risk to ecological receptors from lead cannot be differentiated from background conditions in mixed zone soil from 0 to 10 feet bgs.

6.4 Uncertainty Discussion

One uncertainty, which indicates the soil gas evaluation may be overly conservative, is the depth of the soil gas sample intervals. It is important to note that soil gas samples were collected between 15 and 25 feet bgs. Screening soil gas concentrations at these depths is overly conservative when applied to the typical maximum burrowing owl burrow depth of 3 feet (Cornell Lab of Ornithology, 2017). All of the detected chemicals for which soil gas SLs were available had HQ values less than 0.3, suggesting chemical concentrations in the 15 to 25 feet bgs depth interval are relatively low compared to risk levels, and those concentrations are expected to be even lower in the shallower depth interval occupied by burrowing animals.

The ERA is designed to err on the side of conservatism by utilizing NOAEL-based toxicity information and conservative assumptions such as 100% Site use, 100% bioavailability of COPCs, and uptake of COPCs in the Tier 1 SLERA. A key area of uncertainty in the Site is the lack of toxicity information for a number of ecological receptors and chemicals. This is particularly evident in the lack of ecological soil gas SLs for four of the detected chemicals in subsurface soil gas samples. This makes a quantitative evaluation of risk from these chemicals impossible for these ecological receptors.

Another example of the lack of toxicity information is the lack of ESLs for birds for many of the chemicals evaluated in soil (e.g., most polyaromatic HC compounds). Without adequate avian toxicity information, one is left to infer that levels protective of mammals are also protective of birds, which may overestimate or underestimate actual risk to birds.

The lack of available toxicity information also precluded the quantitative evaluation of reptiles at the Site. Therefore, the SLERA presumes that concentrations that are adequately protective of birds and mammals are also adequately protective of reptiles, but the accuracy of that presumption is unknown. However, for the SLERA, this uncertainty is likely not significant in the overall conclusions because of the limited extent of exceedances and the marginal ecological habitat at the Site, which both serve to limit potential ecological exposures.

6.5 Conclusions and Recommendations

This ERA follows the NMED ERA process (NMED, 2017). This process determined there are no unacceptable adverse risks present to ecological receptors as a result of COPCs present at the Site.

Given the limited extent of concentrations exceeding no-effects SLs and the limited ecological exposure potential, no unacceptable ecological risk exists at the Site due to lead in surface or mixed zone soils in the on-Site area. Although maximum detected concentrations of lead exceeded no-effects based SLs, evaluation of other parameters such as mean, median concentrations, and frequency of detects within the on-Site soil datasets suggest exceedances are limited in extent. In addition, the maintenance of the BFF for Site operations limits the amount and quality of ecological habitat present, and ecological exposures are expected to be minimal for this reason.

This ERA concludes that there is no unacceptable ecological risk present when burrowing owls are considered as possible ecological receptors. Concentrations in soil from 0 to 10 feet bgs are below the SLs or are at background concentrations and pose no unacceptable ecological risk. Concentrations of all on-Site soil gas VOCs in the 15 to 25 feet bgs interval were less than available ESLs. Though no SLs were available for four of the detected VOCs, maximum HQs for the eight VOCs with SLs were less than 0.3, indicating that concentrations are low compared to risk levels. In addition, screening soil gas concentrations at the 15 to 25 feet bgs depth interval is overly conservative when compared to the typical maximum burrow depth of the burrowing owl (3 feet bgs). Soil gas concentrations are expected to be even lower at typical burrow depths. Therefore, no further action is proposed for soil gas concentrations in on-Site soils for protection of ecological receptors.

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FIGURES

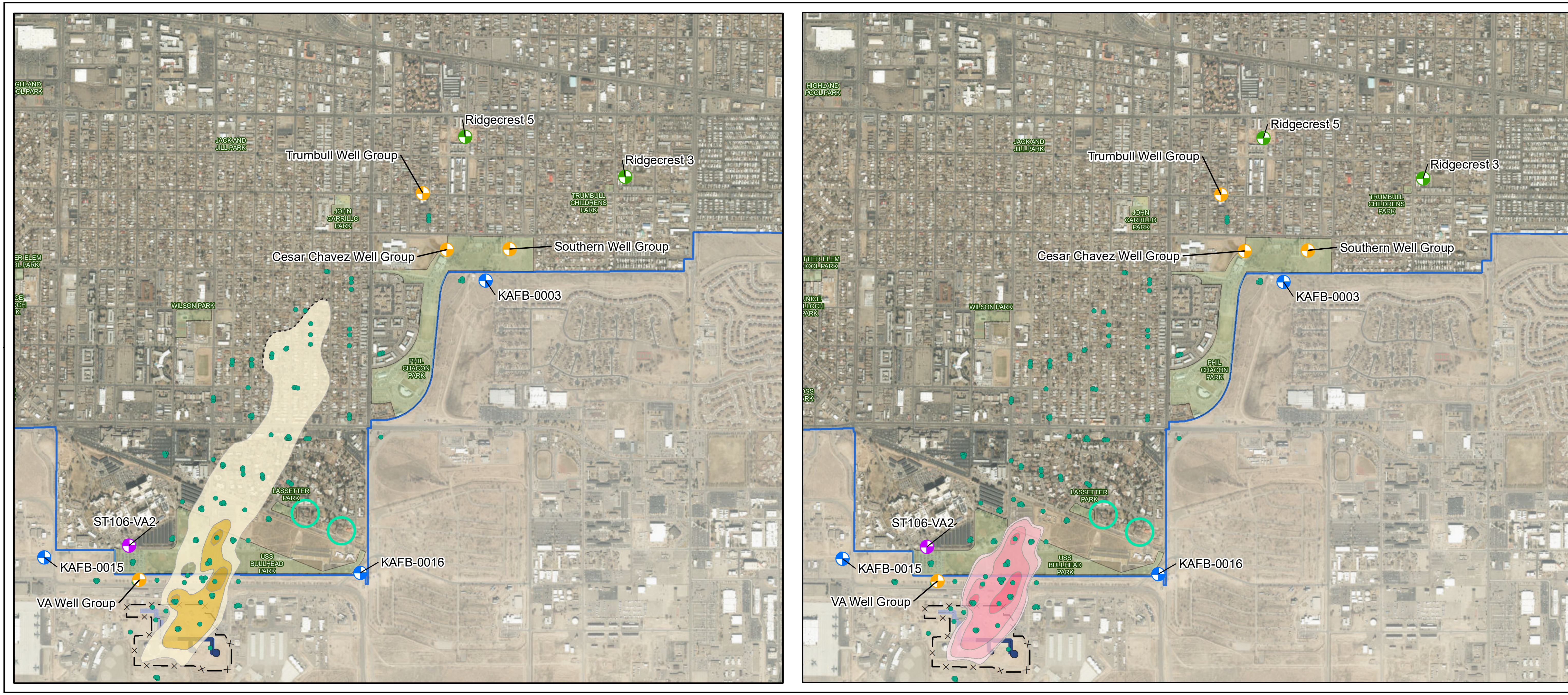


Figure 1-1

EDB and Benzene Plumes
Q4 2015

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Legend

- Inferred EDB Contour

EDB Concentrations (µg/L)
- 0.05
- 0.1
- 1
- 10
- 100

Benzene Concentration (µg/L)
- 0 - 5
- 5 - 10
- 10 - 100
- 100 - 1000
- 1000 - 10000

- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- City of Albuquerque Parks
- Former Buried Fuel Transfer Lines
- Former Aboveground Fuel Transfer Lines
- Former Aboveground Storage Tanks
- Water Authority Drinking Water Supply Well
- VA Drinking Water Supply Well
- KAFB Drinking Water Supply Well
- USGS Sentinel Wells
- Groundwater Monitoring Well Location
- Approximate Location of Private Irrigation Well

Acronyms:
EDB = Ethylene Dibromide
KAFB = Kirtland Air Force Base
µg/L = micrograms per liter
Q = Quarter
USGS = United States Geological Survey
VA = Veteran Affairs

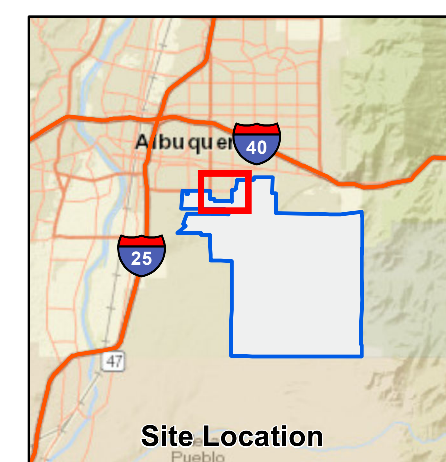
0 500 1,000 2,000 3,000 Feet

1 centimeter = 200 meters *1:20,000*

N

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

Credits: City of Albuquerque, KAFB, ESRI Base Map



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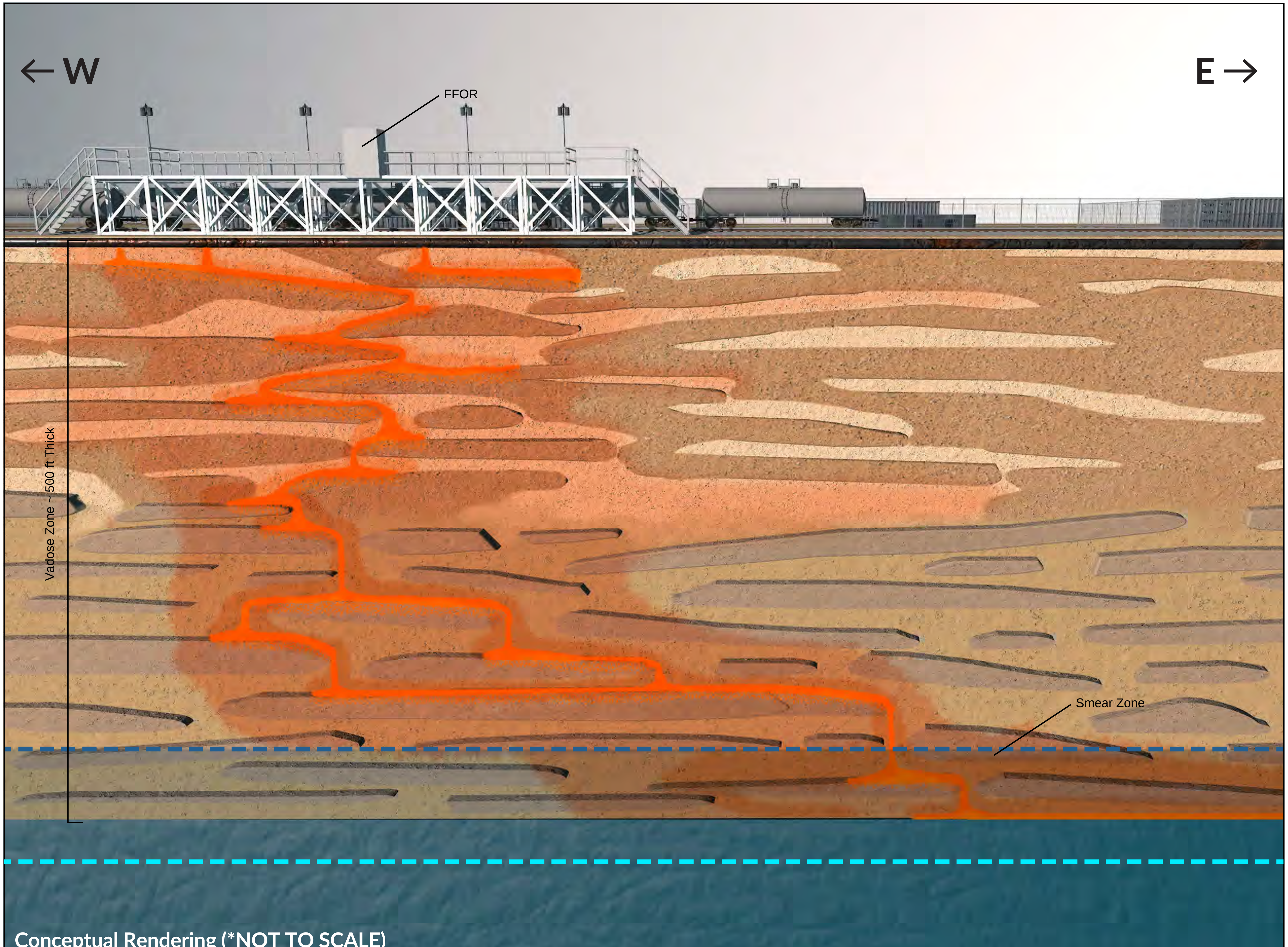
Last Revised: 7/20/2017



Legend

- LNAPL (conceptual transport pathway)
- Soil Vapor within Vadose Zone (conceptual transport mechanism or pathway)
- Alluvial Fan Sediments Lower Permeability
- Alluvial Fan Sediments Higher Permeability
- Ancestral Rio Grande Sediments Permeable
- Ancestral Rio Grande Sediments Less Permeable
- Circa 1970s Groundwater Table
- Circa 2009 Groundwater Table
- Current Groundwater Table

Acronyms:
FFOR = Former Fuel Offloading Rack
ft = feet
LNAPL = light non-aqueous phase liquid

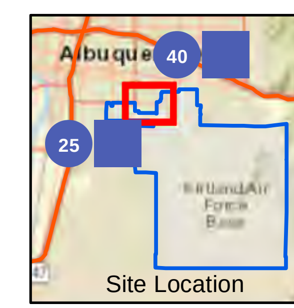


Figure 1-2

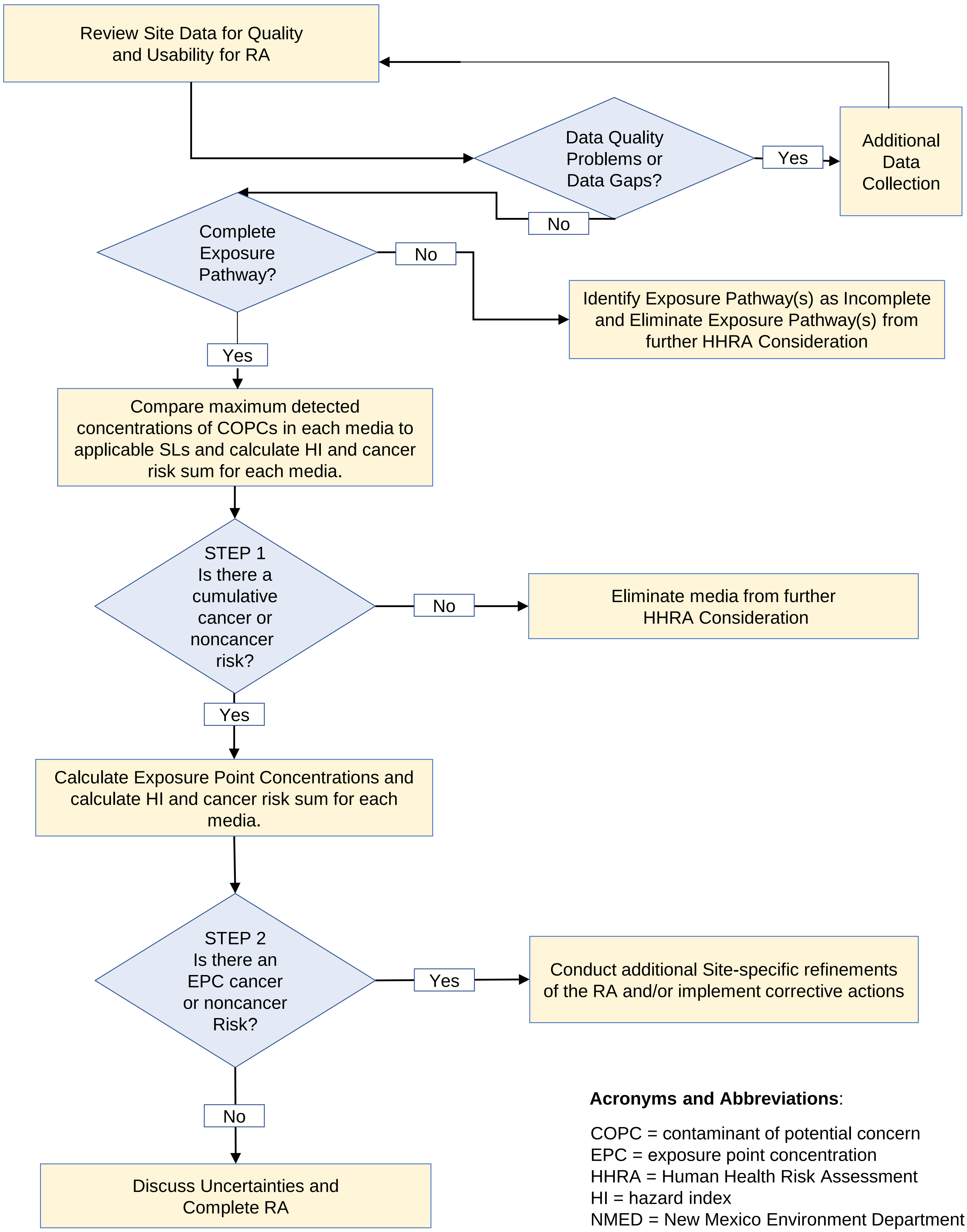
Vadose Zone Conceptual Site Model

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 10-04-2016

Figure 2-1. NMED Screening Level HHRA Process



Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPC = exposure point concentration
HHRA = Human Health Risk Assessment
HI = hazard index
NMED = New Mexico Environment Department
RA = Risk Assessment
SL = screening level

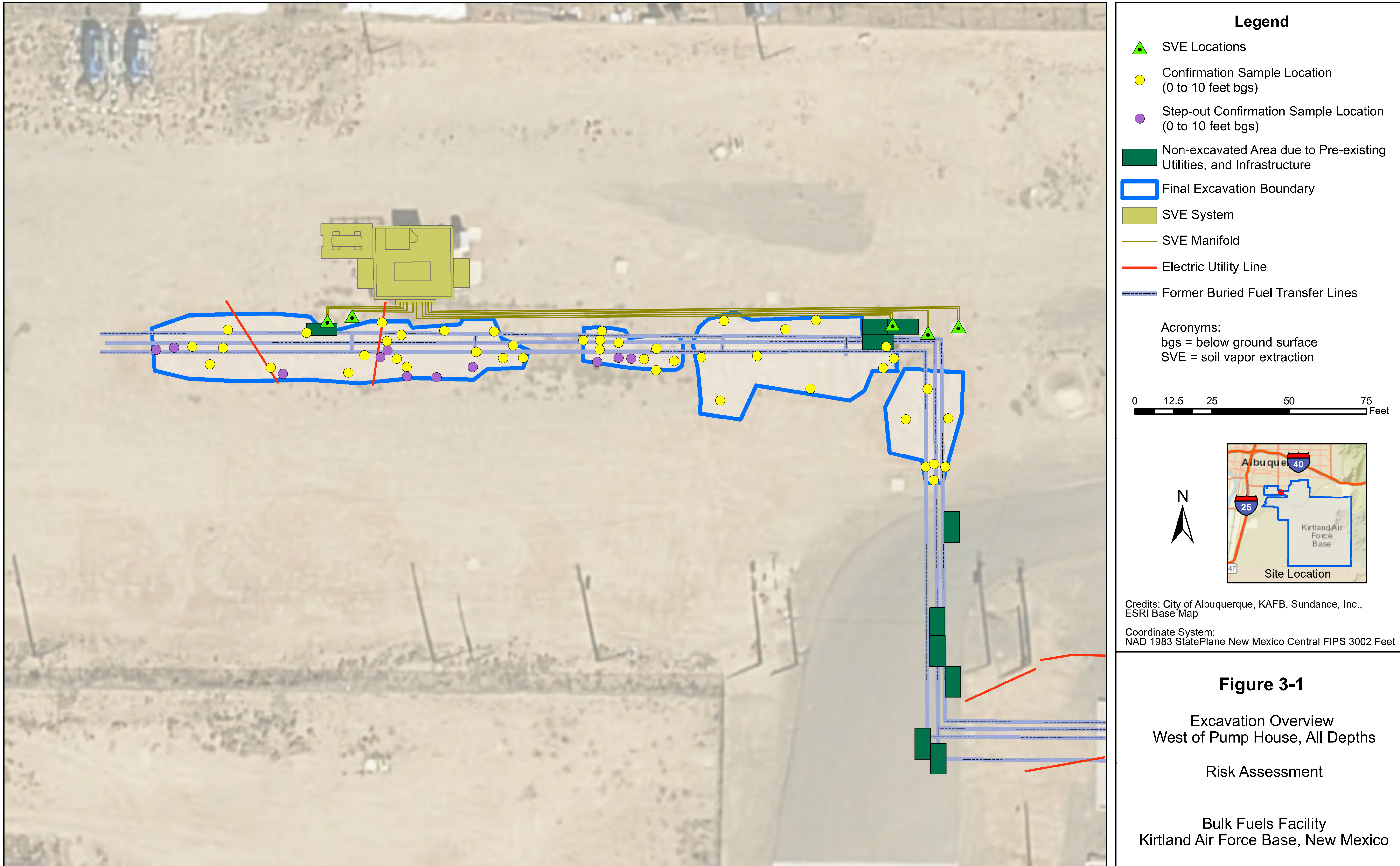


Figure 3-1

Excavation Overview
West of Pump House, All Depths

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

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Last Revised: 6/1/2017

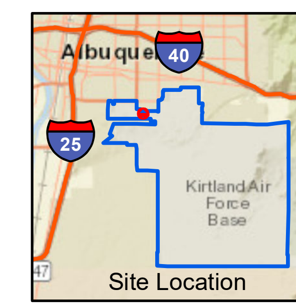
Legend

- Confirmation Sample Location (0 to 10 feet bgs)
- Step-out Confirmation Sample Location (0 to 10 feet bgs)
- Non-excavated Area due to Pre-existing Utilities, and Infrastructure
- Final Excavation Boundary
- Buildings
- Concrete or Asphalt
- Graded Gravel
- Electric Utility Line
- Former Buried Fuel Transfer Lines
- Former Aboveground Fuel Transfer Lines
- Former Aboveground Storage Tanks

Acronyms:
bgs = below ground surface

0 50 100 200 Feet

N



Credits: City of Albuquerque, KAFB, Sundance, Inc., ESRI Base Map

Coordinate System:
NAD 1983 StatePlane New Mexico Central FIPS 3002 Feet

Figure 3-2

Excavation Overview
South of Pump House, All Depths

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

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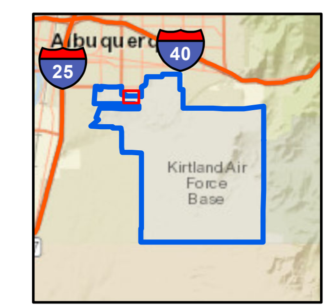
Last Revised: 6/1/2017

Legend

- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- Open Space Owned by Air Force and Air National Guard
- City of Albuquerque Parks
- Source Area
- Former Buried Fuel Transfer Lines
- Former Aboveground Fuel Transfer Lines
- Former Aboveground Storage Tanks
- Soil Vapor Monitoring Location

0 130 260 520 780 Feet

N



Credits: City of Albuquerque, ESRI Basemaps, KAFB, Sundance, Inc.

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

Figure 3-3

Soil Gas Monitoring Network

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

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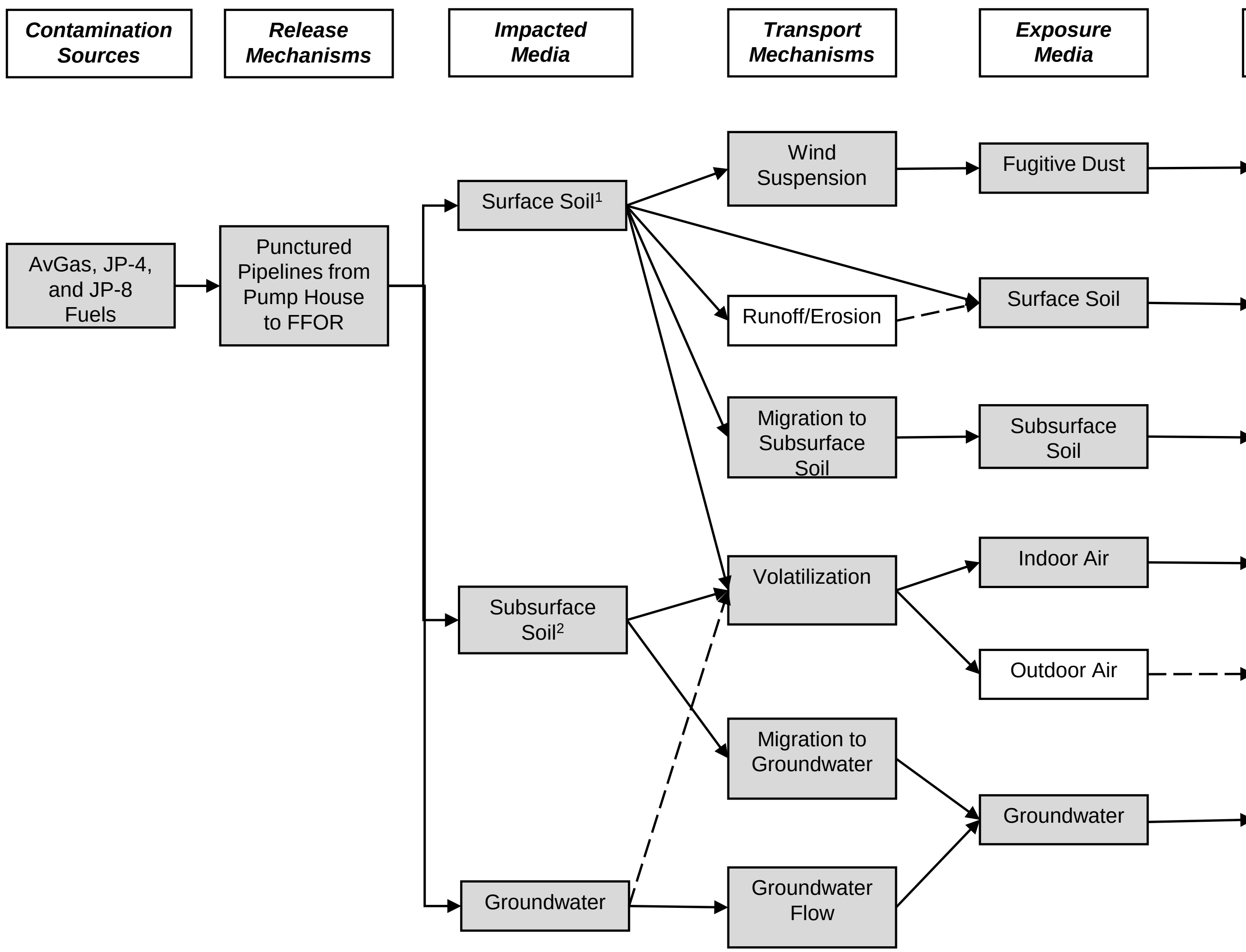
Last Revised: 7/13/2017

Figure 4-1. On-Site Conceptual Site Exposure Model



	HUMAN RECEPTORS						
	CURRENT			FUTURE			
Exposure Route	BFF Commercial/ Industrial Worker	BFF Construc-tion Worker	KAFB Water Consumer	BFF Commercial /Industrial Worker	BFF Construction Worker	BFF Residential Homeowner	KAFB Water Consumer
Ingestion	●	O(3)	O(5)	●	● (6)	●(7)	O(5)
Inhalation of Dust	●	O(3)	O(5)	●	● (6)	●(7)	O(5)
Dermal Contact	●	O(3)	O(5)	●	● (6)	●(7)	O(5)
Ingestion	●	O(3)	O(5)	●	● (6)	●(7)	O(5)
Dermal Contact	O(4)	O(3)	O(5)	O(4)	● (6)	●(7)	O(5)
Ingestion	O(4)	O(3)	O(5)	O(4)	● (6)	●(7)	O(5)
Inhalation of COPCs	●	O(3)	O(5)	●	O	●(7)	O(5)
Inhalation of COPCs	O(8)	O(8)	O(5)	O(8)	● (9)	O(8)	O(5)
Dermal Contact	O(10)	O(10)	O(3)	O(10)	O(10)	O(10)	●(11)
Ingestion	O(10)	O(10)	O(3)	O(10)	O(10)	O(10)	●(11)
Inhalation of COPCs from Tapwater	O(10)	O(10)	O(3)	O(10)	O(10)	O(10)	●(11)

Notes:

1. Surface soil is considered to be soil between 0 and 1 feet bgs.
2. Subsurface soil is considered to be soil between 1 and 10 feet bgs.
3. Institutional controls prevent exposure pathways from being complete. Kirtland AFB administrative controls prevent intrusive work without prior review and approval. Groundwater monitoring prevents exposure to contaminated groundwater.
4. Commercial/industrial receptors are defined as only encountering surface soil.
5. There is no pathway for Kirtland AFB water consumers to come in contact with contaminated soil or air at the BFF.
6. Although current institutional controls prevent exposure to construction workers from soil and soil gas, institutional controls could change in the future. Therefore, this pathway is evaluated as complete.
7. Exposure pathway is only complete if BFF land use were to change to residential in the future.
8. Inhalation of COPCs from ambient outdoor air is an incomplete exposure pathway for these receptors as discussed in Section 4.3.
9. This complete exposure pathway represents inhalation of COPCs by construction workers working in a trench. This pathway is complete but insignificant, and any concerns for construction worker will be captured in the evaluation of industrial exposure to indoor air.
10. There is no pathway for commercial/industrial or construction workers to come in contact with contaminated groundwater at the BFF.
11. NMED requires that groundwater pollution at any place of withdrawal for the present or reasonably foreseeable future use, where the TDS concentration is 10,000 mg/L or less, shall be abated to conform to the NMWQCC standards (NMWQCC, 2011). Because of this requirement, the exposure pathways to future Kirtland AFB water consumers are assessed as complete.

Key:

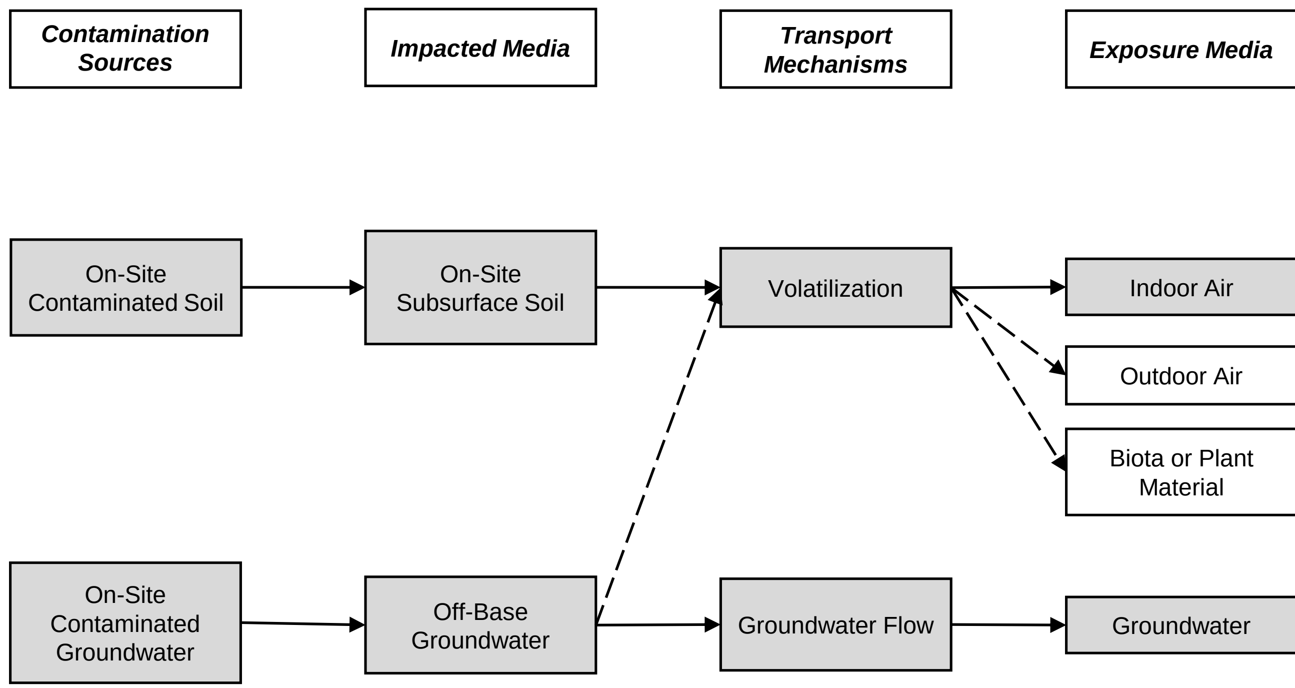
O — Incomplete Pathway ⟶ (dashed)

● — Complete Pathway ⟶ (solid)

Acronyms and Abbreviations:

AFB = Air Force Base
AvGas = aviation gasoline
BFF = Bulk Fuels Facility
bgs = below ground surface
COPC = contaminant of potential concern
FFOR = Former Fuel Offloading Rack
JP-4 = jet propellant 4
JP-8 = jet propellant 8
KAFB = Kirtland Air Force Base
mg/L = milligram per Liter
NMED = New Mexico Environment Department
NMWQCC = New Mexico Water Quality Control Commission
TDS = total dissolved solids

Figure 4-2. Off-Base Conceptual Site Exposure Model



Exposure Route	HUMAN RECEPTORS						
	CURRENT			FUTURE			
	Recreational Bullhead Park Users	Water Authority Drinking Water Supply Well Consumer	Private Well Owner	Recreational Bullhead Park Users	Residential Homeowners in Bullhead Park	Water Authority Drinking Water Supply Well Consumer	Private Well Owner
Inhalation	O (1)	O(2)	O(2)	O (1)	● (3)	O(2)	O(2)
Inhalation	O (4)	O(4)	O(4)	O(4)	O(4)	O(4)	O(4)
Ingestion	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)	O(5)
Direct Contact	O(1)	O(6)	O(6)	O(1)	O(7)	●(8)	●(8)
Ingestion	O(1)	O(6)	O(6)	O(1)	O(7)	●(8)	●(8)
Inhalation of COPCs from Tapwater	O(1)	O(6)	O(6)	O(1)	O(7)	●(8)	●(8)

Notes:
1. No pathway exists for current or future Bullhead Park users to be exposed to contaminated air or groundwater.
2. There is no exposure pathway from contaminated air off-Base to current or future drinking water supply well water consumers or private well owners.
3. Exposure pathway is only complete if Bullhead Park land use were to change to residential in the future.
4. Inhalation of COPCs from outdoor air is an incomplete exposure pathway for all receptors as discussed in Section 4.4.
5. Exposure to receptors while gardening due to uptake from plants or biota is incomplete. The amount of soil gas is insignificant at plant root depths. In addition, there is no contaminated soil, and plants will not uptake contaminated soil gas.
6. Institutional controls prevent exposure pathways from being complete. See Sections 4.2 and 4.4.
7. There is no exposure pathway from contaminated groundwater off-Base to current or future recreational Bullhead Park users.
8. NMED requires that groundwater pollution at any place of withdrawal for the present or reasonably foreseeable future use, where the TDS concentration is 10,000 mg/L or less, shall be abated to conform to the NMWQCC standards (NMWQCC, 2011). Because of this requirement, the exposure pathways to future water consumers are assessed as complete.

Key:

O	Incomplete Pathway
●	Complete Pathway

Acronyms and Abbreviations:
COPC = contaminant of potential concern
mg/L = milligram per Liter
NMED = New Mexico Environment Department
NMWQCC = New Mexico Water Quality Control Commission
TDS = total dissolved solids

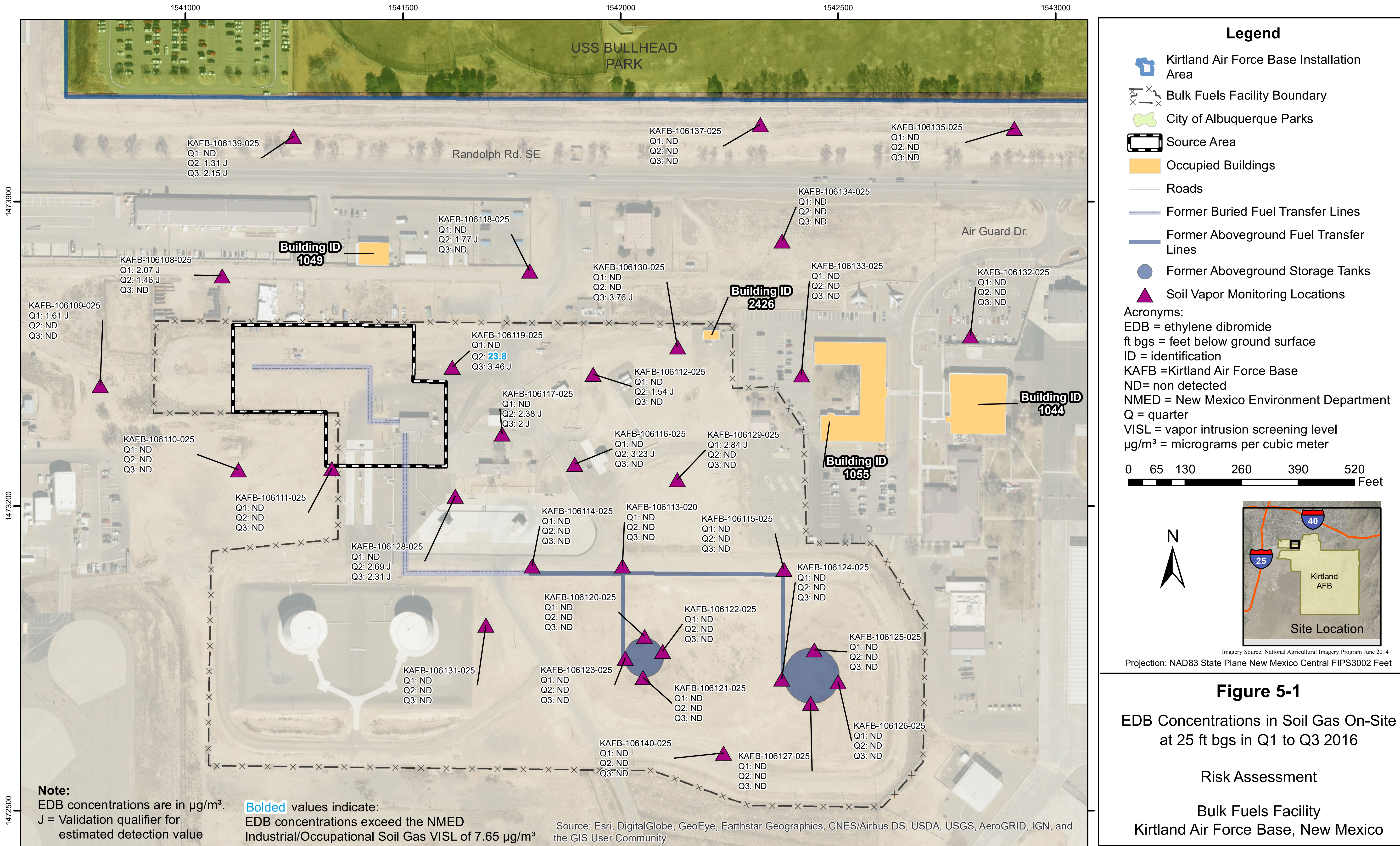


Figure 5-1

EDB Concentrations in Soil Gas On-Site at 25 ft bgs in Q1 to Q3 2016

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

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Revision Date: 7/20/2017

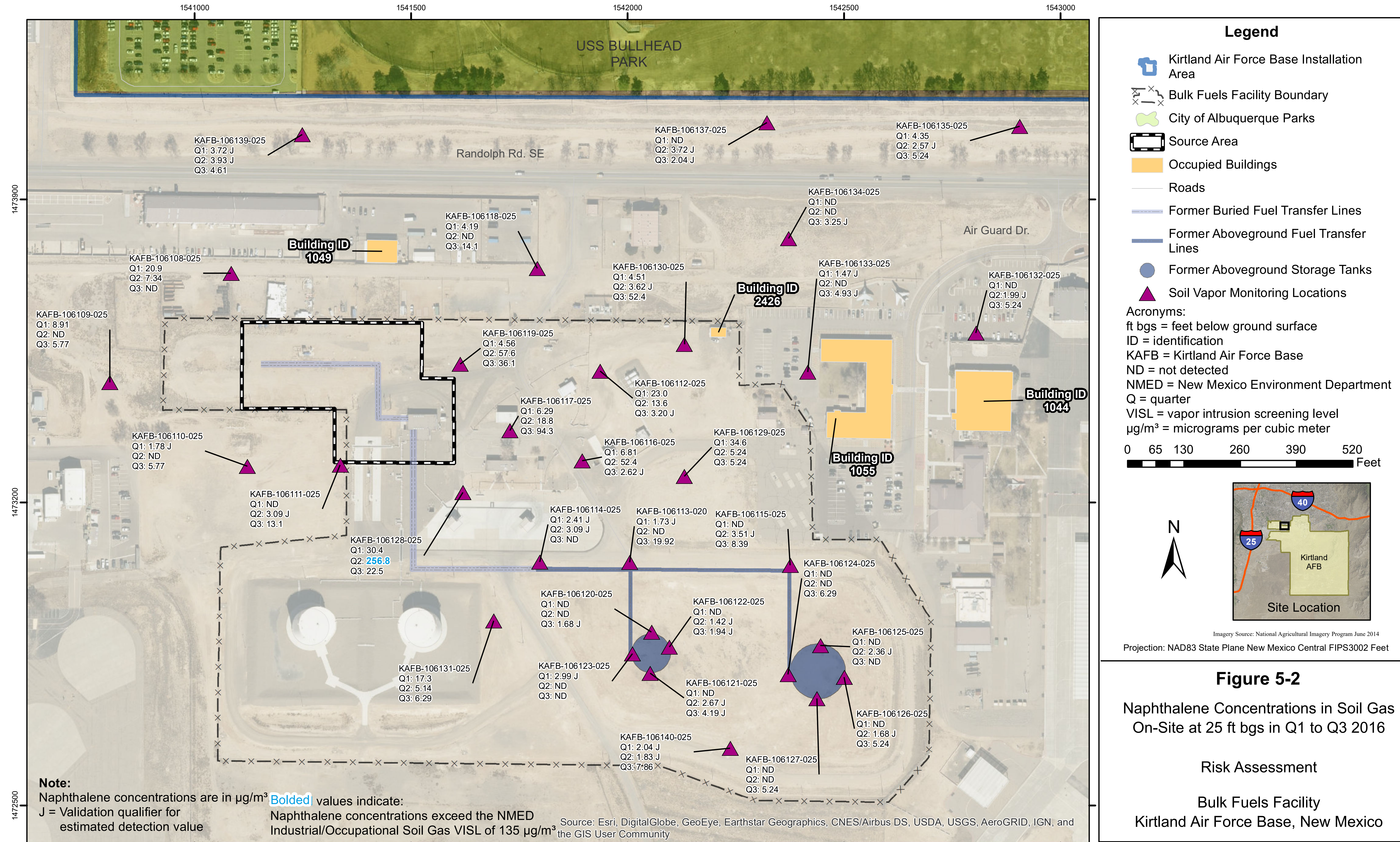

Figure 5-2

Naphthalene Concentrations in Soil Gas On-Site at 25 ft bgs in Q1 to Q3 2016

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Revision Date: 7/20/2017

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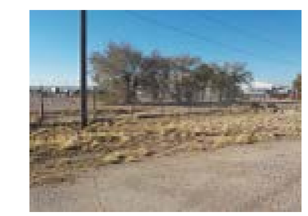
Legend

- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- Buildings
- Roads
- Existing Aboveground Fuel Transfer Lines
- Current Aboveground Tanks

Building 1032



Trees west of Bulk Fuels Facility

Prairie Dog burrows on-Site

N

Projection
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

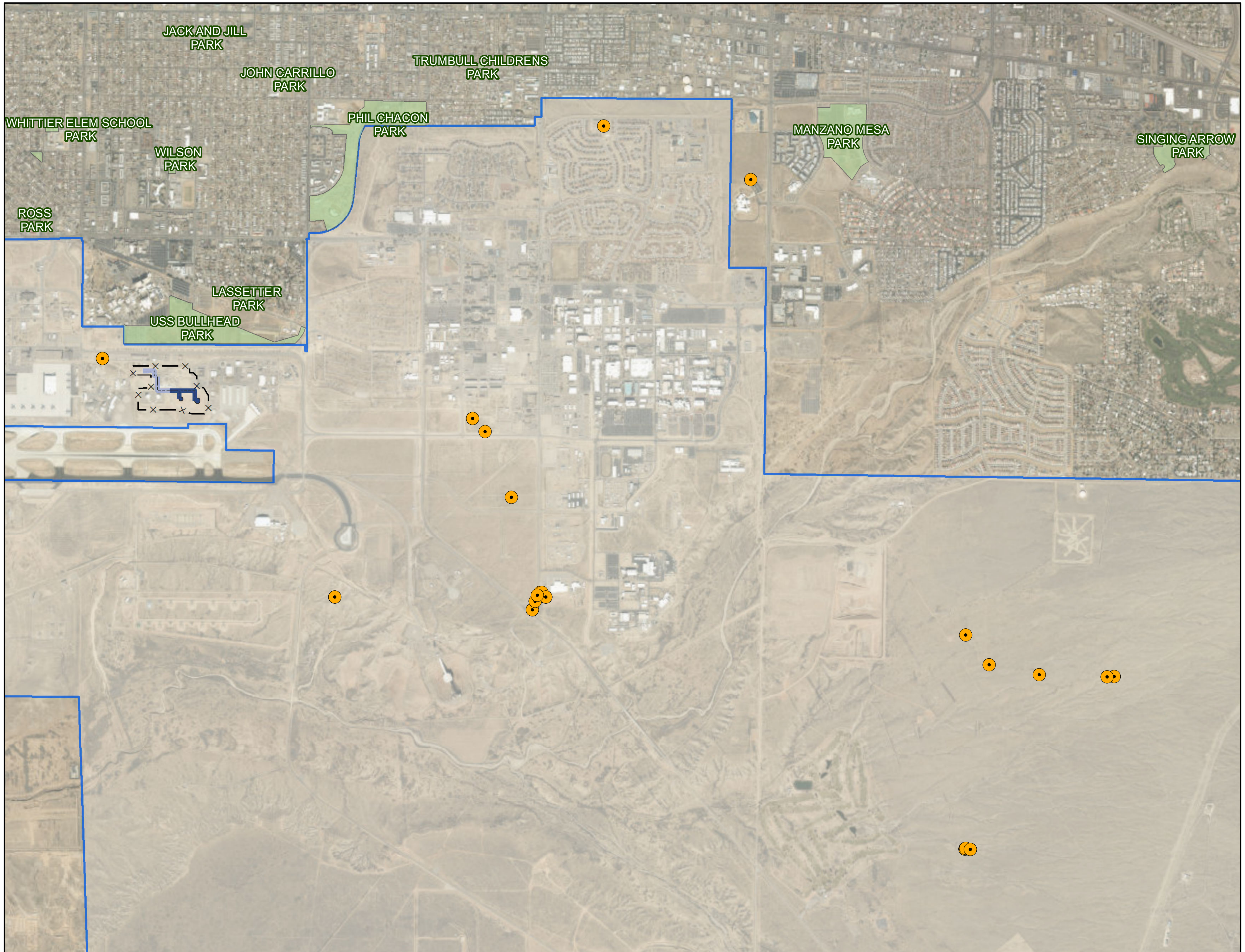
Figure 6-1

Current Bulk Fuels Facility Infrastructure

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 3/3/2017

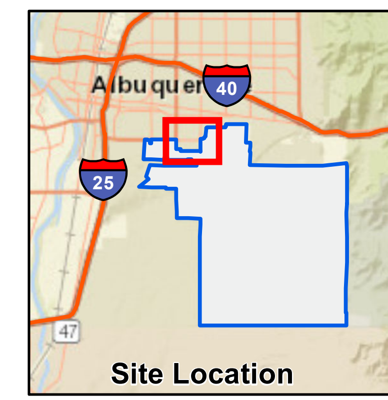


Legend

- Kirtland Air Force Base Installation Area
- Bulk Fuels Facility Area
- City of Albuquerque Parks
- Burrowing Owl Nest Locations
- Former Buried Fuel Transfer Lines
- Former Aboveground Fuel Transfer Lines
- Former Aboveground Storage Tanks

0 750 1,500 3,000
Feet

N



Credits: AFCEC, CSU-CEMML, City of Albuquerque, KAFB, ESRI Base Map

Coordinate System: NAD 1983 State Plane New Mexico Central FIPS 3002 Feet

Figure 6-2

Historical Locations of Burrowing Owl Nests on Kirtland Air Force Base 2015

Risk Assessment

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

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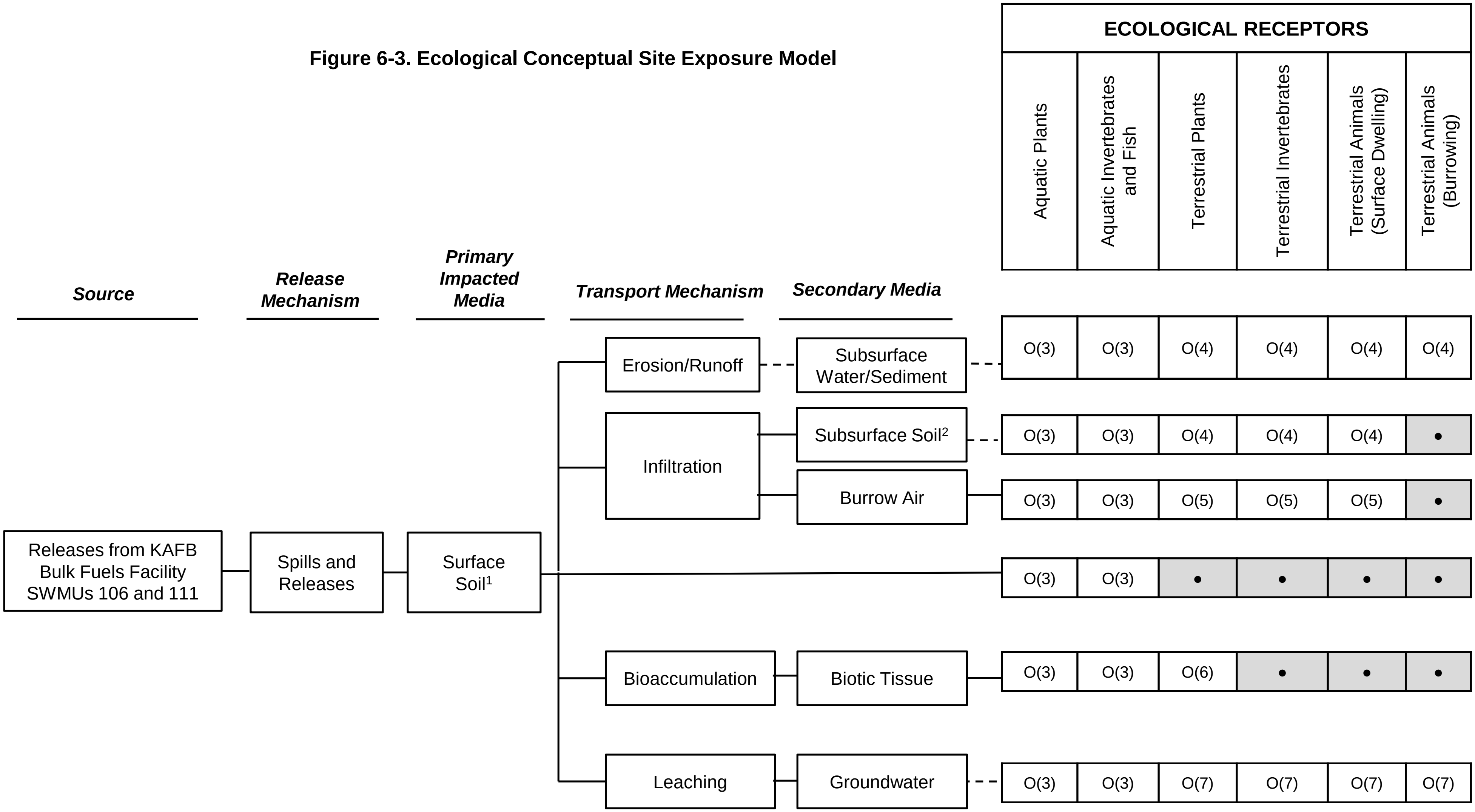
Last Revised: 3/24/2017

Figure 6-3. Ecological Conceptual Site Exposure Model



Notes:

1. Surface soil is considered to be soil between 0 and 1 feet bgs.
2. Subsurface soil is considered to be soil between 1 and 10 feet bgs.
3. No aquatic plants or invertebrates are present at the Site.
4. There is no pathway for terrestrial plants, invertebrates, and animals to encounter subsurface soil or subsurface water/sediment.
5. There is no pathway for terrestrial plants, invertebrates, and surface dwelling animals to come in contact with burrow air.
6. Bioaccumulation to biotic tissue does not occur in plants.
7. Groundwater is approximately 480 feet bgs at the Site. There is no pathway for ecological receptors to come in contact with groundwater.

Key:

O Incomplete Pathway - - - →

• Complete Pathway →

Acronyms and Abbreviations:

bgs = below ground surface

KAFB = Kirtland Air Force Base

SWMU = solid waste management unit

TABLES

Table ES-1. Human Health Risk Assessment Results
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

HHRA Results						
Receptor	**Complete Exposure Pathways**	**Cumulative Carcinogenic Risk**	**Cumulative Non-Carcinogenic Hazard Index**	**EPC Carcinogenic Risk**	**EPC Non-Carcinogenic Hazard Index**	**Current Risk to Human Health?**
On-Site						
Current and Future BFF Industrial Worker	Surface Soil	$2x10^{-10}$	0.00004	N/A	N/A	**No**: concentrations do not exceed target risk levels
	Soil Gas (Indoor)	**$6x10^{-5}$**	0.2	$4x10^{-6}$	N/A	**No**: concentrations do not exceed target risk levels
Future BFF Construction Worker	Mixed Zone Soil	$3x10^{-9}$	0.04	N/A	N/A	**No**: concentrations do not exceed target risk levels
Future Residential Homeowner at the BFF	Mixed Zone Soil	$8x10^{-8}$	0.2	N/A	N/A	**No**: concentrations do not exceed target risk levels
	Soil Gas (Indoor)	**$3x10^{-4}$**	0.9	**$2x10^{-5}$**	N/A	**No**: No current exposure pathway
Future KAFB Water Consumer	Groundwater	**$5x10^{-2}$**	**600**	**$5x10^{-3}$**	**70**	**No**: No current exposure pathway
Off-Base						
Current Bullhead Park Recreational User	None	N/A	N/A	N/A	N/A	**No:** No current exposure pathway
Future Residential Homeowner in Bullhead Park	Soil Gas (Indoor)	$2x10^{-6}$	0.04	N/A	N/A	**No**: No current pathway, calculated risk highly protective
Future Water Authority Drinking Water Supply Well Consumer/Private Well Owner	Groundwater	**$8x10^{-3}$**	**80**	**$1x10^{-4}$**	0.8	**No:** No current exposure pathway

Acronyms and Abbreviations:
BFF = Bulk Fuels Facility
EPC = exposure point concentration
HHRA = Human Health Risk Assessment
KAFB = Kirtland Air Force Base
N/A = not applicable
SWMU = solid waste management unit

Bold = Bolded numbers exceed NMED target risk level (NMED, 2017).

Table 1-1. Current Nature and Extent of Site Contamination as Presented in the RFI Report
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Type of Contamination	Present On-Site	Present Off-Base
Shallow soil	**Yes**: Removed to 20 feet bgs in the area of releases to NMED 2012 residential soil SLs, except for a small unexcavated soil area around infrastructure (1/3 acre)	**No**
Deep soil to top of water table	**Yes**: Residual fuel along LNAPL migration pathway from the source area to the water table approximately 500 feet east of the source area	**No,** with exception of soil directly above water table
Soil Gas	**Yes**: Highest concentrations in area of releases directly below underground pipelines from 50 to 300 feet bgs	**Yes**: Low intermittent concentrations detectible 25 to 450 feet bgs
Free-phase LNAPL floating on groundwater	**Unknown**: Only intermittent sheens of LNAPL measured since Q1 2012 due to LNAPL interim measures, degradation, and rising water levels; the RFI Report identified vertical extent of smearing of residual LNAPL as a data gap and recommended further investigation. Rising water table could encounter trapped LNAPL in vadose zone	**No:** No free-phase LNAPL measured since Q1 2012 due to LNAPL interim measures, degradation, and rising water levels.
Groundwater	**Yes:** LNAPL reached groundwater approximately 500 feet east of the area of releases; the soluble fuel constituents dissolved into groundwater and transported off-Base in the direction of groundwater flow (north-northeast direction)	**Yes:** Dissolved-phase contamination (benzene and EDB) transported downgradient

Acronyms and Abbreviations:
bgs = below ground surface
EDB = ethylene dibromide
LNAPL = light non-aqueous phase liquid
NMED = New Mexico Environment Department
Q = Quarter
RFI = Resource Conservation Recovery Act (RCRA) Facility Investigation
SL = screening level
SWMU = Solid Waste Management Unit

Table 3-1. RCRA Facility Investigation Report List of COPCs
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Soil	Soil Gas	Groundwater
1,2,4-Trimethylbenzene	✓	✓	✓
1,2-Dibromoethane (EDB)	✓	✓	✓
1,2-Dichloroethane	✓	✓	✓
1-Methylnaphthalene	✓		✓
2-Methylnaphthalene	✓		✓
Acetophenone			✓
Benzene	✓	✓	✓
Cyclohexane		✓	
Ethylbenzene	✓	✓	✓
Hexadecane	✓		
Isopropylbenzene (cumene)	✓		
Lead	✓		✓
m & p-Xylenes		✓	
MTBE	✓	✓	
n-Heptane		✓	
n-Hexane		✓	
Naphthalene	✓	✓	✓
o-Xylene		✓	
Toluene	✓	✓	✓
Xylenes (total)	✓	✓	✓

Acronyms and Abbreviations:
COPC = contaminant of potential concern
MTBE = methyl tert-butyl ether
RCRA = Resource Conservation and Recovery Act
SWMU = solid waste management unit

Table 3-2. On-Site Surface Soil (0 to 1 foot bgs)
Summary Statistics
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Total Number of Samples	Number of Detects	Percent Nondetect (%)	Maximum Detect (mg/kg)	Minimum Detect (mg/kg)	Distribution	EPC[a] (mg/kg)	EPC Method
1,2,4-Trimethylbenzene	14	1	93	0.00038	0.00038	N/A	0.00038[c]	Maximum Detection
1,2-Dibromoethane (EDB)	14	0	100	N/A	N/A	N/A	N/A[b]	N/A
1,2-Dichloroethane	14	0	100	N/A	N/A	N/A	N/A[b]	N/A
2-Methylnaphthalene	14	3	79	0.14	0.012	N/A	0.14[c]	Maximum Detection
Benzene	14	11	21	0.0013	0.00020	Nonparametric	0.00074	95% KM (t) UCL
Ethylbenzene	14	1	93	0.00030	0.00030	N/A	0.00030[c]	Maximum Detection
Isopropylbenzene	14	0	100	N/A	N/A	N/A	N/A[b]	N/A
Lead	14	14	0	39	3.6	Gamma	16	95% Adjusted Gamma UCL
MTBE	14	0	100	N/A	N/A	N/A	N/A[b]	N/A
Naphthalene	14	1	93	0.0064	0.0064	N/A	0.0064[c]	Maximum Detection
Toluene	14	10	29	0.0013	0.00022	Nonparametric	0.00071	95% KM (t) UCL
Xylenes (total)	14	1	93	0.00063	0.00063	N/A	0.00063[c]	Maximum Detection

[a] EPCs were calculated using EPA's ProUCL 5.1 (Attachment 2); All nondetects were given the value of the MDL.

[b] No detections. COPC will not be carried through the risk screening as discussed in Section 3.3, any uncertainty with detection limits will be discussed in Section 5.2

[c] Four or fewer detections. Maximum detection was used as EPC.

Note: Field duplicate samples are averaged with their corresponding normal samples.
Note: The COPCs 1-methylnaphthalene and hexadecane were not analyzed in this sample set.

Acronyms and Abbreviations:
% = percent
bgs = below ground surface
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
KM = Kaplan-Meier Statistics
MDL = method detection limit
MTBE = methyl tert-butyl ether
mg/kg = milligram per kilogram
N/A = not applicable, chemical not detected
SWMU = solid waste management unit
UCL = upper confidence limit

Table 3-3. On-Site Mixed Zone Soil (0 to 10 feet bgs)
Summary Statistics
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Total Number of Samples[a]	Number of Detects	Percent Nondetect (%)	Maximum Detect (mg/kg)	Minimum Detect (mg/kg)	Distribution	EPC[b] (mg/kg)	EPC Method
1,2,4-Trimethylbenzene	105	18	83	20	0.00018	Nonparametric	2.7	99% KM (Chebyshev) UCL
1,2-Dibromoethane (EDB)	105	0	100	N/A	N/A	N/A	N/A[c]	N/A
1,2-Dichloroethane	105	0	100	N/A	N/A	N/A	N/A[c]	N/A
1-Methylnaphthalene	12	1	92	0.33	0.33	N/A	0.33[d]	Maximum Detection
2-Methylnaphthalene	117	9	92	16	0.012	Gamma	1.2	95% KM Approximate Gamma UCL
Benzene	105	41	61	0.0033	0.00013	Gamma	0.0077	95% Gamma Approximate UCL
Ethylbenzene	105	12	89	0.47	0.00021	Nonparametric	0.030	95% KM (Chebyshev) UCL
Isopropylbenzene	105	1	99	0.29	0.29	N/A	0.29[d]	Maximum Detection
Lead	105	105	0	71	1.1	Nonparametric	14	95% Chebyshev (Mean, Sd) UCL
MTBE	105	0	100	N/A	N/A	N/A	N/A[c]	N/A
Naphthalene	117	15	87	16	0.00021	Gamma	1.3	95% KM Approximate Gamma UCL
Toluene	105	37	65	0.0045	0.00022	Lognormal	0.00088	KM H-UCL (KM-Log)
Xylenes (total)	105	16	85	3.8	0.00049	Nonparametric	0.22	95% KM (Chebyshev) UCL

[a] Intially, 42 unexcavated soil samples were collected between 0 and 10 feet for all COPCs listed except 1-methylnaphthalene. Then, 63 confirmation samples were collected between 0 to 10 feet depth interval for all COPCs listed except for 1-methylnaphthalene. Twelve step out confirmation samples were collected over the same depth interval for only 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene.

[b] EPCs were calculated using EPA's ProUCL 5.1 (Attachment 2); All nondetects were given the value of the MDL.

[c] No detections. COPC will not be carried through the risk screening as discussed in Section 3.3, any uncertainty with detection limits will be discussed in Section 5.2

[d] Four or fewer detections. Maximum detection was used as EPC.

Note: Field duplicate samples are averaged with their corresponding regular samples.
Note: The COPC hexadecane not analyzed for in this sample set.

Acronyms and Abbreviations:

% = percent
bgs = below ground surface
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
KM = Kaplan-Meier Statistics
MDL = method detection limit
MTBE = methyl tert-butyl ether
mg/kg = milligram per kilogram
N/A = not applicable, chemical not detected
SWMU = solid waste management unit
UCL = upper confidence limit
Sd = standard deviation

Table 3-4. On-Site Soil Gas Summary Statistics, 25-foot Depth (μg/m^3)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Total Number of Samples	Number of Detects	Percent Nondetect (%)	Maximum Detect (μg/m^3)	Minimum Detect (μg/m^3)	Distribution	EPC[a] (μg/m^3)	EPC Method
1,2,4-Trimethlbenzene	93	72	23	640	1.2	Nonparametric	58	95% KM (Chebyshev) UCL
1,2-Dibromoethane (EDB)	93	17	82	24	1.3	Lognormal	1.5	95% H-UCL (KM-Log)
1,2-Dichloroethane	93	0	100	N/A	N/A	N/A	N/A[b]	N/A
Benzene	93	58	38	480	1.3	Lognormal	10	95% H-UCL (KM-Log)
Cyclohexane	93	26	72	380	3.4	Nonparametric	39	95% KM Chebyshev UCL
Ethylbenzene	93	61	34	240	1.3	Nonparametric	24	95% KM Chebyshev UCL
m & p-Xylenes	93	79	15	610	3.1	Nonparametric	86	95% KM Chebyshev UCL
MTBE	93	0	100	N/A	N/A	N/A	N/A[b]	N/A
Naphthalene	93	67	28	260	1.4	Nonparametric	24	95% KM Chebyshev UCL
n-Heptane	93	38	59	490	1.5	Nonparametric	43	95% KM Chebyshev UCL
n-Hexane	93	27	71	600	1.3	Nonparametric	44	95% KM Chebyshev UCL
o-Xylene	93	76	18	280	1.3	Nonparametric	35	95% KM Chebyshev UCL
Toluene	93	89	4	900	1.9	Lognormal	63	95% H-UCL (KM-Log)
Xylenes (total)	93	79	15	910	3.1	Nonparametric	120	95% KM Chebyshev UCL

[a] EPCs were calculated using EPA's ProUCL 5.1 (Attachment 2); All nondetects were given the value of the MDL.

[b] No detections. COPC will not be carried through the risk screening as discussed in Section 3.3, any uncertainty with detection limits will be discussed in Section 5.2

Note: Field duplicate samples are averaged with their corresponding normal samples.

Acronyms and Abbreviations:
% = percent
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
KM = Kaplan-Meier Statistics
MDL = method detection limit
MTBE = methyl tert-butyl ether
μg/m^3 = microgram per cubic meter
N/A = not applicable, chemical not detected
SWMU = solid waste management unit
UCL = upper confidence limit

Table 3-5. Off-Base Soil Gas Summary Statistics, 25-foot Depth (μg/m^3)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Total Number of Samples	Number of Detects	Percent Nondetect (%)	Maximum Detect (μg/m^3)	Minimum Detect (μg/m^3)	Distribution	EPC[a] (μg/m^3)	EPC Method
1,2,4-Trimethylbenzene	12	10	17	9.3	1.3	Nonparametric	4.2	95% KM Chebyshev UCL
1,2-Dibromoethane (EDB)	12	0	100	N/A	N/A	N/A	N/A[b]	N/A
1,2-Dichloroethane	12	0	100	N/A	N/A	N/A	N/A[b]	N/A
Benzene	12	8	33	6.1	1.5	Lognormal	2.7	95% H-UCL (KM-Log)
Cyclohexane	12	2	83	6.5	4.5	N/A	6.5[c]	Maximum Detection
Ethylbenzene	12	8	33	4.8	1.3	Nonparametric	2.6	95% KM (t) UCL
m & p-Xylenes	12	12	0	40	2.9	Gamma	20	95% Gamma Adjusted UCL
MTBE	12	0	100	N/A	N/A	N/A	N/A[b]	N/A
Naphthalene	12	6	50	4.3	2.0	Nonparametric	2.7	95% KM (t) UCL
n-Heptane	12	2	83	2.5	2.2	N/A	2.5[c]	Maximum Detection
n-Hexane	12	3	75	6.0	2.2	N/A	6.0[c]	Maximum Detection
o-Xylene	12	11	8	17	1.4	Gamma	10	95% Gamma Adjusted UCL
Toluene	12	12	0	16	3.0	Normal	12	95% Student's-t UCL
Xylenes (total)	12	12	0	56	2.9	Gamma	28	95% Gamma Adjusted UCL

[a] EPCs were calculated using EPA's ProUCL 5.1 (Attachment 2); All nondetects were given the value of the MDL.

[b] No detections. COPC will not be carried through the risk screening as discussed in Section 3.3, any uncertainty with detection limits will be discussed in Section 5.2

[c] Four or fewer detections. Maximum detection was used as EPC.

Note: Field duplicate samples are averaged with their corresponding normal samples.

Acronyms and Abbreviations:

% = percent
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
KM = Kaplan-Meier Statistics
MDL = method detection limit
MTBE = methyl tert-butyl ether
μg/m^3 = microgram per cubic meter
N/A = not applicable, chemical not detected
SWMU = solid waste management unit
UCL = upper confidence limit

Table 3-6. On-Site Groundwater Summary Statistics (μg/L)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Total Number of Samples	Number of Detects	Percent Nondetect (%)	Maximum Detect (μg/L)	Minimum Detect (μg/L)	Distribution	EPC[a] (μg/L)	EPC Method
1,2,4-Trimethylbenzene	68	20	71	490	1	Gamma	73	95% KM Approximate Gamma UCL
1,2-Dibromoethane (EDB)	68	21	69	93	0.037	Gamma	9.2	95% KM Approximate Gamma UCL
1,2-Dichloroethane	68	7	90	5.5	1.1	Nonparametric	0.96	95% KM (t) UCL
1-Methylnaphthalene	68	14	79	99	1.8	Nonparametric	12	95% KM (t) UCL
2-Methylnaphthalene	68	9	87	110	8.4	Nonparametric	12	95% KM (t) UCL
Acetophenone	68	16	76	4,500	77	Nonparametric	510	95% KM (t) UCL
Benzene	68	22	68	16,000	0.28	Gamma	1700	95% KM Approximate Gamma UCL
Ethylbenzene	68	20	71	1,600	0.58	Gamma	230	95% KM Approximate Gamma UCL
Lead	68	5	93	3.4	1.6	Nonparametric	1.7	95% KM (t) UCL
Naphthalene	68	20	71	230	0.64	Gamma	32	95% KM Approximate Gamma UCL
Toluene	68	19	72	21,000	1.4	Gamma	2600	95% KM Approximate Gamma UCL
Xylenes (total)	68	20	71	5,100	1.9	Gamma	650	95% KM Approximate Gamma UCL

[a] EPCs were calculated using EPA's ProUCL 5.1 (Attachment 2); All nondetects were given the value of the MDL.

Note: Field duplicate samples are averaged with their corresponding normal samples.

Acronyms and Abbreviations:
% = percent
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
KM = Kaplan-Meier Statistics
MDL = method detection limit
μg/L = microgram per Liter
SWMU = solid waste management unit
UCL = upper confidence limit

Table 3-7. Off-Base Groundwater Summary Statistics (μg/L)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Total Number of Samples	Number of Detects	Percent Nondetect (%)	Maximum Detect (μg/L)	Minimum Detect (μg/L)	Distribution	EPC[a] (μg/L)	EPC Method
1,2,4-Trimethylbenzene	197	6	97	120	1.0	Gamma	4.4	95% KM Approximate Gamma UCL
1,2-Dibromoethane (EDB)	197	69	65	12	0.011	Nonparametric	0.62	95% KM Chebyshev UCL
1,2-Dichloroethane	197	36	82	5.5	0.30	Lognormal	0.45	95% H-UCL (KM-Log)
1-Methylnaphthalene	197	7	96	20	5.6	Nonparametric	1.3	95% KM (t) UCL
2-Methylnaphthalene	197	2	99	9.9	1.6	N/A	9.9[b]	Maximimum Detection
Acetophenone	197	7	96	900	1.7	Gamma	35	95% KM Approximate Gamma UCL
Benzene	197	12	94	2,200	0.54	Lognormal	0.90	95% H-UCL (KM-Log)
Ethylbenzene	197	10	95	900	2.7	Gamma	33	95% KM Approximate Gamma UCL
Lead	197	7	96	5.3	1.5	Nonparametric	1.6	95% KM (t) UCL
Naphthalene	197	9	95	35	0.94	Nonparametric	1.1	95% KM (t) UCL
Toluene	197	5	97	2,900	0.31	Nonparametric	74	95% KM (t) UCL
Xylenes (total)	197	5	97	540	16	Nonparametric	15	95% KM (t) UCL

[a] EPCs were calculated using EPA's ProUCL 5.1 (Attachment 2); All nondetects were given the value of the MDL.

[b]Four or fewer detections. Maximum detection was used as EPC.

Note: Field duplicate samples are averaged with their corresponding normal samples.

Acronyms and Abbreviations:

% = percent
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
KM = Kaplan-Meier Statistics
MDL = method detection limit
μg/L = microgram per Liter
N/A = not applicable, chemical not detected
SWMU = solid waste management unit
UCL = upper confidence limit

Table 4-1. On-Site Occupied Buildings
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

On-Site Building Survey Results		
Building Number	**Description of Use**	**Regularly Occupied?**
1026	Helium gas storage	No
1027	Fuel transfer area, roof but no walls	No
1032	Offices, occupied 5 to 8 hours per week	No
1033	Pump House	No
1036	Storage area	No
1041	Fuel station, roof but no walls	No
1044	Air Guard office, always occupied during business hours	Yes
1049	Navy Surveillance, always occupied during business hours	Yes
1055	Air Guard office, always occupied during business hours	Yes
2403	Fuel station, roof but no walls	No
2404	Fuel station, roof but no walls	No
2426	BFF Contractor’s office, occupied 20 to 23 hours per week	Yes

Acronyms and Abbreviations:

BFF = Bulk Fuels Facility
SWMU = solid waste management unit

Table 5-1. Current/Future On-Site Commercial/Industrial Worker, Surface Soil (0 to 1 foot bgs), Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration	NMED SSL[a]	Units	Cumulative Cancer Risk
Soil 0 to 1 foot depth	Benzene	0.0013	86.5	mg/kg	2E-10
	Ethylbenzene	0.00030	365	mg/kg	8E-12
Sum	--	--	--	--	2E-10

[a] NMED carcinogenic Commercial/Industrial SSLs (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

bgs = below ground surface
COPC = contaminant of potential concern
mg/kg = milligram per kilogram
NMED = New Mexico Environment Department
SSL = soil screening level
SWMU = solid waste management unit

Table 5-2. Current/Future On-Site Commercial/Industrial Worker, Surface Soil (0 to 1 foot bgs), Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration	NMED SSL[a]	Units	Cumulative Hazard Quotient
Soil 0 to 1 foot depth	1,2,4-Trimethylbenzene	0.00038	1,800[b]	mg/kg	0.0000002
	2-Methylnaphthalene	0.14	3,370	mg/kg	0.00004
	Benzene	0.0013	724	mg/kg	0.000002
	Ethylbenzene	0.0003	28,800	mg/kg	0.00000001
	Naphthalene	0.0064	16,800	mg/kg	0.0000004
	Toluene	0.0013	61,100	mg/kg	0.00000002
	Xylenes (total)	0.00063	4,240	mg/kg	0.0000001
HI	--	--	--	--	0.00004

[a] NMED non-carcinogenic Commercial/Industrial SSLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Composite Worker Regional SSL (EPA, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

bgs = below ground surface
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
mg/kg = milligram per kilogram
NMED = New Mexico Environment Department
SSL = soil screening level
SWMU = solid waste management unit

Table 5-3. Future Hypothetical On-Site Resident, Mixed Zone Soil (0 to 10 feet bgs), Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration	NMED SSL[a]	Units	Cumulative Cancer Risk
Soil 0 to 10 foot depth	Benzene	0.0033	17.7	mg/kg	2E-09
	Ethylbenzene	0.47	74.5	mg/kg	6E-08
	1-Methylnaphthalene	0.33	172	mg/kg	2E-08
Sum	--	--	--	--	8E-08

[a] NMED non-carcinogenic Residential SSLs (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

bgs = below ground surface
COPC = contaminant of potential concern
mg/kg = milligram per kilogram
NMED = New Mexico Environment Department
SSL = soil screening level
SWMU = solid waste management unit

Table 5-4. Future Hypothetical On-Site Resident, Mixed Zone Soil (0 to 10 feet bgs), Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration	NMED SSL[a]	Units	Cumulative Hazard Quotient
Soil 0 to 10 foot depth	1,2,4-Trimethylbenzene	20	300[b]	mg/kg	0.07
	1-Methylnaphthalene	0.33	4,060	mg/kg	0.00008
	2-Methylnaphthalene	16	232	mg/kg	0.07
	Benzene	0.0033	114	mg/kg	0.00003
	Ethylbenzene	0.47	3,920	mg/kg	0.0001
	Isopropylbenzene	0.29	2,350	mg/kg	0.0001
	Naphthalene	16	1,160	mg/kg	0.01
	Toluene	0.0045	5,220	mg/kg	0.0000009
	Xylenes (total)	3.8	863	mg/kg	0.004
HI	--	--	--	--	0.2

[a] NMED non-carcinogenic Residential SSLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Resident Regional SSL (EPA, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

bgs = below ground surface
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
mg/kg = milligram per kilogram
NMED = New Mexico Environment Department
SSL = soil screening level
SWMU = solid waste management unit

**Table 5-5. Future On-Site Construction Worker, Mixed Zone Soil (0 to 10 feet bgs), Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico**

Medium	COPC	Maximum Detected Concentration	NMED SSL[a]	Units	Cumulative Cancer Risk
Soil 0 to 10 foot depth	Benzene	0.0033	420	mg/kg	8E-11
	Ethylbenzene	0.47	1,760	mg/kg	3E-09
	1-Methylnaphthalene	0.33	6,060	mg/kg	5E-10
Sum	--	--	--	--	3E-09

[a] The NMED carcinogenic Construction Worker SSLs (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

bgs = below ground surface
COPC = contaminant of potential concern
mg/kg = milligram per kilogram
NMED = New Mexico Environment Department
SSL = soil screening level
SWMU = solid waste management unit

Table 5-6. Future On-Site Construction Worker, Mixed Zone Soil (0 to 10 feet bgs), Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration	NMED Soil Screening Level[a]	Units	Cumulative Hazard Quotient
Soil 1 to 10 foot depth	1,2,4-Trimethylbenzene	20	1,800[b]	mg/kg	0.01
	1-Methylnaphthalene	0.33	17,600	mg/kg	0.00002
	2-Methylnaphthalene	16	1,000	mg/kg	0.02
	Benzene	0.0033	141	mg/kg	0.00002
	Ethylbenzene	0.47	5,750	mg/kg	0.00008
	Isopropylbenzene	0.29	2,710	mg/kg	0.0001
	Naphthalene	16	5,020	mg/kg	0.003
	Toluene	0.0045	14,000	mg/kg	0.0000003
	Xylenes (total)	3.8	791	mg/kg	0.005
HI	--	--	--	--	0.04

[a] NMED non-carcinogenic Construction Worker SSLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Composite Worker Regional SSL (EPA, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

bgs = below ground surface
COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
mg/kg = milligram per kilogram
NMED = New Mexico Environment Department
SSL = soil screening level
SWMU = solid waste management unit

**Table 5-7. Current/Future On-Site Commercial/Industrial Worker, Soil Gas Maximum Concentrations, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico**

Medium	COPC	Maximum Detected Concentration*	NMED VISL[a]	Units	Cumulative Cancer Risk
Soil Gas, on-Site, 25-foot depth, all locations	1,2-Dibromoethane (ethylene dibromide; EDB)	24	7.65	μg/m³	**3E-05**
	Benzene	480	588	μg/m³	8E-06
	Ethylbenzene	240	1,840	μg/m³	1E-06
	Naphthalene	260	135	μg/m³	**2E-05**
Sum	--	--	--	--	**6E-05[b]**

* Based on data from Q1 through Q3 2016.
[a] NMED carcinogenic Commercial/Industrial Soil Gas VISLs are used (NMED, 2017).
[b] Total cancer risk for soil gas exceeds the $1x10^{-5}$ target cancer risk level (NMED, 2017) and is further evaluated using statistic-based exposure point concentration (See Table 5-8).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
$\mu g/m^3$ = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SWMU = solid waste management unit
VISL = vapor intrusion screening level

**Table 5-8. Current/Future On-Site Commercial/Industrial Worker, Soil Gas EPC Concentrations, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico**

Medium	COPC	EPC*	NMED VISL[a]	Units	Cancer Risk
Soil Gas, on-Site, 25-foot depth, all locations	1,2-Dibromoethane (ethylene dibromide; EDB)	1.5	7.65	$\mu g/m^3$	2E-06
	Benzene	10	588	$\mu g/m^3$	2E-07
	Ethylbenzene	24	1,840	$\mu g/m^3$	1E-07
	Naphthalene	24	135	$\mu g/m^3$	2E-06
Sum	--	--	--	--	4E-06

* Based on data from Q1 through Q3 2016. EPCs were calculated using EPA's ProUCL 5.1.
[a] NMED carcinogenic Commercial/Industrial VISLs are used (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
$\mu g/m^3$ = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SWMU = Solid Waste Management Unit
VISL = vapor intrusion screening level

Table 5-9. Current/Future On-Site Commercial/Industrial Worker, Soil Gas Maximum Concentration, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED VISL[a]	Units	Cumulative Hazard Quotient
Soil Gas, on-Site, 25-foot depth, all locations	1,2,4-trimethylbenzene	640	8,670[b]	μg/m^3	0.07
	Cyclohexane	380	867,000[b]	μg/m^3	0.0004
	n-heptane	490	60,000[b]	μg/m^3	0.008
	n-hexane	600	115,000	μg/m^3	0.005
	Toluene	900	918,000	μg/m^3	0.001
	m- and p-xylenes	610	16,400	μg/m^3	0.04
	o-xylene	280	16,400	μg/m^3	0.02
	Xylenes (total)	910	16,400	μg/m^3	0.06
HI	--	--	--	--	0.2

* Based on data from Q1 through Q3 2016.
[a] NMED non-carcinogenic Commercial/Industrial Soil Gas VISLs are used except where noted (NMED, 2017).
[b] No NMED VISL is available. NMED VISLs for soil gas are calculated by applying an attenuation factor (alpha) of 0.03 to an indoor air screening level (NMED, 2017), where alpha is the ratio of the presumed indoor air concentration to the concentration in soil gas immediately below a building foundation. An equivalent VISL was calculated by dividing the June 2017 EPA non-carcinogenic Composite Worker Air Regional SL (EPA, 2017) by 0.03.

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
μg/m^3 = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit
VISL = vapor intrusion screening level

**Table 5-10. Future Hypothetical On-Site Resident, Soil Gas Maximum Concentrations, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico**

Medium	COPC	Maximum Detected Concentration*	NMED VISL[a]	Units	Cumulative Cancer Risk
Soil Gas, on-Site, 25-foot depth, all locations	1,2-Dibromoethane (ethylene dibromide; EDB)	24	1.56	μg/m^3	**2E-04**
	Benzene	480	120	μg/m^3	**4E-05**
	Ethylbenzene	240	374	μg/m^3	6E-06
	Naphthalene	260	27.5	μg/m^3	**9E-05**
Sum	--	--	--	--	**3E-04[b]**

* Based on data from Q1 through Q3 2016.
[a] NMED carcinogenic Residential Soil Gas VISLs are used (NMED, 2017).
[b] Total cancer risk for soil gas exceeds the $1x10^{-5}$ target cancer risk level (NMED, 2017) and is further evaluated using statistic-based exposure point concentration (See Table 5-11).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
μg/m^3 = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SWMU = solid waste management unit
VISL = vapor intrusion screening level

**Table 5-11. Future Hypothetical On-Site Resident, Soil Gas EPCs, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico**

Medium	COPC	EPC*	NMED VISL[a]	Units	Cancer Risk
Soil Gas, on-Site, 25-foot depth, all locations	1,2-Dibromoethane (ethylene dibromide; EDB)	1.5	1.56	μg/m^3	**1E-05**
	Benzene	10	120	μg/m^3	8E-07
	Ethylbenzene	24	374	μg/m^3	6E-07
	Naphthalene	24	27.5	μg/m^3	9E-06
Sum	--	--	--	--	**2E-05**

* Based on data from Q1 through Q3 2016. EPCs were calculated using EPA's ProUCL 5.1.
[a] NMED carcinogenic Residential VISLs are used (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
μg/m^3 = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SWMU = solid waste management unit
VISL = vapor intrusion screening level

Table 5-12. Future Hypothetical On-Site Resident, Soil Gas Maximum Concentrations, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED Residential VISL[a]	Units	Cumulative Hazard Quotient
Soil Gas, on-Site, 25-foot depth, all locations	1,2,4-Trimethylbenzene	640	2,100[b]	μg/m^3	0.3
	Cyclohexane	380	210,000[b]	μg/m^3	0.002
	n-Heptane	490	14,000[b]	μg/m^3	0.04
	n-Hexane	600	24,300	μg/m^3	0.02
	Toluene	900	174,000	μg/m^3	0.005
	m- and p-Xylenes	610	3,480	μg/m^3	0.2
	o-Xylene	280	3,480	μg/m^3	0.08
	Xylenes (total)	910	3,480	μg/m^3	0.3
HI	--	--	--	--	0.9

* Based on data from Q1 through Q3 2016.
[a] NMED non-carcinogenic Residential Soil Gas VISLs are used unless not available (NMED, 2017).
[b] No NMED Soil Gas VISL is available. NMED Soil Gas VISLs are calculated by applying an attenuation factor (alpha) of 0.03 to an indoor air screening level (NMED, 2017), where alpha is the ratio of the presumed indoor air concentration to the concentration in soil gas immediately below a building foundation. An equivalent soil gas VISL was calculated by dividing the June 2017 EPA Resident Regional Air SL (EPA, 2017) by 0.03.

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
μg/m^3 = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit
VISL = vapor intrusion screening level

Table 5-13. Future Hypothetical Off-Base Resident, Soil Gas Maximum Concentrations, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED Residential VISL[a]	Units	Cumulative Cancer Risk
Soil Gas, off-Base, 25-foot depth, all locations	Benzene	6.1	120	μg/m^3	5E-07
	Ethylbenzene	4.8	374	μg/m^3	1E-07
	Naphthalene	4.3	27.5	μg/m^3	2E-06
Sum	--	--	--	--	2E-06

* Based on data from Q1 through Q3 2016.
[a] NMED carcinogenic Residential Soil Gas VISLs are used (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
μg/m^3 = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SWMU = solid waste management unit
VISL = vapor intrusion screening level

Table 5-14. Future Hypothetical Off-Base Resident, Soil Gas Maximum Concentrations, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED Residential VISL[a]	Units	Cumulative Hazard Quotient
Soil Gas, off-Base, 25-foot depth, all locations	1,2,4-Trimethylbenzene	9.3	2,100[b]	μg/m³	0.004
	Cyclohexane	6.5	210,000[b]	μg/m³	0.00003
	n-Heptane	2.5	14,000[b]	μg/m³	0.0002
	n-Hexane	6.0	24,300	μg/m³	0.0002
	Toluene	16	174,000	μg/m³	0.00009
	m- and p-Xylenes	40	3,480	μg/m³	0.01
	o-Xylene	17	3,480	μg/m³	0.005
	Xylenes (total)	56	3,480	μg/m³	0.02
HI	--	--	--	--	0.04

* Based on data from Q1 through Q3 2016.

[a] NMED non-carcinogenic Residential Soil Gas VISLs are used except where noted (NMED, 2017).

[b] No NMED Soil Gas VISL is available. NMED Soil Gas VISLs are calculated by applying an attenuation factor (alpha) of 0.03 to an indoor air screening level (NMED, 2017), where alpha is the ratio of the presumed indoor air concentration to the concentration in soil gas immediately below a building foundation. An equivalent soil gas VISL was calculated by dividing the June 2017 EPA non-carcinogenic Resident Air Regional SL (EPA, 2017) by 0.03.

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
μg/m³ = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit
VISL = vapor intrusion screening level

Table 5-15. Future On-Site Domestic Water User, Groundwater Maximum Concentrations, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED Residential Tapwater Screening Level[a]	Units	Cumulative Cancer Risk
On-Site Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	93	0.0747	µg/L	**1E-02**
	1,2-Dichloroethane	5.5	1.71	µg/L	**3E-05**
	1-Methylnaphthalene	99	11.4	µg/L	**9E-05**
	Benzene	16,000	4.55	µg/L	**4E-02**
	Ethylbenzene	1,600	15.0	µg/L	**1E-03**
	Naphthalene	230	1.65	µg/L	**1E-03**
Sum	--	--	--	--	**5E-02[b]**

* Based on data from Q3 and Q4 2015.
[a] NMED carcinogenic Residential Tapwater SLs are used (NMED, 2017).
[b] Total cancer risk for soil gas exceeds the $1x10^{-5}$ target cancer risk level (NMED, 2017) and is further evaluated using statistic-based exposure point concentration (See Table 5-16).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 5-16. Future On-Site Domestic Water User, Groundwater EPCs, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	EPC*	NMED Residential Tapwater Screening Level[a]	Units	Cancer Risk
On-Site Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	9.2	0.0747	µg/L	**1E-03**
	1,2-Dichloroethane	0.96	1.71	µg/L	6E-06
	1-Methylnaphthalene	12	11.4	µg/L	1E-05
	Benzene	1,700	4.55	µg/L	**4E-03**
	Ethylbenzene	230	15.0	µg/L	**2E-04**
	Naphthalene	32	1.65	µg/L	**2E-04**
Sum	--	--	--	--	**5E-03**

* Based on data from Q3 and Q4 2015. EPCs were calculated using EPA's ProUCL 5.1.
[a] NMED carcinogenic Residential Tapwater SLs are used (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 5-17. Future On-Site Domestic Water User, Groundwater Maximum Concentrations, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED Residential Tapwater Screening Level[a]	Units	Cumulative Hazard Quotient
On-Site Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	93	16.9	µg/L	**6**
	1,2-Dichloroethane	5.5	13.0	µg/L	0.4
	1,2,4-Trimethylbenzene	490	56[b]	µg/L	**9**
	1-Methylnaphthalene	99	611	µg/L	0.2
	2-Methylnaphthalene	110	35.1	µg/L	**3**
	Acetophenone	4,500	1,920	µg/L	**2**
	Benzene	16,000	33.2	µg/L	**500**
	Ethylbenzene	1,600	800	µg/L	**2**
	Naphthalene	230	6.11	µg/L	**40**
	Toluene	21,000	1,090	µg/L	**20**
	Xylenes (total)	5,100	193	µg/L	**30**
HI	--	--	--	--	**600[c]**

* Based on data from Q3 and Q4 2015.
[a] NMED non-carcinogenic Residential Tapwater SLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Resident Regional Tapwater SL (EPA, 2017).
[c] Hazard index sum exceeds NMED target hazard index of 1 (NMED, 2017) and is further evaluated using statistic-based exposure point concentration (see Table 5-18).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target HI of 1 (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 5-18. Future On-Site Domestic Water User, Groundwater EPCs, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	EPC*	NMED Residential Tapwater Screening Level[a]	Units	Hazard Quotient
On-Site Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	9.2	16.9	µg/L	0.5
	1,2-Dichloroethane	0.96	13.0	µg/L	0.07
	1,2,4-Trimethylbenzene	73	56[b]	µg/L	1
	1-Methylnaphthalene	12	611	µg/L	0.02
	2-Methylnaphthalene	12	35.1	µg/L	0.3
	Acetophenone	510	1,920	µg/L	0.3
	Benzene	1700	33.2	µg/L	**50**
	Ethylbenzene	230	800	µg/L	0.3
	Naphthalene	32	6.11	µg/L	**5**
	Toluene	2,600	1,090	µg/L	**2**
	Xylenes (total)	650	193	µg/L	**3**
HI	--	--	--	--	**70**

* Based on data from Q3 and Q4 2015. EPCs were calculated using EPA's ProUCL 5.1.
[a] NMED non-carcinogenic Residential Tapwater SLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Resident Regional Tapwater SL (EPA, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target HI of 1 (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point calculation
HI = hazard index
$\mu g/m^3$ = microgram per cubic meter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 5-19. Future Off-Base Domestic Water User, Groundwater Maximum Concentrations, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	Maximum Detected Concentration*	NMED Residential Tapwater Screening Level[a]	Units	Cumulative Cancer Risk
Off-Base Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	12	0.0747	µg/L	**2E-03**
	1,2-Dichloroethane	5.5	1.71	µg/L	**3E-05**
	1-Methylnaphthalene	20	11.4	µg/L	**2E-05**
	Benzene	2,200	4.55	µg/L	**5E-03**
	Ethylbenzene	900	15.0	µg/L	**6E-04**
	Naphthalene	35	1.65	µg/L	**2E-04**
Sum	--	--	--	--	**8E-03[b]**

* Based on data from Q3 and Q4 2015.
[a] NMED carcinogenic Residential Tapwater SLs are used (NMED, 2017).
[b] Total cancer risk exceeds the 1×10^{-5} target cancer risk level (NMED, 2017) and is further evaluated using statistic-based exposure point concentration (see Table 5-20).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 5-20. Future Off-Base Domestic Water User, Groundwater EPCs, Cancer Risk Estimate
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	EPC*	NMED Residential Tapwater Screening Level[a]	Units	Cancer Risk
Off-Base Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	0.62	0.0747	µg/L	**8E-05**
	1,2-Dichloroethane	0.45	1.71	µg/L	3E-06
	1-Methylnaphthalene	1.3	11.4	µg/L	1E-06
	Benzene	0.90	4.55	µg/L	2E-06
	Ethylbenzene	33	15.0	µg/L	**2E-05**
	Naphthalene	1.1	1.65	µg/L	7E-06
Sum	--	--	--	--	**1E-04**

* Based on data from Q3 and Q4 2015. EPCs were calculated using EPA's ProUCL 5.1.
[a] NMED carcinogenic Residential Tapwater SLs are used (NMED, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target cancer risk level (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point concentration
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

**Table 5-21. Future Off-Base Domestic Water User, Groundwater Maximum Concentrations, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico**

Medium	COPC	Maximum Detected Concentration*	NMED Residential Tapwater Screening Level[a]	Units	Cumulative Hazard Quotient
Off-Base Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	12	16.9	µg/L	0.7
	1,2-Dichloroethane	5.5	13.0	µg/L	0.4
	1,2,4-Trimethylbenzene	120	56[b]	µg/L	**2**
	1-Methylnaphthalene	20	611	µg/L	0.03
	2-Methylnaphthalene	9.9	35.1	µg/L	0.3
	Acetophenone	900	1,920	µg/L	0.5
	Benzene	2,200	33.2	µg/L	**70**
	Ethylbenzene	900	800	µg/L	1
	Naphthalene	35	6.11	µg/L	**6**
	Toluene	2,900	1,090	µg/L	**3**
	Xylenes (total)	540	193	µg/L	**3**
HI	--	--	--	--	**80[c]**

* Based on data from Q3 and Q4 2015.
[a] NMED non-carcinogenic Residential Tapwater SLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Resident Regional Tapwater SL (EPA, 2017).
[c] Hazard index exceeds NMED target hazard index of 1 (NMED, 2017) and is further evaluated using statistic-based exposure point concentration (see Table 5-22).

Note: Sum may not add up exactly due to significant figures and rounding.

Bold = Bolded numbers exceed NMED target risk values (NMED, 2017).

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
HI = hazard index
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 5-22. Future Off-Base Domestic Water User, Groundwater EPCs, Noncancer Hazard Index
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Medium	COPC	EPC*	NMED Residential Tapwater Screening Level[a]	Units	Hazard Quotient
Off-Base Groundwater (as Tapwater)	1,2-Dibromoethane (ethylene dibromide; EDB)	0.62	16.9	µg/L	0.04
	1,2-Dichloroethane	0.45	13.0	µg/L	0.03
	1,2,4-Trimethylbenzene	4.4	56[b]	µg/L	0.08
	1-Methylnaphthalene	1.3	611	µg/L	0.002
	2-Methylnaphthalene	9.9	35.1	µg/L	0.3
	Acetophenone	35	1,920	µg/L	0.02
	Benzene	0.90	33.2	µg/L	0.03
	Ethylbenzene	33	800	µg/L	0.04
	Naphthalene	1.1	6.11	µg/L	0.2
	Toluene	74	1,090	µg/L	0.07
	Xylenes (total)	15	193	µg/L	0.08
HI	--	--	--	--	0.8

* Based on data from Q3 and Q4 2015. EPCs were calculated using EPA's ProUCL 5.1.
[a] NMED non-carcinogenic Residential Tapwater SLs are used except where noted (NMED, 2017).
[b] EPA non-carcinogenic Resident Regional Tapwater SL (EPA, 2017).

Note: Sum may not add up exactly due to significant figures and rounding.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
EPA = United States Environmental Protection Agency
EPC = exposure point calculation
HI = hazard index
µg/L = microgram per Liter
NMED = New Mexico Environment Department
Q = Quarter
SL = screening level
SWMU = solid waste management unit

Table 6-1. Ecological Screening of On-Site Surface Soil (0 to 1-foot depth interval)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

	Ecological Soil Screening Level [a] mg/kg											
COPC	Plant ESL	Soil Invertebrate ESL	Small Herbivorous Mammal ESL	Small Omnivorous Mammal ESL	Insectivorous Mammal ESL	Carnivorous Mammal ESL	Herbivorous Bird ESL	Omnivorous Bird ESL	Insectivorous Bird ESL	Carnivorous Bird ESL	Maximum Concentration (mg/kg)	Maximum HQ
1,2,4-Trimethylbenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00038	N/A
1,2-Dibromoethane (Ethylene Dibromide, EDB)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ND	N/A
1,2-Dichloroethane	N/A	N/A	32 [b]	452	89 [b]	2010	**0.85** [b]	21.8	4.6 [b]	167	ND	N/A
2-Methylnaphthalene	N/A	N/A	95 [b]	24 [b]	**16** [b]	4200 [b]	N/A	N/A	N/A	N/A	0.14	8.8E-03
Benzene	N/A	N/A	**31** [b]	240	47 [b]	1070	N/A	N/A	N/A	N/A	0.0013	4.2E-05
Ethylbenzene	N/A	N/A	N/A	**5.16** [c]	N/A	N/A	N/A	N/A	N/A	N/A	0.00030	5.8E-05
Isopropylbenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ND	N/A
Lead	120 [b]	1700 [b]	330 [b]	42.7	72 [b]	190	21 [b]	**7.7**	14 [b]	59.3	39	5.1
MTBE (Methyl tert-butyl ether)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ND	N/A
Naphthalene	**1** [b]	N/A	11 [b]	130	27 [b]	578	3.4 [b]	71	16 [b]	546	0.0064	6.4E-03
Toluene	200 [b]	N/A	54 [b]	236	**23** [b]	1050	N/A	N/A	N/A	N/A	0.0013	5.7E-05
Xylenes (total)	100 [b]	N/A	6.2 [b]	19.1	**1.4** [b]	84.8	90 [b]	506	41 [b]	3890	0.00063	4.5E-4

Table 6-1. Ecological Screening of On-Site Surface Soil (0 to 1-foot depth interval) (CONCLUDED)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Bolded values indicate lowest ESL.
Shaded values indicate hazard quotients greater than 1.

[a] Unless otherwise noted, all ESLs are from NMED's Risk Assessment Guidance for Investigation and Remediation (NMED, 2017).
[b] When ESLs from NMED were not promulgated, ESLs from LANL EcoRisk Database V 3.3 (LANL, 2014) were used.
[c] Region 5 screening level for shrew or vole, obtained from National Oceanic and Atmospheric Administration Screening Quick Reference Table (Buchman, 2008).

Note: COPCs 1-methylnaphthalene and hexadecane were not analyzed for in this sample set.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
ESL = Ecological Screening Level
HQ = hazard quotient
LANL = Los Alamos National Laboratory
mg/kg = milligram per kilogram
N/A = not available
NMED = New Mexico Environment Department
SWMU = solid waste management unit

Table 6-2. Hazard Index Calculations for On-Site Surface Soil (0 to 1-foot depth interval)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Plant HQ	Soil Invert HQ	Herbivorous Mammal HQ	Small Omnivorous Mammal HQ	Insectivorous. Mammal HQ	Carnivorous Mammal HQ	Herbivorous. Bird HQ	Omnivorous Bird HQ	Insectivorous Bird HQ	Carnivorous Bird HQ
1,2,4-Trimethylbenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dibromoethane (Ethylene Dibromide, EDB)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dichloroethane	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-Methylnaphthalene	N/A	N/A	0.0015	0.0058	0.0088	3.3E-05	N/A	N/A	N/A	N/A
Benzene	N/A	N/A	4.2E-05	5.4E-06	2.8E-05	1.2E-06	N/A	N/A	N/A	N/A
Ethylbenzene	N/A	N/A	N/A	5.8E-05	N/A	N/A	N/A	N/A	N/A	N/A
Isopropylbenzene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	0.33	0.023	0.12	0.91	0.54	0.21	1.9	5.1	2.8	0.66
MTBE (Methyl tert-butyl ether)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Naphthalene	0.0064	N/A	0.00058	4.9E-05	0.00024	1.1E-05	0.0019	9.0E-05	0.00040	1.2E-05
Toluene	6.5E-6	N/A	2.4E-05	5.5E-06	5.7E-05	1.2E-06	N/A	N/A	N/A	N/A
Xylenes (total)	6.3E-6	N/A	0.00010	3.3E-05	0.00045	7.4E-06	7.0E-06	1.2E-06	1.5E-05	1.6E-07
Hazard Index	**0.33**	**0.023**	**0.12**	**0.92**	**0.55**	**0.21**	**1.9**	**5.1**	**2.8**	**0.66**

Shaded values indicate HQs or HIs greater than 1.

Note: COPCs 1-methylnaphthalene and hexadecane were not analyzed for in this sample set.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
HI = hazard index
HQ = hazard quotient
N/A = not available
SWMU = solid waste management unit

Table 6-3. Ecological Screening of Mixed Zone Soil (0 to 10 feet bgs)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

	Ecological Soil Screening Level [a] (mg/kg)			
COPC	Small Omnivorous Mammal ESL	Carnivorous Bird ESL	Maximum Concentration (mg/kg)	Maximum HQ
1,2,4-Trimethylbenzene	N/A	N/A	20	N/A
1,2-Dibromoethane (Ethylene Dibromide, EDB)	N/A	N/A	ND	N/A
1,2-Dichloroethane	**452**	167	ND	N/A
1-Methylnaphthalene	N/A	N/A	0.33	N/A
2-Methylnaphthalene	**24**[b]	N/A	16	0.67
Benzene	**240**	N/A	0.0033	0.000014
Ethylbenzene	**5.16**[c]	N/A	0.47	0.091
Isopropylbenzene	N/A	N/A	0.29	N/A
Lead	**42.7**	59.3	71	1.7
MTBE (Methyl tert-butyl ether)	N/A	N/A	ND	N/A
Naphthalene	**130**	546	16	0.12
Toluene	**236**	N/A	0.0045	0.000019
Xylenes (total)	**19.1**	3,890	3.8	0.20

Table 6-3. Ecological Screening of Mixed Zone Soil (0 to 10 feet bgs) (CONCLUDED)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

Bolded values indicate lowest Ecological Screening Level
Shaded values indicate hazard quotients greater than 1

[a] Unless otherwise noted, all ecological screening levels are from NMED's Risk Assessment Guidance for Investigation and Remediation (NMED 2017).
[b] Ecological screening levels are from LANL EcoRisk Database V 3.3 (LANL 2014).
[c] Region 5 screening level for shrew or vole, obtained from NOAA Screening Quick Reference Table (SQuiRT) (Buchman 2008).

Note: COPC Hexadecane were not analyzed for in this sample set.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
HQ = hazard quotient
LANL = Los Alamos National Laboratory
mg/kg = milligram per kilogram
NOAA = National Oceanic and Atmospheric Administration
N/A = not available
ND = nondetect
SWMU = Solid Waste Management Unit

Table 6-4. Hazard Calculations of Mixed Zone Soil (0 to 10 feet bgs)
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Small Omnivorous Mammal HQ	Carnivorous Bird HQ
1,2,4-Trimethylbenzene	N/A	N/A
1,2-Dibromoethane (Ethylene Dibromide, EDB)	N/A	N/A
1,2-Dichloroethane	N/A	N/A
1-Methylnaphthalene	N/A	N/A
2-Methylnaphthalene	0.67	N/A
Benzene	0.000014	N/A
Ethylbenzene	0.091	N/A
Isopropylbenzene	N/A	N/A
Lead	1.7	1.2
MTBE (Methyl tert-butyl ether)	N/A	N/A
Naphthalene	0.12	0.029
Toluene	0.000019	N/A
Xylenes (total)	0.20	0.00098
Hazard Index	**2.7**	**1.2**

Shaded values indicate HIs and HQs greater than 1.
Note: COPC Hexadecane were not analyzed for in this sample set.

Acronyms and Abbreviations:

COPC = contaminant of potential concern
HI = hazard index
HQ = hazard quotient
N/A = not available
ND = nondetect
SWMU = solid waste management unit

Table 6-5. Ecological Screening of Soil Gas Concentrations On-Site (15 to 25-foot depth interval) Risk Assessment Report Bulk Fuels Facility, SWMU ST-106/SS-111 Kirtland Air Force Base, New Mexico

COPC	Maximum Detected Concentration	Soil Gas (Burrowing Mammal) ESL	Units	Source	Does COPC Exceed ESL?[a]
1,2-Dibromoethane (Ethylene Dibromide [EDB])	0.024	N/A	mg/m^3	N/A	N/A
1,2-Dichloroethane	ND	41	mg/m^3	LANL	N
1,2,4-Trimethylbenzene	0.64	7.8	mg/m^3	MWH	N
Benzene	0.48	25	mg/m^3	LANL	N
Cyclohexane	0.38	N/A	mg/m^3	N/A	N/A
Ethylbenzene	0.24	23	mg/m^3	MWH	N
n-Heptane	0.49	N/A	mg/m^3	N/A	N/A
n-Hexane	0.60	N/A	mg/m^3	N/A	N/A
Methyl tert-butyl ether (MTBE)	ND	N/A	mg/m^3	N/A	N
Naphthalene	0.26	1.9	mg/m^3	MWH	N
Toluene	0.90	60	mg/m^3	LANL	N
Xylenes (total)	0.91	87	mg/m^3	LANL	N
m- and p-Xylenes	0.61	7.8	mg/m^3	MWH	N
o-Xylene	0.28	7.8	mg/m^3	MWH	N

Acronyms and Abbreviations:

COPC = contaminant of potential concern
ESL = Ecological Screening Level
LANL = Los Alamos National Laboratory EcoRisk Database v3.3 (2014)
mg/m^3 = milligram per cubic meter
MWH = MWH Americas (2011)
N = no
N/A = not available
ND = nondetect
SWMU = solid waste management unit

Table 6-6. Summary Statistics for Tier 2 Ecological COPCs
Risk Assessment Report
Bulk Fuels Facility, SWMU ST-106/SS-111
Kirtland Air Force Base, New Mexico

COPC	Number of Samples	Detect Frequency	Maximum (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Screening Level [a] (mg/kg)
Surface Soil 0 to 1-foot						
Lead	14	100%	39	11	8.1	7.7 [a]
Mixed Zone Soil 0 to 10 feet						
Lead	105	100%	71	9.3	5.5	59.3 [b]

[a] NMED's Risk Assessment Guidance for Investigation and Remediation for omnivorous birds (NMED, 2017).
[b] NMED's Risk Assessment Guidance for Investigation and Remediation for carnivorous birds (NMED, 2017).

Acronyms and Abbreviations:

% = percent
COPC = contaminant of potential concern
mg/kg = milligram per kilogram
NMED = New Mexico Environmental Department
SWMU = solid waste management unit

Attachment 1.

Investigation of Bias in EDB Analytical Results by Soil Gas Method CARB 422

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

%	percent
±	plus or minus
×	times
ALS	ALS Environmental
CARB 422	California Air Resources Board Method 422
CCV	continuing calibration verification
ECD	electron capture detector
EDB	ethylene dibromide
e.g.	for example
EPA	United States Environmental Protection Agency
GC	gas chromatograph
ICV	initial calibration verification
i.e.	in other words
LCS	laboratory control sample
MS	mass spectrometer
ppbv	parts per billion by volume
Q	Quarter
RA	Risk Assessment
Site	SWMU ST-106/SS-111
SOP	standard operating procedure
SVMP	soil vapor monitoring point
SWMU	solid waste management unit
TO-15	EPA Compendium Method TO-15
VOC	volatile organic compound

LIST OF FIGURES

1 INTRODUCTION

This Attachment provides information supporting the data evaluation presented in Section 3.3 of the solid waste management unit (SWMU) ST-106/SS-111 (Site) Risk Assessment (RA). As discussed in Section 3.3 of the Site RA, review of summary statistics and data plots identified that the analytical results for ethylene dibromide (EDB), which was measured in soil gas by two separate methods, are biased higher in one method than the other (Figures A1-1 and A1-2). This issue warranted an investigation of the EDB soil gas data. Results of this investigation indicate that the bias is due to problems with the laboratory standard operating procedure (SOP) for preparation of calibration standards for California Air Resources Board Method 422 (CARB 422) analysis. It is recommended that soil gas EDB data by United States Environmental Protection Agency (EPA) Compendium Method TO-15 (TO-15) be used for analysis in this RA.

EDB was measured in soil gas by two separate analytical methods, CARB 422 and TO-15. A comparison of 408 EDB soil gas concentration results by CARB 422 and TO-15 shows a very consistent pattern of higher values for CARB 422. Quarter (Q) 3 2015 through Q3 2016 soil gas data was used for this evaluation (USACE, 2017a; USACE, 2017b). Figure A1-1 is a histogram showing the frequency of ratios when comparing EDB soil gas concentration ratios for CARB 422 to TO-15. These EDB soil gas results demonstrate that in 99 percent (%) of detected samples, CARB 422 EDB concentrations were higher than the TO-15 EDB concentrations. Additionally, 92% of the EDB soil gas concentration results showed one to five times higher EDB concentrations by the CARB-422 method. Figure A1-2 is a log-scale scatterplot of soil gas EDB results by the two methods. The EDB soil gas concentrations are tightly clumped along a line indicating EDB concentration ranges had precision and a high degree of consistency by the two methods. However, the line is skewed above the one-to-one ratio, confirming that the EDB soil gas concentrations are higher when analyzed by the CARB 422 method.

To understand what caused this bias the following investigation steps were performed:

1. Laboratory data packages with results of both methods were reviewed to determine if:

    a. an interferent could be responsible for the elevated EDB soil gas concentration results by CARB 422, or

    b. high concentrations of other volatile organic compounds (VOC) could be affecting TO-15 EDB soil gas concentration results; and

2. Laboratory SOPs and calibration standards used in the CARB 422 and TO-15 methods were reviewed by ALS Environmental (ALS).

2 ANALYTICAL METHOD COMPARISON

EDB concentrations in soil gas samples were analyzed by ALS using two different methods: CARB 422 and TO-15. EDB was the only VOC analyzed by CARB 422. EDB and 60 other VOCs were analyzed by TO-15. To evaluate these methods for the bias observed by CARB 422, laboratory data packages were requested. Four data packages were obtained from Q3 2015 and 11 data packages from Q1 2016. Section 2.1 describes a review of CARB 422 chromatograms focusing on identification of EDB and the possibility that an interferent could be responsible for elevated EDB results by this method. Section 2.2 describes the results of a review of laboratory data packages focusing on the ability of TO-15 to identify and quantitate EDB soil gas concentrations in the presence of high VOC concentrations such as methyl ethyl ketone and acetone that were observed after using glue to seal soil vapor monitoring points (SVMPs) in Q1 2015.

CARB 422 was developed to measure hazardous air pollutants in stack gases from stationary sources (in other words [i.e.], fixed emitters of air pollutants) and the air sample is collected on sorbent traps, or by a stainless-steel vessel or vacuum bottle. The method utilizes a gas chromatograph (GC) with an electron capture detector (ECD). The GC separates the VOCs of interest by temperature over a time range and the ECD detects the VOCs. ECDs only respond to VOCs with electronegative components and are restricted to halogenated VOCs such as fluorine, chlorine, bromine, and iodine. The resulting chromatogram is a series of peaks, each of which indicates a detected halogenated VOC.

TO-15 was developed to measure VOCs in ambient air and the air sample is collected on sorbent traps, or by a stainless-steel vessel or vacuum bottle. Like CARB 422, it also uses a GC to separate the VOCs by temperature over a time range, but the detector is a mass spectrometer (MS) rather than an ECD. A mass spectrum collects a chromatogram for each peak and compares the sample spectrum to a reference spectra which are collected under similar instrument conditions. Identification of specific VOCs is based on three factors: 1) retention time (identified in the ALS TO-15 SOP as ±0.1 minutes), 2) the mass fragmentation pattern, and 3) the relative intensity of the target ions (masses). Mass spectrometry is considered a more definitive identification technique than ECD because of the unique mass fragmentation patterns obtained by the GC MS and the reduced chance of misidentification of a VOC.

2.1 Investigation of Possible Interferants in CARB 422 Chromatograms

CARB 422 EDB soil gas concentrations are consistently elevated relative to TO-15 values in samples collected from Q3 2015 through Q3 2016 at 284 SVMPs with varying depth intervals (USACE, 2017a; USACE, 2017b), and EDB concentrations ranging over orders of magnitude (Figure A1-1 and A1-2). The consistency of this bias suggests no plausible basis for suspecting another interferent could be present when analyzing for EDB soil gas concentrations by CARB 422. However, to confirm whether this conclusion was accurate, EDB soil gas concentration results from 16 laboratory data packages were evaluated to determine if interferent was creating the high bias observed by the CARB 422.

It is important to note that the ECD responds equally to all halogenated VOCs, and the peaks are identified based on the time at which they elute from the GC column and are detected (retention time). In ALS's SOP for CARB 422, retention time windows are defined as ±0.1 minutes of the retention time of the daily continuing calibration verification (CCV) standard. Therefore, for ALS's CARB 422 EDB analyses, any peak appearing within the retention time window defined by the CCV is automatically identified as EDB by the instrument software and quantitated.

After the entire analytical sequence has been completed, the ALS analyst reviews the instrument identifications. Using professional judgment, the analyst may remove a detection that indicated a positive detection. Often this occurs when the analyst has reason to believe the peak is actually an interfering compound. When reviewing the laboratory data packages, peaks identified as EDB by the software were manually edited by the analyst and approved by the supervisor to be removed as an EDB detection. The ALS analyst overlaid each sample chromatogram with the chromatogram of the bracketing CCVs to determine which peak should be identified as EDB detection.

Example chromatograms illustrating this process were provided by ALS and are shown in Figures A1-3 and A1-4. In Figure A1-3, the chromatogram shows that the instrument software identified the 2.779 minute peak as EDB; however, as shown in Figure A1-4, when the sample chromatogram was overlaid with the bracketing CCVs, it was clear that the retention time of the sample peak did not match that of EDB in the CCV chromatogram. The identification of the 2.779 minute peak as EDB was then manually deleted. Once discarded as a valid EDB detect, no further consideration was given to this peak.

The review of the laboratory data packages found that ALS was adhering closely to the laboratory SOP when identifying EDB by CARB 422. There is no indication that ALS was incorrectly identifying other closely eluting halogenated VOCs as EDB. It is unlikely that interference was causing the high EDB soil gas concentration bias observed by CARB 422. In addition, there is no evidence that an interferent exists based on review of the halogenated VOCs measured by TO-15.

2.2 Investigation of the Effect of High Concentrations of VOCs on EDB Detections by TO-15

The potential interfering effect of high VOC concentrations on the accuracy of analytical results for EDB by TO-15 was assessed. Sixteen laboratory data packages were evaluated to determine if EDB soil gas concentrations were detected in the presence of high VOC concentrations.

Figures A1-5 through A1-7 depict TO-15 mass spectra from Site samples collected in Q1 2016 with varying mass ratios (i.e., approximately 10, 100, and 1000 times [×]) of fuel to EDB. In Figure A1-5, the mass of fuels exceeded the mass of EDB by 10× and the EDB ions (i.e., 107 and 109) were visible in the spectrum along with fuel ions such as 57 and 71. When the mass of fuels are about 100× (Figure A1-6) or 1000× (Figure A1-7) than the mass of EDB, the EDB ions were not visible in the spectra because EDB detections were dwarfed by the underlying fuel ions. However, the EDB ions (i.e., 107 and 109) were detected by the instrument despite the high fuel concentrations such as n-hexane, decane, heptane, etcetera in soil gas samples.

In addition, all EDB soil gas total ion chromatographs from the data packages accurately depicted the EDB identification in the samples evaluated. This can be observed in Figures A1-5 through A1-7 in the bottom-right corner of each figure where the EDB sample chromatographs in blue were overlaid with the laboratory chromatograph in black. The identification and quantification of EDB results were not affected by high concentrations of other VOCs.

3 INVESTIGATION OF ANALYTICAL BIAS

The consistent, unidirectional bias in EDB soil gas concentrations were determined not to be due to an interferent in the CARB 422 analysis (Section 2.1) or high VOC concentrations invalidating identification of EDB soil gas concentrations by TO-15 (Section 2.2). To further investigate why EDB soil gas results were biased high by CARB 422; the Air Force reviewed the ALS SOPs for both CARB 422 and TO-15. It was determined that TO-15 and CARB 422 used laboratory control samples (LCSs; i.e., working standards) made from different concentrated stock standards purchased from commercial vendors; however, these stock standards were each prepared differently when creating the standards for each method. For TO-15, the stock standard was diluted into individual standards using an automated dispensing system; whereas, for CARB 422 the stock standards were diluted by hand dispensing into low and high calibration standards, which were diluted again by hand into individual standards. Although there were differences in preparation of the LCSs, it was hypothesized that the LCS from each method could be analyzed by the other method to provide information on the CARB 422 bias.

The Air Force requested ALS to analyze the CARB 422 LCS on the GC MS instrument that was used for TO-15 for this project and determined the EDB recovery was 58%. The TO-15 LCS was analyzed on the GC ECD instrument (i.e., GC21) that was used for CARB 422 for this project, but the LCS overwhelmed the instrument and provided no useful information. ALS then calibrated a different GC ECD instrument for CARB 422 and analyzed the “old” CARB 422 LCS (the same LCS used on GC MS and on GC21) and the EDB recovery was 60%.

These low EDB recoveries demonstrates a problem with the preparation of the CARB 422 LCS(s) and the calibration curve used on the GC ECD instrument which returns too high EDB soil gas concentrations. For instance, if the “old” CARB 422 LCS was 10 parts per billion by volume (ppbv) and was previously verified as 10 ppbv by the project GC ECD instrument (i.e., GC21), but when analyzed by two other instruments yielded only 6 ppbv. Working in the opposite direction, a sample known to contain 6 ppbv of EDB would give a result of 10 ppbv on the project GC ECD (i.e., GC21) and will bias EDB soil gas concentrations higher.

When questioned as to the root cause of this discrepancy, ALS theorized that the two initial calibration standards (i.e., the hand-dispensed low and high standards, which were diluted by hand into working standards) and the initial calibration verification (ICV) standard were not allowed to sufficiently equilibrate prior to dilution and analysis. Both standards were made on July 21, 2015. Per the ALS SOP, the equilibration time is 15 to 20 minutes. It was determined all EDB soil gas samples analyzed by CARB 422 were on one instrument (i.e., GC21) using one of two stored calibrations curves on the instrument dated July 21, 2015 and July 29, 2015. Both of the stored calibration curves were performed using the two initial calibration standards which were diluted and the ICV standard made on July 21, 2015. Additionally, ALS did not explain why an automated dispensing system was not used for CARB 422 standard preparation. Therefore, all EDB soil gas samples from the Site analyzed by CARB 422 were affected by improper standard preparations. It is not possible to determine if the equilibrium time and/or hand dispensing contributed more to the improper standard preparations (for example [e.g.], all LCSs and ICV). ALS released a Non-Conformance Corrective Action Report outlining the discrepancy (KAFB, 2017).

The primary information available about the bias between the TO-15 and CARB 422 methods comes from the ALS Non-Conformance Corrective Action Report (KAFB, 2017), and 58% and 60% EDB recovery when analyzing LCS on GC MS and on the different GC ECD instruments, respectively. These two LCS analyses indicate that the CARB 422 EDB soil gas results are biased on average about 1.7

times higher than the TO-15 results. Although the 1.7 times higher is a smaller bias for CARB 422 than that observed one to five higher EDB soil gas concentration results (Figure A1-1); it is still within the range and casts doubt on the reliability of all CARB 422 EDB soil gas concentration results.

4 SUMMARY

The results of these investigations recommend TO-15 EDB soil gas concentration results be used in this RA for the following reasons:

- CARB 422 EDB soil gas concentration results were consistently biased high in relation to TO-15 EDB soil gas results.
- Investigation of laboratory SOPs indicates that preparation of calibration standards is responsible for the bias in CARB 422 concentrations.
- The identification and quantification of EDB soil gas concentrations by TO-15 was not affected by high VOC concentrations such as fuel-related analytes from the Site.

The future use of CARB 422 may be considered where it is important to evaluate EDB soil gas concentrations in the presence of high VOC concentrations, such as monitoring the effectiveness of bioventing or air-lifting interim measures in the source area (KAFB, 2017; NMED 2017). However, this method will only be used if ALS SOP issues for the CARB 422 method are resolved.

5 REFERENCES

KAFB, 2017. Correspondence from Eric H. Froehlich, Base Commander, Kirtland AFB, NM to Mr. John Kieling, Bureau Chief, Hazardous Waste Bureau, New Mexico Environment Department, regarding Requesting a Modification to the *Work Plan for Soil Vapor Monitoring and Drinking Water Monitoring, August 2016, Solid Waste Management Unit ST-106/SS-111,* Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, EPA ID# NM9570024423, HWB-KAFB-13-MISC. 03 April.

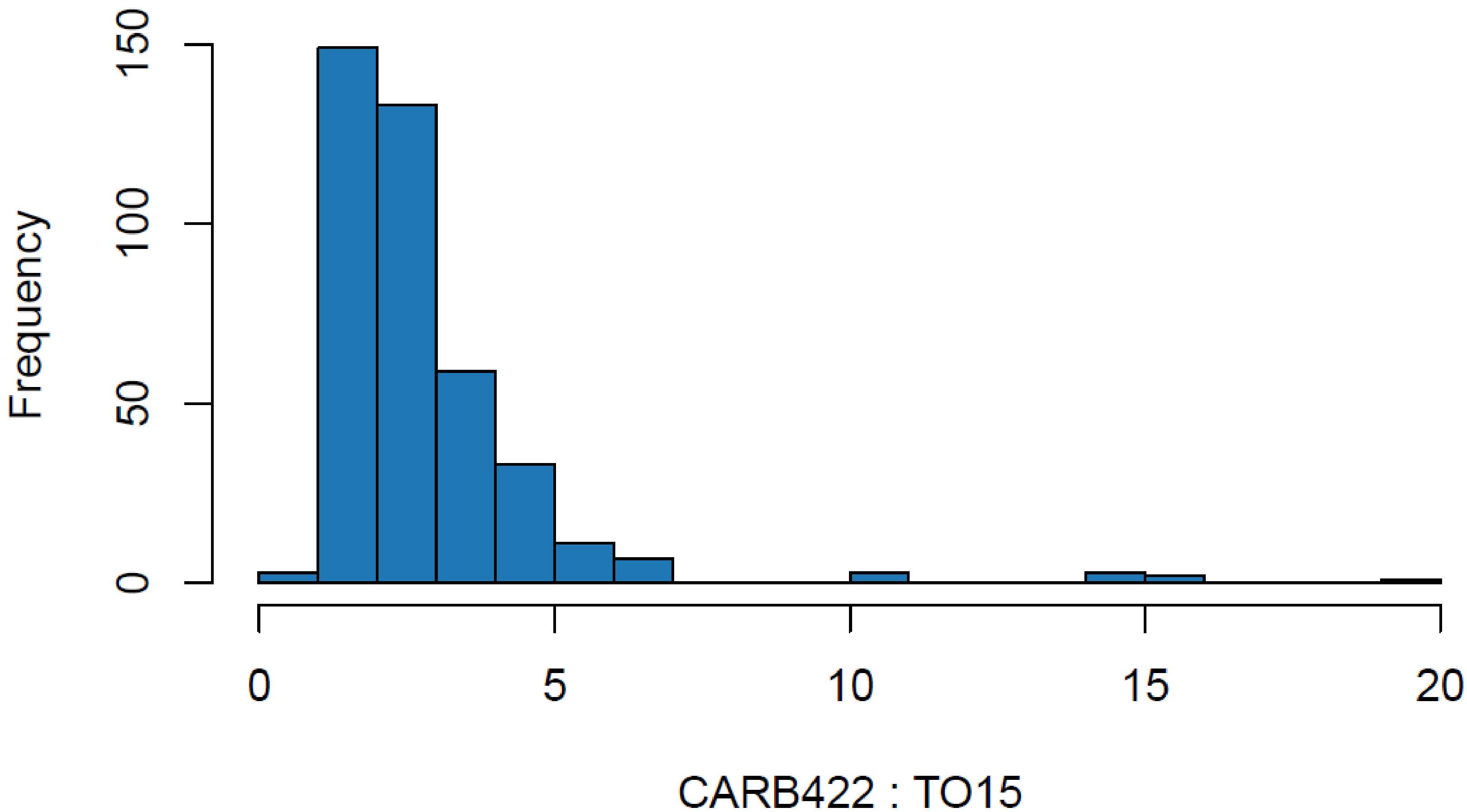
NMED, 2017. Correspondence from Juan Carlos Borrego, Deputy Secretary, New Mexico Environment Department to Colonel E. Froehlich, Base Commander and Lt. Colonel W. Acosta, Civil Engineer Office, Kirtland AFB, NM, regarding Modification Request to the Work Plan for Soil Vapor and Drinking Water Monitoring, August 2016, 27 April.

USACE, 2017a. RCRA Facility Investigation Report Solid Waste Management Unit ST-106/SS-111 Kirtland Air Force Base, New Mexico. Prepared by Sundance Consulting, Inc., for the USACE Albuquerque District under Contract No. W912PP-16-C-0002. January

USACE, 2017b. Quarterly Monitoring Report October – December 2016 and Annual Report for 2016 Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111 Kirtland Air Force Base, New Mexico. Prepared by EA Engineering, Science, and Technology, Inc., PBC., for the USACE Albuquerque District under Contract No. W912DR-12-D-0006 Delivery Order DM01. March.

FIGURES

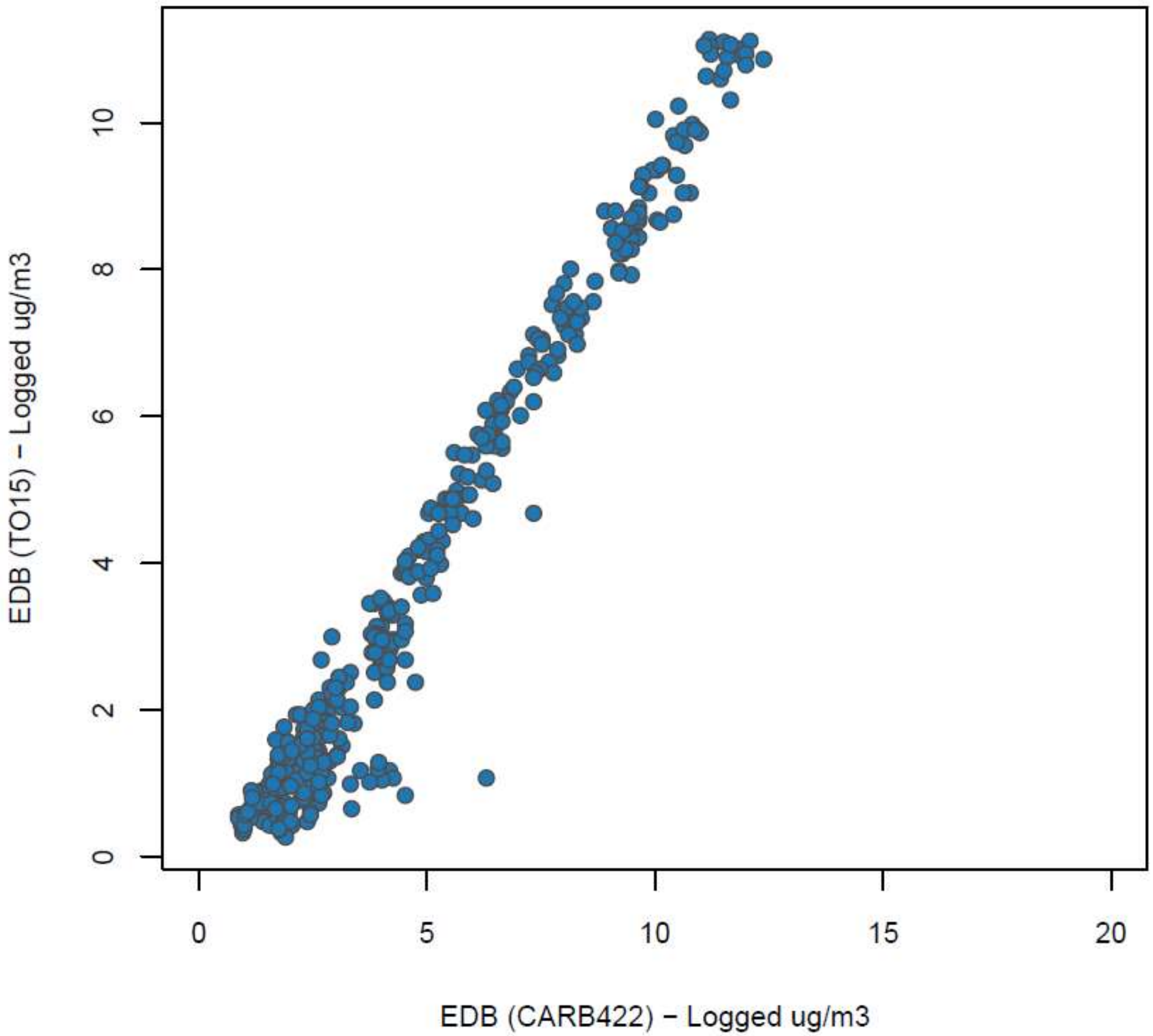
Figure A1-1. Ratio of CARB 422 and TO-15 EDB Soil Gas Results; Detected Values Only[1]



[1] Four outlier paired samples were removed from the graphic to facilitate the visualization.

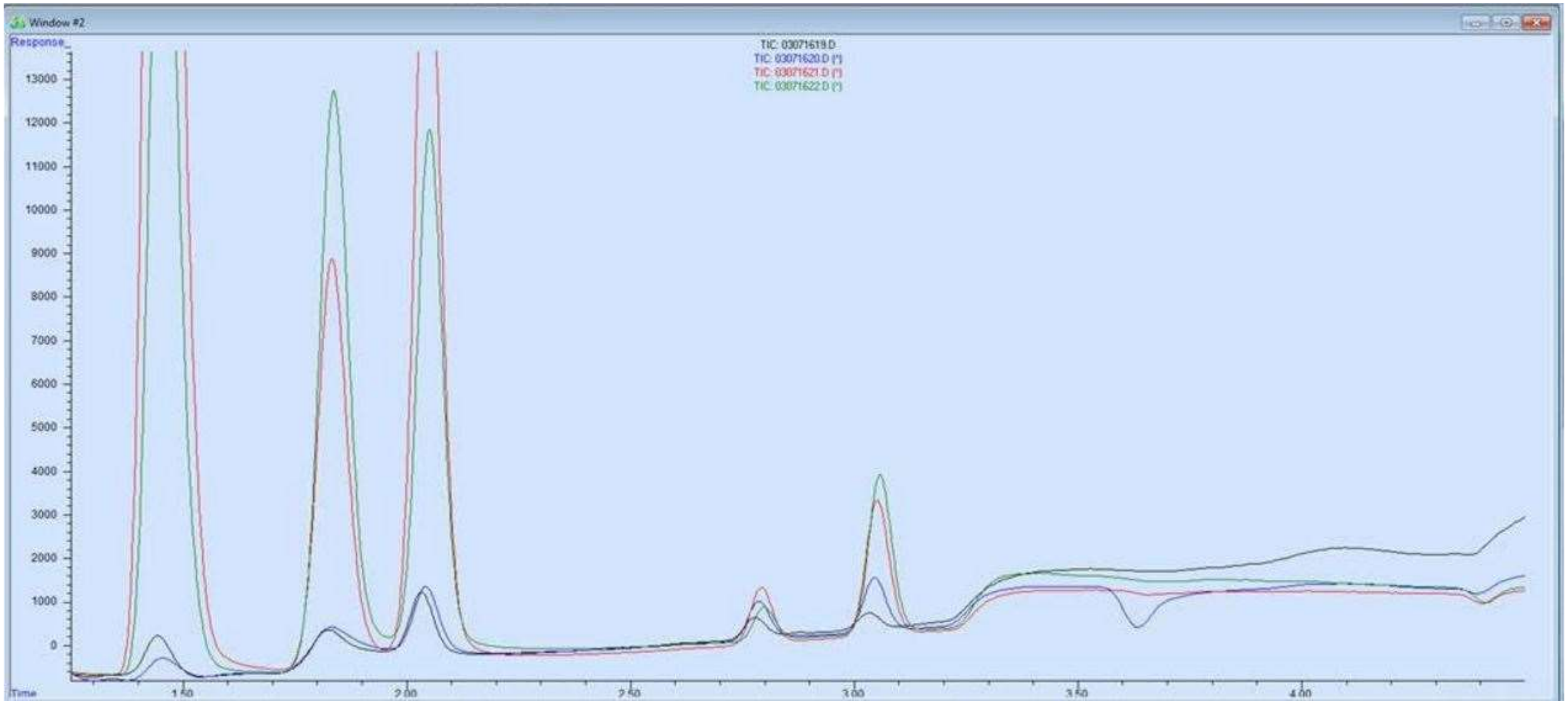
*Q3 2015 through Q3 2016 soil gas data was used for this evaluation (USACE, 2017a; USACE, 2017b).

Figure A1-2. Scatterplot of CARB 422 and TO-15 EDB Soil Gas Results; Detected Values Only



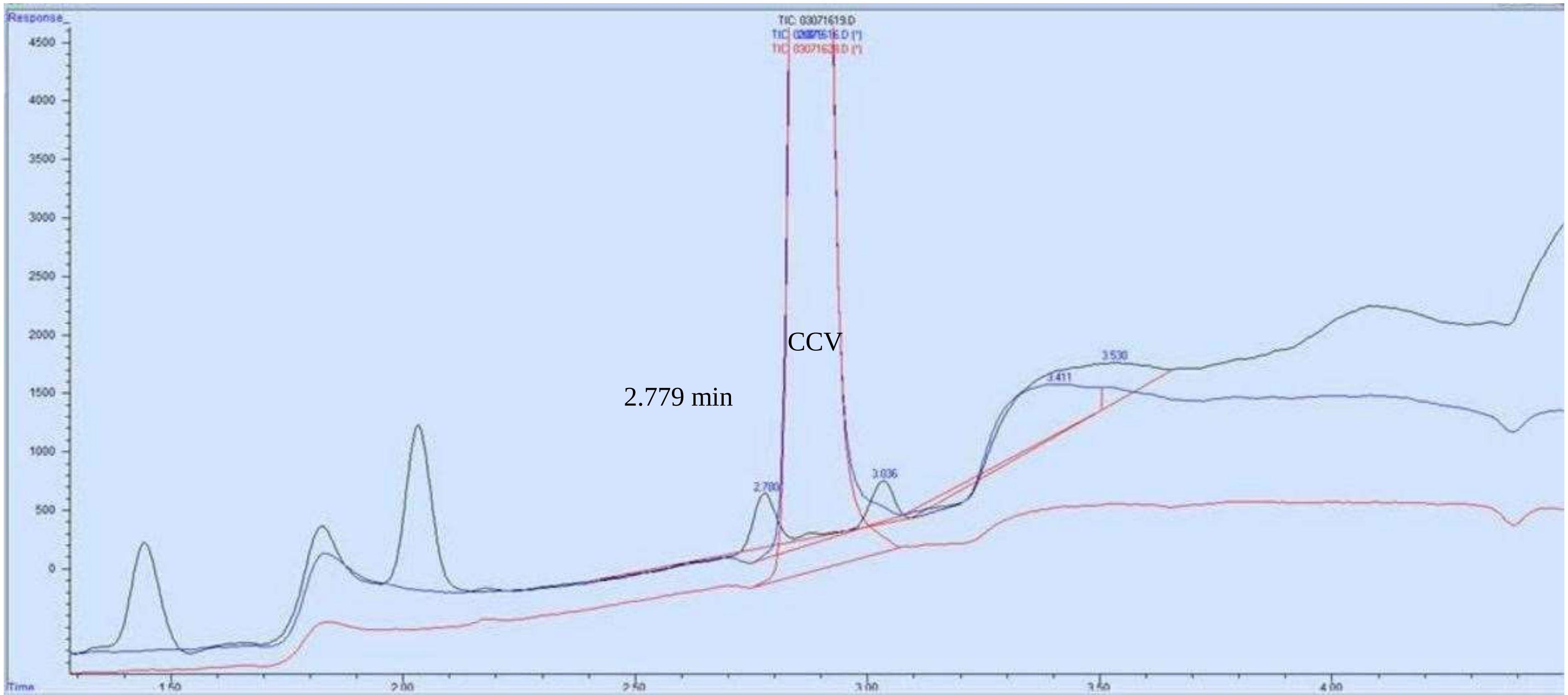
*Q3 2015 through Q3 2016 soil gas data was used for this evaluation (USACE, 2017a; USACE, 2017b).

Figure A1-3. Overlaid Sample Chromatograms



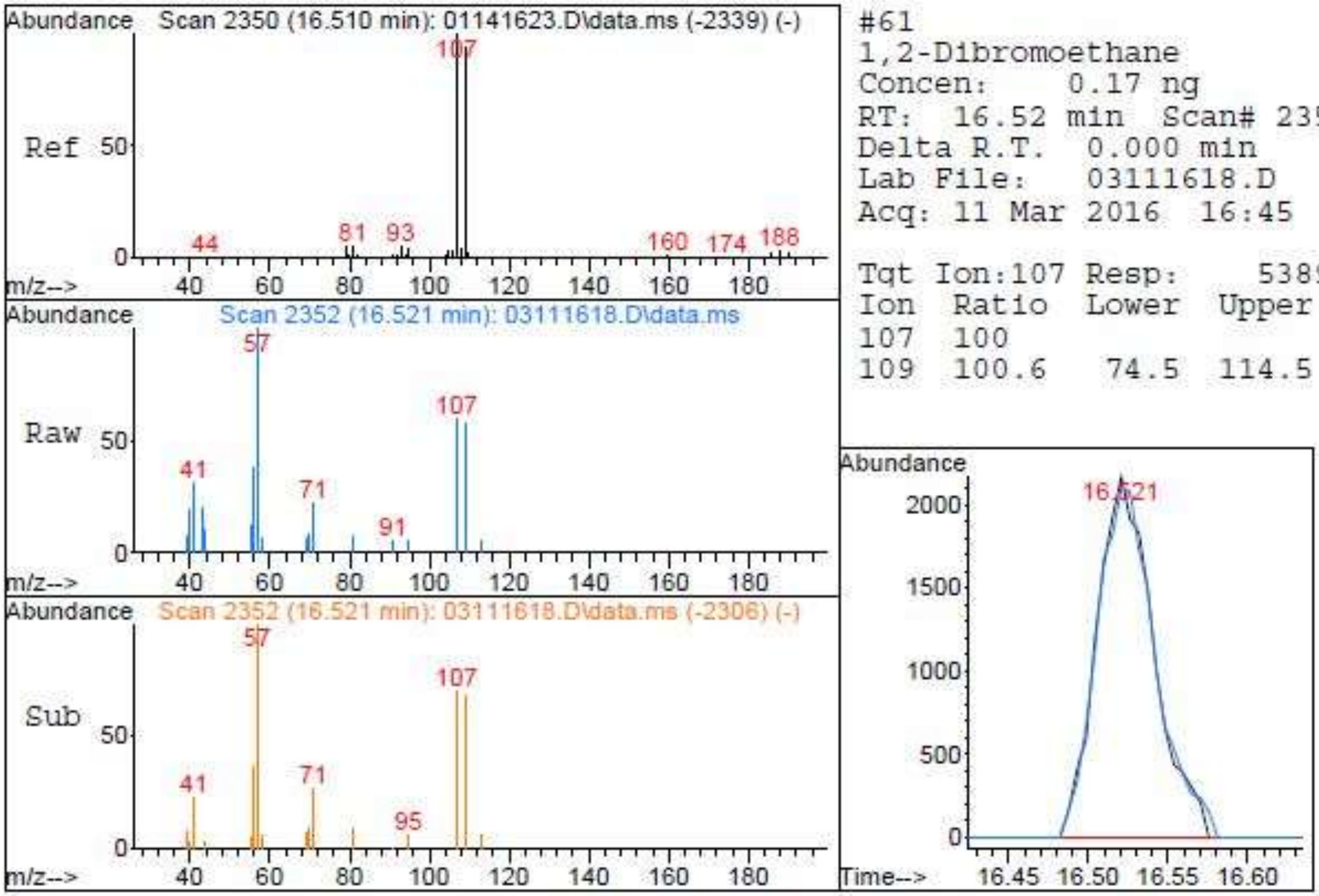
Each colored trace is a Site sample chromatogram. The y-axis is the relative intensity of the peak and the x-axis is the retention time, with the leftmost hash mark at 1.50 minutes and the rightmost hash mark at 4.00 minutes. The instrument files used to construct this overlay are identified at the top of the figure. The peak identified as ethylene dibromide by the instrument software is denoted by its retention time of 2.779 minutes.

Figure A1-4. Overlaid Sample Chromatograms with Continuing Calibration Verification (CCV)



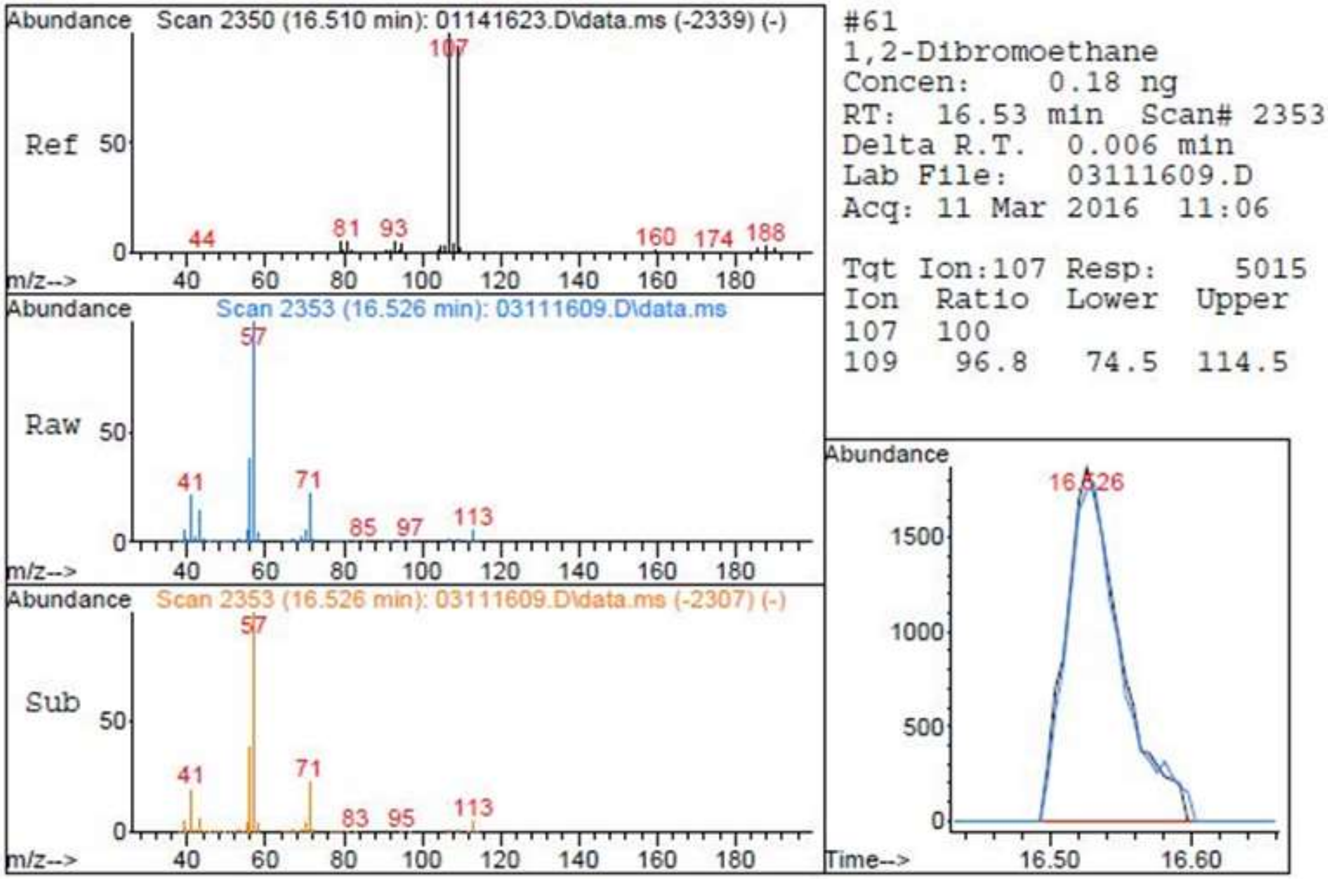
As the CCV peak did not overlap with the peak identified as ethylene dibromide (EDB) by the instrument, the analyst manually eliminated the EDB detect. Each colored trace is a Site sample chromatogram. The y-axis is the relative intensity of the peak and the x-axis is the retention time, with the leftmost hashmark at 1.50 minutes and the rightmost hashmark at 4.00 minutes. The instrument files used to construct this overlay are identified at the top of the window. The CCV is the large peak appearing underneath the files names and the smaller peak to the right of the CCV is the peak identified by the instrument as EDB. The elution times of the smaller peaks are identified above the peak maxima.

Figure A1-5. EDB TO-15 Mass Spectrum with Fuel to EDB Ratio of Approximately 10



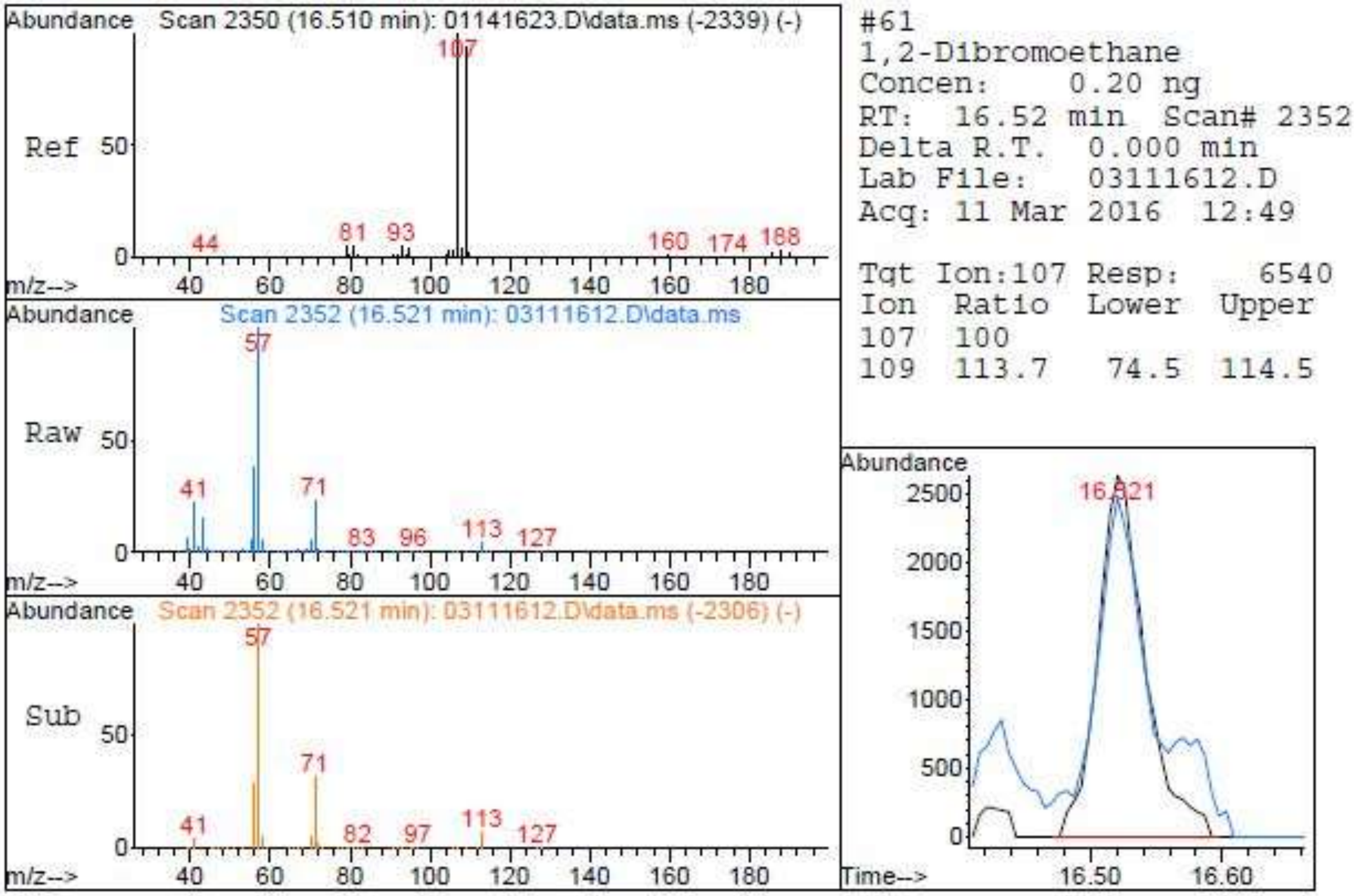
For each spectrum on the left, the y-axis is the percent abundance of the mass detected and the x-axis is the detected mass. The total ion chromatogram in the bottom-right corner is the abundance of the target ion on the y-axis and the retention time on the x-axis. The top block of text in the upper right details sample specific items such as amount of EDB detected, retention time, retention time difference from the expected retention time, file name, and date of analysis. The lower block of text lists the target and secondary ions, the total peak area, the ratio of the secondary ion (109) to the primary ion (107), and the expected ratio range.

Figure A1-6. EDB TO-15 Mass Spectrum with Fuel to EDB Ratio of Approximately 100



For each spectrum on the left, the y-axis is the percent abundance of the mass detected and the x-axis is the detected mass. The top spectra (Ref) is a reference spectrum from a reference sample under similar conditions. The middle spectrum (Raw) is the spectrum collected from the sample at the maxima of the ethylene dibromide (EDB) peak. The bottom spectrum (Sub) is the result of subtracting the reference from the sample spectrum. The total ion chromatogram in the bottom-right corner is the abundance of the target ion on the y-axis and the retention time on the x-axis. The top block of text in the upper right details sample specific items such as amount of EDB detected, retention time, retention time difference from the expected retention time, file name, and date of analysis. The lower block of text lists the target and secondary ions, the total peak area, the ratio of the secondary ion (109) to the primary ion (107), and the expected ratio range.

Figure A1-7. EDB TO-15 Mass Spectrum with Fuel to EDB Ratio of Approximately 1000



For each spectrum on the left, the y-axis is the percent abundance of the mass detected and the x-axis is the detected mass. The total ion chromatogram in the bottom-right corner is the abundance of the target ion on the y-axis and the retention time on the x-axis. The top block of text in the upper right details sample specific items such as amount of ethylene dibromide (EDB) detected, retention time, retention time difference from the expected retention time, file name, and date of analysis. The lower block of text lists the target and secondary ions, the total peak area, the ratio of the secondary ion (109) to the primary ion (107), and the expected ratio range.

Attachment 2.

ProUCL Input and Output Data Files

Attachment 2 (Continued)

Unexcavated Soil Samples from 0 to 1 foot Depth (Input)

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
2	0.000109	0		0.000491	0	
3	0.000147	0		0.000502	0	
4	0.000101	0		0.000675	0	
5	0.000099	0		0.000466	0	
6	0.000134	0		0.000454	0	
7	0.000097	0		0.000615	0	
8	0.000105	0		0.000446	0	
9	0.000159	0		0.000484	0	
10	0.0002965	0		0.000733	0	
11	0.000157	0		0.001365	0	
12	0.000119	0		0.000722	0	
13	0.000112	0		0.000547	0	
14	0.000154	0		0.000518	0	
15	0.000375	1		0.000707	0	

	G	H	I	J	K	L	M	N
1	**1,2-Dichloroethane**	**d_1,2-Dichloroethane**		**Benzene**	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**
2	0.000163	0		0.000142	0		0.000196	0
3	0.000167	0		0.000106	0		0.0002	0
4	0.000224	0		0.0001	0		0.00027	0
5	0.000155	0		0.00115	1		0.000186	0
6	0.000151	0		0.00107	1		0.000181	0
7	0.000204	0		0.000581	1		0.000246	0
8	0.000148	0		0.000866	1		0.000178	0
9	0.000161	0		0.000345	1		0.000193	0
10	0.000244	0		0.0002805	1		0.000293	0
11	0.0004535	0		0.0002035	1		0.0005465	0
12	0.00024	0		0.0002205	1		0.000219	0
13	0.000182	0		0.001312	1		0.000207	0
14	0.000172	0		0.000752	1		0.000283	0
15	0.000235	0		0.000485	1		0.000297	1

	O	P	Q	R	S
1		**Isopropylbenzene**	**d_Isopropylbenzene**		**MTBE (Methyl tert-butyl ether)**
2		0.000083	0		0.000214
3		0.000085	0		0.000219
4		0.000115	0		0.000294
5		0.000079	0		0.000203
6		0.000077	0		0.000198
7		0.000105	0		0.000268
8		0.000076	0		0.000194
9		0.000082	0		0.000211
10		0.000125	0		0.00032
11		0.0002325	0		0.000596
12		0.000123	0		0.000315
13		0.000093	0		0.000239
14		0.000088	0		0.000226
15		0.00012	0		0.000308

	T	U	V	W	X	Y	Z	AA
1	d_MTBE (Methyl tert-butyl ether)		Naphthalene	d_Naphthalene		Toluene	d_Toluene	
2	0		0.000157	0		0.000219	0	
3	0		0.00016	0		0.000353	0	
4	0		0.000216	0		0.0006585	0	
5	0		0.000149	0		0.000249	0	
6	0		0.000145	0		0.000224	1	
7	0		0.000196	0		0.000719	1	
8	0		0.000142	0		0.000873	1	
9	0		0.000155	0		0.000253	1	
10	0		0.000234	0		0.0006	1	
11	0		0.0004365	0		0.000745	1	
12	0		0.000175	0		0.0002205	1	
13	0		0.000165	0		0.001315	1	
14	0		0.000226	0		0.001	1	
15	0		0.00638	1		0.000587	1	

	AB	AC
1	**Xylenes (total)**	**d_Xylenes (total)**
2	0.000392	0
3	0.000527	0
4	0.000364	0
5	0.000355	0
6	0.00048	0
7	0.000348	0
8	0.000378	0
9	0.000573	0
10	0.0010695	0
11	0.000564	0
12	0.000427	0
13	0.000404	0
14	0.000552	0
15	0.000633	1

	A	B	C	D	E
1	**2-Methylnaphthalene**	**d_2-Methylnaphthalene**		**Lead**	**d_Lead**
2	0.0519	1		17.2	1
3	0.00952	0		3.63	1
4	0.00995	0		4.66	1
5	0.00989	0		4.49	1
6	0.009535	0		7.335	1
7	0.00945	0		6.45	1
8	0.139	1		7.42	1
9	0.00949	0		11.9	1
10	0.012	1		9.01	1
11	0.00958	0		9.5	1
12	0.00931	0		8.16	1
13	0.00941	0		39.1	1
14	0.00906	0		18.2	1
15	0.00953	0		5.46	1

Attachment 2 (Continued)

Unexcavated Soil Samples from 0 to 1 foot Depth (Output)

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.14/5/2017 3:48:56 PM
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2,4-Trimethylbenzene

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	1	Number of Non-Detects	13
Number of Distinct Detects	1	Number of Distinct Non-Detects	13

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 1,2,4-Trimethylbenzene was not processed!

1,2-Dibromoethane

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	0	Number of Non-Detects	14
Number of Distinct Detects	0	Number of Distinct Non-Detects	14

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-Dibromoethane was not processed!

1,2-Dichloroethane

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	0	Number of Non-Detects	14
Number of Distinct Detects	0	Number of Distinct Non-Detects	14

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-Dichloroethane was not processed!

Benzene

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	11	Number of Non-Detects	3
Number of Distinct Detects	11	Number of Distinct Non-Detects	3
Minimum Detect	2.0350E-4	Minimum Non-Detect	1.0000E-4
Maximum Detect	0.00131	Maximum Non-Detect	1.4200E-4
Variance Detects	1.5659E-7	Percent Non-Detects	21.43%
Mean Detects	6.6050E-4	SD Detects	3.9571E-4
Median Detects	5.8100E-4	CV Detects	0.599
Skewness Detects	0.393	Kurtosis Detects	-1.322
Mean of Logged Detects	-7.513	SD of Logged Detects	0.675

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.92	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	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	5.4039E-4	KM Standard Error of Mean	1.1377E-4
KM SD	4.0588E-4	95% KM (BCA) UCL	7.1946E-4
95% KM (t) UCL	7.4187E-4	95% KM (Percentile Bootstrap) UCL	7.1704E-4
95% KM (z) UCL	7.2753E-4	95% KM Bootstrap t UCL	7.6333E-4
90% KM Chebyshev UCL	8.8171E-4	95% KM Chebyshev UCL	0.00104
97.5% KM Chebyshev UCL	0.00125	99% KM Chebyshev UCL	0.00167

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.313	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.257	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)	2.783	k star (bias corrected MLE)	2.084
Theta hat (MLE)	2.3737E-4	Theta star (bias corrected MLE)	3.1689E-4
nu hat (MLE)	61.22	nu star (bias corrected)	45.85
Mean (detects)	6.6050E-4		

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	2.0350E-4	Mean	0.00266
Maximum	0.01	Median	8.0900E-4
SD	0.00399	CV	1.5
k hat (MLE)	0.637	k star (bias corrected MLE)	0.548
Theta hat (MLE)	0.00418	Theta star (bias corrected MLE)	0.00485
nu hat (MLE)	17.84	nu star (bias corrected)	15.35

	A	B	C	D	E	F	G	H	I	J	K	L
105					Adjusted Level of Significance (β)	0.0312						
106					Approximate Chi Square Value (15.35, α)	7.508					Adjusted Chi Square Value (15.35, β)	6.792
107					95% Gamma Approximate UCL (use when n>=50)	0.00544					95% Gamma Adjusted UCL (use when n<50)	0.00602
108												
109	Estimates of Gamma Parameters using KM Estimates											
110					Mean (KM)	5.4039E-4					SD (KM)	4.0588E-4
111					Variance (KM)	1.6474E-7					SE of Mean (KM)	1.1377E-4
112					k hat (KM)	1.773					k star (KM)	1.44
113					nu hat (KM)	49.63					nu star (KM)	40.33
114					theta hat (KM)	3.0486E-4					theta star (KM)	3.7517E-4
115					80% gamma percentile (KM)	8.3979E-4					90% gamma percentile (KM)	0.00114
116					95% gamma percentile (KM)	0.00143					99% gamma percentile (KM)	0.00208
117												
118	Gamma Kaplan-Meier (KM) Statistics											
119					Approximate Chi Square Value (40.33, α)	26.78					Adjusted Chi Square Value (40.33, β)	25.32
120					95% Gamma Approximate KM-UCL (use when n>=50)	8.1386E-4					95% Gamma Adjusted KM-UCL (use when n<50)	8.6075E-4
121												
122	Lognormal GOF Test on Detected Observations Only											
123					Shapiro Wilk Test Statistic	0.927	Shapiro Wilk GOF Test					
124					5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level					
125					Lilliefors Test Statistic	0.137	Lilliefors GOF Test					
126					5% Lilliefors Critical Value	0.251	Detected Data appear Lognormal at 5% Significance Level					
127	Detected Data appear Lognormal at 5% Significance Level											
128												
129	Lognormal ROS Statistics Using Imputed Non-Detects											
130					Mean in Original Scale	5.4308E-4					Mean in Log Scale	-7.851
131					SD in Original Scale	4.1820E-4					SD in Log Scale	0.896
132					95% t UCL (assumes normality of ROS data)	7.4102E-4					95% Percentile Bootstrap UCL	7.1786E-4
133					95% BCA Bootstrap UCL	7.4261E-4					95% Bootstrap t UCL	7.6008E-4
134					95% H-UCL (Log ROS)	0.00112						
135												
136	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution											
137					KM Mean (logged)	-7.877					KM Geo Mean	3.7953E-4
138					KM SD (logged)	0.9					95% Critical H Value (KM-Log)	2.632
139					KM Standard Error of Mean (logged)	0.252					95% H-UCL (KM -Log)	0.0011
140					KM SD (logged)	0.9					95% Critical H Value (KM-Log)	2.632
141					KM Standard Error of Mean (logged)	0.252						
142												
143	DL/2 Statistics											
144	DL/2 Normal						DL/2 Log-Transformed					
145					Mean in Original Scale	5.3139E-4					Mean in Log Scale	-7.996
146					SD in Original Scale	4.3161E-4					SD in Log Scale	1.13
147					95% t UCL (Assumes normality)	7.3568E-4					95% H-Stat UCL	0.00164
148	DL/2 is not a recommended method, provided for comparisons and historical reasons											
149												
150	Nonparametric Distribution Free UCL Statistics											
151	Detected Data appear Normal Distributed at 5% Significance Level											
152												
153	Suggested UCL to Use											
154					95% KM (t) UCL	7.4187E-4						
155												
156	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	14	Number of Distinct Observations	14
Number of Detects	1	Number of Non-Detects	13
Number of Distinct Detects	1	Number of Distinct Non-Detects	13

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 Ethylbenzene was not processed!

Isopropylbenzene

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	0	Number of Non-Detects	14
Number of Distinct Detects	0	Number of Distinct Non-Detects	14

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Isopropylbenzene was not processed!

MTBE (Methyl tert-butyl ether)

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	0	Number of Non-Detects	14
Number of Distinct Detects	0	Number of Distinct Non-Detects	14

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable MTBE (Methyl tert-butyl ether) was not processed!

Naphthalene

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	1	Number of Non-Detects	13
Number of Distinct Detects	1	Number of Distinct Non-Detects	13

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 Naphthalene was not processed!

Toluene

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	10	Number of Non-Detects	4
Number of Distinct Detects	10	Number of Distinct Non-Detects	4
Minimum Detect	2.2050E-4	Minimum Non-Detect	2.1900E-4
Maximum Detect	0.00132	Maximum Non-Detect	6.5850E-4
Variance Detects	1.2868E-7	Percent Non-Detects	28.57%
Mean Detects	6.5365E-4	SD Detects	3.5872E-4
Median Detects	6.5950E-4	CV Detects	0.549
Skewness Detects	0.352	Kurtosis Detects	-0.343
Mean of Logged Detects	-7.499	SD of Logged Detects	0.646

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.935	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	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	5.3737E-4	KM Standard Error of Mean	9.7951E-5
KM SD	3.4473E-4	95% KM (BCA) UCL	6.8693E-4
95% KM (t) UCL	7.1084E-4	95% KM (Percentile Bootstrap) UCL	6.8923E-4
95% KM (z) UCL	6.9849E-4	95% KM Bootstrap t UCL	7.3468E-4
90% KM Chebyshev UCL	8.3123E-4	95% KM Chebyshev UCL	9.6433E-4
97.5% KM Chebyshev UCL	0.00115	99% KM Chebyshev UCL	0.00151

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.465	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.732	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.168	k star (bias corrected MLE)	2.285
Theta hat (MLE)	2.0630E-4	Theta star (bias corrected MLE)	2.8612E-4
nu hat (MLE)	63.37	nu star (bias corrected)	45.69
Mean (detects)	6.5365E-4		

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	2.2050E-4	Mean	0.00332
Maximum	0.01	Median	8.0900E-4
SD	0.00439	CV	1.321
k hat (MLE)	0.635	k star (bias corrected MLE)	0.546
Theta hat (MLE)	0.00524	Theta star (bias corrected MLE)	0.00608
nu hat (MLE)	17.77	nu star (bias corrected)	15.3
Adjusted Level of Significance (β)	0.0312		
Approximate Chi Square Value (15.30, α)	7.468	Adjusted Chi Square Value (15.30, β)	6.754
95% Gamma Approximate UCL (use when n>=50)	0.00681	95% Gamma Adjusted UCL (use when n<50)	0.00753

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.3737E-4	SD (KM)	3.4473E-4
Variance (KM)	1.1884E-7	SE of Mean (KM)	9.7951E-5
k hat (KM)	2.43	k star (KM)	1.957
nu hat (KM)	68.04	nu star (KM)	54.79
theta hat (KM)	2.2115E-4	theta star (KM)	2.7462E-4
80% gamma percentile (KM)	8.0660E-4	90% gamma percentile (KM)	0.00105
95% gamma percentile (KM)	0.00128	99% gamma percentile (KM)	0.0018

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (54.79, α)	38.78	Adjusted Chi Square Value (54.79, β)	37
95% Gamma Approximate KM-UCL (use when n>=50)	7.5920E-4	95% Gamma Adjusted KM-UCL (use when n<50)	7.9576E-4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.236	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	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	5.2542E-4	Mean in Log Scale	-7.797
SD in Original Scale	3.6662E-4	SD in Log Scale	0.748
95% t UCL (assumes normality of ROS data)	6.9894E-4	95% Percentile Bootstrap UCL	6.8302E-4
95% BCA Bootstrap UCL	6.9425E-4	95% Bootstrap t UCL	7.3550E-4
95% H-UCL (Log ROS)	8.9522E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.741	KM Geo Mean	4.3469E-4
KM SD (logged)	0.656	95% Critical H Value (KM-Log)	2.288
KM Standard Error of Mean (logged)	0.188	95% H-UCL (KM -Log)	8.1757E-4
KM SD (logged)	0.656	95% Critical H Value (KM-Log)	2.288
KM Standard Error of Mean (logged)	0.188		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	5.1973E-4	Mean in Log Scale	-7.84
SD in Original Scale	3.7376E-4	SD in Log Scale	0.811
95% t UCL (Assumes normality)	6.9663E-4	95% H-Stat UCL	9.5883E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

	A	B	C	D	E	F	G	H	I	J	K	L
313												
314	Nonparametric Distribution Free UCL Statistics											
315	Detected Data appear Normal Distributed at 5% Significance Level											
316												
317	Suggested UCL to Use											
318					95% KM (t) UCL	7.1084E-4						
319												
320	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
321	Recommendations are based upon data size, data distribution, and skewness.											
322	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
323	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
324												
325	Xylenes (total)											
326												
327	General Statistics											
328					Total Number of Observations	14					Number of Distinct Observations	14
329					Number of Detects	1					Number of Non-Detects	13
330					Number of Distinct Detects	1					Number of Distinct Non-Detects	13
331												
332	Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!											
333	It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).											
334												
335	The data set for variable Xylenes (total) was not processed!											
336												
337												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.14/6/2017 10:22:44 AM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	Lead											
12												
13	General Statistics											
14	Total Number of Observations					14	Number of Distinct Observations					14
15							Number of Missing Observations					0
16	Minimum					3.63	Mean					10.89
17	Maximum					39.1	Median					7.79
18	SD					9.238	Std. Error of Mean					2.469
19	Coefficient of Variation					0.848	Skewness					2.485
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic					0.704	Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value					0.874	Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic					0.274	Lilliefors GOF Test					
25	5% Lilliefors Critical Value					0.226	Data Not Normal at 5% Significance Level					
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
30	95% Student's-t UCL					15.27	95% Adjusted-CLT UCL (Chen-1995)					16.71
31							95% Modified-t UCL (Johnson-1978)					15.54
32												
33	Gamma GOF Test											
34	A-D Test Statistic					0.635	Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value					0.745	Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic					0.21	Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value					0.231	Detected data appear Gamma Distributed at 5% Significance Level					
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)					2.405	k star (bias corrected MLE)					1.938
42	Theta hat (MLE)					4.529	Theta star (bias corrected MLE)					5.623
43	nu hat (MLE)					67.35	nu star (bias corrected)					54.25
44	MLE Mean (bias corrected)					10.89	MLE Sd (bias corrected)					7.826
45							Approximate Chi Square Value (0.05)					38.33
46	Adjusted Level of Significance					0.0312	Adjusted Chi Square Value					36.56
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50)					15.42	95% Adjusted Gamma UCL (use when n<50)					16.17
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic					0.941	Shapiro Wilk Lognormal GOF Test					

5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.161	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.289	Mean of logged Data	2.166
Maximum of Logged Data	3.666	SD of logged Data	0.64
Assuming Lognormal Distribution			
95% H-UCL	16.02	90% Chebyshev (MVUE) UCL	16.17
95% Chebyshev (MVUE) UCL	18.73	97.5% Chebyshev (MVUE) UCL	22.27
99% Chebyshev (MVUE) UCL	29.24		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	14.95	95% Jackknife UCL	15.27
95% Standard Bootstrap UCL	14.85	95% Bootstrap-t UCL	20.07
95% Hall's Bootstrap UCL	29.71	95% Percentile Bootstrap UCL	15.09
95% BCA Bootstrap UCL	17		
90% Chebyshev(Mean, Sd) UCL	18.3	95% Chebyshev(Mean, Sd) UCL	21.66
97.5% Chebyshev(Mean, Sd) UCL	26.31	99% Chebyshev(Mean, Sd) UCL	35.46
Suggested UCL to Use			
95% Adjusted Gamma UCL	16.17		
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	14	Number of Distinct Observations	14
Number of Detects	3	Number of Non-Detects	11
Number of Distinct Detects	3	Number of Distinct Non-Detects	11
Minimum Detect	0.012	Minimum Non-Detect	0.00906
Maximum Detect	0.139	Maximum Non-Detect	0.00995
Variance Detects	0.00422	Percent Non-Detects	78.57%
Mean Detects	0.0676	SD Detects	0.0649
Median Detects	0.0519	CV Detects	0.96
Skewness Detects	1.026	Kurtosis Detects	N/A
Mean of Logged Detects	-3.118	SD of Logged Detects	1.233
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	0.956	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.262	**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	0.0216	KM Standard Error of Mean	0.0112
KM SD	0.0344	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0415	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0401	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0553	95% KM Chebyshev UCL	0.0706
97.5% KM Chebyshev UCL	0.0918	99% KM Chebyshev UCL	0.133
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.32	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0513	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7.917	nu star (bias corrected)	N/A
Mean (detects)	0.0676		
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	0.0224
Maximum	0.139	Median	0.01
SD	0.0354	CV	1.583
k hat (MLE)	1.168	k star (bias corrected MLE)	0.965
Theta hat (MLE)	0.0191	Theta star (bias corrected MLE)	0.0232
nu hat (MLE)	32.71	nu star (bias corrected)	27.03
Adjusted Level of Significance (β)	0.0312		
Approximate Chi Square Value (27.03, α)	16.18	Adjusted Chi Square Value (27.03, β)	15.07
95% Gamma Approximate UCL (use when n>=50)	0.0373	95% Gamma Adjusted UCL (use when n<50)	N/A
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.0216	SD (KM)	0.0344
Variance (KM)	0.00118	SE of Mean (KM)	0.0112
k hat (KM)	0.396	k star (KM)	0.359
nu hat (KM)	11.08	nu star (KM)	10.04
theta hat (KM)	0.0546	theta star (KM)	0.0603
80% gamma percentile (KM)	0.0344	90% gamma percentile (KM)	0.0622
95% gamma percentile (KM)	0.0932	99% gamma percentile (KM)	0.172
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (10.04, α)	3.967	Adjusted Chi Square Value (10.04, β)	3.475
95% Gamma Approximate KM-UCL (use when n>=50)	0.0547	95% Gamma Adjusted KM-UCL (use when n<50)	0.0624

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.987	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.218	**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	0.0146	Mean in Log Scale	-7.825
SD in Original Scale	0.0384	SD in Log Scale	2.596
95% t UCL (assumes normality of ROS data)	0.0328	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.812		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-4.364	KM Geo Mean	0.0127
KM SD (logged)	0.8	95% Critical H Value (KM-Log)	2.479
KM Standard Error of Mean (logged)	0.262	95% H-UCL (KM -Log)	0.0304
KM SD (logged)	0.8	95% Critical H Value (KM-Log)	2.479
KM Standard Error of Mean (logged)	0.262		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0182	Mean in Log Scale	-4.87
SD in Original Scale	0.037	SD in Log Scale	1.066
95% t UCL (Assumes normality)	0.0357	95% H-Stat UCL	0.0319
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	0.0415		
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.			

Attachment 2 (Continued)

Mixed Soil Samples from 0 to 10 foot Depth (Input)

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
2	20	1		1.43	0	
3	12	1		1.15	0	
4	4.36	1		0.094	0	
5	2.8	1		0.076	0	
6	1	1		0.046	0	
7	0.635	1		0.039	0	
8	0.31	1		0.024	0	
9	0.19	1		0.024	0	
10	0.1	0		0.02	0	
11	0.026	0		0.0051	0	
12	0.0054	0		0.0046	0	
13	0.0044	0		0.0042	0	
14	0.0044	0		0.0041	0	
15	0.0044	0		0.0041	0	
16	0.00118	1		0.001365	0	
17	0.00107	1		0.00119	0	
18	0.00105	1		0.0008545	0	
19	0.00103	1		0.000824	0	
20	0.00102	1		0.000819	0	
21	0.0008545	0		0.000815	0	
22	0.000824	0		0.000811	0	
23	0.000819	0		0.000802	0	
24	0.000811	0		0.000798	0	
25	0.000802	0		0.000794	0	
26	0.000798	0		0.000765	0	
27	0.000765	0		0.000761	0	
28	0.000754	0		0.000754	0	
29	0.000747	0		0.000748	0	
30	0.000746	0		0.000747	0	
31	0.000739	0		0.000746	0	
32	0.000735	0		0.000739	0	
33	0.0007305	0		0.000735	0	
34	0.000726	0		0.000733	0	
35	0.000722	0		0.0007305	0	
36	0.000722	1		0.000726	0	
37	0.000718	0		0.000725	0	
38	0.000717	0		0.000722	0	
39	0.000715	0		0.000722	0	
40	0.000715	0		0.000718	0	
41	0.000702	0		0.000717	0	
42	0.000697	0		0.000715	0	
43	0.000696	0		0.000715	0	
44	0.000693	0		0.000707	0	
45	0.000688	0		0.000702	0	
46	0.000687	0		0.000697	0	
47	0.000687	0		0.000696	0	
48	0.000678	0		0.000693	0	
49	0.000677	0		0.000688	0	
50	0.000675	0		0.000687	0	
51	0.000674	0		0.000687	0	
52	0.000671	0		0.000678	0	
53	0.000665	0		0.000677	0	
54	0.000663	0		0.000675	0	
55	0.000662	0		0.000675	0	
56	0.000662	0		0.000674	0	
57	0.00066	0		0.000671	0	
58	0.000651	0		0.000665	0	
59	0.000651	0		0.000663	0	
60	0.000642	0		0.000662	0	
61	0.000613	0		0.000662	0	
62	0.00061	0		0.000662	0	
63	0.000584	1		0.00066	0	
64	0.000545	0		0.000657	0	
65	0.000382	0		0.000651	0	
66	0.000375	1		0.000651	0	
67	0.000374	0		0.000642	0	

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
68	0.00037	0		0.0006315	0	
69	0.000369	0		0.000618	0	
70	0.00036	0		0.000615	0	
71	0.000305	0		0.000613	0	
72	0.0002965	0		0.00061	0	
73	0.000259	0		0.000602	0	
74	0.000223	1		0.000602	0	
75	0.000179	1		0.0006015	0	
76	0.0001655	0		0.000587	0	
77	0.000162	0		0.000586	0	
78	0.000159	0		0.000581	0	
79	0.000157	0		0.0005655	0	
80	0.000154	0		0.000565	0	
81	0.000147	0		0.00056	0	
82	0.000144	0		0.000556	0	
83	0.000137	0		0.000547	0	
84	0.000134	0		0.000546	0	
85	0.000134	0		0.000546	0	
86	0.000131	0		0.000545	0	
87	0.000131	0		0.000526	0	
88	0.000127	0		0.000518	0	
89	0.000126	0		0.000518	0	
90	0.000122	0		0.000508	0	
91	0.000121	0		0.000502	0	
92	0.000119	0		0.000493	0	
93	0.000118	0		0.000491	0	
94	0.000114	0		0.000489	0	
95	0.000112	0		0.000484	0	
96	0.000112	0		0.000475	0	
97	0.00011	0		0.000466	0	
98	0.000109	0		0.000463	0	
99	0.000107	0		0.000454	0	
100	0.000106	0		0.000446	0	
101	0.000105	0		0.000382	0	
102	0.000103	0		0.000374	0	
103	0.000101	0		0.00037	0	
104	0.000101	0		0.000369	0	
105	0.000099	0		0.00036	0	
106	0.000097	0		0.000305	0	
107						
108						
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118						

	G	H	I	J	K
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene
2	0.474	0		0.33	1
3	0.382	0		0.012	0
4	0.14	0		0.011	0
5	0.11	0		0.011	0
6	0.066	0		0.0062	0
7	0.056	0		0.006	0
8	0.035	0		0.006	0
9	0.035	0		0.0059	0
10	0.03	0		0.0056	0
11	0.0073	0		0.0056	0
12	0.0066	0		0.0056	0
13	0.006	0		0.0055	0
14	0.006	0			
15	0.006	0			
16	0.0008545	0			
17	0.000824	0			
18	0.000819	0			
19	0.000815	0			
20	0.000811	0			
21	0.000802	0			
22	0.000798	0			
23	0.000794	0			
24	0.000765	0			
25	0.000754	0			
26	0.000747	0			
27	0.000746	0			
28	0.000739	0			
29	0.000735	0			
30	0.0007305	0			
31	0.000726	0			
32	0.000725	0			
33	0.000722	0			
34	0.000718	0			
35	0.000717	0			
36	0.000715	0			
37	0.000715	0			
38	0.000702	0			
39	0.000697	0			
40	0.000696	0			
41	0.000693	0			
42	0.000688	0			
43	0.000687	0			
44	0.000687	0			
45	0.000678	0			
46	0.000677	0			
47	0.000675	0			
48	0.000674	0			
49	0.000671	0			
50	0.000665	0			
51	0.000663	0			
52	0.000662	0			
53	0.000662	0			
54	0.00066	0			
55	0.000651	0			
56	0.000651	0			
57	0.000642	0			
58	0.000613	0			
59	0.00061	0			
60	0.000545	0			
61	0.0004535	0			
62	0.000396	0			
63	0.000382	0			
64	0.000374	0			
65	0.00037	0			
66	0.000369	0			
67	0.00036	0			

	G	H	I	J	K
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene
68	0.000305	0			
69	0.0002525	0			
70	0.000248	0			
71	0.000244	0			
72	0.00024	0			
73	0.000235	0			
74	0.000224	0			
75	0.00022	0			
76	0.000218	0			
77	0.00021	0			
78	0.000205	0			
79	0.000204	0			
80	0.0002	0			
81	0.0002	0			
82	0.0002	0			
83	0.000195	0			
84	0.000195	0			
85	0.000193	0			
86	0.000188	0			
87	0.000188	0			
88	0.000186	0			
89	0.000185	0			
90	0.000182	0			
91	0.000181	0			
92	0.000181	0			
93	0.000175	0			
94	0.000172	0			
95	0.000172	0			
96	0.000169	0			
97	0.000167	0			
98	0.000164	0			
99	0.000163	0			
100	0.000163	0			
101	0.000161	0			
102	0.000158	0			
103	0.000155	0			
104	0.000154	0			
105	0.000151	0			
106	0.000148	0			
107					
108					
109					
110					
111					
112					
113					
114					
115					
116					
117					
118					

	L	M	N	O	P	Q
1		**2-Methylnaphthalene**	**d_2-Methylnaphthalene**		**Benzene**	**d_Benzene**
2		16	1		0.276	0
3		14	1		0.222	0
4		13	1		0.09	0
5		8.13	1		0.073	0
6		1.5	1		0.044	0
7		0.66	0		0.037	0
8		0.64	0		0.023	0
9		0.64	0		0.023	0
10		0.64	0		0.02	0
11		0.64	0		0.0049	0
12		0.64	0		0.0044	0
13		0.64	0		0.004	0
14		0.63	0		0.004	0
15		0.63	0		0.004	0
16		0.375	0		0.00325	1
17		0.14	0		0.003035	1
18		0.14	0		0.00256	1
19		0.14	0		0.0023	1
20		0.139	1		0.0022	1
21		0.13	0		0.002015	1
22		0.13	0		0.00196	1
23		0.13	0		0.00172	1
24		0.13	0		0.001312	1
25		0.13	0		0.00119	1
26		0.13	0		0.00116	1
27		0.13	0		0.00115	1
28		0.125	0		0.00107	1
29		0.12	0		0.00104	1
30		0.0996	0		0.000866	1
31		0.0975	0		0.000861	1
32		0.07	0		0.0008545	0
33		0.07	0		0.000844	1
34		0.07	0		0.000824	0
35		0.069	0		0.000819	0
36		0.069	0		0.000811	0
37		0.068	0		0.000802	0
38		0.067	0		0.0008	1
39		0.067	0		0.000798	0
40		0.067	0		0.000765	0
41		0.0665	0		0.000763	1
42		0.066	0		0.000754	0
43		0.066	0		0.000752	1
44		0.066	0		0.00075	1
45		0.066	0		0.000747	0
46		0.066	0		0.000746	0
47		0.065	0		0.000739	0
48		0.065	0		0.000735	0
49		0.065	0		0.0007305	0
50		0.065	0		0.000722	0
51		0.064	0		0.000719	1
52		0.064	0		0.000718	0
53		0.064	0		0.000717	0
54		0.064	0		0.000715	0
55		0.064	0		0.000715	0
56		0.064	0		0.000702	0
57		0.063	0		0.000697	0
58		0.063	0		0.000696	0
59		0.063	0		0.000693	0
60		0.063	0		0.000688	0
61		0.063	0		0.000687	0
62		0.063	0		0.000687	0
63		0.063	0		0.000678	0
64		0.062	0		0.000677	0
65		0.062	0		0.000675	0
66		0.062	0		0.000674	0
67		0.062	0		0.000671	0

	L	M	N	O	P	Q
1		2-Methylnaphthalene	d_2-Methylnaphthalene		Benzene	d_Benzene
68		0.0519	1		0.000665	0
69		0.0487	0		0.000663	0
70		0.0472	0		0.000662	0
71		0.0266	1		0.000662	0
72		0.013	0		0.00066	0
73		0.012	1		0.000651	0
74		0.012	0		0.000651	0
75		0.012	0		0.000626	1
76		0.0104	0		0.000619	1
77		0.0104	0		0.000613	0
78		0.00998	0		0.00061	0
79		0.00997	0		0.000581	1
80		0.00995	0		0.000577	1
81		0.009905	0		0.000572	1
82		0.00989	0		0.000545	0
83		0.009865	0		0.000544	1
84		0.00984	0		0.000495	1
85		0.00979	0		0.000485	1
86		0.00979	0		0.000382	0
87		0.00978	0		0.000374	0
88		0.00978	0		0.000373	1
89		0.00977	0		0.00037	0
90		0.00971	0		0.000369	0
91		0.00971	0		0.00036	0
92		0.00967	0		0.000354	1
93		0.00966	0		0.000345	1
94		0.00963	0		0.000323	1
95		0.00958	0		0.000305	0
96		0.00955	0		0.000288	1
97		0.00954	0		0.0002805	1
98		0.00954	0		0.0002205	1
99		0.009535	0		0.000217	1
100		0.00953	0		0.0002115	1
101		0.00952	0		0.0002035	1
102		0.00952	0		0.000142	0
103		0.00951	0		0.000131	1
104		0.00949	0		0.000106	0
105		0.00945	0		0.0001	0
106		0.00943	0		0.000098	0
107		0.00941	0			
108		0.00931	0			
109		0.00906	0			
110		0.0065	0			
111		0.0063	0			
112		0.0063	0			
113		0.0062	0			
114		0.0059	0			
115		0.0059	0			
116		0.0059	0			
117		0.0059	0			
118		0.0058	0			

	R	S	T	U	V	W	X
1		Ethylbenzene	d_Ethylbenzene		Isopropylbenzene	d_Isopropylbenzene	
2		0.57	0		0.29	1	
3		0.47	1		0.243	0	
4		0.46	0		0.196	0	
5		0.23	1		0.065	0	
6		0.088	0		0.057	0	
7		0.043	0		0.053	0	
8		0.036	0		0.032	0	
9		0.023	0		0.032	0	
10		0.019	0		0.027	0	
11		0.0047	0		0.017	0	
12		0.0043	0		0.0035	0	
13		0.0039	0		0.0029	0	
14		0.0039	0		0.0029	0	
15		0.0038	0		0.0029	0	
16		0.001064	1		0.0008545	0	
17		0.0008545	0		0.000824	0	
18		0.000851	1		0.000819	0	
19		0.000824	0		0.000815	0	
20		0.000819	0		0.000811	0	
21		0.000815	0		0.000802	0	
22		0.000811	0		0.000798	0	
23		0.000802	0		0.000794	0	
24		0.000798	0		0.000765	0	
25		0.000765	0		0.000754	0	
26		0.000754	0		0.000747	0	
27		0.000747	0		0.000746	0	
28		0.000746	0		0.000739	0	
29		0.000739	0		0.000735	0	
30		0.000735	0		0.0007305	0	
31		0.0007345	1		0.000726	0	
32		0.0007305	0		0.000725	0	
33		0.000726	0		0.000722	0	
34		0.000725	0		0.000718	0	
35		0.000722	0		0.000717	0	
36		0.000718	0		0.000715	0	
37		0.000717	0		0.000715	0	
38		0.000715	0		0.000702	0	
39		0.000715	0		0.000697	0	
40		0.000702	0		0.000696	0	
41		0.000697	0		0.000693	0	
42		0.000696	0		0.000688	0	
43		0.000693	0		0.000687	0	
44		0.000688	0		0.000687	0	
45		0.000687	0		0.000678	0	
46		0.000687	0		0.000677	0	
47		0.000678	0		0.000675	0	
48		0.000677	0		0.000674	0	
49		0.000675	0		0.000671	0	
50		0.000674	0		0.000665	0	
51		0.000671	0		0.000663	0	
52		0.000665	0		0.000662	0	
53		0.000663	0		0.000662	0	
54		0.000662	0		0.00066	0	
55		0.000662	0		0.000651	0	
56		0.00066	0		0.000651	0	
57		0.000659	1		0.000642	0	
58		0.000651	0		0.000613	0	
59		0.000651	0		0.00061	0	
60		0.000642	0		0.000545	0	
61		0.000613	0		0.000382	0	
62		0.00061	0		0.000374	0	
63		0.0005465	0		0.00037	0	
64		0.000545	0		0.000369	0	
65		0.000485	1		0.00036	0	
66		0.000477	0		0.000305	0	
67		0.000459	1		0.0002325	0	

	R	S	T	U	V	W	X
1		Ethylbenzene	d_Ethylbenzene		Isopropylbenzene	d_Isopropylbenzene	
68		0.000382	0		0.000203	0	
69		0.000375	1		0.0001295	0	
70		0.000374	0		0.000127	0	
71		0.00037	0		0.000125	0	
72		0.000369	0		0.000123	0	
73		0.00036	0		0.00012	0	
74		0.000344	1		0.000115	0	
75		0.000305	0		0.000113	0	
76		0.000304	0		0.0001115	0	
77		0.000299	0		0.0001075	0	
78		0.000297	1		0.000105	0	
79		0.000293	0		0.000105	0	
80		0.000283	0		0.000102	0	
81		0.00027	0		0.000102	0	
82		0.000265	0		0.000102	0	
83		0.000252	0		0.0001	0	
84		0.000247	0		0.0001	0	
85		0.000246	0		0.000099	0	
86		0.000241	0		0.000096	0	
87		0.000235	0		0.000096	0	
88		0.000234	0		0.000095	0	
89		0.000232	0		0.000095	0	
90		0.000224	0		0.000093	0	
91		0.000222	0		0.000093	0	
92		0.000219	0		0.000093	0	
93		0.000218	0		0.000089	0	
94		0.00021	1		0.000088	0	
95		0.000207	0		0.000088	0	
96		0.000203	0		0.000086	0	
97		0.0002	0		0.000085	0	
98		0.000197	0		0.000084	0	
99		0.000196	0		0.000083	0	
100		0.000196	0		0.000083	0	
101		0.000193	0		0.000082	0	
102		0.00019	0		0.000081	0	
103		0.000186	0		0.000079	0	
104		0.000185	0		0.000079	0	
105		0.000181	0		0.000077	0	
106		0.000178	0		0.000076	0	
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							

	Y	Z	AA	AB	AC	AD
1	**Lead**	**d_Lead**		**MTBE (Methyl tert-butyl ether)**	**d_MTBE (Methyl tert-butyl ether)**	
2	71	1		0.622	0	
3	59	1		0.502	0	
4	46	1		0.31	0	
5	42.2	1		0.25	0	
6	42	1		0.15	0	
7	39.1	1		0.13	0	
8	35	1		0.08	0	
9	25	1		0.079	0	
10	22	1		0.067	0	
11	18.8	1		0.017	0	
12	18.2	1		0.015	0	
13	18	1		0.014	0	
14	18	1		0.014	0	
15	17.2	1		0.013	0	
16	17	1		0.0008545	0	
17	14	1		0.000824	0	
18	14	1		0.000819	0	
19	13.5	1		0.000815	0	
20	12	1		0.000811	0	
21	11.9	1		0.000802	0	
22	11.255	1		0.000798	0	
23	11	1		0.000794	0	
24	10.1	1		0.000765	0	
25	9.56	1		0.000754	0	
26	9.5	1		0.000747	0	
27	9.01	1		0.000746	0	
28	8.6	1		0.000739	0	
29	8.45	1		0.000735	0	
30	8.28	1		0.0007305	0	
31	8.16	1		0.000726	0	
32	8.11	1		0.000725	0	
33	8.1	1		0.000722	0	
34	7.9	1		0.000718	0	
35	7.6	1		0.000717	0	
36	7.6	1		0.000715	0	
37	7.42	1		0.000715	0	
38	7.335	1		0.000702	0	
39	7.34	1		0.000697	0	
40	7.28	1		0.000696	0	
41	7.12	1		0.000693	0	
42	6.79	1		0.000688	0	
43	6.62	1		0.000687	0	
44	6.6	1		0.000687	0	
45	6.5	1		0.000678	0	
46	6.45	1		0.000677	0	
47	6.21	1		0.000675	0	
48	6.15	1		0.000674	0	
49	6	1		0.000671	0	
50	5.88	1		0.000665	0	
51	5.8	1		0.000663	0	
52	5.8	1		0.000662	0	
53	5.585	1		0.000662	0	
54	5.46	1		0.00066	0	
55	5.3	1		0.000651	0	
56	5.3	1		0.000651	0	
57	5.13	1		0.000642	0	
58	4.85	1		0.000613	0	
59	4.66	1		0.00061	0	
60	4.59	1		0.000596	0	
61	4.55	1		0.000545	0	
62	4.55	1		0.00052	0	
63	4.5	1		0.000382	0	
64	4.5	1		0.000374	0	
65	4.49	1		0.00037	0	
66	4.2	1		0.000369	0	
67	4.1	1		0.00036	0	

	Y	Z	AA	AB	AC	AD
1	Lead	d_Lead		MTBE (Methyl tert-butyl ether)	d_MTBE (Methyl tert-butyl ether)	
68	4.1	1		0.000332	0	
69	4.07	1		0.000326	0	
70	4	1		0.00032	0	
71	3.93	1		0.000315	0	
72	3.9	1		0.000308	0	
73	3.8	1		0.000305	0	
74	3.66	1		0.000294	0	
75	3.655	1		0.000289	0	
76	3.63	1		0.0002865	0	
77	3.6	1		0.000275	0	
78	3.54	1		0.00027	0	
79	3.5	1		0.000268	0	
80	3.5	1		0.000263	0	
81	3.4	1		0.0002625	0	
82	3.4	1		0.000262	0	
83	3.3	1		0.000256	0	
84	3.12	1		0.000256	0	
85	3	1		0.000254	0	
86	2.9	1		0.0002465	0	
87	2.9	1		0.000246	0	
88	2.8	1		0.000244	0	
89	2.7	1		0.000243	0	
90	2.6	1		0.000239	0	
91	2.5	1		0.000238	0	
92	2.5	1		0.000238	0	
93	2.4	1		0.000229	0	
94	2.4	1		0.000226	0	
95	2.4	1		0.000226	0	
96	2.3	1		0.000222	0	
97	2.3	1		0.000219	0	
98	2.2	1		0.000215	0	
99	2	1		0.000214	0	
100	1.9	1		0.000213	0	
101	1.6	1		0.000211	0	
102	1.3	1		0.000207	0	
103	1.3	1		0.000203	0	
104	1.2	1		0.000202	0	
105	1.2	1		0.000198	0	
106	1.1	1		0.000194	0	
107						
108						
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						

	AE	AF	AG	AH	AI	AJ	AK	AL
1	Naphthalene	d_Naphthalene		Toluene	d_Toluene		Xylenes (total)	d_Xylenes (total)
2	16	1		0.688	0		3.8	1
3	15	1		0.554	0		1.11	0
4	12	1		0.091	0		1	1
5	10.9	1		0.073	0		0.898	0
6	7.69	1		0.044	0		0.58	1
7	1.1	1		0.038	0		0.28	1
8	0.84	1		0.024	0		0.24	0
9	0.31	1		0.023	0		0.1	0
10	0.068	0		0.02	0		0.063	0
11	0.018	0		0.0049	0		0.013	0
12	0.012	0		0.00446	1		0.012	0
13	0.011	0		0.0044	0		0.011	0
14	0.011	1		0.00413	1		0.011	0
15	0.01	1		0.004	0		0.011	0
16	0.00638	1		0.004	0		0.003825	1
17	0.0062	0		0.004	0		0.00365	1
18	0.006	0		0.003975	1		0.003165	1
19	0.006	0		0.00371	1		0.00254	1
20	0.0059	0		0.00323	1		0.00234	1
21	0.0056	0		0.00299	1		0.00221	1
22	0.0056	0		0.00276	1		0.001965	1
23	0.0056	0		0.00273	1		0.00171	0
24	0.0055	0		0.00264	1		0.00165	0
25	0.0037	0		0.00229	1		0.00164	0
26	0.003	0		0.00223	1		0.00162	0
27	0.003	0		0.00222	1		0.0016	0
28	0.003	0		0.00179	1		0.0016	0
29	0.00171	0		0.00139	1		0.00153	0
30	0.00165	0		0.001315	1		0.00151	0
31	0.00164	0		0.00129	1		0.001495	0
32	0.00163	0		0.00103	1		0.00149	0
33	0.00162	0		0.00103	1		0.00149	1
34	0.0016	0		0.001	1		0.00148	0
35	0.0016	0		0.000873	1		0.00147	0
36	0.00159	0		0.0008545	0		0.001465	0
37	0.00153	0		0.000824	0		0.00145	0
38	0.00151	0		0.000819	0		0.00144	0
39	0.001495	0		0.000811	0		0.00144	0
40	0.00149	0		0.000802	0		0.00143	0
41	0.00148	0		0.000798	0		0.00143	0
42	0.00147	0		0.000795	1		0.00143	0
43	0.001465	0		0.000795	1		0.0014	0
44	0.00145	0		0.000784	1		0.00139	0
45	0.00145	0		0.000765	0		0.00139	0
46	0.00144	0		0.000764	1		0.00139	0
47	0.00144	0		0.000755	1		0.00138	0
48	0.00143	0		0.000754	0		0.00137	0
49	0.00143	0		0.000754	1		0.00137	0
50	0.00143	0		0.000747	0		0.00136	0
51	0.0014	0		0.000746	0		0.00135	0
52	0.00139	0		0.000745	1		0.00135	0
53	0.00139	0		0.000735	0		0.00135	0
54	0.00139	0		0.0007305	0		0.00134	0
55	0.00138	0		0.000722	0		0.00133	0
56	0.00137	0		0.000719	1		0.00133	0
57	0.00137	0		0.000718	0		0.00132	0
58	0.00136	0		0.000717	0		0.00132	0
59	0.00135	0		0.000715	0		0.00132	0
60	0.00135	0		0.000715	0		0.00132	1
61	0.00135	0		0.000702	0		0.0013	0
62	0.00134	0		0.000697	0		0.0013	0
63	0.00133	0		0.000696	0		0.00128	0
64	0.00133	0		0.000694	1		0.00123	0
65	0.00132	0		0.000693	0		0.00122	0
66	0.00132	0		0.000688	0		0.00109	0
67	0.00132	0		0.000687	0		0.0010695	0

	AE	AF	AG	AH	AI	AJ	AK	AL
1	**Naphthalene**	**d_Naphthalene**		**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
68	0.0013	0		0.000678	0		0.001	1
69	0.0013	0		0.000677	0		0.000932	0
70	0.00128	0		0.000675	0		0.000763	0
71	0.00123	0		0.000674	0		0.0007485	0
72	0.00122	0		0.000671	0		0.00074	0
73	0.0010975	1		0.000665	0		0.000738	0
74	0.00109	0		0.000663	0		0.00072	0
75	0.00103	1		0.000662	0		0.000633	1
76	0.000945	1		0.000662	0		0.00061	0
77	0.000763	0		0.00066	0		0.0005945	0
78	0.0007485	0		0.0006585	0		0.000584	0
79	0.00074	0		0.00061	0		0.000573	0
80	0.000738	0		0.000604	1		0.000564	0
81	0.00072	0		0.0006	1		0.000552	0
82	0.00061	0		0.000587	1		0.000527	0
83	0.0004365	0		0.00050875	1		0.000517	0
84	0.000381	0		0.000429	1		0.0004935	0
85	0.000243	0		0.000382	0		0.000492	1
86	0.000239	0		0.000374	0		0.000483	0
87	0.000234	0		0.00037	0		0.00048	0
88	0.000226	0		0.000369	0		0.000458	0
89	0.000216	0		0.00036	0		0.000454	0
90	0.000212	0		0.000353	0		0.000438	0
91	0.00021	1		0.000305	0		0.000435	0
92	0.0002015	0		0.000298	0		0.000427	0
93	0.000197	0		0.00028	0		0.000426	0
94	0.000196	0		0.00027	0		0.000411	0
95	0.000192	0		0.000268	0		0.000404	0
96	0.000192	0		0.000263	0		0.000404	0
97	0.000187	0		0.000253	0		0.000397	0
98	0.000187	0		0.000253	1		0.000392	0
99	0.000186	0		0.000249	0		0.000385	0
100	0.0001805	0		0.000249	0		0.000382	0
101	0.000179	0		0.000245	0		0.000378	0
102	0.000178	0		0.000238	0		0.000371	0
103	0.000175	0		0.000229	0		0.000364	0
104	0.000174	0		0.000224	1		0.000362	0
105	0.000174	0		0.0002205	1		0.000355	0
106	0.000168	0		0.000219	0		0.000348	0
107	0.000165	0						
108	0.000162	0						
109	0.00016	0						
110	0.000158	0						
111	0.000157	0						
112	0.000156	0						
113	0.000155	0						
114	0.000152	0						
115	0.000149	0						
116	0.000148	0						
117	0.000145	0						
118	0.000142	0						

Attachment 2 (Continued)

Mixed Soil Samples from 0 to 10 foot Depth (Output)

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.17/6/2017 4:31:28 PM								
5	From File			WorkSheet.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	**1,2,4-Trimethylbenzene**											
11												
12	**General Statistics**											
13	Total Number of Observations					105	Number of Distinct Observations					94
14	Number of Detects					18	Number of Non-Detects					87
15	Number of Distinct Detects					18	Number of Distinct Non-Detects					77
16	Minimum Detect					1.7900E-4	Minimum Non-Detect					9.7000E-5
17	Maximum Detect					20	Maximum Non-Detect					0.1
18	Variance Detects					28.09	Percent Non-Detects					82.86%
19	Mean Detects					2.295	SD Detects					5.3
20	Median Detects					0.00113	CV Detects					2.31
21	Skewness Detects					2.812	Kurtosis Detects					7.802
22	Mean of Logged Detects					-3.84	SD of Logged Detects					4.246
23												
24	**Normal GOF Test on Detects Only**											
25	Shapiro Wilk Test Statistic					0.511	**Shapiro Wilk GOF Test**					
26	5% Shapiro Wilk Critical Value					0.897	Detected Data Not Normal at 5% Significance Level					
27	Lilliefors Test Statistic					0.374	**Lilliefors GOF Test**					
28	5% Lilliefors Critical Value					0.202	Detected Data Not Normal at 5% Significance Level					
29	**Detected Data Not Normal at 5% Significance Level**											
30												
31	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
32	KM Mean					0.393	KM Standard Error of Mean					0.231
33	KM SD					2.301	95% KM (BCA) UCL					0.845
34	95% KM (t) UCL					0.777	95% KM (Percentile Bootstrap) UCL					0.805
35	95% KM (z) UCL					0.774	95% KM Bootstrap t UCL					2.147
36	90% KM Chebyshev UCL					1.087	95% KM Chebyshev UCL					1.401
37	97.5% KM Chebyshev UCL					1.837	99% KM Chebyshev UCL					2.693
38												
39	**Gamma GOF Tests on Detected Observations Only**											
40	A-D Test Statistic					1.408	**Anderson-Darling GOF Test**					
41	5% A-D Critical Value					0.924	Detected Data Not Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic					0.322	**Kolmogorov-Smirnov GOF**					
43	5% K-S Critical Value					0.229	Detected Data Not Gamma Distributed at 5% Significance Level					
44	**Detected Data Not Gamma Distributed at 5% Significance Level**											
45												
46	**Gamma Statistics on Detected Data Only**											
47	k hat (MLE)					0.163	k star (bias corrected MLE)					0.173
48	Theta hat (MLE)					14.11	Theta star (bias corrected MLE)					13.3
49	nu hat (MLE)					5.855	nu star (bias corrected)					6.212
50	Mean (detects)					2.295						
51												
52	**Gamma ROS Statistics using Imputed Non-Detects**											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
54	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)											
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
56	This is especially true when the sample size is small.											
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
58	Minimum					1.7900E-4	Mean					0.402
59	Maximum					20	Median					0.01
60	SD					2.311	CV					5.754
61	k hat (MLE)					0.206	k star (bias corrected MLE)					0.206
62	Theta hat (MLE)					1.952	Theta star (bias corrected MLE)					1.948
63	nu hat (MLE)					43.2	nu star (bias corrected)					43.3
64	Adjusted Level of Significance (β)					0.0477						
65	Approximate Chi Square Value (43.30, α)					29.21	Adjusted Chi Square Value (43.30, β)					29.05
66	95% Gamma Approximate UCL (use when n>=50)					0.595	95% Gamma Adjusted UCL (use when n<50)					0.599

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.393	SD (KM)	2.301
Variance (KM)	5.296	SE of Mean (KM)	0.231
k hat (KM)	0.0292	k star (KM)	0.0347
nu hat (KM)	6.138	nu star (KM)	7.296
theta hat (KM)	13.46	theta star (KM)	11.32
80% gamma percentile (KM)	0.0106	90% gamma percentile (KM)	0.324
95% gamma percentile (KM)	1.722	99% gamma percentile (KM)	9.738

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.30, α)	2.334	Adjusted Chi Square Value (7.30, β)	2.296
95% Gamma Approximate KM-UCL (use when n>=50)	1.23	95% Gamma Adjusted KM-UCL (use when n<50)	1.25

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.308	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.202	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	0.393	Mean in Log Scale	-16.34
SD in Original Scale	2.312	SD in Log Scale	6.175
95% t UCL (assumes normality of ROS data)	0.768	95% Percentile Bootstrap UCL	0.809
95% BCA Bootstrap UCL	0.991	95% Bootstrap t UCL	2.125
95% H-UCL (Log ROS)	3433		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-8.247	KM Geo Mean	2.6203E-4
KM SD (logged)	2.651	95% Critical H Value (KM-Log)	4.127
KM Standard Error of Mean (logged)	0.269	95% H-UCL (KM -Log)	0.0258
KM SD (logged)	2.651	95% Critical H Value (KM-Log)	4.127
KM Standard Error of Mean (logged)	0.269		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.394	Mean in Log Scale	-7.665
SD in Original Scale	2.312	SD in Log Scale	2.692
95% t UCL (Assumes normality)	0.769	95% H-Stat UCL	0.053

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

99% KM (Chebyshev) UCL	2.693		

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.

1,2-Dibromoethane

General Statistics

Total Number of Observations	105	Number of Distinct Observations	93
Number of Detects	0	Number of Non-Detects	105
Number of Distinct Detects	0	Number of Distinct Non-Detects	93

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-Dibromoethane was not processed!

1,2-Dichloroethane

General Statistics

Total Number of Observations	105	Number of Distinct Observations	91
Number of Detects	0	Number of Non-Detects	105
Number of Distinct Detects	0	Number of Distinct Non-Detects	91
Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!			
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!			
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).			
The data set for variable 1,2-Dichloroethane was not processed!			
1-Methylnaphthalene			
General Statistics			
Total Number of Observations	12	Number of Distinct Observations	8
Number of Detects	1	Number of Non-Detects	11
Number of Distinct Detects	1	Number of Distinct Non-Detects	7
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 1-Methylnaphthalene was not processed!			
2-Methylnaphthalene			
General Statistics			
Total Number of Observations	117	Number of Distinct Observations	65
Number of Detects	9	Number of Non-Detects	108
Number of Distinct Detects	9	Number of Distinct Non-Detects	57
Minimum Detect	0.012	Minimum Non-Detect	0.0058
Maximum Detect	16	Maximum Non-Detect	0.66
Variance Detects	47.36	Percent Non-Detects	92.31%
Mean Detects	5.873	SD Detects	6.882
Median Detects	1.5	CV Detects	1.172
Skewness Detects	0.531	Kurtosis Detects	-1.893
Mean of Logged Detects	-0.278	SD of Logged Detects	2.968
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.786	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.293	**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	0.458	KM Standard Error of Mean	0.234
KM SD	2.384	95% KM (BCA) UCL	0.875
95% KM (t) UCL	0.846	95% KM (Percentile Bootstrap) UCL	0.854
95% KM (z) UCL	0.843	95% KM Bootstrap t UCL	1.078
90% KM Chebyshev UCL	1.159	95% KM Chebyshev UCL	1.477
97.5% KM Chebyshev UCL	1.918	99% KM Chebyshev UCL	2.784
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.655	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.802	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.3	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

	A–E	F	G–K	L
197	**Gamma Statistics on Detected Data Only**			
198	k hat (MLE)	0.331	k star (bias corrected MLE)	0.295
199	Theta hat (MLE)	17.73	Theta star (bias corrected MLE)	19.92
200	nu hat (MLE)	5.962	nu star (bias corrected)	5.308
201	Mean (detects)	5.873		
202				
203	**Gamma ROS Statistics using Imputed Non-Detects**			
204	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
205	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)			
206	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
207	This is especially true when the sample size is small.			
208	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
209	Minimum	0.01	Mean	0.461
210	Maximum	16	Median	0.01
211	SD	2.393	CV	5.192
212	k hat (MLE)	0.209	k star (bias corrected MLE)	0.209
213	Theta hat (MLE)	2.206	Theta star (bias corrected MLE)	2.203
214	nu hat (MLE)	48.89	nu star (bias corrected)	48.97
215	Adjusted Level of Significance (β)	0.0479		
216	Approximate Chi Square Value (48.97, α)	33.91	Adjusted Chi Square Value (48.97, β)	33.75
217	95% Gamma Approximate UCL (use when n>=50)	0.666	95% Gamma Adjusted UCL (use when n<50)	0.669
218				
219	**Estimates of Gamma Parameters using KM Estimates**			
220	Mean (KM)	0.458	SD (KM)	2.384
221	Variance (KM)	5.682	SE of Mean (KM)	0.234
222	k hat (KM)	0.0369	k star (KM)	0.0417
223	nu hat (KM)	8.64	nu star (KM)	9.752
224	theta hat (KM)	12.41	theta star (KM)	10.99
225	80% gamma percentile (KM)	0.0302	90% gamma percentile (KM)	0.533
226	95% gamma percentile (KM)	2.248	99% gamma percentile (KM)	10.67
227				
228	**Gamma Kaplan-Meier (KM) Statistics**			
229	Approximate Chi Square Value (9.75, α)	3.787	Adjusted Chi Square Value (9.75, β)	3.741
230	95% Gamma Approximate KM-UCL (use when n>=50)	1.179	95% Gamma Adjusted KM-UCL (use when n<50)	1.194
231				
232	**Lognormal GOF Test on Detected Observations Only**			
233	Shapiro Wilk Test Statistic	0.852	**Shapiro Wilk GOF Test**	
234	5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
235	Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**	
236	5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level	
237	**Detected Data appear Lognormal at 5% Significance Level**			
238				
239	**Lognormal ROS Statistics Using Imputed Non-Detects**			
240	Mean in Original Scale	0.452	Mean in Log Scale	-13.19
241	SD in Original Scale	2.395	SD in Log Scale	5.038
242	95% t UCL (assumes normality of ROS data)	0.819	95% Percentile Bootstrap UCL	0.861
243	95% BCA Bootstrap UCL	0.997	95% Bootstrap t UCL	1.101
244	95% H-UCL (Log ROS)	19.65		
245				
246	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
247	KM Mean (logged)	-4.725	KM Geo Mean	0.00887
248	KM SD (logged)	1.529	95% Critical H Value (KM-Log)	2.771
249	KM Standard Error of Mean (logged)	0.156	95% H-UCL (KM -Log)	0.0423
250	KM SD (logged)	1.529	95% Critical H Value (KM-Log)	2.771
251	KM Standard Error of Mean (logged)	0.156		
252				
253	**DL/2 Statistics**			
254	**DL/2 Normal**		**DL/2 Log-Transformed**	
255	Mean in Original Scale	0.498	Mean in Log Scale	-3.697
256	SD in Original Scale	2.388	SD in Log Scale	1.833
257	95% t UCL (Assumes normality)	0.864	95% H-Stat UCL	0.227
258	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
259				
260	**Nonparametric Distribution Free UCL Statistics**			
261	**Detected Data appear Gamma Distributed at 5% Significance Level**			
262				
263	**Suggested UCL to Use**			
264	95% KM Approximate Gamma UCL	1.179		

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	105	Number of Distinct Observations	98
Number of Detects	41	Number of Non-Detects	64
Number of Distinct Detects	41	Number of Distinct Non-Detects	57
Minimum Detect	1.3100E-4	Minimum Non-Detect	9.8000E-5
Maximum Detect	0.00325	Maximum Non-Detect	0.276
Variance Detects	6.3136E-7	Percent Non-Detects	60.95%
Mean Detects	9.6983E-4	SD Detects	7.9458E-4
Median Detects	7.5000E-4	CV Detects	0.819
Skewness Detects	1.412	Kurtosis Detects	1.325
Mean of Logged Detects	-7.245	SD of Logged Detects	0.807

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.941	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.137	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	5.9356E-4	KM Standard Error of Mean	7.0872E-5
KM SD	6.4088E-4	95% KM (BCA) UCL	7.1342E-4
95% KM (t) UCL	7.1119E-4	95% KM (Percentile Bootstrap) UCL	7.1317E-4
95% KM (z) UCL	7.1014E-4	95% KM Bootstrap t UCL	7.2480E-4
90% KM Chebyshev UCL	8.0618E-4	95% KM Chebyshev UCL	9.0249E-4
97.5% KM Chebyshev UCL	0.00104	99% KM Chebyshev UCL	0.0013

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.529	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.116	**Kolmogorov-Smirnov GOF**
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 on Detected Data Only

k hat (MLE)	1.777	k star (bias corrected MLE)	1.664
Theta hat (MLE)	5.4563E-4	Theta star (bias corrected MLE)	5.8295E-4
nu hat (MLE)	145.8	nu star (bias corrected)	136.4
Mean (detects)	9.6983E-4		

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	1.3100E-4	Mean	0.00647
Maximum	0.01	Median	0.01
SD	0.00445	CV	0.688
k hat (MLE)	0.972	k star (bias corrected MLE)	0.95
Theta hat (MLE)	0.00666	Theta star (bias corrected MLE)	0.00681
nu hat (MLE)	204	nu star (bias corrected)	199.5
Adjusted Level of Significance (β)	0.0477		
Approximate Chi Square Value (199.54, α)	167.9	Adjusted Chi Square Value (199.54, β)	167.5
95% Gamma Approximate UCL (use when n>=50)	0.0077	95% Gamma Adjusted UCL (use when n<50)	0.00771

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	5.9356E-4	SD (KM)	6.4088E-4
Variance (KM)	4.1073E-7	SE of Mean (KM)	7.0872E-5
k hat (KM)	0.858	k star (KM)	0.84
nu hat (KM)	180.1	nu star (KM)	176.3
theta hat (KM)	6.9197E-4	theta star (KM)	7.0694E-4
80% gamma percentile (KM)	9.6732E-4	90% gamma percentile (KM)	0.00143
95% gamma percentile (KM)	0.00189	99% gamma percentile (KM)	0.00299
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (176.32, α)	146.6	Adjusted Chi Square Value (176.32, β)	146.2
95% Gamma Approximate KM-UCL (use when n>=50)	7.1385E-4	95% Gamma Adjusted KM-UCL (use when n<50)	7.1568E-4
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.973	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.941	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0654	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.137	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	5.5090E-4	Mean in Log Scale	-7.85
SD in Original Scale	6.0209E-4	SD in Log Scale	0.758
95% t UCL (assumes normality of ROS data)	6.4842E-4	95% Percentile Bootstrap UCL	6.5147E-4
95% BCA Bootstrap UCL	6.7131E-4	95% Bootstrap t UCL	6.6518E-4
95% H-UCL (Log ROS)	6.0345E-4		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-7.861	KM Geo Mean	3.8564E-4
KM SD (logged)	0.911	95% Critical H Value (KM-Log)	2.13
KM Standard Error of Mean (logged)	0.123	95% H-UCL (KM -Log)	7.0633E-4
KM SD (logged)	0.911	95% Critical H Value (KM-Log)	2.13
KM Standard Error of Mean (logged)	0.123		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00448	Mean in Log Scale	-7.321
SD in Original Scale	0.0181	SD in Log Scale	1.455
95% t UCL (Assumes normality)	0.0074	95% H-Stat UCL	0.00279
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	7.1385E-4	95% GROS Approximate Gamma UCL	0.0077
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	105	Number of Distinct Observations	99
Number of Detects	12	Number of Non-Detects	93
Number of Distinct Detects	12	Number of Distinct Non-Detects	87
Minimum Detect	2.1000E-4	Minimum Non-Detect	1.7800E-4
Maximum Detect	0.47	Maximum Non-Detect	0.57
Variance Detects	0.0211	Percent Non-Detects	88.57%
Mean Detects	0.0588	SD Detects	0.145
Median Detects	5.7200E-4	CV Detects	2.472
Skewness Detects	2.579	Kurtosis Detects	6.411
Mean of Logged Detects	-6.538	SD of Logged Detects	2.58

395	**Normal GOF Test on Detects Only**			
396	Shapiro Wilk Test Statistic	0.48	**Shapiro Wilk GOF Test**	
397	5% Shapiro Wilk Critical Value	0.859	Detected Data Not Normal at 5% Significance Level	
398	Lilliefors Test Statistic	0.488	**Lilliefors GOF Test**	
399	5% Lilliefors Critical Value	0.243	Detected Data Not Normal at 5% Significance Level	
400	**Detected Data Not Normal at 5% Significance Level**			
401				
402	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
403	KM Mean	0.00699	KM Standard Error of Mean	0.00522
404	KM SD	0.0509	95% KM (BCA) UCL	0.016
405	95% KM (t) UCL	0.0156	95% KM (Percentile Bootstrap) UCL	0.016
406	95% KM (z) UCL	0.0156	95% KM Bootstrap t UCL	1.815
407	90% KM Chebyshev UCL	0.0226	95% KM Chebyshev UCL	0.0297
408	97.5% KM Chebyshev UCL	0.0396	99% KM Chebyshev UCL	0.0589
409				
410	**Gamma GOF Tests on Detected Observations Only**			
411	A-D Test Statistic	2.668	**Anderson-Darling GOF Test**	
412	5% A-D Critical Value	0.873	Detected Data Not Gamma Distributed at 5% Significance Level	
413	K-S Test Statistic	0.478	**Kolmogorov-Smirnov GOF**	
414	5% K-S Critical Value	0.272	Detected Data Not Gamma Distributed at 5% Significance Level	
415	**Detected Data Not Gamma Distributed at 5% Significance Level**			
416				
417	**Gamma Statistics on Detected Data Only**			
418	k hat (MLE)	0.199	k star (bias corrected MLE)	0.205
419	Theta hat (MLE)	0.296	Theta star (bias corrected MLE)	0.287
420	nu hat (MLE)	4.773	nu star (bias corrected)	4.913
421	Mean (detects)	0.0588		
422				
423	**Gamma ROS Statistics using Imputed Non-Detects**			
424	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
425	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)			
426	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
427	This is especially true when the sample size is small.			
428	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
429	Minimum	2.1000E-4	Mean	0.0156
430	Maximum	0.47	Median	0.01
431	SD	0.0498	CV	3.195
432	k hat (MLE)	0.883	k star (bias corrected MLE)	0.864
433	Theta hat (MLE)	0.0176	Theta star (bias corrected MLE)	0.018
434	nu hat (MLE)	185.3	nu star (bias corrected)	181.4
435	Adjusted Level of Significance (β)	0.0477		
436	Approximate Chi Square Value (181.38, α)	151.2	Adjusted Chi Square Value (181.38, β)	150.8
437	95% Gamma Approximate UCL (use when n>=50)	0.0187	95% Gamma Adjusted UCL (use when n<50)	0.0187
438				
439	**Estimates of Gamma Parameters using KM Estimates**			
440	Mean (KM)	0.00699	SD (KM)	0.0509
441	Variance (KM)	0.00259	SE of Mean (KM)	0.00522
442	k hat (KM)	0.0189	k star (KM)	0.0247
443	nu hat (KM)	3.96	nu star (KM)	5.181
444	theta hat (KM)	0.371	theta star (KM)	0.283
445	80% gamma percentile (KM)	1.9136E-5	90% gamma percentile (KM)	0.00228
446	95% gamma percentile (KM)	0.0218	99% gamma percentile (KM)	0.189
447				
448	**Gamma Kaplan-Meier (KM) Statistics**			
449	Approximate Chi Square Value (5.18, α)	1.237	Adjusted Chi Square Value (5.18, β)	1.211
450	95% Gamma Approximate KM-UCL (use when n>=50)	0.0293	95% Gamma Adjusted KM-UCL (use when n<50)	0.0299
451				
452	**Lognormal GOF Test on Detected Observations Only**			
453	Shapiro Wilk Test Statistic	0.647	**Shapiro Wilk GOF Test**	
454	5% Shapiro Wilk Critical Value	0.859	Detected Data Not Lognormal at 5% Significance Level	
455	Lilliefors Test Statistic	0.381	**Lilliefors GOF Test**	
456	5% Lilliefors Critical Value	0.243	Detected Data Not Lognormal at 5% Significance Level	
457	**Detected Data Not Lognormal at 5% Significance Level**			
458				

459	**Lognormal ROS Statistics Using Imputed Non-Detects**			
460	Mean in Original Scale	0.00672	Mean in Log Scale	-12.36
461	SD in Original Scale	0.0509	SD in Log Scale	2.361
462	95% t UCL (assumes normality of ROS data)	0.015	95% Percentile Bootstrap UCL	0.0157
463	95% BCA Bootstrap UCL	0.0223	95% Bootstrap t UCL	2.033
464	95% H-UCL (Log ROS)	1.6540E-4		
465				
466	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
467	KM Mean (logged)	-8.306	KM Geo Mean	2.4692E-4
468	KM SD (logged)	1.088	95% Critical H Value (KM-Log)	2.29
469	KM Standard Error of Mean (logged)	0.118	95% H-UCL (KM -Log)	5.6953E-4
470	KM SD (logged)	1.088	95% Critical H Value (KM-Log)	2.29
471	KM Standard Error of Mean (logged)	0.118		
472				
473	**DL/2 Statistics**			
474	**DL/2 Normal**		**DL/2 Log-Transformed**	
475	Mean in Original Scale	0.0129	Mean in Log Scale	-7.752
476	SD in Original Scale	0.0615	SD in Log Scale	1.743
477	95% t UCL (Assumes normality)	0.0229	95% H-Stat UCL	0.00328
478	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
479				
480	**Nonparametric Distribution Free UCL Statistics**			
481	**Data do not follow a Discernible Distribution at 5% Significance Level**			
482				
483	**Suggested UCL to Use**			
484	95% KM (Chebyshev) UCL	0.0297		
485				
486	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
487	Recommendations are based upon data size, data distribution, and skewness.			
488	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
489	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
490				
491	**Isopropylbenzene**			
492				
493	**General Statistics**			
494	Total Number of Observations	105	Number of Distinct Observations	87
495	Number of Detects	1	Number of Non-Detects	104
496	Number of Distinct Detects	1	Number of Distinct Non-Detects	86
497				
498	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**			
499	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**			
500				
501	**The data set for variable Isopropylbenzene was not processed!**			
502				
503				
504				
505	**Lead**			
506				
507	**General Statistics**			
508	Total Number of Observations	105	Number of Distinct Observations	88
509			Number of Missing Observations	0
510	Minimum	1.1	Mean	9.274
511	Maximum	71	Median	5.46
512	SD	11.76	Std. Error of Mean	1.147
513	Coefficient of Variation	1.268	Skewness	3.131
514				
515	**Normal GOF Test**			
516	Shapiro Wilk Test Statistic	0.609	**Shapiro Wilk GOF Test**	
517	5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
518	Lilliefors Test Statistic	0.275	**Lilliefors GOF Test**	
519	5% Lilliefors Critical Value	0.0867	Data Not Normal at 5% Significance Level	
520	**Data Not Normal at 5% Significance Level**			
521				
522	**Assuming Normal Distribution**			
523	**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**	
524	95% Student's-t UCL	11.18	95% Adjusted-CLT UCL (Chen-1995)	11.54
525			95% Modified-t UCL (Johnson-1978)	11.24
526				
527	**Gamma GOF Test**			
528	A-D Test Statistic	4.233	**Anderson-Darling Gamma GOF Test**	

529	5% A-D Critical Value	0.776	Data Not Gamma Distributed at 5% Significance Level	
530	K-S Test Statistic	0.167	**Kolmogorov-Smirnov Gamma GOF Test**	
531	5% K-S Critical Value	0.0903	Data Not Gamma Distributed at 5% Significance Level	
532	**Data Not Gamma Distributed at 5% Significance Level**			
533				
534	**Gamma Statistics**			
535	k hat (MLE)	1.27	k star (bias corrected MLE)	1.24
536	Theta hat (MLE)	7.304	Theta star (bias corrected MLE)	7.481
537	nu hat (MLE)	266.6	nu star (bias corrected)	260.3
538	MLE Mean (bias corrected)	9.274	MLE Sd (bias corrected)	8.329
539			Approximate Chi Square Value (0.05)	224
540	Adjusted Level of Significance	0.0477	Adjusted Chi Square Value	223.5
541				
542	**Assuming Gamma Distribution**			
543	95% Approximate Gamma UCL (use when n>=50))	10.78	95% Adjusted Gamma UCL (use when n<50)	10.8
544				
545	**Lognormal GOF Test**			
546	Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**	
547	5% Shapiro Wilk P Value	0.00569	Data Not Lognormal at 5% Significance Level	
548	Lilliefors Test Statistic	0.0889	**Lilliefors Lognormal GOF Test**	
549	5% Lilliefors Critical Value	0.0867	Data Not Lognormal at 5% Significance Level	
550	**Data Not Lognormal at 5% Significance Level**			
551				
552	**Lognormal Statistics**			
553	Minimum of Logged Data	0.0953	Mean of logged Data	1.784
554	Maximum of Logged Data	4.263	SD of logged Data	0.871
555				
556	**Assuming Lognormal Distribution**			
557	95% H-UCL	10.41	90% Chebyshev (MVUE) UCL	11.21
558	95% Chebyshev (MVUE) UCL	12.37	97.5% Chebyshev (MVUE) UCL	13.98
559	99% Chebyshev (MVUE) UCL	17.13		
560				
561	**Nonparametric Distribution Free UCL Statistics**			
562	**Data do not follow a Discernible Distribution (0.05)**			
563				
564	**Nonparametric Distribution Free UCLs**			
565	95% CLT UCL	11.16	95% Jackknife UCL	11.18
566	95% Standard Bootstrap UCL	11.13	95% Bootstrap-t UCL	11.77
567	95% Hall's Bootstrap UCL	11.52	95% Percentile Bootstrap UCL	11.27
568	95% BCA Bootstrap UCL	11.52		
569	90% Chebyshev(Mean, Sd) UCL	12.72	95% Chebyshev(Mean, Sd) UCL	14.28
570	97.5% Chebyshev(Mean, Sd) UCL	16.44	99% Chebyshev(Mean, Sd) UCL	20.69
571				
572	**Suggested UCL to Use**			
573	95% Chebyshev (Mean, Sd) UCL	14.28		
574				
575	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
576	Recommendations are based upon data size, data distribution, and skewness.			
577	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
578	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
579				
580	**MTBE (Methyl tert-butyl ether)**			
581				
582	**General Statistics**			
583	Total Number of Observations	105	Number of Distinct Observations	97
584	Number of Detects	0	Number of Non-Detects	105
585	Number of Distinct Detects	0	Number of Distinct Non-Detects	97
586				
587	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**			
588	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**			
589	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**			
590				
591	**The data set for variable MTBE (Methyl tert-butyl ether) was not processed!**			
592				

	A–E	F	G–K	L
593				
594	Naphthalene			
595				
596	**General Statistics**			
597	Total Number of Observations	117	Number of Distinct Observations	94
598	Number of Detects	15	Number of Non-Detects	102
599	Number of Distinct Detects	15	Number of Distinct Non-Detects	80
600	Minimum Detect	2.1000E-4	Minimum Non-Detect	1.4200E-4
601	Maximum Detect	16	Maximum Non-Detect	0.068
602	Variance Detects	38.07	Percent Non-Detects	87.18%
603	Mean Detects	4.258	SD Detects	6.17
604	Median Detects	0.31	CV Detects	1.449
605	Skewness Detects	1.047	Kurtosis Detects	-0.678
606	Mean of Logged Detects	-2.143	SD of Logged Detects	4.18
607				
608	**Normal GOF Test on Detects Only**			
609	Shapiro Wilk Test Statistic	0.707	**Shapiro Wilk GOF Test**	
610	5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level	
611	Lilliefors Test Statistic	0.362	**Lilliefors GOF Test**	
612	5% Lilliefors Critical Value	0.22	Detected Data Not Normal at 5% Significance Level	
613	**Detected Data Not Normal at 5% Significance Level**			
614				
615	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
616	KM Mean	0.546	KM Standard Error of Mean	0.246
617	KM SD	2.566	95% KM (BCA) UCL	0.953
618	95% KM (t) UCL	0.953	95% KM (Percentile Bootstrap) UCL	0.959
619	95% KM (z) UCL	0.95	95% KM Bootstrap t UCL	1.176
620	90% KM Chebyshev UCL	1.283	95% KM Chebyshev UCL	1.616
621	97.5% KM Chebyshev UCL	2.079	99% KM Chebyshev UCL	2.989
622				
623	**Gamma GOF Tests on Detected Observations Only**			
624	A-D Test Statistic	0.839	**Anderson-Darling GOF Test**	
625	5% A-D Critical Value	0.881	Detected data appear Gamma Distributed at 5% Significance Level	
626	K-S Test Statistic	0.233	**Kolmogorov-Smirnov GOF**	
627	5% K-S Critical Value	0.245	Detected data appear Gamma Distributed at 5% Significance Level	
628	**Detected data appear Gamma Distributed at 5% Significance Level**			
629				
630	**Gamma Statistics on Detected Data Only**			
631	k hat (MLE)	0.204	k star (bias corrected MLE)	0.208
632	Theta hat (MLE)	20.85	Theta star (bias corrected MLE)	20.49
633	nu hat (MLE)	6.126	nu star (bias corrected)	6.234
634	Mean (detects)	4.258		
635				
636	**Gamma ROS Statistics using Imputed Non-Detects**			
637	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
638	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)			
639	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
640	This is especially true when the sample size is small.			
641	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
642	Minimum	2.1000E-4	Mean	0.555
643	Maximum	16	Median	0.01
644	SD	2.575	CV	4.642
645	k hat (MLE)	0.199	k star (bias corrected MLE)	0.2
646	Theta hat (MLE)	2.786	Theta star (bias corrected MLE)	2.778
647	nu hat (MLE)	46.58	nu star (bias corrected)	46.71
648	Adjusted Level of Significance (β)	0.0479		
649	Approximate Chi Square Value (46.71, α)	32.03	Adjusted Chi Square Value (46.71, β)	31.88
650	95% Gamma Approximate UCL (use when n>=50)	0.809	95% Gamma Adjusted UCL (use when n<50)	0.813
651				
652	**Estimates of Gamma Parameters using KM Estimates**			
653	Mean (KM)	0.546	SD (KM)	2.566
654	Variance (KM)	6.582	SE of Mean (KM)	0.246
655	k hat (KM)	0.0453	k star (KM)	0.0498
656	nu hat (KM)	10.6	nu star (KM)	11.66
657	theta hat (KM)	12.05	theta star (KM)	10.96
658	80% gamma percentile (KM)	0.0732	90% gamma percentile (KM)	0.83
659	95% gamma percentile (KM)	2.901	99% gamma percentile (KM)	11.89
660				
661	**Gamma Kaplan-Meier (KM) Statistics**			
662	Approximate Chi Square Value (11.66, α)	5.006	Adjusted Chi Square Value (11.66, β)	4.951

	A–E	F	G–K	L
663	95% Gamma Approximate KM-UCL (use when n>=50)	1.272	95% Gamma Adjusted KM-UCL (use when n<50)	1.286
664				
665	**Lognormal GOF Test on Detected Observations Only**			
666	Shapiro Wilk Test Statistic	0.873	**Shapiro Wilk GOF Test**	
667	5% Shapiro Wilk Critical Value	0.881	Detected Data Not Lognormal at 5% Significance Level	
668	Lilliefors Test Statistic	0.181	**Lilliefors GOF Test**	
669	5% Lilliefors Critical Value	0.22	Detected Data appear Lognormal at 5% Significance Level	
670	**Detected Data appear Approximate Lognormal at 5% Significance Level**			
671				
672	**Lognormal ROS Statistics Using Imputed Non-Detects**			
673	Mean in Original Scale	0.546	Mean in Log Scale	-16.42
674	SD in Original Scale	2.577	SD in Log Scale	6.174
675	95% t UCL (assumes normality of ROS data)	0.941	95% Percentile Bootstrap UCL	0.959
676	95% BCA Bootstrap UCL	1.104	95% Bootstrap t UCL	1.124
677	95% H-UCL (Log ROS)	2476		
678				
679	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
680	KM Mean (logged)	-7.919	KM Geo Mean	3.6382E-4
681	KM SD (logged)	2.672	95% Critical H Value (KM-Log)	4.192
682	KM Standard Error of Mean (logged)	0.261	95% H-UCL (KM -Log)	0.0366
683	KM SD (logged)	2.672	95% Critical H Value (KM-Log)	4.192
684	KM Standard Error of Mean (logged)	0.261		
685				
686	**DL/2 Statistics**			
687	**DL/2 Normal**		**DL/2 Log-Transformed**	
688	Mean in Original Scale	0.547	Mean in Log Scale	-7.022
689	SD in Original Scale	2.576	SD in Log Scale	2.669
690	95% t UCL (Assumes normality)	0.942	95% H-Stat UCL	0.0888
691	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
692				
693	**Nonparametric Distribution Free UCL Statistics**			
694	**Detected Data appear Gamma Distributed at 5% Significance Level**			
695				
696	**Suggested UCL to Use**			
697	95% KM Approximate Gamma UCL	1.272		
698				
699	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
700	Recommendations are based upon data size, data distribution, and skewness.			
701	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
702	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
703				
704	**Toluene**			
705				
706	**General Statistics**			
707	Total Number of Observations	105	Number of Distinct Observations	96
708	Number of Detects	37	Number of Non-Detects	68
709	Number of Distinct Detects	35	Number of Distinct Non-Detects	63
710	Minimum Detect	2.2050E-4	Minimum Non-Detect	2.1900E-4
711	Maximum Detect	0.00446	Maximum Non-Detect	0.688
712	Variance Detects	1.4870E-6	Percent Non-Detects	64.76%
713	Mean Detects	0.00155	SD Detects	0.00122
714	Median Detects	0.001	CV Detects	0.787
715	Skewness Detects	1.012	Kurtosis Detects	-0.159
716	Mean of Logged Detects	-6.781	SD of Logged Detects	0.825
717				
718	**Normal GOF Test on Detects Only**			
719	Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk GOF Test**	
720	5% Shapiro Wilk Critical Value	0.936	Detected Data Not Normal at 5% Significance Level	
721	Lilliefors Test Statistic	0.232	**Lilliefors GOF Test**	
722	5% Lilliefors Critical Value	0.144	Detected Data Not Normal at 5% Significance Level	
723	**Detected Data Not Normal at 5% Significance Level**			
724				

	A–E	F	G–K	L
725	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
726	KM Mean	7.8992E-4	KM Standard Error of Mean	1.0568E-4
727	KM SD	9.9030E-4	95% KM (BCA) UCL	9.5878E-4
728	95% KM (t) UCL	9.6530E-4	95% KM (Percentile Bootstrap) UCL	9.7818E-4
729	95% KM (z) UCL	9.6374E-4	95% KM Bootstrap t UCL	9.8064E-4
730	90% KM Chebyshev UCL	0.00111	95% KM Chebyshev UCL	0.00125
731	97.5% KM Chebyshev UCL	0.00145	99% KM Chebyshev UCL	0.00184
732				
733	**Gamma GOF Tests on Detected Observations Only**			
734	A-D Test Statistic	0.965	**Anderson-Darling GOF Test**	
735	5% A-D Critical Value	0.763	Detected Data Not Gamma Distributed at 5% Significance Level	
736	K-S Test Statistic	0.164	**Kolmogorov-Smirnov GOF**	
737	5% K-S Critical Value	0.147	Detected Data Not Gamma Distributed at 5% Significance Level	
738	**Detected Data Not Gamma Distributed at 5% Significance Level**			
739				
740	**Gamma Statistics on Detected Data Only**			
741	k hat (MLE)	1.755	k star (bias corrected MLE)	1.631
742	Theta hat (MLE)	8.8272E-4	Theta star (bias corrected MLE)	9.5000E-4
743	nu hat (MLE)	129.9	nu star (bias corrected)	120.7
744	Mean (detects)	0.00155		
745				
746	**Gamma ROS Statistics using Imputed Non-Detects**			
747	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
748	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)			
749	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
750	This is especially true when the sample size is small.			
751	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
752	Minimum	2.2050E-4	Mean	0.00702
753	Maximum	0.01	Median	0.01
754	SD	0.00412	CV	0.587
755	k hat (MLE)	1.352	k star (bias corrected MLE)	1.32
756	Theta hat (MLE)	0.00519	Theta star (bias corrected MLE)	0.00532
757	nu hat (MLE)	284	nu star (bias corrected)	277.2
758	Adjusted Level of Significance (β)	0.0477		
759	Approximate Chi Square Value (277.17, α)	239.6	Adjusted Chi Square Value (277.17, β)	239.1
760	95% Gamma Approximate UCL (use when n>=50)	0.00812	95% Gamma Adjusted UCL (use when n<50)	0.00814
761				
762	**Estimates of Gamma Parameters using KM Estimates**			
763	Mean (KM)	7.8992E-4	SD (KM)	9.9030E-4
764	Variance (KM)	9.8069E-7	SE of Mean (KM)	1.0568E-4
765	k hat (KM)	0.636	k star (KM)	0.624
766	nu hat (KM)	133.6	nu star (KM)	131.1
767	theta hat (KM)	0.00124	theta star (KM)	0.00127
768	80% gamma percentile (KM)	0.0013	90% gamma percentile (KM)	0.00204
769	95% gamma percentile (KM)	0.0028	99% gamma percentile (KM)	0.00465
770				
771	**Gamma Kaplan-Meier (KM) Statistics**			
772	Approximate Chi Square Value (131.13, α)	105.7	Adjusted Chi Square Value (131.13, β)	105.4
773	95% Gamma Approximate KM-UCL (use when n>=50)	9.8018E-4	95% Gamma Adjusted KM-UCL (use when n<50)	9.8312E-4
774				
775	**Lognormal GOF Test on Detected Observations Only**			
776	Shapiro Wilk Test Statistic	0.944	**Shapiro Wilk GOF Test**	
777	5% Shapiro Wilk Critical Value	0.936	Detected Data appear Lognormal at 5% Significance Level	
778	Lilliefors Test Statistic	0.126	**Lilliefors GOF Test**	
779	5% Lilliefors Critical Value	0.144	Detected Data appear Lognormal at 5% Significance Level	
780	**Detected Data appear Lognormal at 5% Significance Level**			
781				
782	**Lognormal ROS Statistics Using Imputed Non-Detects**			
783	Mean in Original Scale	7.1029E-4	Mean in Log Scale	-7.794
784	SD in Original Scale	9.5302E-4	SD in Log Scale	0.939
785	95% t UCL (assumes normality of ROS data)	8.6464E-4	95% Percentile Bootstrap UCL	8.5817E-4
786	95% BCA Bootstrap UCL	8.7165E-4	95% Bootstrap t UCL	8.8436E-4
787	95% H-UCL (Log ROS)	7.8126E-4		
788				
789	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
790	KM Mean (logged)	-7.668	KM Geo Mean	4.6778E-4
791	KM SD (logged)	0.932	95% Critical H Value (KM-Log)	2.148
792	KM Standard Error of Mean (logged)	0.106	95% H-UCL (KM -Log)	8.7925E-4
793	KM SD (logged)	0.932	95% Critical H Value (KM-Log)	2.148
794	KM Standard Error of Mean (logged)	0.106		

	A–E	F	G–K	L
795				
796	**DL/2 Statistics**			
797	**DL/2 Normal**		**DL/2 Log-Transformed**	
798	Mean in Original Scale	0.0082	Mean in Log Scale	-7.215
799	SD in Original Scale	0.0431	SD in Log Scale	1.569
800	95% t UCL (Assumes normality)	0.0152	95% H-Stat UCL	0.00388
801	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
802				
803	**Nonparametric Distribution Free UCL Statistics**			
804	**Detected Data appear Lognormal Distributed at 5% Significance Level**			
805				
806	**Suggested UCL to Use**			
807	KM H-UCL	8.7925E-4		
808				
809	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
810	Recommendations are based upon data size, data distribution, and skewness.			
811	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
812	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
813				
814	Xylenes (total)			
815				
816	**General Statistics**			
817	Total Number of Observations	105	Number of Distinct Observations	87
818	Number of Detects	16	Number of Non-Detects	89
819	Number of Distinct Detects	16	Number of Distinct Non-Detects	73
820	Minimum Detect	4.9200E-4	Minimum Non-Detect	3.4800E-4
821	Maximum Detect	3.8	Maximum Non-Detect	1.11
822	Variance Detects	0.922	Percent Non-Detects	84.76%
823	Mean Detects	0.355	SD Detects	0.96
824	Median Detects	0.00244	CV Detects	2.703
825	Skewness Detects	3.494	Kurtosis Detects	12.82
826	Mean of Logged Detects	-4.802	SD of Logged Detects	2.891
827				
828	**Normal GOF Test on Detects Only**			
829	Shapiro Wilk Test Statistic	0.434	**Shapiro Wilk GOF Test**	
830	5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level	
831	Lilliefors Test Statistic	0.393	**Lilliefors GOF Test**	
832	5% Lilliefors Critical Value	0.213	Detected Data Not Normal at 5% Significance Level	
833	**Detected Data Not Normal at 5% Significance Level**			
834				
835	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
836	KM Mean	0.0547	KM Standard Error of Mean	0.0388
837	KM SD	0.385	95% KM (BCA) UCL	0.136
838	95% KM (t) UCL	0.119	95% KM (Percentile Bootstrap) UCL	0.127
839	95% KM (z) UCL	0.119	95% KM Bootstrap t UCL	0.428
840	90% KM Chebyshev UCL	0.171	95% KM Chebyshev UCL	0.224
841	97.5% KM Chebyshev UCL	0.297	99% KM Chebyshev UCL	0.441
842				
843	**Gamma GOF Tests on Detected Observations Only**			
844	A-D Test Statistic	2.46	**Anderson-Darling GOF Test**	
845	5% A-D Critical Value	0.887	Detected Data Not Gamma Distributed at 5% Significance Level	
846	K-S Test Statistic	0.425	**Kolmogorov-Smirnov GOF**	
847	5% K-S Critical Value	0.239	Detected Data Not Gamma Distributed at 5% Significance Level	
848	**Detected Data Not Gamma Distributed at 5% Significance Level**			
849				
850	**Gamma Statistics on Detected Data Only**			
851	k hat (MLE)	0.196	k star (bias corrected MLE)	0.201
852	Theta hat (MLE)	1.813	Theta star (bias corrected MLE)	1.768
853	nu hat (MLE)	6.272	nu star (bias corrected)	6.429
854	Mean (detects)	0.355		
855				
856	**Gamma ROS Statistics using Imputed Non-Detects**			
857	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
858	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)			
859	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
860	This is especially true when the sample size is small.			
861	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			

	A	B	C	D	E	F	G	H	I	J	K	L
862					Minimum	4.9200E-4					Mean	0.0626
863					Maximum	3.8					Median	0.01
864					SD	0.385					CV	6.156
865					k hat (MLE)	0.359					k star (bias corrected MLE)	0.355
866					Theta hat (MLE)	0.174					Theta star (bias corrected MLE)	0.176
867					nu hat (MLE)	75.42					nu star (bias corrected)	74.6
868					Adjusted Level of Significance (β)	0.0477						
869					Approximate Chi Square Value (74.60, α)	55.71					Adjusted Chi Square Value (74.60, β)	55.48
870					95% Gamma Approximate UCL (use when n>=50)	0.0838					95% Gamma Adjusted UCL (use when n<50)	0.0842
871												
872	**Estimates of Gamma Parameters using KM Estimates**											
873					Mean (KM)	0.0547					SD (KM)	0.385
874					Variance (KM)	0.148					SE of Mean (KM)	0.0388
875					k hat (KM)	0.0202					k star (KM)	0.026
876					nu hat (KM)	4.246					nu star (KM)	5.458
877					theta hat (KM)	2.707					theta star (KM)	2.106
878					80% gamma percentile (KM)	2.2549E-4					90% gamma percentile (KM)	0.0212
879					95% gamma percentile (KM)	0.182					99% gamma percentile (KM)	1.463
880												
881	**Gamma Kaplan-Meier (KM) Statistics**											
882					Approximate Chi Square Value (5.46, α)	1.369					Adjusted Chi Square Value (5.46, β)	1.342
883					95% Gamma Approximate KM-UCL (use when n>=50)	0.218					95% Gamma Adjusted KM-UCL (use when n<50)	0.223
884												
885	**Lognormal GOF Test on Detected Observations Only**											
886					Shapiro Wilk Test Statistic	0.768	**Shapiro Wilk GOF Test**					
887					5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level					
888					Lilliefors Test Statistic	0.354	**Lilliefors GOF Test**					
889					5% Lilliefors Critical Value	0.213	Detected Data Not Lognormal at 5% Significance Level					
890	**Detected Data Not Lognormal at 5% Significance Level**											
891												
892	**Lognormal ROS Statistics Using Imputed Non-Detects**											
893					Mean in Original Scale	0.0541					Mean in Log Scale	-12.9
894					SD in Original Scale	0.387					SD in Log Scale	3.862
895					95% t UCL (assumes normality of ROS data)	0.117					95% Percentile Bootstrap UCL	0.125
896					95% BCA Bootstrap UCL	0.191					95% Bootstrap t UCL	0.385
897					95% H-UCL (Log ROS)	0.0379						
898												
899	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
900					KM Mean (logged)	-7.417					KM Geo Mean	6.0122E-4
901					KM SD (logged)	1.586					95% Critical H Value (KM-Log)	2.816
902					KM Standard Error of Mean (logged)	0.164					95% H-UCL (KM -Log)	0.00328
903					KM SD (logged)	1.586					95% Critical H Value (KM-Log)	2.816
904					KM Standard Error of Mean (logged)	0.164						
905												
906	**DL/2 Statistics**											
907	**DL/2 Normal**						**DL/2 Log-Transformed**					
908					Mean in Original Scale	0.0663					Mean in Log Scale	-6.899
909					SD in Original Scale	0.391					SD in Log Scale	2.007
910					95% t UCL (Assumes normality)	0.13					95% H-Stat UCL	0.0145
911	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
912												
913	**Nonparametric Distribution Free UCL Statistics**											
914	**Data do not follow a Discernible Distribution at 5% Significance Level**											
915												
916	**Suggested UCL to Use**											
917					95% KM (Chebyshev) UCL	0.224						
918												
919	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
920	Recommendations are based upon data size, data distribution, and skewness.											
921	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
922	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
923												

Attachment 2 (Continued)

Soil Vapor Samples from Q1 through Q3 2016, On-Base (Input)

	A	B	C	D	E
1	1,2,4-TRIMETHYLBENZENE	d_1,2,4-TRIMETHYLBENZENE		1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	d_1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)
2	1.28	0		1.38	0
3	3.24	1		1.31	0
4	1.62	1		1.31	0
5	81.11	1		3.19	1
6	5.41	1		2.23	0
7	4.77	1		1.38	0
8	5.41	1		1.31	0
9	5.41	1		1.38	0
10	9.34	1		1.38	0
11	5.9	1		1.38	0
12	12.29	1		1.31	0
13	3.29	1		1.31	0
14	5.9	1		1.31	0
15	290.03	1		3.76	1
16	117.98	1		2	1
17	35.39	1		3.46	1
18	19.66	1		2.31	1
19	1.28	0		1.38	0
20	1.23	0		1.38	0
21	32.94	1		1.38	0
22	7.87	1		1.38	0
23	2.26	1		1.38	0
24	1.77	1		1.38	0
25	3.49	1		1.31	0
26	2.41	1		1.46	0
27	2.29	1		1.46	0
28	2.7	1		1.42	0
29	3	1		1.38	0
30	5.41	1		1.31	0
31	2.7	1		1.31	0
32	2.9	1		1.31	0
33	1.18	0		1.31	0
34	1.23	0		1.31	0
35	5.01	1		1.31	0
36	2.11	1		1.31	0
37	2.16	1		1.31	0
38	2.51	1		1.23	0
39	31.21	1		1.31	1
40	1.18	1		1.23	0
41	1.43	1		1.23	0
42	4.28	1		1.23	0
43	8.85	1		1.77	1
44	13.27	1		1.61	1
45	14.26	1		1.54	1
46	7.87	1		1.46	1
47	8.85	1		1.31	0
48	221.21	1		3.23	1
49	18.19	1		2.69	1
50	639.05	1		2.38	1
51	113.06	1		23.82	1
52	1.23	0		1.34	0
53	1.25	0		1.31	0
54	1.18	0		1.31	0
55	1.18	0		1.31	0

	A	B	C	D	E
1	1,2,4-TRIMETHYLBENZENE	d_1,2,4-TRIMETHYLBENZENE		1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	d_1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)
56	1.67	1		1.31	0
57	11.8	1		1.31	0
58	2.06	1		1.23	0
59	1.18	0		1.31	0
60	1.18	0		1.31	0
61	1.77	1		1.23	0
62	1.82	1		1.23	0
63	1.33	1		1.23	0
64	2.11	1		1.38	0
65	4.47	1		1.38	0
66	2.02	1		1.31	0
67	3.69	1		1.46	0
68	23.6	1		2.07	1
69	9.83	1		1.61	1
70	3.42	1		1.38	0
71	1.23	0		1.38	0
72	1.28	0		1.31	0
73	1.52	1		1.31	0
74	7.37	1		1.31	0
75	28.51	1		4.15	1
76	2.75	1		1.38	0
77	6.88	1		1.31	0
78	113.06	1		1.31	0
79	19.42	1		1.08	0
80	1.33	0		1.84	0
81	1.18	0		1.38	0
82	1.77	0		1.31	0
83	1.18	0		1.31	0
84	8.85	1		1.27	0
85	83.57	1		1.23	0
86	3.54	1		1.23	0
87	1.18	0		1.61	0
88	1.18	0		1.31	0
89	1.97	1		1.23	0
90	4.18	1		1.23	0
91	1.18	0		1.23	0
92	1.18	0		1.23	0
93	2.46	1		1.31	0
94	1.62	1		1.31	0

	F	G	H	I	J	K	L	M	N	O
1		1,2-DICHLOROETHANE	d_1,2-DICHLOROETHANE		BENZENE	d_BENZENE		CYCLOHEXANE	d_CYCLOHEXANE	
2		1.38	0		1.37	0		2.48	0	
3		1.34	0		1.31	0		2.41	0	
4		1.3	0		1.34	1		2.34	0	
5		1.34	0		40.73	1		2.43	0	
6		1.38	0		24.6	1		4.13	0	
7		2.23	0		3	1		2.48	0	
8		1.34	0		2.72	1		48.19	1	
9		1.42	0		6.07	1		2.58	0	
10		1.38	0		3.03	1		4.13	1	
11		1.34	0		7.35	1		2.34	0	
12		1.38	0		13.1	1		5.85	1	
13		1.3	0		8.63	1		3.44	1	
14		1.34	0		3.83	1		4.47	1	
15		1.34	0		479.2	1		378.63	1	
16		1.38	0		63.89	1		22.37	1	
17		1.38	0		13.1	1		154.9	1	
18		1.46	0		38.34	1		7.92	1	
19		1.38	0		1.37	0		2.48	0	
20		1.38	0		1.37	0		2.51	0	
21		1.4	0		1.34	0		2.48	0	
22		1.38	0		5.11	1		2.48	0	
23		1.34	0		15.97	1		2.48	0	
24		1.34	0		2.01	1		2.44	0	
25		1.38	0		1.41	1		2.41	0	
26		1.42	0		1.44	0		2.58	0	
27		1.4	0		1.37	0		2.58	0	
28		1.34	0		1.34	0		2.55	0	
29		1.34	0		1.34	0		2.48	0	
30		1.42	0		1.34	0		2.44	0	
31		1.34	0		1.9	1		2.41	0	
32		1.38	0		1.44	1		2.41	0	
33		1.32	0		1.28	0		2.39	0	
34		1.25	0		1.28	0		2.38	0	
35		1.25	0		5.11	1		2.34	0	
36		1.3	0		2.36	1		2.34	0	
37		1.3	0		1.82	1		2.31	0	
38		1.3	0		2.43	1		2.27	0	
39		1.34	0		14.38	1		2.41	0	
40		1.25	0		1.25	0		2.27	0	
41		1.25	0		1.85	1		2.24	0	
42		1.25	0		1.79	1		5.51	1	
43		1.3	0		6.07	1		2.31	0	
44		1.3	0		7.03	1		5.51	1	
45		1.34	0		6.71	1		4.82	1	
46		1.25	0		11.82	1		3.79	1	
47		1.25	0		3.19	1		3.44	1	
48		1.25	0		35.14	1		75.73	1	
49		1.3	0		11.18	1		8.61	1	
50		1.25	0		35.14	1		148.01	1	
51		1.3	0		99.04	1		41.31	1	
52		1.3	0		1.34	0		2.38	0	
53		1.3	0		1.28	0		2.41	0	
54		1.3	0		1.28	0		2.34	0	
55		1.3	0		1.28	0		2.34	0	

	F	G	H	I	J	K	L	M	N	O
1		1,2-DICHLOROETHANE	d_1,2-DICHLOROETHANE		BENZENE	d_BENZENE		CYCLOHEXANE	d_CYCLOHEXANE	
56		1.34	0		1.25	0		2.34	0	
57		1.25	0		5.43	1		2.31	0	
58		1.25	0		2.11	1		2.24	0	
59		1.3	0		1.31	0		2.38	0	
60		1.3	0		1.28	0		2.31	0	
61		1.25	0		1.28	0		2.31	0	
62		1.25	0		1.25	0		2.27	0	
63		1.25	0		1.25	0		2.27	0	
64		1.38	0		1.41	0		2.51	0	
65		1.3	0		1.37	0		2.48	0	
66		1.38	0		2.01	1		4.47	1	
67		1.42	0		1.5	1		2.58	0	
68		1.38	0		11.66	1		53.35	1	
69		1.38	0		9.58	1		251.28	1	
70		1.38	0		54.31	1		8.26	1	
71		1.3	0		1.28	0		2.48	0	
72		1.34	0		8.63	1		2.44	0	
73		1.3	0		4.15	1		2.34	0	
74		1.38	0		3.83	1		2.34	0	
75		1.34	0		7.67	1		2.44	0	
76		1.09	0		4.47	1		2.38	0	
77		1.3	0		4.15	1		2	0	
78		1.3	0		3.51	1		27.88	1	
79		1.3	0		1.88	1		26.85	1	
80		1.38	0		1.85	0		2.51	0	
81		1.17	0		1.28	0		3.37	0	
82		1.25	0		1.25	0		2.38	0	
83		1.86	0		6.07	1		2.34	0	
84		1.25	0		4.15	1		2.31	0	
85		1.3	0		1.92	1		2.27	0	
86		1.3	0		3.16	1		13.08	1	
87		1.66	0		1.63	0		2.41	0	
88		1.25	0		1.25	0		2.27	0	
89		1.25	0		1.25	0		2.27	0	
90		1.34	0		9.58	1		4.82	1	
91		1.21	0		1.25	0		2.27	0	
92		1.25	0		1.25	0		2.24	0	
93		1.3	0		1.28	0		2.34	0	
94		1.3	0		4.15	1		2.34	0	

	P	Q	R	S	T	U	V	W
1	ETHYLBENZENE	d_ETHYLBENZENE		M,P-XYLENE (SUM OF ISOMERS)	d_M,P-XYLENE (SUM OF ISOMERS)		NAPHTHALENE	d_NAPHTHALENE
2	1.39	0		3.82	1		1.52	0
3	1.3	0		9.12	1		3.25	1
4	2.08	1		6.08	1		2.04	1
5	62.96	1		607.87	1		5.71	1
6	4.26	1		20.41	1		5.24	1
7	3.39	1		16.07	1		5.24	1
8	3.95	1		20.41	1		4.93	1
9	6.51	1		17.8	1		5.77	1
10	3.95	1		28.22	1		14.15	1
11	4.78	1		20.84	1		5.77	1
12	10.42	1		42.12	1		13.11	1
13	4.78	1		12.16	1		5.24	1
14	3	1		21.71	1		3.2	1
15	243.17	1		521.03	1		94.36	1
16	78.16	1		269.2	1		52.42	1
17	21.28	1		69.47	1		36.17	1
18	18.67	1		56.44	1		22.54	1
19	1.39	0		2.56	0		1.52	0
20	1.35	0		2.52	0		7.08	1
21	1.35	0		15.85	1		6.29	1
22	3.28	1		6.51	1		2.62	1
23	14.76	1		3.99	1		1.94	1
24	1.61	1		60.79	1		19.92	1
25	1.43	1		6.95	1		1.68	1
26	1.43	0		12.59	1		1.6	0
27	1.35	0		7.38	1		1.52	0
28	1.35	0		6.08	1		6.29	1
29	2.78	1		6.08	1		5.24	1
30	1.65	1		6.08	1		5.24	1
31	1.56	1		5.21	1		7.86	1
32	1.43	1		6.08	1		4.19	1
33	1.3	0		14.33	1		1.47	0
34	1.26	0		7.38	1		1.42	0
35	3.19	1		5.21	1		4.14	1
36	1.95	1		3.08	1		1.99	1
37	1.61	1		6.51	1		2.57	1
38	1.78	1		6.95	1		3.72	1
39	24.1	1		223.61	1		3.8	1
40	1.26	0		11.29	1		1.42	0
41	2.87	1		4.78	1		1.42	0
42	1.3	1		3.86	1		3.09	1
43	5.97	1		23.66	1		1.47	0
44	6.51	1		27.35	1		5.22	1
45	8.25	1		33	1		7.34	1
46	10.42	1		43.42	1		13.63	1
47	3.78	1		17.37	1		5.24	1
48	52.11	1		212.75	1		52.42	1
49	9.12	1		38.64	1		18.87	1
50	73.82	1		264.86	1		256.86	1
51	95.53	1		360.38	1		57.66	1
52	1.35	0		2.43	0		1.47	0
53	1.3	0		2.34	0		1.47	0
54	1.3	0		31.26	1		1.42	0
55	1.26	0		6.08	1		3.51	1

	P	Q	R	S	T	U	V	W
1	ETHYLBENZENE	d_ETHYLBENZENE		M,P-XYLENE (SUM OF ISOMERS)	d_M,P-XYLENE (SUM OF ISOMERS)		NAPHTHALENE	d_NAPHTHALENE
56	1.26	0		4.78	1		3.09	1
57	4.78	1		4.78	1		2.18	1
58	1.48	1		4.78	1		1.42	1
59	1.3	0		2.39	0		1.42	0
60	1.26	0		2.34	0		1.42	0
61	1.26	0		4.3	1		2.36	1
62	1.26	0		3.78	1		1.68	1
63	1.26	0		3.3	1		1.83	1
64	3.82	1		12.16	1		3.72	1
65	4.26	1		9.99	1		1.57	0
66	3.3	1		13.89	1		1.52	0
67	2.08	1		6.95	1		1.47	0
68	7.16	1		19.97	1		20.97	1
69	13.9	1		47.76	1		8.91	1
70	13.9	1		40.38	1		2.02	1
71	1.39	0		26.05	1		1.52	0
72	1.3	0		7.82	1		4.56	1
73	5.65	1		3.6	1		4.51	1
74	1.56	1		3.3	1		1.47	1
75	1.3	0		104.21	1		37.48	1
76	15.85	1		33	1		23.07	1
77	5.21	1		13.03	1		6.81	1
78	18.24	1		69.47	1		6.29	1
79	2.39	1		6.08	1		30.4	1
80	1.39	0		2.61	0		2.1	0
81	1.87	0		3.47	0		1.42	0
82	1.26	0		2.39	0		1.42	0
83	1.26	0		2.34	0		17.3	1
84	4.78	1		26.49	1		4.35	1
85	14.76	1		60.79	1		2.41	1
86	2.3	1		12.16	1		1.73	1
87	1.26	0		2.34	0		1.83	0
88	1.26	0		2.34	0		1.42	0
89	5.65	1		14.33	1		1.42	0
90	4.17	1		12.59	1		2.99	1
91	1.26	0		2.34	0		1.42	0
92	1.22	0		2.3	0		1.36	0
93	1.35	1		12.16	1		4.19	1
94	2.48	1		4.78	1		2.04	1

	X	Y	Z	AA	AB	AC	AD	AE	AF
1		n-HEPTANE	d_n-HEPTANE		n-HEXANE	d_n-HEXANE		O-XYLENE (1,2-DIMETHYLBENZENE)	d_O-XYLENE (1,2-DIMETHYLBENZENE)
2		1.43	0		1.27	0		1.3	0
3		1.39	0		1.2	0		2.61	1
4		1.39	0		1.23	0		1.69	1
5		2.46	1		1.25	0		284.4	1
6		36.48	1		26.08	1		5.64	1
7		2.38	0		2.11	0		5.21	1
8		1.43	0		1.27	0		4.34	1
9		5.33	1		5.64	1		7.82	1
10		1.52	0		1.34	0		4.78	1
11		7.38	1		9.52	1		12.16	1
12		4.92	1		3.52	1		6.95	1
13		3.77	1		3.21	1		6.08	1
14		1.39	0		1.2	0		3.34	1
15		491.83	1		599.21	1		191.04	1
16		39.76	1		28.55	1		86.84	1
17		151.65	1		77.54	1		24.75	1
18		9.02	1		3.52	1		19.54	1
19		1.97	1		1.3	0		23.01	1
20		1.48	0		1.27	0		5.64	1
21		1.43	0		1.27	0		2.39	1
22		1.43	0		1.27	0		2.26	1
23		1.43	0		1.27	0		1.35	1
24		1.43	0		1.27	0		1.3	0
25		1.43	0		1.27	0		1.26	0
26		1.64	1		1.34	0		3.82	1
27		1.52	0		1.34	0		2.26	1
28		1.52	0		1.32	0		1.82	1
29		1.43	0		1.27	0		1.78	1
30		1.43	0		1.27	0		1.78	1
31		1.43	0		1.27	0		1.76	1
32		1.39	0		1.23	0		1.56	1
33		1.52	1		1.23	0		95.52	1
34		1.93	1		1.23	0		5.19	1
35		1.39	0		1.23	0		2.65	1
36		1.39	0		1.2	0		2.52	1
37		1.35	0		1.2	0		2.13	1
38		1.35	0		1.2	0		1.91	1
39		1.35	0		1.16	0		1.22	0
40		6.97	1		3.35	1		3.65	1
41		1.35	0		1.16	0		1.74	1
42		1.31	0		1.16	0		1.35	1
43		13.53	1		3.88	1		18.24	1
44		5.33	1		2.82	1		10.85	1
45		5.08	1		2.68	1		9.12	1
46		4.92	1		2.19	1		8.68	1
47		2.13	1		1.2	0		6.51	1
48		98.37	1		52.87	1		134.6	1
49		32.79	1		20.09	1		82.5	1
50		7.79	1		3.52	1		13.46	1
51		81.97	1		26.79	1		121.57	1
52		3.11	1		1.45	1		14.33	1
53		1.41	0		1.23	0		2.69	1
54		1.39	0		1.2	0		1.78	1
55		1.35	0		1.2	0		1.65	1

	X	Y	Z	AA	AB	AC	AD	AE	AF
1		n-HEPTANE	d_n-HEPTANE		n-HEXANE	d_n-HEXANE		O-XYLENE (1,2-DIMETHYLBENZENE)	d_O-XYLENE (1,2-DIMETHYLBENZENE)
56		1.35	0		1.2	0		1.43	1
57		1.35	0		1.2	0		1.22	0
58		1.31	0		1.16	0		1.17	0
59		1.39	0		1.23	0		1.39	1
60		1.35	0		1.2	0		1.26	1
61		1.35	0		1.2	0		1.22	0
62		1.35	0		1.16	0		1.17	0
63		1.35	0		1.16	0		1.17	0
64		2.54	1		1.34	0		4.08	1
65		11.48	1		1.3	0		4.34	1
66		7.38	1		1.27	0		3.13	1
67		1.48	0		1.2	0		2.39	1
68		241.82	1		236.16	1		16.93	1
69		77.87	1		29.61	1		11.72	1
70		11.48	1		5.99	1		5.86	1
71		1.56	1		1.27	0		13.89	1
72		1.43	0		1.27	0		3.6	1
73		1.35	0		1.2	0		1.43	1
74		1.35	0		1.2	0		1.39	1
75		17.62	1		28.9	1		29.96	1
76		3.93	1		1.27	0		27.14	1
77		3.93	1		1.27	1		13.89	1
78		1.39	0		1.23	0		3.6	1
79		1.19	0		1.23	0		2.95	1
80		11.89	1		12.34	1		30.39	1
81		1.97	0		1.76	0		12.16	1
82		1.89	1		1.3	0		5.21	1
83		1.48	0		1.23	0		1.74	0
84		1.39	0		1.2	0		1.3	0
85		1.35	0		1.2	0		1.17	0
86		1.31	0		1.16	0		1.17	0
87		3.85	1		20.09	1		4.78	1
88		1.39	0		1.9	1		3.99	1
89		1.31	0		1.16	0		1.17	0
90		1.31	0		1.16	0		1.17	0
91		1.31	0		1.16	0		1.17	0
92		1.31	0		1.16	0		1.17	0
93		1.35	0		1.2	0		3.3	1
94		1.35	0		1.2	0		1.52	1

	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1		tert-BUTYL METHYL ETHER	d_tert-BUTYL METHYL ETHER		TOLUENE	d_TOLUENE		XYLENES, TOTAL	d_XYLENES, TOTAL
2		1.44	0		4.15	1		3.82	1
3		1.41	0		9.8	1		11.72	1
4		1.37	0		8.67	1		7.82	1
5		1.42	0		280.75	1		911.8	1
6		2.38	0		25.63	1		26.05	1
7		1.44	0		21.1	1		20.41	1
8		1.41	0		33.92	1		25.62	1
9		1.51	0		25.63	1		22.58	1
10		1.48	0		41.45	1		36.04	1
11		1.48	0		33.54	1		26.92	1
12		1.44	0		71.6	1		56.44	1
13		1.41	0		21.48	1		15.63	1
14		1.37	0		30.15	1		28.66	1
15		1.44	0		904.44	1		738.13	1
16		1.44	0		301.48	1		356.04	1
17		1.55	0		109.29	1		95.52	1
18		1.48	0		162.05	1		78.15	1
19		1.48	0		13.94	1		2.56	0
20		1.44	0		15.07	1		2.52	0
21		1.44	0		7.54	1		82.5	1
22		1.44	0		4.15	1		21.49	1
23		1.44	0		3.43	1		9.12	1
24		1.41	0		3.09	1		5.21	1
25		1.44	0		48.99	1		9.12	1
26		1.51	0		8.48	1		6.51	1
27		1.51	0		5.28	1		7.82	1
28		1.5	0		6.41	1		7.82	1
29		1.44	0		7.91	1		9.55	1
30		1.44	0		12.81	1		16.5	1
31		1.41	0		6.03	1		7.82	1
32		1.41	0		6.03	1		7.82	1
33		1.41	0		109.29	1		319.13	1
34		1.41	0		20.54	1		19.54	1
35		1.39	0		15.07	1		9.55	1
36		1.37	0		6.03	1		6.95	1
37		1.37	0		4.9	1		3.08	1
38		1.37	0		11.68	1		8.68	1
39		1.33	0		10.93	1		9.55	1
40		1.33	0		6.78	1		5.21	1
41		1.33	0		10.93	1		6.51	1
42		1.33	0		16.58	1		14.76	1
43		1.35	0		37.87	1		36.47	1
44		1.41	0		45.22	1		43.42	1
45		1.41	0		56.53	1		65.13	1
46		1.37	0		67.83	1		23.88	1
47		1.37	0		22.23	1		31.91	1
48		1.37	0		195.96	1		295.25	1
49		1.37	0		64.06	1		52.1	1
50		1.37	0		169.58	1		403.8	1
51		1.41	0		716.02	1		477.61	1
52		1.41	0		1.32	0		2.43	0
53		1.37	0		26.38	1		2.34	0
54		1.37	0		6.41	1		6.51	1
55		1.37	0		5.65	1		43.42	1

	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1		tert-BUTYL METHYL ETHER	d_tert-BUTYL METHYL ETHER		TOLUENE	d_TOLUENE		XYLENES, TOTAL	d_XYLENES, TOTAL
56		1.37	0		4.62	1		6.51	1
57		1.33	0		1.92	1		6.08	1
58		1.37	0		9.04	1		8.68	1
59		1.37	0		4.52	1		2.39	0
60		1.37	0		4.15	1		2.34	0
61		1.33	0		2.83	1		5.64	1
62		1.33	0		2.79	1		5.21	1
63		1.33	0		3.58	1		3.3	1
64		1.51	0		17.34	1		16.5	1
65		1.48	0		16.2	1		13.03	1
66		1.44	0		25.25	1		18.67	1
67		1.37	0		7.91	1		9.55	1
68		1.48	0		69.72	1		25.83	1
69		1.48	0		79.14	1		65.13	1
70		1.44	0		165.81	1		52.1	1
71		1.44	0		1.36	0		11.29	1
72		1.44	0		9.04	1		39.95	1
73		1.37	0		22.61	1		4.78	1
74		1.37	0		4.15	1		4.78	1
75		1.44	0		92.33	1		47.76	1
76		1.37	0		27.13	1		16.93	1
77		1.37	0		24.12	1		9.12	1
78		1.37	0		6.03	1		99.86	1
79		1.19	0		37.69	1		132.43	1
80		1.98	0		28.26	1		2.61	0
81		1.37	0		31.28	1		2.39	0
82		1.37	0		12.81	1		3.47	0
83		1.35	0		3.43	1		2.34	0
84		1.33	0		2.3	1		38.64	1
85		1.26	0		2.15	1		91.18	1
86		1.48	0		5.65	1		17.37	1
87		1.73	0		1.32	0		2.34	0
88		1.41	0		1.32	0		2.34	0
89		1.33	0		52.76	1		18.67	1
90		1.33	0		23.36	1		16.5	1
91		1.33	0		7.16	1		2.3	0
92		1.3	0		5.28	1		2.34	0
93		1.37	0		6.78	1		6.51	1
94		1.37	0		33.92	1		15.63	1

Attachment 2 (Continued)

Soil Vapor Samples from Q1 through Q3 2016, On-Base (Output)

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.16/26/2017 1:28:45 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2,4-TRIMETHYLBENZENE

General Statistics

Total Number of Observations	93	Number of Distinct Observations	63
Number of Detects	72	Number of Non-Detects	21
Number of Distinct Detects	60	Number of Distinct Non-Detects	6
Minimum Detect	1.18	Minimum Non-Detect	1.18
Maximum Detect	639.1	Maximum Non-Detect	1.77
Variance Detects	7595	Percent Non-Detects	22.58%
Mean Detects	29.53	SD Detects	87.15
Median Detects	4.89	CV Detects	2.951
Skewness Detects	5.524	Kurtosis Detects	35.17
Mean of Logged Detects	1.936	SD of Logged Detects	1.421

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.363	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.372	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	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	23.13	KM Standard Error of Mean	8.047
KM SD	77.06	95% KM (BCA) UCL	36.81
95% KM (t) UCL	36.5	95% KM (Percentile Bootstrap) UCL	38.17
95% KM (z) UCL	36.37	95% KM Bootstrap t UCL	51.8
90% KM Chebyshev UCL	47.27	95% KM Chebyshev UCL	58.21
97.5% KM Chebyshev UCL	73.39	99% KM Chebyshev UCL	103.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	7.942	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.83	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.261	**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)	0.446	k star (bias corrected MLE)	0.437
Theta hat (MLE)	66.21	Theta star (bias corrected MLE)	67.63
nu hat (MLE)	64.23	nu star (bias corrected)	62.88
Mean (detects)	29.53		

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	22.87
Maximum	639.1	Median	3
SD	77.56	CV	3.392
k hat (MLE)	0.264	k star (bias corrected MLE)	0.262
Theta hat (MLE)	86.73	Theta star (bias corrected MLE)	87.17
nu hat (MLE)	49.04	nu star (bias corrected)	48.79
Adjusted Level of Significance (β)	0.0474		
Approximate Chi Square Value (48.79, α)	33.76	Adjusted Chi Square Value (48.79, β)	33.56
95% Gamma Approximate UCL (use when n>=50)	33.05	95% Gamma Adjusted UCL (use when n<50)	33.24
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	23.13	SD (KM)	77.06
Variance (KM)	5939	SE of Mean (KM)	8.047
k hat (KM)	0.0901	k star (KM)	0.0943
nu hat (KM)	16.76	nu star (KM)	17.55
theta hat (KM)	256.8	theta star (KM)	245.2
80% gamma percentile (KM)	14.7	90% gamma percentile (KM)	60.01
95% gamma percentile (KM)	134.6	99% gamma percentile (KM)	378.2
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (17.55, α)	9.066	Adjusted Chi Square Value (17.55, β)	8.969
95% Gamma Approximate KM-UCL (use when n>=50)	44.78	95% Gamma Adjusted KM-UCL (use when n<50)	45.26
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.875	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	5.1047E-8	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.104	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	22.94	Mean in Log Scale	1.221
SD in Original Scale	77.54	SD in Log Scale	1.848
95% t UCL (assumes normality of ROS data)	36.3	95% Percentile Bootstrap UCL	37.4
95% BCA Bootstrap UCL	43.63	95% Bootstrap t UCL	53.24
95% H-UCL (Log ROS)	34.7		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.536	KM Geo Mean	4.648
KM SD (logged)	1.445	95% Critical H Value (KM-Log)	2.721
KM Standard Error of Mean (logged)	0.151	95% H-UCL (KM -Log)	19.89
KM SD (logged)	1.445	95% Critical H Value (KM-Log)	2.721
KM Standard Error of Mean (logged)	0.151		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	23	Mean in Log Scale	1.39

	A B C D E	F	G H I J K	L
105	SD in Original Scale	77.52	SD in Log Scale	1.61
106	95% t UCL (Assumes normality)	36.36	95% H-Stat UCL	23.92
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
108				
109	**Nonparametric Distribution Free UCL Statistics**			
110	**Data do not follow a Discernible Distribution at 5% Significance Level**			
111				
112	**Suggested UCL to Use**			
113	95% KM (Chebyshev) UCL	58.21		
114				
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
116	Recommendations are based upon data size, data distribution, and skewness.			
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
119				
120	1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)			
121				
122	**General Statistics**			
123	Total Number of Observations	93	Number of Distinct Observations	24
124	Number of Detects	17	Number of Non-Detects	76
125	Number of Distinct Detects	16	Number of Distinct Non-Detects	11
126	Minimum Detect	1.31	Minimum Non-Detect	1.08
127	Maximum Detect	23.82	Maximum Non-Detect	2.23
128	Variance Detects	27.73	Percent Non-Detects	81.72%
129	Mean Detects	3.668	SD Detects	5.266
130	Median Detects	2.31	CV Detects	1.435
131	Skewness Detects	3.935	Kurtosis Detects	15.9
132	Mean of Logged Detects	0.954	SD of Logged Detects	0.674
133				
134	**Normal GOF Test on Detects Only**			
135	Shapiro Wilk Test Statistic	0.408	**Shapiro Wilk GOF Test**	
136	5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level	
137	Lilliefors Test Statistic	0.405	**Lilliefors GOF Test**	
138	5% Lilliefors Critical Value	0.207	Detected Data Not Normal at 5% Significance Level	
139	**Detected Data Not Normal at 5% Significance Level**			
140				
141	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
142	KM Mean	1.555	KM Standard Error of Mean	0.257
143	KM SD	2.402	95% KM (BCA) UCL	2.228
144	95% KM (t) UCL	1.982	95% KM (Percentile Bootstrap) UCL	2.081
145	95% KM (z) UCL	1.978	95% KM Bootstrap t UCL	2.923
146	90% KM Chebyshev UCL	2.326	95% KM Chebyshev UCL	2.675
147	97.5% KM Chebyshev UCL	3.159	99% KM Chebyshev UCL	4.11
148				
149	**Gamma GOF Tests on Detected Observations Only**			
150	A-D Test Statistic	2.139	**Anderson-Darling GOF Test**	
151	5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level	
152	K-S Test Statistic	0.277	**Kolmogorov-Smirnov GOF**	
153	5% K-S Critical Value	0.213	Detected Data Not Gamma Distributed at 5% Significance Level	
154	**Detected Data Not Gamma Distributed at 5% Significance Level**			
155				
156	**Gamma Statistics on Detected Data Only**			

	A	B	C	D	E	F	G	H	I	J	K	L
157					k hat (MLE)	1.591					k star (bias corrected MLE)	1.349
158					Theta hat (MLE)	2.306					Theta star (bias corrected MLE)	2.719
159					nu hat (MLE)	54.08					nu star (bias corrected)	45.87
160					Mean (detects)	3.668						
161												
162	**Gamma ROS Statistics using Imputed Non-Detects**											
163	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
164	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)											
165	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
166	This is especially true when the sample size is small.											
167	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
168					Minimum	0.01					Mean	0.679
169					Maximum	23.82					Median	0.01
170					SD	2.616					CV	3.854
171					k hat (MLE)	0.226					k star (bias corrected MLE)	0.225
172					Theta hat (MLE)	3.009					Theta star (bias corrected MLE)	3.011
173					nu hat (MLE)	41.95					nu star (bias corrected)	41.93
174					Adjusted Level of Significance (β)	0.0474						
175					Approximate Chi Square Value (41.93, α)	28.09					Adjusted Chi Square Value (41.93, β)	27.91
176					95% Gamma Approximate UCL (use when n>=50)	1.013					95% Gamma Adjusted UCL (use when n<50)	1.02
177												
178	**Estimates of Gamma Parameters using KM Estimates**											
179					Mean (KM)	1.555					SD (KM)	2.402
180					Variance (KM)	5.77					SE of Mean (KM)	0.257
181					k hat (KM)	0.419					k star (KM)	0.413
182					nu hat (KM)	77.99					nu star (KM)	76.81
183					theta hat (KM)	3.709					theta star (KM)	3.767
184					80% gamma percentile (KM)	2.519					90% gamma percentile (KM)	4.368
185					95% gamma percentile (KM)	6.392					99% gamma percentile (KM)	11.46
186												
187	**Gamma Kaplan-Meier (KM) Statistics**											
188					Approximate Chi Square Value (76.81, α)	57.62					Adjusted Chi Square Value (76.81, β)	57.36
189					95% Gamma Approximate KM-UCL (use when n>=50)	2.073					95% Gamma Adjusted KM-UCL (use when n<50)	2.083
190												
191	**Lognormal GOF Test on Detected Observations Only**											
192					Shapiro Wilk Test Statistic	0.767	**Shapiro Wilk GOF Test**					
193					5% Shapiro Wilk Critical Value	0.892	Detected Data Not Lognormal at 5% Significance Level					
194					Lilliefors Test Statistic	0.184	**Lilliefors GOF Test**					
195					5% Lilliefors Critical Value	0.207	Detected Data appear Lognormal at 5% Significance Level					
196	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
197												
198	**Lognormal ROS Statistics Using Imputed Non-Detects**											
199					Mean in Original Scale	0.913					Mean in Log Scale	-1.148
200					SD in Original Scale	2.567					SD in Log Scale	1.368
201					95% t UCL (assumes normality of ROS data)	1.355					95% Percentile Bootstrap UCL	1.407
202					95% BCA Bootstrap UCL	1.806					95% Bootstrap t UCL	2.047
203					95% H-UCL (Log ROS)	1.178						
204												
205	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
206					KM Mean (logged)	0.239					KM Geo Mean	1.27
207					KM SD (logged)	0.439					95% Critical H Value (KM-Log)	1.814
208					KM Standard Error of Mean (logged)	0.047					95% H-UCL (KM -Log)	1.52

KM SD (logged)	0.439	95% Critical H Value (KM-Log)	1.814
KM Standard Error of Mean (logged)	0.047		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.218	Mean in Log Scale	-0.157
SD in Original Scale	2.487	SD in Log Scale	0.604
95% t UCL (Assumes normality)	1.646	95% H-Stat UCL	1.157
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	1.52		
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.			
1,2-DICHLOROETHANE			
General Statistics			
Total Number of Observations	93	Number of Distinct Observations	14
Number of Detects	0	Number of Non-Detects	93
Number of Distinct Detects	0	Number of Distinct Non-Detects	14
Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!			
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!			
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).			
The data set for variable 1,2-DICHLOROETHANE was not processed!			
BENZENE			
General Statistics			
Total Number of Observations	93	Number of Distinct Observations	51
Number of Detects	58	Number of Non-Detects	35
Number of Distinct Detects	46	Number of Distinct Non-Detects	9
Minimum Detect	1.34	Minimum Non-Detect	1.25
Maximum Detect	479.2	Maximum Non-Detect	1.85
Variance Detects	4081	Percent Non-Detects	37.63%
Mean Detects	19.58	SD Detects	63.88
Median Detects	5.11	CV Detects	3.262
Skewness Detects	6.802	Kurtosis Detects	49.13
Mean of Logged Detects	1.849	SD of Logged Detects	1.208
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.284	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	

Lilliefors Test Statistic	0.388	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.116	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	12.68	KM Standard Error of Mean	5.313
KM SD	50.79	95% KM (BCA) UCL	23.42
95% KM (t) UCL	21.51	95% KM (Percentile Bootstrap) UCL	23.11
95% KM (z) UCL	21.42	95% KM Bootstrap t UCL	45.61
90% KM Chebyshev UCL	28.62	95% KM Chebyshev UCL	35.84
97.5% KM Chebyshev UCL	45.86	99% KM Chebyshev UCL	65.55
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	5.359	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.81	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.239	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.123	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)	0.555	k star (bias corrected MLE)	0.538
Theta hat (MLE)	35.25	Theta star (bias corrected MLE)	36.38
nu hat (MLE)	64.43	nu star (bias corrected)	62.43
Mean (detects)	19.58		
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	12.22
Maximum	479.2	Median	2.01
SD	51.18	CV	4.189
k hat (MLE)	0.233	k star (bias corrected MLE)	0.233
Theta hat (MLE)	52.42	Theta star (bias corrected MLE)	52.5
nu hat (MLE)	43.35	nu star (bias corrected)	43.28
Adjusted Level of Significance (β)	0.0474		
Approximate Chi Square Value (43.28, α)	29.2	Adjusted Chi Square Value (43.28, β)	29.01
95% Gamma Approximate UCL (use when n>=50)	18.11	95% Gamma Adjusted UCL (use when n<50)	18.22
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	12.68	SD (KM)	50.79
Variance (KM)	2580	SE of Mean (KM)	5.313
k hat (KM)	0.0624	k star (KM)	0.0675
nu hat (KM)	11.6	nu star (KM)	12.56
theta hat (KM)	203.4	theta star (KM)	187.9
80% gamma percentile (KM)	4.17	90% gamma percentile (KM)	26.58
95% gamma percentile (KM)	72.61	99% gamma percentile (KM)	243
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (12.56, α)	5.596	Adjusted Chi Square Value (12.56, β)	5.523

	A	B	C	D	E	F	G	H	I	J	K	L
313	95% Gamma Approximate KM-UCL (use when n>=50)					28.46	95% Gamma Adjusted KM-UCL (use when n<50)					28.84
314												
315	**Lognormal GOF Test on Detected Observations Only**											
316	Shapiro Wilk Approximate Test Statistic					0.909	**Shapiro Wilk GOF Test**					
317	5% Shapiro Wilk P Value					1.8516E-4	Detected Data Not Lognormal at 5% Significance Level					
318	Lilliefors Test Statistic					0.103	**Lilliefors GOF Test**					
319	5% Lilliefors Critical Value					0.116	Detected Data appear Lognormal at 5% Significance Level					
320	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
321												
322	**Lognormal ROS Statistics Using Imputed Non-Detects**											
323	Mean in Original Scale					12.37	Mean in Log Scale					0.755
324	SD in Original Scale					51.14	SD in Log Scale					1.761
325	95% t UCL (assumes normality of ROS data)					21.19	95% Percentile Bootstrap UCL					22.49
326	95% BCA Bootstrap UCL					29.61	95% Bootstrap t UCL					44.25
327	95% H-UCL (Log ROS)					17.73						
328												
329	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
330	KM Mean (logged)					1.238	KM Geo Mean					3.449
331	KM SD (logged)					1.23	95% Critical H Value (KM-Log)					2.483
332	KM Standard Error of Mean (logged)					0.129	95% H-UCL (KM -Log)					10.11
333	KM SD (logged)					1.23	95% Critical H Value (KM-Log)					2.483
334	KM Standard Error of Mean (logged)					0.129						
335												
336	**DL/2 Statistics**											
337	**DL/2 Normal**						**DL/2 Log-Transformed**					
338	Mean in Original Scale					12.46	Mean in Log Scale					0.999
339	SD in Original Scale					51.12	SD in Log Scale					1.456
340	95% t UCL (Assumes normality)					21.27	95% H-Stat UCL					11.86
341	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
342												
343	**Nonparametric Distribution Free UCL Statistics**											
344	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**											
345												
346	**Suggested UCL to Use**											
347	KM H-UCL					10.11						
348												
349	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
350	Recommendations are based upon data size, data distribution, and skewness.											
351	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
352	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
353												
354	CYCLOHEXANE											
355												
356	**General Statistics**											
357	Total Number of Observations					93	Number of Distinct Observations					37
358	Number of Detects					26	Number of Non-Detects					67
359	Number of Distinct Detects					22	Number of Distinct Non-Detects					16
360	Minimum Detect					3.44	Minimum Non-Detect					2
361	Maximum Detect					378.6	Maximum Non-Detect					4.13
362	Variance Detects					8038	Percent Non-Detects					72.04%
363	Mean Detects					50.64	SD Detects					89.66
364	Median Detects					8.435	CV Detects					1.77

	A–E	F	G–K	L
365	Skewness Detects	2.647	Kurtosis Detects	7.204
366	Mean of Logged Detects	2.791	SD of Logged Detects	1.467
367				
368	**Normal GOF Test on Detects Only**			
369	Shapiro Wilk Test Statistic	0.591	**Shapiro Wilk GOF Test**	
370	5% Shapiro Wilk Critical Value	0.92	Detected Data Not Normal at 5% Significance Level	
371	Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
372	5% Lilliefors Critical Value	0.17	Detected Data Not Normal at 5% Significance Level	
373	**Detected Data Not Normal at 5% Significance Level**			
374				
375	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
376	KM Mean	15.6	KM Standard Error of Mean	5.431
377	KM SD	51.35	95% KM (BCA) UCL	25.63
378	95% KM (t) UCL	24.62	95% KM (Percentile Bootstrap) UCL	25.45
379	95% KM (z) UCL	24.53	95% KM Bootstrap t UCL	32.74
380	90% KM Chebyshev UCL	31.89	95% KM Chebyshev UCL	39.27
381	97.5% KM Chebyshev UCL	49.51	99% KM Chebyshev UCL	69.63
382				
383	**Gamma GOF Tests on Detected Observations Only**			
384	A-D Test Statistic	1.932	**Anderson-Darling GOF Test**	
385	5% A-D Critical Value	0.803	Detected Data Not Gamma Distributed at 5% Significance Level	
386	K-S Test Statistic	0.244	**Kolmogorov-Smirnov GOF**	
387	5% K-S Critical Value	0.181	Detected Data Not Gamma Distributed at 5% Significance Level	
388	**Detected Data Not Gamma Distributed at 5% Significance Level**			
389				
390	**Gamma Statistics on Detected Data Only**			
391	k hat (MLE)	0.552	k star (bias corrected MLE)	0.514
392	Theta hat (MLE)	91.74	Theta star (bias corrected MLE)	98.53
393	nu hat (MLE)	28.7	nu star (bias corrected)	26.73
394	Mean (detects)	50.64		
395				
396	**Gamma ROS Statistics using Imputed Non-Detects**			
397	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
398	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)			
399	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
400	This is especially true when the sample size is small.			
401	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
402	Minimum	0.01	Mean	14.16
403	Maximum	378.6	Median	0.01
404	SD	52.02	CV	3.673
405	k hat (MLE)	0.148	k star (bias corrected MLE)	0.151
406	Theta hat (MLE)	95.46	Theta star (bias corrected MLE)	93.95
407	nu hat (MLE)	27.6	nu star (bias corrected)	28.04
408	Adjusted Level of Significance (β)	0.0474		
409	Approximate Chi Square Value (28.04, α)	16.96	Adjusted Chi Square Value (28.04, β)	16.82
410	95% Gamma Approximate UCL (use when n>=50)	23.42	95% Gamma Adjusted UCL (use when n<50)	23.61
411				
412	**Estimates of Gamma Parameters using KM Estimates**			
413	Mean (KM)	15.6	SD (KM)	51.35
414	Variance (KM)	2637	SE of Mean (KM)	5.431
415	k hat (KM)	0.0923	k star (KM)	0.0965
416	nu hat (KM)	17.16	nu star (KM)	17.94

	A–E	F	G–K	L
417	theta hat (KM)	169.1	theta star (KM)	161.7
418	80% gamma percentile (KM)	10.26	90% gamma percentile (KM)	40.88
419	95% gamma percentile (KM)	90.71	99% gamma percentile (KM)	252.3
420				
421	**Gamma Kaplan-Meier (KM) Statistics**			
422	Approximate Chi Square Value (17.94, α)	9.348	Adjusted Chi Square Value (17.94, β)	9.25
423	95% Gamma Approximate KM-UCL (use when n>=50)	29.94	95% Gamma Adjusted KM-UCL (use when n<50)	30.25
424				
425	**Lognormal GOF Test on Detected Observations Only**			
426	Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**	
427	5% Shapiro Wilk Critical Value	0.92	Detected Data Not Lognormal at 5% Significance Level	
428	Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**	
429	5% Lilliefors Critical Value	0.17	Detected Data Not Lognormal at 5% Significance Level	
430	**Detected Data Not Lognormal at 5% Significance Level**			
431				
432	**Lognormal ROS Statistics Using Imputed Non-Detects**			
433	Mean in Original Scale	14.36	Mean in Log Scale	-0.842
434	SD in Original Scale	51.97	SD in Log Scale	2.767
435	95% t UCL (assumes normality of ROS data)	23.31	95% Percentile Bootstrap UCL	23.68
436	95% BCA Bootstrap UCL	28.16	95% Bootstrap t UCL	34.1
437	95% H-UCL (Log ROS)	70.86		
438				
439	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
440	KM Mean (logged)	1.28	KM Geo Mean	3.597
441	KM SD (logged)	1.21	95% Critical H Value (KM-Log)	2.461
442	KM Standard Error of Mean (logged)	0.128	95% H-UCL (KM -Log)	10.21
443	KM SD (logged)	1.21	95% Critical H Value (KM-Log)	2.461
444	KM Standard Error of Mean (logged)	0.128		
445				
446	**DL/2 Statistics**			
447	**DL/2 Normal**		**DL/2 Log-Transformed**	
448	Mean in Original Scale	15.03	Mean in Log Scale	0.916
449	SD in Original Scale	51.78	SD in Log Scale	1.404
450	95% t UCL (Assumes normality)	23.95	95% H-Stat UCL	9.897
451	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
452				
453	**Nonparametric Distribution Free UCL Statistics**			
454	**Data do not follow a Discernible Distribution at 5% Significance Level**			
455				
456	**Suggested UCL to Use**			
457	95% KM (Chebyshev) UCL	39.27		
458				
459	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
460	Recommendations are based upon data size, data distribution, and skewness.			
461	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
462	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
463				
464	**ETHYLBENZENE**			
465				
466	**General Statistics**			
467	Total Number of Observations	93	Number of Distinct Observations	51
468	Number of Detects	61	Number of Non-Detects	32

	A–E	F	G–K	L
469	Number of Distinct Detects	47	Number of Distinct Non-Detects	7
470	Minimum Detect	1.3	Minimum Non-Detect	1.22
471	Maximum Detect	243.2	Maximum Non-Detect	1.87
472	Variance Detects	1262	Percent Non-Detects	34.41%
473	Mean Detects	15.43	SD Detects	35.52
474	Median Detects	4.26	CV Detects	2.302
475	Skewness Detects	4.939	Kurtosis Detects	28.84
476	Mean of Logged Detects	1.757	SD of Logged Detects	1.202
477				
478	**Normal GOF Test on Detects Only**			
479	Shapiro Wilk Test Statistic	0.426	**Normal GOF Test on Detected Observations Only**	
480	5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
481	Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**	
482	5% Lilliefors Critical Value	0.113	Detected Data Not Normal at 5% Significance Level	
483	**Detected Data Not Normal at 5% Significance Level**			
484				
485	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
486	KM Mean	10.54	KM Standard Error of Mean	3.066
487	KM SD	29.32	95% KM (BCA) UCL	16.23
488	95% KM (t) UCL	15.64	95% KM (Percentile Bootstrap) UCL	15.94
489	95% KM (z) UCL	15.58	95% KM Bootstrap t UCL	21.17
490	90% KM Chebyshev UCL	19.74	95% KM Chebyshev UCL	23.91
491	97.5% KM Chebyshev UCL	29.69	99% KM Chebyshev UCL	41.05
492				
493	**Gamma GOF Tests on Detected Observations Only**			
494	A-D Test Statistic	5.151	**Anderson-Darling GOF Test**	
495	5% A-D Critical Value	0.804	Detected Data Not Gamma Distributed at 5% Significance Level	
496	K-S Test Statistic	0.233	**Kolmogorov-Smirnov GOF**	
497	5% K-S Critical Value	0.119	Detected Data Not Gamma Distributed at 5% Significance Level	
498	**Detected Data Not Gamma Distributed at 5% Significance Level**			
499				
500	**Gamma Statistics on Detected Data Only**			
501	k hat (MLE)	0.627	k star (bias corrected MLE)	0.607
502	Theta hat (MLE)	24.61	Theta star (bias corrected MLE)	25.42
503	nu hat (MLE)	76.49	nu star (bias corrected)	74.06
504	Mean (detects)	15.43		
505				
506	**Gamma ROS Statistics using Imputed Non-Detects**			
507	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
508	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)			
509	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
510	This is especially true when the sample size is small.			
511	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
512	Minimum	0.01	Mean	10.12
513	Maximum	243.2	Median	2.3
514	SD	29.62	CV	2.926
515	k hat (MLE)	0.257	k star (bias corrected MLE)	0.256
516	Theta hat (MLE)	39.34	Theta star (bias corrected MLE)	39.51
517	nu hat (MLE)	47.87	nu star (bias corrected)	47.66
518	Adjusted Level of Significance (β)	0.0474		
519	Approximate Chi Square Value (47.66, α)	32.81	Adjusted Chi Square Value (47.66, β)	32.62
520	95% Gamma Approximate UCL (use when n>=50)	14.7	95% Gamma Adjusted UCL (use when n<50)	14.79

	A–E	F	G–K	L
521				
522	**Estimates of Gamma Parameters using KM Estimates**			
523	Mean (KM)	10.54	SD (KM)	29.32
524	Variance (KM)	859.7	SE of Mean (KM)	3.066
525	k hat (KM)	0.129	k star (KM)	0.132
526	nu hat (KM)	24.04	nu star (KM)	24.6
527	theta hat (KM)	81.55	theta star (KM)	79.7
528	80% gamma percentile (KM)	10.25	90% gamma percentile (KM)	30.58
529	95% gamma percentile (KM)	59.33	99% gamma percentile (KM)	145
530				
531	**Gamma Kaplan-Meier (KM) Statistics**			
532	Approximate Chi Square Value (24.60, α)	14.31	Adjusted Chi Square Value (24.60, β)	14.18
533	95% Gamma Approximate KM-UCL (use when n>=50)	18.13	95% Gamma Adjusted KM-UCL (use when n<50)	18.29
534				
535	**Lognormal GOF Test on Detected Observations Only**			
536	Shapiro Wilk Approximate Test Statistic	0.899	**Shapiro Wilk GOF Test**	
537	5% Shapiro Wilk P Value	2.9905E-5	Detected Data Not Lognormal at 5% Significance Level	
538	Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**	
539	5% Lilliefors Critical Value	0.113	Detected Data Not Lognormal at 5% Significance Level	
540	**Detected Data Not Lognormal at 5% Significance Level**			
541				
542	**Lognormal ROS Statistics Using Imputed Non-Detects**			
543	Mean in Original Scale	10.26	Mean in Log Scale	0.778
544	SD in Original Scale	29.57	SD in Log Scale	1.72
545	95% t UCL (assumes normality of ROS data)	15.36	95% Percentile Bootstrap UCL	16
546	95% BCA Bootstrap UCL	17.56	95% Bootstrap t UCL	20.29
547	95% H-UCL (Log ROS)	16.51		
548				
549	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
550	KM Mean (logged)	1.222	KM Geo Mean	3.394
551	KM SD (logged)	1.216	95% Critical H Value (KM-Log)	2.468
552	KM Standard Error of Mean (logged)	0.127	95% H-UCL (KM -Log)	9.718
553	KM SD (logged)	1.216	95% Critical H Value (KM-Log)	2.468
554	KM Standard Error of Mean (logged)	0.127		
555				
556	**DL/2 Statistics**			
557	**DL/2 Normal**		**DL/2 Log-Transformed**	
558	Mean in Original Scale	10.35	Mean in Log Scale	1.009
559	SD in Original Scale	29.54	SD in Log Scale	1.422
560	95% t UCL (Assumes normality)	15.44	95% H-Stat UCL	11.25
561	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
562				
563	**Nonparametric Distribution Free UCL Statistics**			
564	**Data do not follow a Discernible Distribution at 5% Significance Level**			
565				
566	**Suggested UCL to Use**			
567	95% KM (Chebyshev) UCL	23.91		
568				
569	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
570	Recommendations are based upon data size, data distribution, and skewness.			
571	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
572	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 (SUM OF ISOMERS)

General Statistics

Total Number of Observations	93	Number of Distinct Observations	62
Number of Detects	79	Number of Non-Detects	14
Number of Distinct Detects	54	Number of Distinct Non-Detects	8
Minimum Detect	3.08	Minimum Non-Detect	2.3
Maximum Detect	607.9	Maximum Non-Detect	3.47
Variance Detects	11245	Percent Non-Detects	15.05%
Mean Detects	48.34	SD Detects	106
Median Detects	12.59	CV Detects	2.194
Skewness Detects	3.736	Kurtosis Detects	14.82
Mean of Logged Detects	2.802	SD of Logged Detects	1.281

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.46	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.341	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0998	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	41.41	KM Standard Error of Mean	10.28
KM SD	98.5	95% KM (BCA) UCL	58.1
95% KM (t) UCL	58.49	95% KM (Percentile Bootstrap) UCL	59.27
95% KM (z) UCL	58.32	95% KM Bootstrap t UCL	69.42
90% KM Chebyshev UCL	72.25	95% KM Chebyshev UCL	86.22
97.5% KM Chebyshev UCL	105.6	99% KM Chebyshev UCL	143.7

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.63	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.811	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	**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)	0.577	k star (bias corrected MLE)	0.564
Theta hat (MLE)	83.72	Theta star (bias corrected MLE)	85.73
nu hat (MLE)	91.22	nu star (bias corrected)	89.09
Mean (detects)	48.34		

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	41.06
Maximum	607.9	Median	9.99
SD	99.18	CV	2.415

	A	B	C	D	E	F	G	H	I	J	K	L
625					k hat (MLE)	0.334					k star (bias corrected MLE)	0.33
626					Theta hat (MLE)	122.9					Theta star (bias corrected MLE)	124.3
627					nu hat (MLE)	62.14					nu star (bias corrected)	61.47
628					Adjusted Level of Significance (β)	0.0474						
629					Approximate Chi Square Value (61.47, α)	44.43					Adjusted Chi Square Value (61.47, β)	44.21
630					95% Gamma Approximate UCL (use when n>=50)	56.8					95% Gamma Adjusted UCL (use when n<50)	57.1
631												
632	**Estimates of Gamma Parameters using KM Estimates**											
633					Mean (KM)	41.41					SD (KM)	98.5
634					Variance (KM)	9702					SE of Mean (KM)	10.28
635					k hat (KM)	0.177					k star (KM)	0.178
636					nu hat (KM)	32.87					nu star (KM)	33.15
637					theta hat (KM)	234.3					theta star (KM)	232.4
638					80% gamma percentile (KM)	51.06					90% gamma percentile (KM)	124.8
639					95% gamma percentile (KM)	219.6					99% gamma percentile (KM)	485.7
640												
641	**Gamma Kaplan-Meier (KM) Statistics**											
642					Approximate Chi Square Value (33.15, α)	20.98					Adjusted Chi Square Value (33.15, β)	20.83
643					95% Gamma Approximate KM-UCL (use when n>=50)	65.41					95% Gamma Adjusted KM-UCL (use when n<50)	65.89
644												
645	**Lognormal GOF Test on Detected Observations Only**											
646					Shapiro Wilk Approximate Test Statistic	0.898	**Shapiro Wilk GOF Test**					
647					5% Shapiro Wilk P Value	5.4933E-7	Detected Data Not Lognormal at 5% Significance Level					
648					Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**					
649					5% Lilliefors Critical Value	0.0998	Detected Data Not Lognormal at 5% Significance Level					
650	**Detected Data Not Lognormal at 5% Significance Level**											
651												
652	**Lognormal ROS Statistics Using Imputed Non-Detects**											
653					Mean in Original Scale	41.22					Mean in Log Scale	2.378
654					SD in Original Scale	99.11					SD in Log Scale	1.56
655					95% t UCL (assumes normality of ROS data)	58.3					95% Percentile Bootstrap UCL	59.73
656					95% BCA Bootstrap UCL	63.92					95% Bootstrap t UCL	67.81
657					95% H-UCL (Log ROS)	57.92						
658												
659	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
660					KM Mean (logged)	2.506					KM Geo Mean	12.26
661					KM SD (logged)	1.368					95% Critical H Value (KM-Log)	2.633
662					KM Standard Error of Mean (logged)	0.143					95% H-UCL (KM -Log)	45.46
663					KM SD (logged)	1.368					95% Critical H Value (KM-Log)	2.633
664					KM Standard Error of Mean (logged)	0.143						
665												
666	**DL/2 Statistics**											
667	**DL/2 Normal**						**DL/2 Log-Transformed**					
668					Mean in Original Scale	41.25					Mean in Log Scale	2.412
669					SD in Original Scale	99.1					SD in Log Scale	1.504
670					95% t UCL (Assumes normality)	58.32					95% H-Stat UCL	53.52
671	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
672												
673	**Nonparametric Distribution Free UCL Statistics**											
674	**Data do not follow a Discernible Distribution at 5% Significance Level**											
675												
676	**Suggested UCL to Use**											

95% KM (Chebyshev) UCL	86.22		

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	93	Number of Distinct Observations	58
Number of Detects	67	Number of Non-Detects	26
Number of Distinct Detects	53	Number of Distinct Non-Detects	8
Minimum Detect	1.42	Minimum Non-Detect	1.36
Maximum Detect	256.9	Maximum Non-Detect	2.1
Variance Detects	1166	Percent Non-Detects	27.96%
Mean Detects	14.71	SD Detects	34.14
Median Detects	5.24	CV Detects	2.322
Skewness Detects	5.827	Kurtosis Detects	39.44
Mean of Logged Detects	1.839	SD of Logged Detects	1.107

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.397	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.349	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.108	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	10.98	KM Standard Error of Mean	3.07
KM SD	29.38	95% KM (BCA) UCL	17.18
95% KM (t) UCL	16.08	95% KM (Percentile Bootstrap) UCL	16.44
95% KM (z) UCL	16.03	95% KM Bootstrap t UCL	22.03
90% KM Chebyshev UCL	20.19	95% KM Chebyshev UCL	24.36
97.5% KM Chebyshev UCL	30.15	99% KM Chebyshev UCL	41.52

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.403	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.796	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.26	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.114	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)	0.71	k star (bias corrected MLE)	0.688
Theta hat (MLE)	20.71	Theta star (bias corrected MLE)	21.37
nu hat (MLE)	95.14	nu star (bias corrected)	92.21
Mean (detects)	14.71		

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)

	A	B	C	D	E	F	G	H	I	J	K	L
729	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
730	This is especially true when the sample size is small.											
731	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
732					Minimum	0.01					Mean	10.6
733					Maximum	256.9					Median	3.25
734					SD	29.67					CV	2.8
735					k hat (MLE)	0.297					k star (bias corrected MLE)	0.295
736					Theta hat (MLE)	35.65					Theta star (bias corrected MLE)	35.95
737					nu hat (MLE)	55.29					nu star (bias corrected)	54.84
738					Adjusted Level of Significance (β)	0.0474						
739					Approximate Chi Square Value (54.84, α)	38.82					Adjusted Chi Square Value (54.84, β)	38.61
740					95% Gamma Approximate UCL (use when n>=50)	14.97					95% Gamma Adjusted UCL (use when n<50)	15.05
741												
742	**Estimates of Gamma Parameters using KM Estimates**											
743					Mean (KM)	10.98					SD (KM)	29.38
744					Variance (KM)	863.2					SE of Mean (KM)	3.07
745					k hat (KM)	0.14					k star (KM)	0.142
746					nu hat (KM)	25.97					nu star (KM)	26.47
747					theta hat (KM)	78.63					theta star (KM)	77.16
748					80% gamma percentile (KM)	11.42					90% gamma percentile (KM)	32.29
749					95% gamma percentile (KM)	61.02					99% gamma percentile (KM)	145.3
750												
751	**Gamma Kaplan-Meier (KM) Statistics**											
752					Approximate Chi Square Value (26.47, α)	15.74					Adjusted Chi Square Value (26.47, β)	15.61
753					95% Gamma Approximate KM-UCL (use when n>=50)	18.46					95% Gamma Adjusted KM-UCL (use when n<50)	18.62
754												
755	**Lognormal GOF Test on Detected Observations Only**											
756					Shapiro Wilk Approximate Test Statistic	0.903	**Shapiro Wilk GOF Test**					
757					5% Shapiro Wilk P Value	1.6334E-5	Detected Data Not Lognormal at 5% Significance Level					
758					Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**					
759					5% Lilliefors Critical Value	0.108	Detected Data Not Lognormal at 5% Significance Level					
760	**Detected Data Not Lognormal at 5% Significance Level**											
761												
762	**Lognormal ROS Statistics Using Imputed Non-Detects**											
763					Mean in Original Scale	10.76					Mean in Log Scale	1.137
764					SD in Original Scale	29.61					SD in Log Scale	1.498
765					95% t UCL (assumes normality of ROS data)	15.86					95% Percentile Bootstrap UCL	16.4
766					95% BCA Bootstrap UCL	21.7					95% Bootstrap t UCL	22.19
767					95% H-UCL (Log ROS)	14.8						
768												
769	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
770					KM Mean (logged)	1.413					KM Geo Mean	4.107
771					KM SD (logged)	1.157					95% Critical H Value (KM-Log)	2.405
772					KM Standard Error of Mean (logged)	0.121					95% H-UCL (KM -Log)	10.72
773					KM SD (logged)	1.157					95% Critical H Value (KM-Log)	2.405
774					KM Standard Error of Mean (logged)	0.121						
775												
776	**DL/2 Statistics**											
777	**DL/2 Normal**						**DL/2 Log-Transformed**					
778					Mean in Original Scale	10.8					Mean in Log Scale	1.243
779					SD in Original Scale	29.6					SD in Log Scale	1.344
780					95% t UCL (Assumes normality)	15.9					95% H-Stat UCL	12.32

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	24.36

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.

n-HEPTANE

General Statistics

Total Number of Observations	93	Number of Distinct Observations	41
Number of Detects	38	Number of Non-Detects	55
Number of Distinct Detects	33	Number of Distinct Non-Detects	10
Minimum Detect	1.52	Minimum Non-Detect	1.19
Maximum Detect	491.8	Maximum Non-Detect	2.38
Variance Detects	8061	Percent Non-Detects	59.14%
Mean Detects	37.34	SD Detects	89.79
Median Detects	6.15	CV Detects	2.405
Skewness Detects	4.073	Kurtosis Detects	18.58
Mean of Logged Detects	2.223	SD of Logged Detects	1.507

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.449	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.938	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.35	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.142	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	15.96	KM Standard Error of Mean	6.237
KM SD	59.35	95% KM (BCA) UCL	28.8
95% KM (t) UCL	26.33	95% KM (Percentile Bootstrap) UCL	27.71
95% KM (z) UCL	26.22	95% KM Bootstrap t UCL	42.12
90% KM Chebyshev UCL	34.67	95% KM Chebyshev UCL	43.15
97.5% KM Chebyshev UCL	54.91	99% KM Chebyshev UCL	78.02

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.466	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.822	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.152	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)	0.461	k star (bias corrected MLE)	0.442
Theta hat (MLE)	81.08	Theta star (bias corrected MLE)	84.53

nu hat (MLE)	35	nu star (bias corrected)	33.57
Mean (detects)	37.34		
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	15.26
Maximum	491.8	Median	0.01
SD	59.85	CV	3.922
k hat (MLE)	0.167	k star (bias corrected MLE)	0.168
Theta hat (MLE)	91.58	Theta star (bias corrected MLE)	90.61
nu hat (MLE)	31	nu star (bias corrected)	31.33
Adjusted Level of Significance (β)	0.0474		
Approximate Chi Square Value (31.33, α)	19.54	Adjusted Chi Square Value (31.33, β)	19.4
95% Gamma Approximate UCL (use when n>=50)	24.47	95% Gamma Adjusted UCL (use when n<50)	24.65
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	15.96	SD (KM)	59.35
Variance (KM)	3523	SE of Mean (KM)	6.237
k hat (KM)	0.0723	k star (KM)	0.0772
nu hat (KM)	13.45	nu star (KM)	14.35
theta hat (KM)	220.7	theta star (KM)	206.9
80% gamma percentile (KM)	7.067	90% gamma percentile (KM)	36.97
95% gamma percentile (KM)	92.63	99% gamma percentile (KM)	287.6
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (14.35, α)	6.812	Adjusted Chi Square Value (14.35, β)	6.73
95% Gamma Approximate KM-UCL (use when n>=50)	33.63	95% Gamma Adjusted KM-UCL (use when n<50)	34.03
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.897	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.938	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.142	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	15.4	Mean in Log Scale	-0.376
SD in Original Scale	59.82	SD in Log Scale	2.612
95% t UCL (assumes normality of ROS data)	25.7	95% Percentile Bootstrap UCL	26.72
95% BCA Bootstrap UCL	31.54	95% Bootstrap t UCL	40.01
95% H-UCL (Log ROS)	65.34		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.012	KM Geo Mean	2.751
KM SD (logged)	1.385	95% Critical H Value (KM-Log)	2.653
KM Standard Error of Mean (logged)	0.146	95% H-UCL (KM -Log)	10.52
KM SD (logged)	1.385	95% Critical H Value (KM-Log)	2.653
KM Standard Error of Mean (logged)	0.146		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	15.67	Mean in Log Scale	0.7
SD in Original Scale	59.75	SD in Log Scale	1.594
95% t UCL (Assumes normality)	25.97	95% H-Stat UCL	11.59

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

Suggested UCL to Use

95% KM (Chebyshev) UCL	43.15

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.

n-HEXANE

General Statistics

Total Number of Observations	93	Number of Distinct Observations	33
Number of Detects	27	Number of Non-Detects	66
Number of Distinct Detects	24	Number of Distinct Non-Detects	10
Minimum Detect	1.27	Minimum Non-Detect	1.16
Maximum Detect	599.2	Maximum Non-Detect	2.11
Variance Detects	14396	Percent Non-Detects	70.97%
Mean Detects	44.91	SD Detects	120
Median Detects	5.99	CV Detects	2.671
Skewness Detects	4.237	Kurtosis Detects	19.02
Mean of Logged Detects	2.322	SD of Logged Detects	1.565

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.389	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.403	**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	13.86	KM Standard Error of Mean	7.025
KM SD	66.48	95% KM (BCA) UCL	27.18
95% KM (t) UCL	25.54	95% KM (Percentile Bootstrap) UCL	26.42
95% KM (z) UCL	25.42	95% KM Bootstrap t UCL	74.71
90% KM Chebyshev UCL	34.94	95% KM Chebyshev UCL	44.48
97.5% KM Chebyshev UCL	57.73	99% KM Chebyshev UCL	83.76

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.326	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.822	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.25	**Kolmogorov-Smirnov GOF**

	A	B	C	D	E	F	G	H	I	J	K	L
937					5% K-S Critical Value	0.179	Detected Data Not Gamma Distributed at 5% Significance Level					
938	**Detected Data Not Gamma Distributed at 5% Significance Level**											
939												
940	**Gamma Statistics on Detected Data Only**											
941					k hat (MLE)	0.437					k star (bias corrected MLE)	0.413
942					Theta hat (MLE)	102.7					Theta star (bias corrected MLE)	108.6
943					nu hat (MLE)	23.62					nu star (bias corrected)	22.33
944					Mean (detects)	44.91						
945												
946	**Gamma ROS Statistics using Imputed Non-Detects**											
947	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
948	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)											
949	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
950	This is especially true when the sample size is small.											
951	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
952					Minimum	0.01					Mean	13.05
953					Maximum	599.2					Median	0.01
954					SD	67					CV	5.135
955					k hat (MLE)	0.149					k star (bias corrected MLE)	0.151
956					Theta hat (MLE)	87.55					Theta star (bias corrected MLE)	86.19
957					nu hat (MLE)	27.72					nu star (bias corrected)	28.16
958					Adjusted Level of Significance (β)	0.0474						
959					Approximate Chi Square Value (28.16, α)	17.05					Adjusted Chi Square Value (28.16, β)	16.91
960					95% Gamma Approximate UCL (use when n>=50)	21.55					95% Gamma Adjusted UCL (use when n<50)	21.72
961												
962	**Estimates of Gamma Parameters using KM Estimates**											
963					Mean (KM)	13.86					SD (KM)	66.48
964					Variance (KM)	4419					SE of Mean (KM)	7.025
965					k hat (KM)	0.0435					k star (KM)	0.0493
966					nu hat (KM)	8.089					nu star (KM)	9.161
967					theta hat (KM)	318.8					theta star (KM)	281.5
968					80% gamma percentile (KM)	1.782					90% gamma percentile (KM)	20.75
969					95% gamma percentile (KM)	73.33					99% gamma percentile (KM)	303.4
970												
971	**Gamma Kaplan-Meier (KM) Statistics**											
972					Approximate Chi Square Value (9.16, α)	3.425					Adjusted Chi Square Value (9.16, β)	3.37
973					95% Gamma Approximate KM-UCL (use when n>=50)	37.09					95% Gamma Adjusted KM-UCL (use when n<50)	37.69
974												
975	**Lognormal GOF Test on Detected Observations Only**											
976					Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**					
977					5% Shapiro Wilk Critical Value	0.923	Detected Data Not Lognormal at 5% Significance Level					
978					Lilliefors Test Statistic	0.176	**Lilliefors GOF Test**					
979					5% Lilliefors Critical Value	0.167	Detected Data Not Lognormal at 5% Significance Level					
980	**Detected Data Not Lognormal at 5% Significance Level**											
981												
982	**Lognormal ROS Statistics Using Imputed Non-Detects**											
983					Mean in Original Scale	13.16					Mean in Log Scale	-1.469
984					SD in Original Scale	66.98					SD in Log Scale	3.035
985					95% t UCL (assumes normality of ROS data)	24.7					95% Percentile Bootstrap UCL	26.34
986					95% BCA Bootstrap UCL	32.8					95% Bootstrap t UCL	73.62
987					95% H-UCL (Log ROS)	104.6						
988												

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.78	KM Geo Mean	2.181
KM SD (logged)	1.287	95% Critical H Value (KM-Log)	2.545
KM Standard Error of Mean (logged)	0.136	95% H-UCL (KM -Log)	7.028
KM SD (logged)	1.287	95% Critical H Value (KM-Log)	2.545
KM Standard Error of Mean (logged)	0.136		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	13.48	Mean in Log Scale	0.338
SD in Original Scale	66.91	SD in Log Scale	1.525
95% t UCL (Assumes normality)	25.01	95% H-Stat UCL	7.012
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	44.48		
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.			
O-XYLENE (1,2-DIMETHYLBENZENE)			
General Statistics			
Total Number of Observations	93	Number of Distinct Observations	65
Number of Detects	76	Number of Non-Detects	17
Number of Distinct Detects	62	Number of Distinct Non-Detects	5
Minimum Detect	1.26	Minimum Non-Detect	1.17
Maximum Detect	284.4	Maximum Non-Detect	1.74
Variance Detects	2028	Percent Non-Detects	18.28%
Mean Detects	19.36	SD Detects	45.04
Median Detects	4.34	CV Detects	2.327
Skewness Detects	4.055	Kurtosis Detects	18.51
Mean of Logged Detects	1.798	SD of Logged Detects	1.319
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.447	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.347	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.102	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	16.03	KM Standard Error of Mean	4.285
KM SD	41.05	95% KM (BCA) UCL	23.82
95% KM (t) UCL	23.15	95% KM (Percentile Bootstrap) UCL	23.92
95% KM (z) UCL	23.08	95% KM Bootstrap t UCL	27.66
90% KM Chebyshev UCL	28.89	95% KM Chebyshev UCL	34.71

	A–E	F	G–K	L
1041	97.5% KM Chebyshev UCL	42.79	99% KM Chebyshev UCL	58.67
1042				
1043	**Gamma GOF Tests on Detected Observations Only**			
1044	A-D Test Statistic	7.005	**Anderson-Darling GOF Test**	
1045	5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
1046	K-S Test Statistic	0.224	**Kolmogorov-Smirnov GOF**	
1047	5% K-S Critical Value	0.108	Detected Data Not Gamma Distributed at 5% Significance Level	
1048	**Detected Data Not Gamma Distributed at 5% Significance Level**			
1049				
1050	**Gamma Statistics on Detected Data Only**			
1051	k hat (MLE)	0.539	k star (bias corrected MLE)	0.526
1052	Theta hat (MLE)	35.92	Theta star (bias corrected MLE)	36.77
1053	nu hat (MLE)	81.91	nu star (bias corrected)	80.01
1054	Mean (detects)	19.36		
1055				
1056	**Gamma ROS Statistics using Imputed Non-Detects**			
1057	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
1058	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)			
1059	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
1060	This is especially true when the sample size is small.			
1061	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
1062	Minimum	0.01	Mean	15.82
1063	Maximum	284.4	Median	3.3
1064	SD	41.35	CV	2.614
1065	k hat (MLE)	0.32	k star (bias corrected MLE)	0.317
1066	Theta hat (MLE)	49.46	Theta star (bias corrected MLE)	49.96
1067	nu hat (MLE)	59.48	nu star (bias corrected)	58.9
1068	Adjusted Level of Significance (β)	0.0474		
1069	Approximate Chi Square Value (58.90, α)	42.25	Adjusted Chi Square Value (58.90, β)	42.03
1070	95% Gamma Approximate UCL (use when n>=50)	22.05	95% Gamma Adjusted UCL (use when n<50)	22.17
1071				
1072	**Estimates of Gamma Parameters using KM Estimates**			
1073	Mean (KM)	16.03	SD (KM)	41.05
1074	Variance (KM)	1685	SE of Mean (KM)	4.285
1075	k hat (KM)	0.153	k star (KM)	0.155
1076	nu hat (KM)	28.37	nu star (KM)	28.79
1077	theta hat (KM)	105.1	theta star (KM)	103.6
1078	80% gamma percentile (KM)	17.9	90% gamma percentile (KM)	47.74
1079	95% gamma percentile (KM)	87.69	99% gamma percentile (KM)	202.9
1080				
1081	**Gamma Kaplan-Meier (KM) Statistics**			
1082	Approximate Chi Square Value (28.79, α)	17.54	Adjusted Chi Square Value (28.79, β)	17.4
1083	95% Gamma Approximate KM-UCL (use when n>=50)	26.31	95% Gamma Adjusted KM-UCL (use when n<50)	26.52
1084				
1085	**Lognormal GOF Test on Detected Observations Only**			
1086	Shapiro Wilk Approximate Test Statistic	0.883	**Shapiro Wilk GOF Test**	
1087	5% Shapiro Wilk P Value	6.9125E-8	Detected Data Not Lognormal at 5% Significance Level	
1088	Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**	
1089	5% Lilliefors Critical Value	0.102	Detected Data Not Lognormal at 5% Significance Level	
1090	**Detected Data Not Lognormal at 5% Significance Level**			
1091				
1092	**Lognormal ROS Statistics Using Imputed Non-Detects**			

Mean in Original Scale	15.88	Mean in Log Scale	1.266
SD in Original Scale	41.33	SD in Log Scale	1.657
95% t UCL (assumes normality of ROS data)	23.01	95% Percentile Bootstrap UCL	23.24
95% BCA Bootstrap UCL	25.05	95% Bootstrap t UCL	27.64
95% H-UCL (Log ROS)	23.38		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.499	KM Geo Mean	4.477
KM SD (logged)	1.343	95% Critical H Value (KM-Log)	2.606
KM Standard Error of Mean (logged)	0.14	95% H-UCL (KM -Log)	15.88
KM SD (logged)	1.343	95% Critical H Value (KM-Log)	2.606
KM Standard Error of Mean (logged)	0.14		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	15.93	Mean in Log Scale	1.381
SD in Original Scale	41.31	SD in Log Scale	1.485
95% t UCL (Assumes normality)	23.05	95% H-Stat UCL	18.39

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	34.71		

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.

tert-BUTYL METHYL ETHER

General Statistics

Total Number of Observations	93	Number of Distinct Observations	17
Number of Detects	0	Number of Non-Detects	93
Number of Distinct Detects	0	Number of Distinct Non-Detects	17

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable tert-BUTYL METHYL ETHER was not processed!

Toluene

General Statistics

Total Number of Observations	93	Number of Distinct Observations	72
Number of Detects	89	Number of Non-Detects	4
Number of Distinct Detects	70	Number of Distinct Non-Detects	2
Minimum Detect	1.92	Minimum Non-Detect	1.32

	A–E	F	G–K	L
1145	Maximum Detect	904.4	Maximum Non-Detect	1.36
1146	Variance Detects	16596	Percent Non-Detects	4.301%
1147	Mean Detects	52.96	SD Detects	128.8
1148	Median Detects	15.07	CV Detects	2.432
1149	Skewness Detects	5.104	Kurtosis Detects	28.99
1150	Mean of Logged Detects	2.864	SD of Logged Detects	1.345
1151				
1152	**Normal GOF Test on Detects Only**			
1153	Shapiro Wilk Test Statistic	0.408	**Normal GOF Test on Detected Observations Only**	
1154	5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
1155	Lilliefors Test Statistic	0.346	**Lilliefors GOF Test**	
1156	5% Lilliefors Critical Value	0.0941	Detected Data Not Normal at 5% Significance Level	
1157	**Detected Data Not Normal at 5% Significance Level**			
1158				
1159	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
1160	KM Mean	50.74	KM Standard Error of Mean	13.11
1161	KM SD	125.8	95% KM (BCA) UCL	75.41
1162	95% KM (t) UCL	72.53	95% KM (Percentile Bootstrap) UCL	74.29
1163	95% KM (z) UCL	72.31	95% KM Bootstrap t UCL	98.32
1164	90% KM Chebyshev UCL	90.08	95% KM Chebyshev UCL	107.9
1165	97.5% KM Chebyshev UCL	132.6	99% KM Chebyshev UCL	181.2
1166				
1167	**Gamma GOF Tests on Detected Observations Only**			
1168	A-D Test Statistic	5.156	**Anderson-Darling GOF Test**	
1169	5% A-D Critical Value	0.812	Detected Data Not Gamma Distributed at 5% Significance Level	
1170	K-S Test Statistic	0.183	**Kolmogorov-Smirnov GOF**	
1171	5% K-S Critical Value	0.0998	Detected Data Not Gamma Distributed at 5% Significance Level	
1172	**Detected Data Not Gamma Distributed at 5% Significance Level**			
1173				
1174	**Gamma Statistics on Detected Data Only**			
1175	k hat (MLE)	0.564	k star (bias corrected MLE)	0.553
1176	Theta hat (MLE)	93.88	Theta star (bias corrected MLE)	95.84
1177	nu hat (MLE)	100.4	nu star (bias corrected)	98.37
1178	Mean (detects)	52.96		
1179				
1180	**Gamma ROS Statistics using Imputed Non-Detects**			
1181	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
1182	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)			
1183	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
1184	This is especially true when the sample size is small.			
1185	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
1186	Minimum	0.01	Mean	50.69
1187	Maximum	904.4	Median	13.94
1188	SD	126.5	CV	2.495
1189	k hat (MLE)	0.465	k star (bias corrected MLE)	0.457
1190	Theta hat (MLE)	109.1	Theta star (bias corrected MLE)	110.9
1191	nu hat (MLE)	86.43	nu star (bias corrected)	84.98
1192	Adjusted Level of Significance (β)	0.0474		
1193	Approximate Chi Square Value (84.98, α)	64.73	Adjusted Chi Square Value (84.98, β)	64.45
1194	95% Gamma Approximate UCL (use when n>=50)	66.54	95% Gamma Adjusted UCL (use when n<50)	66.83
1195				
1196	**Estimates of Gamma Parameters using KM Estimates**			

	A–E	F	G–K	L
1197	Mean (KM)	50.74	SD (KM)	125.8
1198	Variance (KM)	15814	SE of Mean (KM)	13.11
1199	k hat (KM)	0.163	k star (KM)	0.165
1200	nu hat (KM)	30.29	nu star (KM)	30.64
1201	theta hat (KM)	311.6	theta star (KM)	308
1202	80% gamma percentile (KM)	59.35	90% gamma percentile (KM)	152.1
1203	95% gamma percentile (KM)	273.9	99% gamma percentile (KM)	621
1204				
1205	**Gamma Kaplan-Meier (KM) Statistics**			
1206	Approximate Chi Square Value (30.64, α)	19	Adjusted Chi Square Value (30.64, β)	18.85
1207	95% Gamma Approximate KM-UCL (use when n>=50)	81.84	95% Gamma Adjusted KM-UCL (use when n<50)	82.47
1208				
1209	**Lognormal GOF Test on Detected Observations Only**			
1210	Shapiro Wilk Approximate Test Statistic	0.948	**Shapiro Wilk GOF Test**	
1211	5% Shapiro Wilk P Value	0.00369	Detected Data Not Lognormal at 5% Significance Level	
1212	Lilliefors Test Statistic	0.0933	**Lilliefors GOF Test**	
1213	5% Lilliefors Critical Value	0.0941	Detected Data appear Lognormal at 5% Significance Level	
1214	**Detected Data appear Approximate Lognormal at 5% Significance Level**			
1215				
1216	**Lognormal ROS Statistics Using Imputed Non-Detects**			
1217	Mean in Original Scale	50.72	Mean in Log Scale	2.726
1218	SD in Original Scale	126.4	SD in Log Scale	1.472
1219	95% t UCL (assumes normality of ROS data)	72.5	95% Percentile Bootstrap UCL	75.34
1220	95% BCA Bootstrap UCL	83.51	95% Bootstrap t UCL	98.88
1221	95% H-UCL (Log ROS)	68.78		
1222				
1223	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
1224	KM Mean (logged)	2.753	KM Geo Mean	15.69
1225	KM SD (logged)	1.41	95% Critical H Value (KM-Log)	2.681
1226	KM Standard Error of Mean (logged)	0.147	95% H-UCL (KM -Log)	62.88
1227	KM SD (logged)	1.41	95% Critical H Value (KM-Log)	2.681
1228	KM Standard Error of Mean (logged)	0.147		
1229				
1230	**DL/2 Statistics**			
1231	**DL/2 Normal**		**DL/2 Log-Transformed**	
1232	Mean in Original Scale	50.71	Mean in Log Scale	2.724
1233	SD in Original Scale	126.4	SD in Log Scale	1.475
1234	95% t UCL (Assumes normality)	72.5	95% H-Stat UCL	69.13
1235	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
1236				
1237	**Nonparametric Distribution Free UCL Statistics**			
1238	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**			
1239				
1240	**Suggested UCL to Use**			
1241	KM H-UCL	62.88		
1242				
1243	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
1244	Recommendations are based upon data size, data distribution, and skewness.			
1245	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
1246	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
1247				
1248	XYLENES, TOTAL			

General Statistics			
Total Number of Observations	93	Number of Distinct Observations	63
Number of Detects	79	Number of Non-Detects	14
Number of Distinct Detects	55	Number of Distinct Non-Detects	8
Minimum Detect	3.08	Minimum Non-Detect	2.3
Maximum Detect	911.8	Maximum Non-Detect	3.47
Variance Detects	23337	Percent Non-Detects	15.05%
Mean Detects	67.63	SD Detects	152.8
Median Detects	16.93	CV Detects	2.259
Skewness Detects	3.883	Kurtosis Detects	16.33
Mean of Logged Detects	3.09	SD of Logged Detects	1.313
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.453	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.342	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0998	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	57.8	KM Standard Error of Mean	14.8
KM SD	141.8	95% KM (BCA) UCL	82.42
95% KM (t) UCL	82.39	95% KM (Percentile Bootstrap) UCL	84.67
95% KM (z) UCL	82.14	95% KM Bootstrap t UCL	95.39
90% KM Chebyshev UCL	102.2	95% KM Chebyshev UCL	122.3
97.5% KM Chebyshev UCL	150.2	99% KM Chebyshev UCL	205.1
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	6.581	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.813	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.208	**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)	0.556	k star (bias corrected MLE)	0.543
Theta hat (MLE)	121.6	Theta star (bias corrected MLE)	124.5
nu hat (MLE)	87.85	nu star (bias corrected)	85.85
Mean (detects)	67.63		
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	57.45
Maximum	911.8	Median	13.03
SD	142.7	CV	2.485
k hat (MLE)	0.322	k star (bias corrected MLE)	0.318
Theta hat (MLE)	178.6	Theta star (bias corrected MLE)	180.4

nu hat (MLE)	59.84	nu star (bias corrected)	59.24
Adjusted Level of Significance (β)	0.0474		
Approximate Chi Square Value (59.24, α)	42.54	Adjusted Chi Square Value (59.24, β)	42.32
95% Gamma Approximate UCL (use when n>=50)	80	95% Gamma Adjusted UCL (use when n<50)	80.42
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	57.8	SD (KM)	141.8
Variance (KM)	20119	SE of Mean (KM)	14.8
k hat (KM)	0.166	k star (KM)	0.168
nu hat (KM)	30.88	nu star (KM)	31.22
theta hat (KM)	348.1	theta star (KM)	344.3
80% gamma percentile (KM)	68.49	90% gamma percentile (KM)	173.5
95% gamma percentile (KM)	310.7	99% gamma percentile (KM)	700.2
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (31.22, α)	19.45	Adjusted Chi Square Value (31.22, β)	19.31
95% Gamma Approximate KM-UCL (use when n>=50)	92.75	95% Gamma Adjusted KM-UCL (use when n<50)	93.45
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.911	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	7.6540E-6	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0998	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	57.64	Mean in Log Scale	2.655
SD in Original Scale	142.7	SD in Log Scale	1.6
95% t UCL (assumes normality of ROS data)	82.22	95% Percentile Bootstrap UCL	83.55
95% BCA Bootstrap UCL	90.71	95% Bootstrap t UCL	95.85
95% H-UCL (Log ROS)	83.06		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	2.751	KM Geo Mean	15.66
KM SD (logged)	1.447	95% Critical H Value (KM-Log)	2.724
KM Standard Error of Mean (logged)	0.151	95% H-UCL (KM -Log)	67.32
KM SD (logged)	1.447	95% Critical H Value (KM-Log)	2.724
KM Standard Error of Mean (logged)	0.151		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	57.64	Mean in Log Scale	2.656
SD in Original Scale	142.7	SD in Log Scale	1.592
95% t UCL (Assumes normality)	82.22	95% H-Stat UCL	81.82
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	122.3		

	A	B	C	D	E	F	G	H	I	J	K	L
1353	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1354	Recommendations are based upon data size, data distribution, and skewness.											
1355	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1356	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1357												

Attachment 2 (Continued)

Soil Vapor Samples from Q1 through Q3 2016, Off-Base (Input)

	A	B	C	D	E
1	1,2,4-TRIMETHYLBENZENE	d_1,2,4-TRIMETHYLBENZENE		1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)	d_1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)
2	1.23	0		1.31	0
3	3.93	1		1.31	0
4	1.43	1		1.31	0
5	9.34	1		1.31	0
6	3.22	1		1.23	0
7	2.48	1		1.27	0
8	2.11	1		1.31	0
9	4.28	1		1.31	0
10	3.54	1		1.38	0
11	2.11	1		1.38	0
12	1.28	0		1.31	0
13	1.28	1		1.31	0

	F	G	H	I	J	K	L	M	N	O
1		1,2-DICHLOROETHANE	d_1,2-DICHLOROETHANE		BENZENE	d_BENZENE		CYCLOHEXANE	d_CYCLOHEXANE	
2		1.42	0		1.34	0		2.55	0	
3		1.38	0		1.31	0		2.48	0	
4		1.34	0		1.28	0		2.44	0	
5		1.34	0		1.28	0		2.41	0	
6		1.3	0		3.43	1		2.38	0	
7		1.3	0		1.47	1		2.34	0	
8		1.3	0		1.5	1		2.31	0	
9		1.27	0		2.04	1		2.31	0	
10		1.25	0		1.98	1		2.31	0	
11		1.25	0		2.14	1		2.27	0	
12		1.25	0		1.5	1		4.47	1	
13		1.25	0		6.07	1		6.54	1	

	P	Q	R	S	T	U	V	W
1	ETHYLBENZENE	d_ETHYLBENZENE		M,P-XYLENE (SUM OF ISOMERS)	d_M,P-XYLENE (SUM OF ISOMERS)		NAPHTHALENE	d_NAPHTHALENE
2	1.35	0		11.72	1		1.52	0
3	1.3	0		2.87	1		1.47	0
4	1.26	0		5.64	1		1.42	0
5	1.26	0		5.21	1		1.42	0
6	2.32	1		4.3	1		1.42	0
7	1.98	1		14.55	1		1.42	0
8	2.52	1		39.95	1		2.04	1
9	1.3	1		16.07	1		2.41	1
10	2.69	1		8.68	1		2.04	1
11	2.43	1		14.33	1		3.62	1
12	1.69	1		14.76	1		2.83	1
13	4.78	1		12.59	1		4.3	1

	X	Y	Z	AA	AB	AC	AD	AE	AF
1		n-HEPTANE	d_n-HEPTANE		n-HEXANE	d_n-HEXANE		O-XYLENE (1,2-DIMETHYLBENZENE)	d_O-XYLENE (1,2-DIMETHYLBENZENE)
2		1.48	0		1.3	0		1.22	0
3		1.43	0		1.27	0		4.23	1
4		1.43	0		1.27	0		2.08	1
5		1.39	0		1.23	0		3.52	1
6		1.39	0		1.23	0		3.91	1
7		1.39	0		1.2	0		1.78	1
8		1.35	0		1.2	0		1.43	1
9		1.35	0		1.2	0		5.86	1
10		1.35	0		1.16	0		16.93	1
11		1.35	0		4.23	1		6.51	1
12		2.21	1		2.22	1		5.21	1
13		2.54	1		5.99	1		5.21	1

	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1		tert-BUTYL METHYL ETHER	d_tert-BUTYL METHYL ETHER		TOLUENE	d_TOLUENE		XYLENES, TOTAL	d_XYLENES, TOTAL
2		1.48	0		2.94	1		2.87	1
3		1.44	0		14.89	1		7.82	1
4		1.44	0		11.12	1		6.95	1
5		1.41	0		15.45	1		5.64	1
6		1.37	0		10.55	1		20.19	1
7		1.37	0		4.9	1		15.85	1
8		1.37	0		9.04	1		56.44	1
9		1.37	0		16.2	1		22.58	1
10		1.37	0		13.19	1		12.16	1
11		1.37	0		4.9	1		19.54	1
12		1.35	0		4.9	1		19.97	1
13		1.33	0		8.67	1		16.5	1

Attachment 2 (Continued)

Soil Vapor Samples from Q1 through Q3 2016, Off-Base (Output)

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.16/26/2017 1:56:54 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2,4-TRIMETHYLBENZENE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	10
Number of Detects	10	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	1.28	Minimum Non-Detect	1.23
Maximum Detect	9.34	Maximum Non-Detect	1.28
Variance Detects	5.437	Percent Non-Detects	16.67%
Mean Detects	3.372	SD Detects	2.332
Median Detects	2.85	CV Detects	0.691
Skewness Detects	2.106	Kurtosis Detects	5.321
Mean of Logged Detects	1.05	SD of Logged Detects	0.583

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.775	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.248	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	3.015	KM Standard Error of Mean	0.661
KM SD	2.171	95% KM (BCA) UCL	4.234
95% KM (t) UCL	4.202	95% KM (Percentile Bootstrap) UCL	4.123
95% KM (z) UCL	4.102	95% KM Bootstrap t UCL	5.135
90% KM Chebyshev UCL	4.997	95% KM Chebyshev UCL	5.895
97.5% KM Chebyshev UCL	7.141	99% KM Chebyshev UCL	9.589

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.363	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.732	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.165	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.268	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.172	k star (bias corrected MLE)	2.287
Theta hat (MLE)	1.063	Theta star (bias corrected MLE)	1.475
nu hat (MLE)	63.43	nu star (bias corrected)	45.74
Mean (detects)	3.372		

Gamma ROS Statistics using Imputed Non-Detects

53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
54	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)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	2.812
59	Maximum	9.34	Median	2.295
60	SD	2.482	CV	0.883
61	k hat (MLE)	0.658	k star (bias corrected MLE)	0.549
62	Theta hat (MLE)	4.273	Theta star (bias corrected MLE)	5.121
63	nu hat (MLE)	15.79	nu star (bias corrected)	13.18
64	Adjusted Level of Significance (β)	0.029		
65	Approximate Chi Square Value (13.18, α)	6.012	Adjusted Chi Square Value (13.18, β)	5.291
66	95% Gamma Approximate UCL (use when n>=50)	6.163	95% Gamma Adjusted UCL (use when n<50)	7.002
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	3.015	SD (KM)	2.171
70	Variance (KM)	4.715	SE of Mean (KM)	0.661
71	k hat (KM)	1.928	k star (KM)	1.502
72	nu hat (KM)	46.27	nu star (KM)	36.04
73	theta hat (KM)	1.564	theta star (KM)	2.008
74	80% gamma percentile (KM)	4.664	90% gamma percentile (KM)	6.281
75	95% gamma percentile (KM)	7.851	99% gamma percentile (KM)	11.4
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (36.04, α)	23.3	Adjusted Chi Square Value (36.04, β)	21.75
79	95% Gamma Approximate KM-UCL (use when n>=50)	4.663	95% Gamma Adjusted KM-UCL (use when n<50)	4.996
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.144	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.262	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	2.93	Mean in Log Scale	0.82
90	SD in Original Scale	2.349	SD in Log Scale	0.753
91	95% t UCL (assumes normality of ROS data)	4.147	95% Percentile Bootstrap UCL	4.072
92	95% BCA Bootstrap UCL	4.465	95% Bootstrap t UCL	4.97
93	95% H-UCL (Log ROS)	5.307		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	0.909	KM Geo Mean	2.482
97	KM SD (logged)	0.594	95% Critical H Value (KM-Log)	2.263
98	KM Standard Error of Mean (logged)	0.181	95% H-UCL (KM -Log)	4.444
99	KM SD (logged)	0.594	95% Critical H Value (KM-Log)	2.263
100	KM Standard Error of Mean (logged)	0.181		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	2.915	Mean in Log Scale	0.797

SD in Original Scale	2.364	SD in Log Scale	0.791
95% t UCL (Assumes normality)	4.14	95% H-Stat UCL	5.583

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	4.202		

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.

1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE)

General Statistics

Total Number of Observations	12	Number of Distinct Observations	4
Number of Detects	0	Number of Non-Detects	12
Number of Distinct Detects	0	Number of Distinct Non-Detects	4

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) was not processed!

1,2-DICHLOROETHANE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	6
Number of Detects	0	Number of Non-Detects	12
Number of Distinct Detects	0	Number of Distinct Non-Detects	6

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-DICHLOROETHANE was not processed!

BENZENE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	10
Number of Detects	8	Number of Non-Detects	4
Number of Distinct Detects	7	Number of Distinct Non-Detects	3

	A–E	F	G–K	L
157	Minimum Detect	1.47	Minimum Non-Detect	1.28
158	Maximum Detect	6.07	Maximum Non-Detect	1.34
159	Variance Detects	2.469	Percent Non-Detects	33.33%
160	Mean Detects	2.516	SD Detects	1.571
161	Median Detects	2.01	CV Detects	0.624
162	Skewness Detects	2.067	Kurtosis Detects	4.309
163	Mean of Logged Detects	0.799	SD of Logged Detects	0.493
164				
165	**Normal GOF Test on Detects Only**			
166	Shapiro Wilk Test Statistic	0.713	**Shapiro Wilk GOF Test**	
167	5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
168	Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**	
169	5% Lilliefors Critical Value	0.283	Detected Data Not Normal at 5% Significance Level	
170	**Detected Data Not Normal at 5% Significance Level**			
171				
172	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
173	KM Mean	2.104	KM Standard Error of Mean	0.412
174	KM SD	1.334	95% KM (BCA) UCL	2.763
175	95% KM (t) UCL	2.844	95% KM (Percentile Bootstrap) UCL	2.813
176	95% KM (z) UCL	2.781	95% KM Bootstrap t UCL	4.396
177	90% KM Chebyshev UCL	3.339	95% KM Chebyshev UCL	3.899
178	97.5% KM Chebyshev UCL	4.675	99% KM Chebyshev UCL	6.2
179				
180	**Gamma GOF Tests on Detected Observations Only**			
181	A-D Test Statistic	0.787	**Anderson-Darling GOF Test**	
182	5% A-D Critical Value	0.719	Detected Data Not Gamma Distributed at 5% Significance Level	
183	K-S Test Statistic	0.312	**Kolmogorov-Smirnov GOF**	
184	5% K-S Critical Value	0.295	Detected Data Not Gamma Distributed at 5% Significance Level	
185	**Detected Data Not Gamma Distributed at 5% Significance Level**			
186				
187	**Gamma Statistics on Detected Data Only**			
188	k hat (MLE)	4.187	k star (bias corrected MLE)	2.7
189	Theta hat (MLE)	0.601	Theta star (bias corrected MLE)	0.932
190	nu hat (MLE)	66.99	nu star (bias corrected)	43.2
191	Mean (detects)	2.516		
192				
193	**Gamma ROS Statistics using Imputed Non-Detects**			
194	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
195	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)			
196	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
197	This is especially true when the sample size is small.			
198	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
199	Minimum	0.01	Mean	1.681
200	Maximum	6.07	Median	1.5
201	SD	1.759	CV	1.046
202	k hat (MLE)	0.428	k star (bias corrected MLE)	0.376
203	Theta hat (MLE)	3.93	Theta star (bias corrected MLE)	4.466
204	nu hat (MLE)	10.27	nu star (bias corrected)	9.033
205	Adjusted Level of Significance (β)	0.029		
206	Approximate Chi Square Value (9.03, α)	3.347	Adjusted Chi Square Value (9.03, β)	2.84
207	95% Gamma Approximate UCL (use when n>=50)	4.537	95% Gamma Adjusted UCL (use when n<50)	5.346
208				

209	**Estimates of Gamma Parameters using KM Estimates**			
210	Mean (KM)	2.104	SD (KM)	1.334
211	Variance (KM)	1.78	SE of Mean (KM)	0.412
212	k hat (KM)	2.488	k star (KM)	1.921
213	nu hat (KM)	59.71	nu star (KM)	46.12
214	theta hat (KM)	0.846	theta star (KM)	1.095
215	80% gamma percentile (KM)	3.165	90% gamma percentile (KM)	4.131
216	95% gamma percentile (KM)	5.055	99% gamma percentile (KM)	7.109
217				
218	**Gamma Kaplan-Meier (KM) Statistics**			
219	Approximate Chi Square Value (46.12, α)	31.53	Adjusted Chi Square Value (46.12, β)	29.7
220	95% Gamma Approximate KM-UCL (use when n>=50)	3.077	95% Gamma Adjusted KM-UCL (use when n<50)	3.267
221				
222	**Lognormal GOF Test on Detected Observations Only**			
223	Shapiro Wilk Test Statistic	0.824	**Shapiro Wilk GOF Test**	
224	5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
225	Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**	
226	5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level	
227	**Detected Data appear Lognormal at 5% Significance Level**			
228				
229	**Lognormal ROS Statistics Using Imputed Non-Detects**			
230	Mean in Original Scale	1.9	Mean in Log Scale	0.395
231	SD in Original Scale	1.55	SD in Log Scale	0.719
232	95% t UCL (assumes normality of ROS data)	2.703	95% Percentile Bootstrap UCL	2.654
233	95% BCA Bootstrap UCL	2.852	95% Bootstrap t UCL	3.419
234	95% H-UCL (Log ROS)	3.264		
235				
236	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
237	KM Mean (logged)	0.615	KM Geo Mean	1.849
238	KM SD (logged)	0.458	95% Critical H Value (KM-Log)	2.09
239	KM Standard Error of Mean (logged)	0.141	95% H-UCL (KM -Log)	2.739
240	KM SD (logged)	0.458	95% Critical H Value (KM-Log)	2.09
241	KM Standard Error of Mean (logged)	0.141		
242				
243	**DL/2 Statistics**			
244	**DL/2 Normal**		**DL/2 Log-Transformed**	
245	Mean in Original Scale	1.895	Mean in Log Scale	0.389
246	SD in Original Scale	1.554	SD in Log Scale	0.721
247	95% t UCL (Assumes normality)	2.7	95% H-Stat UCL	3.258
248	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
249				
250	**Nonparametric Distribution Free UCL Statistics**			
251	**Detected Data appear Lognormal Distributed at 5% Significance Level**			
252				
253	**Suggested UCL to Use**			
254	KM Student's t	2.626	KM H-UCL	2.739
255				
256	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
257	Recommendations are based upon data size, data distribution, and skewness.			
258	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
259	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
260				

CYCLOHEXANE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	10
Number of Detects	2	Number of Non-Detects	10
Number of Distinct Detects	2	Number of Distinct Non-Detects	8
Minimum Detect	4.47	Minimum Non-Detect	2.27
Maximum Detect	6.54	Maximum Non-Detect	2.55
Variance Detects	2.142	Percent Non-Detects	83.33%
Mean Detects	5.505	SD Detects	1.464
Median Detects	5.505	CV Detects	0.266
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.688	SD of Logged Detects	0.269

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	2.809	KM Standard Error of Mean	0.522
KM SD	1.278	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.746	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.667	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.374	95% KM Chebyshev UCL	5.083
97.5% KM Chebyshev UCL	6.066	99% KM Chebyshev UCL	7.998

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	27.95	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.197	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	111.8	nu star (bias corrected)	N/A
Mean (detects)	5.505		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.809	SD (KM)	1.278
Variance (KM)	1.632	SE of Mean (KM)	0.522
k hat (KM)	4.835	k star (KM)	3.682
nu hat (KM)	116	nu star (KM)	88.37
theta hat (KM)	0.581	theta star (KM)	0.763
80% gamma percentile (KM)	3.911	90% gamma percentile (KM)	4.772
95% gamma percentile (KM)	5.568	99% gamma percentile (KM)	7.274

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.029
Approximate Chi Square Value (88.37, α)	67.7	Adjusted Chi Square Value (88.37, β)	64.94
95% Gamma Approximate KM-UCL (use when n>=50)	3.667	95% Gamma Adjusted KM-UCL (use when n<50)	3.823

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	1.803	Mean in Log Scale	0.305
SD in Original Scale	1.804	SD in Log Scale	0.696
95% t UCL (assumes normality of ROS data)	2.739	95% Percentile Bootstrap UCL	2.698
95% BCA Bootstrap UCL	2.985	95% Bootstrap t UCL	6.875
95% H-UCL (Log ROS)	2.865		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.964	KM Geo Mean	2.623
KM SD (logged)	0.333	95% Critical H Value (KM-Log)	1.958
KM Standard Error of Mean (logged)	0.136	95% H-UCL (KM -Log)	3.374
KM SD (logged)	0.333	95% Critical H Value (KM-Log)	1.958
KM Standard Error of Mean (logged)	0.136		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.909	Mean in Log Scale	0.426
SD in Original Scale	1.737	SD in Log Scale	0.596
95% t UCL (Assumes normality)	2.81	95% H-Stat UCL	2.747
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	3.746	KM H-UCL	3.374
95% KM (BCA) UCL	N/A		
Warning: One or more Recommended UCL(s) not available!			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
ETHYLBENZENE			
General Statistics			
Total Number of Observations	12	Number of Distinct Observations	10
Number of Detects	8	Number of Non-Detects	4
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	1.3	Minimum Non-Detect	1.26
Maximum Detect	4.78	Maximum Non-Detect	1.35
Variance Detects	1.09	Percent Non-Detects	33.33%
Mean Detects	2.464	SD Detects	1.044
Median Detects	2.375	CV Detects	0.424
Skewness Detects	1.722	Kurtosis Detects	4.06
Mean of Logged Detects	0.835	SD of Logged Detects	0.381
Normal GOF Test on Detects Only			

	A	B	C	D	E	F	G	H	I	J	K	L
365					Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk GOF Test**					
366					5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level					
367					Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**					
368					5% Lilliefors Critical Value	0.283	Detected Data Not Normal at 5% Significance Level					
369	**Detected Data appear Approximate Normal at 5% Significance Level**											
370												
371	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
372					KM Mean	2.063					KM Standard Error of Mean	0.302
373					KM SD	0.978					95% KM (BCA) UCL	2.593
374					95% KM (t) UCL	2.605					95% KM (Percentile Bootstrap) UCL	2.515
375					95% KM (z) UCL	2.56					95% KM Bootstrap t UCL	2.872
376					90% KM Chebyshev UCL	2.969					95% KM Chebyshev UCL	3.379
377					97.5% KM Chebyshev UCL	3.948					99% KM Chebyshev UCL	5.066
378												
379	**Gamma GOF Tests on Detected Observations Only**											
380					A-D Test Statistic	0.385	**Anderson-Darling GOF Test**					
381					5% A-D Critical Value	0.717	Detected data appear Gamma Distributed at 5% Significance Level					
382					K-S Test Statistic	0.232	**Kolmogorov-Smirnov GOF**					
383					5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Level					
384	**Detected data appear Gamma Distributed at 5% Significance Level**											
385												
386	**Gamma Statistics on Detected Data Only**											
387					k hat (MLE)	7.631					k star (bias corrected MLE)	4.853
388					Theta hat (MLE)	0.323					Theta star (bias corrected MLE)	0.508
389					nu hat (MLE)	122.1					nu star (bias corrected)	77.65
390					Mean (detects)	2.464						
391												
392	**Gamma ROS Statistics using Imputed Non-Detects**											
393	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
394	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)											
395	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
396	This is especially true when the sample size is small.											
397	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
398					Minimum	0.116					Mean	1.784
399					Maximum	4.78					Median	1.835
400					SD	1.31					CV	0.734
401					k hat (MLE)	1.505					k star (bias corrected MLE)	1.184
402					Theta hat (MLE)	1.186					Theta star (bias corrected MLE)	1.507
403					nu hat (MLE)	36.11					nu star (bias corrected)	28.42
404					Adjusted Level of Significance (β)	0.029						
405					Approximate Chi Square Value (28.42, α)	17.25					Adjusted Chi Square Value (28.42, β)	15.94
406					95% Gamma Approximate UCL (use when n>=50)	2.938					95% Gamma Adjusted UCL (use when n<50)	3.181
407												
408	**Estimates of Gamma Parameters using KM Estimates**											
409					Mean (KM)	2.063					SD (KM)	0.978
410					Variance (KM)	0.956					SE of Mean (KM)	0.302
411					k hat (KM)	4.452					k star (KM)	3.394
412					nu hat (KM)	106.8					nu star (KM)	81.46
413					theta hat (KM)	0.464					theta star (KM)	0.608
414					80% gamma percentile (KM)	2.9					90% gamma percentile (KM)	3.565
415					95% gamma percentile (KM)	4.182					99% gamma percentile (KM)	5.51
416												

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (81.46, α)	61.66	Adjusted Chi Square Value (81.46, β)	59.04
95% Gamma Approximate KM-UCL (use when n>=50)	2.726	95% Gamma Adjusted KM-UCL (use when n<50)	2.847
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.947	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.283	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	1.953	Mean in Log Scale	0.531
SD in Original Scale	1.125	SD in Log Scale	0.546
95% t UCL (assumes normality of ROS data)	2.537	95% Percentile Bootstrap UCL	2.505
95% BCA Bootstrap UCL	2.607	95% Bootstrap t UCL	2.729
95% H-UCL (Log ROS)	2.835		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.634	KM Geo Mean	1.885
KM SD (logged)	0.406	95% Critical H Value (KM-Log)	2.033
KM Standard Error of Mean (logged)	0.125	95% H-UCL (KM -Log)	2.626
KM SD (logged)	0.406	95% Critical H Value (KM-Log)	2.033
KM Standard Error of Mean (logged)	0.125		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.858	Mean in Log Scale	0.411
SD in Original Scale	1.222	SD in Log Scale	0.696
95% t UCL (Assumes normality)	2.492	95% H-Stat UCL	3.185
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Approximate Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	2.605		
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.			
M,P-XYLENE (SUM OF ISOMERS)			
General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0

Minimum	2.87	Mean	12.56
Maximum	39.95	Median	12.16
SD	9.79	Std. Error of Mean	2.826
Coefficient of Variation	0.78	Skewness	2.136
Normal GOF Test			
Shapiro Wilk Test Statistic	0.766	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.63	95% Adjusted-CLT UCL (Chen-1995)	19.07
		95% Modified-t UCL (Johnson-1978)	17.92
Gamma GOF Test			
A-D Test Statistic	0.43	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.741	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	0.248	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.283	k star (bias corrected MLE)	1.767
Theta hat (MLE)	5.501	Theta star (bias corrected MLE)	7.104
nu hat (MLE)	54.78	nu star (bias corrected)	42.42
MLE Mean (bias corrected)	12.56	MLE Sd (bias corrected)	9.444
		Approximate Chi Square Value (0.05)	28.49
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	26.76
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	18.7	95% Adjusted Gamma UCL (use when n<50)	19.91
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.175	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.054	Mean of logged Data	2.295
Maximum of Logged Data	3.688	SD of logged Data	0.719
Assuming Lognormal Distribution			
95% H-UCL	21.83	90% Chebyshev (MVUE) UCL	20.67
95% Chebyshev (MVUE) UCL	24.36	97.5% Chebyshev (MVUE) UCL	29.48
99% Chebyshev (MVUE) UCL	39.54		
Nonparametric Distribution Free UCL Statistics			

Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	17.2	95% Jackknife UCL	17.63
95% Standard Bootstrap UCL	16.96	95% Bootstrap-t UCL	20.65
95% Hall's Bootstrap UCL	38.51	95% Percentile Bootstrap UCL	17.46
95% BCA Bootstrap UCL	19.07		
90% Chebyshev(Mean, Sd) UCL	21.03	95% Chebyshev(Mean, Sd) UCL	24.87
97.5% Chebyshev(Mean, Sd) UCL	30.2	99% Chebyshev(Mean, Sd) UCL	40.68
Suggested UCL to Use			
95% Adjusted Gamma UCL	19.91		
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	12	Number of Distinct Observations	8
Number of Detects	6	Number of Non-Detects	6
Number of Distinct Detects	5	Number of Distinct Non-Detects	3
Minimum Detect	2.04	Minimum Non-Detect	1.42
Maximum Detect	4.3	Maximum Non-Detect	1.52
Variance Detects	0.84	Percent Non-Detects	50%
Mean Detects	2.873	SD Detects	0.916
Median Detects	2.62	CV Detects	0.319
Skewness Detects	0.804	Kurtosis Detects	-0.825
Mean of Logged Detects	1.015	SD of Logged Detects	0.307
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.193	**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) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	2.147	KM Standard Error of Mean	0.296
KM SD	0.937	95% KM (BCA) UCL	2.638
95% KM (t) UCL	2.679	95% KM (Percentile Bootstrap) UCL	2.614
95% KM (z) UCL	2.634	95% KM Bootstrap t UCL	2.707
90% KM Chebyshev UCL	3.036	95% KM Chebyshev UCL	3.438
97.5% KM Chebyshev UCL	3.997	99% KM Chebyshev UCL	5.095
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.352	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level	

	A–E	F	G–K	L
573	**Detected data appear Gamma Distributed at 5% Significance Level**			
574				
575	**Gamma Statistics on Detected Data Only**			
576	k hat (MLE)	12.56	k star (bias corrected MLE)	6.393
577	Theta hat (MLE)	0.229	Theta star (bias corrected MLE)	0.449
578	nu hat (MLE)	150.8	nu star (bias corrected)	76.72
579	Mean (detects)	2.873		
580				
581	**Gamma ROS Statistics using Imputed Non-Detects**			
582	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
583	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)			
584	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
585	This is especially true when the sample size is small.			
586	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
587	Minimum	0.01	Mean	1.697
588	Maximum	4.3	Median	1.586
589	SD	1.4	CV	0.825
590	k hat (MLE)	0.9	k star (bias corrected MLE)	0.73
591	Theta hat (MLE)	1.886	Theta star (bias corrected MLE)	2.323
592	nu hat (MLE)	21.59	nu star (bias corrected)	17.53
593	Adjusted Level of Significance (β)	0.029		
594	Approximate Chi Square Value (17.53, α)	9.051	Adjusted Chi Square Value (17.53, β)	8.137
595	95% Gamma Approximate UCL (use when n>=50)	3.285	95% Gamma Adjusted UCL (use when n<50)	3.655
596				
597	**Estimates of Gamma Parameters using KM Estimates**			
598	Mean (KM)	2.147	SD (KM)	0.937
599	Variance (KM)	0.878	SE of Mean (KM)	0.296
600	k hat (KM)	5.249	k star (KM)	3.992
601	nu hat (KM)	126	nu star (KM)	95.82
602	theta hat (KM)	0.409	theta star (KM)	0.538
603	80% gamma percentile (KM)	2.96	90% gamma percentile (KM)	3.587
604	95% gamma percentile (KM)	4.163	99% gamma percentile (KM)	5.395
605				
606	**Gamma Kaplan-Meier (KM) Statistics**			
607	Approximate Chi Square Value (95.82, α)	74.24	Adjusted Chi Square Value (95.82, β)	71.35
608	95% Gamma Approximate KM-UCL (use when n>=50)	2.771	95% Gamma Adjusted KM-UCL (use when n<50)	2.883
609				
610	**Lognormal GOF Test on Detected Observations Only**			
611	Shapiro Wilk Test Statistic	0.908	**Shapiro Wilk GOF Test**	
612	5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
613	Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**	
614	5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	
615	**Detected Data appear Lognormal at 5% Significance Level**			
616				
617	**Lognormal ROS Statistics Using Imputed Non-Detects**			
618	Mean in Original Scale	1.993	Mean in Log Scale	0.551
619	SD in Original Scale	1.119	SD in Log Scale	0.547
620	95% t UCL (assumes normality of ROS data)	2.573	95% Percentile Bootstrap UCL	2.534
621	95% BCA Bootstrap UCL	2.589	95% Bootstrap t UCL	2.752
622	95% H-UCL (Log ROS)	2.899		
623				
624	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			

625	KM Mean (logged)	0.683	KM Geo Mean	1.98
626	KM SD (logged)	0.387	95% Critical H Value (KM-Log)	2.012
627	KM Standard Error of Mean (logged)	0.122	95% H-UCL (KM -Log)	2.698
628	KM SD (logged)	0.387	95% Critical H Value (KM-Log)	2.012
629	KM Standard Error of Mean (logged)	0.122		
630				
631	**DL/2 Statistics**			
632	**DL/2 Normal**		**DL/2 Log-Transformed**	
633	Mean in Original Scale	1.798	Mean in Log Scale	0.345
634	SD in Original Scale	1.282	SD in Log Scale	0.73
635	95% t UCL (Assumes normality)	2.463	95% H-Stat UCL	3.168
636	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
637				
638	**Nonparametric Distribution Free UCL Statistics**			
639	**Detected Data appear Normal Distributed at 5% Significance Level**			
640				
641	**Suggested UCL to Use**			
642	95% KM (t) UCL	2.679		
643				
644	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
645	Recommendations are based upon data size, data distribution, and skewness.			
646	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
647	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
648				
649	n-HEPTANE			
650				
651	**General Statistics**			
652	Total Number of Observations	12	Number of Distinct Observations	6
653	Number of Detects	2	Number of Non-Detects	10
654	Number of Distinct Detects	2	Number of Distinct Non-Detects	4
655	Minimum Detect	2.21	Minimum Non-Detect	1.35
656	Maximum Detect	2.54	Maximum Non-Detect	1.48
657	Variance Detects	0.0545	Percent Non-Detects	83.33%
658	Mean Detects	2.375	SD Detects	0.233
659	Median Detects	2.375	CV Detects	0.0983
660	Skewness Detects	N/A	Kurtosis Detects	N/A
661	Mean of Logged Detects	0.863	SD of Logged Detects	0.0984
662				
663	**Warning: Data set has only 2 Detected Values.**			
664	**This is not enough to compute meaningful or reliable statistics and estimates.**			
665				
666				
667	**Normal GOF Test on Detects Only**			
668	**Not Enough Data to Perform GOF Test**			
669				
670	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
671	KM Mean	1.521	KM Standard Error of Mean	0.158
672	KM SD	0.388	95% KM (BCA) UCL	N/A
673	95% KM (t) UCL	1.805	95% KM (Percentile Bootstrap) UCL	N/A
674	95% KM (z) UCL	1.781	95% KM Bootstrap t UCL	N/A
675	90% KM Chebyshev UCL	1.996	95% KM Chebyshev UCL	2.211
676	97.5% KM Chebyshev UCL	2.51	99% KM Chebyshev UCL	3.096

677				
678	**Gamma GOF Tests on Detected Observations Only**			
679	**Not Enough Data to Perform GOF Test**			
680				
681	**Gamma Statistics on Detected Data Only**			
682	k hat (MLE)	206.9	k star (bias corrected MLE)	N/A
683	Theta hat (MLE)	0.0115	Theta star (bias corrected MLE)	N/A
684	nu hat (MLE)	827.4	nu star (bias corrected)	N/A
685	Mean (detects)	2.375		
686				
687	**Estimates of Gamma Parameters using KM Estimates**			
688	Mean (KM)	1.521	SD (KM)	0.388
689	Variance (KM)	0.15	SE of Mean (KM)	0.158
690	k hat (KM)	15.37	k star (KM)	11.59
691	nu hat (KM)	368.9	nu star (KM)	278
692	theta hat (KM)	0.0989	theta star (KM)	0.131
693	80% gamma percentile (KM)	1.879	90% gamma percentile (KM)	2.114
694	95% gamma percentile (KM)	2.323	99% gamma percentile (KM)	2.748
695				
696	**Gamma Kaplan-Meier (KM) Statistics**			
697			Adjusted Level of Significance (β)	0.029
698	Approximate Chi Square Value (278.04, α)	240.4	Adjusted Chi Square Value (278.04, β)	235.1
699	95% Gamma Approximate KM-UCL (use when n>=50)	1.759	95% Gamma Adjusted KM-UCL (use when n<50)	1.799
700				
701	**Lognormal GOF Test on Detected Observations Only**			
702	**Not Enough Data to Perform GOF Test**			
703				
704	**Lognormal ROS Statistics Using Imputed Non-Detects**			
705	Mean in Original Scale	1.481	Mean in Log Scale	0.352
706	SD in Original Scale	0.47	SD in Log Scale	0.288
707	95% t UCL (assumes normality of ROS data)	1.724	95% Percentile Bootstrap UCL	1.707
708	95% BCA Bootstrap UCL	1.743	95% Bootstrap t UCL	1.88
709	95% H-UCL (Log ROS)	1.75		
710				
711	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
712	KM Mean (logged)	0.394	KM Geo Mean	1.483
713	KM SD (logged)	0.212	95% Critical H Value (KM-Log)	1.852
714	KM Standard Error of Mean (logged)	0.0864	95% H-UCL (KM -Log)	1.706
715	KM SD (logged)	0.212	95% Critical H Value (KM-Log)	1.852
716	KM Standard Error of Mean (logged)	0.0864		
717				
718	**DL/2 Statistics**			
719	**DL/2 Normal**		**DL/2 Log-Transformed**	
720	Mean in Original Scale	0.975	Mean in Log Scale	-0.159
721	SD in Original Scale	0.658	SD in Log Scale	0.479
722	95% t UCL (Assumes normality)	1.316	95% H-Stat UCL	1.298
723	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
724				
725	**Nonparametric Distribution Free UCL Statistics**			
726	**Data do not follow a Discernible Distribution at 5% Significance Level**			
727				
728	**Suggested UCL to Use**			

95% KM (t) UCL	1.805	KM H-UCL	1.706
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!

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

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

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

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

n-HEXANE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	8
Number of Detects	3	Number of Non-Detects	9
Number of Distinct Detects	3	Number of Distinct Non-Detects	5
Minimum Detect	2.22	Minimum Non-Detect	1.16
Maximum Detect	5.99	Maximum Non-Detect	1.3
Variance Detects	3.558	Percent Non-Detects	75%
Mean Detects	4.147	SD Detects	1.886
Median Detects	4.23	CV Detects	0.455
Skewness Detects	-0.198	Kurtosis Detects	N/A
Mean of Logged Detects	1.343	SD of Logged Detects	0.504

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	0.999	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	**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	1.907	KM Standard Error of Mean	0.532
KM SD	1.505	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.862	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.782	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3.503	95% KM Chebyshev UCL	4.226
97.5% KM Chebyshev UCL	5.23	99% KM Chebyshev UCL	7.202

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	6.488	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.639	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	38.93	nu star (bias corrected)	N/A
Mean (detects)	4.147		

Gamma ROS Statistics using Imputed Non-Detects

	A	B	C	D	E	F	G	H	I	J	K	L
781	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
782	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)											
783	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
784	This is especially true when the sample size is small.											
785	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
786	Minimum					0.01	Mean					1.044
787	Maximum					5.99	Median					0.01
788	SD					2.036	CV					1.95
789	k hat (MLE)					0.228	k star (bias corrected MLE)					0.227
790	Theta hat (MLE)					4.579	Theta star (bias corrected MLE)					4.609
791	nu hat (MLE)					5.473	nu star (bias corrected)					5.438
792	Adjusted Level of Significance (β)					0.029						
793	Approximate Chi Square Value (5.44, α)					1.36	Adjusted Chi Square Value (5.44, β)					1.076
794	95% Gamma Approximate UCL (use when n>=50)					4.176	95% Gamma Adjusted UCL (use when n<50)					N/A
795												
796	**Estimates of Gamma Parameters using KM Estimates**											
797	Mean (KM)					1.907	SD (KM)					1.505
798	Variance (KM)					2.266	SE of Mean (KM)					0.532
799	k hat (KM)					1.605	k star (KM)					1.259
800	nu hat (KM)					38.51	nu star (KM)					30.22
801	theta hat (KM)					1.188	theta star (KM)					1.514
802	80% gamma percentile (KM)					3.005	90% gamma percentile (KM)					4.148
803	95% gamma percentile (KM)					5.271	99% gamma percentile (KM)					7.837
804												
805	**Gamma Kaplan-Meier (KM) Statistics**											
806	Approximate Chi Square Value (30.22, α)					18.66	Adjusted Chi Square Value (30.22, β)					17.29
807	95% Gamma Approximate KM-UCL (use when n>=50)					3.087	95% Gamma Adjusted KM-UCL (use when n<50)					3.332
808												
809	**Lognormal GOF Test on Detected Observations Only**											
810	Shapiro Wilk Test Statistic					0.971	**Shapiro Wilk GOF Test**					
811	5% Shapiro Wilk Critical Value					0.767	Detected Data appear Lognormal at 5% Significance Level					
812	Lilliefors Test Statistic					0.245	**Lilliefors GOF Test**					
813	5% Lilliefors Critical Value					0.425	Detected Data appear Lognormal at 5% Significance Level					
814	**Detected Data appear Lognormal at 5% Significance Level**											
815												
816	**Lognormal ROS Statistics Using Imputed Non-Detects**											
817	Mean in Original Scale					1.369	Mean in Log Scale					-0.362
818	SD in Original Scale					1.867	SD in Log Scale					1.143
819	95% t UCL (assumes normality of ROS data)					2.338	95% Percentile Bootstrap UCL					2.287
820	95% BCA Bootstrap UCL					2.534	95% Bootstrap t UCL					3.929
821	95% H-UCL (Log ROS)					4						
822												
823	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
824	KM Mean (logged)					0.447	KM Geo Mean					1.564
825	KM SD (logged)					0.557	95% Critical H Value (KM-Log)					2.213
826	KM Standard Error of Mean (logged)					0.197	95% H-UCL (KM -Log)					2.647
827	KM SD (logged)					0.557	95% Critical H Value (KM-Log)					2.213
828	KM Standard Error of Mean (logged)					0.197						
829												
830	**DL/2 Statistics**											
831	**DL/2 Normal**						**DL/2 Log-Transformed**					
832	Mean in Original Scale					1.498	Mean in Log Scale					-0.0299

SD in Original Scale	1.789	SD in Log Scale	0.856
95% t UCL (Assumes normality)	2.425	95% H-Stat UCL	2.783
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	2.862		
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.			
O-XYLENE (1,2-DIMETHYLBENZENE)			
General Statistics			
Total Number of Observations	12	Number of Distinct Observations	11
Number of Detects	11	Number of Non-Detects	1
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	1.43	Minimum Non-Detect	1.22
Maximum Detect	16.93	Maximum Non-Detect	1.22
Variance Detects	18.08	Percent Non-Detects	8.333%
Mean Detects	5.152	SD Detects	4.252
Median Detects	4.23	CV Detects	0.825
Skewness Detects	2.402	Kurtosis Detects	6.866
Mean of Logged Detects	1.409	SD of Logged Detects	0.69
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.251	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	4.824	KM Standard Error of Mean	1.22
KM SD	4.031	95% KM (BCA) UCL	7.144
95% KM (t) UCL	7.016	95% KM (Percentile Bootstrap) UCL	6.76
95% KM (z) UCL	6.831	95% KM Bootstrap t UCL	8.821
90% KM Chebyshev UCL	8.485	95% KM Chebyshev UCL	10.14
97.5% KM Chebyshev UCL	12.45	99% KM Chebyshev UCL	16.97
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.439	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.188	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.258	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			

	A	B	C	D	E	F	G	H	I	J	K	L
885					k hat (MLE)	2.327					k star (bias corrected MLE)	1.753
886					Theta hat (MLE)	2.214					Theta star (bias corrected MLE)	2.939
887					nu hat (MLE)	51.19					nu star (bias corrected)	38.56
888					Mean (detects)	5.152						
889												
890	**Gamma ROS Statistics using Imputed Non-Detects**											
891	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
892	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)											
893	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
894	This is especially true when the sample size is small.											
895	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
896					Minimum	0.01					Mean	4.723
897					Maximum	16.93					Median	4.07
898					SD	4.317					CV	0.914
899					k hat (MLE)	0.906					k star (bias corrected MLE)	0.735
900					Theta hat (MLE)	5.211					Theta star (bias corrected MLE)	6.423
901					nu hat (MLE)	21.75					nu star (bias corrected)	17.65
902					Adjusted Level of Significance (β)	0.029						
903					Approximate Chi Square Value (17.65, α)	9.138					Adjusted Chi Square Value (17.65, β)	8.218
904					95% Gamma Approximate UCL (use when n>=50)	9.123					95% Gamma Adjusted UCL (use when n<50)	10.14
905												
906	**Estimates of Gamma Parameters using KM Estimates**											
907					Mean (KM)	4.824					SD (KM)	4.031
908					Variance (KM)	16.25					SE of Mean (KM)	1.22
909					k hat (KM)	1.432					k star (KM)	1.13
910					nu hat (KM)	34.38					nu star (KM)	27.12
911					theta hat (KM)	3.368					theta star (KM)	4.27
912					80% gamma percentile (KM)	7.682					90% gamma percentile (KM)	10.78
913					95% gamma percentile (KM)	13.85					99% gamma percentile (KM)	20.9
914												
915	**Gamma Kaplan-Meier (KM) Statistics**											
916					Approximate Chi Square Value (27.12, α)	16.24					Adjusted Chi Square Value (27.12, β)	14.97
917					95% Gamma Approximate KM-UCL (use when n>=50)	8.054					95% Gamma Adjusted KM-UCL (use when n<50)	8.739
918												
919	**Lognormal GOF Test on Detected Observations Only**											
920					Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**					
921					5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level					
922					Lilliefors Test Statistic	0.16	**Lilliefors GOF Test**					
923					5% Lilliefors Critical Value	0.251	Detected Data appear Lognormal at 5% Significance Level					
924	**Detected Data appear Lognormal at 5% Significance Level**											
925												
926	**Lognormal ROS Statistics Using Imputed Non-Detects**											
927					Mean in Original Scale	4.787					Mean in Log Scale	1.271
928					SD in Original Scale	4.246					SD in Log Scale	0.814
929					95% t UCL (assumes normality of ROS data)	6.989					95% Percentile Bootstrap UCL	6.829
930					95% BCA Bootstrap UCL	7.58					95% Bootstrap t UCL	8.592
931					95% H-UCL (Log ROS)	9.382						
932												
933	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
934					KM Mean (logged)	1.308					KM Geo Mean	3.7
935					KM SD (logged)	0.713					95% Critical H Value (KM-Log)	2.434
936					KM Standard Error of Mean (logged)	0.216					95% H-UCL (KM -Log)	8.053

KM SD (logged)	0.713	95% Critical H Value (KM-Log)	2.434
KM Standard Error of Mean (logged)	0.216		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.773	Mean in Log Scale	1.251
SD in Original Scale	4.261	SD in Log Scale	0.857
95% t UCL (Assumes normality)	6.982	95% H-Stat UCL	10.04

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 Adjusted Gamma UCL	8.739	95% GROS Adjusted Gamma UCL	10.14

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.

tert-BUTYL METHYL ETHER

General Statistics

Total Number of Observations	12	Number of Distinct Observations	6
Number of Detects	0	Number of Non-Detects	12
Number of Distinct Detects	0	Number of Distinct Non-Detects	6

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable tert-BUTYL METHYL ETHER was not processed!

TOLUENE

General Statistics

Total Number of Observations	12	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2.94	Mean	9.729
Maximum	16.2	Median	9.795
SD	4.607	Std. Error of Mean	1.33
Coefficient of Variation	0.474	Skewness	-0.0134

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.186	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.243	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L
989												
990	Assuming Normal Distribution											
991	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
992					95% Student's-t UCL	12.12					95% Adjusted-CLT UCL (Chen-1995)	11.91
993											95% Modified-t UCL (Johnson-1978)	12.12
994												
995	Gamma GOF Test											
996					A-D Test Statistic	0.465	Anderson-Darling Gamma GOF Test					
997					5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level					
998					K-S Test Statistic	0.191	Kolmogorov-Smirnov Gamma GOF Test					
999					5% K-S Critical Value	0.246	Detected data appear Gamma Distributed at 5% Significance Level					
1000	Detected data appear Gamma Distributed at 5% Significance Level											
1001												
1002	Gamma Statistics											
1003					k hat (MLE)	4.09					k star (bias corrected MLE)	3.123
1004					Theta hat (MLE)	2.379					Theta star (bias corrected MLE)	3.115
1005					nu hat (MLE)	98.17					nu star (bias corrected)	74.96
1006					MLE Mean (bias corrected)	9.729					MLE Sd (bias corrected)	5.505
1007											Approximate Chi Square Value (0.05)	56.02
1008					Adjusted Level of Significance	0.029					Adjusted Chi Square Value	53.53
1009												
1010	Assuming Gamma Distribution											
1011					95% Approximate Gamma UCL (use when n>=50))	13.02					95% Adjusted Gamma UCL (use when n<50)	13.62
1012												
1013	Lognormal GOF Test											
1014					Shapiro Wilk Test Statistic	0.902	Shapiro Wilk Lognormal GOF Test					
1015					5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level					
1016					Lilliefors Test Statistic	0.175	Lilliefors Lognormal GOF Test					
1017					5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level					
1018	Data appear Lognormal at 5% Significance Level											
1019												
1020	Lognormal Statistics											
1021					Minimum of Logged Data	1.078					Mean of logged Data	2.148
1022					Maximum of Logged Data	2.785					SD of logged Data	0.559
1023												
1024	Assuming Lognormal Distribution											
1025					95% H-UCL	14.56					90% Chebyshev (MVUE) UCL	14.79
1026					95% Chebyshev (MVUE) UCL	17.02					97.5% Chebyshev (MVUE) UCL	20.11
1027					99% Chebyshev (MVUE) UCL	26.19						
1028												
1029	Nonparametric Distribution Free UCL Statistics											
1030	Data appear to follow a Discernible Distribution at 5% Significance Level											
1031												
1032	Nonparametric Distribution Free UCLs											
1033					95% CLT UCL	11.92					95% Jackknife UCL	12.12
1034					95% Standard Bootstrap UCL	11.79					95% Bootstrap-t UCL	12.07
1035					95% Hall's Bootstrap UCL	11.84					95% Percentile Bootstrap UCL	11.76
1036					95% BCA Bootstrap UCL	11.82						
1037					90% Chebyshev(Mean, Sd) UCL	13.72					95% Chebyshev(Mean, Sd) UCL	15.53
1038					97.5% Chebyshev(Mean, Sd) UCL	18.03					99% Chebyshev(Mean, Sd) UCL	22.96
1039												
1040	Suggested UCL to Use											

	A–E	F	G–K	L
1041	95% Student's-t UCL	12.12		
1042				
1043	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
1044	Recommendations are based upon data size, data distribution, and skewness.			
1045	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
1046	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
1047				
1048	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**			
1049	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**			
1050				
1051				
1052	XYLENES, TOTAL			
1053				
1054	**General Statistics**			
1055	Total Number of Observations	12	Number of Distinct Observations	12
1056			Number of Missing Observations	0
1057	Minimum	2.87	Mean	17.21
1058	Maximum	56.44	Median	16.18
1059	SD	13.98	Std. Error of Mean	4.036
1060	Coefficient of Variation	0.812	Skewness	2.157
1061				
1062	**Normal GOF Test**			
1063	Shapiro Wilk Test Statistic	0.77	**Shapiro Wilk GOF Test**	
1064	5% Shapiro Wilk Critical Value	0.859	Data Not Normal at 5% Significance Level	
1065	Lilliefors Test Statistic	0.267	**Lilliefors GOF Test**	
1066	5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level	
1067	**Data Not Normal at 5% Significance Level**			
1068				
1069	**Assuming Normal Distribution**			
1070	**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**	
1071	95% Student's-t UCL	24.46	95% Adjusted-CLT UCL (Chen-1995)	26.53
1072			95% Modified-t UCL (Johnson-1978)	24.88
1073				
1074	**Gamma GOF Test**			
1075	A-D Test Statistic	0.375	**Anderson-Darling Gamma GOF Test**	
1076	5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
1077	K-S Test Statistic	0.179	**Kolmogorov-Smirnov Gamma GOF Test**	
1078	5% K-S Critical Value	0.249	Detected data appear Gamma Distributed at 5% Significance Level	
1079	**Detected data appear Gamma Distributed at 5% Significance Level**			
1080				
1081	**Gamma Statistics**			
1082	k hat (MLE)	2.038	k star (bias corrected MLE)	1.584
1083	Theta hat (MLE)	8.442	Theta star (bias corrected MLE)	10.86
1084	nu hat (MLE)	48.92	nu star (bias corrected)	38.02
1085	MLE Mean (bias corrected)	17.21	MLE Sd (bias corrected)	13.67
1086			Approximate Chi Square Value (0.05)	24.9
1087	Adjusted Level of Significance	0.029	Adjusted Chi Square Value	23.29
1088				
1089	**Assuming Gamma Distribution**			
1090	95% Approximate Gamma UCL (use when n>=50)	26.28	95% Adjusted Gamma UCL (use when n<50)	28.09
1091				
1092	**Lognormal GOF Test**			

1093	Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk Lognormal GOF Test**	
1094	5% Shapiro Wilk Critical Value	0.859	Data appear Lognormal at 5% Significance Level	
1095	Lilliefors Test Statistic	0.176	**Lilliefors Lognormal GOF Test**	
1096	5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	
1097	**Data appear Lognormal at 5% Significance Level**			
1098				
1099	**Lognormal Statistics**			
1100	Minimum of Logged Data	1.054	Mean of logged Data	2.581
1101	Maximum of Logged Data	4.033	SD of logged Data	0.782
1102				
1103	**Assuming Lognormal Distribution**			
1104	95% H-UCL	32.66	90% Chebyshev (MVUE) UCL	29.74
1105	95% Chebyshev (MVUE) UCL	35.34	97.5% Chebyshev (MVUE) UCL	43.11
1106	99% Chebyshev (MVUE) UCL	58.37		
1107				
1108	**Nonparametric Distribution Free UCL Statistics**			
1109	**Data appear to follow a Discernible Distribution at 5% Significance Level**			
1110				
1111	**Nonparametric Distribution Free UCLs**			
1112	95% CLT UCL	23.85	95% Jackknife UCL	24.46
1113	95% Standard Bootstrap UCL	23.55	95% Bootstrap-t UCL	28.9
1114	95% Hall's Bootstrap UCL	54.14	95% Percentile Bootstrap UCL	24.49
1115	95% BCA Bootstrap UCL	26.54		
1116	90% Chebyshev(Mean, Sd) UCL	29.32	95% Chebyshev(Mean, Sd) UCL	34.8
1117	97.5% Chebyshev(Mean, Sd) UCL	42.42	99% Chebyshev(Mean, Sd) UCL	57.37
1118				
1119	**Suggested UCL to Use**			
1120	95% Adjusted Gamma UCL	28.09		
1121				
1122	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
1123	Recommendations are based upon data size, data distribution, and skewness.			
1124	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
1125	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
1126				

Attachment 2 (Continued)

Groundwater Samples from Q3 and Q4 2015, On-Base (Input)

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dichloroethane	d_1,2-Dibromoethane	
2	493	1		93	1	
3	410	1		70.2	1	
4	400	1		18	1	
5	361	1		15.1	1	
6	250	1		9.12	1	
7	212	1		6.58	1	
8	109	1		6.17	1	
9	109	1		5.22	1	
10	83.2	1		5.18	1	
11	71.2	1		3.76	1	
12	69.5	1		3.31	1	
13	42.5	1		2.27	1	
14	23.5	1		0.997	1	
15	13.2	1		0.686	1	
16	9.77	1		0.255	1	
17	5.99	1		0.241	1	
18	4.86	1		0.216	1	
19	2.13	1		0.0953	1	
20	1.59	1		0.0759	1	
21	1	1		0.0664	1	
22	0.5	0		0.0368	1	
23	0.5	0		0.00966	0	
24	0.25	0		0.00964	0	
25	0.25	0		0.00957	0	
26	0.25	0		0.00953	0	
27	0.25	0		0.00952	0	
28	0.25	0		0.00949	0	
29	0.25	0		0.00947	0	
30	0.25	0		0.00946	0	
31	0.25	0		0.00946	0	
32	0.25	0		0.00945	0	
33	0.25	0		0.00945	0	
34	0.25	0		0.009445	0	
35	0.25	0		0.00943	0	
36	0.25	0		0.00942	0	
37	0.25	0		0.00942	0	
38	0.25	0		0.009415	0	
39	0.25	0		0.0094	0	
40	0.25	0		0.0094	0	
41	0.25	0		0.00939	0	
42	0.25	0		0.00939	0	
43	0.25	0		0.00939	0	
44	0.25	0		0.009385	0	
45	0.25	0		0.00938	0	
46	0.25	0		0.00938	0	
47	0.25	0		0.00938	0	
48	0.25	0		0.009375	0	
49	0.25	0		0.00937	0	
50	0.25	0		0.00937	0	

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dichloroethane	d_1,2-Dibromoethane	
51	0.25	0		0.00937	0	
52	0.25	0		0.00936	0	
53	0.25	0		0.00935	0	
54	0.25	0		0.00935	0	
55	0.25	0		0.00934	0	
56	0.25	0		0.00934	0	
57	0.25	0		0.00934	0	
58	0.25	0		0.00933	0	
59	0.25	0		0.00933	0	
60	0.25	0		0.00933	0	
61	0.25	0		0.00933	0	
62	0.25	0		0.00931	0	
63	0.25	0		0.0093	0	
64	0.25	0		0.00929	0	
65	0.25	0		0.00928	0	
66	0.25	0		0.00926	0	
67	0.25	0		0.00923	0	
68	0.25	0		0.00919	0	
69	0.25	0		0.00917	0	

	G	H	I	J	K	L
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene	
2	50	0		98.8	1	
3	25	0		79.2	1	
4	25	0		66.8	1	
5	12.5	0		65.8	0	
6	5.52	1		62.5	0	
7	5.22	1		61.5	1	
8	5	0		60.7	0	
9	5	0		39.7	1	
10	5	0		38.6	1	
11	5	0		31.9	1	
12	4.84	1		22.7	1	
13	4.3	1		14.7	1	
14	4.04	1		14.7	0	
15	2.5	0		13.3	1	
16	2.5	0		12.4	1	
17	2.5	0		10.3	1	
18	2.5	0		2.55	1	
19	2.12	1		1.84	1	
20	1.13	1		1.47	0	
21	0.5	0		1.275	0	
22	0.5	0		1.25	0	
23	0.5	0		1.25	0	
24	0.25	0		1.25	0	
25	0.25	0		1.25	0	
26	0.25	0		1.25	0	
27	0.25	0		1.24	0	
28	0.25	0		1.24	0	
29	0.25	0		1.24	0	
30	0.25	0		1.23	0	
31	0.25	0		1.23	0	
32	0.25	0		1.23	0	
33	0.25	0		1.21	0	
34	0.25	0		1.21	0	
35	0.25	0		1.2	0	
36	0.25	0		1.2	0	
37	0.25	0		1.2	0	
38	0.25	0		1.2	0	
39	0.25	0		1.2	0	
40	0.25	0		1.2	0	
41	0.25	0		1.19	0	
42	0.25	0		1.19	0	
43	0.25	0		1.19	0	
44	0.25	0		1.19	0	
45	0.25	0		1.19	0	
46	0.25	0		1.19	0	
47	0.25	0		1.18	0	
48	0.25	0		1.18	0	
49	0.25	0		1.18	0	
50	0.25	0		1.18	0	

	G	H	I	J	K	L
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene	
51	0.25	0		1.18	0	
52	0.25	0		1.18	0	
53	0.25	0		1.18	0	
54	0.25	0		1.18	0	
55	0.25	0		1.18	0	
56	0.25	0		1.17	0	
57	0.25	0		1.17	0	
58	0.25	0		1.16	0	
59	0.25	0		1.16	0	
60	0.25	0		1.16	0	
61	0.25	0		1.16	0	
62	0.25	0		1.16	0	
63	0.25	0		1.16	0	
64	0.25	0		1.16	0	
65	0.25	0		1.16	0	
66	0.25	0		1.16	0	
67	0.25	0		1.16	0	
68	0.25	0		1.16	0	
69	0.25	0		1.16	0	

	M	N	O	P	Q	R	S
1	2-Methylnaphthalene	d_2-Methylnaphthalene		Acetophenone	d_Acetophenone		Benzene
2	105	1		4520	1		16000
3	75.5	1		2830	1		8940
4	73.8	1		2550	1		6540
5	73.6	1		2400	1		5580
6	65.8	0		2150	1		5290
7	62.5	0		1980	1		2710
8	60.7	0		1660	1		1960
9	41.1	1		1260	1		1920
10	25.4	1		968	1		1890
11	22.7	1		796	1		1770
12	22.1	1		640	1		1400
13	14.7	0		220	1		1010
14	12.3	0		152	1		697
15	12.1	0		139	1		453
16	8.44	1		84.6	1		385
17	6.25	0		77.1	1		320
18	1.47	0		12.3	0		259
19	1.275	0		6.25	0		108
20	1.25	0		1.47	0		53.7
21	1.25	0		1.275	0		19.1
22	1.25	0		1.25	0		2.31
23	1.25	0		1.25	0		0.5
24	1.25	0		1.25	0		0.275
25	1.24	0		1.25	0		0.25
26	1.24	0		1.25	0		0.25
27	1.24	0		1.24	0		0.25
28	1.23	0		1.24	0		0.25
29	1.23	0		1.24	0		0.25
30	1.23	0		1.23	0		0.25
31	1.21	0		1.23	0		0.25
32	1.21	0		1.23	0		0.25
33	1.2	0		1.21	0		0.25
34	1.2	0		1.21	0		0.25
35	1.2	0		1.2	0		0.25
36	1.2	0		1.2	0		0.25
37	1.2	0		1.2	0		0.25
38	1.2	0		1.2	0		0.25
39	1.2	0		1.2	0		0.25
40	1.19	0		1.2	0		0.25
41	1.19	0		1.19	0		0.25
42	1.19	0		1.19	0		0.25
43	1.19	0		1.19	0		0.25
44	1.19	0		1.19	0		0.25
45	1.19	0		1.19	0		0.25
46	1.18	0		1.18	0		0.25
47	1.18	0		1.18	0		0.25
48	1.18	0		1.18	0		0.25
49	1.18	0		1.18	0		0.25
50	1.18	0		1.18	0		0.25

	M	N	O	P	Q	R	S
1	**2-Methylnaphthalene**	**d_2-Methylnaphthalene**		**Acetophenone**	**d_Acetophenone**		**Benzene**
51	1.18	0		1.18	0		0.25
52	1.18	0		1.18	0		0.25
53	1.18	0		1.18	0		0.25
54	1.18	0		1.18	0		0.25
55	1.17	0		1.17	0		0.25
56	1.17	0		1.17	0		0.25
57	1.17	0		1.17	0		0.25
58	1.16	0		1.16	0		0.25
59	1.16	0		1.16	0		0.25
60	1.16	0		1.16	0		0.25
61	1.16	0		1.16	0		0.25
62	1.16	0		1.16	0		0.25
63	1.16	0		1.16	0		0.25
64	1.16	0		1.16	0		0.25
65	1.16	0		1.16	0		0.25
66	1.16	0		1.16	0		0.25
67	1.16	0		1.16	0		0.25
68	1.16	0		1.16	0		0.25
69	1.16	0		1.16	0		0.25

	T	U	V	W	X	Y	Z	AA	AB
1	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**		**Lead**	**d_Lead**		**Naphthalene**
2	1		1550	1		7.5	0		227
3	1		1370	1		7.5	0		190
4	1		1160	1		3.44	1		178
5	1		1060	1		3.17	1		143
6	1		818	1		3	0		60.4
7	1		802	1		3	0		54.8
8	1		423	1		3	0		53.5
9	1		360	1		2.38	1		52.7
10	1		303	1		2.06	1		51.2
11	1		231	1		2	0		44.9
12	1		188	1		1.57	1		40.4
13	1		184	1		1.5	0		35.2
14	1		79	1		1.5	0		22.5
15	1		57.9	1		1.5	0		18.3
16	1		54	1		1.5	0		11.2
17	1		51	1		1.5	0		7.88
18	1		39.8	1		1.5	0		6.94
19	1		14.3	1		1.5	0		4.1
20	1		6.49	1		1.5	0		1.66
21	1		0.582	1		1.5	0		0.635
22	1		0.5	0		1.5	0		0.5
23	0		0.5	0		1.5	0		0.5
24	1		0.25	0		1.5	0		0.25
25	0		0.25	0		1.5	0		0.25
26	0		0.25	0		1.5	0		0.25
27	0		0.25	0		1.5	0		0.25
28	0		0.25	0		1.5	0		0.25
29	0		0.25	0		1.5	0		0.25
30	0		0.25	0		1.5	0		0.25
31	0		0.25	0		1.5	0		0.25
32	0		0.25	0		1.5	0		0.25
33	0		0.25	0		1.5	0		0.25
34	0		0.25	0		1.5	0		0.25
35	0		0.25	0		1.5	0		0.25
36	0		0.25	0		1.5	0		0.25
37	0		0.25	0		1.5	0		0.25
38	0		0.25	0		1.5	0		0.25
39	0		0.25	0		1.5	0		0.25
40	0		0.25	0		1.5	0		0.25
41	0		0.25	0		1.5	0		0.25
42	0		0.25	0		1.5	0		0.25
43	0		0.25	0		1.5	0		0.25
44	0		0.25	0		1.5	0		0.25
45	0		0.25	0		1.5	0		0.25
46	0		0.25	0		1.5	0		0.25
47	0		0.25	0		1.5	0		0.25
48	0		0.25	0		1.5	0		0.25
49	0		0.25	0		1.5	0		0.25
50	0		0.25	0		1.5	0		0.25

	T	U	V	W	X	Y	Z	AA	AB
1	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**		**Lead**	**d_Lead**		**Naphthalene**
51	0		0.25	0		1.5	0		0.25
52	0		0.25	0		1.5	0		0.25
53	0		0.25	0		1.5	0		0.25
54	0		0.25	0		1.5	0		0.25
55	0		0.25	0		1.5	0		0.25
56	0		0.25	0		1.5	0		0.25
57	0		0.25	0		1.5	0		0.25
58	0		0.25	0		1.5	0		0.25
59	0		0.25	0		1.5	0		0.25
60	0		0.25	0		1.5	0		0.25
61	0		0.25	0		1.5	0		0.25
62	0		0.25	0		1.5	0		0.25
63	0		0.25	0		1.5	0		0.25
64	0		0.25	0		1.5	0		0.25
65	0		0.25	0		1.5	0		0.25
66	0		0.25	0		1.5	0		0.25
67	0		0.25	0		1.5	0		0.25
68	0		0.25	0		1.5	0		0.25
69	0		0.25	0		1.5	0		0.25

	AC	AD	AE	AF	AG	AH	AI
1	**d_Naphthalene**		**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
2	1		21400	1		5120	1
3	1		15600	1		4230	1
4	1		14300	1		3290	1
5	1		13100	1		2920	1
6	1		3250	1		1520	1
7	1		2810	1		1290	1
8	1		1890	1		895	1
9	1		1760	1		614	1
10	1		1500	1		582	1
11	1		955	1		571	1
12	1		910	1		558	1
13	1		831	1		377	1
14	1		632	1		307	1
15	1		485	1		189	1
16	1		248	1		108	1
17	1		146	1		25.7	1
18	1		3.42	1		5.26	1
19	1		1.44	1		2.51	1
20	1		1.38	1		2.17	1
21	1		0.5	0		1.92	1
22	0		0.5	0		1.5	0
23	0		0.5	0		1.5	0
24	0		0.5	0		0.75	0
25	0		0.25	0		0.75	0
26	0		0.25	0		0.75	0
27	0		0.25	0		0.75	0
28	0		0.25	0		0.75	0
29	0		0.25	0		0.75	0
30	0		0.25	0		0.75	0
31	0		0.25	0		0.75	0
32	0		0.25	0		0.75	0
33	0		0.25	0		0.75	0
34	0		0.25	0		0.75	0
35	0		0.25	0		0.75	0
36	0		0.25	0		0.75	0
37	0		0.25	0		0.75	0
38	0		0.25	0		0.75	0
39	0		0.25	0		0.75	0
40	0		0.25	0		0.75	0
41	0		0.25	0		0.75	0
42	0		0.25	0		0.75	0
43	0		0.25	0		0.75	0
44	0		0.25	0		0.75	0
45	0		0.25	0		0.75	0
46	0		0.25	0		0.75	0
47	0		0.25	0		0.75	0
48	0		0.25	0		0.75	0
49	0		0.25	0		0.75	0
50	0		0.25	0		0.75	0

	AC	AD	AE	AF	AG	AH	AI
1	**d_Naphthalene**		**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
51	0		0.25	0		0.75	0
52	0		0.25	0		0.75	0
53	0		0.25	0		0.75	0
54	0		0.25	0		0.75	0
55	0		0.25	0		0.75	0
56	0		0.25	0		0.75	0
57	0		0.25	0		0.75	0
58	0		0.25	0		0.75	0
59	0		0.25	0		0.75	0
60	0		0.25	0		0.75	0
61	0		0.25	0		0.75	0
62	0		0.25	0		0.75	0
63	0		0.25	0		0.75	0
64	0		0.25	0		0.75	0
65	0		0.25	0		0.75	0
66	0		0.25	0		0.75	0
67	0		0.25	0		0.75	0
68	0		0.25	0		0.75	0
69	0		0.25	0		0.75	0

Attachment 2 (Continued)

Groundwater Samples from Q3 and Q4 2015, On-Base (Output)

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.16/20/2017 9:44:13 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2,4-Trimethylbenzene

General Statistics

Total Number of Observations	68	Number of Distinct Observations	21
Number of Detects	20	Number of Non-Detects	48
Number of Distinct Detects	19	Number of Distinct Non-Detects	2
Minimum Detect	1	Minimum Non-Detect	0.25
Maximum Detect	493	Maximum Non-Detect	0.5
Variance Detects	26058	Percent Non-Detects	70.59%
Mean Detects	133.6	SD Detects	161.4
Median Detects	70.35	CV Detects	1.208
Skewness Detects	1.15	Kurtosis Detects	-0.0712
Mean of Logged Detects	3.682	SD of Logged Detects	1.991

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.792	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.261	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	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	39.48	KM Standard Error of Mean	13.03
KM SD	104.8	95% KM (BCA) UCL	63.82
95% KM (t) UCL	61.22	95% KM (Percentile Bootstrap) UCL	61.59
95% KM (z) UCL	60.92	95% KM Bootstrap t UCL	70.36
90% KM Chebyshev UCL	78.58	95% KM Chebyshev UCL	96.29
97.5% KM Chebyshev UCL	120.9	99% KM Chebyshev UCL	169.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.37	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.801	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.114	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.205	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)	0.52	k star (bias corrected MLE)	0.476
Theta hat (MLE)	256.7	Theta star (bias corrected MLE)	280.9
nu hat (MLE)	20.82	nu star (bias corrected)	19.03
Mean (detects)	133.6		

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	39.31
Maximum	493	Median	0.01
SD	105.6	CV	2.686
k hat (MLE)	0.134	k star (bias corrected MLE)	0.138
Theta hat (MLE)	293.8	Theta star (bias corrected MLE)	285.5
nu hat (MLE)	18.2	nu star (bias corrected)	18.73
Adjusted Level of Significance (β)	0.0465		
Approximate Chi Square Value (18.73, α)	9.918	Adjusted Chi Square Value (18.73, β)	9.779
95% Gamma Approximate UCL (use when n>=50)	74.22	95% Gamma Adjusted UCL (use when n<50)	75.28

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	39.48	SD (KM)	104.8
Variance (KM)	10974	SE of Mean (KM)	13.03
k hat (KM)	0.142	k star (KM)	0.146
nu hat (KM)	19.31	nu star (KM)	19.8
theta hat (KM)	278	theta star (KM)	271.2
80% gamma percentile (KM)	41.9	90% gamma percentile (KM)	116.5
95% gamma percentile (KM)	218.5	99% gamma percentile (KM)	516.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (19.80, α)	10.7	Adjusted Chi Square Value (19.80, β)	10.56
95% Gamma Approximate KM-UCL (use when n>=50)	73.03	95% Gamma Adjusted KM-UCL (use when n<50)	74.04

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	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	39.6	Mean in Log Scale	-0.893
SD in Original Scale	105.5	SD in Log Scale	3.855
95% t UCL (assumes normality of ROS data)	60.94	95% Percentile Bootstrap UCL	61.91
95% BCA Bootstrap UCL	66.24	95% Bootstrap t UCL	69.35
95% H-UCL (Log ROS)	6963		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.104	KM Geo Mean	1.11
KM SD (logged)	2.538	95% Critical H Value (KM-Log)	3.068
KM Standard Error of Mean (logged)	0.316	95% H-UCL (KM -Log)	71.98
KM SD (logged)	2.538	95% Critical H Value (KM-Log)	3.068
KM Standard Error of Mean (logged)	0.316		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	39.39	Mean in Log Scale	-0.364
SD in Original Scale	105.6	SD in Log Scale	2.84
95% t UCL (Assumes normality)	60.74	95% H-Stat UCL	128.5

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	73.03		

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.

1,2-Dibromoethane

General Statistics

Total Number of Observations	68	Number of Distinct Observations	52
Number of Detects	21	Number of Non-Detects	47
Number of Distinct Detects	21	Number of Distinct Non-Detects	31
Minimum Detect	0.0368	Minimum Non-Detect	0.00917
Maximum Detect	93	Maximum Non-Detect	0.00966
Variance Detects	581.2	Percent Non-Detects	69.12%
Mean Detects	11.46	SD Detects	24.11
Median Detects	3.31	CV Detects	2.104
Skewness Detects	2.88	Kurtosis Detects	7.747
Mean of Logged Detects	0.538	SD of Logged Detects	2.304

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.51	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.348	**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	3.544	KM Standard Error of Mean	1.753

	A	B	C	D	E	F	G	H	I	J	K	L
143					KM SD	14.1					95% KM (BCA) UCL	7.069
144					95% KM (t) UCL	6.467					95% KM (Percentile Bootstrap) UCL	6.761
145					95% KM (z) UCL	6.427					95% KM Bootstrap t UCL	14.82
146					90% KM Chebyshev UCL	8.802					95% KM Chebyshev UCL	11.18
147					97.5% KM Chebyshev UCL	14.49					99% KM Chebyshev UCL	20.98
148												
149	**Gamma GOF Tests on Detected Observations Only**											
150					A-D Test Statistic	0.696	**Anderson-Darling GOF Test**					
151					5% A-D Critical Value	0.835	Detected data appear Gamma Distributed at 5% Significance Level					
152					K-S Test Statistic	0.155	**Kolmogorov-Smirnov GOF**					
153					5% K-S Critical Value	0.204	Detected data appear Gamma Distributed at 5% Significance Level					
154	**Detected data appear Gamma Distributed at 5% Significance Level**											
155												
156	**Gamma Statistics on Detected Data Only**											
157					k hat (MLE)	0.353					k star (bias corrected MLE)	0.335
158					Theta hat (MLE)	32.43					Theta star (bias corrected MLE)	34.24
159					nu hat (MLE)	14.84					nu star (bias corrected)	14.05
160					Mean (detects)	11.46						
161												
162	**Gamma ROS Statistics using Imputed Non-Detects**											
163	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
164	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)											
165	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
166	This is especially true when the sample size is small.											
167	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
168					Minimum	0.01					Mean	3.545
169					Maximum	93					Median	0.01
170					SD	14.21					CV	4.008
171					k hat (MLE)	0.175					k star (bias corrected MLE)	0.177
172					Theta hat (MLE)	20.21					Theta star (bias corrected MLE)	19.98
173					nu hat (MLE)	23.85					nu star (bias corrected)	24.13
174					Adjusted Level of Significance (β)	0.0465						
175					Approximate Chi Square Value (24.13, α)	13.95					Adjusted Chi Square Value (24.13, β)	13.78
176					95% Gamma Approximate UCL (use when n>=50)	6.133					95% Gamma Adjusted UCL (use when n<50)	6.208
177												
178	**Estimates of Gamma Parameters using KM Estimates**											
179					Mean (KM)	3.544					SD (KM)	14.1
180					Variance (KM)	198.9					SE of Mean (KM)	1.753
181					k hat (KM)	0.0632					k star (KM)	0.0702
182					nu hat (KM)	8.589					nu star (KM)	9.544
183					theta hat (KM)	56.12					theta star (KM)	50.51
184					80% gamma percentile (KM)	1.277					90% gamma percentile (KM)	7.663
185					95% gamma percentile (KM)	20.39					99% gamma percentile (KM)	66.71
186												
187	**Gamma Kaplan-Meier (KM) Statistics**											
188					Approximate Chi Square Value (9.54, α)	3.659					Adjusted Chi Square Value (9.54, β)	3.58
189					95% Gamma Approximate KM-UCL (use when n>=50)	9.245					95% Gamma Adjusted KM-UCL (use when n<50)	9.449
190												
191	**Lognormal GOF Test on Detected Observations Only**											
192					Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**					
193					5% Shapiro Wilk Critical Value	0.908	Detected Data appear Lognormal at 5% Significance Level					
194					Lilliefors Test Statistic	0.136	**Lilliefors GOF Test**					
195					5% Lilliefors Critical Value	0.188	Detected Data appear Lognormal at 5% Significance Level					
196	**Detected Data appear Lognormal at 5% Significance Level**											
197												

Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	3.54	Mean in Log Scale	-4.502
SD in Original Scale	14.21	SD in Log Scale	3.795
95% t UCL (assumes normality of ROS data)	6.414	95% Percentile Bootstrap UCL	6.537
95% BCA Bootstrap UCL	8.097	95% Bootstrap t UCL	14.79
95% H-UCL (Log ROS)	138.8		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-3.077	KM Geo Mean	0.0461
KM SD (logged)	2.72	95% Critical H Value (KM-Log)	3.26
KM Standard Error of Mean (logged)	0.338	95% H-UCL (KM -Log)	5.506
KM SD (logged)	2.72	95% Critical H Value (KM-Log)	3.26
KM Standard Error of Mean (logged)	0.338		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3.541	Mean in Log Scale	-3.54
SD in Original Scale	14.21	SD in Log Scale	3.021
95% t UCL (Assumes normality)	6.415	95% H-Stat UCL	11.02
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	9.245		
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.			
1,2-Dichloroethane			
General Statistics			
Total Number of Observations	68	Number of Distinct Observations	14
Number of Detects	7	Number of Non-Detects	61
Number of Distinct Detects	7	Number of Distinct Non-Detects	7
Minimum Detect	1.13	Minimum Non-Detect	0.25
Maximum Detect	5.52	Maximum Non-Detect	50
Variance Detects	2.711	Percent Non-Detects	89.71%
Mean Detects	3.881	SD Detects	1.647
Median Detects	4.3	CV Detects	0.424
Skewness Detects	-0.969	Kurtosis Detects	-0.434
Mean of Logged Detects	1.238	SD of Logged Detects	0.586
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.253	**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) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.667	KM Standard Error of Mean	0.174
KM SD	1.26	95% KM (BCA) UCL	0.931
95% KM (t) UCL	0.957	95% KM (Percentile Bootstrap) UCL	0.932
95% KM (z) UCL	0.953	95% KM Bootstrap t UCL	0.925
90% KM Chebyshev UCL	1.188	95% KM Chebyshev UCL	1.424
97.5% KM Chebyshev UCL	1.752	99% KM Chebyshev UCL	2.395
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.638	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

	A–E	F	G–K	L
265				
266	**Gamma Statistics on Detected Data Only**			
267	k hat (MLE)	4.391	k star (bias corrected MLE)	2.605
268	Theta hat (MLE)	0.884	Theta star (bias corrected MLE)	1.49
269	nu hat (MLE)	61.48	nu star (bias corrected)	36.46
270	Mean (detects)	3.881		
271				
272	**Gamma ROS Statistics using Imputed Non-Detects**			
273	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
274	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)			
275	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
276	This is especially true when the sample size is small.			
277	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
278	Minimum	0.01	Mean	0.584
279	Maximum	5.52	Median	0.01
280	SD	1.3	CV	2.225
281	k hat (MLE)	0.271	k star (bias corrected MLE)	0.269
282	Theta hat (MLE)	2.156	Theta star (bias corrected MLE)	2.174
283	nu hat (MLE)	36.84	nu star (bias corrected)	36.55
284	Adjusted Level of Significance (β)	0.0465		
285	Approximate Chi Square Value (36.55, α)	23.71	Adjusted Chi Square Value (36.55, β)	23.49
286	95% Gamma Approximate UCL (use when n>=50)	0.9	95% Gamma Adjusted UCL (use when n<50)	0.909
287				
288	**Estimates of Gamma Parameters using KM Estimates**			
289	Mean (KM)	0.667	SD (KM)	1.26
290	Variance (KM)	1.589	SE of Mean (KM)	0.174
291	k hat (KM)	0.28	k star (KM)	0.278
292	nu hat (KM)	38.1	nu star (KM)	37.76
293	theta hat (KM)	2.381	theta star (KM)	2.403
294	80% gamma percentile (KM)	1.002	90% gamma percentile (KM)	1.985
295	95% gamma percentile (KM)	3.128	99% gamma percentile (KM)	6.128
296				
297	**Gamma Kaplan-Meier (KM) Statistics**			
298	Approximate Chi Square Value (37.76, α)	24.69	Adjusted Chi Square Value (37.76, β)	24.46
299	95% Gamma Approximate KM-UCL (use when n>=50)	1.02	95% Gamma Adjusted KM-UCL (use when n<50)	1.03
300				
301	**Lognormal GOF Test on Detected Observations Only**			
302	Shapiro Wilk Test Statistic	0.803	**Shapiro Wilk GOF Test**	
303	5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level	
304	Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**	
305	5% Lilliefors Critical Value	0.304	Detected Data Not Lognormal at 5% Significance Level	
306	**Detected Data Not Lognormal at 5% Significance Level**			
307				
308	**Lognormal ROS Statistics Using Imputed Non-Detects**			
309	Mean in Original Scale	0.871	Mean in Log Scale	-0.74
310	SD in Original Scale	1.202	SD in Log Scale	1.08
311	95% t UCL (assumes normality of ROS data)	1.115	95% Percentile Bootstrap UCL	1.116
312	95% BCA Bootstrap UCL	1.15	95% Bootstrap t UCL	1.205
313	95% H-UCL (Log ROS)	1.151		
314				
315	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
316	KM Mean (logged)	-1.081	KM Geo Mean	0.339
317	KM SD (logged)	0.858	95% Critical H Value (KM-Log)	2.153
318	KM Standard Error of Mean (logged)	0.119	95% H-UCL (KM -Log)	0.614
319	KM SD (logged)	0.858	95% Critical H Value (KM-Log)	2.153
320	KM Standard Error of Mean (logged)	0.119		
321				
322	**DL/2 Statistics**			
323	**DL/2 Normal**		**DL/2 Log-Transformed**	
324	Mean in Original Scale	1.543	Mean in Log Scale	-1.125
325	SD in Original Scale	3.802	SD in Log Scale	1.552
326	95% t UCL (Assumes normality)	2.312	95% H-Stat UCL	1.714
327	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
328				
329	**Nonparametric Distribution Free UCL Statistics**			
330	**Detected Data appear Normal Distributed at 5% Significance Level**			
331				
332	**Suggested UCL to Use**			
333	95% KM (t) UCL	0.957		

	A–E	F	G–K	L
334				
335	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
336	Recommendations are based upon data size, data distribution, and skewness.			
337	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
338	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
339				
340	**1-Methylnaphthalene**			
341				
342	**General Statistics**			
343	Total Number of Observations	68	Number of Distinct Observations	28
344	Number of Detects	14	Number of Non-Detects	54
345	Number of Distinct Detects	14	Number of Distinct Non-Detects	15
346	Minimum Detect	1.84	Minimum Non-Detect	1.16
347	Maximum Detect	98.8	Maximum Non-Detect	65.8
348	Variance Detects	929.9	Percent Non-Detects	79.41%
349	Mean Detects	35.31	SD Detects	30.49
350	Median Detects	27.3	CV Detects	0.864
351	Skewness Detects	0.849	Kurtosis Detects	-0.312
352	Mean of Logged Detects	3.063	SD of Logged Detects	1.212
353				
354	**Normal GOF Test on Detects Only**			
355	Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk GOF Test**	
356	5% Shapiro Wilk Critical Value	0.874	Detected Data appear Normal at 5% Significance Level	
357	Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**	
358	5% Lilliefors Critical Value	0.226	Detected Data appear Normal at 5% Significance Level	
359	**Detected Data appear Normal at 5% Significance Level**			
360				
361	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
362	KM Mean	8.354	KM Standard Error of Mean	2.441
363	KM SD	19.27	95% KM (BCA) UCL	12.5
364	95% KM (t) UCL	12.43	95% KM (Percentile Bootstrap) UCL	12.43
365	95% KM (z) UCL	12.37	95% KM Bootstrap t UCL	14.3
366	90% KM Chebyshev UCL	15.68	95% KM Chebyshev UCL	18.99
367	97.5% KM Chebyshev UCL	23.6	99% KM Chebyshev UCL	32.64
368				
369	**Gamma GOF Tests on Detected Observations Only**			
370	A-D Test Statistic	0.233	**Anderson-Darling GOF Test**	
371	5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level	
372	K-S Test Statistic	0.116	**Kolmogorov-Smirnov GOF**	
373	5% K-S Critical Value	0.234	Detected data appear Gamma Distributed at 5% Significance Level	
374	**Detected data appear Gamma Distributed at 5% Significance Level**			
375				
376	**Gamma Statistics on Detected Data Only**			
377	k hat (MLE)	1.135	k star (bias corrected MLE)	0.939
378	Theta hat (MLE)	31.11	Theta star (bias corrected MLE)	37.59
379	nu hat (MLE)	31.77	nu star (bias corrected)	26.3
380	Mean (detects)	35.31		
381				
382	**Gamma ROS Statistics using Imputed Non-Detects**			
383	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
384	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)			
385	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
386	This is especially true when the sample size is small.			
387	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
388	Minimum	0.01	Mean	7.277
389	Maximum	98.8	Median	0.01
390	SD	19.68	CV	2.704
391	k hat (MLE)	0.153	k star (bias corrected MLE)	0.156
392	Theta hat (MLE)	47.58	Theta star (bias corrected MLE)	46.65
393	nu hat (MLE)	20.8	nu star (bias corrected)	21.22
394	Adjusted Level of Significance (β)	0.0465		
395	Approximate Chi Square Value (21.22, α)	11.75	Adjusted Chi Square Value (21.22, β)	11.6
396	95% Gamma Approximate UCL (use when n>=50)	13.14	95% Gamma Adjusted UCL (use when n<50)	13.31
397				

	A–E	F	G–K	L
398	Estimates of Gamma Parameters using KM Estimates			
399	Mean (KM)	8.354	SD (KM)	19.27
400	Variance (KM)	371.3	SE of Mean (KM)	2.441
401	k hat (KM)	0.188	k star (KM)	0.189
402	nu hat (KM)	25.56	nu star (KM)	25.77
403	theta hat (KM)	44.45	theta star (KM)	44.09
404	80% gamma percentile (KM)	10.69	90% gamma percentile (KM)	25.24
405	95% gamma percentile (KM)	43.64	99% gamma percentile (KM)	94.76
406				
407	Gamma Kaplan-Meier (KM) Statistics			
408	Approximate Chi Square Value (25.77, α)	15.2	Adjusted Chi Square Value (25.77, β)	15.02
409	95% Gamma Approximate KM-UCL (use when n>=50)	14.16	95% Gamma Adjusted KM-UCL (use when n<50)	14.33
410				
411	Lognormal GOF Test on Detected Observations Only			
412	Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test	
413	5% Shapiro Wilk Critical Value	0.874	Detected Data appear Lognormal at 5% Significance Level	
414	Lilliefors Test Statistic	0.131	Lilliefors GOF Test	
415	5% Lilliefors Critical Value	0.226	Detected Data appear Lognormal at 5% Significance Level	
416	Detected Data appear Lognormal at 5% Significance Level			
417				
418	Lognormal ROS Statistics Using Imputed Non-Detects			
419	Mean in Original Scale	7.887	Mean in Log Scale	-0.0724
420	SD in Original Scale	19.46	SD in Log Scale	2.037
421	95% t UCL (assumes normality of ROS data)	11.82	95% Percentile Bootstrap UCL	12
422	95% BCA Bootstrap UCL	12.65	95% Bootstrap t UCL	13.45
423	95% H-UCL (Log ROS)	15.54		
424				
425	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
426	KM Mean (logged)	0.77	KM Geo Mean	2.159
427	KM SD (logged)	1.305	95% Critical H Value (KM-Log)	2.134
428	KM Standard Error of Mean (logged)	0.167	95% H-UCL (KM -Log)	7.116
429	KM SD (logged)	1.305	95% Critical H Value (KM-Log)	2.134
430	KM Standard Error of Mean (logged)	0.167		
431				
432	DL/2 Statistics			
433	DL/2 Normal		DL/2 Log-Transformed	
434	Mean in Original Scale	9.208	Mean in Log Scale	0.436
435	SD in Original Scale	20.01	SD in Log Scale	1.685
436	95% t UCL (Assumes normality)	13.26	95% H-Stat UCL	10.86
437	DL/2 is not a recommended method, provided for comparisons and historical reasons			
438				
439	Nonparametric Distribution Free UCL Statistics			
440	Detected Data appear Normal Distributed at 5% Significance Level			
441				
442	Suggested UCL to Use			
443	95% KM (t) UCL	12.43		
444				
445	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
446	Recommendations are based upon data size, data distribution, and skewness.			
447	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
448	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
449				
450	2-Methylnaphthalene			
451				
452	General Statistics			
453	Total Number of Observations	68	Number of Distinct Observations	27
454	Number of Detects	9	Number of Non-Detects	59
455	Number of Distinct Detects	9	Number of Distinct Non-Detects	18
456	Minimum Detect	8.44	Minimum Non-Detect	1.16
457	Maximum Detect	105	Maximum Non-Detect	65.8
458	Variance Detects	1092	Percent Non-Detects	86.76%
459	Mean Detects	49.74	SD Detects	33.04
460	Median Detects	41.1	CV Detects	0.664
461	Skewness Detects	0.388	Kurtosis Detects	-1.243
462	Mean of Logged Detects	3.653	SD of Logged Detects	0.819
463				

	A	B	C	D	E	F	G	H	I	J	K	L
464	**Normal GOF Test on Detects Only**											
465	Shapiro Wilk Test Statistic					0.904	**Shapiro Wilk GOF Test**					
466	5% Shapiro Wilk Critical Value					0.829	Detected Data appear Normal at 5% Significance Level					
467	Lilliefors Test Statistic					0.214	**Lilliefors GOF Test**					
468	5% Lilliefors Critical Value					0.274	Detected Data appear Normal at 5% Significance Level					
469	**Detected Data appear Normal at 5% Significance Level**											
470												
471	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
472	KM Mean					7.678	KM Standard Error of Mean					2.582
473	KM SD					20.01	95% KM (BCA) UCL					11.84
474	95% KM (t) UCL					11.98	95% KM (Percentile Bootstrap) UCL					11.96
475	95% KM (z) UCL					11.92	95% KM Bootstrap t UCL					12.93
476	90% KM Chebyshev UCL					15.42	95% KM Chebyshev UCL					18.93
477	97.5% KM Chebyshev UCL					23.8	99% KM Chebyshev UCL					33.37
478												
479	**Gamma GOF Tests on Detected Observations Only**											
480	A-D Test Statistic					0.424	**Anderson-Darling GOF Test**					
481	5% A-D Critical Value					0.729	Detected data appear Gamma Distributed at 5% Significance Level					
482	K-S Test Statistic					0.242	**Kolmogorov-Smirnov GOF**					
483	5% K-S Critical Value					0.282	Detected data appear Gamma Distributed at 5% Significance Level					
484	**Detected data appear Gamma Distributed at 5% Significance Level**											
485												
486	**Gamma Statistics on Detected Data Only**											
487	k hat (MLE)					2.124	k star (bias corrected MLE)					1.49
488	Theta hat (MLE)					23.41	Theta star (bias corrected MLE)					33.37
489	nu hat (MLE)					38.24	nu star (bias corrected)					26.83
490	Mean (detects)					49.74						
491												
492	**Gamma ROS Statistics using Imputed Non-Detects**											
493	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
494	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)											
495	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
496	This is especially true when the sample size is small.											
497	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
498	Minimum					0.01	Mean					6.592
499	Maximum					105	Median					0.01
500	SD					20.46	CV					3.104
501	k hat (MLE)					0.143	k star (bias corrected MLE)					0.147
502	Theta hat (MLE)					45.99	Theta star (bias corrected MLE)					44.9
503	nu hat (MLE)					19.49	nu star (bias corrected)					19.97
504	Adjusted Level of Significance (β)					0.0465						
505	Approximate Chi Square Value (19.97, α)					10.83	Adjusted Chi Square Value (19.97, β)					10.68
506	95% Gamma Approximate UCL (use when n>=50)					12.16	95% Gamma Adjusted UCL (use when n<50)					12.32
507												
508	**Estimates of Gamma Parameters using KM Estimates**											
509	Mean (KM)					7.678	SD (KM)					20.01
510	Variance (KM)					400.6	SE of Mean (KM)					2.582
511	k hat (KM)					0.147	k star (KM)					0.15
512	nu hat (KM)					20.01	nu star (KM)					20.46
513	theta hat (KM)					52.17	theta star (KM)					51.02
514	80% gamma percentile (KM)					8.38	90% gamma percentile (KM)					22.78
515	95% gamma percentile (KM)					42.23	99% gamma percentile (KM)					98.65
516												
517	**Gamma Kaplan-Meier (KM) Statistics**											
518	Approximate Chi Square Value (20.46, α)					11.19	Adjusted Chi Square Value (20.46, β)					11.05
519	95% Gamma Approximate KM-UCL (use when n>=50)					14.04	95% Gamma Adjusted KM-UCL (use when n<50)					14.23
520												
521	**Lognormal GOF Test on Detected Observations Only**											
522	Shapiro Wilk Test Statistic					0.915	**Shapiro Wilk GOF Test**					
523	5% Shapiro Wilk Critical Value					0.829	Detected Data appear Lognormal at 5% Significance Level					
524	Lilliefors Test Statistic					0.229	**Lilliefors GOF Test**					
525	5% Lilliefors Critical Value					0.274	Detected Data appear Lognormal at 5% Significance Level					
526	**Detected Data appear Lognormal at 5% Significance Level**											
527												
528	**Lognormal ROS Statistics Using Imputed Non-Detects**											
529	Mean in Original Scale					8.238	Mean in Log Scale					0.588
530	SD in Original Scale					20.01	SD in Log Scale					1.615
531	95% t UCL (assumes normality of ROS data)					12.29	95% Percentile Bootstrap UCL					12.41
532	95% BCA Bootstrap UCL					13.67	95% Bootstrap t UCL					14.62
533	95% H-UCL (Log ROS)					10.84						

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.625	KM Geo Mean	1.867
KM SD (logged)	1.23	95% Critical H Value (KM-Log)	2.139
KM Standard Error of Mean (logged)	0.16	95% H-UCL (KM -Log)	5.488
KM SD (logged)	1.23	95% Critical H Value (KM-Log)	2.139
KM Standard Error of Mean (logged)	0.16		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.765	Mean in Log Scale	0.344
SD in Original Scale	20.77	SD in Log Scale	1.633
95% t UCL (Assumes normality)	12.97	95% H-Stat UCL	8.824

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	11.98		

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.

Acetophenone

General Statistics

Total Number of Observations	68	Number of Distinct Observations	29
Number of Detects	16	Number of Non-Detects	52
Number of Distinct Detects	16	Number of Distinct Non-Detects	13
Minimum Detect	77.1	Minimum Non-Detect	1.16
Maximum Detect	4520	Maximum Non-Detect	12.3
Variance Detects	1615817	Percent Non-Detects	76.47%
Mean Detects	1402	SD Detects	1271
Median Detects	1114	CV Detects	0.907
Skewness Detects	0.942	Kurtosis Detects	0.695
Mean of Logged Detects	6.623	SD of Logged Detects	1.359

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.149	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.213	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	330.7	KM Standard Error of Mean	105.5
KM SD	842.2	95% KM (BCA) UCL	519.1
95% KM (t) UCL	506.6	95% KM (Percentile Bootstrap) UCL	513.2
95% KM (z) UCL	504.2	95% KM Bootstrap t UCL	575.6
90% KM Chebyshev UCL	647.1	95% KM Chebyshev UCL	790.5
97.5% KM Chebyshev UCL	989.4	99% KM Chebyshev UCL	1380

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.472	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.766	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.153	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.222	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)	0.934	k star (bias corrected MLE)	0.801
Theta hat (MLE)	1500	Theta star (bias corrected MLE)	1751
nu hat (MLE)	29.9	nu star (bias corrected)	25.62
Mean (detects)	1402		

	A–E	F	G–K	L
602	**Gamma ROS Statistics using Imputed Non-Detects**			
603	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
604	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)			
605	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
606	This is especially true when the sample size is small.			
607	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
608	Minimum	0.01	Mean	329.8
609	Maximum	4520	Median	0.01
610	SD	848.8	CV	2.574
611	k hat (MLE)	0.104	k star (bias corrected MLE)	0.109
612	Theta hat (MLE)	3168	Theta star (bias corrected MLE)	3017
613	nu hat (MLE)	14.16	nu star (bias corrected)	14.87
614	Adjusted Level of Significance (β)	0.0465		
615	Approximate Chi Square Value (14.87, α)	7.168	Adjusted Chi Square Value (14.87, β)	7.052
616	95% Gamma Approximate UCL (use when n>=50)	684	95% Gamma Adjusted UCL (use when n<50)	695.2
617				
618	**Estimates of Gamma Parameters using KM Estimates**			
619	Mean (KM)	330.7	SD (KM)	842.2
620	Variance (KM)	709351	SE of Mean (KM)	105.5
621	k hat (KM)	0.154	k star (KM)	0.157
622	nu hat (KM)	20.97	nu star (KM)	21.37
623	theta hat (KM)	2145	theta star (KM)	2104
624	80% gamma percentile (KM)	373.5	90% gamma percentile (KM)	986.4
625	95% gamma percentile (KM)	1803	99% gamma percentile (KM)	4151
626				
627	**Gamma Kaplan-Meier (KM) Statistics**			
628	Approximate Chi Square Value (21.37, α)	11.87	Adjusted Chi Square Value (21.37, β)	11.72
629	95% Gamma Approximate KM-UCL (use when n>=50)	595.5	95% Gamma Adjusted KM-UCL (use when n<50)	603.3
630				
631	**Lognormal GOF Test on Detected Observations Only**			
632	Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**	
633	5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level	
634	Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**	
635	5% Lilliefors Critical Value	0.213	Detected Data appear Lognormal at 5% Significance Level	
636	**Detected Data appear Lognormal at 5% Significance Level**			
637				
638	**Lognormal ROS Statistics Using Imputed Non-Detects**			
639	Mean in Original Scale	342.5	Mean in Log Scale	3.031
640	SD in Original Scale	844	SD in Log Scale	2.493
641	95% t UCL (assumes normality of ROS data)	513.2	95% Percentile Bootstrap UCL	523.2
642	95% BCA Bootstrap UCL	553.4	95% Bootstrap t UCL	588.8
643	95% H-UCL (Log ROS)	1171		
644				
645	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
646	KM Mean (logged)	1.672	KM Geo Mean	5.321
647	KM SD (logged)	2.819	95% Critical H Value (KM-Log)	3.397
648	KM Standard Error of Mean (logged)	0.353	95% H-UCL (KM -Log)	912.7
649	KM SD (logged)	2.819	95% Critical H Value (KM-Log)	3.397
650	KM Standard Error of Mean (logged)	0.353		
651				
652	**DL/2 Statistics**			
653	**DL/2 Normal**		**DL/2 Log-Transformed**	
654	Mean in Original Scale	330.4	Mean in Log Scale	1.226
655	SD in Original Scale	848.6	SD in Log Scale	3.103
656	95% t UCL (Assumes normality)	502	95% H-Stat UCL	1803
657	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
658				
659	**Nonparametric Distribution Free UCL Statistics**			
660	**Detected Data appear Normal Distributed at 5% Significance Level**			
661				
662	**Suggested UCL to Use**			
663	95% KM (t) UCL	506.6		
664				
665	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
666	Recommendations are based upon data size, data distribution, and skewness.			
667	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
668	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
669				

	A–E	F	G–K	L
670	**Benzene**			
671				
672	**General Statistics**			
673	Total Number of Observations	68	Number of Distinct Observations	24
674	Number of Detects	22	Number of Non-Detects	46
675	Number of Distinct Detects	22	Number of Distinct Non-Detects	2
676	Minimum Detect	0.275	Minimum Non-Detect	0.25
677	Maximum Detect	16000	Maximum Non-Detect	0.5
678	Variance Detects	14957982	Percent Non-Detects	67.65%
679	Mean Detects	2605	SD Detects	3868
680	Median Detects	1205	CV Detects	1.485
681	Skewness Detects	2.372	Kurtosis Detects	6.301
682	Mean of Logged Detects	6.277	SD of Logged Detects	2.706
683				
684	**Normal GOF Test on Detects Only**			
685	Shapiro Wilk Test Statistic	0.692	**Shapiro Wilk GOF Test**	
686	5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level	
687	Lilliefors Test Statistic	0.293	**Lilliefors GOF Test**	
688	5% Lilliefors Critical Value	0.184	Detected Data Not Normal at 5% Significance Level	
689	**Detected Data Not Normal at 5% Significance Level**			
690				
691	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
692	KM Mean	842.9	KM Standard Error of Mean	306.7
693	KM SD	2471	95% KM (BCA) UCL	1388
694	95% KM (t) UCL	1354	95% KM (Percentile Bootstrap) UCL	1400
695	95% KM (z) UCL	1347	95% KM Bootstrap t UCL	1695
696	90% KM Chebyshev UCL	1763	95% KM Chebyshev UCL	2180
697	97.5% KM Chebyshev UCL	2758	99% KM Chebyshev UCL	3894
698				
699	**Gamma GOF Tests on Detected Observations Only**			
700	A-D Test Statistic	0.148	**Anderson-Darling GOF Test**	
701	5% A-D Critical Value	0.823	Detected data appear Gamma Distributed at 5% Significance Level	
702	K-S Test Statistic	0.0889	**Kolmogorov-Smirnov GOF**	
703	5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level	
704	**Detected data appear Gamma Distributed at 5% Significance Level**			
705				
706	**Gamma Statistics on Detected Data Only**			
707	k hat (MLE)	0.412	k star (bias corrected MLE)	0.386
708	Theta hat (MLE)	6317	Theta star (bias corrected MLE)	6741
709	nu hat (MLE)	18.14	nu star (bias corrected)	17
710	Mean (detects)	2605		
711				
712	**Gamma ROS Statistics using Imputed Non-Detects**			
713	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
714	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)			
715	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
716	This is especially true when the sample size is small.			
717	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
718	Minimum	0.01	Mean	842.8
719	Maximum	16000	Median	0.01
720	SD	2489	CV	2.953
721	k hat (MLE)	0.103	k star (bias corrected MLE)	0.109
722	Theta hat (MLE)	8151	Theta star (bias corrected MLE)	7757
723	nu hat (MLE)	14.06	nu star (bias corrected)	14.78
724	Adjusted Level of Significance (β)	0.0465		
725	Approximate Chi Square Value (14.78, α)	7.105	Adjusted Chi Square Value (14.78, β)	6.99
726	95% Gamma Approximate UCL (use when n>=50)	1752	95% Gamma Adjusted UCL (use when n<50)	1781
727				
728	**Estimates of Gamma Parameters using KM Estimates**			
729	Mean (KM)	842.9	SD (KM)	2471
730	Variance (KM)	6104133	SE of Mean (KM)	306.7
731	k hat (KM)	0.116	k star (KM)	0.121
732	nu hat (KM)	15.83	nu star (KM)	16.47
733	theta hat (KM)	7242	theta star (KM)	6962
734	80% gamma percentile (KM)	746.7	90% gamma percentile (KM)	2394
735	95% gamma percentile (KM)	4805	99% gamma percentile (KM)	12146
736				
737	**Gamma Kaplan-Meier (KM) Statistics**			
738	Approximate Chi Square Value (16.47, α)	8.291	Adjusted Chi Square Value (16.47, β)	8.166
739	95% Gamma Approximate KM-UCL (use when n>=50)	1674	95% Gamma Adjusted KM-UCL (use when n<50)	1700
740				
741	**Lognormal GOF Test on Detected Observations Only**			
742	Shapiro Wilk Test Statistic	0.88	**Shapiro Wilk GOF Test**	
743	5% Shapiro Wilk Critical Value	0.911	Detected Data Not Lognormal at 5% Significance Level	
744	Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**	
745	5% Lilliefors Critical Value	0.184	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	844.7	Mean in Log Scale	1.096
SD in Original Scale	2488	SD in Log Scale	4.66
95% t UCL (assumes normality of ROS data)	1348	95% Percentile Bootstrap UCL	1396
95% BCA Bootstrap UCL	1539	95% Bootstrap t UCL	1751
95% H-UCL (Log ROS)	4960943		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.093	KM Geo Mean	2.983
KM SD (logged)	3.888	95% Critical H Value (KM-Log)	4.957
KM Standard Error of Mean (logged)	0.483	95% H-UCL (KM -Log)	60140
KM SD (logged)	3.888	95% Critical H Value (KM-Log)	4.957
KM Standard Error of Mean (logged)	0.483		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	842.8	Mean in Log Scale	0.634
SD in Original Scale	2489	SD in Log Scale	4.214
95% t UCL (Assumes normality)	1346	95% H-Stat UCL	221526

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	1674		

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	68	Number of Distinct Observations	22
Number of Detects	20	Number of Non-Detects	48
Number of Distinct Detects	20	Number of Distinct Non-Detects	2
Minimum Detect	0.582	Minimum Non-Detect	0.25
Maximum Detect	1550	Maximum Non-Detect	0.5
Variance Detects	251096	Percent Non-Detects	70.59%
Mean Detects	437.6	SD Detects	501.1
Median Detects	209.5	CV Detects	1.145
Skewness Detects	1.091	Kurtosis Detects	-0.139
Mean of Logged Detects	4.977	SD of Logged Detects	2.028

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.813	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	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	128.9	KM Standard Error of Mean	41.24
KM SD	331.5	95% KM (BCA) UCL	195.5
95% KM (t) UCL	197.7	95% KM (Percentile Bootstrap) UCL	203.3
95% KM (z) UCL	196.7	95% KM Bootstrap t UCL	223.9
90% KM Chebyshev UCL	252.6	95% KM Chebyshev UCL	308.6
97.5% KM Chebyshev UCL	386.4	99% KM Chebyshev UCL	539.2

809	**Gamma GOF Tests on Detected Observations Only**			
810	A-D Test Statistic	0.257	**Anderson-Darling GOF Test**	
811	5% A-D Critical Value	0.797	Detected data appear Gamma Distributed at 5% Significance Level	
812	K-S Test Statistic	0.125	**Kolmogorov-Smirnov GOF**	
813	5% K-S Critical Value	0.204	Detected data appear Gamma Distributed at 5% Significance Level	
814	**Detected data appear Gamma Distributed at 5% Significance Level**			
815				
816	**Gamma Statistics on Detected Data Only**			
817	k hat (MLE)	0.565	k star (bias corrected MLE)	0.513
818	Theta hat (MLE)	774.8	Theta star (bias corrected MLE)	852.4
819	nu hat (MLE)	22.59	nu star (bias corrected)	20.54
820	Mean (detects)	437.6		
821				
822	**Gamma ROS Statistics using Imputed Non-Detects**			
823	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
824	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)			
825	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
826	This is especially true when the sample size is small.			
827	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
828	Minimum	0.01	Mean	128.7
829	Maximum	1550	Median	0.01
830	SD	334	CV	2.595
831	k hat (MLE)	0.119	k star (bias corrected MLE)	0.124
832	Theta hat (MLE)	1078	Theta star (bias corrected MLE)	1038
833	nu hat (MLE)	16.24	nu star (bias corrected)	16.86
834	Adjusted Level of Significance (β)	0.0465		
835	Approximate Chi Square Value (16.86, α)	8.572	Adjusted Chi Square Value (16.86, β)	8.443
836	95% Gamma Approximate UCL (use when n>=50)	253.2	95% Gamma Adjusted UCL (use when n<50)	257
837				
838	**Estimates of Gamma Parameters using KM Estimates**			
839	Mean (KM)	128.9	SD (KM)	331.5
840	Variance (KM)	109871	SE of Mean (KM)	41.24
841	k hat (KM)	0.151	k star (KM)	0.154
842	nu hat (KM)	20.56	nu star (KM)	20.99
843	theta hat (KM)	852.5	theta star (KM)	835.2
844	80% gamma percentile (KM)	143.5	90% gamma percentile (KM)	383.6
845	95% gamma percentile (KM)	705.4	99% gamma percentile (KM)	1634
846				
847	**Gamma Kaplan-Meier (KM) Statistics**			
848	Approximate Chi Square Value (20.99, α)	11.58	Adjusted Chi Square Value (20.99, β)	11.43
849	95% Gamma Approximate KM-UCL (use when n>=50)	233.5	95% Gamma Adjusted KM-UCL (use when n<50)	236.6
850				
851	**Lognormal GOF Test on Detected Observations Only**			
852	Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk GOF Test**	
853	5% Shapiro Wilk Critical Value	0.905	Detected Data appear Lognormal at 5% Significance Level	
854	Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**	
855	5% Lilliefors Critical Value	0.192	Detected Data appear Lognormal at 5% Significance Level	
856	**Detected Data appear Lognormal at 5% Significance Level**			
857				
858	**Lognormal ROS Statistics Using Imputed Non-Detects**			
859	Mean in Original Scale	130	Mean in Log Scale	0.589
860	SD in Original Scale	333.5	SD in Log Scale	3.715
861	95% t UCL (assumes normality of ROS data)	197.4	95% Percentile Bootstrap UCL	199.6
862	95% BCA Bootstrap UCL	217.9	95% Bootstrap t UCL	226.8
863	95% H-UCL (Log ROS)	15185		
864				
865	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
866	KM Mean (logged)	0.485	KM Geo Mean	1.625
867	KM SD (logged)	3.091	95% Critical H Value (KM-Log)	3.83
868	KM Standard Error of Mean (logged)	0.385	95% H-UCL (KM -Log)	820.7
869	KM SD (logged)	3.091	95% Critical H Value (KM-Log)	3.83
870	KM Standard Error of Mean (logged)	0.385		
871				
872	**DL/2 Statistics**			
873	**DL/2 Normal**		**DL/2 Log-Transformed**	
874	Mean in Original Scale	128.8	Mean in Log Scale	0.0165
875	SD in Original Scale	334	SD in Log Scale	3.404
876	95% t UCL (Assumes normality)	196.3	95% H-Stat UCL	1967
877	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
878				
879	**Nonparametric Distribution Free UCL Statistics**			
880	**Detected Data appear Gamma Distributed at 5% Significance Level**			
881				
882	**Suggested UCL to Use**			
883	95% KM Approximate Gamma UCL	233.5		
884				

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	68	Number of Distinct Observations	9
Number of Detects	5	Number of Non-Detects	63
Number of Distinct Detects	5	Number of Distinct Non-Detects	4
Minimum Detect	1.57	Minimum Non-Detect	1.5
Maximum Detect	3.44	Maximum Non-Detect	7.5
Variance Detects	0.601	Percent Non-Detects	92.65%
Mean Detects	2.524	SD Detects	0.775
Median Detects	2.38	CV Detects	0.307
Skewness Detects	0.06	Kurtosis Detects	-1.925
Mean of Logged Detects	0.886	SD of Logged Detects	0.32
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.198	**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	1.579	KM Standard Error of Mean	0.0459
KM SD	0.332	95% KM (BCA) UCL	1.652
95% KM (t) UCL	1.655	95% KM (Percentile Bootstrap) UCL	1.656
95% KM (z) UCL	1.654	95% KM Bootstrap t UCL	1.636
90% KM Chebyshev UCL	1.716	95% KM Chebyshev UCL	1.779
97.5% KM Chebyshev UCL	1.865	99% KM Chebyshev UCL	2.036
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.248	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.226	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.357	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)	12.72	k star (bias corrected MLE)	5.221
Theta hat (MLE)	0.198	Theta star (bias corrected MLE)	0.483
nu hat (MLE)	127.2	nu star (bias corrected)	52.21
Mean (detects)	2.524		
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	0.307
Maximum	3.44	Median	0.01
SD	0.721	CV	2.353
k hat (MLE)	0.297	k star (bias corrected MLE)	0.294
Theta hat (MLE)	1.033	Theta star (bias corrected MLE)	1.044
nu hat (MLE)	40.39	nu star (bias corrected)	39.94
Adjusted Level of Significance (β)	0.0465		
Approximate Chi Square Value (39.94, α)	26.46	Adjusted Chi Square Value (39.94, β)	26.23
95% Gamma Approximate UCL (use when n>=50)	0.463	95% Gamma Adjusted UCL (use when n<50)	0.467

	A–E	F	G–K	L
948	**Estimates of Gamma Parameters using KM Estimates**			
949	Mean (KM)	1.579	SD (KM)	0.332
950	Variance (KM)	0.11	SE of Mean (KM)	0.0459
951	k hat (KM)	22.56	k star (KM)	21.58
952	nu hat (KM)	3069	nu star (KM)	2935
953	theta hat (KM)	0.07	theta star (KM)	0.0732
954	80% gamma percentile (KM)	1.855	90% gamma percentile (KM)	2.027
955	95% gamma percentile (KM)	2.176	99% gamma percentile (KM)	2.475
956				
957	**Gamma Kaplan-Meier (KM) Statistics**			
958	Approximate Chi Square Value (N/A, α)	2810	Adjusted Chi Square Value (N/A, β)	2807
959	95% Gamma Approximate KM-UCL (use when n>=50)	1.649	95% Gamma Adjusted KM-UCL (use when n<50)	1.65
960				
961	**Lognormal GOF Test on Detected Observations Only**			
962	Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**	
963	5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
964	Lilliefors Test Statistic	0.198	**Lilliefors GOF Test**	
965	5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level	
966	**Detected Data appear Lognormal at 5% Significance Level**			
967				
968	**Lognormal ROS Statistics Using Imputed Non-Detects**			
969	Mean in Original Scale	0.66	Mean in Log Scale	-0.775
970	SD in Original Scale	0.652	SD in Log Scale	0.847
971	95% t UCL (assumes normality of ROS data)	0.792	95% Percentile Bootstrap UCL	0.798
972	95% BCA Bootstrap UCL	0.813	95% Bootstrap t UCL	0.825
973	95% H-UCL (Log ROS)	0.824		
974				
975	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
976	KM Mean (logged)	0.442	KM Geo Mean	1.557
977	KM SD (logged)	0.15	95% Critical H Value (KM-Log)	1.697
978	KM Standard Error of Mean (logged)	0.0208	95% H-UCL (KM -Log)	1.624
979	KM SD (logged)	0.15	95% Critical H Value (KM-Log)	1.697
980	KM Standard Error of Mean (logged)	0.0208		
981				
982	**DL/2 Statistics**			
983	**DL/2 Normal**		**DL/2 Log-Transformed**	
984	Mean in Original Scale	1.005	Mean in Log Scale	-0.119
985	SD in Original Scale	0.707	SD in Log Scale	0.424
986	95% t UCL (Assumes normality)	1.148	95% H-Stat UCL	1.068
987	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
988				
989	**Nonparametric Distribution Free UCL Statistics**			
990	**Detected Data appear Normal Distributed at 5% Significance Level**			
991				
992	**Suggested UCL to Use**			
993	95% KM (t) UCL	1.655		
994				
995	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
996	Recommendations are based upon data size, data distribution, and skewness.			
997	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
998	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
999				
1000	**Naphthalene**			
1001				
1002	**General Statistics**			
1003	Total Number of Observations	68	Number of Distinct Observations	22
1004	Number of Detects	20	Number of Non-Detects	48
1005	Number of Distinct Detects	20	Number of Distinct Non-Detects	2
1006	Minimum Detect	0.635	Minimum Non-Detect	0.25
1007	Maximum Detect	227	Maximum Non-Detect	0.5
1008	Variance Detects	4639	Percent Non-Detects	70.59%
1009	Mean Detects	60.22	SD Detects	68.11
1010	Median Detects	42.65	CV Detects	1.131
1011	Skewness Detects	1.457	Kurtosis Detects	1.02
1012	Mean of Logged Detects	3.288	SD of Logged Detects	1.579
1013				
1014	**Normal GOF Test on Detects Only**			
1015	Shapiro Wilk Test Statistic	0.777	**Shapiro Wilk GOF Test**	
1016	5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level	
1017	Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
1018	5% Lilliefors Critical Value	0.192	Detected Data Not Normal at 5% Significance Level	
1019	**Detected Data Not Normal at 5% Significance Level**			

	A–E	F	G–K	L
1020				
1021	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
1022	KM Mean	17.89	KM Standard Error of Mean	5.623
1023	KM SD	45.2	95% KM (BCA) UCL	29.47
1024	95% KM (t) UCL	27.27	95% KM (Percentile Bootstrap) UCL	27.65
1025	95% KM (z) UCL	27.14	95% KM Bootstrap t UCL	30.89
1026	90% KM Chebyshev UCL	34.76	95% KM Chebyshev UCL	42.4
1027	97.5% KM Chebyshev UCL	53	99% KM Chebyshev UCL	73.84
1028				
1029	**Gamma GOF Tests on Detected Observations Only**			
1030	A-D Test Statistic	0.328	**Anderson-Darling GOF Test**	
1031	5% A-D Critical Value	0.78	Detected data appear Gamma Distributed at 5% Significance Level	
1032	K-S Test Statistic	0.147	**Kolmogorov-Smirnov GOF**	
1033	5% K-S Critical Value	0.201	Detected data appear Gamma Distributed at 5% Significance Level	
1034	**Detected data appear Gamma Distributed at 5% Significance Level**			
1035				
1036	**Gamma Statistics on Detected Data Only**			
1037	k hat (MLE)	0.741	k star (bias corrected MLE)	0.663
1038	Theta hat (MLE)	81.3	Theta star (bias corrected MLE)	90.83
1039	nu hat (MLE)	29.63	nu star (bias corrected)	26.52
1040	Mean (detects)	60.22		
1041				
1042	**Gamma ROS Statistics using Imputed Non-Detects**			
1043	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
1044	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)			
1045	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
1046	This is especially true when the sample size is small.			
1047	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
1048	Minimum	0.01	Mean	17.72
1049	Maximum	227	Median	0.01
1050	SD	45.6	CV	2.574
1051	k hat (MLE)	0.149	k star (bias corrected MLE)	0.152
1052	Theta hat (MLE)	118.8	Theta star (bias corrected MLE)	116.3
1053	nu hat (MLE)	20.28	nu star (bias corrected)	20.72
1054	Adjusted Level of Significance (β)	0.0465		
1055	Approximate Chi Square Value (20.72, α)	11.38	Adjusted Chi Square Value (20.72, β)	11.23
1056	95% Gamma Approximate UCL (use when n>=50)	32.25	95% Gamma Adjusted UCL (use when n<50)	32.68
1057				
1058	**Estimates of Gamma Parameters using KM Estimates**			
1059	Mean (KM)	17.89	SD (KM)	45.2
1060	Variance (KM)	2043	SE of Mean (KM)	5.623
1061	k hat (KM)	0.157	k star (KM)	0.16
1062	nu hat (KM)	21.3	nu star (KM)	21.69
1063	theta hat (KM)	114.2	theta star (KM)	112.1
1064	80% gamma percentile (KM)	20.43	90% gamma percentile (KM)	53.44
1065	95% gamma percentile (KM)	97.23	99% gamma percentile (KM)	222.7
1066				
1067	**Gamma Kaplan-Meier (KM) Statistics**			
1068	Approximate Chi Square Value (21.69, α)	12.11	Adjusted Chi Square Value (21.69, β)	11.95
1069	95% Gamma Approximate KM-UCL (use when n>=50)	32.04	95% Gamma Adjusted KM-UCL (use when n<50)	32.46
1070				
1071	**Lognormal GOF Test on Detected Observations Only**			
1072	Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**	
1073	5% Shapiro Wilk Critical Value	0.905	Detected Data appear Lognormal at 5% Significance Level	
1074	Lilliefors Test Statistic	0.169	**Lilliefors GOF Test**	
1075	5% Lilliefors Critical Value	0.192	Detected Data appear Lognormal at 5% Significance Level	
1076	**Detected Data appear Lognormal at 5% Significance Level**			
1077				
1078	**Lognormal ROS Statistics Using Imputed Non-Detects**			
1079	Mean in Original Scale	18.18	Mean in Log Scale	-0.239
1080	SD in Original Scale	45.42	SD in Log Scale	2.978
1081	95% t UCL (assumes normality of ROS data)	27.37	95% Percentile Bootstrap UCL	27.24
1082	95% BCA Bootstrap UCL	30.75	95% Bootstrap t UCL	31.98
1083	95% H-UCL (Log ROS)	252		
1084				
1085	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
1086	KM Mean (logged)	-0.0114	KM Geo Mean	0.989
1087	KM SD (logged)	2.288	95% Critical H Value (KM-Log)	3.084
1088	KM Standard Error of Mean (logged)	0.285	95% H-UCL (KM -Log)	32.05
1089	KM SD (logged)	2.288	95% Critical H Value (KM-Log)	3.084
1090	KM Standard Error of Mean (logged)	0.285		
1091				

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	17.8	Mean in Log Scale	-0.48
SD in Original Scale	45.57	SD in Log Scale	2.594
95% t UCL (Assumes normality)	27.02	95% H-Stat UCL	47.99

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	32.04		

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.

Toluene

General Statistics

Total Number of Observations	68	Number of Distinct Observations	21
Number of Detects	19	Number of Non-Detects	49
Number of Distinct Detects	19	Number of Distinct Non-Detects	2
Minimum Detect	1.38	Minimum Non-Detect	0.25
Maximum Detect	21400	Maximum Non-Detect	0.5
Variance Detects	42921735	Percent Non-Detects	72.06%
Mean Detects	4201	SD Detects	6551
Median Detects	955	CV Detects	1.559
Skewness Detects	1.7	Kurtosis Detects	1.622
Mean of Logged Detects	6.446	SD of Logged Detects	2.932

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.663	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.347	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	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	1174	KM Standard Error of Mean	481.2
KM SD	3862	95% KM (BCA) UCL	2007
95% KM (t) UCL	1977	95% KM (Percentile Bootstrap) UCL	2003
95% KM (z) UCL	1966	95% KM Bootstrap t UCL	2638
90% KM Chebyshev UCL	2618	95% KM Chebyshev UCL	3271
97.5% KM Chebyshev UCL	4179	99% KM Chebyshev UCL	5962

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.467	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.832	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.127	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.214	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)	0.354	k star (bias corrected MLE)	0.333
Theta hat (MLE)	11873	Theta star (bias corrected MLE)	12614
nu hat (MLE)	13.45	nu star (bias corrected)	12.66
Mean (detects)	4201		

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	1174
Maximum	21400	Median	0.01
SD	3891	CV	3.314
k hat (MLE)	0.0952	k star (bias corrected MLE)	0.101
Theta hat (MLE)	12334	Theta star (bias corrected MLE)	11648
nu hat (MLE)	12.94	nu star (bias corrected)	13.71
Adjusted Level of Significance (β)	0.0465		
Approximate Chi Square Value (13.71, α)	6.371	Adjusted Chi Square Value (13.71, β)	6.262
95% Gamma Approximate UCL (use when n>=50)	2526	95% Gamma Adjusted UCL (use when n<50)	2569

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	1174	SD (KM)	3862
Variance (KM)	14914934	SE of Mean (KM)	481.2
k hat (KM)	0.0924	k star (KM)	0.0981
nu hat (KM)	12.57	nu star (KM)	13.35
theta hat (KM)	12704	theta star (KM)	11963
80% gamma percentile (KM)	792.6	90% gamma percentile (KM)	3100
95% gamma percentile (KM)	6822	99% gamma percentile (KM)	18825
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (13.35, α)	6.127	Adjusted Chi Square Value (13.35, β)	6.021
95% Gamma Approximate KM-UCL (use when n>=50)	2558	95% Gamma Adjusted KM-UCL (use when n<50)	2603
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.201	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.197	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	1175	Mean in Log Scale	-0.0387
SD in Original Scale	3890	SD in Log Scale	5.337
95% t UCL (assumes normality of ROS data)	1962	95% Percentile Bootstrap UCL	2026
95% BCA Bootstrap UCL	2273	95% Bootstrap t UCL	2640
95% H-UCL (Log ROS)	1.279E+8		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.802	KM Geo Mean	2.23
KM SD (logged)	3.825	95% Critical H Value (KM-Log)	4.866
KM Standard Error of Mean (logged)	0.477	95% H-UCL (KM -Log)	32525
KM SD (logged)	3.825	95% Critical H Value (KM-Log)	4.866
KM Standard Error of Mean (logged)	0.477		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1174	Mean in Log Scale	0.343
SD in Original Scale	3891	SD in Log Scale	4.122
95% t UCL (Assumes normality)	1961	95% H-Stat UCL	99429
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	2558		

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.

Xylenes (total)

General Statistics			
Total Number of Observations	68	Number of Distinct Observations	22
Number of Detects	20	Number of Non-Detects	48
Number of Distinct Detects	20	Number of Distinct Non-Detects	2
Minimum Detect	1.92	Minimum Non-Detect	0.75
Maximum Detect	5120	Maximum Non-Detect	1.5
Variance Detects	2332293	Percent Non-Detects	70.59%
Mean Detects	1130	SD Detects	1527
Median Detects	564.5	CV Detects	1.351
Skewness Detects	1.617	Kurtosis Detects	1.622
Mean of Logged Detects	5.427	SD of Logged Detects	2.601
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.744	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.905	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.282	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.192	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
1241	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1242	KM Mean					333	KM Standard Error of Mean					119.1
1243	KM SD					957.4	95% KM (BCA) UCL					562.3
1244	95% KM (t) UCL					531.7	95% KM (Percentile Bootstrap) UCL					539.6
1245	95% KM (z) UCL					528.9	95% KM Bootstrap t UCL					652.1
1246	90% KM Chebyshev UCL					690.4	95% KM Chebyshev UCL					852.2
1247	97.5% KM Chebyshev UCL					1077	99% KM Chebyshev UCL					1518
1248												
1249	**Gamma GOF Tests on Detected Observations Only**											
1250	A-D Test Statistic					0.363	**Anderson-Darling GOF Test**					
1251	5% A-D Critical Value					0.822	Detected data appear Gamma Distributed at 5% Significance Level					
1252	K-S Test Statistic					0.113	**Kolmogorov-Smirnov GOF**					
1253	5% K-S Critical Value					0.207	Detected data appear Gamma Distributed at 5% Significance Level					
1254	**Detected data appear Gamma Distributed at 5% Significance Level**											
1255												
1256	**Gamma Statistics on Detected Data Only**											
1257	k hat (MLE)					0.409	k star (bias corrected MLE)					0.381
1258	Theta hat (MLE)					2763	Theta star (bias corrected MLE)					2967
1259	nu hat (MLE)					16.36	nu star (bias corrected)					15.24
1260	Mean (detects)					1130						
1261												
1262	**Gamma ROS Statistics using Imputed Non-Detects**											
1263	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1264	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)											
1265	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1266	This is especially true when the sample size is small.											
1267	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1268	Minimum					0.01	Mean					332.5
1269	Maximum					5120	Median					0.01
1270	SD					964.7	CV					2.901
1271	k hat (MLE)					0.108	k star (bias corrected MLE)					0.113
1272	Theta hat (MLE)					3084	Theta star (bias corrected MLE)					2946
1273	nu hat (MLE)					14.66	nu star (bias corrected)					15.35
1274	Adjusted Level of Significance (β)					0.0465						
1275	Approximate Chi Square Value (15.35, α)					7.504	Adjusted Chi Square Value (15.35, β)					7.385
1276	95% Gamma Approximate UCL (use when n>=50)					680	95% Gamma Adjusted UCL (use when n<50)					691
1277												
1278	**Estimates of Gamma Parameters using KM Estimates**											
1279	Mean (KM)					333	SD (KM)					957.4
1280	Variance (KM)					916619	SE of Mean (KM)					119.1
1281	k hat (KM)					0.121	k star (KM)					0.125
1282	nu hat (KM)					16.45	nu star (KM)					17.06
1283	theta hat (KM)					2753	theta star (KM)					2655
1284	80% gamma percentile (KM)					306.6	90% gamma percentile (KM)					954.5
1285	95% gamma percentile (KM)					1889	99% gamma percentile (KM)					4711
1286												
1287	**Gamma Kaplan-Meier (KM) Statistics**											
1288	Approximate Chi Square Value (17.06, α)					8.716	Adjusted Chi Square Value (17.06, β)					8.586
1289	95% Gamma Approximate KM-UCL (use when n>=50)					651.9	95% Gamma Adjusted KM-UCL (use when n<50)					661.7
1290												
1291	**Lognormal GOF Test on Detected Observations Only**											
1292	Shapiro Wilk Test Statistic					0.869	**Shapiro Wilk GOF Test**					
1293	5% Shapiro Wilk Critical Value					0.905	Detected Data Not Lognormal at 5% Significance Level					
1294	Lilliefors Test Statistic					0.196	**Lilliefors GOF Test**					
1295	5% Lilliefors Critical Value					0.192	Detected Data Not Lognormal at 5% Significance Level					
1296	**Detected Data Not Lognormal at 5% Significance Level**											
1297												
1298	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1299	Mean in Original Scale					333.2	Mean in Log Scale					-0.22
1300	SD in Original Scale					964.4	SD in Log Scale					4.779
1301	95% t UCL (assumes normality of ROS data)					528.3	95% Percentile Bootstrap UCL					536.4
1302	95% BCA Bootstrap UCL					597.4	95% Bootstrap t UCL					667.6
1303	95% H-UCL (Log ROS)					2831200						
1304												
1305	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1306	KM Mean (logged)					1.393	KM Geo Mean					4.028
1307	KM SD (logged)					2.945	95% Critical H Value (KM-Log)					3.602
1308	KM Standard Error of Mean (logged)					0.366	95% H-UCL (KM -Log)					1124
1309	KM SD (logged)					2.945	95% Critical H Value (KM-Log)					3.602
1310	KM Standard Error of Mean (logged)					0.366						
1311												

	A	B	C	D	E	F	G	H	I	J	K	L
1312	**DL/2 Statistics**											
1313	**DL/2 Normal**						**DL/2 Log-Transformed**					
1314	Mean in Original Scale					332.8	Mean in Log Scale					0.924
1315	SD in Original Scale					964.6	SD in Log Scale					3.242
1316	95% t UCL (Assumes normality)					527.9	95% H-Stat UCL					2386
1317	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1318												
1319	**Nonparametric Distribution Free UCL Statistics**											
1320	**Detected Data appear Gamma Distributed at 5% Significance Level**											
1321												
1322	**Suggested UCL to Use**											
1323	95% KM Approximate Gamma UCL					651.9						
1324												
1325	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1326	Recommendations are based upon data size, data distribution, and skewness.											
1327	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1328	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1329												

Attachment 2 (Continued)

Groundwater Samples from Q3 and Q4 2015, Off-Base (Input)

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
2	117	1		11.5	1	
3	111	1		8.16	1	
4	13.5	1		7.42	1	
5	9.14	1		6.96	1	
6	4.97	1		0.865	1	
7	1.25	0		0.825	1	
8	1.0065	1		0.8005	1	
9	0.5	0		0.696	1	
10	0.5	0		0.665	1	
11	0.5	0		0.558	1	
12	0.5	0		0.523	1	
13	0.5	0		0.4655	1	
14	0.5	0		0.397	1	
15	0.5	0		0.38	1	
16	0.5	0		0.366	1	
17	0.5	0		0.316	1	
18	0.5	0		0.297	1	
19	0.5	0		0.242	1	
20	0.5	0		0.228	1	
21	0.5	0		0.227	1	
22	0.5	0		0.183	1	
23	0.5	0		0.1585	1	
24	0.5	0		0.158	1	
25	0.5	0		0.143	1	
26	0.5	0		0.138	1	
27	0.5	0		0.137	1	
28	0.5	0		0.131	1	
29	0.5	0		0.119	1	
30	0.5	0		0.109	1	
31	0.5	0		0.107	1	
32	0.5	0		0.106	1	
33	0.5	0		0.1	1	
34	0.5	0		0.0962	1	
35	0.25	0		0.0897	1	
36	0.25	0		0.0877	1	
37	0.25	0		0.0857	1	
38	0.25	0		0.0818	1	
39	0.25	0		0.0787	1	
40	0.25	0		0.07795	1	
41	0.25	0		0.0766	1	
42	0.25	0		0.073	1	
43	0.25	0		0.072	1	
44	0.25	0		0.062	1	
45	0.25	0		0.0576	1	
46	0.25	0		0.0544	1	
47	0.25	0		0.0511	1	
48	0.25	0		0.0503	1	
49	0.25	0		0.0484	1	
50	0.25	0		0.0474	1	
51	0.25	0		0.0442	1	
52	0.25	0		0.0365	1	

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
53	0.25	0		0.03435	1	
54	0.25	0		0.0335	1	
55	0.25	0		0.0332	1	
56	0.25	0		0.0329	1	
57	0.25	0		0.0322	1	
58	0.25	0		0.0296	1	
59	0.25	0		0.0286	1	
60	0.25	0		0.0268	1	
61	0.25	0		0.025	1	
62	0.25	0		0.0217	1	
63	0.25	0		0.0214	1	
64	0.25	0		0.0211	1	
65	0.25	0		0.0208	1	
66	0.25	0		0.0192	1	
67	0.25	0		0.0178	1	
68	0.25	0		0.0149	1	
69	0.25	0		0.0148	1	
70	0.25	0		0.011	1	
71	0.25	0		0.00985	0	
72	0.25	0		0.00968	0	
73	0.25	0		0.00968	0	
74	0.25	0		0.00966	0	
75	0.25	0		0.00963	0	
76	0.25	0		0.00962	0	
77	0.25	0		0.0096	0	
78	0.25	0		0.00958	0	
79	0.25	0		0.00958	0	
80	0.25	0		0.00958	0	
81	0.25	0		0.00958	0	
82	0.25	0		0.00957	0	
83	0.25	0		0.00956	0	
84	0.25	0		0.00956	0	
85	0.25	0		0.00956	0	
86	0.25	0		0.00954	0	
87	0.25	0		0.00954	0	
88	0.25	0		0.00954	0	
89	0.25	0		0.00953	0	
90	0.25	0		0.00953	0	
91	0.25	0		0.00953	0	
92	0.25	0		0.00952	0	
93	0.25	0		0.00952	0	
94	0.25	0		0.00952	0	
95	0.25	0		0.00951	0	
96	0.25	0		0.00951	0	
97	0.25	0		0.00951	0	
98	0.25	0		0.00951	0	
99	0.25	0		0.0095	0	
100	0.25	0		0.00949	0	
101	0.25	0		0.00949	0	
102	0.25	0		0.00949	0	
103	0.25	0		0.00949	0	
104	0.25	0		0.00949	0	

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
105	0.25	0		0.00948	0	
106	0.25	0		0.00948	0	
107	0.25	0		0.00948	0	
108	0.25	0		0.00947	0	
109	0.25	0		0.00947	0	
110	0.25	0		0.00947	0	
111	0.25	0		0.00947	0	
112	0.25	0		0.00946	0	
113	0.25	0		0.00946	0	
114	0.25	0		0.00946	0	
115	0.25	0		0.00945	0	
116	0.25	0		0.00945	0	
117	0.25	0		0.009445	0	
118	0.25	0		0.00944	0	
119	0.25	0		0.00944	0	
120	0.25	0		0.00944	0	
121	0.25	0		0.00943	0	
122	0.25	0		0.00943	0	
123	0.25	0		0.00943	0	
124	0.25	0		0.00943	0	
125	0.25	0		0.00943	0	
126	0.25	0		0.00943	0	
127	0.25	0		0.00942	0	
128	0.25	0		0.00942	0	
129	0.25	0		0.00942	0	
130	0.25	0		0.009415	0	
131	0.25	0		0.00941	0	
132	0.25	0		0.00941	0	
133	0.25	0		0.00941	0	
134	0.25	0		0.00941	0	
135	0.25	0		0.00941	0	
136	0.25	0		0.00941	0	
137	0.25	0		0.0094	0	
138	0.25	0		0.0094	0	
139	0.25	0		0.0094	0	
140	0.25	0		0.00939	0	
141	0.25	0		0.00939	0	
142	0.25	0		0.00939	0	
143	0.25	0		0.00939	0	
144	0.25	0		0.00938	0	
145	0.25	0		0.00938	0	
146	0.25	0		0.00938	0	
147	0.25	0		0.009375	0	
148	0.25	0		0.00937	0	
149	0.25	0		0.00937	0	
150	0.25	0		0.00937	0	
151	0.25	0		0.00937	0	
152	0.25	0		0.00937	0	
153	0.25	0		0.00936	0	
154	0.25	0		0.00936	0	
155	0.25	0		0.00936	0	
156	0.25	0		0.00936	0	

	A	B	C	D	E	F
1	1,2,4-Trimethylbenzene	d_1,2,4-Trimethylbenzene		1,2-Dibromoethane	d_1,2-Dibromoethane	
157	0.25	0		0.00936	0	
158	0.25	0		0.00936	0	
159	0.25	0		0.00935	0	
160	0.25	0		0.00934	0	
161	0.25	0		0.00934	0	
162	0.25	0		0.00934	0	
163	0.25	0		0.00934	0	
164	0.25	0		0.00933	0	
165	0.25	0		0.00933	0	
166	0.25	0		0.00932	0	
167	0.25	0		0.00932	0	
168	0.25	0		0.00932	0	
169	0.25	0		0.00932	0	
170	0.25	0		0.00932	0	
171	0.25	0		0.00931	0	
172	0.25	0		0.00931	0	
173	0.25	0		0.00931	0	
174	0.25	0		0.00931	0	
175	0.25	0		0.00931	0	
176	0.25	0		0.0093	0	
177	0.25	0		0.0093	0	
178	0.25	0		0.00929	0	
179	0.25	0		0.00929	0	
180	0.25	0		0.00929	0	
181	0.25	0		0.00928	0	
182	0.25	0		0.00928	0	
183	0.25	0		0.00927	0	
184	0.25	0		0.00927	0	
185	0.25	0		0.00927	0	
186	0.25	0		0.00927	0	
187	0.25	0		0.00926	0	
188	0.25	0		0.00926	0	
189	0.25	0		0.00926	0	
190	0.25	0		0.00924	0	
191	0.25	0		0.00924	0	
192	0.25	0		0.00924	0	
193	0.25	0		0.00923	0	
194	0.25	0		0.00923	0	
195	0.25	0		0.00922	0	
196	0.25	0		0.00919	0	
197	0.25	0		0.00914	0	
198	0.25	0		0.00903	0	

	G	H	I	J	K	L
1	**1,2-Dichloroethane**	**d_1,2-Dichloroethane**		**1-Methylnaphthalene**	**d_1-Methylnaphthalene**	
2	5.45	1		20.4	1	
3	5.41	1		18.6	1	
4	5	0		12.5	0	
5	4.24	1		11.6	1	
6	3.98	1		11.35	1	
7	3.83	1		10.8	1	
8	2.95	1		6.34	1	
9	2.57	1		5.62	1	
10	2.04	1		1.32	0	
11	1.94	1		1.28	0	
12	1.86	1		1.25	0	
13	1.44	1		1.25	0	
14	1.44	1		1.25	0	
15	1.37	1		1.25	0	
16	1.345	1		1.25	0	
17	1.09	1		1.25	0	
18	1.07	1		1.25	0	
19	1.05	1		1.25	0	
20	0.947	1		1.25	0	
21	0.8755	1		1.25	0	
22	0.807	1		1.25	0	
23	0.759	1		1.25	0	
24	0.758	1		1.25	0	
25	0.757	1		1.25	0	
26	0.7215	1		1.25	0	
27	0.707	1		1.25	0	
28	0.645	1		1.24	0	
29	0.644	1		1.24	0	
30	0.625	1		1.24	0	
31	0.568	1		1.24	0	
32	0.568	1		1.24	0	
33	0.502	1		1.24	0	
34	0.5	0		1.24	0	
35	0.5	0		1.24	0	
36	0.5	0		1.24	0	
37	0.5	0		1.24	0	
38	0.401	1		1.24	0	
39	0.39	1		1.24	0	
40	0.33	1		1.23	0	
41	0.3275	1		1.23	0	
42	0.295	1		1.23	0	
43	0.25	0		1.23	0	
44	0.25	0		1.23	0	
45	0.25	0		1.23	0	
46	0.25	0		1.23	0	
47	0.25	0		1.23	0	
48	0.25	0		1.23	0	
49	0.25	0		1.23	0	
50	0.25	0		1.23	0	
51	0.25	0		1.23	0	
52	0.25	0		1.23	0	

	G	H	I	J	K	L
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene	
53	0.25	0		1.23	0	
54	0.25	0		1.23	0	
55	0.25	0		1.23	0	
56	0.25	0		1.21	0	
57	0.25	0		1.21	0	
58	0.25	0		1.21	0	
59	0.25	0		1.21	0	
60	0.25	0		1.21	0	
61	0.25	0		1.21	0	
62	0.25	0		1.21	0	
63	0.25	0		1.21	0	
64	0.25	0		1.21	0	
65	0.25	0		1.21	0	
66	0.25	0		1.21	0	
67	0.25	0		1.21	0	
68	0.25	0		1.21	0	
69	0.25	0		1.21	0	
70	0.25	0		1.21	0	
71	0.25	0		1.21	0	
72	0.25	0		1.21	0	
73	0.25	0		1.21	0	
74	0.25	0		1.205	0	
75	0.25	0		1.2	0	
76	0.25	0		1.2	0	
77	0.25	0		1.2	0	
78	0.25	0		1.2	0	
79	0.25	0		1.2	0	
80	0.25	0		1.2	0	
81	0.25	0		1.2	0	
82	0.25	0		1.2	0	
83	0.25	0		1.2	0	
84	0.25	0		1.2	0	
85	0.25	0		1.2	0	
86	0.25	0		1.2	0	
87	0.25	0		1.2	0	
88	0.25	0		1.2	0	
89	0.25	0		1.2	0	
90	0.25	0		1.2	0	
91	0.25	0		1.2	0	
92	0.25	0		1.2	0	
93	0.25	0		1.2	0	
94	0.25	0		1.2	0	
95	0.25	0		1.2	0	
96	0.25	0		1.2	0	
97	0.25	0		1.2	0	
98	0.25	0		1.2	0	
99	0.25	0		1.2	0	
100	0.25	0		1.2	0	
101	0.25	0		1.2	0	
102	0.25	0		1.2	0	
103	0.25	0		1.2	0	
104	0.25	0		1.195	0	

	G	H	I	J	K	L
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene	
105	0.25	0		1.195	0	
106	0.25	0		1.19	0	
107	0.25	0		1.19	0	
108	0.25	0		1.19	0	
109	0.25	0		1.19	0	
110	0.25	0		1.19	0	
111	0.25	0		1.19	0	
112	0.25	0		1.19	0	
113	0.25	0		1.19	0	
114	0.25	0		1.19	0	
115	0.25	0		1.19	0	
116	0.25	0		1.19	0	
117	0.25	0		1.19	0	
118	0.25	0		1.19	0	
119	0.25	0		1.19	0	
120	0.25	0		1.19	0	
121	0.25	0		1.19	0	
122	0.25	0		1.19	0	
123	0.25	0		1.19	0	
124	0.25	0		1.19	0	
125	0.25	0		1.19	0	
126	0.25	0		1.19	0	
127	0.25	0		1.19	0	
128	0.25	0		1.19	0	
129	0.25	0		1.18	0	
130	0.25	0		1.18	0	
131	0.25	0		1.18	0	
132	0.25	0		1.18	0	
133	0.25	0		1.18	0	
134	0.25	0		1.18	0	
135	0.25	0		1.18	0	
136	0.25	0		1.18	0	
137	0.25	0		1.18	0	
138	0.25	0		1.18	0	
139	0.25	0		1.18	0	
140	0.25	0		1.18	0	
141	0.25	0		1.18	0	
142	0.25	0		1.18	0	
143	0.25	0		1.18	0	
144	0.25	0		1.18	0	
145	0.25	0		1.18	0	
146	0.25	0		1.18	0	
147	0.25	0		1.18	0	
148	0.25	0		1.18	0	
149	0.25	0		1.18	0	
150	0.25	0		1.18	0	
151	0.25	0		1.18	0	
152	0.25	0		1.18	0	
153	0.25	0		1.18	0	
154	0.25	0		1.18	0	
155	0.25	0		1.18	0	
156	0.25	0		1.18	0	

	G	H	I	J	K	L
1	1,2-Dichloroethane	d_1,2-Dichloroethane		1-Methylnaphthalene	d_1-Methylnaphthalene	
157	0.25	0		1.18	0	
158	0.25	0		1.18	0	
159	0.25	0		1.18	0	
160	0.25	0		1.18	0	
161	0.25	0		1.18	0	
162	0.25	0		1.18	0	
163	0.25	0		1.18	0	
164	0.25	0		1.18	0	
165	0.25	0		1.18	0	
166	0.25	0		1.18	0	
167	0.25	0		1.18	0	
168	0.25	0		1.18	0	
169	0.25	0		1.18	0	
170	0.25	0		1.18	0	
171	0.25	0		1.18	0	
172	0.25	0		1.18	0	
173	0.25	0		1.18	0	
174	0.25	0		1.175	0	
175	0.25	0		1.17	0	
176	0.25	0		1.17	0	
177	0.25	0		1.17	0	
178	0.25	0		1.17	0	
179	0.25	0		1.17	0	
180	0.25	0		1.17	0	
181	0.25	0		1.17	0	
182	0.25	0		1.17	0	
183	0.25	0		1.17	0	
184	0.25	0		1.165	0	
185	0.25	0		1.16	0	
186	0.25	0		1.16	0	
187	0.25	0		1.16	0	
188	0.25	0		1.16	0	
189	0.25	0		1.16	0	
190	0.25	0		1.16	0	
191	0.25	0		1.16	0	
192	0.25	0		1.16	0	
193	0.25	0		1.16	0	
194	0.25	0		1.16	0	
195	0.25	0		1.16	0	
196	0.25	0		1.16	0	
197	0.25	0		1.16	0	
198	0.25	0		0.619	0	

	M	N	O	P	Q	R
1	**2-Methylnaphthalene**	**d_2-Methylnaphthalene**		**Acetophenone**	**d_Acetophenone**	
2	12.5	0		903	1	
3	11.6	0		860	1	
4	9.93	1		129	1	
5	1.61	1		122	1	
6	1.32	0		8.78	1	
7	1.28	0		3.68	1	
8	1.25	0		1.68	1	
9	1.25	0		1.32	0	
10	1.25	0		1.28	0	
11	1.25	0		1.25	0	
12	1.25	0		1.25	0	
13	1.25	0		1.25	0	
14	1.25	0		1.25	0	
15	1.25	0		1.25	0	
16	1.25	0		1.25	0	
17	1.25	0		1.25	0	
18	1.25	0		1.25	0	
19	1.25	0		1.25	0	
20	1.25	0		1.25	0	
21	1.25	0		1.25	0	
22	1.25	0		1.25	0	
23	1.25	0		1.25	0	
24	1.25	0		1.25	0	
25	1.24	0		1.25	0	
26	1.24	0		1.25	0	
27	1.24	0		1.25	0	
28	1.24	0		1.24	0	
29	1.24	0		1.24	0	
30	1.24	0		1.24	0	
31	1.24	0		1.24	0	
32	1.24	0		1.24	0	
33	1.24	0		1.24	0	
34	1.24	0		1.24	0	
35	1.24	0		1.24	0	
36	1.24	0		1.24	0	
37	1.23	0		1.24	0	
38	1.23	0		1.24	0	
39	1.23	0		1.24	0	
40	1.23	0		1.23	0	
41	1.23	0		1.23	0	
42	1.23	0		1.23	0	
43	1.23	0		1.23	0	
44	1.23	0		1.23	0	
45	1.23	0		1.23	0	
46	1.23	0		1.23	0	
47	1.23	0		1.23	0	
48	1.23	0		1.23	0	
49	1.23	0		1.23	0	
50	1.23	0		1.23	0	
51	1.23	0		1.23	0	
52	1.23	0		1.23	0	

	M	N	O	P	Q	R
1	2-Methylnaphthalene	d_2-Methylnaphthalene		Acetophenone	d_Acetophenone	
53	1.21	0		1.23	0	
54	1.21	0		1.23	0	
55	1.21	0		1.23	0	
56	1.21	0		1.21	0	
57	1.21	0		1.21	0	
58	1.21	0		1.21	0	
59	1.21	0		1.21	0	
60	1.21	0		1.21	0	
61	1.21	0		1.21	0	
62	1.21	0		1.21	0	
63	1.21	0		1.21	0	
64	1.21	0		1.21	0	
65	1.21	0		1.21	0	
66	1.21	0		1.21	0	
67	1.21	0		1.21	0	
68	1.21	0		1.21	0	
69	1.21	0		1.21	0	
70	1.21	0		1.21	0	
71	1.21	0		1.21	0	
72	1.205	0		1.21	0	
73	1.2	0		1.21	0	
74	1.2	0		1.21	0	
75	1.2	0		1.205	0	
76	1.2	0		1.2	0	
77	1.2	0		1.2	0	
78	1.2	0		1.2	0	
79	1.2	0		1.2	0	
80	1.2	0		1.2	0	
81	1.2	0		1.2	0	
82	1.2	0		1.2	0	
83	1.2	0		1.2	0	
84	1.2	0		1.2	0	
85	1.2	0		1.2	0	
86	1.2	0		1.2	0	
87	1.2	0		1.2	0	
88	1.2	0		1.2	0	
89	1.2	0		1.2	0	
90	1.2	0		1.2	0	
91	1.2	0		1.2	0	
92	1.2	0		1.2	0	
93	1.2	0		1.2	0	
94	1.2	0		1.2	0	
95	1.2	0		1.2	0	
96	1.2	0		1.2	0	
97	1.2	0		1.2	0	
98	1.2	0		1.2	0	
99	1.2	0		1.2	0	
100	1.2	0		1.2	0	
101	1.2	0		1.2	0	
102	1.195	0		1.2	0	
103	1.195	0		1.2	0	
104	1.19	0		1.2	0	

	M	N	O	P	Q	R
1	2-Methylnaphthalene	d_2-Methylnaphthalene		Acetophenone	d_Acetophenone	
105	1.19	0		1.195	0	
106	1.19	0		1.195	0	
107	1.19	0		1.19	0	
108	1.19	0		1.19	0	
109	1.19	0		1.19	0	
110	1.19	0		1.19	0	
111	1.19	0		1.19	0	
112	1.19	0		1.19	0	
113	1.19	0		1.19	0	
114	1.19	0		1.19	0	
115	1.19	0		1.19	0	
116	1.19	0		1.19	0	
117	1.19	0		1.19	0	
118	1.19	0		1.19	0	
119	1.19	0		1.19	0	
120	1.19	0		1.19	0	
121	1.19	0		1.19	0	
122	1.19	0		1.19	0	
123	1.19	0		1.19	0	
124	1.19	0		1.19	0	
125	1.19	0		1.19	0	
126	1.19	0		1.19	0	
127	1.18	0		1.19	0	
128	1.18	0		1.18	0	
129	1.18	0		1.18	0	
130	1.18	0		1.18	0	
131	1.18	0		1.18	0	
132	1.18	0		1.18	0	
133	1.18	0		1.18	0	
134	1.18	0		1.18	0	
135	1.18	0		1.18	0	
136	1.18	0		1.18	0	
137	1.18	0		1.18	0	
138	1.18	0		1.18	0	
139	1.18	0		1.18	0	
140	1.18	0		1.18	0	
141	1.18	0		1.18	0	
142	1.18	0		1.18	0	
143	1.18	0		1.18	0	
144	1.18	0		1.18	0	
145	1.18	0		1.18	0	
146	1.18	0		1.18	0	
147	1.18	0		1.18	0	
148	1.18	0		1.18	0	
149	1.18	0		1.18	0	
150	1.18	0		1.18	0	
151	1.18	0		1.18	0	
152	1.18	0		1.18	0	
153	1.18	0		1.18	0	
154	1.18	0		1.18	0	
155	1.18	0		1.18	0	
156	1.18	0		1.18	0	

	M	N	O	P	Q	R
1	**2-Methylnaphthalene**	**d_2-Methylnaphthalene**		**Acetophenone**	**d_Acetophenone**	
157	1.18	0		1.18	0	
158	1.18	0		1.18	0	
159	1.18	0		1.18	0	
160	1.18	0		1.18	0	
161	1.18	0		1.18	0	
162	1.18	0		1.18	0	
163	1.18	0		1.18	0	
164	1.18	0		1.18	0	
165	1.18	0		1.18	0	
166	1.18	0		1.18	0	
167	1.18	0		1.18	0	
168	1.18	0		1.18	0	
169	1.18	0		1.18	0	
170	1.18	0		1.18	0	
171	1.18	0		1.18	0	
172	1.175	0		1.175	0	
173	1.175	0		1.175	0	
174	1.17	0		1.17	0	
175	1.17	0		1.17	0	
176	1.17	0		1.17	0	
177	1.17	0		1.17	0	
178	1.17	0		1.17	0	
179	1.17	0		1.17	0	
180	1.17	0		1.17	0	
181	1.17	0		1.17	0	
182	1.17	0		1.17	0	
183	1.165	0		1.165	0	
184	1.16	0		1.16	0	
185	1.16	0		1.16	0	
186	1.16	0		1.16	0	
187	1.16	0		1.16	0	
188	1.16	0		1.16	0	
189	1.16	0		1.16	0	
190	1.16	0		1.16	0	
191	1.16	0		1.16	0	
192	1.16	0		1.16	0	
193	1.16	0		1.16	0	
194	1.16	0		1.16	0	
195	1.16	0		1.16	0	
196	1.16	0		1.16	0	
197	1.16	0		1.16	0	
198	0.619	0		0.619	0	

	S	T	U	V	W	X	Y	Z	AA
1	**Benzene**	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**		**Lead**	**d_Lead**	
2	2170	1		903	1		5.3	1	
3	1990	1		748	1		4.52	1	
4	508	1		186	1		3.83	1	
5	479	1		73.4	1		3	0	
6	36.7	1		64.8	1		3	0	
7	6.535	1		50.4	1		3	0	
8	4.21	1		6.79	1		3	0	
9	1.945	1		6.49	1		3	0	
10	1.25	0		5.69	1		3	0	
11	1.24	1		2.71	1		3	0	
12	0.624	1		1.25	0		2.18	1	
13	0.544	1		0.5	0		2.11	1	
14	0.538	1		0.5	0		2.07	1	
15	0.5	0		0.5	0		2	0	
16	0.5	0		0.5	0		2	0	
17	0.5	0		0.5	0		2	0	
18	0.5	0		0.5	0		2	0	
19	0.5	0		0.5	0		1.9	0	
20	0.5	0		0.5	0		1.9	0	
21	0.5	0		0.5	0		1.9	0	
22	0.5	0		0.5	0		1.9	0	
23	0.5	0		0.5	0		1.9	0	
24	0.5	0		0.5	0		1.9	0	
25	0.5	0		0.5	0		1.8	0	
26	0.5	0		0.5	0		1.8	0	
27	0.5	0		0.5	0		1.75	0	
28	0.5	0		0.5	0		1.7	0	
29	0.5	0		0.5	0		1.7	0	
30	0.5	0		0.5	0		1.6	0	
31	0.5	0		0.5	0		1.6	0	
32	0.5	0		0.5	0		1.54	1	
33	0.5	0		0.5	0		1.5	0	
34	0.5	0		0.375	0		1.5	0	
35	0.25	0		0.25	0		1.5	0	
36	0.25	0		0.25	0		1.5	0	
37	0.25	0		0.25	0		1.5	0	
38	0.25	0		0.25	0		1.5	0	
39	0.25	0		0.25	0		1.5	0	
40	0.25	0		0.25	0		1.5	0	
41	0.25	0		0.25	0		1.5	0	
42	0.25	0		0.25	0		1.5	0	
43	0.25	0		0.25	0		1.5	0	
44	0.25	0		0.25	0		1.5	0	
45	0.25	0		0.25	0		1.5	0	
46	0.25	0		0.25	0		1.5	0	
47	0.25	0		0.25	0		1.5	0	
48	0.25	0		0.25	0		1.5	0	
49	0.25	0		0.25	0		1.5	0	
50	0.25	0		0.25	0		1.5	0	
51	0.25	0		0.25	0		1.5	0	
52	0.25	0		0.25	0		1.5	0	

	S	T	U	V	W	X	Y	Z	AA
1	**Benzene**	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**		**Lead**	**d_Lead**	
53	0.25	0		0.25	0		1.5	0	
54	0.25	0		0.25	0		1.5	0	
55	0.25	0		0.25	0		1.5	0	
56	0.25	0		0.25	0		1.5	0	
57	0.25	0		0.25	0		1.5	0	
58	0.25	0		0.25	0		1.5	0	
59	0.25	0		0.25	0		1.5	0	
60	0.25	0		0.25	0		1.5	0	
61	0.25	0		0.25	0		1.5	0	
62	0.25	0		0.25	0		1.5	0	
63	0.25	0		0.25	0		1.5	0	
64	0.25	0		0.25	0		1.5	0	
65	0.25	0		0.25	0		1.5	0	
66	0.25	0		0.25	0		1.5	0	
67	0.25	0		0.25	0		1.5	0	
68	0.25	0		0.25	0		1.5	0	
69	0.25	0		0.25	0		1.5	0	
70	0.25	0		0.25	0		1.5	0	
71	0.25	0		0.25	0		1.5	0	
72	0.25	0		0.25	0		1.5	0	
73	0.25	0		0.25	0		1.5	0	
74	0.25	0		0.25	0		1.5	0	
75	0.25	0		0.25	0		1.5	0	
76	0.25	0		0.25	0		1.5	0	
77	0.25	0		0.25	0		1.5	0	
78	0.25	0		0.25	0		1.5	0	
79	0.25	0		0.25	0		1.5	0	
80	0.25	0		0.25	0		1.5	0	
81	0.25	0		0.25	0		1.5	0	
82	0.25	0		0.25	0		1.5	0	
83	0.25	0		0.25	0		1.5	0	
84	0.25	0		0.25	0		1.5	0	
85	0.25	0		0.25	0		1.5	0	
86	0.25	0		0.25	0		1.5	0	
87	0.25	0		0.25	0		1.5	0	
88	0.25	0		0.25	0		1.5	0	
89	0.25	0		0.25	0		1.5	0	
90	0.25	0		0.25	0		1.5	0	
91	0.25	0		0.25	0		1.5	0	
92	0.25	0		0.25	0		1.5	0	
93	0.25	0		0.25	0		1.5	0	
94	0.25	0		0.25	0		1.5	0	
95	0.25	0		0.25	0		1.5	0	
96	0.25	0		0.25	0		1.5	0	
97	0.25	0		0.25	0		1.5	0	
98	0.25	0		0.25	0		1.5	0	
99	0.25	0		0.25	0		1.5	0	
100	0.25	0		0.25	0		1.5	0	
101	0.25	0		0.25	0		1.5	0	
102	0.25	0		0.25	0		1.5	0	
103	0.25	0		0.25	0		1.5	0	
104	0.25	0		0.25	0		1.5	0	

	S	T	U	V	W	X	Y	Z	AA
1	**Benzene**	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**		**Lead**	**d_Lead**	
105	0.25	0		0.25	0		1.5	0	
106	0.25	0		0.25	0		1.5	0	
107	0.25	0		0.25	0		1.5	0	
108	0.25	0		0.25	0		1.5	0	
109	0.25	0		0.25	0		1.5	0	
110	0.25	0		0.25	0		1.5	0	
111	0.25	0		0.25	0		1.5	0	
112	0.25	0		0.25	0		1.5	0	
113	0.25	0		0.25	0		1.5	0	
114	0.25	0		0.25	0		1.5	0	
115	0.25	0		0.25	0		1.5	0	
116	0.25	0		0.25	0		1.5	0	
117	0.25	0		0.25	0		1.5	0	
118	0.25	0		0.25	0		1.5	0	
119	0.25	0		0.25	0		1.5	0	
120	0.25	0		0.25	0		1.5	0	
121	0.25	0		0.25	0		1.5	0	
122	0.25	0		0.25	0		1.5	0	
123	0.25	0		0.25	0		1.5	0	
124	0.25	0		0.25	0		1.5	0	
125	0.25	0		0.25	0		1.5	0	
126	0.25	0		0.25	0		1.5	0	
127	0.25	0		0.25	0		1.5	0	
128	0.25	0		0.25	0		1.5	0	
129	0.25	0		0.25	0		1.5	0	
130	0.25	0		0.25	0		1.5	0	
131	0.25	0		0.25	0		1.5	0	
132	0.25	0		0.25	0		1.5	0	
133	0.25	0		0.25	0		1.5	0	
134	0.25	0		0.25	0		1.5	0	
135	0.25	0		0.25	0		1.5	0	
136	0.25	0		0.25	0		1.5	0	
137	0.25	0		0.25	0		1.5	0	
138	0.25	0		0.25	0		1.5	0	
139	0.25	0		0.25	0		1.5	0	
140	0.25	0		0.25	0		1.5	0	
141	0.25	0		0.25	0		1.5	0	
142	0.25	0		0.25	0		1.5	0	
143	0.25	0		0.25	0		1.5	0	
144	0.25	0		0.25	0		1.5	0	
145	0.25	0		0.25	0		1.5	0	
146	0.25	0		0.25	0		1.5	0	
147	0.25	0		0.25	0		1.5	0	
148	0.25	0		0.25	0		1.5	0	
149	0.25	0		0.25	0		1.5	0	
150	0.25	0		0.25	0		1.5	0	
151	0.25	0		0.25	0		1.5	0	
152	0.25	0		0.25	0		1.5	0	
153	0.25	0		0.25	0		1.5	0	
154	0.25	0		0.25	0		1.5	0	
155	0.25	0		0.25	0		1.5	0	
156	0.25	0		0.25	0		1.5	0	

	S	T	U	V	W	X	Y	Z	AA
1	**Benzene**	**d_Benzene**		**Ethylbenzene**	**d_Ethylbenzene**		**Lead**	**d_Lead**	
157	0.25	0		0.25	0		1.5	0	
158	0.25	0		0.25	0		1.5	0	
159	0.25	0		0.25	0		1.5	0	
160	0.25	0		0.25	0		1.5	0	
161	0.25	0		0.25	0		1.5	0	
162	0.25	0		0.25	0		1.5	0	
163	0.25	0		0.25	0		1.5	0	
164	0.25	0		0.25	0		1.5	0	
165	0.25	0		0.25	0		1.5	0	
166	0.25	0		0.25	0		1.5	0	
167	0.25	0		0.25	0		1.5	0	
168	0.25	0		0.25	0		1.5	0	
169	0.25	0		0.25	0		1.5	0	
170	0.25	0		0.25	0		1.5	0	
171	0.25	0		0.25	0		1.5	0	
172	0.25	0		0.25	0		1.5	0	
173	0.25	0		0.25	0		1.5	0	
174	0.25	0		0.25	0		1.5	0	
175	0.25	0		0.25	0		1.5	0	
176	0.25	0		0.25	0		1.5	0	
177	0.25	0		0.25	0		1.5	0	
178	0.25	0		0.25	0		1.5	0	
179	0.25	0		0.25	0		1.5	0	
180	0.25	0		0.25	0		1.5	0	
181	0.25	0		0.25	0		1.5	0	
182	0.25	0		0.25	0		1.5	0	
183	0.25	0		0.25	0		1.5	0	
184	0.25	0		0.25	0		1.5	0	
185	0.25	0		0.25	0		1.5	0	
186	0.25	0		0.25	0		1.5	0	
187	0.25	0		0.25	0		1.5	0	
188	0.25	0		0.25	0		1.5	0	
189	0.25	0		0.25	0		1.5	0	
190	0.25	0		0.25	0		1.5	0	
191	0.25	0		0.25	0		1.5	0	
192	0.25	0		0.25	0		1.5	0	
193	0.25	0		0.25	0		1.5	0	
194	0.25	0		0.25	0		1.5	0	
195	0.25	0		0.25	0		1.5	0	
196	0.25	0		0.25	0		1.5	0	
197	0.25	0		0.25	0		1.5	0	
198	0.25	0		0.25	0		1.5	0	

	AB	AC	AD	AE	AF	AG
1	MTBE (Methyl tert-butyl ether)	d_MTBE (Methyl tert-butyl ether)		Naphthalene	d_Naphthalene	
2	5	0		35	1	
3	5	0		23.8	1	
4	2.5	0		11.5	1	
5	1.25	0		6.87	1	
6	1.25	0		4.88	1	
7	0.645	1		3.21	1	
8	0.562	1		2.55	1	
9	0.5	0		1.25	0	
10	0.5	0		1.03	1	
11	0.5	0		0.938	1	
12	0.5	0		0.5	0	
13	0.5	0		0.5	0	
14	0.5	0		0.5	0	
15	0.5	0		0.5	0	
16	0.5	0		0.5	0	
17	0.5	0		0.5	0	
18	0.5	0		0.5	0	
19	0.5	0		0.5	0	
20	0.5	0		0.5	0	
21	0.5	0		0.5	0	
22	0.5	0		0.5	0	
23	0.5	0		0.5	0	
24	0.5	0		0.5	0	
25	0.5	0		0.5	0	
26	0.5	0		0.5	0	
27	0.5	0		0.5	0	
28	0.5	0		0.5	0	
29	0.5	0		0.5	0	
30	0.5	0		0.5	0	
31	0.5	0		0.5	0	
32	0.5	0		0.5	0	
33	0.5	0		0.5	0	
34	0.375	0		0.5	0	
35	0.25	0		0.375	0	
36	0.25	0		0.25	0	
37	0.25	0		0.25	0	
38	0.25	0		0.25	0	
39	0.25	0		0.25	0	
40	0.25	0		0.25	0	
41	0.25	0		0.25	0	
42	0.25	0		0.25	0	
43	0.25	0		0.25	0	
44	0.25	0		0.25	0	
45	0.25	0		0.25	0	
46	0.25	0		0.25	0	
47	0.25	0		0.25	0	
48	0.25	0		0.25	0	
49	0.25	0		0.25	0	
50	0.25	0		0.25	0	
51	0.25	0		0.25	0	
52	0.25	0		0.25	0	

	AB	AC	AD	AE	AF	AG
1	**MTBE (Methyl tert-butyl ether)**	**d_MTBE (Methyl tert-butyl ether)**		**Naphthalene**	**d_Naphthalene**	
53	0.25	0		0.25	0	
54	0.25	0		0.25	0	
55	0.25	0		0.25	0	
56	0.25	0		0.25	0	
57	0.25	0		0.25	0	
58	0.25	0		0.25	0	
59	0.25	0		0.25	0	
60	0.25	0		0.25	0	
61	0.25	0		0.25	0	
62	0.25	0		0.25	0	
63	0.25	0		0.25	0	
64	0.25	0		0.25	0	
65	0.25	0		0.25	0	
66	0.25	0		0.25	0	
67	0.25	0		0.25	0	
68	0.25	0		0.25	0	
69	0.25	0		0.25	0	
70	0.25	0		0.25	0	
71	0.25	0		0.25	0	
72	0.25	0		0.25	0	
73	0.25	0		0.25	0	
74	0.25	0		0.25	0	
75	0.25	0		0.25	0	
76	0.25	0		0.25	0	
77	0.25	0		0.25	0	
78	0.25	0		0.25	0	
79	0.25	0		0.25	0	
80	0.25	0		0.25	0	
81	0.25	0		0.25	0	
82	0.25	0		0.25	0	
83	0.25	0		0.25	0	
84	0.25	0		0.25	0	
85	0.25	0		0.25	0	
86	0.25	0		0.25	0	
87	0.25	0		0.25	0	
88	0.25	0		0.25	0	
89	0.25	0		0.25	0	
90	0.25	0		0.25	0	
91	0.25	0		0.25	0	
92	0.25	0		0.25	0	
93	0.25	0		0.25	0	
94	0.25	0		0.25	0	
95	0.25	0		0.25	0	
96	0.25	0		0.25	0	
97	0.25	0		0.25	0	
98	0.25	0		0.25	0	
99	0.25	0		0.25	0	
100	0.25	0		0.25	0	
101	0.25	0		0.25	0	
102	0.25	0		0.25	0	
103	0.25	0		0.25	0	
104	0.25	0		0.25	0	

	AB	AC	AD	AE	AF	AG
1	MTBE (Methyl tert-butyl ether)	d_MTBE (Methyl tert-butyl ether)		Naphthalene	d_Naphthalene	
105	0.25	0		0.25	0	
106	0.25	0		0.25	0	
107	0.25	0		0.25	0	
108	0.25	0		0.25	0	
109	0.25	0		0.25	0	
110	0.25	0		0.25	0	
111	0.25	0		0.25	0	
112	0.25	0		0.25	0	
113	0.25	0		0.25	0	
114	0.25	0		0.25	0	
115	0.25	0		0.25	0	
116	0.25	0		0.25	0	
117	0.25	0		0.25	0	
118	0.25	0		0.25	0	
119	0.25	0		0.25	0	
120	0.25	0		0.25	0	
121	0.25	0		0.25	0	
122	0.25	0		0.25	0	
123	0.25	0		0.25	0	
124	0.25	0		0.25	0	
125	0.25	0		0.25	0	
126	0.25	0		0.25	0	
127	0.25	0		0.25	0	
128	0.25	0		0.25	0	
129	0.25	0		0.25	0	
130	0.25	0		0.25	0	
131	0.25	0		0.25	0	
132	0.25	0		0.25	0	
133	0.25	0		0.25	0	
134	0.25	0		0.25	0	
135	0.25	0		0.25	0	
136	0.25	0		0.25	0	
137	0.25	0		0.25	0	
138	0.25	0		0.25	0	
139	0.25	0		0.25	0	
140	0.25	0		0.25	0	
141	0.25	0		0.25	0	
142	0.25	0		0.25	0	
143	0.25	0		0.25	0	
144	0.25	0		0.25	0	
145	0.25	0		0.25	0	
146	0.25	0		0.25	0	
147	0.25	0		0.25	0	
148	0.25	0		0.25	0	
149	0.25	0		0.25	0	
150	0.25	0		0.25	0	
151	0.25	0		0.25	0	
152	0.25	0		0.25	0	
153	0.25	0		0.25	0	
154	0.25	0		0.25	0	
155	0.25	0		0.25	0	
156	0.25	0		0.25	0	

	AB	AC	AD	AE	AF	AG
1	**MTBE (Methyl tert-butyl ether)**	**d_MTBE (Methyl tert-butyl ether)**		**Naphthalene**	**d_Naphthalene**	
157	0.25	0		0.25	0	
158	0.25	0		0.25	0	
159	0.25	0		0.25	0	
160	0.25	0		0.25	0	
161	0.25	0		0.25	0	
162	0.25	0		0.25	0	
163	0.25	0		0.25	0	
164	0.25	0		0.25	0	
165	0.25	0		0.25	0	
166	0.25	0		0.25	0	
167	0.25	0		0.25	0	
168	0.25	0		0.25	0	
169	0.25	0		0.25	0	
170	0.25	0		0.25	0	
171	0.25	0		0.25	0	
172	0.25	0		0.25	0	
173	0.25	0		0.25	0	
174	0.25	0		0.25	0	
175	0.25	0		0.25	0	
176	0.25	0		0.25	0	
177	0.25	0		0.25	0	
178	0.25	0		0.25	0	
179	0.25	0		0.25	0	
180	0.25	0		0.25	0	
181	0.25	0		0.25	0	
182	0.25	0		0.25	0	
183	0.25	0		0.25	0	
184	0.25	0		0.25	0	
185	0.25	0		0.25	0	
186	0.25	0		0.25	0	
187	0.25	0		0.25	0	
188	0.25	0		0.25	0	
189	0.25	0		0.25	0	
190	0.25	0		0.25	0	
191	0.25	0		0.25	0	
192	0.25	0		0.25	0	
193	0.25	0		0.25	0	
194	0.25	0		0.25	0	
195	0.25	0		0.25	0	
196	0.25	0		0.25	0	
197	0.25	0		0.25	0	
198	0.25	0		0.25	0	

	AH	AI	AJ	AK	AL
1	**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
2	2880	1		537	1
3	2860	1		534	1
4	561	1		132	1
5	560	1		95.4	1
6	1.25	0		16.4	1
7	0.5	0		3.75	0
8	0.5	0		1.66	0
9	0.5	0		1.5	0
10	0.5	0		1.5	0
11	0.5	0		1.5	0
12	0.5	0		1.5	0
13	0.5	0		1.5	0
14	0.5	0		1.5	0
15	0.5	0		1.5	0
16	0.5	0		1.5	0
17	0.5	0		1.5	0
18	0.5	0		1.5	0
19	0.5	0		1.5	0
20	0.5	0		1.5	0
21	0.5	0		1.5	0
22	0.5	0		1.5	0
23	0.5	0		1.5	0
24	0.5	0		1.5	0
25	0.5	0		1.5	0
26	0.5	0		1.5	0
27	0.5	0		1.5	0
28	0.5	0		1.5	0
29	0.5	0		1.5	0
30	0.5	0		1.5	0
31	0.5	0		1.5	0
32	0.5	0		1.5	0
33	0.5	0		1.5	0
34	0.375	0		1.5	0
35	0.308	1		0.75	0
36	0.25	0		0.75	0
37	0.25	0		0.75	0
38	0.25	0		0.75	0
39	0.25	0		0.75	0
40	0.25	0		0.75	0
41	0.25	0		0.75	0
42	0.25	0		0.75	0
43	0.25	0		0.75	0
44	0.25	0		0.75	0
45	0.25	0		0.75	0
46	0.25	0		0.75	0
47	0.25	0		0.75	0
48	0.25	0		0.75	0
49	0.25	0		0.75	0
50	0.25	0		0.75	0
51	0.25	0		0.75	0
52	0.25	0		0.75	0

	AH	AI	AJ	AK	AL
1	**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
53	0.25	0		0.75	0
54	0.25	0		0.75	0
55	0.25	0		0.75	0
56	0.25	0		0.75	0
57	0.25	0		0.75	0
58	0.25	0		0.75	0
59	0.25	0		0.75	0
60	0.25	0		0.75	0
61	0.25	0		0.75	0
62	0.25	0		0.75	0
63	0.25	0		0.75	0
64	0.25	0		0.75	0
65	0.25	0		0.75	0
66	0.25	0		0.75	0
67	0.25	0		0.75	0
68	0.25	0		0.75	0
69	0.25	0		0.75	0
70	0.25	0		0.75	0
71	0.25	0		0.75	0
72	0.25	0		0.75	0
73	0.25	0		0.75	0
74	0.25	0		0.75	0
75	0.25	0		0.75	0
76	0.25	0		0.75	0
77	0.25	0		0.75	0
78	0.25	0		0.75	0
79	0.25	0		0.75	0
80	0.25	0		0.75	0
81	0.25	0		0.75	0
82	0.25	0		0.75	0
83	0.25	0		0.75	0
84	0.25	0		0.75	0
85	0.25	0		0.75	0
86	0.25	0		0.75	0
87	0.25	0		0.75	0
88	0.25	0		0.75	0
89	0.25	0		0.75	0
90	0.25	0		0.75	0
91	0.25	0		0.75	0
92	0.25	0		0.75	0
93	0.25	0		0.75	0
94	0.25	0		0.75	0
95	0.25	0		0.75	0
96	0.25	0		0.75	0
97	0.25	0		0.75	0
98	0.25	0		0.75	0
99	0.25	0		0.75	0
100	0.25	0		0.75	0
101	0.25	0		0.75	0
102	0.25	0		0.75	0
103	0.25	0		0.75	0
104	0.25	0		0.75	0

	AH	AI	AJ	AK	AL
1	**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
105	0.25	0		0.75	0
106	0.25	0		0.75	0
107	0.25	0		0.75	0
108	0.25	0		0.75	0
109	0.25	0		0.75	0
110	0.25	0		0.75	0
111	0.25	0		0.75	0
112	0.25	0		0.75	0
113	0.25	0		0.75	0
114	0.25	0		0.75	0
115	0.25	0		0.75	0
116	0.25	0		0.75	0
117	0.25	0		0.75	0
118	0.25	0		0.75	0
119	0.25	0		0.75	0
120	0.25	0		0.75	0
121	0.25	0		0.75	0
122	0.25	0		0.75	0
123	0.25	0		0.75	0
124	0.25	0		0.75	0
125	0.25	0		0.75	0
126	0.25	0		0.75	0
127	0.25	0		0.75	0
128	0.25	0		0.75	0
129	0.25	0		0.75	0
130	0.25	0		0.75	0
131	0.25	0		0.75	0
132	0.25	0		0.75	0
133	0.25	0		0.75	0
134	0.25	0		0.75	0
135	0.25	0		0.75	0
136	0.25	0		0.75	0
137	0.25	0		0.75	0
138	0.25	0		0.75	0
139	0.25	0		0.75	0
140	0.25	0		0.75	0
141	0.25	0		0.75	0
142	0.25	0		0.75	0
143	0.25	0		0.75	0
144	0.25	0		0.75	0
145	0.25	0		0.75	0
146	0.25	0		0.75	0
147	0.25	0		0.75	0
148	0.25	0		0.75	0
149	0.25	0		0.75	0
150	0.25	0		0.75	0
151	0.25	0		0.75	0
152	0.25	0		0.75	0
153	0.25	0		0.75	0
154	0.25	0		0.75	0
155	0.25	0		0.75	0
156	0.25	0		0.75	0

	AH	AI	AJ	AK	AL
1	**Toluene**	**d_Toluene**		**Xylenes (total)**	**d_Xylenes (total)**
157	0.25	0		0.75	0
158	0.25	0		0.75	0
159	0.25	0		0.75	0
160	0.25	0		0.75	0
161	0.25	0		0.75	0
162	0.25	0		0.75	0
163	0.25	0		0.75	0
164	0.25	0		0.75	0
165	0.25	0		0.75	0
166	0.25	0		0.75	0
167	0.25	0		0.75	0
168	0.25	0		0.75	0
169	0.25	0		0.75	0
170	0.25	0		0.75	0
171	0.25	0		0.75	0
172	0.25	0		0.75	0
173	0.25	0		0.75	0
174	0.25	0		0.75	0
175	0.25	0		0.75	0
176	0.25	0		0.75	0
177	0.25	0		0.75	0
178	0.25	0		0.75	0
179	0.25	0		0.75	0
180	0.25	0		0.75	0
181	0.25	0		0.75	0
182	0.25	0		0.75	0
183	0.25	0		0.75	0
184	0.25	0		0.75	0
185	0.25	0		0.75	0
186	0.25	0		0.75	0
187	0.25	0		0.75	0
188	0.25	0		0.75	0
189	0.25	0		0.75	0
190	0.25	0		0.75	0
191	0.25	0		0.75	0
192	0.25	0		0.75	0
193	0.25	0		0.75	0
194	0.25	0		0.75	0
195	0.25	0		0.75	0
196	0.25	0		0.75	0
197	0.25	0		0.75	0
198	0.25	0		0.75	0

Attachment 2 (Continued)

Groundwater Samples from Q3 and Q4 2015, Off-Base (Output)

	A–E	F	G–K	L
1	UCL Statistics for Data Sets with Non-Detects			
2				
3	User Selected Options			
4	Date/Time of Computation	ProUCL 5.16/20/2017 9:15:37 AM		
5	From File	WorkSheet.xls		
6	Full Precision	OFF		
7	Confidence Coefficient	95%		
8	Number of Bootstrap Operations	2000		
9				
10	**1,2,4-Trimethylbenzene**			
11				
12	**General Statistics**			
13	Total Number of Observations	197	Number of Distinct Observations	9
14	Number of Detects	6	Number of Non-Detects	191
15	Number of Distinct Detects	6	Number of Distinct Non-Detects	3
16	Minimum Detect	1.007	Minimum Non-Detect	0.25
17	Maximum Detect	117	Maximum Non-Detect	1.25
18	Variance Detects	3065	Percent Non-Detects	96.95%
19	Mean Detects	42.77	SD Detects	55.36
20	Median Detects	11.32	CV Detects	1.294
21	Skewness Detects	0.949	Kurtosis Detects	-1.845
22	Mean of Logged Detects	2.649	SD of Logged Detects	1.843
23				
24	**Normal GOF Test on Detects Only**			
25	Shapiro Wilk Test Statistic	0.716	**Shapiro Wilk GOF Test**	
26	5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level	
27	Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**	
28	5% Lilliefors Critical Value	0.325	Detected Data Not Normal at 5% Significance Level	
29	**Detected Data Not Normal at 5% Significance Level**			
30				
31	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
32	KM Mean	1.545	KM Standard Error of Mean	0.894
33	KM SD	11.45	95% KM (BCA) UCL	3.195
34	95% KM (t) UCL	3.022	95% KM (Percentile Bootstrap) UCL	3.197
35	95% KM (z) UCL	3.015	95% KM Bootstrap t UCL	10.89
36	90% KM Chebyshev UCL	4.227	95% KM Chebyshev UCL	5.442
37	97.5% KM Chebyshev UCL	7.128	99% KM Chebyshev UCL	10.44
38				
39	**Gamma GOF Tests on Detected Observations Only**			
40	A-D Test Statistic	0.467	**Anderson-Darling GOF Test**	
41	5% A-D Critical Value	0.732	Detected data appear Gamma Distributed at 5% Significance Level	
42	K-S Test Statistic	0.268	**Kolmogorov-Smirnov GOF**	
43	5% K-S Critical Value	0.347	Detected data appear Gamma Distributed at 5% Significance Level	
44	**Detected data appear Gamma Distributed at 5% Significance Level**			
45				
46	**Gamma Statistics on Detected Data Only**			
47	k hat (MLE)	0.564	k star (bias corrected MLE)	0.393
48	Theta hat (MLE)	75.87	Theta star (bias corrected MLE)	108.8
49	nu hat (MLE)	6.764	nu star (bias corrected)	4.716
50	Mean (detects)	42.77		
51				
52	**Gamma ROS Statistics using Imputed Non-Detects**			
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
54	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)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	1.312
59	Maximum	117	Median	0.01
60	SD	11.51	CV	8.77
61	k hat (MLE)	0.163	k star (bias corrected MLE)	0.164
62	Theta hat (MLE)	8.048	Theta star (bias corrected MLE)	8.004
63	nu hat (MLE)	64.25	nu star (bias corrected)	64.6
64	Adjusted Level of Significance (β)	0.0488		
65	Approximate Chi Square Value (64.60, α)	47.11	Adjusted Chi Square Value (64.60, β)	47
66	95% Gamma Approximate UCL (use when n>=50)	1.8	95% Gamma Adjusted UCL (use when n<50)	1.804

	A	B	C	D	E	F	G	H	I	J	K	L
67												
68	**Estimates of Gamma Parameters using KM Estimates**											
69					Mean (KM)	1.545					SD (KM)	11.45
70					Variance (KM)	131.2					SE of Mean (KM)	0.894
71					k hat (KM)	0.0182					k star (KM)	0.0213
72					nu hat (KM)	7.17					nu star (KM)	8.394
73					theta hat (KM)	84.91					theta star (KM)	72.52
74					80% gamma percentile (KM)	0.00117					90% gamma percentile (KM)	0.296
75					95% gamma percentile (KM)	3.93					99% gamma percentile (KM)	42.82
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78					Approximate Chi Square Value (8.39, α)	2.965					Adjusted Chi Square Value (8.39, β)	2.941
79					95% Gamma Approximate KM-UCL (use when n>=50)	4.374					95% Gamma Adjusted KM-UCL (use when n<50)	4.409
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82					Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**					
83					5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level					
84					Lilliefors Test Statistic	0.202	**Lilliefors GOF Test**					
85					5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level					
86	**Detected Data appear Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89					Mean in Original Scale	1.317					Mean in Log Scale	-12.2
90					SD in Original Scale	11.51					SD in Log Scale	6.505
91					95% t UCL (assumes normality of ROS data)	2.672					95% Percentile Bootstrap UCL	2.939
92					95% BCA Bootstrap UCL	3.594					95% Bootstrap t UCL	14.86
93					95% H-UCL (Log ROS)	537857						
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96					KM Mean (logged)	-1.263					KM Geo Mean	0.283
97					KM SD (logged)	0.753					95% Critical H Value (KM-Log)	1.978
98					KM Standard Error of Mean (logged)	0.0588					95% H-UCL (KM -Log)	0.418
99					KM SD (logged)	0.753					95% Critical H Value (KM-Log)	1.978
100					KM Standard Error of Mean (logged)	0.0588						
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**						**DL/2 Log-Transformed**					
104					Mean in Original Scale	1.443					Mean in Log Scale	-1.836
105					SD in Original Scale	11.49					SD in Log Scale	0.888
106					95% t UCL (Assumes normality)	2.796					95% H-Stat UCL	0.27
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Gamma Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM Approximate Gamma UCL	4.374						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												
120	**1,2-Dibromoethane**											
121												
122	**General Statistics**											
123					Total Number of Observations	197					Number of Distinct Observations	116
124					Number of Detects	69					Number of Non-Detects	128
125					Number of Distinct Detects	69					Number of Distinct Non-Detects	47
126					Minimum Detect	0.011					Minimum Non-Detect	0.00903
127					Maximum Detect	11.5					Maximum Non-Detect	0.00985
128					Variance Detects	4.083					Percent Non-Detects	64.97%
129					Mean Detects	0.655					SD Detects	2.021
130					Median Detects	0.0877					CV Detects	3.085
131					Skewness Detects	4.127					Kurtosis Detects	16.8
132					Mean of Logged Detects	-2.156					SD of Logged Detects	1.545
133												
134	**Normal GOF Test on Detects Only**											
135					Shapiro Wilk Test Statistic	0.343	**Normal GOF Test on Detected Observations Only**					
136					5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level					
137					Lilliefors Test Statistic	0.401	**Lilliefors GOF Test**					
138					5% Lilliefors Critical Value	0.107	Detected Data Not Normal at 5% Significance Level					
139	**Detected Data Not Normal at 5% Significance Level**											
140												
141	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
142					KM Mean	0.235					KM Standard Error of Mean	0.088
143					KM SD	1.226					95% KM (BCA) UCL	0.383
144					95% KM (t) UCL	0.381					95% KM (Percentile Bootstrap) UCL	0.385
145					95% KM (z) UCL	0.38					95% KM Bootstrap t UCL	0.526
146					90% KM Chebyshev UCL	0.499					95% KM Chebyshev UCL	0.619
147					97.5% KM Chebyshev UCL	0.785					99% KM Chebyshev UCL	1.111

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.044	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.845	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.254	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.115	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)	0.383	k star (bias corrected MLE)	0.376
Theta hat (MLE)	1.712	Theta star (bias corrected MLE)	1.744
nu hat (MLE)	52.8	nu star (bias corrected)	51.83
Mean (detects)	0.655		

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	0.236
Maximum	11.5	Median	0.01
SD	1.23	CV	5.212
k hat (MLE)	0.3	k star (bias corrected MLE)	0.298
Theta hat (MLE)	0.788	Theta star (bias corrected MLE)	0.791
nu hat (MLE)	118	nu star (bias corrected)	117.5
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (117.55, α)	93.51	Adjusted Chi Square Value (117.55, β)	93.36
95% Gamma Approximate UCL (use when n>=50)	0.297	95% Gamma Adjusted UCL (use when n<50)	0.297

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.235	SD (KM)	1.226
Variance (KM)	1.504	SE of Mean (KM)	0.088
k hat (KM)	0.0368	k star (KM)	0.0396
nu hat (KM)	14.5	nu star (KM)	15.61
theta hat (KM)	6.394	theta star (KM)	5.938
80% gamma percentile (KM)	0.0123	90% gamma percentile (KM)	0.251
95% gamma percentile (KM)	1.122	99% gamma percentile (KM)	5.578

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (15.61, α)	7.687	Adjusted Chi Square Value (15.61, β)	7.646
95% Gamma Approximate KM-UCL (use when n>=50)	0.478	95% Gamma Adjusted KM-UCL (use when n<50)	0.48

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.906	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	1.8401E-5	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

	A–E	F	G–K	L
198	**Lognormal ROS Statistics Using Imputed Non-Detects**			
199	Mean in Original Scale	0.231	Mean in Log Scale	-5.147
200	SD in Original Scale	1.23	SD in Log Scale	2.571
201	95% t UCL (assumes normality of ROS data)	0.376	95% Percentile Bootstrap UCL	0.391
202	95% BCA Bootstrap UCL	0.451	95% Bootstrap t UCL	0.522
203	95% H-UCL (Log ROS)	0.325		
204				
205	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
206	KM Mean (logged)	-3.814	KM Geo Mean	0.0221
207	KM SD (logged)	1.518	95% Critical H Value (KM-Log)	2.682
208	KM Standard Error of Mean (logged)	0.109	95% H-UCL (KM -Log)	0.0935
209	KM SD (logged)	1.518	95% Critical H Value (KM-Log)	2.682
210	KM Standard Error of Mean (logged)	0.109		
211				
212	**DL/2 Statistics**			
213	**DL/2 Normal**		**DL/2 Log-Transformed**	
214	Mean in Original Scale	0.232	Mean in Log Scale	-4.237
215	SD in Original Scale	1.23	SD in Log Scale	1.782
216	95% t UCL (Assumes normality)	0.377	95% H-Stat UCL	0.103
217	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
218				
219	**Nonparametric Distribution Free UCL Statistics**			
220	**Data do not follow a Discernible Distribution at 5% Significance Level**			
221				
222	**Suggested UCL to Use**			
223	95% KM (Chebyshev) UCL	0.619		
224				
225	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
226	Recommendations are based upon data size, data distribution, and skewness.			
227	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
228	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
229				
230	**1,2-Dichloroethane**			
231				
232	**General Statistics**			
233	Total Number of Observations	197	Number of Distinct Observations	37
234	Number of Detects	36	Number of Non-Detects	161
235	Number of Distinct Detects	34	Number of Distinct Non-Detects	3
236	Minimum Detect	0.295	Minimum Non-Detect	0.25
237	Maximum Detect	5.45	Maximum Non-Detect	5
238	Variance Detects	2.003	Percent Non-Detects	81.73%
239	Mean Detects	1.52	SD Detects	1.415
240	Median Detects	0.911	CV Detects	0.931
241	Skewness Detects	1.654	Kurtosis Detects	1.881
242	Mean of Logged Detects	0.0761	SD of Logged Detects	0.813
243				
244	**Normal GOF Test on Detects Only**			
245	Shapiro Wilk Test Statistic	0.759	**Shapiro Wilk GOF Test**	
246	5% Shapiro Wilk Critical Value	0.935	Detected Data Not Normal at 5% Significance Level	
247	Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**	
248	5% Lilliefors Critical Value	0.145	Detected Data Not Normal at 5% Significance Level	
249	**Detected Data Not Normal at 5% Significance Level**			
250				
251	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
252	KM Mean	0.483	KM Standard Error of Mean	0.056
253	KM SD	0.773	95% KM (BCA) UCL	0.583
254	95% KM (t) UCL	0.575	95% KM (Percentile Bootstrap) UCL	0.578
255	95% KM (z) UCL	0.575	95% KM Bootstrap t UCL	0.605
256	90% KM Chebyshev UCL	0.651	95% KM Chebyshev UCL	0.727
257	97.5% KM Chebyshev UCL	0.832	99% KM Chebyshev UCL	1.04
258				
259	**Gamma GOF Tests on Detected Observations Only**			
260	A-D Test Statistic	1.229	**Anderson-Darling GOF Test**	
261	5% A-D Critical Value	0.765	Detected Data Not Gamma Distributed at 5% Significance Level	
262	K-S Test Statistic	0.162	**Kolmogorov-Smirnov GOF**	
263	5% K-S Critical Value	0.149	Detected Data Not Gamma Distributed at 5% Significance Level	
264	**Detected Data Not Gamma Distributed at 5% Significance Level**			

	A	B	C	D	E	F	G	H	I	J	K	L
265												
266	**Gamma Statistics on Detected Data Only**											
267					k hat (MLE)	1.607					k star (bias corrected MLE)	1.492
268					Theta hat (MLE)	0.945					Theta star (bias corrected MLE)	1.018
269					nu hat (MLE)	115.7					nu star (bias corrected)	107.4
270					Mean (detects)	1.52						
271												
272	**Gamma ROS Statistics using Imputed Non-Detects**											
273	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
274	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)											
275	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
276	This is especially true when the sample size is small.											
277	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
278					Minimum	0.01					Mean	0.286
279					Maximum	5.45					Median	0.01
280					SD	0.836					CV	2.926
281					k hat (MLE)	0.279					k star (bias corrected MLE)	0.278
282					Theta hat (MLE)	1.023					Theta star (bias corrected MLE)	1.026
283					nu hat (MLE)	110.1					nu star (bias corrected)	109.7
284					Adjusted Level of Significance (β)	0.0488						
285					Approximate Chi Square Value (109.72, α)	86.54					Adjusted Chi Square Value (109.72, β)	86.39
286					95% Gamma Approximate UCL (use when n>=50)	0.362					95% Gamma Adjusted UCL (use when n<50)	0.363
287												
288	**Estimates of Gamma Parameters using KM Estimates**											
289					Mean (KM)	0.483					SD (KM)	0.773
290					Variance (KM)	0.598					SE of Mean (KM)	0.056
291					k hat (KM)	0.39					k star (KM)	0.388
292					nu hat (KM)	153.7					nu star (KM)	152.7
293					theta hat (KM)	1.238					theta star (KM)	1.246
294					80% gamma percentile (KM)	0.776					90% gamma percentile (KM)	1.372
295					95% gamma percentile (KM)	2.029					99% gamma percentile (KM)	3.686
296												
297	**Gamma Kaplan-Meier (KM) Statistics**											
298					Approximate Chi Square Value (152.69, α)	125.1					Adjusted Chi Square Value (152.69, β)	124.9
299					95% Gamma Approximate KM-UCL (use when n>=50)	0.589					95% Gamma Adjusted KM-UCL (use when n<50)	0.59
300												
301	**Lognormal GOF Test on Detected Observations Only**											
302					Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**					
303					5% Shapiro Wilk Critical Value	0.935	Detected Data appear Lognormal at 5% Significance Level					
304					Lilliefors Test Statistic	0.112	**Lilliefors GOF Test**					
305					5% Lilliefors Critical Value	0.145	Detected Data appear Lognormal at 5% Significance Level					
306	**Detected Data appear Lognormal at 5% Significance Level**											
307												
308	**Lognormal ROS Statistics Using Imputed Non-Detects**											
309					Mean in Original Scale	0.352					Mean in Log Scale	-2.503
310					SD in Original Scale	0.819					SD in Log Scale	1.763
311					95% t UCL (assumes normality of ROS data)	0.449					95% Percentile Bootstrap UCL	0.453
312					95% BCA Bootstrap UCL	0.47					95% Bootstrap t UCL	0.482
313					95% H-UCL (Log ROS)	0.562						
314												
315	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
316					KM Mean (logged)	-1.118					KM Geo Mean	0.327
317					KM SD (logged)	0.662					95% Critical H Value (KM-Log)	1.914
318					KM Standard Error of Mean (logged)	0.0479					95% H-UCL (KM -Log)	0.446
319					KM SD (logged)	0.662					95% Critical H Value (KM-Log)	1.914
320					KM Standard Error of Mean (logged)	0.0479						
321												
322	**DL/2 Statistics**											
323	**DL/2 Normal**						**DL/2 Log-Transformed**					
324					Mean in Original Scale	0.394					Mean in Log Scale	-1.656
325					SD in Original Scale	0.819					SD in Log Scale	0.92
326					95% t UCL (Assumes normality)	0.491					95% H-Stat UCL	0.335
327	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
328												
329	**Nonparametric Distribution Free UCL Statistics**											
330	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
331												
332	**Suggested UCL to Use**											
333					KM H-UCL	0.446						

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.

1-Methylnaphthalene

General Statistics

Total Number of Observations	197	Number of Distinct Observations	24
Number of Detects	7	Number of Non-Detects	190
Number of Distinct Detects	7	Number of Distinct Non-Detects	17
Minimum Detect	5.62	Minimum Non-Detect	0.619
Maximum Detect	20.4	Maximum Non-Detect	12.5
Variance Detects	31.47	Percent Non-Detects	96.45%
Mean Detects	12.1	SD Detects	5.61
Median Detects	11.35	CV Detects	0.464
Skewness Detects	0.502	Kurtosis Detects	-0.972
Mean of Logged Detects	2.396	SD of Logged Detects	0.486

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	**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) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.028	KM Standard Error of Mean	0.18
KM SD	2.342	95% KM (BCA) UCL	1.827
95% KM (t) UCL	1.326	95% KM (Percentile Bootstrap) UCL	1.737
95% KM (z) UCL	1.325	95% KM Bootstrap t UCL	1.262
90% KM Chebyshev UCL	1.569	95% KM Chebyshev UCL	1.815
97.5% KM Chebyshev UCL	2.155	99% KM Chebyshev UCL	2.823

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.362	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.313	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)	5.296	k star (bias corrected MLE)	3.122
Theta hat (MLE)	2.285	Theta star (bias corrected MLE)	3.877
nu hat (MLE)	74.15	nu star (bias corrected)	43.7
Mean (detects)	12.1		

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	0.458
Maximum	20.4	Median	0.01
SD	2.453	CV	5.36
k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	2.197	Theta star (bias corrected MLE)	2.194
nu hat (MLE)	82.09	nu star (bias corrected)	82.18
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (82.18, α)	62.29	Adjusted Chi Square Value (82.18, β)	62.16
95% Gamma Approximate UCL (use when n>=50)	0.604	95% Gamma Adjusted UCL (use when n<50)	0.605

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.028	SD (KM)	2.342
Variance (KM)	5.486	SE of Mean (KM)	0.18
k hat (KM)	0.193	k star (KM)	0.193
nu hat (KM)	75.91	nu star (KM)	76.09
theta hat (KM)	5.336	theta star (KM)	5.324
80% gamma percentile (KM)	1.329	90% gamma percentile (KM)	3.108
95% gamma percentile (KM)	5.345	99% gamma percentile (KM)	11.54

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (76.09, α)	57	Adjusted Chi Square Value (76.09, β)	56.87
95% Gamma Approximate KM-UCL (use when n>=50)	1.373	95% Gamma Adjusted KM-UCL (use when n<50)	1.375
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.201	**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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.175	Mean in Log Scale	-0.753
SD in Original Scale	2.477	SD in Log Scale	1.304
95% t UCL (assumes normality of ROS data)	1.467	95% Percentile Bootstrap UCL	1.469
95% BCA Bootstrap UCL	1.554	95% Bootstrap t UCL	1.613
95% H-UCL (Log ROS)	1.387		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.377	KM Geo Mean	0.686
KM SD (logged)	0.54	95% Critical H Value (KM-Log)	1.839
KM Standard Error of Mean (logged)	0.0416	95% H-UCL (KM -Log)	0.852
KM SD (logged)	0.54	95% Critical H Value (KM-Log)	1.839
KM Standard Error of Mean (logged)	0.0416		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.036	Mean in Log Scale	-0.399
SD in Original Scale	2.379	SD in Log Scale	0.572
95% t UCL (Assumes normality)	1.316	95% H-Stat UCL	0.853
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	1.326		
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	197	Number of Distinct Observations	20
Number of Detects	2	Number of Non-Detects	195
Number of Distinct Detects	2	Number of Distinct Non-Detects	18
Minimum Detect	1.61	Minimum Non-Detect	0.619
Maximum Detect	9.93	Maximum Non-Detect	12.5
Variance Detects	34.61	Percent Non-Detects	98.98%
Mean Detects	5.77	SD Detects	5.883
Median Detects	5.77	CV Detects	1.02
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.386	SD of Logged Detects	1.286
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	0.672	KM Standard Error of Mean	0.0677
KM SD	0.668	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.784	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.783	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.875	95% KM Chebyshev UCL	0.967
97.5% KM Chebyshev UCL	1.095	99% KM Chebyshev UCL	1.345
Gamma GOF Tests on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.508	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.826	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.033	nu star (bias corrected)	N/A
Mean (detects)	5.77		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.672	SD (KM)	0.668
Variance (KM)	0.447	SE of Mean (KM)	0.0677
k hat (KM)	1.01	k star (KM)	0.998
nu hat (KM)	398	nu star (KM)	393.3
theta hat (KM)	0.665	theta star (KM)	0.673
80% gamma percentile (KM)	1.081	90% gamma percentile (KM)	1.548
95% gamma percentile (KM)	2.014	99% gamma percentile (KM)	3.097

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0488
Approximate Chi Square Value (393.26, α)	348.3	Adjusted Chi Square Value (393.26, β)	348
95% Gamma Approximate KM-UCL (use when n>=50)	0.759	95% Gamma Adjusted KM-UCL (use when n<50)	0.759

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	0.0587	Mean in Log Scale	-18.25
SD in Original Scale	0.716	SD in Log Scale	6.654
95% t UCL (assumes normality of ROS data)	0.143	95% Percentile Bootstrap UCL	0.16
95% BCA Bootstrap UCL	0.261	95% Bootstrap t UCL	37.82
95% H-UCL (Log ROS)	4076		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.461	KM Geo Mean	0.631
KM SD (logged)	0.209	95% Critical H Value (KM-Log)	1.693
KM Standard Error of Mean (logged)	0.0212	95% H-UCL (KM -Log)	0.661
KM SD (logged)	0.209	95% Critical H Value (KM-Log)	1.693
KM Standard Error of Mean (logged)	0.0212		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.706	Mean in Log Scale	-0.471
SD in Original Scale	0.86	SD in Log Scale	0.317
95% t UCL (Assumes normality)	0.808	95% H-Stat UCL	0.683

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	0.967		

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.

Acetophenone

General Statistics

Total Number of Observations	197	Number of Distinct Observations	23
Number of Detects	7	Number of Non-Detects	190
Number of Distinct Detects	7	Number of Distinct Non-Detects	16
Minimum Detect	1.68	Minimum Non-Detect	0.619
Maximum Detect	903	Maximum Non-Detect	1.32
Variance Detects	166501	Percent Non-Detects	96.45%
Mean Detects	289.7	SD Detects	408
Median Detects	122	CV Detects	1.408
Skewness Detects	1.16	Kurtosis Detects	-0.881
Mean of Logged Detects	3.889	SD of Logged Detects	2.566

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.703	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.367	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	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	10.89	KM Standard Error of Mean	6.855
KM SD	89.08	95% KM (BCA) UCL	24.72
95% KM (t) UCL	22.22	95% KM (Percentile Bootstrap) UCL	23.89
95% KM (z) UCL	22.17	95% KM Bootstrap t UCL	68.63
90% KM Chebyshev UCL	31.46	95% KM Chebyshev UCL	40.77
97.5% KM Chebyshev UCL	53.7	99% KM Chebyshev UCL	79.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.435	**Anderson-Darling GOF Test**

	A	B	C	D	E	F	G	H	I	J	K	L
568					5% A-D Critical Value	0.772	Detected data appear Gamma Distributed at 5% Significance Level					
569					K-S Test Statistic	0.218	**Kolmogorov-Smirnov GOF**					
570					5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level					
571	**Detected data appear Gamma Distributed at 5% Significance Level**											
572												
573	**Gamma Statistics on Detected Data Only**											
574					k hat (MLE)	0.374					k star (bias corrected MLE)	0.309
575					Theta hat (MLE)	775.3					Theta star (bias corrected MLE)	938.3
576					nu hat (MLE)	5.232					nu star (bias corrected)	4.323
577					Mean (detects)	289.7						
578												
579	**Gamma ROS Statistics using Imputed Non-Detects**											
580	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
581	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)											
582	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
583	This is especially true when the sample size is small.											
584	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
585					Minimum	0.01					Mean	10.3
586					Maximum	903					Median	0.01
587					SD	89.38					CV	8.673
588					k hat (MLE)	0.12					k star (bias corrected MLE)	0.121
589					Theta hat (MLE)	86.19					Theta star (bias corrected MLE)	85.07
590					nu hat (MLE)	47.11					nu star (bias corrected)	47.72
591					Adjusted Level of Significance (β)	0.0488						
592					Approximate Chi Square Value (47.72, α)	32.87					Adjusted Chi Square Value (47.72, β)	32.78
593					95% Gamma Approximate UCL (use when n>=50)	14.96					95% Gamma Adjusted UCL (use when n<50)	15
594												
595	**Estimates of Gamma Parameters using KM Estimates**											
596					Mean (KM)	10.89					SD (KM)	89.08
597					Variance (KM)	7936					SE of Mean (KM)	6.855
598					k hat (KM)	0.015					k star (KM)	0.0181
599					nu hat (KM)	5.89					nu star (KM)	7.134
600					theta hat (KM)	728.6					theta star (KM)	601.6
601					80% gamma percentile (KM)	0.00152					90% gamma percentile (KM)	1.02
602					95% gamma percentile (KM)	20.86					99% gamma percentile (KM)	307.2
603												
604	**Gamma Kaplan-Meier (KM) Statistics**											
605					Approximate Chi Square Value (7.13, α)	2.244					Adjusted Chi Square Value (7.13, β)	2.224
606					95% Gamma Approximate KM-UCL (use when n>=50)	34.62					95% Gamma Adjusted KM-UCL (use when n<50)	34.93
607												
608	**Lognormal GOF Test on Detected Observations Only**											
609					Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk GOF Test**					
610					5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level					
611					Lilliefors Test Statistic	0.211	**Lilliefors GOF Test**					
612					5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level					
613	**Detected Data appear Lognormal at 5% Significance Level**											
614												
615	**Lognormal ROS Statistics Using Imputed Non-Detects**											
616					Mean in Original Scale	10.3					Mean in Log Scale	-15.39
617					SD in Original Scale	89.38					SD in Log Scale	8.036
618					95% t UCL (assumes normality of ROS data)	20.82					95% Percentile Bootstrap UCL	23.01
619					95% BCA Bootstrap UCL	27.75					95% Bootstrap t UCL	103.2
620					95% H-UCL (Log ROS)	1.337E+1(						
621												

622	Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
623	KM Mean (logged)	-0.324	KM Geo Mean	0.723
624	KM SD (logged)	0.924	95% Critical H Value (KM-Log)	2.111
625	KM Standard Error of Mean (logged)	0.0711	95% H-UCL (KM -Log)	1.274
626	KM SD (logged)	0.924	95% Critical H Value (KM-Log)	2.111
627	KM Standard Error of Mean (logged)	0.0711		
628				
629	DL/2 Statistics			
630	DL/2 Normal		DL/2 Log-Transformed	
631	Mean in Original Scale	10.87	Mean in Log Scale	-0.357
632	SD in Original Scale	89.31	SD in Log Scale	0.934
633	95% t UCL (Assumes normality)	21.39	95% H-Stat UCL	1.246
634	DL/2 is not a recommended method, provided for comparisons and historical reasons			
635				
636	Nonparametric Distribution Free UCL Statistics			
637	Detected Data appear Gamma Distributed at 5% Significance Level			
638				
639	Suggested UCL to Use			
640	95% KM Approximate Gamma UCL	34.62		
641				
642	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
643	Recommendations are based upon data size, data distribution, and skewness.			
644	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
645	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
646				
647	Benzene			
648				
649	General Statistics			
650	Total Number of Observations	197	Number of Distinct Observations	15
651	Number of Detects	12	Number of Non-Detects	185
652	Number of Distinct Detects	12	Number of Distinct Non-Detects	3
653	Minimum Detect	0.538	Minimum Non-Detect	0.25
654	Maximum Detect	2170	Maximum Non-Detect	1.25
655	Variance Detects	627742	Percent Non-Detects	93.91%
656	Mean Detects	433.3	SD Detects	792.3
657	Median Detects	5.373	CV Detects	1.829
658	Skewness Detects	1.84	Kurtosis Detects	2.059
659	Mean of Logged Detects	2.815	SD of Logged Detects	3.283
660				
661	Normal GOF Test on Detects Only			
662	Shapiro Wilk Test Statistic	0.607	Shapiro Wilk GOF Test	
663	5% Shapiro Wilk Critical Value	0.859	Detected Data Not Normal at 5% Significance Level	
664	Lilliefors Test Statistic	0.358	Lilliefors GOF Test	
665	5% Lilliefors Critical Value	0.243	Detected Data Not Normal at 5% Significance Level	
666	Detected Data Not Normal at 5% Significance Level			
667				
668	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
669	KM Mean	26.63	KM Standard Error of Mean	15.92
670	KM SD	214	95% KM (BCA) UCL	56.9
671	95% KM (t) UCL	52.94	95% KM (Percentile Bootstrap) UCL	53.75
672	95% KM (z) UCL	52.82	95% KM Bootstrap t UCL	159.6
673	90% KM Chebyshev UCL	74.39	95% KM Chebyshev UCL	96.03
674	97.5% KM Chebyshev UCL	126.1	99% KM Chebyshev UCL	185
675				
676	Gamma GOF Tests on Detected Observations Only			
677	A-D Test Statistic	0.977	Anderson-Darling GOF Test	
678	5% A-D Critical Value	0.861	Detected Data Not Gamma Distributed at 5% Significance Level	
679	K-S Test Statistic	0.275	Kolmogorov-Smirnov GOF	
680	5% K-S Critical Value	0.27	Detected Data Not Gamma Distributed at 5% Significance Level	
681	Detected Data Not Gamma Distributed at 5% Significance Level			
682				
683	Gamma Statistics on Detected Data Only			
684	k hat (MLE)	0.222	k star (bias corrected MLE)	0.222
685	Theta hat (MLE)	1949	Theta star (bias corrected MLE)	1950
686	nu hat (MLE)	5.334	nu star (bias corrected)	5.334
687	Mean (detects)	433.3		
688				
689	Gamma ROS Statistics using Imputed Non-Detects			
690	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
691	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)			
692	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
693	This is especially true when the sample size is small.			
694	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			

	A B C D E	F	G H I J K	L
695	Minimum	0.01	Mean	26.4
696	Maximum	2170	Median	0.01
697	SD	214.5	CV	8.126
698	k hat (MLE)	0.108	k star (bias corrected MLE)	0.11
699	Theta hat (MLE)	243.9	Theta star (bias corrected MLE)	240.1
700	nu hat (MLE)	42.65	nu star (bias corrected)	43.33
701	Adjusted Level of Significance (β)	0.0488		
702	Approximate Chi Square Value (43.33, α)	29.24	Adjusted Chi Square Value (43.33, β)	29.15
703	95% Gamma Approximate UCL (use when n>=50)	39.13	95% Gamma Adjusted UCL (use when n<50)	39.24
704				
705	**Estimates of Gamma Parameters using KM Estimates**			
706	Mean (KM)	26.63	SD (KM)	214
707	Variance (KM)	45778	SE of Mean (KM)	15.92
708	k hat (KM)	0.0155	k star (KM)	0.0186
709	nu hat (KM)	6.102	nu star (KM)	7.343
710	theta hat (KM)	1719	theta star (KM)	1429
711	80% gamma percentile (KM)	0.00514	90% gamma percentile (KM)	2.861
712	95% gamma percentile (KM)	53.89	99% gamma percentile (KM)	749.3
713				
714	**Gamma Kaplan-Meier (KM) Statistics**			
715	Approximate Chi Square Value (7.34, α)	2.361	Adjusted Chi Square Value (7.34, β)	2.34
716	95% Gamma Approximate KM-UCL (use when n>=50)	82.83	95% Gamma Adjusted KM-UCL (use when n<50)	83.56
717				
718	**Lognormal GOF Test on Detected Observations Only**			
719	Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**	
720	5% Shapiro Wilk Critical Value	0.859	Detected Data Not Lognormal at 5% Significance Level	
721	Lilliefors Test Statistic	0.196	**Lilliefors GOF Test**	
722	5% Lilliefors Critical Value	0.243	Detected Data appear Lognormal at 5% Significance Level	
723	**Detected Data appear Approximate Lognormal at 5% Significance Level**			
724				
725	**Lognormal ROS Statistics Using Imputed Non-Detects**			
726	Mean in Original Scale	26.4	Mean in Log Scale	-16.38
727	SD in Original Scale	214.5	SD in Log Scale	9.592
728	95% t UCL (assumes normality of ROS data)	51.66	95% Percentile Bootstrap UCL	55.19
729	95% BCA Bootstrap UCL	68.57	95% Bootstrap t UCL	121
730	95% H-UCL (Log ROS)	6.710E+16		
731				
732	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
733	KM Mean (logged)	-1.13	KM Geo Mean	0.323
734	KM SD (logged)	1.269	95% Critical H Value (KM-Log)	2.427
735	KM Standard Error of Mean (logged)	0.0945	95% H-UCL (KM -Log)	0.901
736	KM SD (logged)	1.269	95% Critical H Value (KM-Log)	2.427
737	KM Standard Error of Mean (logged)	0.0945		
738				
739	**DL/2 Statistics**			
740	**DL/2 Normal**		**DL/2 Log-Transformed**	
741	Mean in Original Scale	26.53	Mean in Log Scale	-1.703
742	SD in Original Scale	214.5	SD in Log Scale	1.411
743	95% t UCL (Assumes normality)	51.78	95% H-Stat UCL	0.639
744	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
745				
746	**Nonparametric Distribution Free UCL Statistics**			
747	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**			
748				
749	**Suggested UCL to Use**			
750	KM H-UCL	0.901		
751				
752	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
753	Recommendations are based upon data size, data distribution, and skewness.			
754	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
755	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
756				
757	**Ethylbenzene**			
758				
759	**General Statistics**			
760	Total Number of Observations	197	Number of Distinct Observations	14
761	Number of Detects	10	Number of Non-Detects	187
762	Number of Distinct Detects	10	Number of Distinct Non-Detects	4
763	Minimum Detect	2.71	Minimum Non-Detect	0.25
764	Maximum Detect	903	Maximum Non-Detect	1.25
765	Variance Detects	111403	Percent Non-Detects	94.92%
766	Mean Detects	204.7	SD Detects	333.8
767	Median Detects	57.6	CV Detects	1.63
768	Skewness Detects	1.72	Kurtosis Detects	1.506
769	Mean of Logged Detects	3.756	SD of Logged Detects	2.075

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.651	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.262	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	10.63	KM Standard Error of Mean	6.33
KM SD	84.29	95% KM (BCA) UCL	22.96
95% KM (t) UCL	21.09	95% KM (Percentile Bootstrap) UCL	21.09
95% KM (z) UCL	21.04	95% KM Bootstrap t UCL	61.02
90% KM Chebyshev UCL	29.62	95% KM Chebyshev UCL	38.22
97.5% KM Chebyshev UCL	50.16	99% KM Chebyshev UCL	73.61
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.579	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.792	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.212	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.284	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)	0.417	k star (bias corrected MLE)	0.359
Theta hat (MLE)	490.5	Theta star (bias corrected MLE)	570.6
nu hat (MLE)	8.347	nu star (bias corrected)	7.176
Mean (detects)	204.7		
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	0.01	Mean	10.4
Maximum	903	Median	0.01
SD	84.53	CV	8.126
k hat (MLE)	0.121	k star (bias corrected MLE)	0.123
Theta hat (MLE)	85.69	Theta star (bias corrected MLE)	84.62
nu hat (MLE)	47.83	nu star (bias corrected)	48.43
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (48.43, α)	33.46	Adjusted Chi Square Value (48.43, β)	33.37
95% Gamma Approximate UCL (use when n>=50)	15.06	95% Gamma Adjusted UCL (use when n<50)	15.1
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	10.63	SD (KM)	84.29
Variance (KM)	7104	SE of Mean (KM)	6.33
k hat (KM)	0.0159	k star (KM)	0.019
nu hat (KM)	6.266	nu star (KM)	7.504
theta hat (KM)	668.3	theta star (KM)	558.1
80% gamma percentile (KM)	0.0026	90% gamma percentile (KM)	1.263
95% gamma percentile (KM)	22.39	99% gamma percentile (KM)	298.6
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (7.50, α)	2.451	Adjusted Chi Square Value (7.50, β)	2.43
95% Gamma Approximate KM-UCL (use when n>=50)	32.54	95% Gamma Adjusted KM-UCL (use when n<50)	32.82
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.262	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	10.44	Mean in Log Scale	-9.87
SD in Original Scale	84.52	SD in Log Scale	6.554
95% t UCL (assumes normality of ROS data)	20.4	95% Percentile Bootstrap UCL	21.39
95% BCA Bootstrap UCL	26.9	95% Bootstrap t UCL	83.92
95% H-UCL (Log ROS)	8070035		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-1.125	KM Geo Mean	0.325
KM SD (logged)	1.213	95% Critical H Value (KM-Log)	2.371
KM Standard Error of Mean (logged)	0.0911	95% H-UCL (KM -Log)	0.832
KM SD (logged)	1.213	95% Critical H Value (KM-Log)	2.371
KM Standard Error of Mean (logged)	0.0911		

	A	B	C	D	E	F	G	H	I	J	K	L
848												
849	DL/2 Statistics											
850	DL/2 Normal						DL/2 Log-Transformed					
851	Mean in Original Scale					10.53	Mean in Log Scale					-1.699
852	SD in Original Scale					84.51	SD in Log Scale					1.362
853	95% t UCL (Assumes normality)					20.48	95% H-Stat UCL					0.591
854	DL/2 is not a recommended method, provided for comparisons and historical reasons											
855												
856	Nonparametric Distribution Free UCL Statistics											
857	Detected Data appear Gamma Distributed at 5% Significance Level											
858												
859	Suggested UCL to Use											
860	95% KM Approximate Gamma UCL					32.54						
861												
862	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
863	Recommendations are based upon data size, data distribution, and skewness.											
864	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
865	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
866												
867	Lead											
868												
869	General Statistics											
870	Total Number of Observations					197	Number of Distinct Observations					15
871	Number of Detects					7	Number of Non-Detects					190
872	Number of Distinct Detects					7	Number of Distinct Non-Detects					8
873	Minimum Detect					1.54	Minimum Non-Detect					1.5
874	Maximum Detect					5.3	Maximum Non-Detect					3
875	Variance Detects					2.118	Percent Non-Detects					96.45%
876	Mean Detects					3.079	SD Detects					1.455
877	Median Detects					2.18	CV Detects					0.473
878	Skewness Detects					0.612	Kurtosis Detects					-1.534
879	Mean of Logged Detects					1.029	SD of Logged Detects					0.47
880												
881	Normal GOF Test on Detects Only											
882	Shapiro Wilk Test Statistic					0.871	Shapiro Wilk GOF Test					
883	5% Shapiro Wilk Critical Value					0.803	Detected Data appear Normal at 5% Significance Level					
884	Lilliefors Test Statistic					0.303	Lilliefors GOF Test					
885	5% Lilliefors Critical Value					0.304	Detected Data appear Normal at 5% Significance Level					
886	Detected Data appear Normal at 5% Significance Level											
887												
888	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
889	KM Mean					1.556	KM Standard Error of Mean					0.0298
890	KM SD					0.387	95% KM (BCA) UCL					1.617
891	95% KM (t) UCL					1.606	95% KM (Percentile Bootstrap) UCL					1.607
892	95% KM (z) UCL					1.606	95% KM Bootstrap t UCL					1.62
893	90% KM Chebyshev UCL					1.646	95% KM Chebyshev UCL					1.687
894	97.5% KM Chebyshev UCL					1.743	99% KM Chebyshev UCL					1.853
895												
896	Gamma GOF Tests on Detected Observations Only											
897	A-D Test Statistic					0.507	Anderson-Darling GOF Test					
898	5% A-D Critical Value					0.71	Detected data appear Gamma Distributed at 5% Significance Level					
899	K-S Test Statistic					0.301	Kolmogorov-Smirnov GOF					
900	5% K-S Critical Value					0.313	Detected data appear Gamma Distributed at 5% Significance Level					
901	Detected data appear Gamma Distributed at 5% Significance Level											
902												
903	Gamma Statistics on Detected Data Only											
904	k hat (MLE)					5.41	k star (bias corrected MLE)					3.187
905	Theta hat (MLE)					0.569	Theta star (bias corrected MLE)					0.966
906	nu hat (MLE)					75.74	nu star (bias corrected)					44.61
907	Mean (detects)					3.079						
908												
909	Gamma ROS Statistics using Imputed Non-Detects											
910	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
911	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)											
912	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
913	This is especially true when the sample size is small.											
914	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
915	Minimum					0.01	Mean					0.133
916	Maximum					5.3	Median					0.01
917	SD					0.63	CV					4.72
918	k hat (MLE)					0.301	k star (bias corrected MLE)					0.299
919	Theta hat (MLE)					0.444	Theta star (bias corrected MLE)					0.445
920	nu hat (MLE)					118.5	nu star (bias corrected)					118
921	Adjusted Level of Significance (β)					0.0488						
922	Approximate Chi Square Value (118.00, α)					93.92	Adjusted Chi Square Value (118.00, β)					93.76
923	95% Gamma Approximate UCL (use when n>=50)					0.168	95% Gamma Adjusted UCL (use when n<50)					0.168
924												

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	1.556	SD (KM)	0.387
Variance (KM)	0.15	SE of Mean (KM)	0.0298
k hat (KM)	16.14	k star (KM)	15.9
nu hat (KM)	6360	nu star (KM)	6265
theta hat (KM)	0.0964	theta star (KM)	0.0979
80% gamma percentile (KM)	1.872	90% gamma percentile (KM)	2.073
95% gamma percentile (KM)	2.249	99% gamma percentile (KM)	2.605
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, α)	6082	Adjusted Chi Square Value (N/A, β)	6080
95% Gamma Approximate KM-UCL (use when n>=50)	1.603	95% Gamma Adjusted KM-UCL (use when n<50)	1.604
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.897	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**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			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.298	Mean in Log Scale	-2.262
SD in Original Scale	0.643	SD in Log Scale	1.449
95% t UCL (assumes normality of ROS data)	0.374	95% Percentile Bootstrap UCL	0.376
95% BCA Bootstrap UCL	0.4	95% Bootstrap t UCL	0.405
95% H-UCL (Log ROS)	0.389		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.428	KM Geo Mean	1.534
KM SD (logged)	0.142	95% Critical H Value (KM-Log)	1.675
KM Standard Error of Mean (logged)	0.0109	95% H-UCL (KM -Log)	1.576
KM SD (logged)	0.142	95% Critical H Value (KM-Log)	1.675
KM Standard Error of Mean (logged)	0.0109		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.874	Mean in Log Scale	-0.199
SD in Original Scale	0.516	SD in Log Scale	0.286
95% t UCL (Assumes normality)	0.935	95% H-Stat UCL	0.885
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	1.606		
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	197	Number of Distinct Observations	13
Number of Detects	9	Number of Non-Detects	188
Number of Distinct Detects	9	Number of Distinct Non-Detects	4
Minimum Detect	0.938	Minimum Non-Detect	0.25
Maximum Detect	35	Maximum Non-Detect	1.25
Variance Detects	139.7	Percent Non-Detects	95.43%
Mean Detects	9.975	SD Detects	11.82
Median Detects	4.88	CV Detects	1.185
Skewness Detects	1.555	Kurtosis Detects	1.57
Mean of Logged Detects	1.639	SD of Logged Detects	1.273
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.782	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
998	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
999					KM Mean	0.694					KM Standard Error of Mean	0.237
1000					KM SD	3.13					95% KM (BCA) UCL	1.116
1001					95% KM (t) UCL	1.085					95% KM (Percentile Bootstrap) UCL	1.094
1002					95% KM (z) UCL	1.083					95% KM Bootstrap t UCL	1.735
1003					90% KM Chebyshev UCL	1.404					95% KM Chebyshev UCL	1.725
1004					97.5% KM Chebyshev UCL	2.172					99% KM Chebyshev UCL	3.048
1005												
1006	**Gamma GOF Tests on Detected Observations Only**											
1007					A-D Test Statistic	0.307	**Anderson-Darling GOF Test**					
1008					5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level					
1009					K-S Test Statistic	0.152	**Kolmogorov-Smirnov GOF**					
1010					5% K-S Critical Value	0.288	Detected data appear Gamma Distributed at 5% Significance Level					
1011	**Detected data appear Gamma Distributed at 5% Significance Level**											
1012												
1013	**Gamma Statistics on Detected Data Only**											
1014					k hat (MLE)	0.886					k star (bias corrected MLE)	0.664
1015					Theta hat (MLE)	11.26					Theta star (bias corrected MLE)	15.01
1016					nu hat (MLE)	15.94					nu star (bias corrected)	11.96
1017					Mean (detects)	9.975						
1018												
1019	**Gamma ROS Statistics using Imputed Non-Detects**											
1020	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1021	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)											
1022	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1023	This is especially true when the sample size is small.											
1024	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1025					Minimum	0.01					Mean	0.465
1026					Maximum	35					Median	0.01
1027					SD	3.171					CV	6.815
1028					k hat (MLE)	0.206					k star (bias corrected MLE)	0.206
1029					Theta hat (MLE)	2.258					Theta star (bias corrected MLE)	2.255
1030					nu hat (MLE)	81.19					nu star (bias corrected)	81.28
1031					Adjusted Level of Significance (β)	0.0488						
1032					Approximate Chi Square Value (81.28, α)	61.51					Adjusted Chi Square Value (81.28, β)	61.38
1033					95% Gamma Approximate UCL (use when n>=50)	0.615					95% Gamma Adjusted UCL (use when n<50)	0.616
1034												
1035	**Estimates of Gamma Parameters using KM Estimates**											
1036					Mean (KM)	0.694					SD (KM)	3.13
1037					Variance (KM)	9.798					SE of Mean (KM)	0.237
1038					k hat (KM)	0.0492					k star (KM)	0.0518
1039					nu hat (KM)	19.39					nu star (KM)	20.42
1040					theta hat (KM)	14.11					theta star (KM)	13.39
1041					80% gamma percentile (KM)	0.107					90% gamma percentile (KM)	1.11
1042					95% gamma percentile (KM)	3.739					99% gamma percentile (KM)	14.89
1043												
1044	**Gamma Kaplan-Meier (KM) Statistics**											
1045					Approximate Chi Square Value (20.42, α)	11.16					Adjusted Chi Square Value (20.42, β)	11.11
1046					95% Gamma Approximate KM-UCL (use when n>=50)	1.27					95% Gamma Adjusted KM-UCL (use when n<50)	1.276
1047												
1048	**Lognormal GOF Test on Detected Observations Only**											
1049					Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk GOF Test**					
1050					5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level					
1051					Lilliefors Test Statistic	0.119	**Lilliefors GOF Test**					
1052					5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level					
1053	**Detected Data appear Lognormal at 5% Significance Level**											
1054												
1055	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1056					Mean in Original Scale	0.486					Mean in Log Scale	-7.125
1057					SD in Original Scale	3.17					SD in Log Scale	4.122
1058					95% t UCL (assumes normality of ROS data)	0.859					95% Percentile Bootstrap UCL	0.891
1059					95% BCA Bootstrap UCL	1.044					95% Bootstrap t UCL	1.533
1060					95% H-UCL (Log ROS)	22.61						
1061												
1062	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1063					KM Mean (logged)	-1.248					KM Geo Mean	0.287
1064					KM SD (logged)	0.682					95% Critical H Value (KM-Log)	1.927
1065					KM Standard Error of Mean (logged)	0.0515					95% H-UCL (KM -Log)	0.398
1066					KM SD (logged)	0.682					95% Critical H Value (KM-Log)	1.927
1067					KM Standard Error of Mean (logged)	0.0515						
1068												
1069	**DL/2 Statistics**											
1070			**DL/2 Normal**						**DL/2 Log-Transformed**			
1071					Mean in Original Scale	0.592					Mean in Log Scale	-1.818
1072					SD in Original Scale	3.153					SD in Log Scale	0.838
1073					95% t UCL (Assumes normality)	0.964					95% H-Stat UCL	0.261
1074	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.085		

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.

Toluene

General Statistics

Total Number of Observations	197	Number of Distinct Observations	9
Number of Detects	5	Number of Non-Detects	192
Number of Distinct Detects	5	Number of Distinct Non-Detects	4
Minimum Detect	0.308	Minimum Non-Detect	0.25
Maximum Detect	2880	Maximum Non-Detect	1.25
Variance Detects	1921703	Percent Non-Detects	97.46%
Mean Detects	1372	SD Detects	1386
Median Detects	561	CV Detects	1.01
Skewness Detects	0.48	Kurtosis Detects	-3.099
Mean of Logged Detects	5.481	SD of Logged Detects	3.811

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.793	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	**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	35.07	KM Standard Error of Mean	23.3
KM SD	292.5	95% KM (BCA) UCL	73.24
95% KM (t) UCL	73.59	95% KM (Percentile Bootstrap) UCL	76.08
95% KM (z) UCL	73.4	95% KM Bootstrap t UCL	121.9
90% KM Chebyshev UCL	105	95% KM Chebyshev UCL	136.6
97.5% KM Chebyshev UCL	180.6	99% KM Chebyshev UCL	266.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.613	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.331	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.377	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)	0.381	k star (bias corrected MLE)	0.286
Theta hat (MLE)	3606	Theta star (bias corrected MLE)	4806
nu hat (MLE)	3.805	nu star (bias corrected)	2.855
Mean (detects)	1372		

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	34.84
Maximum	2880	Median	0.01
SD	293.3	CV	8.419
k hat (MLE)	0.102	k star (bias corrected MLE)	0.104
Theta hat (MLE)	339.9	Theta star (bias corrected MLE)	334
nu hat (MLE)	40.38	nu star (bias corrected)	41.1
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (41.10, α)	27.4	Adjusted Chi Square Value (41.10, β)	27.32
95% Gamma Approximate UCL (use when n>=50)	52.25	95% Gamma Adjusted UCL (use when n<50)	52.4

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	35.07	SD (KM)	292.5
Variance (KM)	85584	SE of Mean (KM)	23.3
k hat (KM)	0.0144	k star (KM)	0.0175
nu hat (KM)	5.663	nu star (KM)	6.91
theta hat (KM)	2440	theta star (KM)	2000
80% gamma percentile (KM)	0.0034	90% gamma percentile (KM)	2.806
95% gamma percentile (KM)	63.05	99% gamma percentile (KM)	991.1

	A B C D E	F	G H I J K	L
1156				
1157	**Gamma Kaplan-Meier (KM) Statistics**			
1158	Approximate Chi Square Value (6.91, α)	2.121	Adjusted Chi Square Value (6.91, β)	2.102
1159	95% Gamma Approximate KM-UCL (use when n>=50)	114.2	95% Gamma Adjusted KM-UCL (use when n<50)	115.3
1160				
1161	**Lognormal GOF Test on Detected Observations Only**			
1162	Shapiro Wilk Test Statistic	0.721	**Shapiro Wilk GOF Test**	
1163	5% Shapiro Wilk Critical Value	0.762	Detected Data Not Lognormal at 5% Significance Level	
1164	Lilliefors Test Statistic	0.388	**Lilliefors GOF Test**	
1165	5% Lilliefors Critical Value	0.343	Detected Data Not Lognormal at 5% Significance Level	
1166	**Detected Data Not Lognormal at 5% Significance Level**			
1167				
1168	**Lognormal ROS Statistics Using Imputed Non-Detects**			
1169	Mean in Original Scale	34.84	Mean in Log Scale	-21.41
1170	SD in Original Scale	293.3	SD in Log Scale	11.34
1171	95% t UCL (assumes normality of ROS data)	69.38	95% Percentile Bootstrap UCL	69.76
1172	95% BCA Bootstrap UCL	93.02	95% Bootstrap t UCL	186.8
1173	95% H-UCL (Log ROS)	N/A		
1174				
1175	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
1176	KM Mean (logged)	-1.212	KM Geo Mean	0.298
1177	KM SD (logged)	1.209	95% Critical H Value (KM-Log)	2.367
1178	KM Standard Error of Mean (logged)	0.0963	95% H-UCL (KM -Log)	0.758
1179	KM SD (logged)	1.209	95% Critical H Value (KM-Log)	2.367
1180	KM Standard Error of Mean (logged)	0.0963		
1181				
1182	**DL/2 Statistics**			
1183	**DL/2 Normal**		**DL/2 Log-Transformed**	
1184	Mean in Original Scale	34.97	Mean in Log Scale	-1.782
1185	SD in Original Scale	293.3	SD in Log Scale	1.321
1186	95% t UCL (Assumes normality)	69.51	95% H-Stat UCL	0.509
1187	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
1188				
1189	**Nonparametric Distribution Free UCL Statistics**			
1190	**Detected Data appear Normal Distributed at 5% Significance Level**			
1191				
1192	**Suggested UCL to Use**			
1193	95% KM (t) UCL	73.59		
1194				
1195	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
1196	Recommendations are based upon data size, data distribution, and skewness.			
1197	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
1198	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
1199				
1200	**Xylenes (total)**			
1201				
1202	**General Statistics**			
1203	Total Number of Observations	197	Number of Distinct Observations	9
1204	Number of Detects	5	Number of Non-Detects	192
1205	Number of Distinct Detects	5	Number of Distinct Non-Detects	4
1206	Minimum Detect	16.4	Minimum Non-Detect	0.75
1207	Maximum Detect	537	Maximum Non-Detect	3.75
1208	Variance Detects	63645	Percent Non-Detects	97.46%
1209	Mean Detects	263	SD Detects	252.3
1210	Median Detects	132	CV Detects	0.959
1211	Skewness Detects	0.481	Kurtosis Detects	-3.12
1212	Mean of Logged Detects	4.961	SD of Logged Detects	1.445
1213				
1214	**Normal GOF Test on Detects Only**			
1215	Shapiro Wilk Test Statistic	0.802	**Shapiro Wilk GOF Test**	
1216	5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level	
1217	Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**	
1218	5% Lilliefors Critical Value	0.343	Detected Data appear Normal at 5% Significance Level	
1219	**Detected Data appear Normal at 5% Significance Level**			
1220				
1221	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
1222	KM Mean	7.405	KM Standard Error of Mean	4.358
1223	KM SD	54.71	95% KM (BCA) UCL	15.05
1224	95% KM (t) UCL	14.61	95% KM (Percentile Bootstrap) UCL	N/A
1225	95% KM (z) UCL	14.57	95% KM Bootstrap t UCL	20.14
1226	90% KM Chebyshev UCL	20.48	95% KM Chebyshev UCL	26.4
1227	97.5% KM Chebyshev UCL	34.62	99% KM Chebyshev UCL	50.77
1228				
1229	**Gamma GOF Tests on Detected Observations Only**			
1230	A-D Test Statistic	0.379	**Anderson-Darling GOF Test**	
1231	5% A-D Critical Value	0.693	Detected data appear Gamma Distributed at 5% Significance Level	
1232	K-S Test Statistic	0.266	**Kolmogorov-Smirnov GOF**	
1233	5% K-S Critical Value	0.365	Detected data appear Gamma Distributed at 5% Significance Level	
1234	**Detected data appear Gamma Distributed at 5% Significance Level**			
1235				

	A–E	F	G–K	L
1236	**Gamma Statistics on Detected Data Only**			
1237	k hat (MLE)	0.95	k star (bias corrected MLE)	0.513
1238	Theta hat (MLE)	276.7	Theta star (bias corrected MLE)	512.1
1239	nu hat (MLE)	9.503	nu star (bias corrected)	5.135
1240	Mean (detects)	263		
1241				
1242	**Gamma ROS Statistics using Imputed Non-Detects**			
1243	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
1244	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)			
1245	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
1246	This is especially true when the sample size is small.			
1247	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
1248	Minimum	0.01	Mean	6.684
1249	Maximum	537	Median	0.01
1250	SD	54.94	CV	8.219
1251	k hat (MLE)	0.126	k star (bias corrected MLE)	0.127
1252	Theta hat (MLE)	53.12	Theta star (bias corrected MLE)	52.51
1253	nu hat (MLE)	49.57	nu star (bias corrected)	50.15
1254	Adjusted Level of Significance (β)	0.0488		
1255	Approximate Chi Square Value (50.15, α)	34.89	Adjusted Chi Square Value (50.15, β)	34.8
1256	95% Gamma Approximate UCL (use when n>=50)	9.607	95% Gamma Adjusted UCL (use when n<50)	9.633
1257				
1258	**Estimates of Gamma Parameters using KM Estimates**			
1259	Mean (KM)	7.405	SD (KM)	54.71
1260	Variance (KM)	2993	SE of Mean (KM)	4.358
1261	k hat (KM)	0.0183	k star (KM)	0.0214
1262	nu hat (KM)	7.218	nu star (KM)	8.442
1263	theta hat (KM)	404.2	theta star (KM)	345.6
1264	80% gamma percentile (KM)	0.00592	90% gamma percentile (KM)	1.451
1265	95% gamma percentile (KM)	19	99% gamma percentile (KM)	205.1
1266				
1267	**Gamma Kaplan-Meier (KM) Statistics**			
1268	Approximate Chi Square Value (8.44, α)	2.994	Adjusted Chi Square Value (8.44, β)	2.97
1269	95% Gamma Approximate KM-UCL (use when n>=50)	20.88	95% Gamma Adjusted KM-UCL (use when n<50)	21.05
1270				
1271	**Lognormal GOF Test on Detected Observations Only**			
1272	Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk GOF Test**	
1273	5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
1274	Lilliefors Test Statistic	0.219	**Lilliefors GOF Test**	
1275	5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level	
1276	**Detected Data appear Lognormal at 5% Significance Level**			
1277				
1278	**Lognormal ROS Statistics Using Imputed Non-Detects**			
1279	Mean in Original Scale	6.971	Mean in Log Scale	-7.34
1280	SD in Original Scale	54.92	SD in Log Scale	5.229
1281	95% t UCL (assumes normality of ROS data)	13.44	95% Percentile Bootstrap UCL	13.49
1282	95% BCA Bootstrap UCL	18.27	95% Bootstrap t UCL	39.41
1283	95% H-UCL (Log ROS)	8863		
1284				
1285	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
1286	KM Mean (logged)	-0.154	KM Geo Mean	0.857
1287	KM SD (logged)	0.851	95% Critical H Value (KM-Log)	2.052
1288	KM Standard Error of Mean (logged)	0.0678	95% H-UCL (KM -Log)	1.394
1289	KM SD (logged)	0.851	95% Critical H Value (KM-Log)	2.052
1290	KM Standard Error of Mean (logged)	0.0678		
1291				
1292	**DL/2 Statistics**			
1293	**DL/2 Normal**		**DL/2 Log-Transformed**	
1294	Mean in Original Scale	7.099	Mean in Log Scale	-0.726
1295	SD in Original Scale	54.89	SD in Log Scale	0.979
1296	95% t UCL (Assumes normality)	13.56	95% H-Stat UCL	0.908
1297	**DL/2 is not a recommended method, provided for comparisons and historical reasons**			
1298				
1299	**Nonparametric Distribution Free UCL Statistics**			
1300	**Detected Data appear Normal Distributed at 5% Significance Level**			
1301				
1302	**Suggested UCL to Use**			
1303	95% KM (t) UCL	14.61		
1304				
1305	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
1306	Recommendations are based upon data size, data distribution, and skewness.			
1307	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
1308	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
1309				