100006501

Bonita Peak Mining District

Human Health Risk Assessment

Revision 0

June 2019

Prepared for and with direction by:

U.S. Environmental Protection Agency, Region 8
1595 Wynkoop Street
Denver, Colorado 80202

Prepared by:
CDM Federal Programs Corporation
555 17th Street, Suite 500
Denver, Colorado 80202

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms and Abbreviations

°F	degrees Fahrenheit
<	less than
≤	less than or equal to
≥	greater than or equal to
µg	microgram
µm	micrometer
%	percent
95UCL	95% Upper Confidence Limit
AALM	All Ages Lead Model
ABA	acid-base accounting
ABS	activity-based sampling
ADAF	age-dependent adjustment factor
AF	absorption fraction
ALM	Adult Lead Methodology
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
BKSF	biokinetic slope factor
BLM	Bureau of Land Management
BW	body weight
C	concentration of chemical
CDC	Center for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COPC	chemical of potential concern
Cr(III)	trivalent chromium
Cr(VI)	hexavalent chromium
CSM	conceptual site model
CTE	Central Tendency Exposure
dL	deciliter
DI	daily intake
DIL	daily intake averaged over a lifetime
DRI	dietary reference intake
EC	exposure concentration
ED	exposure duration
EF	exposure frequency
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESAT	Environmental Services Assistance Team
ET	exposure time
EU	exposure unit
FNB	Food and Nutrition Board
g	gram

GM	geometric mean
GSD	geometric standard deviation
HHRA	human health risk assessment
HI	hazard index
HIF	human intake factor
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic Model
IQ	intelligence quotient
IR	intake rate
IRIS	Integrated Risk Information System
IVBA	in vitro bioaccessibility
IWTP	Interim Water Treatment Plant
IUR	inhalation unit risk
kg	kilogram
L	liter
LOAEL	lowest-observed-adverse-effect level
m^3	cubic meter
MDL	method detection limit
mg	milligram
mm	millimeter
NCEA	National Center for Environmental Assessment
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no-observed-adverse-effect level
NPL	National Priorities List
OLEM	Office of Land and Emergency Management
OSWER	Office of Solid Waste and Emergency Response
PbB	concentration of lead in blood
PbB0	baseline blood lead level
PEF	particulate emission factor
PPRTV	Provisional Peer Reviewed Toxicity Value
RAGS	Risk Assessment Guidance for Superfund
RBA	relative bioavailability
RBC	risk-based concentration
RfD	reference dose
RfC	reference concentration
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SF	slope factor
Site	Bonita Peak Mining District Site
SPLP	synthetic precipitation leaching procedure
TRW	Technical Review Workgroup
TWA	time-weighted average
TWF	time-weighting factor
UCL	upper confidence limit
UF	uncertainty factor

USFS	U.S. Forest Service
WOE	weight of evidence
WSDOH	Washington State Department of Health
XRF	X-ray fluorescence

Section 1
Introduction

1.1 Purpose

The Bonita Peak Mining District Superfund Site (Site) is located in southwestern Colorado. The Site consists of 48 historic mines or mining-related sources where ongoing releases of metal-laden water and sediments are occurring within the Mineral Creek, Cement Creek, and Upper Animas River drainages in San Juan County. Drainages within the Site contain over 400 abandoned or inactive mines, where large- to small-scale mining operations occurred. San Juan County is comprised of 10 historic mining districts (Colorado Geological Survey 2017). Historic mining districts within the Mineral Creek, Cement Creek, and Upper Animas River drainages include Animas, Animas Forks, Cement Creek, Eureka, Ice Lake Basin, and Mineral Point. Hereafter, the term "mining districts" or "Site" is used to refer to the mining districts within these three drainages. This document is a baseline human health risk assessment (HHRA) for the mining districts. The purpose of this document is to characterize the potential risks to humans, both now and in the future, from exposures to contaminants that may be present in the mining districts, assuming that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media. The mining districts are primarily used by humans for recreational, occupational, and tribal purposes. The receptor populations of interest for the risk assessment included campers, hikers, hunters, recreational fishermen, all-terrain vehicle (ATV) guides, ATV recreational riders, and county road workers. An addendum to this risk assessment will be developed to evaluate tribal exposures once the necessary exposure data are available.

The results of this assessment are intended to help inform risk managers and the public about current and potential future health risks to humans that may occur as a result of exposure to mining-related contaminants due to recreational and occupational activities, and to help determine if there is a need for action to protect public health at the Site. Site managers will also consider the results of the ecological risk assessment and any regulatory requirements in determining appropriate remedial actions for the Site. As appropriate, discussions and recommendations on how to manage potential risks will be provided in the Feasibility Study. The identification of remedial action levels, which will guide future remediation efforts, will be provided in the Record of Decision.

The methods used to evaluate risks in this HHRA are consistent with current guidelines for human health risk assessment provided by the U.S. Environmental Protection Agency (EPA) for use at Superfund sites (EPA 1989, 1991a, 1991b, 1992, 1997, 2002a, 2002b, 2002c, 2004, 2009a).

1.2 Organization

In addition to this introduction, this report is organized into the following sections:

Site Description and Data Summary:

Section 2 This section provides a description of the Site and a review of data that characterize the nature and extent of environmental contamination in the mining districts.

Risk Evaluation Based on Chronic Exposure:

Section 3 This section identifies human exposure scenarios of potential concern in the mining districts, and identifies chemicals of potential concern (COPCs) for each exposure medium.

Section 4 This section summarizes chronic exposure and risk to humans from non-lead COPCs. This includes a description of the basic methods and data used to evaluate exposure and risk from non-lead chemicals, the estimated cancer and non-cancer risk levels in the mining districts, a discussion of the uncertainties in the evaluation, review of background concentrations, and risk conclusions.

Section 5 This section summarizes chronic exposure and risk to humans from lead. This includes a description of the basic methods and data used to evaluate exposure and risk from lead, the estimated levels of risk, a discussion of the uncertainties in the evaluation, review of background concentrations, and risk conclusions.

Risk Evaluation Based on Acute Exposure:

Section 6 This section summarizes a screening-level acute risk evaluation for humans exposed to arsenic and lead. This includes a description of the basic methods and data used to evaluate exposure and risk, the development and application of the acute screening levels, review of background concentrations, and conclusions.

Conclusions and References:

Section 7 This section provides a summary of the chronic risk conclusions and acute screening-level evaluation based on the information provided in Section 4 through Section 6.

Section 8 This section provides full citations for EPA guidance documents, site-specific documents, and scientific publications referenced in this report.

All tables, figures, and appendices cited in the text are provided at the end of the report.

Section 2
Site Characterization

This section provides a description of the mining districts and watersheds within the Site, a review of data that characterize the nature and extent of environmental contamination in the mining districts, and an overview of response actions performed to date.

2.1 Site Location

The Bonita Peak Mining District Superfund Site is located near Silverton in southwestern Colorado in San Juan County. There are three main drainages (Cement Creek, Mineral Creek, and Upper Animas River) that flow into the Animas River at Silverton, as shown in Figure 2-1. There are over 400 abandoned or inactive mines where mining operations have occurred within these three drainages. The Site consists of 48 historic mines or mining-related sources where ongoing releases of metal-laden water and sediments are occurring within the Mineral Creek, Cement Creek, and Upper Animas River drainages in San Juan County. This HHRA quantifies exposures for the Site within these three drainages; it includes both an evaluation of the 48 historic mines or mining-related sources, along with a broader evaluation of exposures and risks within these three drainages.

The headwaters of the Animas River watershed are in the San Juan and Silverton calderas. The Upper Animas River begins approximately 14 miles northeast of Silverton. The Cement Creek watershed originates in the San Juan Mountains in San Juan County, and is a tributary to the Upper Animas River. Cement Creek is approximately eight miles long, flowing from north to south before the confluence with the Animas River at Silverton. The Animas River flows south from Silverton to Durango, Colorado, crosses into New Mexico, and joins the San Juan River in Farmington, New Mexico. Mineral Creek originates at the top of Red Mountain Pass and flows from north to south approximately 9.3 miles before entering the Animas River southwest of the town of Silverton.

2.2 Site History

The discovery of gold and silver brought miners to the Silverton area and Animas Mining District in the early 1870s. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. It was not until 1890 that a serious attempt was made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, there were twelve concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down circa 1905, and mines were consolidated into fewer and larger operations with facilities for milling large volumes of ore. After 1907, mining and milling continued throughout the basins whenever prices were relatively favorable.

2.3 Response Actions

On August 5, 2015, EPA was conducting an investigation of the Gold King Mine near Silverton to assess the ongoing water releases from the mine, treat mine water, and assess the feasibility of further mine remediation. While excavating above the collapsed adit, pressurized water began leaking above the mine tunnel, spilling about three million gallons of water stored behind the collapsed portal into Cement Creek.

Following the release, EPA initiated emergency removal actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104. Emergency response actions included:

- Installation of the Gladstone Interim Water Treatment Plant (IWTP) in the former townsite of Gladstone, Colorado with a treatment capacity of 1,200 gallons per minute (EPA 2016a)
- Construction of a series of equalization ponds to ensure consistent influent flow rates into the Gladstone IWTP (EPA 2016a)
- Stabilization of the Gold King Mine adit portal entrance with shotcrete and steel reinforcement structures (EPA 2016b)
- Improvement of access road to the Gold King Mine adit portal (EPA 2016b).

Since October 2015, EPA has been treating the discharge from the Gold King Mine at the Gladstone IWTP.

Due to releases of hazardous substances into the environment and potential human and ecological health impacts, EPA proposed 48 historic mine features for addition to the National Priorities List (NPL) on April 7, 2016 (EPA 2016c) and conducted a 68-day public comment period on the proposal. After reviewing and responding to all comments in a responsiveness summary, EPA added the Site to the NPL on September 9, 2016.

2.4 Physical Setting

The Site is situated within the Animas River watershed in a heavily forested area of the San Juan mountains. The elevation of the Site ranges from approximately 9,500 feet to 12,800 feet above mean sea level.

2.5 Climate

The Site has an alpine climate with snowy, cold winters and cool summers. The greatest amount of snowfall is between November and April, with an average snowfall of 12 feet per year (EPA 2016b). Long-term precipitation data are collected from the National Oceanic and Atmospheric Administration (NOAA) weather station at Silverton. The weather station has a latitude of 37.809 N and a longitude of 107.663 W. In 2016, the Silverton station recorded annual precipitation of approximately 19 inches (NOAA 2017). In this alpine climate region, the mean temperatures range from 8 degrees Fahrenheit (°F) to 24°F in January and 36°F to 72°F in July (Chapman et al. 2006).

2.6 Land Use

The land ownership within the mining districts of the Site varies, with land owned privately, by the U.S. Forest Service (USFS), the Bureau of Land Management (BLM), San Juan County, the Town of Silverton, and the State of Colorado. The mining districts are used recreationally in the summer months (mainly between Memorial Day and Labor Day) for a variety of activities, including camping, hiking, hunting, fishing, and riding ATVs. Downhill skiing at Silverton Mountain and Kendall Mountain Ski Area, cross-country skiing, snowshoeing, and snowmobiling (where permitted) are popular activities in the winter.

2.7 Basis for Potential Human Health Concern

Mining sites are generally associated with the occurrence of elevated levels of a number of different metals in solid mine wastes (tailings, waste rock, spilled ore, etc.) and in surface water draining from mine shafts and adits. Excess exposures to metals are known to cause a range of non-cancer and cancer effects in humans. Visitors to the mining districts within the Site boundaries and occupational workers (e.g., roadway workers) therein could be at risk of adverse health effects if excessive exposure to contaminated environmental media were to occur.

2.8 Data Summary

Numerous studies have been performed to investigate and characterize the nature and extent of environmental contamination in the mining districts. For this evaluation, attention was focused on data collected in 2015 and later (EPA 2015a, 2016d, 2016e, 2017a, 2018a). This is because recent data are likely to be more representative of current conditions than older data, and are often better documented. Data were downloaded from the Bonita Peak Mining District Scribe database on March 20, 2019 (version 90) to ensure that the most current data were utilized in preparing this HHRA[1]. Appendix A contains a copy of the Bonita Peak Mining District Scribe database, limited to the date range used in this document. The data summary presented below is consistent with this download; any changes made to the Scribe database after this date are not included in this document. Appendix A also contains a list of the samples per medium used in the risk calculations.

For details regarding sampling and analytical methodology of each environmental investigation, refer to the applicable governing documents: EPA 2015a, 2016d, 2016e, 2017a, 2018a. Detailed analytical results are presented in the Sampling Activities Reports for 2015, 2016, and 2017 (EPA 2015b, 2016f, 2018d, respectively). Analytical results for 2018 will be presented in a forthcoming Sampling Activities Report for 2018. Available data are described below, stratified by environmental medium. A detailed data adequacy evaluation of these results, including an evaluation of spatial and temporal representativeness and detection limit adequacy, is presented in Section 4.4.1.4.

[1] Analytical results with an R-qualifier (i.e., data rejected by the data validator) have been excluded from summary statistics. Consequently, the number of results for individual analytes for a medium may vary.

2.8.1 Soil and Mine Waste

With few exceptions, soil and mine waste samples collected from 2015 to 2018 were composite samples. Samples were collected from overbank locations, mine waste deposits/tailings piles, floodplain areas of the Animas River, select road segments, campgrounds, and upland reference locations. The sampling methodology for each soil type is presented. Figure 2-2 through Figure 2-4 present the soil sampling locations for the Animas River, Cement Creek, and Mineral Creek drainages, respectively, for the various soil and waste types described.

Overbank Soils – Overbank soil is riparian sediment that has been deposited on the banks of a river or stream by flood waters. Overbank samples were collected using a 5-point composite technique at a depth of 0-2 inches. Samples were collected from the streambanks' poorly vegetated or un-vegetated soils.

Waste Rock – Waste rock pile samples were collected using either a 30-point composite or 5-point composite technique at a depth of 0-6 inches for each location. In cases where the area was not large enough for a 30-point composite, a 5-point composite was collected.

Floodplain – The floodplain of the Animas River in the area from Kittimack Tailings to Eureka was divided into polygons to investigate contaminant levels in the Kittimack Tailings piles. A 30-point composite sample was collected from each polygon at a depth of 0-6 inches. Test pits were created using a backhoe at several places along the floodplain of the Animas River. Samples were collected from each test pit at depths of 0–6 inches, 6–18 inches, and 18–30 inches. Because floodplain tailings samples were collected from tailing deposits, they were evaluated similar to waste rock in the exposure assessment and risk characterization.

Roadway Soils – Unpaved roads were sampled with a 5-point composite across the road, perpendicular to travel, and samples were collected from a depth of 0-2 inches at each point along the transect within the roadway. The majority of roadway samples were collected in 2016, with a portion of the roadway along the Animas River sampled in 2018 to fill a gap in the 2016 sampling.

Camping Area Soils – Campground soil samples were collected using either a 30-point or 5-point composite, depending on size of the campground. Samples were collected from a depth of 0-2 inches using plastic scoops after breaking up the soil with a shovel. Samples were collected from 14 campgrounds in 2016, including the USFS South Mineral Campground (hereafter referred to as the USFS campground) and 13 "dispersed" campsites in designated backcountry areas located in the mining districts[2]. A dispersed campsite is an area that is suitable for camping or where camping is known to occur, but may not be a formal campground. Dispersed campsites identified for sampling were those where campers had frequently been observed to be present. Campground samples were collected again in 2018 from select campgrounds to gather bioavailability data and better document the extent of the sampling area using the Global Positioning System. For those campsites where samples were collected in both 2016 and 2018,

[2] Four of the dispersed campsites were resampled in July 2018 to collect samples for in vitro bioaccessibility (IVBA) analysis and to better characterize the campsite exposure area. These locations were selected because they had higher concentrations relative to the remaining dispersed campsites measured in the initial campsite sampling conducted in 2016.

the samples collected in 2018 have been used in preference to the samples collected in 2016 because they are more representative of the expected exposure area.

Upland Reference Locations – Upland areas, located upgradient of contamination sources at the Site, were sampled using composite sampling. Fifteen subsamples were randomly collected to comprise the composite sample. Only natural, non-developed areas not likely to be impacted by roads, and other anthropogenic features that might be sources of contamination, were selected. A range of different upland vegetation communities consisting of subalpine forests and meadows and alpine meadows were sampled. In total, 34 samples were collected from 7 unique areas (2 areas within the Animas River watershed, 2 areas in the Cement Creek Watershed, 2 areas within the Mineral Creek watershed, and 1 in the Cunningham Creek[3] drainage).

Soil and waste material samples were homogenized and sieved using a No. 10 sieve with a 2-millimeter (mm) opening at EPA's Environmental Services Assistance Team (ESAT) Region 8 laboratory in Golden, Colorado. Ten percent (%) of each sample type (i.e., waste rock, campground, and roadway soils) were also sieved using a No. 60 mesh sieve with a 250-micrometer (µm) opening because inorganics have been shown to concentrate in the fine fraction and this fraction is most likely to adhere to skin and be ingested (EPA 2000). Samples were analyzed for total recoverable metals, mercury, synthetic precipitation leaching procedure (SPLP), and acid-base accounting (ABA). Twenty-eight samples from a range of soil types, including waste rock, roadway soils, and dispersed campsite soils, were sent to the University of Colorado, Laboratory for Environmental and Geological Studies for IVBA analysis of arsenic and lead (see Section 4.1.4 and Section 5.2.4, respectively, for additional information on the IVBA results). Table 2-1 presents summary statistics for all soil samples collected within the mining districts that were analyzed for total recoverable metals and mercury. Summaries of the SPLP and ABA results are presented in their respective Sampling Activities Reports, however, these results are not used in this HHRA.

For the purposes of risk characterization, soil/mine waste samples were restricted to include only those collected from 0-2 inches or 0-6 inches because receptors are most likely to be exposed to contaminants present in surficial material (see Section 3.2.1 for more information on soil/waste material exposure depth interval).

2.8.2 Sediment

Composite sediment samples were collected from 2015 to 2018 and analyzed for total recoverable metals and mercury. Sediment samples were collected from a depth of 0 to 1 inches in shallow aqueous areas up to 12 inches in depth. Several sediment subsamples were collected from a stream segment 50 meters upstream to 50 meters downstream of the actual sampling location. The subsamples were combined and homogenized in the field after collection. Figure 2-5 through Figure 2-7 present the sediment sampling locations within the Animas River, Cement Creek, and Mineral Creek drainages, respectively. Table 2-2 presents summary statistics for all sediment samples collected within the mining districts.

[3] Cunningham Creek flows north, joining the Animas River downgradient from Howardsville, Colorado.

2.8.3 Surface Water

Grab surface water samples were collected from 2015 to 2018 at locations along the Animas River, Cement Creek, Mineral Creek, Eureka Gulch, several adits, and smaller tributaries and analyzed for dissolved and total recoverable metals and several water quality parameters. Figure 2-5 through 2-7 present the surface water sampling locations within the Animas River, Cement Creek, and Mineral Creek drainages, respectively. Table 2-3 presents summary statistics for total recoverable metals in all surface water samples collected within the mining districts. Total recoverable metal concentrations are presented in preference to the dissolved concentrations because this is the fraction most representative of human health exposures from ingestion of surface water.

2.8.4 Groundwater

Two groundwater samples have been collected from a known drinking water source at the USFS campground. These samples were collected from the USFS campground in 2010[4] and 2017. Table 2-4 presents summary statistics for the groundwater samples collected at the USFS campground.

Although other groundwater samples were collected in 2016 through 2018, these were collected from monitoring wells that are not used as a drinking water source and were not included in the risk estimates.

2.8.5 Fish Tissue

In 2016, fish tissue samples were collected from three locations within the mining districts (Animas Above Cunningham, South Fork of Mineral Creek, and Mineral Creek below Mill Creek) and two reference locations (Maggie Gulch, Mill Creek). Figure 2-8 presents the fish sampling locations. As seen, locations where fish were captured and tissue was collected for analysis are denoted with green symbols. Twenty-three fish were collected using electroshocking and fillet tissues were analyzed for total recoverable metals and mercury. Locations where fish were captured but tissue was not collected for analysis are denoted with orange symbols. In some locations, fish were not captured, as indicated by red symbols. All fish collected were brook trout (*Salvelinus fontinalis)*. The collected fish were categorized as edible, subedible, and forage, depending on size. Table 2-5 presents summary statistics for total recoverable metals and mercury in edible fish fillet tissue samples, because these samples represent the fish size and tissue type that human receptors are likely to ingest.

2.8.6 Game Tissue

In 2017, game tissue samples from three dusky grouse (*Dendragapus obscurus*) and two mule deer (*Odocoileus hemionus*) were collected. Figure 2-9 presents the game sampling locations. Both organ and muscle tissues were collected and analyzed for total recoverable metals and mercury. However, the risk characterization only evaluated exposures from muscle tissues, as this represents the type of tissue that human receptors are likely to ingest most frequently.

[4] One groundwater sample was collected in 2010 from the USFS campground. Because data for drinking water are so sparse, this is the only sample used in this risk evaluation collected prior to 2015. The results for this sample are not in the Scribe database but were provided by USFS.

Tables 2-6 and 2-7 present summary statistics for grouse samples (breast tissue) and deer samples (back strap, front roast, rear roast, and tenderloin cuts), respectively.

2.8.7 Roadway Air

In fall 2017, nine stationary roadway air samples were collected from lower elevation, unpaved earthen roads in the mining districts. Samples were collected over an 8-hour period with a fixed volumetric flow rate of 2.75 liters per minute. The sampling pumps (cyclones) were set up as close to the road as possible and placed on a pedestal so the intake port was 6 feet above the ground surface (i.e., the approximate breathing height of an adult roadway worker). Figure 2-10 presents the roadway air sampling locations. The roadway air samples were analyzed for arsenic, chromium, manganese, and lead. Table 2-8 presents summary statistics for roadway air samples.

2.8.8 ATV Activity-Based Sampling Air

In fall 2018, ATV activity-based sampling (ABS) was performed on select routes within the mining districts frequented by ATV guides and ATV recreational riders. The ATV ABS was conducted with single operators on two ATVs driven on two routes (the Alpine Loop and a remote roadway), as depicted in Figure 2-11. The operators wore air filter cassettes that sampled air concentrations within their breathing zone while driving. Sixteen ABS air samples were collected and analyzed for total recoverable metals. Table 2-9 presents summary statistics for ATV ABS air samples.

2.9 Data Validation

Based on the governing documents (EPA 2015a, 2016d, 2016e, 2017a, 2018a), 10% of the analysis results were validated. Validation was performed in accordance with the EPA Contract Laboratory Program (CLP) *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA 2017b). All data presented in the data summary were deemed valid and appropriate for use in the risk assessment with the exception of R-qualified (rejected) analytical results. Any analytical results that were R-qualified by the data validator were excluded from any exposure and risk calculations. Although R-qualified results were infrequently reported, antimony, selenium, and thallium were more frequently rejected for soil samples. Likewise, R-qualified results for mercury in surface water were more frequently rejected. Adequacy of spatial and temporal representativeness, given the exclusion of rejected analyses, is presented in the uncertainty discussion (see Section 4.4.1).

For a subset of soil samples, multiple analytical results are available in the database. These soil samples were analyzed by two laboratories: EPA's ESAT Region 8 laboratory and a CLP laboratory. Analytical results provided by the ESAT laboratory were used in preference to the CLP laboratory because of a lower frequency of qualifiers.

This page intentionally left blank.

Section 3
Exposure Assessment

Exposure is the process by which humans come into contact with chemicals in the environment. In general, humans can be exposed to chemicals in a variety of environmental media (e.g., soil, sediment, water, air, or food), and these exposures can occur through several pathways (e.g., ingestion, dermal contact, or inhalation).

3.1 Site Conceptual Model

Figure 3-1 presents the conceptual site model (CSM) for human exposures in the mining districts. The CSM summarizes EPA's current understanding of how chemical contaminants that have been released to the environment might result in exposure of human receptors. The main features of this CSM and the rationalization supporting decisions about the receptors and pathways identified for risk quantification in the HHRA are discussed below.

3.1.1 Primary Sources of Contamination

The Site consists of historic mines and mining-related sources that have resulted in the direct deposition of various types of solid wastes (tailings and waste rock) that were placed onto soil near the mines or were discharged into nearby streams. In addition, contaminated water from mine adits also discharges directly into streams. There are three primary drainages within the Site, including Mineral Creek, Cement Creek, and the Upper Animas River (Figure 2-1). Metals are the primary COPCs at the Site.

3.1.2 Transport in the Environment

Chemical contaminants released from historic mining operations may migrate in the environment by several processes:

- Fine-grained soil/solid waste particulates may be released into air as a consequence of either wind erosion and/or human disturbances (e.g., ATV use).
- Soil/solid wastes may be eroded into streams, resulting in contamination of both surface water and stream sediments.
- Adit discharges may be released into streams, resulting in contamination of both surface water and stream sediments.
- Contaminants in soil, sediment, or surface water may be taken up into the tissues of plants and animals (game and fish).
- Contaminants in soil/solid wastes may be dissolved by water (rain or snowmelt) and enter surface water via run-off, resulting in contamination of both surface water and stream sediments.

- Contaminants in soil/solid wastes may be dissolved by water (rain or snowmelt) and infiltrate into subsurface soils and migrate downward into groundwater.
- Groundwater may interact with streams, resulting in contamination of both surface water and stream sediments.

3.1.3 Populations of Chief Concern

Currently, the mining districts are primarily used for recreational, occupational, and tribal purposes. Risks to on-site remediation workers and nearby residences will not be quantified. Future land uses are expected to be consistent with current use. Based on this expectation, the human populations most likely to be exposed are identified below.

ATV Guides/Recreational Rider: ATV use is likely to result in higher than average exposures to contaminated soils, both by incidental ingestion of soil and by inhalation of dust particles that are released from soil into air by the riding activity. Both a high-end exposure scenario (ATV guide) and average exposure scenario (ATV recreational rider) were evaluated in the HHRA. For the ATV guide, the receptors of interest are adults. The ATV recreational rider population is assumed to include older children (ages 6–16 years old) and adults. Note that four-wheel-drive vehicle riders could also be exposed by the same exposure routes; however, because exposure is expected to be greater for an ATV recreational rider compared to a Jeep rider, Jeep rider exposures have been conservatively represented by the ATV recreational rider.

Hiker: The hiker was selected to represent a typical exposure at the Site. The hiker population is assumed to include older children (ages 6–12 years old) and adults.

Camper: Camping along the drainages and in the USFS campground is thought to be a reasonable current or future land use. There is one established campground, the USFS campground, and multiple locations of dispersed campsites in designated backcountry areas throughout the mining districts. It is assumed that people who camp include children (less than 6 years old), older children (ages 6–16 years old), and adults.

Recreational Fisherman: The recreational fisherman population represents individuals who may fish along streams in the mining districts and includes older children (ages 6–16 years old) and adults. Whitewater rafters or kayakers could also be exposed by similar exposure routes. Because exposure frequency is expected to be greater for the fisherman, because more areas at the Site are suitable for fishing than rafting or kayaking, these exposures have been conservatively represented by the fisherman.

Hunter: The hunter population represents individuals who may hunt and ingest wild game in the mining districts. The hunter population is assumed to include older children (ages 6–16 years old) and adults.

County Road Worker: County road workers represent individuals that perform road maintenance along county roads within the mining districts. For the road worker, the receptors of interest are adults.

Tribal Member: The tribal population represents individuals from the Southern Ute Indian Tribe, Ute Mountain Ute Indian Tribe, and Ute Indian Tribe who may access the mining districts to

harvest plants for medicinal purposes, wild foods that are gathered and consumed (e.g., shoots, berries), and willows for weaving. Consultation is underway to determine if the Jicarilla Apache and Navajo Nation Tribal members also access the mining districts for similar gathering activities. The tribes may utilize the mining districts to exercise their hunting and gathering rights under the Brunot Agreement. An addendum to this risk assessment will be developed to evaluate tribal exposures once the necessary exposure data are available.

3.2 Exposure Pathways of Chief Concern

Not all exposure pathways for these human populations are likely to be of equal concern. First, to be of concern, an exposure pathway must be "complete." That is, there must be contact between a human receptor and a contaminated environmental medium. For pathways that are complete, the relative importance of one to another is related to the amount of chemical taken into the body by each pathway. Complete exposure scenarios that may be significant are shown in Figure 3-1 by boxes containing a solid circle. In the HHRA, attention is focused on quantification of exposure from these pathways to determine if resulting risk is unacceptable. Complete exposure scenarios likely to be minor contributors to total exposure and risk are shown in Figure 3-1 by boxes containing an "X." For some minor pathways (identified by footnote 6), a semiquantitative evaluation was performed to support this designation. For example, for ingestion of surface water, illustrative calculations were performed, using risk estimates for the maximally exposed receptor (i.e., camper) and information on the relative exposure frequency/duration of other receptors (e.g., hiker, hunter) to the camper, to demonstrate potential risks to these receptors are likely to be similar to (or lower than) the camper. For the remaining minor pathways (identified with an "X" and no footnote) such as dermal exposures with soil, a qualitative evaluation was performed in the risk assessment to support the designation.

The following sections present a more detailed description of these pathways and an analysis of their relative importance for human exposure.

3.2.1 Exposures to Soil/Solid Wastes

In general, most recreational and occupational activities that may be conducted at the Site, such as hiking, hunting, and riding, would most likely only come into contact with soils and waste materials at the surface (i.e., within the upper 6 inches) and not at deeper depths. Because samples have been collected under a variety of sampling designs, which used a range of different depth intervals, all samples with a bottom depth of 6 inches or less were used to evaluate exposures to receptors from soil or soil-like[5] media.

Incidental Ingestion of Surface Soil

Even though few people intentionally ingest soil, anyone who has direct contact with contaminated surface soil may incidentally ingest small amounts that adhere to their hands during outdoor activities. Incidental ingestion of soil is often one of the most important routes of human exposure, so ingestion of surface soil was evaluated quantitatively for most receptors.

[5] In this section, the term "soil" is used for simplicity, but should be interpreted to represent both soil and soil-like waste materials (e.g., tailings and waste rock materials).

Dermal Contact with Surface Soil

Receptors may have dermal exposure to contaminated soil. Even though information is limited on the rate and extent of dermal absorption of metals in soil across the skin, most scientists consider this pathway is likely to be minor in comparison to the amount of exposure that occurs by the oral route. This view is based on the recognition that most metals tend to bind to soils (reducing the likelihood that they would dissociate from the soil and cross the skin), and ionic species such as metals have a relatively low tendency to cross the skin even when contact does occur. Based on this, and recognizing current methods and data are very limited for attempting to quantify dermal absorption of chemicals from soil, dermal contact with soil is not evaluated quantitatively, but is identified as a potential source of uncertainty.

Inhalation of Airborne Soil Particulates

Whenever contaminated soils are exposed at the surface, fine-grained particles may become suspended in air by wind and/or human activity and humans in the area could inhale those particles. In cases where the soil is disturbed only by wind or light human activity (e.g., walking/hiking), the amount of particulate material inhaled from air is generally quite small compared to the amount that is typically assumed for incidental ingestion. Therefore, inhalation of soil particulates generated by wind erosion or walking is considered a minor pathway for most receptors.

When surface soil is disturbed by mechanical forces, such as during ATV use, dust levels in air may be significant and intake of soil from inhalation of airborne dusts may become similar to, or even higher than, the ingestion pathway. Thus, inhalation of soil particulates generated during ATV use was evaluated quantitatively.

For county road workers, dust levels in air generated through disturbance of roadway soils may be significant. Because air concentrations include fugitive dust emissions generated from roadway activity and wind disturbance, both transport mechanisms were evaluated quantitatively.

3.2.2 Exposures to Sediment

Incidental Ingestion of Sediment

Receptors are unlikely to intentionally ingest sediment, but, as described above for surface soil, individuals having direct contact with contaminated sediments may incidentally ingest small amounts that adhere to their hands during recreational activities along streams (e.g., fishing, rafting, or playing). Thus, incidental ingestion of sediment was evaluated for campers and recreational fishermen because these two populations are likely to interact most with streams in the mining districts.

Dermal Contact with Sediment

Receptors who come into contact with contaminated sediments may get some of the material on their skin during recreational activities along streams. Similar to dermal contact with soil, dermal contact with sediment was not evaluated quantitatively but is identified as a potential source of uncertainty.

3.2.3 Exposures to Surface Water

Ingestion of Surface Water

It is not expected that most visitors in the mining districts will intentionally ingest surface water. However, campers could ingest water from creeks as drinking water and incidental ingestion of water might occur during recreational activities (e.g., camping, fishing, rafting, swimming/bathing). Based on this, ingestion of surface water as drinking water and incidental ingestion of surface water were evaluated for campers at the dispersed campsites. At the USFS campground, incidental ingestion of surface water was evaluated for campers, but it was assumed groundwater from the campground well would be ingested as the primary drinking water source (see Section 3.2.4). Incidental ingestion of surface water was also evaluated for the fishermen.

Dermal Contact with Surface Water

Visitors to the mining districts may have occasional dermal contact with surface water while recreating along the streams. Similar to dermal contact with soils or sediments (discussed above), uptake of metals across the skin from contact with water is usually thought to be a minor exposure pathway because of the relatively low tendency of metals to cross the skin even when contact does occur. For this reason, this pathway was not evaluated. However, exclusion of this pathway is identified as a source of potential uncertainty.

3.2.4 Exposures to Groundwater

While groundwater is not typically accessible to recreational and occupational receptors within the mining districts, a well pump located at the USFS campground could be used as a drinking water source. Based on this, ingestion of groundwater as drinking water was evaluated for campers at the USFS campground.

3.2.5 Exposures to Terrestrial and Aquatic Biota

Ingestion of Wild Game

Big game animals (e.g., deer, elk, or bear) and terrestrial birds (e.g., grouse) that inhabit the mining districts may take up contaminants either from eating vegetation grown in contaminated soils and/or by incidental ingestion of soil while feeding. Contaminants may accumulate in animal muscle and organ tissues. Consequently, hunters ingesting the meat of game animals harvested from the mining districts may be exposed, and this pathway was retained for quantitative evaluation.

The types of hunting within the three watersheds of interest in the mining districts is expected to be focused on large game mammals, such as deer and elk. Inspection of historical small game harvest records provided by Colorado Parks and Wildlife (2018) indicates small game (e.g., rabbits or squirrels) is not typically harvested by hunters in San Juan County. Additionally, it is expected the type of bird hunting within three watersheds of interest in the mining districts, which are characterized by high mountain creeks and rivers, would be more focused on upland terrestrial game such as grouse or pheasant and not waterfowl.

Ingestion of Fish from Area Creeks

Fish living in streams within the mining districts may take up contaminants from surface water, sediment, or the diet into their tissues, leading to exposure of humans who eat fish caught from the contaminated waters. Thus, this pathway was evaluated quantitatively for recreational fishermen.

3.3 Exposure Units

An exposure unit (EU), also referred to as an exposure area, is an area where a receptor may be exposed to one or more environmental media over a specified period of time (e.g., lifetime). In general, receptors are assumed to move about at random within an exposure unit. There are multiple receptor populations of interest, including ATV guides, ATV recreational riders, hikers, fishermen, hunters, campers, and county road workers[6]. Figure 3-1 identifies the exposure media and exposure pathways for each receptor. For the purposes of evaluating receptor exposures, the mining districts are divided into EUs relative to the receptor use, as presented in Figure 3-2 through Figure 3-5.

3.3.1 Hiker, Hunter, and County Road Worker

The county road worker, hiker, and hunter are anticipated to be exposed to media along the drainages because access to the mining districts is obtained along roads that follow waterways. Because the mining districts encompass a large area, they have been subdivided into drainage-specific exposure units for these receptors. Due to its size, the Animas River drainage is subdivided into two reaches: EU1, the section of the Animas River upstream of the confluence of the south fork of the Animas River, and EU2, the section of the Animas River above the main stem of Cement Creek but downstream of the confluence of the south fork of the Animas River. Cement Creek (EU3) and Mineral Creek (EU4)[7] comprise the remaining EUs for these receptors. EU1 through EU4 are shown in Figure 3-2.

3.3.2 ATV Guide and ATV Recreational Rider

The ATV guide is anticipated to primarily use the Alpine Loop for the majority of their riding time because it is well suited for ATV tours. The Alpine Loop has been designated as EU5a (see the red ATV route in Figure 2-11). The ATV recreational rider is anticipated to use all roadways within the mining districts. For this reason, all roadways were considered to comprise the EU for the ATV recreational rider (EU5b). Roadway soil sampling locations within EU5a and EU5b are depicted in Figure 3-3.

3.3.3 Camper

As noted above, there is one established campground, the USFS campground, and multiple locations of dispersed campsites in designated backcountry areas located within the mining districts. Because the exposure media (i.e., the drinking water source) and the style of camping (managed campground with facilities versus dispersed backcountry campsites) differ for each

[6] Residential land use and developed areas such as the town of Silverton were not evaluated as part of this HHRA.

[7] The roadway along Mineral Creek is paved; however, there are dirt roads within the drainage that were used to evaluate risk to the roadway worker in EU4.

type of campground, these have been evaluated as separate EUs. The USFS campground has been designated as EU6 and the collective[8] dispersed backcountry campsite locations have been designated as EU7, as shown in Figure 3-4.

3.3.4 Recreational Fisherman

Because fish presence and availability of fish tissue samples representative of the Site are limited to Mineral Creek and the lower section of the Animas River, the EUs for the recreational fisherman are limited to Mineral Creek (EU8) and the lower section of the Animas River (EU9), as shown in Figure 3-5.

3.4 COPC Selection

COPCs are chemicals that exist in the environment at concentrations that might be of potential health concern to humans and that are or might be derived, at least in part, from source areas within the mining districts.

3.4.1 COPC Selection Process

The procedure used to identify COPCs for the evaluation of risks to human receptors from potentially contaminated environmental media (soil, sediment, surface water, groundwater, fish tissue, game tissue, and air) is shown in Figure 3-6. This COPC selection procedure is intended to be conservative; that is, it is expected that some chemicals may be identified as COPCs that are of little or no concern but no chemicals of authentic concern will be overlooked.

In brief, the COPC selection procedure classifies each analyte into one of three categories:

- COPC
- Not a COPC
- Source of Uncertainty

The COPC selection procedure compares the maximum detected concentration for each analyte in each medium to a risk-based concentration (RBC). An RBC is a concentration of a chemical in a medium that is believed to pose negligible health risk to a specified population of human receptors. For carcinogens, this is a concentration that corresponds to a cancer risk of 1E-06. For non-carcinogens, this is a concentration that corresponds to a hazard quotient (HQ) of 0.1. (See Section 4.3.1 for information on the how cancer risks and HQs are expressed and interpreted.)

If the maximum detected concentration exceeds the RBC, the chemical is selected as a COPC. If the maximum detected concentration does not exceed the RBC, the chemical is unlikely to pose any health risk even to maximally exposed individuals, and it is not selected as a COPC.

If the chemical was not detected in any of the samples, then the detection limit is evaluated as part of the uncertainty evaluation (see Section 4.4.1). If the detection limit was below the RBC, then the chemical is unlikely to be of concern and is excluded as a COPC. However, if the detection limit was above the RBC, this is identified as a source of uncertainty.

[8] It is assumed multiple backcountry sites could be visited throughout the year; therefore, the datasets across sites were combined for the purposes of deriving chronic exposure estimates.

If a chemical does not have an RBC, this is identified as a source of uncertainty unless the chemical is a beneficial nutrient and the expected intake (because of exposures from sources in the mining districts) is within the range that is considered healthful (see Section 3.4.3).

For media types for which RBC values were not available (i.e., tissues, air), the list of COPCs for associated media was used to identify COPCs for those media type. If a chemical was selected as a COPC for soil, it was also retained as a COPC for game tissue and air. If a chemical was selected as a COPC for surface water or sediment, it was retained as a COPC for fish tissue. In addition, chemicals that are bioaccumulative in tissue (e.g., mercury) were automatically retained as COPCs.

3.4.2 Source of RBC Values

For this assessment, RBC values for use in the COPC selection were obtained from EPA's Regional Screening Level (RSL) tables (EPA 2018b) using default values that are protective of industrial worker exposures to soil and residential exposures to tap water. Soil and sediment were screened using industrial soil RSLs and surface water and groundwater were screened using residential tap water RSLs. This choice of RBC values for COPC selection is likely to be conservative for recreational and occupational receptors who are likely to have lower exposure frequencies than industrial workers and residents.

Although measured chromium concentrations in environmental media were based on total chromium, for the purposes of COPC selection, maximum concentrations were compared to RSLs based on hexavalent chromium, which is the more toxic form.

3.4.3 Evaluation of Beneficial Minerals

A number of metals are beneficial minerals, meaning a certain level of intake is required to maintain good health. This includes calcium, chromium, copper, iron, magnesium, manganese, molybdenum, potassium, selenium, sodium, and zinc (Food and Nutrition Board [FNB] 2013). However, excess intake of these minerals may cause adverse effects. If EPA has established an RBC for such minerals, they were evaluated as described above; however, because of their low toxicity (even at high doses), EPA has not derived RBC values for some, including calcium, magnesium, potassium, and sodium. These four analytes were evaluated by calculating an effective RBC, as follows:

$$\text{Effective RBC} = \text{DRI} / \text{DI}$$

where:

DRI = Dietary reference intake by a child (milligrams [mg]/day), derived from the FNB (2013)

DI = Daily intake of medium (kilograms [kg]/day of soil, or liters [L]/day of water)

If the average concentration in media did not exceed the effective RBC, the chemical was excluded as a COPC.

3.4.4 Results

The application of this COPC selection process to the data available from the mining districts is presented in Table 3-1 through Table 3-4. Note, the dataset used for COPC selection was restricted to the data representative of the various exposure units. For example, surface water data collected from seeps, springs, mine adits, etc. have not been included in the COPC selection because these surface water sources are not representative of the surface water that receptors are likely to be exposed to. The results of the COPC selection are summarized in Table 3-5 and described below.

The exposure media that require quantitative assessment include soil, sediment, and surface water for multiple metals, including lead. For groundwater, only chromium requires quantitative evaluation. As noted above, the COPCs for air and game tissue are the same as those for soil, and the COPCs for fish tissue are the same as those for surface water and sediment. Mercury was added as a COPC to fish and game tissue because it is bioaccumulative.

Because metals occur naturally in the environment, it is expected some fraction of the concentrations present in the environment may be because of natural background and are not mining-related. However, consistent with EPA guidance on the *Role of Background in the CERCLA Cleanup Program* (EPA 2002d), all COPCs are retained for further evaluation in the risk characterization, regardless of source. Comparisons to background and background risks are discussed as part of the risk characterization to provide a frame of reference for interpreting Site risks.

There were multiple metals in the aqueous media for which all sample results were non-detect. For surface water samples, all mercury analytical results were non-detect. For groundwater samples, aluminum, antimony, arsenic, beryllium, cadmium, iron, manganese, and selenium analytical results were all non-detect. The chemicals listed for surface water and groundwater that were all non-detect were evaluated in the uncertainty assessment to determine if the detection limits were adequate for use in risk assessment.

The results of the beneficial mineral screen are summarized in Table 3-6. As seen, the maximum DI did not exceed the effective beneficial RBC for any mineral; thus, these four beneficial minerals were not selected as COPCs.

Section 4 provides an evaluation of exposure and risks from these exposure scenarios for all COPCs except lead, and Section 5 provides an assessment of exposure and risks from lead. Exposures from any metals not retained as COPCs are likely to be sufficiently small that they are not of concern.

This page intentionally left blank.

Section 4

Evaluating Chronic Exposure and Risk from Non-Lead COPCs

This section summarizes chronic exposure and risk to humans from non-lead COPCs in the mining districts. This section includes a description of the basic methods and data used to evaluate chronic exposure from non-lead chemicals, the estimated cancer and non-cancer risk levels related to these exposures, a discussion of the uncertainties in the evaluation, a review of background concentrations, and risk conclusions.

Risks from lead are evaluated using a different approach than for most other chemicals in that lead risks are determined based on estimated blood lead levels. The lead-specific approach for chronic exposure and risk evaluation is presented in Section 5.

4.1 Quantification of Chronic Exposure

4.1.1 Basic Equation

4.1.1.1 Ingestion Exposures

The amount of chemical which is ingested by receptors exposed to media may be quantified using the following general equation:

$$DI = C \cdot (IR / BW) \cdot (EF \cdot ED / AT) \cdot RBA$$

where:

DI = Daily intake of chemical (mg/kg of body weight/day).

C = Concentration of the chemical in the contaminated environmental medium to which the person is exposed. The units are mg/kg for soil/sediment (as dry weight), mg/L for water, and mg/kg (as wet weight) for fish and game tissues.

IR = Intake rate of the contaminated environmental medium. The units are kg/day for soil, L/day for water, kg/day (as wet weight) for fish and game.

BW = Body weight of the exposed person (kg).

EF = Exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.

ED = Exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

AT = Averaging time (days). This term specifies the length of time over which the average dose is calculated. For a chemical which causes non-cancer effects, the

averaging time is equal to the exposure duration. For a chemical that causes cancer effects, the averaging time is 70 years (25,550 days).

RBA = Relative bioavailability.

Note that the factors EF, ED, and AT combine to yield a factor between zero and one. Values near 1.0 indicate that exposure is nearly continuous over the specified averaging period, while values near zero indicate that exposure occurs only rarely.

For mathematical convenience, the general equation for calculating dose can be written as:

$$DI = C \cdot HIF \cdot RBA$$

where:

HIF = Human intake factor. This term describes the average amount of an environmental medium contacted by the exposed person each day.

The value of HIF is typically given by:

$$HIF = (IR / BW) \cdot (EF \cdot ED / AT)$$

The units of HIF are kg/kg-day (as dry weight) for soil/sediment, L/kg-day for water, and kg/kg-day (as wet weight) for fish and game tissues.

When the same individual may be exposed beginning as a child and extending into adulthood, exposure was calculated as the time-weighted average (TWA) lifetime exposure for evaluating non-cancer and cancer risks, as recommended in EPA guidance (EPA 1989). Lifetime exposure estimates for both cancer and non-cancer must account for differences in daily ingestion rates, body weights, and exposure durations for children and adults. For example, the ATV recreational rider population is assumed to include older children (ages 6–16 years old) and adults. This is accomplished by using factors for an older child for the first portion of the exposure duration and adult factors for the remaining years of the exposure period, as shown below:

$$TWA - DI = C \times \left[\frac{IR_c \times EF_c \times ED_c}{BW_c \times (AT_c + AT_a)} + \frac{IR_a \times EF_a \times ED_a}{BW_a \times (AT_c + AT_a)}\right]$$

where:

TWA-DI = Time-weighted average daily intake (mg/kg-day)

C = Chemical concentration (mg/L, mg/kg)

IR = Intake rate for an older child (IR_c) and an adult (IR_a) (mg/day, L/day)

EF = Exposure frequency for an older child (EF_c) and an adult (EF_a) (days/year)

ED = Exposure duration for an older child (ED_c) and an adult (ED_a) (years)

BW = Body weight for an older child (BW_c) and an adult (BW_a) (kg)

AT = Averaging time for an older child (AT_c) and an adult (AT_a) (days)

For the ATV guide and roadway worker, no time-weighted adjustment is necessary, as it is assumed the population is comprised of adults only (16+ years). For the ATV recreational rider, hiker, fisherman, and hunter, daily intakes are time-weighted (as described above) to account for exposures that begin as an older child and continue into adulthood. For the camper, daily intakes are time-weighted to include exposure as a child (less than [<] 6 years), older child (6–16 years), and an adult (greater than or equal to [≥]16 years).

4.1.1.2 Inhalation Exposures

Inhalation exposures are evaluated in accordance with the inhalation dosimetry methodology presented in EPA's *Risk Assessment Guidance for Superfund (RAGS) Part F: Inhalation Risk Assessment* (EPA 2009a).

In accordance with EPA (2009a), the human intake equation does not include an inhalation rate or body weight because the amount of the chemical that reaches the target tissue is not a simple function of these factors. Therefore, the inhaled exposure concentration (EC) for chronic exposures is calculated as:

$$EC = C \cdot (ET \cdot EF \cdot ED / AT)$$

where:

EC = Exposure Concentration (micrograms [µg]/cubic meter [m^3]). This is the time-weighted concentration based on the characteristics of the exposure scenario being evaluated.

C = Concentration of the chemical in air (µg/m^3) to which the person is exposed.

ET = Exposure time (hours/day). This describes how long a person is likely to be exposed to the contaminated medium over the course of a typical day.

EF = Exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.

ED = Exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

AT = Averaging time (hours). This term specifies the length of time over which the time-weighted average concentration is calculated. The averaging time for non-cancer risk is equal to the exposure duration. The averaging time for cancer is 70 years (613,200 hours).

For mathematical convenience, the general equation for exposure concentration can be written as:

$$EC = C \cdot TWF$$

where:

TWF = Time-weighting factor (unitless). The value of TWF is given by:

$$TWF = (ET \cdot EF \cdot ED / AT)$$

As described above, when the same individual may be exposed beginning as a child and extending into adulthood (e.g., the camper), exposure was calculated as the TWA lifetime exposure.

4.1.2 Human Chronic Exposure Parameters

For every exposure pathway of potential concern, it is expected that there will be differences between different individuals in the level of exposure at a specific location because of differences in intake rates, body weights, exposure frequencies, and exposure durations. Thus, there is normally a wide range of average daily intakes between different members of an exposed population. Because of this, all daily intake calculations must specify what part of the range of doses is being estimated. Typically, attention is focused on intakes that are "average" or are otherwise near the central portion of the range, and on intakes that are near the upper end of the range (e.g., the 95th percentile). These two exposure estimates are referred to as Central Tendency Exposure (CTE) and Reasonable Maximum Exposure (RME), respectively.

Table 4-1 through Table 4-9 list the CTE and RME exposure parameters and resultant HIF values used in this assessment for recreational and occupational populations. Some of the values are informed by site-specific information, some are based on EPA default guidelines, and others are based on professional judgment or are estimated by extrapolation from other sites. The footnotes in the tables provide the basis and supporting rationale for each selected exposure parameter. Supplemental information for some exposure parameters is provided below.

ATV Guide (Area Use Factor) – Many guided ATV trips are conducted along the full Alpine Loop (i.e., from Silverton to Lake City); thus, portions of the guided trip are outside the Site. To account for the time spent by guides in areas beyond the Site, an assumed area use factor of 50% was used based on input provided by local guide services.

ATV Guide and ATV Recreational Rider (Riding Time) – Because it is not anticipated that the entire exposure time for the ATV guide and ATV recreational rider is spent riding an ATV (i.e., it is assumed a portion of the riding time may include stops), a riding time factor was incorporated into exposure calculations. An assumed ATV riding time factor of 75% was used for RME based on input from multiple local guide services. For CTE, the ATV riding time factor was assumed to be 50%.

ATV Recreational Rider (Exposure Time) – The exposure time for the RME ATV recreational rider was assumed to be less than the exposure time for the RME ATV guide (8 hours, based on a standard work day). A value of six hours was assumed for the RME ATV recreational rider.

Dispersed Camper (Exposure Frequency) – For the RME dispersed camper, the exposure frequency is based on the assumption the camper visits the Site the maximum allowable number of days specified in *Guidelines for the San Juan National Forest* (USFS 2017). As stated in these guidelines, campers are permitted to camp in a national forest for up to 14 days per month for 2 months. After they have been in the forest for 28 days, campers are to leave the national forest. The 28-day exposure frequency on national forest land is also protective of campers on BLM land in the mining districts, as the BLM has an annual limit of 14 days for dispersed camping. CTE exposure frequency was assumed to be one-half of the RME (i.e., 7 days per year).

USFS Camper (Exposure Frequency) – For the USFS camper, the RME exposure frequency is based on the maximum allowable days at the USFS campground (i.e., 14 days per year). CTE exposure frequency was assumed to be one-half of the RME (i.e., 7 days per year).

Child Camper (Ingestion Rate) – For the USFS camper and dispersed camper, the soil ingestion rate for RME and CTE is based on soil ingestion rates for campgrounds, as provided in the *Child-Specific Exposure Factors Handbook* (EPA 2008). For RME, the soil ingestion rate is based on the calculated[9] 95th percentile of the data for all girls and boys (429 mg/day). For CTE, the soil ingestion rate is based on the mean of the reported geometric means for girls and boys (203 mg/day).

Recreational Fisherman (Incidental Ingestion Rate): Incidental ingestion from splashing or hand-to-face contact during wading assumed to be 10% of the EPA-recommended default incidentally ingested during swimming (EPA 1989). This ingestion rate is assumed to be representative of potential exposure to the fisherman. As noted previously, rafters or kayakers could also be exposed by incidental ingestion. However, exposure frequency is expected to be greater for the fisherman because more areas at the Site are suitable for fishing than rafting or kayaking, therefore these exposures have been conservatively represented by the fisherman.

Hunter (Ingestion Rate for Large Game) – For the RME hunter, the ingestion rate was assumed to be two meals per week, comprised of a half-pound (0.227 kg) serving of meat per meal. It was also conservatively assumed that 100% of the large game ingested by the hunter was harvested from within the mining districts. These assumptions consider that large game may be harvested throughout the archery season, muzzle season, and multiple rifle seasons and that game tissue may be available for consumption over extended periods.

Hunter (Ingestion Rate for Terrestrial Birds) – The bag limit for grouse at the Site (three grouse per day until nine are in possession, without a seasonal maximum) effectively results in an unlimited amount of birds that may be harvested. Therefore, bag limits could not be used to determine a Site-specific ingestion rate. For the RME hunter, the terrestrial bird ingestion rate was assumed to be 1 meal per 2 weeks, or one-half meal per week, comprised of a quarter-pound (0.114 kg) serving of meat per meal, or one-half the portion assumed for large game. It was also assumed that 100% of the terrestrial birds ingested were harvested from within the mining districts.

[9] The 95th percentile was calculated from the reported geometric mean (GM) and geometric standard deviation (GSD).

4.1.3 Exposure Point Concentrations for Chronic Exposure

Based on the assumption of random exposure over an exposure area, risk from a chemical within an exposure area is related to the arithmetic mean concentration of that chemical averaged over the entire exposure area. Since the true arithmetic mean concentration cannot be calculated with certainty from a limited number of measurements, EPA recommends that the 95% upper confidence limit (95UCL) of the arithmetic mean for each exposure area be used as the exposure point concentration (EPC) when calculating exposure and risk at that location (EPA 1992).

The mathematical approach most appropriate for computing the 95UCL of a dataset depends on a number of factors, including the number of data points available, the shape of the distribution of the values, and the degree of censoring (EPA 2002b). Because of the complexity of this process, the EPA Technical Support Center has developed a software application called ProUCL v5.1.00 (EPA 2015c) to assist in the estimation of 95UCL values. ProUCL calculates 95UCLs for a dataset using several different strategies and recommends which 95UCL is considered preferable based on the properties of the dataset. In the calculation of the 95UCL, results ranked as non-detect are evaluated in ProUCL using regression on order statistics. It is recommended that a minimum of 8–10 samples be used when calculating the 95UCL. If the minimum detection frequency requirements for ProUCL are not met, the EPC is set equal to the maximum detected value. If ProUCL provides more than one recommended 95UCL to use; the higher value is used as the EPC. If the 95UCL exceeded the maximum concentration, the recommended 95UCL was selected, with the exception of cases where the recommended 95UCL was based on bootstrap-t. In these cases, the 95UCL based on the 99% Chebyshev inequality was selected per ProUCL guidance. The use of the Chebyshev inequality to compute upper confidence limits (UCLs) tends to yield more conservative (but stable) UCLs than other methods available in ProUCL software. The EPCs selected for use in the risk characterization are presented in Table 4-10. The ProUCL output for all COPCs used in exposure and risk calculations are presented in Appendix B.

4.1.3.1 Approach for Soil and Soil-Like Media

It is expected that hikers and hunters may be exposed to both waste rock and overbank soil. Therefore, the EPC values used in the risk calculations for these two receptors were weighted such that a portion of the exposure time was spent on overbank soil and the remainder of the time was spent on waste rock materials. The results of the "halo" sampling, which was conducted in the summer of 2017 for select mine locations within the Site, was used to inform the appropriate weighting proportions. As described in EPA (2017a), the halo area, or zone of influence for mine locations, was delineated to distinguish between areas of impacted soils and non-impacted soils using in situ X-ray fluorescence (XRF). XRF results were used to estimate a conservative halo acreage for mine locations that was then extrapolated to non-surveyed mine locations. Based on this sampling, it was estimated that approximately 2% of surficial soil material in the mining districts is comprised of mine-impacted soils (EPA 2017c). Because it is anticipated that mine waste may serve as an attraction to visitors, and that the time exposed to mine waste will not be directly related to the areal coverage of mine waste relative to overbank soil, it was assumed 10% of the hunter and hiker exposure occurs on waste rock materials and 90% occurs on overbank soils.

The time-weighted EPC was calculated as follows:

$$EPC_{time\text{-}weighted} = 0.9 \cdot EPC_{overbank} + 0.1 \cdot EPC_{waste\ rock}$$

As discussed in Section 2.8.1, only 10% (19 samples) of waste rock, campground, and roadway soils were sieved to 250 µm in size; therefore, samples sieved to 2 mm in size were used in the EPC calculations for non-lead COPCs. See Section 4.4.1.5 for a discussion of the potential uncertainty due to the use of this approach.

4.1.3.2 Approach for Surface Water, Sediments, Campsite Soils

Surface water samples were collected from many locations, including the main stream reaches, mine adits, and seeps and springs. Because it is more likely that fisherman will be exposed to surface water and sediment in the main stream reaches, samples were limited to those collected from locations in these areas for use in the calculation of the EPC values. Samples collected from adits, seeps, and springs were excluded from the EPC calculations.

For campers, surface water and sediment samples included in the calculation of the EPC were restricted to those collected from sampling locations within approximately one-quarter mile from the camping location in the main stream reaches (i.e., the USFS campground or dispersed campground).

For dispersed campsite soils, composite samples collected from dispersed campsites were grouped together for computation of the chronic EPC for campsite soil. This chronic EPC is representative of the long-term average concentration in soil to which dispersed campers may be exposed, based on the assumption campers may go to different campsites over several years. For campsites for which more than one sample was available (i.e., a sample was collected in 2016 and 2018), the sample collected in 2018 was used in preference to the 2016 sample because the location information for the 2018 sample is better documented and paired IVBA data are available.

For USFS campground soils, the EPC is based on the single composite soil sample collected from the USFS campground.

4.1.3.3 Approach for Airborne Dust during ATV Use

Recall there are two EUs for evaluating ATV exposures: the Alpine Loop portion within the Site (EU5a) and all unpaved roadways within the mining districts beyond the Alpine Loop (EU5b). For EU5a, ATV ABS data were collected from the entire portion of the Alpine Loop within the Site (Figure 2-11). These data represent the airborne particulate levels generated while ATV guiding. Samples were collected for the leading and following rider. Sample results for the following rider were elevated relative to the leading rider. Therefore, to be conservative in estimating exposure, the data for the following rider were used to compute the EPC. The average concentration for the follower was computed because the EPC is meant to representative of a long-term average[10].

[10] The average concentration was computed due to the small sample size (five samples were collected for the following rider). The number of samples do not meet the minimum recommended sample number (i.e., 8–10 samples) recommended by ProUCL.

For EU5b, measured air data are not available for all roadways. In the absence of measured values for all roadways, the concentration of contaminants in air that would occur during ATV recreational riding was estimated using the following equation:

$$C(air) = C(soil) \cdot PEF$$

where:

C(air) = concentration of contaminant in air (µg/m^3)

C(soil) = concentration of contaminant in soil (µg/kg)

PEF = particulate emission factor (kg of soil per m^3 of air)

Appendix C presents the derivation of the Site-specific PEF for ATV recreational riding used in the risk assessment. The resulting PEF value is 5.6E-07 kg/m^3.

4.1.3.4 Approach for Airborne Dust from Roadways

Stationary air samples were collected along unpaved roads within the drainages to evaluate human health exposures and risks associated with inhaling road dust caused by passing ATVs and vehicles during the course of a work day for roadway workers. These direct measurements were used in the calculation of the EPC for metals in air.

4.1.3.5 Approach for Fish Ingestion

Samples of fillets from edible fish were used in calculation of the EPC values. Samples of subedible fish and forage fish were not used in EPC calculations. Fish tissue concentrations were reported by the laboratory as dry weight and converted to wet weight for use in EPC calculations using the sample-specific information on percent solids and the following equation:

$$\text{Concentration as wet weight} = \text{Concentration as dry weight} \cdot \text{percent solids} / 100$$

4.1.3.6 Approach for Game Ingestion

Although some people may ingest organ tissues, most individuals will prefer to ingest muscle tissues (e.g., backstrap for deer, breast for grouse). Therefore, samples collected from the muscle tissues were used in calculation of the EPC values for use in risk calculations. Organ tissue samples were used to compute an organ-specific EPC for use in discussing the uncertainty of only evaluating muscle tissue in the risk characterization. See Section 4.4 for a discussion of this uncertainty. Similar to fish tissue, game tissue results were reported by the laboratory as dry weight and converted to wet weight for use in EPC calculations using the same equation in Section 4.1.3.5.

4.1.4 Relative Bioavailability of Metals in Soil and Other Solid Media

An accurate assessment of human exposure to ingested chemicals requires knowledge of the amount of chemical absorbed from the gastrointestinal tract into the body from the site medium compared to the amount of absorption that occurred in the toxicity studies used to derive the toxicity factors. This ratio (amount absorbed from the site medium compared to the amount absorbed in toxicity tests) is referred to as relative bioavailability (RBA).

In general, metals in soil or soil-like media at mining sites exist in the form of mineral particles that are not rapidly solubilized in gastrointestinal fluids when ingested, while toxicity studies often utilize readily soluble forms of the test chemical. Thus, oral RBA values for metals in soil or soil-like media may be less than 1.0.

Conceptually, the most reliable method for obtaining site-specific estimates of RBA in soil or other solid media is to measure the gastrointestinal absorption in animals dosed with site soils compared to that for a fully soluble form of the metal. However, such in vivo tests are relatively costly and take considerable time to perform. No such animal data are available for any soil samples from the Site. One strategy to quantify bioavailability is to perform laboratory-based measurements of metal solubilization from soil samples. In this approach, a sample of soil or sediment is extracted using a fluid that has properties that resemble a gastrointestinal fluid, and the amount of metals solubilized from the sample into the fluid under a standard set of extraction conditions is measured. The amount of metal that is solubilized is referred to as the IVBA. The IVBA is then utilized to predict the in vivo RBA of the metal in that sample through an empiric correlation model that relates IVBA to in vivo RBA. To date, EPA has developed IVBA-to-RBA correlation models for arsenic (EPA 2017d) and lead (EPA 2007).

EPA conducted IVBA testing for arsenic and lead on 28 dispersed campsites, roadway, and waste rock samples collected from the mining districts. As shown in Table 4-10, IVBA values for arsenic ranged from 0–13%, suggesting the RBA of arsenic in these dispersed campsite, roadway, and waste rock materials is likely to be low. Arsenic RBA was predicted from the IVBA data using the regression model recommended in EPA (2017d) using the following equation (where the IVBA and RBA values are expressed as fractions, not percentages):

$$RBA = 0.79 \cdot IVBA + 0.03$$

It is not uncommon for mine waste and soils that are impacted by mining activities to have lower bioavailability because of the nature of the arsenic forms present in these materials. When media-specific arsenic RBA values were available (e.g., campsite soil, roadway soil, and waste rock), the average arsenic RBA for each medium was included in the risk calculations. For other solid media (i.e., overbank soils, sediment), the EPA default arsenic RBA of 0.60 was assumed (EPA 2012).

With the exception of lead (discussed in Section 5), RBA data are absent for other metals, so the RBA for all other non-lead metals was assumed to be 1.0. The RBA values employed in this risk assessment are likely to be conservative. See Section 4.4 for a discussion of the potential uncertainty due to RBA assumptions.

4.1.5 Chromium Valence State

In the environment, chromium may be present in various valence states, but the trivalent form, Cr(III), and hexavalent form, Cr(VI), are the most predominant, depending upon the nature of the contamination source and environmental conditions (Shahid et al. 2017). In the absence of a specific Cr(VI) source, chromium exists in the environment mainly as Cr(III) (Agency for Toxic Substances and Disease Registry [ATSDR] 2012; Han et al. 2004). Because the valence state of chromium is not known and data are available only for total chromium, risk calculations assumed the majority (90%) of the total chromium present in the collected environmental media samples was Cr(III) and the remainder (10%) was Cr(VI). This assumption is likely to be conservative

given there are no specific sources of Cr(VI) within the mining districts. See Section 4.4 for a discussion of the potential uncertainty due to the use of this approach.

4.2 Toxicity Assessment

4.2.1 Overview

The objective of a toxicity assessment is to identify the types of adverse health effects that are caused by a particular chemical, and how the appearance of these adverse effects depends on exposure level. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure. For the purposes of this HHRA, focus will be on long-term chronic exposures, recognizing that short-term exposures do occur (see Appendix F for a screening-level evaluation of acute exposures). Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical may cause, and how the occurrence of these effects depends upon dose, route, and duration of exposure.

The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the non-cancer effects of the chemical, while the second addresses the cancer effects of the chemical. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and non-cancer effects.

4.2.1.1 Non-Cancer Effects

Essentially all chemicals can cause adverse health effects at a sufficient dose. However, when the dose is sufficiently low, typically no adverse effect is observed. Thus, in characterizing the non-cancer effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be safe, while doses above the threshold are likely to cause an effect.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect, and the lowest dose which does produce an effect. These are referred to as the no-observed-adverse-effect level (NOAEL) and the lowest-observed-adverse-effect level (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, in order to be conservative (protective), non-cancer risk evaluations are not based directly on the threshold exposure level but on a value referred to as the reference dose (RfD) for oral exposures (e.g., incidental ingestion of soil, ingestion of drinking water, ingestion of dietary items), with units of mg per kg body weight per day (mg/kg-day), or the reference concentration (RfC), with units of mg/m^3 for inhalation exposures. The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The RfD and RfC values are derived from the NOAEL, LOAEL, or benchmark dose by dividing by a UF that reflects the limitations of the data used. If the data are from studies in humans, and if the observations are considered to be very reliable, the UF may be as small as 1.0. However, the UF is normally at least 10, and can be much higher if the data are limited. UFs are assigned to account

for uncertainty arising from extrapolation of animal data to humans, the use of a LOAEL instead of a NOAEL, the use of less than chronic exposure, and other limitations in the available data (e.g., lack of reproductive data).

The effect of dividing the NOAEL or the LOAEL by a UF is to ensure that the RfD or RfC is not higher than the threshold level for adverse effects. Thus, there is always a "margin of safety" built into a RfD and RfC, and levels equal to or less than the RfD or RfC are nearly certain to be without any risk of adverse effect. Levels higher than the RfD or RfC may carry some risk, but because of the margin of safety, a level above the RfD or RfC does not mean that an effect will necessarily occur. The protectiveness of this margin of safety will vary from chemical to chemical, depending upon the quality of the data and the size of any applied UF. A chemical for which large UF has been applied will generally have a higher margin of safety than a chemical with a smaller UF.

4.2.1.2 Cancer Effects

For cancer effects, the toxicity assessment process has two components. The first is a qualitative evaluation of the weight of evidence (WOE) that the chemical does or does not cause cancer in humans. Previously, this evaluation was performed by EPA using the system summarized below:

WOE Group	Meaning	Description
A	Known human carcinogen	Sufficient evidence of cancer in humans.
B1	Probable human carcinogen	Suggestive evidence of cancer incidence in humans.
B2	Probable human carcinogen	Sufficient evidence of cancer in animals, but lack of data or insufficient data in humans.
C	Possible human carcinogen	Suggestive evidence of carcinogenicity in animals.
D	Cannot be evaluated	No evidence or inadequate evidence of cancer in animals or humans.
E	Not carcinogenic to humans	Strong evidence that it does not cause cancer in humans.

EPA has developed a revised classification system for characterizing the weight of evidence for carcinogens (EPA 2005a). However, this system has not yet been implemented for a number of chemicals, so the older classification scheme is retained for use in this assessment.

For chemicals which are classified in Group A, B1, B2, or C using EPA guidelines (EPA 1986), the second part of the toxicity assessment is to describe the carcinogenic potency of the chemical. This is done by quantifying how the number of cancers observed in exposed animals or humans increases as the dose increases. Typically, it is assumed that the dose-response curve for cancer has no threshold, arising from the origin and increasing linearly until high doses are reached. Thus, the most convenient descriptor of cancer potency is the slope of the dose-response curve at low doses (where the slope is still linear). This is referred to as the slope factor (SF), which has dimensions of risk of cancer per unit dose.

Estimating the cancer SF is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses, frequently in the part of the dose-response curve that is no longer linear. Thus, it is necessary to use mathematical models to extrapolate

from the observed high dose data to the desired (but unmeasurable) slope at low dose. In order to account for the uncertainty in this extrapolation process, EPA typically chooses to employ the 95UCL of the slope as the SF. That is, there is a 95% probability that the true cancer potency is lower than the value chosen for the SF. This approach ensures that there is a margin of safety in cancer risk estimates.

For inhalation exposures, cancer risk is characterized by an inhalation unit risk (IUR) value. This value represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 microgram per cubic meter ($\mu g/m^3$) in air.

4.2.2 Toxicity Values

Toxicity values (RfD, RfC, SF, and IUR values) established by EPA are listed in the Integrated Risk Information System (IRIS) (EPA 2018c). Other toxicity values are available as interim recommendations from EPA's Superfund Technical Assistance Center operated by the National Center for Environmental Assessment (NCEA). A toxicity value hierarchy was developed by EPA for use in site-specific risk assessments (EPA 2003a). This hierarchy provides an order of preference of toxicity values, with Tier 1 being the preferred source of toxicity information, if available, then Tier 2, followed by Tier 3. The recommended hierarchy of toxicity values is:

- Tier 1 – EPA's IRIS: IRIS assessments have undergone external peer review in accordance with EPA peer review guidance at the time of the assessment. IRIS health assessments contain EPA consensus toxicity values.
- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs): The Office of Research and Development/NCEA/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program.
- Tier 3 – Other Toxicity Values: Tier 3 includes additional EPA and non-EPA sources of toxicity information, such as the California Environmental Protection Agency and ATSDR. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer-reviewed.

The EPA RSL tables include a summary of toxicity values derived from these sources using the tiered system described above. These tables are maintained by EPA and periodically updated (EPA 2018b). All toxicity values used in this assessment were taken from the most recent version of the RSL tables (November 2018), except as noted below. Table 4-12 shows the toxicity values used for evaluation of human health risks from COPCs. For metals with different values for different chemical forms, the values selected were based on the chemical form most similar to that expected to occur at the Site. Points to note regarding the data in this table include:

- Two oral RfD values are available for cadmium, depending on exposure medium (diet or water). The value for water is assumed to apply to surface water and groundwater, while the value for diet is assumed to apply to all other media (i.e., soil, sediment, fish and game tissue, and air).
- Two oral RfD values are available for manganese depending on exposure medium (diet or non-diet). The value for diet is assumed to apply to items in the diet (i.e., fish and game

tissue), while the value for non-diet is assumed to apply to all other media types (i.e., soil, sediment, air, and water). The non-diet RfD for manganese (4.7E-02 mg/kg-day) is based on the oral RfD of 1.4E-01 mg/kg-day in the diet. In accordance with recommendations in IRIS (EPA 2018c), for application to non-diet exposures, the RfD was adjusted by dividing by a modifying factor of 3.

Qualitative information for non-carcinogens is also provided in Table 4-12 in the form of target tissues for chronic exposures. Target tissues are important for the evaluation of combined non-cancer exposures to multiple chemicals (see Section 4.3.1).

4.3 Risk Characterization

4.3.1 Basic Approach

The following subsections provide the basic approach for characterizing for non-cancer hazards and cancer risks for chronic exposures.

4.3.1.1 Non-cancer effects

The potential for non-cancer effects from a COPC is evaluated by comparing the estimated site-related exposure for a receptor over a specified time-period to the RfD or RfC for that COPC. This ratio of site-related exposure to the safe exposure level is called the HQ. If an individual is exposed to more than one chemical, a screening-level estimate of the total non-cancer hazard is derived simply by summing the HQ values across individual chemicals and exposure pathways. This total is referred to as the hazard index (HI). If the HI value is less than or equal to [≤] 1, non-cancer hazards are not expected from any chemical, alone or in combination with others. If the screening level HI exceeds 1, it may be appropriate to perform a follow-on evaluation in which HQ values are added only across chemicals that affect the same target tissue or organ system (e.g., the liver). This is because chemicals that do not cause toxicity in the same tissues are not likely to cause additive effects.

Hazards from Ingestion

The potential for non-cancer effects from ingestion is evaluated by comparing the estimated daily intake of the chemical over a specific time period with the RfD for that chemical derived for a similar exposure period, as follows (EPA 1989):

$$HQ = DI / RfD$$

where:

DI = Daily Intake (mg/kg-day)

RfD = Reference Dose (mg/kg-day)

Hazards from Inhalation

For inhalation exposures, the potential for non-cancer effects is evaluated by comparing the time-weighted EC over a specific time-period to the RfC for that chemical, as follows (EPA 1994a):

$$HQ = EC / RfC$$

where:

EC = Exposure Concentration (mg/m^3)

RfC = Inhalation Reference Concentration (mg/m^3)

4.3.1.2 Cancer effects

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. Excess cancer risks are summed across all carcinogenic chemicals and all exposure pathways that contribute to exposure of an individual in a given population. The level of total cancer risk that is of concern is a matter of personal, community, and regulatory judgment. In general, EPA considers excess cancer risks that are below 1E-06 to be so small as to be negligible, and risks above 1E-04 to be sufficiently large that some sort of remediation is desirable[11]. Excess cancer risks that range between 1E-04 and 1E-06 are generally considered to be acceptable (EPA 1991b), although this is evaluated on a case-by-case basis, and EPA may determine that risks lower than 1E-04 are not sufficiently protective and warrant remedial action. Cancer risks for each chemical are calculated as described below.

Risks from Ingestion

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. The excess risk of cancer from ingestion exposure to a chemical is calculated as follows (EPA 1989):

$$\text{Excess Cancer Risk} = 1 - \exp(-DI_L \cdot SF)$$

where:

DI_L = Daily intake, averaged over a lifetime (mg/kg-day)

SF = Slope Factor $(mg/kg\text{-}day)^{-1}$

In most cases (except when the product of $DI_L \cdot SF$ is larger than about 0.01), this equation may be approximated by the following:

$$\text{Excess Cancer Risk} = DI_L \cdot SF$$

Risks from Inhalation

The excess risk of cancer from inhalation exposure to a chemical is calculated based on IUR values, as follows (EPA 2009a):

$$\text{Excess Cancer Risk} = EC \cdot IUR$$

[11] Excess cancer risk can be expressed in several formats. A cancer risk expressed in a scientific notation format as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. Similarly, a cancer risk of 1E-04 is equivalent to 1 in 10,000 or 10^{-4}. For the purposes of this document, all cancer risks are presented in a scientific notation format.

where:

EC = Exposure Concentration ($\mu g/m^3$)

IUR = Inhalation Unit Risk $(\mu g/m^3)^{-1}$

Mutagenic Modes of Action

For chemicals identified as having a mutagenic mode of action for carcinogenesis, cancer risks were estimated in accordance with the *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (EPA 2005b). As shown in Table 4-12, the only COPC with a mutagenic mode of action is Cr(VI). When evaluating exposures to Cr(VI), the default age-dependent adjustment factors (ADAFs) were applied to the cancer slope factor to account for differences in potency that may occur from exposure during early life (up to age 16), as follows:

- 0 to <2 years: ADAF = 10
- 2 to <16 years: ADAF = 3
- ≥ 16 years: ADAF = 1 (i.e., no adjustment necessary)

EPA (2005b) further indicates that any grouping of ages in the exposure assessment will need to be integrated with the ADAF age groupings to derive age group-specific risk estimates. For each age interval 'i', the cancer risk for exposure by a specified pathway is computed as:

$$Risk_i = C \cdot (HIF \cdot ED_i / ED_{total}) \cdot SF \cdot ADAF_i$$

where:

$Risk_i$ = Excess cancer risk for age interval "i"

C = concentration of chemical in the exposure medium (e.g., mg/kg for soil)

HIF = human intake factor for the exposure medium (e.g., kg/kg-day for soil)

ED_i = exposure duration for age interval "i" (years)

ED_{total} = total exposure duration (years)

SF = cancer slope factor $(mg/kg\text{-}day)^{-1}$

$ADAF_i$ = Age-dependent adjustment factor for age interval "i" (unitless)

Total risk to the individual is the sum of the risks across all age intervals:

$$Total\ Risk = Risk_{0-<2} + Risk_{6-<16} + Risk_{16+}$$

As seen in the equation above, the HIF term is time-weighted (ED_i / ED_{total}) to be specific to the age interval "i". For the receptors of interest, the following time-weighting factors were applied to each age interval when quantifying exposures from Cr(VI).

Age Group	Age Interval	ADAF (unitless)	ATV Guide, Road Worker	Hiker, Fisherman, Hunter	Camper
Child	1 [0–<2 years]	10	---	---	CTE: 1.00, RME: 0.33
	2 [2–<6 years]	3	---	---	CTE: 0, RME: 0.67
Older Child	3 [6–<16 years]	3	---	0.50	0.50
Adult	4 [16 years]	1	1.00	0.50	0.50

--- = this age group is not applicable to this receptor

For example, for the RME camper at the USFS campground (see Tables 4-5 and 4-7), the total exposure duration is 26 years (6 years as a child, 10 years as an older child, and 10 years as an adult). For the purposes of the ADAF time-weighting adjustment, this exposure is allocated as 2 years in age interval 1, 4 years in age interval 2, 10 years in age interval 3, and 10 years in age interval 4. An example calculation for the ADAF-adjustment for incidental soil ingestion is shown in the following inset:

CALCULATION EXAMPLE OF ADAF-ADJUSTMENT:

Excess Cancer Risk = [Csoil · (HIFsoil, child · ED0-<2yrs / EDchild) · SF · ADAF0–<2yrs] +
[Csoil · (HIFsoil, child · ED2-<6yrs / EDchild) · SF · ADAF2–<6yrs] +
[Csoil · (HIFsoil, adult · ED6-<16yrs / EDadult) · SF · ADAF6–<16yrs] +
[Csoil · (HIFsoil, adult · ED16+yrs / EDadult) · SF · ADAF16+yrs]

When the receptor-specific exposure parameter values are substituted, the equation becomes:
Excess Cancer Risk = [Csoil · (9.40E-08 kg/kg-d · 2 yrs / 6 yrs) · SF · 10] +
[Csoil · (9.40E-08 kg/kg-d · 4 yrs / 6 yrs) · SF · 3] +
[Csoil · (3.86E-08 kg/kg-d · 10 yrs / 20 yrs) · SF · 3] +
[Csoil · (3.86E-08 kg/kg-d · 10 yrs / 20 yrs) · SF · 1]

Risks associated with inhalation exposure to carcinogens that act via a mutagenic mode of action are calculated in similar fashion by applying the appropriate ADAF(s) along with the corresponding IUR, using pertinent estimates of exposure concentration.

4.3.2 Results

Detailed calculations of chronic exposure and risk from non-lead COPCs for each exposure scenario are provided in Appendix D for both the CTE and RME scenarios. Non-cancer HIs and total cancer risks (across chemicals) based on RME scenarios are summarized in Table 4-13. As seen, all risk estimates are within EPA's acceptable risk guidelines (i.e., HI values ≤1 and cancer risk values <1E-04). The following sections present the main conclusions for RME scenarios.

4.3.2.1 ATV Guide and ATV Recreational Rider

Risks were evaluated for ATV guides while traveling the Alpine Loop (EU5a; Appendix D-1) and ATV recreational riders while traveling all roadways at the Site (EU5b; Appendix D-2). Exposures were quantified for inhalation of particulates caused by human disturbance (i.e., ATV recreational

riding) and incidental ingestion of roadway soil. RME non-cancer HIs are ≤1 and cancer risks are <1E-04 for both the ATV guide and the ATV recreational rider.

4.3.2.2 Hiker

Risks were evaluated for hikers while hiking along drainages in EU1 (Animas River upstream of the south fork), EU2 (Animas River downstream of the south fork), EU3 (Cement Creek), and EU4 (Mineral Creek) (see Appendix D-3 through Appendix D-6, respectively). Exposures were quantified for incidental ingestion of a mixture of overbank soil and waste rock. RME non-cancer HIs are <1 and cancer risks are <1E-04 for all exposure units.

4.3.2.3 Camper (USFS Campground)

Risks were evaluated for campers at the USFS campground (EU6; Appendix D-7). Exposures were quantified for incidental ingestion of surface water, ingestion of groundwater (as drinking water), and incidental ingestion of sediment and soil. RME non-cancer HIs are <1 and cancer risks are <1E-04.

4.3.2.4 Camper (Dispersed Locations)

Risks were evaluated for campers in dispersed camping locations (EU7; Appendix D-8). Exposures were quantified for ingestion of surface water (as drinking water) and incidental ingestion of surface water, sediment, and campsite soil. RME non-cancer HIs are ≤1 and cancer risks are <1E-04.

4.3.2.5 Fisherman

Risks were evaluated for fishermen who fish in Mineral Creek (EU8; Appendix D-9) and the lower portion of the Animas River (EU9; Appendix D-10). Exposures were quantified for incidental ingestion of surface water and sediment and ingestion of fish. RME non-cancer HIs are <1 and cancer risks are <1E-04 for both exposure units.

4.3.2.6 Hunter

Risks were evaluated for hunters while hunting along drainages in EU1 (Animas River upstream of the south fork), EU2 (Animas River downstream of the south fork), EU3 (Cement Creek), and EU4 (Mineral Creek) (see Appendix D-11 to D-14, respectively). Exposures were quantified for ingestion of game (grouse and deer) and incidental ingestion of overbank soil/waste rock. RME non-cancer HIs are less than 1 and cancer risks are less than 1E-04 for all exposure units.

4.3.2.7 Road Worker

Risks were evaluated for road workers while working along drainages in EU1 (Animas River upstream of the south fork), EU2 (Animas River downstream of the south fork), EU3 (Cement Creek), and EU4 (Mineral Creek) (see Appendix D-15 to D-18, respectively). Exposures were quantified for inhalation of particulates caused by roadway soil disturbances and incidental ingestion of roadway soil. RME non-cancer HIs are ≤1 and cancer risks are <1E-04 for all exposure units.

4.4 Uncertainty Assessment

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with contaminated media, and the true dose-response curves for non-cancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment. The following sections review the main sources of uncertainty in the chronic risk calculations for non-lead COPCs.

4.4.1 Uncertainties in Exposure Assessment

4.4.1.1 Uncertainties from Exposure Pathways Not Evaluated

As discussed above, humans may be exposed to chemicals by a number of pathways, but not all of these pathways were evaluated quantitatively in this risk assessment. In most cases, this is because the contribution of the pathway omitted is believed to be minor compared to one or more other pathways that were evaluated. For example, dermal exposure to metals in soil, sediment, and water were not quantified. Omission of these minor pathways will result in a small underestimation of exposure and risk, but the magnitude of this underestimation is not expected to be significant.

As seen in Figure 3-1, some pathways were not evaluated quantitatively for all receptors, recognizing that the pathways were to be evaluated for more sensitive receptors (because of greater exposure frequencies, incidental ingestion rates, exposure time, etc.). These pathways were denoted with an "X" and footnote number 6 in the CSM (Figure 3-1). In brief, incidental ingestion of surface water and sediment was not evaluated quantitatively for hikers and hunters because these pathways were evaluated for campers. Table 4-14 presents a comparison of exposure input parameters for the camper (adult in dispersed camping locations) versus the hiker and hunter. As seen, the ratio of the HIF values reveals that exposure rates for the hunter from incidental ingestion of surface water and sediment are 20% lower than the exposure rates for the camper. The exposure rates for the hiker from incidental ingestion of surface water and sediment are 60% lower than the exposure rates for the camper. Because non-cancer and cancer risks are below the target thresholds for these pathways for the dispersed camper (see Table 4-13; RME HI for from incidental ingestion surface water and sediment is 0.1, cancer risk from incidental ingestion surface water and sediment is 1E-07), it expected that non-cancer and cancer risks for these pathways for the hunter and hiker would contribute very minimally to the cumulative risk for these receptors.

4.4.1.2 Uncertainties from Chemicals Not Evaluated

As discussed above, quantitative risk estimates are derived only for COPCs. Chemicals that were detected in Site samples but excluded as COPCs may contribute a small amount of added risk. However, the contribution is expected to be so small that this is not a source of significant uncertainty. It is noted that some analytes were not evaluated because they were not measured in media for some samples. For roadway air samples, antimony, cadmium, cobalt, iron, thallium, and zinc were not analyzed. For ATV ABS air samples, antimony, cobalt, and thallium were not

analyzed. For surface water samples collected near the USFS campground, cobalt, molybdenum, potassium, thallium, and vanadium were not analyzed. In the absence of data, no conclusions can be drawn regarding the potential for risk from these analytes.

4.4.1.3 Uncertainties in Exposure Point Concentrations

In all exposure calculations, the desired input parameter is the true mean concentration of a contaminant within a medium, averaged over the area where random exposure occurs. However, because the true mean cannot be calculated based on a limited set of measurements, EPA (1989, 1992) recommends that the exposure estimate be based on the 95UCL. When data are plentiful and inter-sample variability is not large, the UCL may be only slightly higher than the mean of the data. However, when data are sparse or are highly variable, the 95UCL may be substantially greater than the mean of the available data. Thus, use of the UCL is expected to result in a conservative estimate of risk in most cases. As seen in Appendix D, even where the 95UCL exceeds the maximum concentration (denoted with footnote C in the tables), estimated non-cancer HIs are ≤1 and cancer risks are <1E-04.

Measured air concentrations were not available for ATV recreational riders that ride on unpaved roads outside the Alpine Loop (i.e., in EU5b). Air samples were only collected to represent exposures for road workers and ATV guides riding within the Alpine Loop (i.e., in EU5a). Therefore, when quantifying dust inhalation exposures for ATV recreational riders, airborne concentrations were estimated using a screening-level soil-to-air PEF. In general, such predicted concentration values have high uncertainty compared to measured values, so the actual concentrations of metals in airborne dust are uncertain, and true values might be either higher or lower than calculated. In order to be conservative, measured air data during ATV ABS for the following (versus leading) rider were used in the PEF calculations. Because manganese was detected in each ATV ABS air sample, manganese air and soil concentrations were used as the basis of the PEF, which was applied to all COPCs. It is not expected there are chemical-specific differences in soil-to-air releases.

The soil EPC for the hiker and hunter is weighted based on an assumed fraction of time spent exposed to overbank soil (90%) and to waste rock (10%). This weighting approach is based on professional judgement, recognizing that hikers and hunters will encounter waste materials in the mining districts for only a small portion of the time. Because this weighting approach was based on professional judgement, the true values might be either higher or lower than estimated.

The EPC for game tissue (deer and grouse) was limited to muscle tissue. It is possible that a hunter may ingest the organs of game animals and organ tissues may have higher concentrations of metals present depending on the chemical. However, the frequency that organs collected from the Site may be ingested compared to muscle tissue from the Site is expected to be significantly less. Because ingestion of organ tissues was not included in this evaluation, a small underestimation of exposure and risk is possible, but the magnitude of this underestimation is not expected to be significant.

4.4.1.4 Uncertainties in Data Adequacy

An evaluation of data adequacy is performed in two steps. The first step is to determine if the data are representative in space and time. This is usually a qualitative assessment. The second step is

to determine if the data are statistically adequate. For data to be used for evaluation of risks to humans, statistical adequacy considers the magnitude of the uncertainty in the measured average exposure concentration, the proximity of the exposure concentration to a decision threshold, and whether the uncertainty is too large to support confident decision-making.

Spatial and Temporal Representativeness

Surface Soil/Mine Waste

A variety of soil/mine waste types have been sampled, including overbank soil, floodplain, waste rock, roadway, campground, and upland reference soil, as described in Section 2.8.1. Samples were collected using a composite approach, which means the reported concentration for a sample is representative of the average within a larger sampling area. Because the average (mean) concentration is the statistic of interest for the purposes of risk assessment, use of a composite sampling methodology provides a better estimate of exposures compared to a discrete (grab) sampling methodology.

Mine waste materials were deposited and soils became contaminated several decades ago when mining activities were actively occurring at the Site. While the valence state and chemical form of metals may change based on environmental conditions, total concentrations in surface soil/mine waste are not expected to vary over time. Samples collected from 2015–2018 are likely to be representative of both current and future exposure conditions.

Samples of mine waste have been collected from each of the 48 mines included in the NPL listing. Roadway soil samples have been collected from each of the roadways along the major drainages and from many of the subdrainages, with a greater sample density near the mine locations. Campground soil samples have been collected from the USFS campground and 14 dispersed campsite locations. While there are dispersed camping locations that have not been characterized, the locations that have been characterized are those that are anticipated to be used most frequently and are likely to be representative of unsampled locations. The upland reference soil samples were collected from a variety of locations in areas that did not appear to be impacted by Site activities. Therefore, it is concluded the surface soil/mine waste data are spatially and temporally representative, and these media have been adequately characterized for use in this HHRA.

Sediment/Surface Water

Multiple surface water sampling events have been conducted from 2015–2018. Samples have been collected throughout each of the three main drainages (Mineral Creek, Cement Creek, and the Animas River) and all subdrainages, as described in Section 2.8.2 and Section 2.8.3. Samples have been collected upstream and downstream of surface water inputs with the potential to influence in-stream surface water and sediment concentrations. Although the available sediment and surface water data are representative of the Site drainages and subdrainages, there are no Site-specific data available from background locations to provide information on metal concentrations in areas that are unimpacted by Site activities.

As discussed in Section 2.3, in summer 2015, there was an uncontrolled release of mining-impacted water to the Animas River. Because the purpose of the HHRA is to evaluate exposures under current and future conditions, only samples collected from 2015–2018 were included in the risk characterization to ensure the data were representative of post-spill conditions.

Metals concentrations have the potential to vary temporally in surface water, both in the short term (diurnally) and long term (seasonally within a year and from year to year). Human exposures to sediment/surface water are most likely to occur during the summer months (between Memorial Day and Labor Day). In general, sediment/surface water samples have been collected in spring (during high-flow conditions) and in fall (during low-flow conditions).

As described above, available sediment and surface water data from the Site are spatially and temporally representative, therefore, these media have been adequately characterized for use in this HHRA.

Groundwater

Access to groundwater is generally limited to the USFS campground. Groundwater samples have been collected from the campground well. Therefore, the spatial representativeness for groundwater is adequate. However, there are only two grab samples (one in August 2010 and one in June 2017), thus, the available groundwater data only represent these two limited time intervals. Even so, both samples were collected during the summer months, when human exposures are most likely to occur at the USFS campground. The temporal representativeness of the groundwater dataset could be improved, however, the need for this may depend on the statistical adequacy of the analytical results. Because the risk characterization did not indicate measured groundwater concentrations for the campground well resulted in unacceptable exposures, the data have been deemed adequate for use in performing screening-level exposure estimates in this HHRA.

Dietary Items (Game and Fish Tissue)

There are a variety of animals that may be harvested from the Site by hunters and fishermen for consumption. Game tissue samples were collected for deer and grouse, which are two species that are likely to be most commonly hunted at the Site. Although game tissues were only collected from in the Mineral Creek drainage, because deer and grouse have relatively large home range sizes, they may forage across the Site; thus, contamination levels in their tissues represent a composite of multiple areas within the Site. While there were only a few animals that were harvested (two deer and three grouse), it is expected the collected samples are representative of other game animals present at within the mining districts.

Fish tissue samples were collected from each of the main drainages and subdrainages where fish were present. While it is expected that contamination levels in fish tissues vary by species and size (larger, older fish tend to have higher tissue levels than smaller, younger fish), the fish samples were collected for a species (brook trout) and size most likely to be kept for consumption by fishermen.

As described above, while the tissue dataset is limited, the collected samples are representative of the types of tissues that may be ingested by humans and are adequate for use in this HHRA.

Air

Because stationary roadway air samples have been collected from the main unpaved roads within each of the main drainages at the Site, the spatial representativeness of these samples is deemed adequate for use in this HHRA. The roadway air samples were collected during fall 2017, during a time when roadway use was moderately high. While these samples were not collected during peak activity on the roadways at the Site (July through August), it is reasonable to expect that these samples are representative of average roadway air conditions spanning the spring to fall months when there is no snow on the ground.

ATV ABS air samples were collected throughout the Alpine Loop (EU5a) and are representative of the inhalation exposures for the ATV guide. The ATV ABS air samples were collected following a relatively dry summer for the mining districts and are therefore representative of the high-end of air concentrations that could be experienced.

There are no measured data on air concentrations during ATV recreational riding on unpaved roadways outside the Alpine Loop (EU5b). Therefore, inhalation exposures for the ATV recreational riders were evaluated using estimated air concentrations derived from Site roadway soil concentrations as detailed in Section 4.1.3.3. As noted above, concentrations in surface soil are not expected to vary over time and the available roadway soil dataset is representative of the roads where ATV recreational riding is most likely to occur. Therefore, the roadway soil used to estimate air concentration while riding ATVs in EU5b has been adequately characterized for use in this HHRA.

Detection Limit Adequacy

Detection limit adequacy is determined by performing an evaluation of the achieved laboratory detection limits for each chemical in each media in cases where the samples were all non-detect to determine if the achieved detection limits were low enough to support risk management decision-making. This detection limit adequacy evaluation is presented in Section 4.4.1.3 for non-lead chemicals and discussed in detail below.

During the COPC selection process, several analytes were non-detect in Site media based on the Site-wide dataset. For surface water, all analytical results for mercury were non-detect. As shown in Table 3-3, the mean of the method detection limits (MDLs) was less than the residential tap water RSL, which indicates the achieved MDLs were adequate to support the HHRA.

For groundwater samples collected at the USFS campground, all analytical results for aluminum, antimony, arsenic, beryllium, cadmium, iron, manganese, and selenium were non-detect. As shown in Table 3-4, with the exception of arsenic, the mean of the MDLs was less than the residential tap water RSL for all analytes. Because the tap water RSL is intended to be protective of residential exposure, it is likely to be overly conservative for a camper exposure scenario. Therefore, risk calculations for the child camper at the USFS campground (the most sensitive receptor) were performed using one-half the average MDL as the EPC to determine if the

achieved arsenic MDL for groundwater was adequate for the types of receptors expected at the Site. The results of this evaluation are shown in Table 4-15 and reveal an HQ value for arsenic of 0.2 and cancer risk at 3E-05, both are which are within EPA's acceptable risk range. Based on this, it is likely that arsenic in groundwater at the USFS campground is not significantly contributing to risk at the Site.

In some instances, analytical results for some COPCs were all non-detect for certain EUs. In order to determine if the MDLs were adequate to support risk management decisions at the Site, risk calculations were performed using one-half the average MDL as the EPC for the most sensitive receptor in the EU. Table 4-16 presents this detection limit adequacy evaluation. As seen, with three exceptions, risks computed using one-half the MDL as the EPC are all within EPA's acceptable risk range.

- Arsenic, cadmium, and chromium in ATV ABS air (ATV guide) – For ATV ABS air, analytical results were non-detect for several metals. Risk calculations for the ATV guide were performed using one-half the average MDL as the EPC to determine if the MDL was adequate for ATV ABS air. As seen in Table 4-16 (Panel A), the results of this evaluation reveal HQ values ≤1 and cancer risk <1E-04. This demonstrates that the MDLs achieved during the analysis of the ATV ABS air samples were adequate to determine if COPCs may be present at unacceptable exposure levels. Because the non-cancer HQ for arsenic based on one-half the average MDL was equal to 1, an alternative evaluation of arsenic was performed by estimating the potential air concentration during ATV use from measured roadway soil concentrations using the Site-specific PEF (as developed in Appendix C). The resulting arsenic HQ using the predicted air concentration was 0.02. This alternative evaluation provides another line of evidence to demonstrate that arsenic concentrations in air due to ATV use are not significantly contributing to risks at the Site.

- Thallium in deer tissue (Hunter) – Although thallium was not detected in deer tissues, when risk calculations were performed using one-half the average MDL as the EPC (see Table 4-16, Panel H), the non-cancer HQ due to ingestion of thallium in deer tissue for the hunter was greater than 1 (HQ value of 7). This shows the MDL achieved during the analysis of thallium in deer tissue (using the best laboratory practices and analytical methods) was too high to determine if it may be present at unacceptable exposure levels. Although this is a source of uncertainty and might lead to an underestimate of risk, it is important to note that there is little reason to suppose thallium is actually present in Site media at levels of concern because of historical mining activities. A comparison of the 95UCL on the mean for upland reference soil (1.1 mg/kg) versus Site soil EPCs for each EU (see Appendix Tables D-11a through D-14a) reveals that Site soil concentrations are less than upland reference soil. This suggests thallium levels in environmental media at the Site, including deer tissues, are likely to be representative of local reference conditions. Consequently, the inadequate detection limit for thallium in deer tissue is not likely to be a significant limitation.

- Arsenic in roadway air (Road Worker) – For arsenic in roadway air, all analytical results were non-detect. Risk calculations for the roadway worker were performed using one-half the average MDL as the EPC to determine if the MDL was adequate for roadway air. As seen

in Table 4-16 (Panel I), the results of this evaluation reveal a HQ value for arsenic of 30 and cancer risk at 3E-04, both are which are above EPA's acceptable risk range. This shows the MDL achieved during the analysis of arsenic in roadway air samples was too high to determine if it may be present at an unacceptable exposure level. The potential issue with inadequate MDLs was recognized at the time of the development of the governing sampling and analysis plan for the roadway air sampling (EPA 2017a). Air samples were collected using the best available sampling techniques and analytical methods.

Because the non-cancer HQ for arsenic based on one-half the average MDL was greater than 1, and the cancer risk was greater than 1E-04, an alternative evaluation of arsenic was performed by estimating the potential air concentration using measured roadway soil concentration. Although there are default PEF equations provided in the literature to estimate air concentrations for a construction worker exposure scenario, use of these equations requires many assumptions about the dust emission sources (e.g., vehicle size, vehicle distance traveled, frequency of days without rainfall). There are Site-specific measurements of dust emissions during ATV use, which is more representative of the types of vehicles roadway workers would likely encounter along Site roadways. Therefore, the Site-specific PEF for ATV guides was used (as developed in Appendix C) to estimate potential air concentrations for roadway workers. Recall that this Site-specific PEF was derived using only data collected from the following rider, thus, this is likely to be a conservative estimate of airborne exposures for a roadway worker. Risk estimates are based on the arsenic EPC for soil in EU1, where the highest EPC was calculated for the roadway worker. The resulting arsenic HQ using the predicted air concentration was 0.3 and the cancer risk was 2E-06. This alternative evaluation provides another line of evidence to demonstrate that arsenic concentrations in air are not significantly contributing to risks at the Site.

4.4.1.5 Uncertainty in the Soil Particle Size Fraction

The soil particle size fraction selected for use in EPC calculations was the bulk fraction (i.e., passing a 2-mm sieve), recognizing that only 10% of samples were sieved to 250 µm. As shown in Table 4-17, the average ratio of the bulk concentration to the 250-µm concentration across all soil types and all metals was about 0.90, which indicates the results for the two size fractions are generally similar. Use of the bulk fraction in the EPC calculations has the potential to slightly underestimate the exposure concentration, but the difference in concentration does not alter risk conclusions. When increasing risk estimates by 10%, RME non-cancer HIs are ≤1 and cancer risks are <1E-04 for all receptors (detailed calculations not shown). Note, this ratio is based on a comparison of 10% of the samples, so the actual value may be higher or lower if data were available for a larger fraction of the samples.

4.4.1.6 Uncertainties in Human Exposure Parameters

Accurate calculation of risk values requires accurate estimates of the level of human exposure that is occurring. However, many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. Likewise, data are absent on the amount of actual amount of environmental medium ingested by recreational visitors and workers, and the values used in the calculations are based mainly on professional judgment. In general, when exposure data were limited or absent, the exposure parameters were chosen in a

way that was intended to be conservative. Because of this, the values selected are more likely to overestimate than underestimate actual exposure and risk.

4.4.1.7 Uncertainties in Chemical Absorption (RBA)

The risk from an ingested chemical depends on how much of the ingested chemical is absorbed from the gastrointestinal tract into the body. Understanding bioavailability is especially important for metals in soil and soil-like materials at mining sites, because some of the metals may exist in poorly absorbable forms, and failure to account for this may result in a substantial overestimation of exposure and risk. In the absence of data, the default approach is to assume that the RBA is 1.0 for most metals. Use of this default assumption is likely to overestimate the true risk with the magnitude of the error depending on the true RBA value.

For arsenic, data from the IVBA analysis suggest that Site-specific RBA is likely to be no higher than 0.14 (the maximum estimated value), with an average RBA value of 0.06 across all media for which data are available. The average arsenic RBA value was used when quantifying soil/mine waste ingestion exposures for arsenic. As part of this uncertainty evaluation, risk estimates were determined based on the maximum arsenic RBA to evaluate the potential uncertainty arising from use of the average RBA. Receptors with HI values and/or cancer risk values within a factor of 3 of EPA's acceptable risk levels were evaluated to determine if using a higher media-specific RBA value (e.g., 0.14) would result in an unacceptable non-cancer hazard or cancer risk. A factor of 3 was conservatively chosen because of the ratio of the maximum RBA (0.14) to the average RBA (0.06). Inspection of Table 4-13 reveals the following receptor/exposure unit combinations that warrant evaluation:

- Fisherman in EU9
- Roadway worker in EU1
- Roadway worker in EU4

Substitution of an RBA of 0.14 into the risk calculations (detailed calculations not shown) for these receptors minimally increased non-cancer hazard and cancer risk because arsenic was not a risk driver. Estimated non-cancer hazard and cancer risk would still be within EPA's acceptable risk range even if the maximum arsenic RBA were assumed.

4.4.1.8 Uncertainties in Chromium Valence State

In the environment, chromium may be present in various valence states, but the trivalent form and the hexavalent form are the most predominant, depending upon the nature of the contamination source and environmental conditions (Shahid et al. 2017). In the absence of a specific Cr(VI) source, chromium exists in the environment mainly as Cr(III) (ATSDR 2012; Han et al. 2004). The valence state of chromium in soil at the Site is not known, and data are available only for total chromium. However, given that there are no specific sources of Cr(VI) at the Site, risk calculations assumed a 90% of the chromium was Cr(III) and 10% was Cr(VI). Even if it were assumed 30% of the total chromium concentration were hexavalent chromium, risks would still be within the acceptable risk range (detailed calculations not shown).

4.4.2 Uncertainties in Toxicity Values

Toxicity information for many chemicals is often limited. Consequently, there are varying degrees of uncertainty associated with toxicity values (i.e., SF, RfD, RfC, or IUR). For example, uncertainties can arise from the following sources:

- Extrapolation from animal studies to humans
- Extrapolation from high dose to low dose
- Extrapolation from continuous exposure to intermittent exposure
- Limited or inconsistent toxicity studies

In general, uncertainty in toxicity factors is one of the largest sources of uncertainty in risk estimates at a site. Because of the conservative methods EPA uses in dealing with the uncertainties, it is much more likely that the uncertainty will result in an overestimation rather than an underestimation of risk.

4.4.3 Uncertainties in Risk Estimates

Because risk estimates for a chemical are derived by combining uncertain estimates of exposure and toxicity (see above), the risk estimates for each chemical are more uncertain than either the exposure estimate or the toxicity estimate alone. Additional uncertainty arises from the issue of how to combine risk estimates across different chemicals. In some cases, the effects caused by one chemical do not influence the effects caused by other chemicals. In other cases, the effects of one chemical may interact with effects of other chemicals, causing responses that are approximately additive, greater than additive (synergistic), or less than additive (antagonistic). In most cases, available toxicity data are insufficient to define what type of interaction is expected, so EPA generally assumes effects are additive for non-carcinogens that act on the same target tissue and for carcinogens (all target tissues). Because documented cases of synergistic interactions between chemicals are relatively uncommon, this approach is likely to be reasonable for most chemicals.

For non-carcinogens, summing HQ values across different chemicals is properly applied only to compounds that induce the same effect by the same mechanism of action. Consequently, summation of HQ values for compounds that are not expected to include the same type of effects or that do not act by the same mechanisms could overestimate the potential for effects. Thus, all the HI values in this report, which sum HQ values across multiple metals without regard to the target tissue, are likely to overestimate the true level of human health non-cancer hazard.

Section 5

Evaluating Exposure and Risk from Lead

5.1 Overview

Risks from lead are evaluated using a somewhat different approach than for most other chemicals. First, because lead is widespread in the environment, exposure can occur from many different sources. Thus, lead risks are usually based on consideration of total exposure (all sources) rather than just site-related sources. Second, because studies of lead exposures and resultant health effects in humans have traditionally been described in terms of blood lead level, lead exposures and risks are typically assessed by describing the levels of lead that may occur in the blood of exposed populations and comparing these to blood lead levels of potential health concern. For convenience, the concentration of lead in blood is usually abbreviated PbB, and it is expressed in units of µg/deciliter (dL).

Concern over health effects from elevated blood lead levels is greatest for young children or the fetus of pregnant women. There are several reasons for this focus on young children or the fetus, including the following: (1) young children typically have higher exposures to lead-contaminated media per unit body weight than adults, (2) young children typically have higher lead absorption rates than adults, and (3) young children and fetuses are more susceptible to effects of lead than are adults.

The EPA Office of Land and Emergency Management (OLEM) Directive 9200.2-167 (EPA 2016g), issued on December 22, 2016, builds on two earlier OLEM (then Office of Solid Waste and Emergency Response [OSWER]) Directives 9355.4-12, July 1994, and 9299.4-27P, August 1998, which established the current approach for addressing lead in soil at CERCLA and Resource Conservation and Recovery Act sites. The directive discusses evidence that adverse health effects are associated with PbB less than 10 µg/dL. EPA's Office of Research and Development reviewed the health effects evidence for lead in the 2013 Integrated Science Assessment for Lead and found that several studies have observed "clear evidence of cognitive function decrements [as measured by Full Scale intelligence quotient (IQ), academic performance, and executive function] in young children with mean or group PbB between 2 and 8 µg/dL."

In addition, the National Toxicology Program's Monograph on Health Effects of Low-Level Lead found sufficient evidence of delayed puberty, reduced post-natal growth, and decreased hearing for children with PbB below 10 µg/dL, and adverse effects on academic achievement, IQ, other cognitive measures, attention-related behaviors, and behavioral problems with PbB below 5 µg/dL. For these reasons, target PbBs of 5, 8, and 10 µg/dL have been identified for evaluation in this risk assessment to inform future risk management decisions. EPA has set the goal that there should be no more than a 5% chance that a child will have a blood lead value above these levels. For convenience, the probability of a blood lead value exceeding 5 µg/dL, 8 µg/dL, and 10 µg/dL is referred to as P5, P8, and P10, respectively.

Although the value of PbB is based on studies in young children, it is generally assumed that the same value is applicable to a fetus in utero. Available data suggest that the ratio of the blood lead level in a fetus to that of the mother is approximately 0.9 (Goyer 1990). For example, PbB in a pregnant female that would correspond to a blood lead level of 5 µg/dL in the fetus is:

PbB(mother) = 5/0.9 = 5.5 µg/dL

5.2 Lead Exposure Models and Parameters

EPA recommends the use of toxicokinetic models to correlate blood lead concentrations with exposure and adverse health effects. The use of the Integrated Exposure Uptake Biokinetic Model (IEUBK) model is recommended to evaluate exposures from lead-contaminated media in children in a residential setting (EPA 1994b), and the Adult Lead Methodology (ALM) to evaluate potential risks from lead exposure in adults (females of childbearing age) (EPA 2003b). Both the IEUBK model and the ALM can be used to predict blood lead concentrations in exposed individuals and estimate the probability of a blood lead concentration exceeding a level of concern as described below.

5.2.1 IEUBK Model

The IEUBK model developed by EPA predicts the likely range of blood lead levels in a population of young children (aged 0–84 months) exposed to a specified set of environmental lead levels (EPA 1994b). This model requires as input data on the levels of lead in soil, dust, water, air, and diet at a particular location and on the amount of these media ingested or inhaled by a child living at that location. All inputs to the IEUBK model are central tendency point estimates (i.e., CTE). These point estimates are used to calculate an estimate of the central tendency (the GM) of the distribution of blood lead values that might occur in a population of children exposed to the specified conditions. Assuming the distribution is lognormal, and given (as input) an estimate of the variability between different children (the GSD), the model calculates the expected distribution of blood lead values, and estimates the probability that any random child might have a blood lead value over the set target blood lead level (e.g., 8 µg/dL).

5.2.2 Adult Lead Model

The ALM (EPA 2003b, 2009b), based on the work of Bowers et al. (1994), predicts the blood lead level in a person with a Site-related lead exposure by summing the "baseline" blood lead level (PbB0) (that which would occur in the absence of any Site-related exposures) with the increment in blood lead that is expected as a result of increased exposure due to contact with a lead-contaminated Site medium. The latter is estimated by multiplying the average daily absorbed dose of lead from Site-related exposures by a "biokinetic slope factor" (BKSF). Thus, the basic equation for exposure to lead is:

$$PbB = PbB0 + BKSF \cdot \Sigma (C_m \cdot IR_m \cdot AF_m)]$$

where:

PbB = Geometric mean blood lead concentration (µg/dL) in women of child-bearing age that are exposed at the Site

PbB0 = "Background" geometric mean blood lead concentration (µg/dL) in women of child-bearing age in the absence of exposures to the Site

BKSF = Biokinetic slope factor (µg/dL blood lead increase per µg/day lead absorbed)

C_m = Average lead concentration in medium "m", expressed in units of µg/gram (g) (soil), µg/kg (tissue), µg/L (water), or µg/m^3 (air)

IR_m = Intake rate of medium "m", expressed in units of g/day (soil), g/day (tissue), L/day (water), or m^3/day (air)

AF_m = Absorption fraction of lead from medium "m" (dimensionless)

Once the GM blood lead value in adult women who are exposed at the Site is calculated, the full distribution of likely blood lead values in the population of exposed individuals can then be estimated by assuming the distribution is lognormal with a specified individual GSD (GSD_i). The 95th percentile of the predicted distribution is given by the following equation (Aitchison and Brown 1957):

$$95th = GM \cdot GSD_i^{1.645}$$

5.2.3 Evaluation of Intermittent Exposures

Both the IEUBK model and the ALM are designed to evaluate exposures that are approximately continuous (365 days/year). However, for most of the exposure scenarios of concern at the Site, exposures are intermittent, occurring less than 365 days per year (see Tables 4-1 through 4-9).

When exposure is intermittent rather than continuous, the IEUBK and ALM models can still be used by adjusting the Site-related exposure concentration that occurs during the exposure interval to a continuous exposure rate that yields the same total yearly exposure. However, this adjustment is reasonable only in cases where exposure occurs with a relatively constant frequency over a time interval long enough to establish an approximately steady-state response (EPA 2003c). Short-term exposures are not suitable for approximations as continuous exposures. To prevent applications of the lead models to exposure scenarios where an adjustment from intermittent to continuous exposure is not appropriate, EPA (2003c) recommends that these models only be applied to exposures that satisfy two criteria:

- The exposure frequency during the exposure interval is at least 1 day per week
- The duration of the exposure interval is at least 3 consecutive months

Because the child camper (ages 0–6 years old) does not meet both requirements based on CTE exposure frequency (7 days per year), when estimating lead exposures, the exposure frequency was increased to 1 day per week for 3 consecutive months, or 13 days per year. With one exception, all the adult receptors meet the minimum requirements. The adult camper at the USFS campground (EU6) was not included because the minimum exposure frequency requirements were not met based on CTE parameters. For each receptor, continuous exposures were determined such that they accounted for contributions from both impacted media while on-site and unimpacted (background) media while off-site, as described below.

5.2.3.1 IEUBK Model

For the IEUBK model, the average Site lead concentration was adjusted by simulating continuous exposure as follows:

$$C(adjusted) = C(Site) \cdot (EF/365) + C(background) \cdot (365-EF)/365$$

where:

C(adjusted) = TWA lead concentration

C(Site) = Average lead concentration in Site medium

EF = Exposure frequency (days/year)

C(background) = Background lead concentration in uncontaminated medium

The background value for soil used in these calculations was 100 mg/kg, which is the mean of upland reference soil samples collected at the Site. For indoor surficial dust, the background level was assumed to be 70% of the concentration in soil (i.e., 100 mg/kg · 0.7 = 70 mg/kg), as is usually assumed in the IEUBK model.

For children who may camp at the USFS campground, the water collected from the well was used as the drinking water source. For children who may camp at the dispersed campsites, surface water samples collected from near the dispersed campsite areas were used as the drinking water source. For water, the background value was assumed to be 0.9 µg/L (EPA 2017e).

5.2.3.2 ALM Model

The same general approach followed for the IEUBK model is followed for the ALM model, excluding the contribution from background. This is because the PbB0 term used in the ALM is intended to represent background exposure to lead. Thus, the average Site lead concentration was adjusted as follows:

$$C(adjusted) = C(Site) \cdot (EF/365)$$

5.2.4 IEUBK Model Inputs

Lead risks for children camping at the USFS campground (EU6) or in the dispersed campsites (EU7) were calculated using the IEUBK model. Table 5-1 presents the IEUBK input parameters used in this assessment. All these parameters are EPA defaults except as described below.

Relative Bioavailability

The default value of RBA for lead in soil and dust assumed by the IEUBK model is 0.60 (EPA 2007). Studies of lead RBA at a variety of mine sites suggests this is a typical value, but values at some sites may be higher or lower (EPA 2007). Similar to the approach described above for arsenic, EPA has developed a method for measuring the IVBA of lead in soil. The resultant IVBA results can then be used to estimate RBA values using the following equation (where the IVBA and RBA values are expressed as fractions, not percentages) (EPA 2017d):

$$RBA = 0.878 \cdot IVBA - 0.028$$

EPA measured the IVBA of lead in several dispersed campsite soils, roadway soils, and waste rock samples collected in the mining districts. Table 5-2 presents the lead IVBA and estimated RBA values for these samples. As seen, IVBA values for lead were variable (0.01–0.89), corresponding to RBA values of 0–0.75. The average RBA across all samples was 0.27. This value is lower than the EPA default lead RBA value of 0.60, suggesting that lead is in a form that is less readily absorbed. It is not uncommon for mine waste and soils that are impacted by mining activities to have lower bioavailability because of the nature of the lead forms present in these materials. It is possible that soils and sediments that are less impacted by mining could have higher bioavailability, as observed for the soil in the dispersed campsites where the average RBA is 0.54.

The only child exposure scenario evaluated using the IEUBK model was at campgrounds; the lead RBA used in the IEUBK model was 0.54. Based on a default absolute absorption fraction of 0.50 for lead in water and diet, this RBA corresponds to an absolute bioavailability of 0.27 (27%) for soil and dust in the IEUBK model. See Section 4.4 for a discussion of the potential uncertainty due to RBA assumptions.

Maternal Blood Lead

In accordance with recent EPA guidance (EPA 2017f), an altered maternal blood lead concentration of 0.6 µg/dL was used instead of the IEUBK default 1.0 µg/dL.

Intake Rates

Altered water intake rates, inhalation rates, dietary intake rates, and soil intake rates were used, as summarized in Table 5-1 (EPA 2017e). For the soil/dust intake rates, a time-weighted average was computed using the default residential intake rate to represent time spent off-site, and a camping ingestion rate[12] for time spent on-site camping. As discussed in Section 5.2.3, the exposure frequency assumed for child campers was adjusted to 13 days per year to satisfy the minimum requirements of the IEUBK model. The remainder of the year was assumed to be spent at an off-site residence.

Drinking Water Concentration

An altered drinking water concentration of 0.9 µg/L was used instead of the default of 4 µg/dL for the period when receptors are not at the Site. This alternate drinking water concentration is based on the Lead Technical Review Workgroup (TRW) reanalysis of national drinking water system data reported to EPA (EPA 2017e).

Age Range

In accordance with recent EPA guidance, the age range evaluated was from 12–72 months (EPA 2017e) rather than 0–84 months, which is the default setting in the IEUBK model.

5.2.5 ALM Inputs

Lead risks for adult receptors (women of child-bearing age) were calculated using the ALM. The EPC for soil and other solid media used was the mean concentration. For lead in game, calculations were based on lead in muscle tissue, since lead accumulates in bone and bones are

[12] Values are based on the average of the geometric mean intake rates for boys and girls, as reported in Table 5-6 in the *Child-Specific Exposure Factors Handbook* (USEPA 2008). The geometric mean value for children 5–6 years old was assumed to be equal to the geometric mean for children ages 4–5 years old.

not generally eaten. For lead in fish tissue, calculations were based on lead concentration in fillet samples. Intake rates and exposure frequencies were the same as assumed for CTE non-lead exposures (see Table 4-1 through Table 4-9). Table 5-3 summarizes the ALM-specific input values selected for each scenario. All values are EPA-recommended defaults except as noted below.

Absorption Fraction Values

The ALM model identifies a default absorption fraction (AF) for soluble lead in soil of 0.20, but does not specify AF values for other media. In order to estimate AF values for lead in water, diet, and air, the following assumptions were made:

AF(water) = AF (soluble lead) = 0.20

The assumed AF for water is set equal to the default AF for soluble lead (EPA 2003b). Although the soluble lead AF is likely to be most applicable to dissolved lead in water, applying this AF for exposures to total lead in water is consistent with ALM guidance for drinking water exposures (EPA 2003b) and likely to be conservative.

AF(diet) = 0.20

The assumed AF for diet is based on the recommended value for lead in food established in the ALM guidance (EPA 2003b). As acknowledged in the guidance, this assumption may result in an overestimation of absorption from dietary items.

AF(air) = 0.32

The assumed AF for air is the same as the default level established for the IEUBK model (EPA 1994b).

Relative Bioavailability

Similar to the approach used for arsenic, when media-specific lead RBA values were available (e.g., campground soil, roadway soil, and waste rock), the average lead RBA for each medium was included in risk calculations. For other solid media (i.e., overbank soils, sediment), the EPA default lead RBA of 0.60 was assumed (EPA 2007). See Section 4.4 for a discussion of the potential uncertainty due to RBA assumptions.

5.2.6 Concentration of Lead in Site Media

For both the IEUBK model and the ALM, the concentration of lead in Site media was calculated using the same approach as was used in the non-lead risk evaluation (as presented in Section 4.1.3), with the following exceptions:

- The EPC was equal to the time-weighted mean soil lead concentration. Similar to the time-weighted intake rate for soil/dust, the concentration of lead in soil was also time-weighted to account for lead exposure while off-site. For the off-site contribution, a background soil lead concentration of 100 mg/kg was used. This value is based on mean concentration for samples collected from upland reference locations. For on-site exposure while camping in dispersed campsites (EU7), a bulk soil lead concentration of 5,703 mg/kg was used (the mean concentration across all dispersed campsites). For on-site exposure while camping at the USFS campground (EU6), a bulk soil lead concentration of 252 mg/kg was used.

- The lead results used to compute the EPC were based on the fine (250-µm) size fraction. An adjustment factor was applied to estimate the fine fraction from the 2-mm result (EPA 2000, 2017e). The adjustment factor was determined by performing a regression analysis of the lead results for samples sieved to 2 mm and to 250 µm. The regression analysis is presented in Figure 5-1. As shown, lead concentrations for the fine fraction were estimated from the bulk concentration, as follows[13]:

$$C_{soil,\ 250\text{-}\mu m} = 1.625 \cdot C_{soil,\ 2\text{-}mm} - 226.36$$

where:

$C_{soil,\ 250\text{-}\mu m}$ = Estimated lead concentration in soil for the fine (250-µm) fraction

$C_{soil,\ 2\text{-}mm}$ = Measured lead concentration in soil for the bulk (2-mm) fraction

5.3 Results

5.3.1 Risk to Recreational Children

Appendix E presents the IEUBK output files for lead. Table 5-4 summarizes lead risks for recreational children who visit the Site to camp at the USFS campground (EU6) and the dispersed campsites (EU7) for a range of target blood lead levels (5 µg/dL, 8 µg/dL, and 10 µg/dL). This evaluation includes exposures to lead in soil and water used as a drinking water source. As shown, risks appear to be below all target blood lead levels evaluated for the USFS campground. For the dispersed campsites, P8 and P10 values were less than 5%, but P5 values were estimated to be 22%.

Because the IEUBK model is was not designed to evaluate short-term exposures, a supplemental lead evaluation was conducted as part of the uncertainty assessment (see Section 5.4).

5.3.2 Risks to Recreational Adults

The ALM evaluated adult exposures to lead due to ingestion/inhalation of soil, incidental ingestion of sediment, incidental ingestion of surface water, ingestion of surface water as drinking water, ingestion of fish, and ingestion of game, as appropriate for the various receptors (see Table 5-3 for complete pathways).Table 5-5, Panel A summarizes the probability of blood lead values exceeding 5 µg/dL, 8 µg/dL, and 10 µg/dL in the fetuses of pregnant women who may visit the Site for a variety of recreational purposes (i.e., ATV recreational riding, camping, hiking, fishing, and hunting). As shown, risks appear to be well below all target blood lead levels evaluated for all adult recreational receptors. The probability of exceeding the target PbB ranges from 0.01%–0.3%.

Since it is possible for campers to return to the same campsite throughout the year, an additional ALM evaluation was performed to assess potential lead risks from individual camping areas. Table 5-6 summarizes the probability of blood lead values exceeding 5 µg/dL, 8 µg/dL, and 10 µg/dL in the fetuses of pregnant women on a campsite-specific basis. As seen, with the exception

[13] In order to be conservative, for cases where the predicted concentration of lead in soil for the fine fraction resulted in a value less than what was measured in the bulk fraction, the concentration in the bulk fraction was adopted. This situation occurs when bulk concentrations are less than about 140 mg/kg.

of dispersed campsites 3, 4, and 7, estimated P5 values were less than 5% for all camping areas. Dispersed campsites 3, 4, and 7 have P5 and P8 values greater than 5%, with campsites 3 and 4 having P10 values greater than 5%.

5.3.3 Risks to Occupational Adults

As shown in Table 5-5, Panel B, risks appear to be well below all target blood lead levels evaluated for all occupational (roadway) workers in EU1, EU3, and EU4, but not EU2. For EU2, P10 and P8 values were less than 5%, but the P5 value was 8%.

These lead risk estimates are based on exposures from ingestion/inhalation of soil and assume an exposure frequency of 100 days per year for 6 hours per day for 10 years within each individual EU. However, long-term roadway worker exposures are not likely to be restricted to a single EU, but would include exposures across multiple EUs. If it were assumed that exposures encompass multiple EUs (area-weighted relative to the approximate road length for each EU), the P5 value for the roadway worker would be approximately 3%.

5.4 Uncertainty Assessment

Quantification of risks to humans from exposures to lead is subject to a number of data limitations and uncertainties. These include:

- Uncertainty in the true average concentration of lead in each environmental medium at each exposure area.
- Uncertainty in the spatial and temporal variability in each of the Site media, as discussed in Section 4.4.1.4.
- Uncertainty in the RBA for various media. Site-specific RBA values were utilized for campsite soil, roadway soil, and waste rock. The measured RBA values for each media type were variable, with the average RBA used in risk calculations. The following bullets discuss whether risk conclusions for lead would differ if a different RBA statistic (i.e., the 95UCL on the mean rather than the arithmetic mean) were used in the lead models:
    - For campsite soil, the average RBA was similar to the default RBA. Because of this, use of the average RBA for campsite soils is unlikely to underestimate risk.
    - For roadway soil, there is an inadequate number of data points to compute a reliable 95UCL, making the arithmetic mean the best estimate of the mean. The lead RBA for roadway soil would have to be 0.27 in an exposure unit in order for P5 to be greater than 5%. Likewise, the RBA for roadway soil would have to be 0.48 in order for P8 to be greater than 5%, and would need to be greater than EPA's default RBA (0.60) in order for P10 to be greater than 5%.
    - For waste rock, the 95UCL is 0.31 (as compared to the average RBA of 0.23). Recognizing that waste rock comprises a minimal amount of the total exposure to receptors at the Site, even if the 95UCL RBA for waste rock were used in the risk estimates, the overall risk conclusions would not change.

- Uncertainty in the true intake rates of each environmental medium by each group of receptors. Values used in these calculations are thought to be conservative (more likely to be high than low).
- Uncertainty in the true absorption rates of lead from each medium.
- Uncertainty in the true relationship between lead intake levels and the resultant increase in blood lead levels, both in children (IEUBK model) and in adults (ALM model).
- Uncertainty in the true variability in exposure and response between different people, which results in uncertainty in the calculation of blood lead levels (Griffin et al. 1999).
- Uncertainty in short duration/intermittent exposures using the IEUBK model. There is considerable uncertainty in using the IEUBK model for evaluating short duration/intermittent exposures. Because of this, an alternate lead modeling approach was considered as part of the uncertainty evaluation. EPA's All Ages Lead Model (AALM) was used to evaluate chronic risk for children who camp in EU7 (dispersed campsites). Focus was placed on this receptor and EU because of the predicted probability of blood lead levels exceeding 5 µg/dL (22%). As noted in Section 5.2.3, the exposure frequency of a CTE receptor is assumed to be 7 days. The age range for evaluation of childhood lead exposure is 12–72 months. With the exception of these values, all other inputs (e.g., RBA, EPCs) that were used for the IEUBK model were incorporated into the AALM model. Figure 5-2 presents the predicted blood lead levels over the period of a child's exposure from age 12–72 months, with 7 consecutive days per year of exposure at a dispersed campsite. As seen, blood lead levels peak when the child is exposed to Site soil, but levels quickly return to a baseline levels. The baseline level does not increase above 5 µg/dL at any time throughout the 12–72-month exposure duration and the P5 is 3.5%, as shown in Figure 5-3. This evaluation suggests that there may be peak blood lead levels that may be of concern, but from a chronic exposure perspective, long-term blood lead levels are below the range of target blood lead levels evaluated. See Section 6 and Appendix F for an evaluation of acute lead risk.

Because of these uncertainties, the values reported above should be understood to be estimates.

5.5 Background Evaluation

Most metals occur naturally in soil and water, especially in mineralized areas where mining occurs. Given the uncertainties in risk estimates, as outlined above, a review of the background data sources available for Site soil was performed to provide prospective regarding Site risk estimates relative to background conditions.

Statistical comparisons to the available background datasets were performed using the procedures recommended in EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA 2002c). An evaluation of background soil (Table 5-7) was performed based on a comparison of concentrations from Site-specific upland reference soil locations to soil sample results available from Smith et al. (2013), which provide measured metal concentrations for native soils across the United States. Surface soil (depth of 0–5 centimeters) samples from Smith et al. were selected from sampling locations in Colorado that represented a

forested upland environment. Site roadway soil samples from multiple EUs were the focus of the evaluation. The roadway soil samples in the Alpine Loop and all roadway soil samples from the Site were evaluated. Statistical comparisons were made using the two-sample hypothesis testing approach, Form 2 (Wilcoxon Mann-Whitney test), provided in ProUCL v5.1.00 (EPA 2015c) to determine if levels of lead in soil at the Site are present at natural levels or are higher than would be expected. The analysis indicates that lead is elevated in roadway soil samples relative to both background datasets for all EUs evaluated. Thus, lead exposures at the Site are likely to be attributable to mining-related releases.

For informational purposes, a review of the potential risks due to exposure to soil (inhalation and incidental ingestion) in the Site-specific upland reference soil locations was performed using the exposure parameters for the road worker. The detailed calculations are presented in Table 5-8. As shown, estimated lead risks due to exposure to background soil appear to be below EPA's health-based goal (i.e., the probability of exceeding the target PbB is less than 5%).

Section 6

Screening-Level Acute Risk Evaluation

Because acute screening levels are not readily available for evaluating Site media, acute screening levels were derived for lead and arsenic in soil/waste rock based on a camping exposure scenario. Soil/waste rock were evaluated because they represent the majority of exposure for a receptor; exposure to surface water is considered minor relative to solid media exposure. Lead and arsenic were selected for evaluation because soil concentrations are notably elevated at several locations within the mining districts and both are often important human health risk drivers for mining-related contamination. The camping scenario was selected for the derivation of acute screening levels because the camper is anticipated to be the most sedentary of receptors (i.e., not moving about being exposed to a variety of soil/mine waste sources, in contrast with hiker, hunter, fisherman, ATV guide and recreational rider, and road worker receptors). Derivation of screening levels for a sedentary receptor allows for the application of these screening levels to smaller exposure areas, such as individual campgrounds and dispersed areas suitable for camping.

Focus was placed on evaluating acute exposures to children because children are often more vulnerable to pollutants than adults because of differences in behavior and biology that can lead to greater exposure and/or unique windows of susceptibility during development. Additionally, soil ingestion rates for young children are higher than adults due to increased frequency of contact through hand-to-mouth or object-to-mouth activity. Thus, exposure parameters used in the derivation of the acute screening levels were tailored for children 2 years of age. Two exposure scenarios for a child that may camp within the mining districts were evaluated:

- Scenario 1: Child, based on CTE soil intake rates specific to a camping exposure scenario
- Scenario 2: Child, based on RME soil intake rates specific to a camping exposure scenario

This section presents an overview of the detailed acute risk evaluation presented in Appendix F.

6.1 Derivation of Acute Screening Levels

6.1.1 Lead

For lead, the AALM was used for evaluating short-term exposure scenarios. The AALM is still in development, however, a beta version (FORTRAN 1.0) of this model is available (upon EPA request) and was used in researching effects of lead exposures at various life stages to support the development of the acute screening levels.

Acute screening levels for lead were developed based on a 2-day and 14-day exposure to soil/waste rock using the inputs provided in Appendix F and for the two exposure scenarios described above. The acute screening levels were derived by determining the soil/waste rock concentration that would result in a predicted peak PbB concentration of 19.5 µg/dL. Per EPA (2016h), a PbB level of 20 µg/dL could be considered as a short-term elevation in PbB that would trigger a response action. This is based on the interpretation of the Center for Disease Control

(CDC) recommendation that PbB levels in the range of 20–44 µg/dL would result in a home visit by a public health agency within 24 hours of a referral from a physician (CDC 2012). For the purposes of this evaluation, 19.5 µg/dL was selected as target PbB for establishing an acute screening level to account for rounding to two significant digits. Table 6-1 presents the acute screening levels for lead based on a 2-day and 14-day exposure for soil and waste rock.

6.1.2 Arsenic

Acute toxicity information is generally lacking for arsenic, and acute arsenic screening levels specific to the type of receptors present within the mining districts (i.e., recreational visitors) are not available. Washington State Department of Health (WSDOH) provides a synopsis of published scientific information related to soil exposure and acute toxicity in *Hazards of Short-term Exposure to Arsenic Contaminated Soil* (WSDOH 1999). Transient adverse health effects commonly occur when doses between 0.035 and 0.071 milligrams of arsenic per kilogram of body weight (mg/kg BW) are ingested. The best estimate of an acute threshold for transient effects is 0.05 mg/kg BW. Using the acute transient effect dose information, acute arsenic screening levels were derived for the same two exposure scenarios that were evaluated for lead. Table 6-2 presents the acute screening levels for arsenic based on a 2-day and 14-day exposure for soil and waste rock.

6.2 Acute Risk Evaluation

For the acute risk evaluation, exposure was assumed to occur over a small exposure area compared to the chronic risk evaluation. In the chronic evaluation, exposures were evaluated for larger EUs, but in the acute evaluation, exposures were evaluated for individual sampling locations. When making comparisons to samples collected from camping areas, the 14-day screening level was selected. When making comparisons to samples from waste rock areas, the 2-day screening level was selected. Samples collected from waste rock areas are more remote (i.e., less accessible) and are not representative of areas that are frequently used for camping.

6.2.1 Lead

For the camping area soils, there are multiple samples with lead concentrations that exceed the 14-day CTE and RME acute screening levels, as shown in Figure F-2 in Appendix F. Because it may be unreasonable to assume that RME soil ingestion rates, which are specific to a camping scenario, are realistic for 14 days, it may be more appropriate to focus on samples that exceed the CTE acute screening level. Considering this, samples collected from dispersed campsites 2, 3, 4, and 7 had the greatest exceedance margin of the CTE screening level.

For waste rock, there were many samples that exceeded the 2-day CTE and RME acute screening levels. However, evaluation of the locations where samples were collected is a critical step in the risk management decision process. When evaluating samples in exceedance of the acute screening levels, the physical attributes of the location from which the sample was collected should be considered. For example, samples collected from the steep slopes of a waste pile are not representative of areas where camping may occur. Thus, application of the acute camping screening levels to these areas would be inappropriate.

For the upland reference soils, there were a few exceedances of the RME screening level, but no exceedances of the CTE screening level. This indicates that lead concentration in areas at the Site

that are not impacted by mining activities would not pose an acute risk to campers based on typical soil ingestion rates. However, if the soil ingestion rate were to be at an RME level for 14 consecutive days, acute risks have the potential to be unacceptable in upland reference areas. Because unacceptable exposures are not expected in unimpacted areas, this further supports the conclusion that the 14-day RME screening level is likely to be overly conservative. This should be taken into consideration during risk management decision-making.

6.2.2 Arsenic

For the camping area soil, concentrations of arsenic do not exceed the 14-day CTE acute screening level, but there were some locations with soil concentrations greater than the RME screening level, as shown in Figure F-3 in Appendix F. For waste rock, there were four samples (collected from three mining areas, including the Koehler Mine, Junction Mine, and Longfellow Mine) that exceeded the 2-day CTE acute screening level and three additional samples that exceeded the RME screening level. For the upland reference soils, the measured arsenic concentrations are below the range of possible screening levels for all samples.

This page intentionally left blank.

Section 7
Conclusions

This document presents the results of a baseline HHRA for Bonita Peak Mining District Superfund Site. Specifically, the HHRA evaluated exposures within the mining districts in the Mineral Creek, Cement Creek, and Upper Animas River drainages. The HHRA evaluated potential risks to humans, both now and in the future, from exposures to contaminants that may be present in the mining districts, assuming that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media.

The Site consists of historic mines and mining-related sources that have resulted in the direct deposition of various types of solid wastes (tailings and waste rock) that were placed onto soil near the mines or were discharged into nearby streams. In addition, contaminated water from mine adits discharges directly into streams. Metals are the primary COPCs at the Site.

The mining districts are primarily used by humans for recreational, occupational, and tribal purposes. The receptor populations of interest for the risk assessment included campers, hikers, hunters, recreational fishermen, ATV recreational riders, ATV guides, and county road workers. An addendum to this risk assessment will be developed to evaluate tribal exposures once the necessary exposure data are available.

The HHRA included an evaluation of chronic exposures to both lead and non-lead COPCs and a screening-level evaluation of acute exposures from lead and arsenic. The overall risk conclusions of these evaluations are summarized below.

7.1 Chronic Exposure

The sections below provide a summary of risks to receptors at the Site from chronic exposure. Chronic exposure and risk to humans from non-lead COPCs were evaluated based on both cancer and non-cancer effects. Risks from lead were evaluated using a different approach in which exposure models were used to estimate blood lead levels for the two receptor types of primary interest (i.e., young children and women of child-bearing age).

7.1.1 Non-Lead COPCs

Estimated risks to recreational and occupational receptors at the Site from exposure to non-lead COPCs in a variety of media are within the EPA's acceptable risk guidelines for non-cancer and cancer effects (Table 4-13). Based on this, it is concluded that Site-related risks from chronic exposure to non-lead COPCs for recreational and occupational receptors are below a level of concern.

7.1.2 Lead

The following conclusions pertain to the range of receptors evaluated for lead exposure. When estimating potential risks from exposures to lead, a range of target blood lead levels (from 5–10

µg/dL) was evaluated. Risk managers will need to determine the appropriate target to support project decision-making.

- Camper (child, age 12–72 months) – For the USFS campground, estimated risks are below EPA's health-based goal, regardless of the target blood lead level. For the dispersed campsites, the probability of exceeding EPA's health-based goal was less than 5% based on target blood lead levels of 8 µg/dL and 10 µg/dL, but not based on a target of 5 µg/dL (P5 was 22%).
- Adult recreational receptors (ATV guide, ATV recreational rider, dispersed camper, hiker, fisherman, and hunter) – Estimated lead risks appear to be well below all target blood lead levels evaluated for all adult recreational receptors (P5 values range from 0.01%–0.3%). However, the evaluation of the dispersed campsites assumed average exposure across of all dispersed campsites. An evaluation of lead risk for individual campsites revealed three dispersed campsites (campsites 3, 4, and 7) have potentially unacceptable lead risks, if these campsites were used exclusively. For these three dispersed campsites, P5 and P8 values were greater than 5%, and campsites 3 and 4 had P10 values greater than 5%.
- Roadway worker – Estimated lead risks are below EPA's health-based goal, regardless of the target blood lead level. The P5 value was approximately 3% if it were assumed the exposures spanned multiple EUs (i.e., exposures were area-weighted relative to the approximate road length for each EU).

7.2 Acute Exposure

The sections below provide a summary of the screening-level evaluation of risks to receptors at the Site from acute exposure. As part of this evaluation, acute screening levels were developed for lead and arsenic to provide a means to screen available soil and waste rock samples to identify locations where acute exposures have the potential to be unacceptable. There are two types of acute screening levels: one based on a 14-day exposure duration, which is applicable to camping areas, and one based on a 2-day exposure duration, which is applicable to waste rock areas. Although two exposure scenarios (CTE and RME) were evaluated, it is likely that the CTE scenario is the most appropriate when evaluating camping area soil samples and the RME scenario is most appropriate when evaluating waste rock samples.

7.2.1 Lead

For camping areas, there are several soil samples with lead concentrations that exceed the 14-day CTE acute screening level. Samples collected from dispersed campsites 2, 3, 4, and 7 had the greatest exceedance margin of the 14-day CTE acute screening result.

For waste rock, there were many samples that exceeded the 2-day RME screening level. However, risk managers must consider the physical attributes of the sampling location to support remedial decision-making. For example, application of the acute screening levels, which are based on a camping exposure scenario, would not be appropriate for samples collected from a steep slope or have other attributes that would make the location undesirable for camping.

7.2.2 Arsenic

For the camping area soils, concentrations of arsenic do not exceed the 14-day CTE acute screening level. However, there were several waste samples that exceeded the 2-day RME acute screening level. The highest screening level exceedances were for waste rock samples collected from the Koehler Mine, Junction Mine, and Longfellow Mine.

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with contaminated media, and the true dose-response curves for non-cancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment.

Site managers will also consider the results of the ecological risk assessment and any regulatory requirements in determining appropriate remedial actions for the Site. As appropriate, discussions and recommendations on how to manage potential risks will be provided in the Feasibility Study. The identification of remedial action levels, which will guide future remediation efforts, will be provided in the Record of Decision.

This page intentionally left blank.

Section 8
References

Aitchison, J. and J.A.C. Brown. 1957. *The Lognormal Distribution*. University of Cambridge Department of Applied Economics Monograph. Cambridge, United Kingdom: Cambridge University Press.

ATSDR. 2012. *Toxicological Profile for Chromium*. ATSDR Toxicological Profiles Web Site. Available at https://www.atsdr.cdc.gov/toxprofiles/tp7.pdf.

Bowers, T.S., B.D. Beck, and H.S. Karam. 1994. "Assessing the Relationship Between Environmental Lead Concentrations and Adult Blood Lead Levels." *Risk Analysis*, 14:183–189.

CDC. 2012. *CDC Recommendations for Children's Blood Lead Levels (BLLs)*. Atlanta, Georgia: Centers for Disease Control and Prevention.

Chapman, S.S., G.E. Griffith, J.M. Ornemik, A.B. Price, J. Freeouf, and D.L. Schrupp. 2006. Ecoregions of Colorado (USGS color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia (map scale 1:1,200,000).

Colorado Geological Survey. 2017. San Juan County. Accessed at: http://coloradogeologicalsurvey.org/mineral-resources/historic-mining-districts/san-juan-county/ on June 20, 2017.

Colorado Parks and Wildlife. 2018. Small Game Statistics. Accessed at: http://cpw.state.co.us/thingstodo/Pages/SmallGameStatistics.aspx on November 13, 2018.

EPA. 1986. *Guidelines for Carcinogen Risk Assessment*. Office of Research and Development. EPA/630/R-00/004.

EPA. 1989. *Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part A)*. Office of Emergency and Remedial Response. EPA/540/1-89/002.

EPA. 1991a. *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*. OSWER. Directive 9285.6-03.

EPA. 1991b. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*. OSWER. Directive 9355.0-30.

EPA. 1992. *Supplemental Guidance to RAGS: Calculating the Concentration Term*. OSWER. Publication 9285.7-081.

EPA. 1994a. *Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry*. Office of Research and Development. EPA/600/8-90/066F.

EPA. 1994b. *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*. Office of Emergency and Remedial Response. Publication 9285.7-15-1. EPA/540/R-93/081.

EPA. 1997. *Exposure Factors Handbook, Volumes I, II, and III*. Office of Research and Development. EPA/600/P-95/002Fa.

EPA. 2000. *Short Sheet: TRW Recommendations for Sampling and Analysis of Soil at Lead (Pb) Sites*. EPA-540-F-00-010.

EPA. 2002a. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. OSWER. Publication 9355.4-24.

EPA. 2002b. *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*. Office of Emergency and Remedial Response. Publication 9285.6-10.

EPA. 2002c. *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*. Office of Emergency and Remedial Response. EPA-540-R-01-003.

EPA. 2002d. *Role of Background in the CERCLA Cleanup Program*. OSWER. Directive 9285.6-07P.

EPA. 2003a. *Human Health Toxicity Values in Superfund Risk Assessments*. OSWER. Directive 9285.7-53.

EPA. 2003b. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*. Final. EPA-540-R-03-001.

EPA. 2003c. *Assessing Intermittent or Variable Exposures at Lead Sites. U.S. Environmental Protection Agency*. OSWER. EPA-540-R-03-008.

EPA. 2004. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).* Final. Office of Emergency and Remedial Response. EPA/540/R/99/005.

EPA. 2005a. *Guidelines for Carcinogenic Risk Assessment*. Office of Research and Development. EPA/630/P-03/001F.

EPA. 2005b. *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens*. EPA Risk Assessment Forum. EPA/630/R-03/003F.

EPA. 2007. *Estimation of Relative Bioavailability of Lead in Soil and Soil-Like Material Using In Vivo and In Vitro Methods*. OSWER. Publication 9285.7-77.

EPA. 2009a. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*. Office of Superfund Remediation and Technology Innovation. EPA-540-R-070-002.

EPA. 2009b. *Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters*. Office of Superfund Remediation and Technology Innovation. Publication 9200.2-82.

EPA. 2012. *Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil*. OSWER. Publication 9200.1-113.

EPA. 2015a. *Sampling and Analysis Plan/Quality Assurance Project Plan, 2015 Events*. Upper Animas Mining District, San Juan County, CO. Revision 0. Prepared for EPA Region 8 Ecosystem Protection and Remediation Program Support by TechLaw, Inc.

EPA. 2015b. *Sampling Activities Report, 2015 Sampling Events*. Bonita Peak Mining District Site, San Juan County, CO. Revision 1. Prepared for EPA Region 8 Ecosystem Protection and Remediation Program Support by TechLaw, Inc.

EPA. 2015c. ProUCL *Version 5.1.00 Technical Guide*. Office of Research and Development. EPA/600/R-07/041.

EPA. 2016a. *One Year After the Gold King Mine Incident, A Retrospective of EPA's Efforts to Restore and Protect Impacted Communities*. Available at https://www.epa.gov/sites/production/files/2016-08/documents/mstanislausgkm1yrreportwhole8-1-16.pdf.

EPA. 2016b. Action Memorandum: Documentation of an Emergency Removal Action at the Gold King Mine Release Site, San Juan County, Colorado, Initiated Pursuant to the On-Scene Coordinator's Delegated Authority under CERCLA Section 104 and a Request for Approval and Funding to Continue Emergency Removal Action Including Exceptions from the 12-month and $2 Million Statutory Limits on Removal Actions. Available at https://semspub.epa.gov/work/08/1766119.pdf.

EPA. 2016c. Federal Register. EPA-HQ-SFUND-1994-0002. Vol. 81. No. 67. Thursday, April 7. Proposed Rules: 20277–20283.

EPA. 2016d. *Sampling and Analysis Plan/Quality Assurance Project Plan, 2016 Events*. Bonita Peak Mining District, San Juan County, CO. Revision 0. Prepared for EPA Region 8 Ecosystem Protection and Remediation Program Support by TechLaw, Inc.

EPA. 2016e. *Sampling and Analysis Plan/Quality Assurance Project Plan, Fall 2016 Sampling Event*. Bonita Peak Mining District, San Juan County, Colorado. Prepared for EPA Region 8 Ecosystem Protection and Remediation Program Support by TechLaw, Inc.

EPA. 2016f. *Sampling Activities Report, 2015 Sampling Events*. Bonita Peak Mining District Site, San Juan County, CO. Prepared for EPA Region 8 Ecosystem Protection and Remediation Program Support by TechLaw, Inc.

EPA. 2016g. *Updated Scientific Considerations for Lead in Soil Cleanups*. OLEM Directive 9200.2-167.

EPA. 2016h. *Recommendations for Assessing Short-term Exposure Involving Lead at Superfund Sites*. Office of Land and Emergency Management. OLEM Directive 9285.6-54.

EPA. 2017a. *Sampling and Analysis Plan/Quality Assurance Project Plan*, *2017-2018 Combined Risk Assessment Sampling Events*. Bonita Peak Mining District, San Juan County, Colorado.

EPA. 2017b. *National Functional Guidelines for Inorganic Superfund Data Review* (ISM02.4). OLEM Directive 9355.0-135. EPA-540-R-2017-001.

EPA. 2017c. *Digging Deeper Bonita Peak Mining District, Terrestrial Ecological Risk Assessment*. Presentation by Brian Sanchez. October.

EPA. 2017d. *Release of Standard Operating Procedure for an In Vitro Bioaccessibility Assay for Lead and Arsenic in Soil and Validation Assessment of the In Vitro Arsenic Bioaccessibility Assay for Predicting Relative Bioavailability of Arsenic in Soils and Soil-Like Materials at Superfund Sites*. Available at https://semspub.epa.gov/work/HQ/196751.pdf.

EPA. 2017e. *Headquarters Lead Consultation Intake Form for the Colorado Smelter Superfund Site*. Submitted 4/11/17. Available at https://semspub.epa.gov/work/08/1884173.pdf.

EPA. 2017f. Transmittal of Update to the Adult Lead Methodology's Default Baseline Lead Concentration and Geometric Standard Deviation Parameters. OLEM Directive 9285.6-56.

EPA. 2018a. Bonita Peak Mining District, Field Sampling Plan: 2018 All-Terrain Vehicle Activity-Based Sampling Investigation Revision 0. Prepared by CDM Federal Programs Corporation under a contract to U.S. Army Corps of Engineers Omaha District. September 19.

EPA. 2018b. Regional Screening Levels (RSLs). November 2017 version. Available at https://www.epa.gov/risk/regional-screening-levels-rsls.

EPA. 2018c. IRIS. Available at https://www.epa.gov/iris.

EPA. 2018d. *Sampling Activities Report, 2017 Sampling Events*. Bonita Peak Mining District Site, San Juan County, CO. Prepared for EPA Region 8 Ecosystem Protection and Remediation Program Support by TechLaw, Inc.

FNB. 2013. *Dietary Reference Intakes (DRIs): Estimated Average Requirements*. Food and Nutrition Board, Institute of Medicine, National Academies of Science. Available at https://ods.od.nih.gov/Health_Information/Dietary_Reference_Intakes.aspx.

Goyer, R.A. 1990. "Transplacental Transport of Lead." *Environ. Health Perspect*. 89:101-105.

Griffin, S., A. Marcus, T. Schultz, and S. Walker. 1999. "Calculating the Interindividual Geometric Standard Deviation for Use in the Integrated Exposure Uptake Biokinetic Model for Lead in Children." *Environ. Health Perspect*. 107:481-487.

Han, F.X., Y. Su, B.B.M. Sridhar, and D.L. Monts. 2004. "Distribution, transformation and bioavailability of trivalent and hexavalent chromium in contaminated soil." *Plant and Soil* 265(1):243-252.

NOAA. 2017. Global Summary of the Year Station Details (2016). Accessed at https://www.ncdc.noaa.gov/cdo-web/datasets/GSOY/stations/ GHCND:USC00057656/detail on June 5, 2017.

Shahid, M., S. Shashad, M. Rafiq, S. Khalid, I. Bibi, N.K. Niazi, C. Dumat, and M.I. Rashid. 2017. "Chromium speciation, bioavailability, uptake, toxicity and detoxification in soil-plant system: A review." *Chemosphere* 178:513-533. http://dx.doi.org/10.1016/j.chemosphere.2017.03.074

Smith, D.B., W.F. Cannon, L.G. Woodruff, Solano, Federico, Kilburn, J.E., and D.L. Fey. 2013. Geochemical and mineralogical data for soils of the conterminous United States: USGS Data Series 801, 19 p. Available at https://pubs.usgs.gov/ds/80.

USFS. 2017. *Guidelines for the San Juan National Forest*. Available at https://www.fs.usda.gov/activity/sanjuan/recreation/camping-cabins/?recid=42728&actid=34.

WSDOH. 1999. *Hazards of Short-Term Exposure to Arsenic Contaminated Soil.* Washington State Department of Health. Accessed at https://www.doh.wa.gov/Portals/1/Documents/Pubs/334-284.pdf on February 13, 2018.

This page intentionally left blank.

Tables

This page intentionally left blank.

TABLE 2-1
SUMMARY STATISTICS FOR SOIL AND MINE WASTE
Bonita Peak Mining District

Panel A: Locations Within the Mining Districts

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Mean Concentration (mg/kg)*	Standard Deviation (mg/kg)*	Maximum Detected Concentration (mg/kg)	Mean MDL of NDs (mg/kg)*
Aluminum	7429-90-5	520	520	100%	9,597	5,011	48,300	--
Antimony	7440-36-0	513	450	88%	10	31	332	0.18
Arsenic	7440-38-2	519	518	99.8%	86	623	13,700	0.070
Barium	7440-39-3	484	483	99.8%	107	97	1,110	0.027
Beryllium	7440-41-7	519	369	71%	0.63	0.72	9.0	0.35
Cadmium	7440-43-9	520	476	92%	6.9	19	216	0.030
Calcium	7440-70-2	520	509	98%	3,203	5,978	86,000	8.5
Chromium	7440-47-3	520	516	99.2%	4.6	2.2	17	0.77
Cobalt	7440-48-4	484	481	99%	8.9	11	126	0.16
Copper	7440-50-8	520	518	99.6%	256	463	3,830	0.026
Iron	7439-89-6	520	520	100%	37,066	31,441	317,000	--
Lead	7439-92-1	520	520	100%	2,312	4,672	44,200	--
Magnesium	7439-95-4	520	520	100%	3,739	2,123	11,500	--
Manganese	7439-96-5	519	519	100%	4,430	10,134	96,100	--
Mercury	7439-97-6	510	475	93%	0.22	0.59	7.6	0.0017
Molybdenum	7439-98-7	350	280	80%	9.0	18	159	0.099
Nickel	7440-02-0	520	514	99%	4.6	5.1	67	0.38
Potassium	7440-09-7	67	67	100%	1,129	603	2,940	--
Selenium	7782-49-2	520	409	79%	1.7	2.1	32	0.43
Silver	7440-22-4	517	460	89%	7.5	13	97	0.10
Sodium	7440-23-5	198	76	38%	99	48	325	96
Strontium	7440-24-6	98	98	100%	33	23	152	--
Thallium	7440-28-0	512	226	44%	0.41	0.64	6.0	0.24
Vanadium	7440-62-2	484	484	100%	18	9	76	--
Zinc	7440-66-6	520	520	100%	1,592	4,346	66,800	--

Panel B: Upland Soil Reference Locations

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Mean Concentration (mg/kg)*	Standard Deviation (mg/kg)*	Maximum Detected Concentration (mg/kg)	Mean MDL of NDs (mg/kg)
Aluminum	7429-90-5	34	34	100%	9,257	3,178	14,600	--
Antimony	7440-36-0	34	14	41%	0.37	0.27	1.2	0.20
Arsenic	7440-38-2	34	34	100%	10	8.3	26	--
Barium	7440-39-3	34	34	100%	175	81	456	--
Beryllium	7440-41-7	34	5	15%	0.58	0.71	3.3	0.37
Cadmium	7440-43-9	34	34	100%	0.91	1.5	6.5	--
Calcium	7440-70-2	34	34	100%	5,917	5,301	21,400	--
Chromium	7440-47-3	34	34	100%	6.1	1.2	9.2	--
Cobalt	7440-48-4	34	34	100%	6.1	2.8	14	--
Copper	7440-50-8	34	34	100%	23	15	79	--
Iron	7439-89-6	34	34	100%	18,194	11,280	62,000	--
Lead	7439-92-1	34	34	100%	100	120	431	--
Magnesium	7439-95-4	34	34	100%	3,109	1,136	5,560	--
Manganese	7439-96-5	34	34	100%	1,249	1,306	7,020	--
Mercury	7439-97-6	34	34	100%	0.087	0.10	0.61	--
Molybdenum	7439-98-7	17	7	41%	1.8	2.3	7.3	0.50
Nickel	7440-02-0	34	34	100%	5.3	2.7	15	--
Potassium	7440-09-7	34	34	100%	1,237	334	1,950	--
Selenium	7782-49-2	34	8	24%	0.59	0.49	2.2	0.37
Silver	7440-22-4	34	15	44%	0.48	0.43	1.6	0.21
Sodium	7440-23-5	34	0	0%	93	31	All ND	93
Strontium	7440-24-6	17	17	100%	72	60	188	--
Thallium	7440-28-0	34	2	6%	0.43	0.28	1.7	0.36
Vanadium	7440-62-2	34	34	100%	18	5.6	29	--
Zinc	7440-66-6	34	34	100%	138	117	527	--

Notes:
*Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- not applicable
mg/kg = milligram per kilogram
MDL = mthod detection limit
N = number
ND = non-detect

TABLE 2-2
SUMMARY STATISTICS FOR SEDIMENT
Bonita Peak Mining District

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Mean Conc. (mg/kg)*	Standard Deviation (mg/kg)*	Maximum Detected Conc. (mg/kg)	Mean DL of NDs (mg/kg)*
Aluminum	7429-90-5	660	660	100%	13,019	8,210	61,600	--
Antimony	7440-36-0	649	468	72%	2.3	4.0	43	0.015
Arsenic	7440-38-2	660	656	99%	68	220	3,080	0.012
Barium	7440-39-3	515	515	100%	88	57	454	--
Beryllium	7440-41-7	660	522	79%	2.1	4.0	48	0.015
Cadmium	7440-43-9	660	614	93%	7.4	19	268	0.0070
Calcium	7440-70-2	660	652	99%	2,477	1,823	19,000	0.18
Chromium	7440-47-3	658	638	97%	3.9	2.2	37	0.21
Cobalt	7440-48-4	515	512	99%	14	12	86	0.0027
Copper	7440-50-8	660	657	100%	264	539	6,560	0.17
Iron	7439-89-6	660	660	100%	62,136	80,217	926,000	--
Lead	7439-92-1	660	659	100%	1,020	2,330	26,900	0.020
Magnesium	7439-95-4	660	657	100%	4,281	2,154	16,100	1.8
Manganese	7439-96-5	660	660	100%	5,613	8,884	112,000	--
Mercury	7439-97-6	552	491	89%	0.13	0.60	13	0.00042
Molybdenum	7439-98-7	248	161	65%	4.8	8.5	88	0.0041
Nickel	7440-02-0	659	648	98%	6.6	5.8	80	0.10
Potassium	7440-09-7	468	461	99%	922	667	7,900	14
Selenium	7782-49-2	639	471	74%	1.4	6.9	174	0.056
Silver	7440-22-4	656	537	82%	3.0	5.2	43	0.019
Sodium	7440-23-5	468	89	19%	22	41	231	4.6
Strontium	7440-24-6	145	142	98%	43	60	684	0.066
Thallium	7440-28-0	634	264	42%	0.56	6.81	171	0.025
Vanadium	7440-62-2	515	514	100%	21	12	141	0.10
Zinc	7440-66-6	660	660	100%	1,692	3,181	37,300	--

Notes:

*Non-detects were evaluated at 1/2 the method detection limit (MDL)

-- = not applicable

Conc. = concentration

DL = detection limit

MDL = method detection limit

mg/kg = milligram per kilogram

N = number

ND = non-detect

TABLE 2-3
SUMMARY STATISTICS FOR SURFACE WATER
Bonita Peak Mining District

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Average Concentration (µg/L)*	Standard Deviation (µg/L)*	Maximum Detected Concentration (µg/L)	Mean DL of NDs (µg/L)*
Aluminum	7429-90-5	2039	1928	95%	3,050	6,965	79,300	9
Antimony	7440-36-0	1822	28	2%	1.2	0.61	12.5	1.2
Arsenic	7440-38-2	2032	369	18%	15	196	6,400	1.2
Barium	7440-39-3	860	254	30%	18	18	280	13
Beryllium	7440-41-7	2032	315	16%	1.9	7.9	185.0	1.0
Cadmium	7440-43-9	2039	1477	72%	7.8	37	1,090	0.24
Calcium	7440-70-2	2065	2060	100%	67,676	83,849	475,000	50
Chromium	7440-47-3	2039	96	5%	2.5	1.15	24.3	2.4
Cobalt	7440-48-4	860	539	63%	10.7	27	227	0.24
Copper	7440-50-8	2039	1613	79%	180	832	12,300	1.2
Iron	7439-89-6	2032	1485	73%	8,278	26,028	398,000	50
Lead	7439-92-1	2039	1640	80%	45	226	4,550	0.22
Magnesium	7439-95-4	2065	2060	100%	5,953	7,444	67,900	50.0
Manganese	7439-96-5	2039	1948	96%	4,321	12,687	200,000	1.0
Mercury	7439-97-6	130	0	0%	0	0	All ND	0.028
Molybdenum	7439-98-7	333	20	6%	2.9	1.5	17.8	2.6
Nickel	7440-02-0	2032	840	41%	6.7	15	208	1.2
Potassium	7440-09-7	1042	900	86%	695	591	6,470	110
Selenium	7782-49-2	2032	24	1.2%	2.4	0.87	19.1	2.4
Silver	7440-22-4	2032	14	0.7%	1.2	0.61	20	1.2
Sodium	7440-23-5	1043	1024	98%	2,652	2,945	37,200	125
Strontium	7440-24-6	1172	1172	100%	730	1,260	13,100	--
Thallium	7440-28-0	2032	204	10%	2.9	3.3	85	2.2
Vanadium	7440-62-2	860	172	20%	4.6	3.5	58.50	5
Zinc	7440-66-6	2039	1893	93%	2,670	9,768	278,000	5

Notes:
*Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
µg/L = microgram per liter
DL = detection limit
MDL = method detection limit
N = number
ND = non-detect

TABLE 2-4
SUMMARY STATISTICS FOR GROUNDWATER
Bonita Peak Mining District

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Maximum Detected Concentration (µg/L)	Mean DL of NDs (µg/L)*
Aluminum	7429-90-5	2	0	0%	All ND	3.0
Antimony	7440-36-0	2	0	0%	All ND	0.075
Arsenic	7440-38-2	2	0	0%	All ND	0.075
Barium	7440-39-3	1	1	100%	40	--
Beryllium	7440-41-7	2	0	0%	All ND	0.063
Cadmium	7440-43-9	2	0	0%	All ND	0.014
Calcium	7440-70-2	1	1	100%	42300	--
Chromium	7440-47-3	2	1	50%	2.0	0.25
Copper	7440-50-8	2	2	100%	11	--
Iron	7439-89-6	2	0	0%	All ND	3.8
Lead	7439-92-1	2	1	50%	0.30	0.025
Magnesium	7439-95-4	1	1	100%	3700	--
Manganese	7439-96-5	2	0	0%	All ND	0.063
Mercury	7439-97-6	1	0	0%	All ND	0.010
Nickel	7440-02-0	2	1	50%	1.0	0.13
Selenium	7782-49-2	2	0	0%	All ND	0.15
Silver	7440-22-4	2	1	50%	0.12	0.13
Sodium	7440-23-5	1	1	100%	3500	--
Strontium	7440-24-6	1	1	100%	370	--
Thallium	7440-28-0	2	0	0%	All ND	0.13
Zinc	7440-66-6	2	2	100%	120	--

Notes:
*Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
µg/L = microgram per liter
DL = detection limit
MDL = method detection limit
N = number
ND = non-detect

TABLE 2-5
SUMMARY STATISTICS FOR FISH TISSUE
Bonita Peak Mining District

Panel A: Locations Within the Mining Districts

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Average Concentration (mg/kg, wet weight)*	Standard Deviation (mg/kg, wet weight)*	Maximum Detected Concentration (mg/kg, wet weight)	Mean DL of NDs (mg/kg, wet weight)*
Aluminum	7429-90-5	13	0	0%	1.1	0.092	All ND	1.1
Antimony	7440-36-0	13	0	0%	0.027	0.0023	All ND	0.027
Arsenic	7440-38-2	13	7	54%	0.19	0.21	0.55	0.026
Beryllium	7440-41-7	13	0	0%	0.053	0.0046	All ND	0.053
Cadmium	7440-43-9	13	13	100%	0.041	0.024	0.080	--
Calcium	7440-70-2	13	13	100%	191	52	340	--
Chromium	7440-47-3	13	13	100%	0.89	0.19	1.5	--
Copper	7440-50-8	13	13	100%	0.48	0.094	0.67	--
Iron	7439-89-6	13	0	0%	5.3	0.46	All ND	5.3
Lead	7439-92-1	13	12	92%	0.031	0.023	0.07	0.0050
Magnesium	7439-95-4	13	13	100%	227	13	247	--
Manganese	7439-96-5	13	3	23%	0.15	0.10	0.42	0.11
Mercury	7439-97-6	13	13	100%	0.032	0.012	0.058	--
Nickel	7440-02-0	13	0	0%	0.027	0.0023	All ND	0.027
Selenium	7782-49-2	13	13	100%	0.70	0.22	0.99	--
Silver	7440-22-4	13	0	0%	0.027	0.0023	All ND	0.027
Strontium	7440-24-6	13	12	92%	0.46	0.25	0.90	0.11
Thallium	7440-28-0	13	0	0%	0.053	0.0046	All ND	0.053
Uranium	7440-61-1	13	0	0%	0.0053	0.00046	All ND	0.0053
Zinc	7440-66-6	13	13	100%	11	4.0	21	--

Panel B: Reference Locations

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Average Concentration (mg/kg, wet weight)*	Standard Deviation (mg/kg, wet weight)*	Maximum Detected Concentration (mg/kg, wet weight)	Mean DL of NDs (mg/kg, wet weight)*
Aluminum	7429-90-5	10	1	10%	1.2	0.43	2.5	1.1
Antimony	7440-36-0	10	0	0%	0.028	0.0014	All ND	0.028
Arsenic	7440-38-2	10	5	50%	0.081	0.064	0.21	0.027
Beryllium	7440-41-7	10	0	0%	0.055	0.0029	All ND	0.055
Cadmium	7440-43-9	10	6	60%	0.018	0.014	0.045	0.0055
Calcium	7440-70-2	10	10	100%	138	26	176	--
Chromium	7440-47-3	10	10	100%	0.87	0.040	0.92	--
Copper	7440-50-8	10	10	100%	0.42	0.056	0.54	--
Iron	7439-89-6	10	0	0%	5.5	0.27	All ND	5.5
Lead	7439-92-1	10	6	60%	0.041	0.052	0.14	0.0055
Magnesium	7439-95-4	10	10	100%	248	8.2	266	--
Manganese	7439-96-5	10	2	20%	0.20	0.20	0.61	0.11
Mercury	7439-97-6	10	8	80%	0.030	0.012	0.044	0.012
Nickel	7440-02-0	10	0	0%	0.028	0.0014	All ND	0.028
Selenium	7782-49-2	10	10	100%	0.74	0.20	1.2	--
Silver	7440-22-4	10	0	0%	0.028	0.0014	All ND	0.028
Strontium	7440-24-6	10	9	90%	0.36	0.17	0.67	0.11
Thallium	7440-28-0	10	0	0%	0.055	0.0027	All ND	0.055
Uranium	7440-61-1	10	0	0%	0.0055	0.00027	All ND	0.0055
Zinc	7440-66-6	10	10	100%	5.9	1.2	7.8	--

Notes:
*Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
MDL = method detection limit
mg/kg = milligrams per kilogram
N = number
ND = non-detect

TABLE 2-6
SUMMARY STATISTICS FOR GAME TISSUE – GROUSE
Bonita Peak Mining District

Analyte	CAS	N Samples[a]	N Detected Samples	Detection Frequency	Average Concentration (mg/kg, wet weight)[b]	Standard Deviation (mg/kg, wet weight)[b]	Maximum Detected Concentration (mg/kg, wet weight)	Mean DL of NDs (mg/kg)[b]
Aluminum	7429-90-5	3	0	0%	1.4	0.033	All ND	1.4
Antimony	7440-36-0	3	0	0%	0.035	0.00080	All ND	0.035
Arsenic	7440-38-2	3	0	0%	0.035	0.00080	All ND	0.035
Barium	7440-39-3	3	0	0%	0.035	0.00080	All ND	0.035
Beryllium	7440-41-7	3	0	0%	0.069	0.0016	All ND	0.069
Cadmium	7440-43-9	3	1	33%	0.012	0.0094	0.023	0.0069
Calcium	7440-70-2	3	3	100%	30	0.66	31	--
Chromium	7440-47-3	3	3	100%	0.84	0.030	0.87	--
Cobalt	7440-48-4	3	0	0%	0.0069	0.00016	All ND	0.0069
Copper	7440-50-8	3	3	100%	0.49	0.021	0.51	--
Iron	7439-89-6	3	0	0%	6.9	0.16	All ND	6.9
Lead	7439-92-1	3	1	33%	0.042	0.060	0.11	0.0069
Magnesium	7439-95-4	3	3	100%	331	4.8	335	--
Manganese	7439-96-5	3	0	0%	0.14	0.0033	All ND	0.14
Mercury	7439-97-6	3	0	0%	0.0063	0.00064	All ND	0.0063
Molybdenum	7439-98-7	3	0	0%	0.069	0.0016	All ND	0.069
Nickel	7440-02-0	3	0	0%	0.035	0.00080	All ND	0.035
Potassium	7440-09-7	3	3	100%	3746	210	3988	--
Selenium	7782-49-2	3	0	0%	0.069	0.0016	All ND	0.069
Silver	7440-22-4	3	0	0%	0.035	0.00080	All ND	0.035
Sodium	7440-23-5	3	3	100%	522	158	643	--
Strontium	7440-24-6	3	0	0%	0.14	0.0033	All ND	0.14
Thallium	7440-28-0	3	0	0%	0.069	0.0016	All ND	0.069
Vanadium	7440-62-2	3	0	0%	0.14	0.0033	All ND	0.14
Zinc	7440-66-6	3	3	100%	4.9	0.036	4.9	--

Notes:
[a] Includes grouse muscle tissue collected from the breast.
[b] Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
MDL = method detection limit
mg/kg = milligrams per kilogram
N = number
ND = non-detect

TABLE 2-7
SUMMARY STATISTICS FOR GAME TISSUE – DEER
Bonita Peak Mining District

Analyte	CAS	N Samples[a]	N Detected Samples	Detection Frequency	Average Concentration (mg/kg, wet weight)[b]	Standard Deviation (mg/kg, wet weight)[b]	Maximum Detected Concentration (mg/kg, wet weight)	Mean DL of NDs (mg/kg)[b]
Aluminum	7429-90-5	8	0	0%	1.3	0.095	All ND	1.3
Antimony	7440-36-0	8	0	0%	0.032	0.0024	All ND	0.032
Arsenic	7440-38-2	8	0	0%	0.032	0.0024	All ND	0.032
Barium	7440-39-3	8	0	0%	0.032	0.0024	All ND	0.032
Beryllium	7440-41-7	8	0	0%	0.065	0.0048	All ND	0.065
Cadmium	7440-43-9	8	0	0%	0.0065	0.00048	All ND	0.0065
Calcium	7440-70-2	8	8	100%	33	4.5	39	--
Chromium	7440-47-3	8	8	100%	0.75	0.042	0.80	--
Cobalt	7440-48-4	8	0	0%	0.0065	0.00048	All ND	0.0065
Copper	7440-50-8	8	8	100%	1.6	0.43	2.2	--
Iron	7439-89-6	8	8	100%	25	7.1	35	--
Lead	7439-92-1	8	1	13%	0.0081	0.0044	0.019	0.0065
Magnesium	7439-95-4	8	8	100%	245	35	279	--
Manganese	7439-96-5	8	2	25%	0.18	0.087	0.35	0.13
Mercury	7439-97-6	8	0	0%	0.0081	0.0020	All ND	0.0081
Molybdenum	7439-98-7	8	0	0%	0.065	0.0048	All ND	0.065
Nickel	7440-02-0	8	1	13%	0.039	0.018	0.083	0.033
Potassium	7440-09-7	8	8	100%	3610	439	3896	--
Selenium	7782-49-2	8	4	50%	0.14	0.084	0.27	0.063
Silver	7440-22-4	8	0	0%	0.032	0.0024	All ND	0.032
Sodium	7440-23-5	8	8	100%	342	60	433	--
Strontium	7440-24-6	8	0	0%	0.13	0.0095	All ND	0.13
Thallium	7440-28-0	8	0	0%	0.065	0.0048	All ND	0.065
Vanadium	7440-62-2	8	0	0%	0.13	0.0095	All ND	0.13
Zinc	7440-66-6	8	8	100%	30	16	65	--

Notes:
[a] Includes deer muscle tissue collected from the backstrap, front roast, back roast, and tenderloin.
[b] Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
MDL = method detection limit
mg/kg = milligrams per kilogram
N = number
ND = non-detect

TABLE 2-8
SUMMARY STATISTICS FOR ROADWAY AIR
Bonita Peak Mining District

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Average Concentration (µg/m³)*	Standard Deviation (µg/m³)*	Maximum Detected Concentration (µg/m³)	Mean DL of NDs (µg/m³)*
Arsenic	7440-38-2	9	0	0%	0.0047	0.000055	All ND	0.0047
Chromium	7440-47-3	9	9	100%	0.20	0.019	0.23	--
Lead	7439-92-1	9	5	56%	0.033	0.060	0.19	0.033
Manganese	7439-96-5	9	9	100%	0.10	0.11	0.37	--

Notes:
*Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
MDL = method detection limit
µg/m³ = micrograms per cubic meter
N = number
ND = non-detect

TABLE 2-9
SUMMARY STATISTICS FOR ACTIVITY-BASED SAMPLING AIR
Bonita Peak Mining District

Analyte	CAS	N Samples	N Detected Samples	Detection Frequency	Average Concentration (µg/m³)*	Standard Deviation (µg/m³)*	Maximum Detected Concentration (µg/m³)	Mean DL of NDs (µg/m³)*
Aluminum	7429-90-5	16	12	75%	8	7.9	35	3.1
Arsenic	7440-38-2	16	0	0%	1.2	0.46	All ND	1.2
Beryllium	7440-41-7	16	0	0%	0.0063	0.0023	All ND	0.0063
Cadmium	7440-43-9	16	0	0%	0.038	0.014	All ND	0.038
Calcium	7440-70-2	16	2	13%	8.3	3.8	19	7.6
Chromium	7440-47-3	16	0	0%	0.63	0.23	All ND	0.63
Copper	7440-50-8	16	2	13%	0.30	0.19	0.73	0.24
Iron	7439-89-6	16	9	56%	7.7	8.9	39	2.6
Lead	7439-92-1	16	0	0%	0.63	0.23	All ND	0.63
Manganese	7439-96-5	16	13	81%	0.45	0.38	1.5	0.075
Nickel	7440-02-0	16	4	25%	0.082	0.050	0.21	0.065
Selenium	7782-49-2	16	0	0%	1.2	0.46	All ND	1.2
Silver	7440-22-4	16	0	0%	0.12	0.046	All ND	0.12
Sodium	7440-23-5	16	16	100%	18	6.9	27	--
Zinc	7440-66-6	16	4	25%	0.36	0.30	1.3	0.25

Notes:
*Non-detects were evaluated at 1/2 the method detection limit (MDL)
-- = not applicable
MDL = method detection limit
µg/m³ = micrograms per cubic meter
N = number
ND = non-detect

TABLE 3-1
SOIL AND MINE WASTE COPC SELECTION
Bonita Peak Mining District

Chemical	Summary Statistics						RBC (mg/kg)[a]	COPC Selection					
	No. of Samples	No. Detected	Detection Frequency	Mean DL of NDs (mg/kg) [b]	Mean Conc. (mg/kg) [b]	Max. Conc. (mg/kg)[b]		Is Max. Det. Conc. > RBC?	Beneficial Mineral?	DI > RDI (or DRV)?	Is Mean DL of NDs > RBC?	Is Chemical a COPC? (Y/N)	Type of Evaluation
Aluminum	520	520	100%	--	9597	48300	110000	N	N	--	--	N	--
Antimony	513	450	88%	0.18	10	332	47	Y	N	--	--	Y	Quant.
Arsenic	519	518	99.8%	0.07	86	13700	3	Y	N	--	--	Y	Quant.
Barium	484	483	99.8%	0.027	107	1110	22000	N	N	--	--	N	--
Beryllium	519	369	71%	0.35	0.63	9	230	N	N	--	--	N	--
Cadmium	520	476	92%	0.03	6.9	216	98	Y	N	--	--	Y	Quant.
Calcium	520	509	98%	9	3203	86000	No RBC	--	Y	N	--	N	--
Chromium[c]	520	516	99.2%	0.77	4.6	16.5	6.3	Y	N	--	--	Y	Quant.
Cobalt	484	481	99%	0.16	8.9	126	35	Y	N	--	--	Y	Quant.
Copper	520	518	99.6%	0.026	256	3830	4700	N	N	--	--	N	--
Iron	520	520	100%	--	37066	317000	82000	Y	N	--	--	Y	Quant.
Lead	520	520	100%	--	2312	44200	800	Y	N	--	--	Y	Quant.
Magnesium	520	520	100%	--	3739	11500	No RBC	--	Y	N	--	N	--
Manganese	519	519	100%	--	4430	96100	2600	Y	N	--	--	Y	Quant.
Mercury	510	475	93%	0.0017	0.22	7.6	35	N	N	--	--	N	--
Molybdenum	350	280	80%	0.099	9.0	159	580	N	N	--	--	N	--
Nickel	520	514	99%	0.38	4.6	66.8	2200	N	N	--	--	N	--
Potassium	67	67	100%	--	1129	2940	No RBC	--	Y	N	--	N	--
Selenium	520	409	79%	0.43	2	32.3	580	N	N	--	--	N	--
Silver	517	460	89%	0.103	8	96.9	580	N	N	--	--	N	--
Sodium	198	76	38%	95.7	99	325	No RBC	--	Y	N	--	N	--
Strontium	98	98	100%	--	33	152	70000	N	N	--	--	N	--
Thallium	512	226	44%	0.24	0.41	6	1.2	Y	N	--	--	Y	Quant.
Vanadium	484	484	100%	--	18	76.1	580	N	N	--	--	N	--
Zinc	520	520	100%	--	1592	66800	35000	Y	N	--	--	Y	Quant.

[a] RBC is based on USEPA Industrial Soil RSL.
[b] Non-detected results were evaluated at 1/2 the MDL.
[c] RBC is based on Chromium (VI).

Notes:

conc. - concentration
COPC - chemical of potential concern
Det. - detect
DI - daily intake
DL - detection limit
DRV - Daily Reference Value
max. - maximum
mg/kg - milligram per kilogram
N - no
ND - non-detect
No. - number
Quant. - quantitative
RBC - risk-based concentration
RDI - Reference Daily Intake
RL - reporting limit
Y - yes

TABLE 3-2
SEDIMENT COPC SELECTION
Bonita Peak Mining District

Chemical	Summary Statistics						RBC (mg/kg)[a]	COPC Selection					
	No. of Samples	No. Detected	Detection Frequency	Mean DL of NDs (mg/kg)	Mean Conc. (mg/kg) [b]	Max. Conc. (mg/kg)		Is Max. Det. Conc. > RBC?	Beneficial Mineral?	DI > RDI (or DRV)?	Is Mean DL of NDs > RBC?	Is Chemical a COPC? (Y/N)	Type of Evaluation
Aluminum	177	177	100%	--	12831	61600	110000	N	N	--	--	N	--
Antimony	177	129	73%	0.01	2.2	43	47	N	N	--	--	N	--
Arsenic	177	177	100%	--	67	448	3.0	Y	N	--	--	Y	Quant.
Barium	133	133	100%	--	96	267	22000	N	N	--	--	N	--
Beryllium	177	152	86%	0.01	1.7	15	230	N	N	--	--	N	--
Cadmium	177	176	99%	0.003	7.2	268	98	Y	N	--	--	Y	Quant.
Calcium	177	177	100%	--	2946	12100	No RBC	--	Y	N	--	N	--
Chromium[c]	177	170	96%	0.1	3.6	37	6.3	Y	N	--	--	Y	Quant.
Cobalt	133	133	100%	--	14	52	35	Y	N	--	--	Y	Quant.
Copper	177	177	100%	--	300	5630	4700	Y	N	--	--	Y	Quant.
Iron	177	177	100%	--	45074	250000	82000	Y	N	--	--	Y	Quant.
Lead	177	177	100%	--	1168	22400	800	Y	N	--	--	Y	Quant.
Magnesium	177	177	100%	--	4217	8010	No RBC	--	Y	N	--	N	--
Manganese	177	177	100%	--	5042	42300	2600	Y	N	--	--	Y	Quant.
Mercury	142	131	92%	0.0003	0.08	1	35	N	N	--	--	N	--
Molybdenum	54	35	65%	0.0	4.1	30	580	N	N	--	--	N	--
Nickel	177	177	100%	--	7.5	46.7	2200	N	N	--	--	N	--
Potassium	139	138	99%	31	987.1	2630	No RBC	--	Y	N	--	N	--
Selenium	176	136	77%	0.1	1.9	174	580	N	N	--	--	N	--
Silver	177	136	77%	0.01	2.7	40.7	580	N	N	--	--	N	--
Sodium	139	37	27%	5	29.22	231.0	No RBC	--	Y	N	--	N	--
Thallium	175	52	30%	0.02	1.16	171	1.2	Y	N	--	--	Y	Quant.
Vanadium	133	133	100%	--	18	45.3	580	N	N	--	--	N	--
Zinc	177	177	100%	--	1749	37300	35000	Y	N	--	--	Y	Quant.

[a] RBC is based on USEPA Industrial Soil RSL.
[b] Non-detected results were evaluated at 1/2 the MDL.
[c] RBC is based on Chromium (VI).

Notes:

conc. - concentration
COPC - chemical of potential concern
Det. - detect
DI - daily intake
DL - detection limit
DRV - Daily Reference Value
max. - maximum
mg/kg - milligram per kilogram
N - no
ND - non-detect
No. - number
Quant. - quantitative
RBC - risk-based concentration
RDI - Reference Daily Intake
RL - reporting limit
Y - yes

TABLE 3-3
SURFACE WATER COPC SELECTION
Bonita Peak Mining District

Chemical	Summary Statistics						RBC (µg/L)[a]	COPC Selection					
	No. of Samples	No. Detected	Detection Frequency	Mean DL of NDs (µg/L)	Mean Conc. (µg/L)[b]	Max. Conc. (µg/L)[b]		Is Max. Det. Conc. > RBC?	Beneficial Mineral?	DI > RDI (or DRV)?	Is Mean DL of NDs > RBC?	Is Chemical a COPC? (Y/N)	Type of Evaluation
Aluminum	432	424	98%	9	741	9350	2000	Y	N	--	--	Y	Quant.
Antimony	387	4	1.0%	1.1	1.2	5.0	0.78	Y	N	--	--	Y	Quant.
Arsenic	429	60	14%	1.2	2	25	0.052	Y	N	--	--	Y	Quant.
Barium	208	50	24%	13	17	78.6	380	N	N	--	--	N	--
Beryllium	429	19	4%	0.9	0.9	4.6	2.5	Y	N	--	--	Y	Quant.
Cadmium	432	329	76%	0.24	1.8	62	0.92	Y	N	--	--	Y	Quant.
Calcium	434	433	100%	50	43020	217000	No RBC	--	Y	N	--	N	--
Chromium[c]	432	7	1.6%	2.3	2.3	8.8	0.035	Y	N	--	--	Y	Quant.
Cobalt	208	86	41%	0.25	1.92	29	0.60	Y	N	--	--	Y	Quant.
Copper	432	369	85%	1.2	19	327	80	Y	N	--	--	Y	Quant.
Iron	429	321	75%	46	1312	31100	1400	Y	N	--	--	Y	Quant.
Lead	432	393	91%	0.20	17	778	15	Y	N	--	--	Y	Quant.
Magnesium	434	433	100%	50	3148	17600	No RBC	--	Y	N	--	N	--
Manganese	432	419	97%	1.0	795	33500	43	Y	N	--	--	Y	Quant.
Mercury	5	0	0%	0.05	0	All ND	0.57	--	N	--	N	N	Qual.
Molybdenum	139	17	12%	2.5	3	8.92	10	N	N	--	--	N	--
Nickel	429	67	16%	1.3	2.0	23.1	39	N	N	--	--	N	--
Potassium	253	242	96%	81	531	1860	No RBC	--	Y	N	--	N	--
Selenium	429	2	0.5%	2.3	2.3	5.21	10	N	N	--	--	N	--
Silver	429	3	0.7%	1.1	1.1	0.09	9.4	N	N	--	--	N	--
Sodium	253	252	100%	125	2651	11200	No RBC	--	Y	N	--	N	--
Strontium	221	221	100%	--	436	2100	1200	Y	N	--	--	Y	Quant.
Thallium	429	45	10%	2.0	2.8	28	0.020	Y	N	--	--	Y	Quant.
Vanadium	208	38	18%	5	4.1	3.3	8.6	N	N	--	--	N	--
Zinc	432	429	99%	5	595	13400	600	Y	N	--	--	Y	Quant.

[a] RBC based on USEPA tapwater Regional Screening Level.
[b] Non-detected results were evaluated at 1/2 the MDL.
[c] RBC is based on Chromium (VI).

Notes:

µg/L - micrograms per liter
conc. - concentration
COPC - chemical of potential concern
Det. - detect
DI - daily intake
DL - detection limit
DRV - Daily Reference Value
max. - maximum
N - no
ND - non-detect
No. - number
Qual - retained for qualitative evaluation in the uncertainty assessment
Quant. - quantitative
RBC - risk-based concentration
RDI - Reference Daily Intake
RL - reporting limit
Y - yes

TABLE 3-4
GROUNDWATER COPC SELECTION
Bonita Peak Mining District

Chemical	Summary Statistics					RBC (µg/L)[a]	COPC Selection					
	No. of Samples	No. Detected	Detection Frequency	Mean DL of NDs (µg/L)	Max. Conc. (µg/L)[b]		Is Max. Det. Conc. > RBC?	Beneficial Mineral?	DI > RDI (or DRV)?	Is Mean DL of NDs > RBC?	Is Chemical a COPC? (Y/N)	Type of Evaluation
Aluminum	2	0	0%	3.0	All ND	2000	--	N	--	N	N	Qual.
Antimony	2	0	0%	0.075	All ND	0.78	--	N	--	N	N	Qual.
Arsenic	2	0	0%	0.075	All ND	0.052	--	N	--	Y	N	Qual.
Barium	1	1	100%	--	40	380	N	N	--	--	N	--
Beryllium	2	0	0%	0.063	All ND	2.5	--	N	--	N	N	Qual.
Cadmium	2	0	0%	0.014	All ND	0.92	--	N	--	N	N	Qual.
Calcium	1	1	100%	--	42300	No RBC	--	Y	N	--	N	--
Chromium[c]	2	1	50%	0.25	2.0	0.035	Y	N	--	--	Y	Quant.
Copper	2	2	100%	--	11	80	N	N	--	--	N	--
Iron	2	0	0%	3.8	All ND	1400	--	N	--	N	N	Qual.
Lead	2	1	50%	0.025	0.30	15	N	N	--	--	N	--
Magnesium	1	1	100%	--	3700	No RBC	--	Y	N	--	N	--
Manganese	2	0	0%	0.063	All ND	43	--	N	--	N	N	Qual.
Nickel	2	1	50%	0.13	1.0	39	N	N	--	--	N	--
Potassium	0	--	--	--	--	--	--	Y	--	--	N	--
Selenium	2	0	0%	0.15	All ND	10	--	N	--	N	N	Qual.
Silver	2	1	50%	0.13	0.12	9.4	N	N	--	--	N	--
Sodium	1	1	100%	--	3500	No RBC	--	Y	N	--	N	--
Strontium	1	1	100%	--	370	1200	N	N	--	--	N	--
Zinc	2	2	100%	--	120	600	N	N	--	--	N	--

[a] Screening level based on USEPA tapwater Regional Screening Level.
[b] Non-detected results were evaluated at 1/2 the MDL.
[c] RBC is based on Chromium (VI).

Notes:

µg/L - micrograms per liter
conc. - concentration
COPC - chemical of potential concern
Det. - detect
DI - daily intake
DL - detection limit
DRV - Daily Reference Value
max. - maximum
N - no
ND - non-detect
No. - number
Qual - retained for qualitative evaluation in the uncertainty assessment
Quant. - quantitative
RBC - risk-based concentration
RDI - Reference Daily Intake
RL - reporting limit
Y - yes

TABLE 3-5
COPCS RETAINED FOR QUANTITATIVE EVALUATION
Bonita Peak Mining District

Soil and Mine Waste	Sediment	Surface Water	Groundwater	Air[a]	Fish Tissue[b]	Game Tissue[c]
Antimony	Arsenic	Aluminum	Chromium	Antimony	Aluminum	Antimony
Arsenic	Cadmium	Antimony		Arsenic	Antimony	Arsenic
Cadmium	Chromium	Arsenic		Cadmium	Arsenic	Cadmium
Chromium	Cobalt	Beryllium		Chromium	Beryllium	Chromium
Cobalt	Copper	Cadmium		Cobalt	Cadmium	Cobalt
Iron	Iron	Chromium		Iron	Chromium	Iron
Lead	Lead	Cobalt		Lead	Cobalt	Lead
Manganese	Manganese	Copper		Manganese	Copper	Manganese
Thallium	Thallium	Iron		Thallium	Iron	Mercury
Zinc	Zinc	Lead		Zinc	Lead	Thallium
		Manganese			Manganese	Zinc
		Strontium			Mercury	
		Thallium			Strontium	
		Zinc			Thallium	
					Zinc	

Notes:
[a] List of COPCs is the same as that for soil.
[b] List of COPCs is the same as that for surface water and sediment, with mercury added because it is bioaccumulative.
[c] List of COPCs is the same as that for soil, with mercury added because it is bioaccumulative.

COPC - chemical of potential concern

TABLE 3-6
EVALUATION OF BENEFICAL MINERALS
Bonita Peak Mining District

Media Type	Essential Nutrient	Maximum Concentration		RME Intake Rate (IR)		Maximum Daily Intake [1] (mg/day)	Accepted Daily Intake [2]		Ratio
		Value	Units	Value	Units		Value	Source	
Surface Water	Calcium	217,000	µg/L	2.5	L/day	543	1,000	RDI	0.5
	Magnesium	17,600	µg/L	2.5	L/day	44	400	RDI	0.1
	Potassium	1,860	µg/L	2.5	L/day	5	3,500	DRV	0.0013
	Sodium	11,200	µg/L	2.5	L/day	28	2,400	DRV	0.012
Groundwater	Calcium	42,300	µg/L	2.5	L/day	106	1,000	RDI	0.1
	Magnesium	3,700	µg/L	2.5	L/day	9	400	RDI	0.02
	Potassium	--	--	--	--	--	--	--	--
	Sodium	3,500	µg/L	2.5	L/day	9	2,400	DRV	0.004
Sediment	Calcium	12,100	mg/kg	100	mg/day	1.2	1,000	RDI	0.001
	Magnesium	8,010	mg/kg	100	mg/day	0.8	400	RDI	0.002
	Potassium	2,630	mg/kg	100	mg/day	0.3	3,500	DRV	0.00008
	Sodium	231	mg/kg	100	mg/day	0.02	2,400	DRV	0.000010
Soil	Calcium	86,000	mg/kg	330	mg/day	28	1,000	RDI	0.03
	Magnesium	11,500	mg/kg	330	mg/day	3.8	400	RDI	0.01
	Potassium	2,940	mg/kg	330	mg/day	1.0	3,500	DRV	0.0003
	Sodium	325	mg/kg	330	mg/day	0.1	2,400	DRV	0.00004

Notes:

[1] Calculated from maximum concentration and RME intake rate for the maximally exposed receptor (highest intake rate).
Max Daily Intake = Cmax * IR. Conversion factors applied (as necessary) to yield daily intake in units of mg/day. Phosphorus in environmental media assumed to be present as phosphate. Maximum site concentration converted to phosphorus by multiplying by 0.316 (mass phosphorus/mass of phosphate).

[2] Values are Reference Daily Intake (RDI) or Daily Reference Value (DRV). RDIs replace the term "U. S. Recommended Daily Allowances" (introduced in 1973 as a reference value for vitamins, minerals, and protein). DRVs are for nutrients for which no set of standards previously existed. Values obtained from http://www.fda.gov/fdac/special/foodlabel/dvs.html.

-- - results not available

µg/L - micrograms per liter

L/day - liters per day

mg/day - milligrams per day

mg/kg - milligrams per kilogram

TABLE 4-1
EXPOSURE PARAMETERS FOR ATV GUIDES
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Adult	Source	Adult	Source
General	Body weight	kg	80	[1]	80	[1]
	Exposure frequency	days/yr	32	[4, a]	48	[5, a]
	Exposure duration	yr	12	[4]	20	[4]
	Averaging Time, Cancer	yr	70	[2]	70	[2]
	Averaging Time, Noncancer	yr	12	[2]	20	[2]
Inhalation of Particulates	Exposure time	hr/day	4	[4, b]	8	[5]
	Riding time factor	unitless	0.5	[6]	0.75	[6]
	Area Use Factor (Alpine Loop)	unitless	0.4	[6]	0.6	[6]
	TWF (noncancer)	unitless	2.9E-03		2.0E-02	
	TWF (cancer)	unitless	5.0E-04		5.6E-03	
Ingestion of Soil	Ingestion rate	mg/day	100	[4, c]	200	[4, c]
	Conversion factor	kg/mg	1E-06	--	1E-06	--
	Area Use Factor (Alpine Loop)	unitless	0.4		0.6	
	HIF (noncancer)	kg/kg-d	4.4E-08		2.0E-07	
	HIF (cancer)	kg/kg-d	7.5E-09		5.6E-08	

Sources:
[1] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure
[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.
[3] USEPA 1998. Draft Water Quality Criteria Methodology Revisions.
[4] Professional judgment.
[5] Personal communication with Michael Constantine of Silverton Jeep Trail Tours in Silverton, CO
[6] Site-specific survey of ATV guides.

Notes:
[a] Assumes exposure occurs over the course of 16 weeks (roughly Memorial Day to Labor Day) at a frequency of 2 day/week for a CTE rider and 3 days/week for an RME rider.
[b] Assumes CTE is one-half of RME.
[c] Assumes soil ingestion rate is twice that of a resident. The ingestion rate for an ATV rider is assumed to include soil that is incidentally ingested from hand-to-mouth activities and soil that is ingested as non-respirable (non-PM10) particles of dust in air.

ATV = all-terrain vehicle
CTE = central tendency exposure
d = day
HIF = human intake factor
hr = hour
kg = kilogram
m^3 = cubic meter
mg = milligram
RME = reasonable maximum exposure
TWF = time weighting factor
yr = year

TABLE 4-2
EXPOSURE PARAMETERS FOR ATV RECREATIONAL RIDERS
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body Weight (older child)	kg	44	[1, a]	44	[1, a]
	Body weight (adult)	kg	80	[2]	80	[2]
	Exposure frequency	days/yr	16	[4, b]	32	[4, b]
	Exposure duration (older child)	yr	6	[4]	10	[2, d]
	Exposure duration (adult)	yr	6	[4]	10	[2, d]
	Averaging Time, Cancer	yr	70	[3]	70	[3]
	Averaging Time, Noncancer	yr	12	[3]	20	[3]
Inhalation of Particulates	Exposure time	hr/day	4	[4]	6	[4]
	Riding time factor	unitless	0.5	[4]	0.75	[4]
	Area Use Factor	unitless	1	[4]	1	[4]
	PEF	kg/m^3	5.6E-07	[5]	5.6E-07	[5]
	TWF (noncancer)	unitless	3.7E-03		1.6E-02	
	TWF (cancer)	unitless	6.3E-04		4.7E-03	
Incidental Ingestion of Soil/Mine Waste	Ingestion rate	mg/day	100	[4, c]	200	[4, c]
	Conversion factor	kg/mg	1E-06	--	1E-06	--
	HIF (noncancer)	kg/kg-d	7.7E-08		3.1E-07	
	HIF (cancer)	kg/kg-d	1.3E-08		8.8E-08	

Sources:

[1] USEPA 2011. Exposure Factors Handbook.

[2] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.

[4] Professional judgment.

[5] See Appendix C for derivation of the PEF.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes exposure occurs over the course of 16 weeks (roughly Memorial Day to Labor Day) at a frequency of 1 day/week for a CTE rider and 2 days/week for an RME rider.

[c] Assumes soil ingestion rate is twice that of a resident. The ingestion rate for an ATV rider is assumed to include soil that is incidentally ingested from hand-to-mouth activities and soil that is ingested as non-respirable (non-PM10) particles of dust in air.

[d] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

ATV = all-terrain vehicle
CTE = central tendency exposure
d = day
HIF = human intake factor
hr = hour
kg = kilogram
m^3 = cubic meter
mg = milligram
PEF = particulate emission factor
RME = reasonable maximum exposure
TWF = time weighting factor
yr = year

TABLE 4-3
EXPOSURE PARAMETERS FOR HIKERS
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body Weight (older child)	kg	44	[1, a]	44	[1, a]
	Body weight (adult)	kg	80	[2]	80	[2]
	Exposure frequency	days/yr	32	[4, b]	64	[4, b]
	Exposure duration (older child)	yr	6	[4]	10	[2, e]
	Exposure duration (adult)	yr	6	[4]	10	[2, e]
	Averaging Time, Cancer	yr	70	[3]	70	[3]
	Averaging Time, Noncancer	yr	12	[3]	20	[3]
Incidental Ingestion of Soil/Mine Waste	Ingestion rate	mg/day	50	[4, c]	100	[4, d]
	Conversion factor	kg/mg	1E-06	--	1E-06	--
	HIF (noncancer)	kg/kg-d	7.7E-08		3.1E-07	
	HIF (cancer)	kg/kg-d	1.3E-08		8.8E-08	

Sources:

[1] USEPA 2011. Exposure Factors Handbook.
[2] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.
[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.
[4] Professional judgment.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.
[b] Assumes exposure occurs over the course of 16 weeks (roughly Memorial Day to Labor Day) at a frequency of 2 days/week for a CTE visitor and 4 days/week for an RME visitor.
[c] CTE exposure frequency assumed to be half that of the RME receptor.
[d] Assumes soil ingestion by a hiker is similar to that of a resident.
[e] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

CTE = central tendency exposure
d = day
HIF = human intake factor
hr = hour
kg = kilogram
m^3 = cubic meter
mg = milligram
RME = reasonable maximum exposure
TWF = time weighting factor
yr = year

TABLE 4-4
EXPOSURE PARAMETERS FOR RECREATIONAL FISHERMAN
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body Weight (older child)	kg	44	[3, a]	44	[3, a]
	Body weight (adult)	kg	80	[1]	80	[1]
	Exposure frequency	days/yr	30	[4]	60	[4]
	Exposure duration (older child)	yr	6	[4]	10	[1, i]
	Exposure duration (adult)	yr	6	[4]	10	[1, i]
	Averaging Time, Cancer	yr	70	[2]	70	[2]
	Averaging Time, Noncancer	yr	12	[2]	20	[2]
Incidental Ingestion of Sediment	Ingestion rate	mg/day	50	[4, b]	100	[4, b]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	7.2E-08		2.9E-07	
	HIF (cancer)	kg/kg-d	1.2E-08		8.3E-08	
Incidental Ingestion of Surface Water	Ingestion rate	mL/day	2.1	[3, f, g]	7.1	[3, f, g]
	Conversion factor	L/mL	1E-03		1E-03	
	HIF (noncancer)	L/kg-d	3.0E-06		2.1E-05	
	HIF (cancer)	L/kg-d	5.2E-07		5.9E-06	
Ingestion of Fish	Ingestion rate (total)	g/day	12	[3, c]	43	[3, c]
	Exposure frequency	days/yr	350	[5, h]	350	[5, h]
	Conversion factor	kg/g	1E-03		1E-03	
	Fraction from Site	unitless	0.1	[4, d]	0.2	[4, d]
	HIF (noncancer)	kg/kg-d	2.0E-05		1.5E-04	
	HIF (cancer)	kg/kg-d	3.5E-06		4.2E-05	

Sources:

[1] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[3] USEPA 2011. Exposure Factors Handbook.

[4] Professional judgement.

[5] USEPA 1991. Standard Default Exposure Factors. OSWER Directive 9285.6-03.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes sediment ingestion is similar to that of a resident. CTE exposure assumed to be half that of an RME receptor.

[c] Based on long-term average mean and 95th percentile ingestion rates presented in EFH Table 10-5 for freshwater recreational fish intake by consuming anglers in North Dakota (nearest state to Colorado with data).

[d] Assumes 10% and 20% of fish consumed annually are from the drainage areas impacted by the Site.

[e] Per USEPA (1989), long-term average intake rates are to be applied at an exposure frequency of 365 days/year.

[f] Incidental ingestion from splashing or hand-to-face contact during wading assumed to be 10% of USEPA (1989) recommended default incidentally ingested during swimming.

[g] Table 3-5, USEPA 2011.

[h] Assumed to be equal to the residential default exposure frequency.

[i] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

CTE = Central Tendency Exposure
d = day
g = gram
HIF = Human Intake Factor
kg = kilogram
L = liter
mg = milligram
mL = milliliter
RME = Reasonable Maximum Exposure
yr = year

TABLE 4-5
EXPOSURE PARAMETERS FOR ADULT CAMPERS (USFS CAMPGROUND)
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight (older child)	kg	44	[3, a]	44	[3, a]
	Body weight (adult)	kg	80	[4]	80	[4]
	Exposure frequency	days/yr	7	[5, b]	14	[7, b]
	Exposure duration (older child)	yr	6	[6]	10	[4, g]
	Exposure duration (adult)	yr	6	[6]	10	[4, g]
	Averaging Time, Cancer	yr	70	[2]	70	[2]
	Averaging Time, Noncancer	yr	12	[2]	20	[2]
Incidental Ingestion of Soil/Mine Waste	Ingestion rate	mg/day	100	[5, d]	200	[5, d]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	3.4E-08		1.4E-07	
	HIF (cancer)	kg/kg-d	5.8E-09		3.9E-08	
Incidental Ingestion of Sediment	Ingestion rate	mg/day	50	[5, c]	100	[5]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	1.7E-08		6.8E-08	
	HIF (cancer)	kg/kg-d	2.9E-09		1.9E-08	
Incidental Ingestion of Surface Water	Ingestion rate	mL/hr	2.1	[3, e, f]	7.1	[3, e, f]
	Exposure time	hr/d	0.5	[5]	1.5	[5]
	Conversion factor	L/mL	1E-03		1E-03	
	HIF (noncancer)	L/kg-d	3.5E-07		7.2E-06	
	HIF (cancer)	L/kg-d	6.1E-08		2.1E-06	
Ingestion of Groundwater (as drinking water)	Ingestion rate	L/day	1.4	[1, 2]	2.5	[4]
	HIF (noncancer)	L/kg-d	4.7E-04		1.7E-03	
	HIF (cancer)	L/kg-d	8.1E-05		4.8E-04	

Sources:

[1] USEPA 1991. Standard Default Exposure Factors. OSWER Directive 9285.6-03.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[3] USEPA 2011. Exposure Factors Handbook.

[4] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[5] Professional judgement.

[6] USEPA 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

[7] USFS. Guidelines for the San Juan National Forest. https://www.fs.usda.gov/activity/sanjuan/recreation/camping-cabins/?recid=42728&actid=34

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes exposure for an RME visitor is limited to 14 days/year per Source 7 and a CTE visitor's exposure is half of the RME visitor (i.e., 7 days).

[c] Assumes CTE value is half of the RME value.

[d] Assumes RME soil ingestion by a camper is twice that of a resident.

[e] Incidental ingestion from splashing or hand-to-face contact during wading assumed to be 10% of USEPA (1989) recommended default incidentally ingested during swimming.

[f] Table 3-5, USEPA 2011.

[g] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

CTE = central tendency exposure
d = day
HIF = human intake factor
hr = hour
kg = kilogram
L = liter
mg = milligram
mL = milliliter
RME = reasonable maximum exposure
USFS = United States Forest Service
yr = year

TABLE 4-6
EXPOSURE PARAMETERS FOR ADULT CAMPERS (DISPERSED CAMPING)
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight (older child)	kg	44	[3, a]	44	[3, a]
	Body weight (adult)	kg	80	[4]	80	[4]
	Exposure frequency	days/yr	14	[5, b]	28	[5, b]
	Exposure duration (older child)	yr	6	[6]	10	[4, g]
	Exposure duration (adult)	yr	6	[6]	10	[4, g]
	Averaging Time, Cancer	yr	70	[2]	70	[2]
	Averaging Time, Noncancer	yr	12	[2]	20	[2]
Incidental Ingestion of Soil/Mine Waste	Ingestion rate	mg/day	100	[5, d]	200	[5, d]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	6.8E-08		2.7E-07	
	HIF (cancer)	kg/kg-d	1.2E-08		7.7E-08	
Incidental Ingestion of Sediment	Ingestion rate	mg/day	50	[5, c]	100	[5]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	3.4E-08		1.4E-07	
	HIF (cancer)	kg/kg-d	5.8E-09		3.9E-08	
Incidental Ingestion of Surface Water	Ingestion rate	mL/hr	2.1	[3, e]	7.1	[3, e]
	Exposure time	hr/d	0.5	[5]	1.5	[5]
	Conversion factor	L/mL	1E-03		1E-03	
	HIF (noncancer)	L/kg-d	7.1E-07		1.4E-05	
	HIF (cancer)	L/kg-d	1.2E-07		4.1E-06	
Ingestion of Surface Water (as drinking water)	Ingestion rate	L/day	1.4	[1, 2]	2.5	[4]
	HIF (noncancer)	L/kg-d	9.5E-04		3.4E-03	
	HIF (cancer)	L/kg-d	1.6E-04		9.7E-04	

Sources:

[1] USEPA 1991. Standard Default Exposure Factors. OSWER Directive 9285.6-03.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[3] USEPA 2011. Exposure Factors Handbook.

[4] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[5] Professional judgement

[6] USEPA 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

[7] USFS. Guidelines for the San Juan National Forest. https://www.fs.usda.gov/activity/sanjuan/recreation/camping-cabins/?recid=42728&actid=34

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes the RME dispersed camper visits the Site the maximum allowable number of days specified in Source 7 (USFS guidelines). This frequency is also protective of dispersed camper who may use BLM land for dispersed camping with an annual limit of 14 days. CTE is assumed to be one-half of the RME frequency.

[c] Assumes CTE value is half of the RME value.

[d] Assumes RME soil ingestion by a camper is twice that of a resident.

[e] Incidental ingestion from splashing or hand-to-face contact during wading assumed to be 10% of USEPA (1989) recommended default incidentally ingested during swimming.

[f] Table 3-5, USEPA 2011.

[g] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

CTE = central tendency exposure
d = day
HIF = human intake factor
hr = hour
kg = kilogram
L = liter
mg = milligram
mL = milliliter
RME = reasonable maximum exposure
yr = year

TABLE 4-7
EXPOSURE PARAMETERS FOR CHILD CAMPERS (USFS CAMPGROUND AND DISPERSED CAMPING)
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight	kg	15	[2]	15	[2]
	Exposure frequency	days/yr	7	[3, f]	14	[3, f]
	Exposure duration	yr	2	[3]	6	[3]
	Averaging Time, Cancer	yr	70	[1]	70	[1]
	Averaging Time, Noncancer	yr	2	[1]	6	[1]
Incidental Ingestion of Soil/Mine Waste	Ingestion rate	mg/day	203	[6, b]	429	[6, b]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	2.6E-07		1.1E-06	
	HIF (cancer)	kg/kg-d	7.4E-09		9.4E-08	
Incidental Ingestion of Surface Water	Ingestion rate	mL/hr	4.9	[5, d, e]	12	[5, d, e]
	Exposure time	hr/d	0.5	[3]	1.5	[3]
	Conversion factor	L/mL	1E-03		1E-03	
	HIF (noncancer)	L/kg-d	3.1E-06		4.6E-05	
	HIF (cancer)	L/kg-d	8.9E-08		3.9E-06	
Incidental Ingestion of Sediment	Ingestion rate	mg/day	50	[3, a]	100	[3, a]
	Conversion factor	kg/mg	1E-06		1E-06	
	HIF (noncancer)	kg/kg-d	6.4E-08		2.6E-07	
	HIF (cancer)	kg/kg-d	1.8E-09		2.2E-08	
Ingestion of Water (surface water for dispersed camper, ground water for USFS camper)	Ingestion rate	L/day	0.5	[1, c]	0.78	[4]
	HIF (noncancer)	L/kg-d	6.4E-04		2.0E-03	
	HIF (cancer)	L/kg-d	1.8E-05		1.7E-04	

Sources:

[1] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[2] USEPA 1991. Standard Default Exposure Factors. OSWER Directive 9285.6-03.

[3] Professional judgement.

[4] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[5] USEPA 2011. Exposure Factors Handbook.

[6] USEPA. 2008. Child-Specific Exposure Factors Handbook.

Notes:

[a] Assumes sediment ingestion is similar to that of a resident. CTE exposure assumed to be half that of an RME receptor.

[b] Assumes RME soil ingestion is represented by the 95th percentile of all girls and boys ages zero to five years old. Assumes CTE soil ingestion is represented by the mean of all girls and boys ages zero to six years old. The average value for age 5-6 years old was assumed to be equal to the average for ages 4-5 years old.

[c] Assumes water intake by camper is similar to a resident

[d] Incidental ingestion from splashing or hand-to-face contact during wading assumed to be 10% of USEPA (1989) recommended default incidentally ingested during swimming.

[e] Table 3-5, USEPA 2011.

[f] Assumes exposure for an RME visitor is limited to 14 days/year and a CTE visitor's exposure is half of the RME visitor (i.e., 7 days).

CTE = central tendency exposure
d = day
HIF = human intake factor
hr = hour
kg = kilogram
L = liter
mg = milligram
mL = milliliter
RME = reasonable maximum exposure
yr = year

TABLE 4-8
EXPOSURE PARAMETERS FOR HUNTERS
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight (older child)	kg	44	[4, c]	44	[4, c]
	Body weight (adult)	kg	80	[1]	80	[1]
	Exposure frequency	days/yr	10	[3, a]	20	[3, a]
	Exposure duration (older child)	yr	6	[3]	10	[1, f]
	Exposure duration (adult)	yr	6	[3]	10	[1, f]
	Averaging Time, Cancer	yr	70	[2]	70	[2]
	Averaging Time, Noncancer	yr	12	[2]	20	[2]
Incidental Ingestion of Soil/Mine Waste	Ingestion rate	mg/day	50	[3, a]	100	[3, a]
	Conversion factor	kg/mg	1E-06	--	1E-06	--
	HIF (noncancer)	kg/kg-d	2.4E-08		9.7E-08	
	HIF (cancer)	kg/kg-d	4.1E-09		2.8E-08	
Ingestion of Large Game (Deer)	Ingestion rate	meals/wk	1	[3, a]	2	[3, a]
	Conversion factor	wk/d	0.14		0.14	
	Meal weight	kg/meal	0.114	[3, b]	0.227	[3, b]
	Fraction from Site	unitless	1	[3]	1	[3]
	Exposure Frequency	days/yr	350	[5, e]	350	[5, e]
	HIF (noncancer)	kg/kg-d	2.7E-04		1.1E-03	
	HIF (cancer)	kg/kg-d	4.7E-05		3.1E-04	
Ingestion of Terrestrial Birds (Grouse)	Ingestion rate	meals/wk	0.25	[3, a]	0.5	[3, a]
	Conversion factor	wk/d	0.14		0.14	
	Meal weight	kg/meal	0.057	[3, b]	0.11	[3, b]
	Fraction from Site	unitless	1	[3]	1	[3]
	Exposure Frequency	days/yr	350	[5, e]	350	[5, e]
	HIF (noncancer)	kg/kg-d	3.4E-05		1.4E-04	
	HIF (cancer)	kg/kg-d	5.9E-06		3.9E-05	

Sources:

[1] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[3] Professional judgement.

[4] USEPA 2011. Exposure Factors Handbook.

[5] USEPA 1991. Standard Default Exposure Factors. OSWER Directive 9285.6-03.

Notes:

[a] Assumed value.

[b] Assumes 0.25 pound/meal for CTE value and 0.5 pound/meal for RME value for the deer. Assumes grouse portions are half that of deer.

[c] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[d] Per USEPA (1989), long-term average intake rates are to be applied at an exposure frequency of 365 days/year.

[e] Assumed to be equal to the residential default exposure frequency.

[f] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

CTE = central tendency exposure
d = day
HIF = human intake factor
kg = kilogram
mg = milligram
RME = reasonable maximum exposure
wk = week
yr = year

TABLE 4-9
EXPOSURE PARAMETERS FOR ROADWAY WORKERS
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight (adult)	kg	80	[2]	80	[2]
	Exposure frequency	days/yr	100	[4, a]	100	[4, a]
	Exposure duration	yr	5	[4]	10	[4]
	Averaging Time, Cancer	yr	70	[3]	70	[3]
	Averaging Time, Noncancer	yr	5	[3]	10	[3]
Inhalation of Particulates	Exposure time	hr/day	6	[4]	8	[2]
	TWF (noncancer)	unitless	6.8E-02		9.1E-02	
	TWF (cancer)	unitless	4.9E-03		1.3E-02	
Incidental Ingestion of Soil	Ingestion rate	mg/day	165	[4, b]	330	[1]
	Conversion factor	kg/mg	1E-06	--	1E-06	--
	HIF (noncancer)	kg/kg-d	5.7E-07		1.1E-06	
	HIF (cancer)	kg/kg-d	4.0E-08		1.6E-07	

Sources:

[1] USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

[2] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.

[4] Professional judgment.

Notes:

[a] Assumes exposure occurs over the course of 20 weeks when roads may not be covered with snow for 5 days/week.
[b] Assumes soil ingestion rate for a CTE receptor is half that of the RME receptor.

CTE = central tendency exposure
HIF = human intake factor
hr = hour
kg = kilogram
mg = milligram
RME = reasonable maximum exposure
TWF = time weighting factor
yr = year

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
ATV Guide	EU5a	Soil	Antimony	2.445	95% Chebyshev (Mean, Sd) UCL
ATV Guide	EU5a	Soil	Arsenic	24.72	95% Adjusted Gamma UCL
ATV Guide	EU5a	Soil	Cadmium	1.846	95% Adjusted Gamma UCL
ATV Guide	EU5a	Soil	Chromium	5.329	95% Student's-t UCL
ATV Guide	EU5a	Soil	Chromium(III)	4.8	calculated using assumed 90:10 ratio (chromium III: chromium VI)
ATV Guide	EU5a	Soil	Chromium(VI)	0.53	calculated using assumed 90:10 ratio (chromium III: chromium VI)
ATV Guide	EU5a	Soil	Cobalt	6.544	95% Student's-t UCL
ATV Guide	EU5a	Soil	Iron	36313	95% Student's-t UCL
ATV Guide	EU5a	Soil	Manganese	1571	95% H-UCL
ATV Guide	EU5a	Soil	Thallium	0.19	KM H-UCL
ATV Guide	EU5a	Soil	Zinc	751.5	95% Chebyshev (Mean, Sd) UCL
ATV Rec	EU5b	Soil	Antimony	16.03	95% KM (Chebyshev) UCL
ATV Rec	EU5b	Soil	Arsenic	46.92	95% Approximate Gamma UCL
ATV Rec	EU5b	Soil	Cadmium	5.12	95% H-UCL
ATV Rec	EU5b	Soil	Chromium	5.139	95% Approximate Gamma UCL
ATV Rec	EU5b	Soil	Chromium(III)	4.6	calculated using assumed 90:10 ratio (chromium III: chromium VI)
ATV Rec	EU5b	Soil	Chromium(VI)	0.51	calculated using assumed 90:10 ratio (chromium III: chromium VI)
ATV Rec	EU5b	Soil	Cobalt	8.551	95% H-UCL
ATV Rec	EU5b	Soil	Iron	31787	95% Student's-t UCL
ATV Rec	EU5b	Soil	Manganese	4429	95% Chebyshev (Mean, Sd) UCL
ATV Rec	EU5b	Soil	Thallium	0.614	95% KM (Chebyshev) UCL
ATV Rec	EU5b	Soil	Zinc	1056	95% H-UCL
Camper - Campground	EU6	Groundwater	Chromium	0.002	Low detection frequency; value shown is the maximum detected concentration.
Camper - Campground	EU6	Groundwater	Chromium(III)	0.0018	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Groundwater	Chromium(VI)	0.00	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Sediment	Arsenic	28.1	95% Student's-t UCL
Camper - Campground	EU6	Sediment	Cadmium	3.617	95% Student's-t UCL
Camper - Campground	EU6	Sediment	Chromium	3.474	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Camper - Campground	EU6	Sediment	Chromium(III)	3.1266	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Sediment	Chromium(VI)	0.3474	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Sediment	Cobalt	34.12	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Camper - Campground	EU6	Sediment	Copper	24.67	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Camper - Campground	EU6	Sediment	Iron	33017	95% Student's-t UCL
Camper - Campground	EU6	Sediment	Manganese	2879	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Camper - Campground	EU6	Sediment	Zinc	1017	95% Student's-t UCL
Camper - Campground	EU6	Sediment	Thallium	--	All non-detect
Camper - Campground	EU6	Soil	Antimony	0.8	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Arsenic	18.7	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Cadmium	1.1	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Chromium	4.8	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Chromium(III)	4.3	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Soil	Chromium(VI)	0.48	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Soil	Cobalt	9.4	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Iron	22100	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Manganese	1400	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Thallium	0.099	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Soil	Zinc	270	One sample collected; value shown is the maximum detected concentration.
Camper - Campground	EU6	Surface Water	Aluminum	0.8799	95% Student's-t UCL
Camper - Campground	EU6	Surface Water	Antimony	--	All non-detect
Camper - Campground	EU6	Surface Water	Arsenic	0.00013	Low detection frequency; value shown is the maximum detected concentration.
Camper - Campground	EU6	Surface Water	Beryllium	--	All non-detect
Camper - Campground	EU6	Surface Water	Cadmium	0.00024	Low detection frequency; value shown is the maximum detected concentration.
Camper - Campground	EU6	Surface Water	Chromium	--	All non-detect
Camper - Campground	EU6	Surface Water	Chromium(III)	--	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Surface Water	Chromium(VI)	--	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Campground	EU6	Surface Water	Cobalt	0.97	Only one sample
Camper - Campground	EU6	Surface Water	Copper	--	All non-detect
Camper - Campground	EU6	Surface Water	Iron	0.1764	95% KM (t) UCL
Camper - Campground	EU6	Surface Water	Manganese	0.1375	95% Student's-t UCL
Camper - Campground	EU6	Surface Water	Strontium	0.1944	95% Student's-t UCL
Camper - Campground	EU6	Surface Water	Thallium	0.00853	Low detection frequency; value shown is the maximum detected concentration.
Camper - Campground	EU6	Surface Water	Zinc	0.06052	95% Student's-t UCL
Camper - Dispersed	EU7	Sediment	Arsenic	32.33	95% Adjusted Gamma UCL
Camper - Dispersed	EU7	Sediment	Cadmium	41.16	95% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Sediment	Chromium	4.063	95% KM (t) UCL
Camper - Dispersed	EU7	Sediment	Chromium(III)	3.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Dispersed	EU7	Sediment	Chromium(VI)	0.41	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Dispersed	EU7	Sediment	Cobalt	12.35	95% Student's-t UCL
Camper - Dispersed	EU7	Sediment	Copper	933.1	95% Chebyshev (Mean, Sd) UCL
Camper - Dispersed	EU7	Sediment	Iron	70145	95% Chebyshev (Mean, Sd) UCL
Camper - Dispersed	EU7	Sediment	Manganese	7951	95% Adjusted Gamma UCL
Camper - Dispersed	EU7	Sediment	Thallium	0.172	95% KM Adjusted Gamma UCL
Camper - Dispersed	EU7	Sediment	Zinc	3207	95% H-UCL

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
Camper - Dispersed	EU7	Soil	Antimony	50.77	97.5% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Soil	Arsenic	44.86	95% Student's-t UCL
Camper - Dispersed	EU7	Soil	Cadmium	14.42	95% Adjusted Gamma UCL
Camper - Dispersed	EU7	Soil	Chromium	7.369	95% Student's-t UCL
Camper - Dispersed	EU7	Soil	Chromium(III)	6.6	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Dispersed	EU7	Soil	Chromium(VI)	0.74	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Dispersed	EU7	Soil	Cobalt	12.66	95% Adjusted Gamma UCL
Camper - Dispersed	EU7	Soil	Iron	34108	95% Student's-t UCL
Camper - Dispersed	EU7	Soil	Manganese	3290	95% Adjusted Gamma UCL
Camper - Dispersed	EU7	Soil	Thallium	0.342	95% KM Adjusted Gamma UCL
Camper - Dispersed	EU7	Soil	Zinc	2213	95% Adjusted Gamma UCL
Camper - Dispersed	EU7	Surface Water	Aluminum	1.156	95% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Surface Water	Antimony	0.00504	Low detection frequency; value shown is the maximum detected concentration.
Camper - Dispersed	EU7	Surface Water	Arsenic	0.000767	95% KM (t) UCL
Camper - Dispersed	EU7	Surface Water	Beryllium	0.00463	Low detection frequency; value shown is the maximum detected concentration.
Camper - Dispersed	EU7	Surface Water	Cadmium	0.00483	95% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Surface Water	Chromium	0.00876	Low detection frequency; value shown is the maximum detected concentration.
Camper - Dispersed	EU7	Surface Water	Chromium(III)	0.0079	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Dispersed	EU7	Surface Water	Chromium(VI)	0.00	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Camper - Dispersed	EU7	Surface Water	Cobalt	0.003063	95% KM Approximate Gamma UCL
Camper - Dispersed	EU7	Surface Water	Copper	0.03008	95% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Surface Water	Iron	3.093	95% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Surface Water	Manganese	0.8432	95% KM (Chebyshev) UCL
Camper - Dispersed	EU7	Surface Water	Strontium	0.4923	95% Approximate Gamma UCL
Camper - Dispersed	EU7	Surface Water	Thallium	0.001361	KM Student's t
Camper - Dispersed	EU7	Surface Water	Zinc	1.184	95% KM (Chebyshev) UCL
Hiker	EU1	Soil-Overbank	Antimony	3.983	95% KM (t) UCL
Hiker	EU1	Soil-Overbank	Arsenic	76.16	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Overbank	Cadmium	25.94	KM H-UCL
Hiker	EU1	Soil-Overbank	Chromium	5.421	95% Student's-t UCL
Hiker	EU1	Soil-Overbank	Chromium(III)	4.9	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU1	Soil-Overbank	Chromium(VI)	0.54	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU1	Soil-Overbank	Cobalt	18.01	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Overbank	Iron	37002	95% Modified-t UCL
Hiker	EU1	Soil-Overbank	Manganese	10872	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Overbank	Thallium	0.654	95% KM (t) UCL
Hiker	EU1	Soil-Overbank	Zinc	1999	95% H-UCL
Hiker	EU1	Soil-Waste Rock	Antimony	115.8	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Waste Rock	Arsenic	271	95% H-UCL
Hiker	EU1	Soil-Waste Rock	Cadmium	25.06	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Waste Rock	Chromium	2.98	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Waste Rock	Chromium(III)	2.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU1	Soil-Waste Rock	Chromium(VI)	0.30	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU1	Soil-Waste Rock	Cobalt	10.8	95% H-UCL
Hiker	EU1	Soil-Waste Rock	Iron	41105	95% Student's-t UCL
Hiker	EU1	Soil-Waste Rock	Manganese	2480	95% Adjusted Gamma UCL
Hiker	EU1	Soil-Waste Rock	Thallium	2.518	95% KM Adjusted Gamma UCL
Hiker	EU1	Soil-Waste Rock	Zinc	7017	95% Adjusted Gamma UCL
Hiker	EU2	Soil-Overbank	Antimony	27.29	KM H-UCL
Hiker	EU2	Soil-Overbank	Arsenic	40.23	95% H-UCL
Hiker	EU2	Soil-Overbank	Cadmium	8.822	95% KM Adjusted Gamma UCL
Hiker	EU2	Soil-Overbank	Chromium	5.794	95% Student's-t UCL
Hiker	EU2	Soil-Overbank	Chromium(III)	5.2	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU2	Soil-Overbank	Chromium(VI)	0.58	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU2	Soil-Overbank	Cobalt	13.16	95% Student's-t UCL
Hiker	EU2	Soil-Overbank	Iron	40511	95% Student's-t UCL
Hiker	EU2	Soil-Overbank	Manganese	11796	95% Chebyshev (Mean, Sd) UCL
Hiker	EU2	Soil-Overbank	Thallium	0.428	95% KM (t) UCL
Hiker	EU2	Soil-Overbank	Zinc	2443	95% H-UCL
Hiker	EU2	Soil-Waste Rock	Antimony	19.4	95% KM Approximate Gamma UCL
Hiker	EU2	Soil-Waste Rock	Arsenic	48.35	95% Chebyshev (Mean, Sd) UCL
Hiker	EU2	Soil-Waste Rock	Cadmium	23.27	95% Chebyshev (Mean, Sd) UCL
Hiker	EU2	Soil-Waste Rock	Chromium	5.139	95% KM (t) UCL
Hiker	EU2	Soil-Waste Rock	Chromium(III)	4.6	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU2	Soil-Waste Rock	Chromium(VI)	0.51	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU2	Soil-Waste Rock	Cobalt	10.56	95% KM (t) UCL
Hiker	EU2	Soil-Waste Rock	Iron	30533	95% Student's-t UCL
Hiker	EU2	Soil-Waste Rock	Manganese	25324	95% Chebyshev (Mean, Sd) UCL
Hiker	EU2	Soil-Waste Rock	Thallium	0.308	95% KM Approximate Gamma UCL
Hiker	EU2	Soil-Waste Rock	Zinc	5180	95% Chebyshev (Mean, Sd) UCL

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
Hiker	EU3	Soil-Overbank	Antimony	2.757	95% Approximate Gamma UCL
Hiker	EU3	Soil-Overbank	Arsenic	41.45	95% Student's-t UCL
Hiker	EU3	Soil-Overbank	Cadmium	7.297	KM H-UCL
Hiker	EU3	Soil-Overbank	Chromium	5.572	95% Chebyshev (Mean, Sd) UCL
Hiker	EU3	Soil-Overbank	Chromium(III)	5.0	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU3	Soil-Overbank	Chromium(VI)	0.56	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU3	Soil-Overbank	Cobalt	9.078	95% KM Approximate Gamma UCL
Hiker	EU3	Soil-Overbank	Iron	55155	95% Modified-t UCL
Hiker	EU3	Soil-Overbank	Manganese	2836	95% H-UCL
Hiker	EU3	Soil-Overbank	Thallium	1	Low detection frequency; value shown is the maximum detected concentration.
Hiker	EU3	Soil-Overbank	Zinc	1133	95% Chebyshev (Mean, Sd) UCL
Hiker	EU3	Soil-Waste Rock	Antimony	45.02	95% Adjusted Gamma UCL
Hiker	EU3	Soil-Waste Rock	Arsenic	106.6	95% Student's-t UCL
Hiker	EU3	Soil-Waste Rock	Cadmium	13.78	95% Adjusted Gamma UCL
Hiker	EU3	Soil-Waste Rock	Chromium	4.279	95% Student's-t UCL
Hiker	EU3	Soil-Waste Rock	Chromium(III)	3.9	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU3	Soil-Waste Rock	Chromium(VI)	0.43	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU3	Soil-Waste Rock	Cobalt	9.959	95% Adjusted Gamma UCL
Hiker	EU3	Soil-Waste Rock	Iron	83648	95% H-UCL
Hiker	EU3	Soil-Waste Rock	Manganese	1287	95% H-UCL
Hiker	EU3	Soil-Waste Rock	Thallium	0.421	95% Student's-t UCL
Hiker	EU3	Soil-Waste Rock	Zinc	9608	95% Adjusted Gamma UCL
Hiker	EU4	Soil-Overbank	Antimony	2.53	KM H-UCL
Hiker	EU4	Soil-Overbank	Arsenic	56.24	KM H-UCL
Hiker	EU4	Soil-Overbank	Cadmium	2.925	KM H-UCL
Hiker	EU4	Soil-Overbank	Chromium	4.743	95% Approximate Gamma UCL
Hiker	EU4	Soil-Overbank	Chromium(III)	4.3	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU4	Soil-Overbank	Chromium(VI)	0.47	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU4	Soil-Overbank	Cobalt	15.65	95% H-UCL
Hiker	EU4	Soil-Overbank	Iron	61544	95% H-UCL
Hiker	EU4	Soil-Overbank	Manganese	1986	95% H-UCL
Hiker	EU4	Soil-Overbank	Thallium	0.125	95% KM (Chebyshev) UCL
Hiker	EU4	Soil-Overbank	Zinc	458.1	95% H-UCL
Hiker	EU4	Soil-Waste Rock	Antimony	77.26	95% Adjusted Gamma UCL
Hiker	EU4	Soil-Waste Rock	Arsenic	10393	99% Chebyshev (Mean, Sd) UCL
Hiker	EU4	Soil-Waste Rock	Cadmium	170.7	UCL exceeded maximum conc; value shown is UCL. 99% KM (Chebyshev) UCL
Hiker	EU4	Soil-Waste Rock	Chromium	7.438	95% Adjusted Gamma UCL
Hiker	EU4	Soil-Waste Rock	Chromium(III)	6.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU4	Soil-Waste Rock	Chromium(VI)	0.74	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hiker	EU4	Soil-Waste Rock	Cobalt	45.95	95% Chebyshev (Mean, Sd) UCL
Hiker	EU4	Soil-Waste Rock	Iron	112627	95% Adjusted Gamma UCL
Hiker	EU4	Soil-Waste Rock	Manganese	55261	99% Chebyshev (Mean, Sd) UCL
Hiker	EU4	Soil-Waste Rock	Thallium	0.883	KM H-UCL
Hiker	EU4	Soil-Waste Rock	Zinc	51919	99% Chebyshev (Mean, Sd) UCL
Hunter	Deer	Game	Antimony	--	All non-detect
Hunter	Deer	Game	Arsenic	--	All non-detect
Hunter	Deer	Game	Cadmium	--	All non-detect
Hunter	Deer	Game	Chromium	0.776	95% Student's-t UCL
Hunter	Deer	Game	Chromium(III)	0.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	Deer	Game	Chromium(VI)	0.08	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	Deer	Game	Cobalt	--	All non-detect
Hunter	Deer	Game	Iron	29.46	95% Student's-t UCL
Hunter	Deer	Game	Manganese	0.345	Low detection frequency; value shown is the maximum detected concentration.
Hunter	Deer	Game	Mercury	--	All non-detect
Hunter	Deer	Game	Thallium	--	All non-detect
Hunter	Deer	Game	Zinc	40.84	95% Student's-t UCL
Hunter	EU1	Soil-Overbank	Antimony	3.983	95% KM (t) UCL
Hunter	EU1	Soil-Overbank	Arsenic	76.16	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Overbank	Cadmium	25.94	KM H-UCL
Hunter	EU1	Soil-Overbank	Chromium	5.421	95% Student's-t UCL
Hunter	EU1	Soil-Overbank	Chromium(III)	4.9	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU1	Soil-Overbank	Chromium(VI)	0.54	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU1	Soil-Overbank	Cobalt	18.01	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Overbank	Iron	37002	95% Modified-t UCL
Hunter	EU1	Soil-Overbank	Manganese	10872	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Overbank	Thallium	0.654	95% KM (t) UCL
Hunter	EU1	Soil-Overbank	Zinc	1999	95% H-UCL

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
Hunter	EU1	Soil-Waste Rock	Antimony	115.8	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Waste Rock	Arsenic	271	95% H-UCL
Hunter	EU1	Soil-Waste Rock	Cadmium	25.06	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Waste Rock	Chromium	2.98	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Waste Rock	Chromium(III)	2.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU1	Soil-Waste Rock	Chromium(VI)	0.30	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU1	Soil-Waste Rock	Cobalt	10.8	95% H-UCL
Hunter	EU1	Soil-Waste Rock	Iron	41105	95% Student's-t UCL
Hunter	EU1	Soil-Waste Rock	Manganese	2480	95% Adjusted Gamma UCL
Hunter	EU1	Soil-Waste Rock	Thallium	2.518	95% KM Adjusted Gamma UCL
Hunter	EU1	Soil-Waste Rock	Zinc	7017	95% Adjusted Gamma UCL
Hunter	EU2	Soil-Overbank	Antimony	27.29	KM H-UCL
Hunter	EU2	Soil-Overbank	Arsenic	40.23	95% H-UCL
Hunter	EU2	Soil-Overbank	Cadmium	8.822	95% KM Adjusted Gamma UCL
Hunter	EU2	Soil-Overbank	Chromium	5.794	95% Student's-t UCL
Hunter	EU2	Soil-Overbank	Chromium(III)	5.2	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU2	Soil-Overbank	Chromium(VI)	0.58	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU2	Soil-Overbank	Cobalt	13.16	95% Student's-t UCL
Hunter	EU2	Soil-Overbank	Iron	40511	95% Student's-t UCL
Hunter	EU2	Soil-Overbank	Manganese	11796	95% Chebyshev (Mean, Sd) UCL
Hunter	EU2	Soil-Overbank	Thallium	0.428	95% KM (t) UCL
Hunter	EU2	Soil-Overbank	Zinc	2443	95% H-UCL
Hunter	EU2	Soil-Waste Rock	Antimony	19.4	95% KM Approximate Gamma UCL
Hunter	EU2	Soil-Waste Rock	Arsenic	48.35	95% Chebyshev (Mean, Sd) UCL
Hunter	EU2	Soil-Waste Rock	Cadmium	23.27	95% Chebyshev (Mean, Sd) UCL
Hunter	EU2	Soil-Waste Rock	Chromium	5.139	95% KM (t) UCL
Hunter	EU2	Soil-Waste Rock	Chromium(III)	4.6	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU2	Soil-Waste Rock	Chromium(VI)	0.51	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU2	Soil-Waste Rock	Cobalt	10.56	95% KM (t) UCL
Hunter	EU2	Soil-Waste Rock	Iron	30533	95% Student's-t UCL
Hunter	EU2	Soil-Waste Rock	Manganese	25324	95% Chebyshev (Mean, Sd) UCL
Hunter	EU2	Soil-Waste Rock	Thallium	0.308	95% KM Approximate Gamma UCL
Hunter	EU2	Soil-Waste Rock	Zinc	5180	95% Chebyshev (Mean, Sd) UCL
Hunter	EU3	Soil-Overbank	Antimony	2.757	95% Approximate Gamma UCL
Hunter	EU3	Soil-Overbank	Arsenic	41.45	95% Student's-t UCL
Hunter	EU3	Soil-Overbank	Cadmium	7.297	KM H-UCL
Hunter	EU3	Soil-Overbank	Chromium	5.572	95% Chebyshev (Mean, Sd) UCL
Hunter	EU3	Soil-Overbank	Chromium(III)	5.0	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU3	Soil-Overbank	Chromium(VI)	0.56	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU3	Soil-Overbank	Cobalt	9.078	95% KM Approximate Gamma UCL
Hunter	EU3	Soil-Overbank	Iron	55155	95% Modified-t UCL
Hunter	EU3	Soil-Overbank	Manganese	2836	95% H-UCL
Hunter	EU3	Soil-Overbank	Thallium	1	Low detection frequency; value shown is the maximum detected concentration.
Hunter	EU3	Soil-Overbank	Zinc	1133	95% Chebyshev (Mean, Sd) UCL
Hunter	EU3	Soil-Waste Rock	Antimony	45.02	95% Adjusted Gamma UCL
Hunter	EU3	Soil-Waste Rock	Arsenic	106.6	95% Student's-t UCL
Hunter	EU3	Soil-Waste Rock	Cadmium	13.78	95% Adjusted Gamma UCL
Hunter	EU3	Soil-Waste Rock	Chromium	4.279	95% Student's-t UCL
Hunter	EU3	Soil-Waste Rock	Chromium(III)	3.9	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU3	Soil-Waste Rock	Chromium(VI)	0.43	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU3	Soil-Waste Rock	Cobalt	9.959	95% Adjusted Gamma UCL
Hunter	EU3	Soil-Waste Rock	Iron	83648	95% H-UCL
Hunter	EU3	Soil-Waste Rock	Manganese	1287	95% H-UCL
Hunter	EU3	Soil-Waste Rock	Thallium	0.421	95% Student's-t UCL
Hunter	EU3	Soil-Waste Rock	Zinc	9608	95% Adjusted Gamma UCL
Hunter	EU4	Soil-Overbank	Antimony	2.53	KM H-UCL
Hunter	EU4	Soil-Overbank	Arsenic	56.24	KM H-UCL
Hunter	EU4	Soil-Overbank	Cadmium	2.925	KM H-UCL
Hunter	EU4	Soil-Overbank	Chromium	4.743	95% Approximate Gamma UCL
Hunter	EU4	Soil-Overbank	Chromium(III)	4.3	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU4	Soil-Overbank	Chromium(VI)	0.47	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU4	Soil-Overbank	Cobalt	15.65	95% H-UCL
Hunter	EU4	Soil-Overbank	Iron	61544	95% H-UCL
Hunter	EU4	Soil-Overbank	Manganese	1986	95% H-UCL
Hunter	EU4	Soil-Overbank	Thallium	0.125	95% KM (Chebyshev) UCL
Hunter	EU4	Soil-Overbank	Zinc	458.1	95% H-UCL

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
Hunter	EU4	Soil-Waste Rock	Antimony	77.26	95% Adjusted Gamma UCL
Hunter	EU4	Soil-Waste Rock	Arsenic	10393	99% Chebyshev (Mean, Sd) UCL
Hunter	EU4	Soil-Waste Rock	Cadmium	170.7	UCL exceeded maximum conc; value shown is UCL. 99% KM (Chebyshev) UCL
Hunter	EU4	Soil-Waste Rock	Chromium	7.438	95% Adjusted Gamma UCL
Hunter	EU4	Soil-Waste Rock	Chromium(III)	6.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU4	Soil-Waste Rock	Chromium(VI)	0.74	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	EU4	Soil-Waste Rock	Cobalt	45.95	95% Chebyshev (Mean, Sd) UCL
Hunter	EU4	Soil-Waste Rock	Iron	112627	95% Adjusted Gamma UCL
Hunter	EU4	Soil-Waste Rock	Manganese	55261	99% Chebyshev (Mean, Sd) UCL
Hunter	EU4	Soil-Waste Rock	Thallium	0.883	KM H-UCL
Hunter	EU4	Soil-Waste Rock	Zinc	51919	99% Chebyshev (Mean, Sd) UCL
Hunter	Grouse	Game	Antimony	--	All non-detect
Hunter	Grouse	Game	Arsenic	--	All non-detect
Hunter	Grouse	Game	Cadmium	0.023	Low detection frequency; value shown is the maximum detected concentration.
Hunter	Grouse	Game	Chromium	0.89	95% Student's-t UCL
Hunter	Grouse	Game	Chromium(III)	0.8	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	Grouse	Game	Chromium(VI)	0.09	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Hunter	Grouse	Game	Cobalt	--	All non-detect
Hunter	Grouse	Game	Iron	--	All non-detect
Hunter	Grouse	Game	Manganese	--	All non-detect
Hunter	Grouse	Game	Mercury	--	All non-detect
Hunter	Grouse	Game	Thallium	--	All non-detect
Hunter	Grouse	Game	Zinc	4.919	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Recreational Fisherman	EU8	Fish	Aluminum	--	All non-detect
Recreational Fisherman	EU8	Fish	Antimony	--	All non-detect
Recreational Fisherman	EU8	Fish	Arsenic	0.43	95% KM (t) UCL
Recreational Fisherman	EU8	Fish	Beryllium	--	All non-detect
Recreational Fisherman	EU8	Fish	Cadmium	0.0448	95% Student's-t UCL
Recreational Fisherman	EU8	Fish	Chromium	0.861	95% Student's-t UCL
Recreational Fisherman	EU8	Fish	Chromium(III)	0.8	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU8	Fish	Chromium(VI)	0.09	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU8	Fish	Copper	0.537	95% Student's-t UCL
Recreational Fisherman	EU8	Fish	Iron	--	All non-detect
Recreational Fisherman	EU8	Fish	Manganese	--	All non-detect
Recreational Fisherman	EU8	Fish	Mercury	0.0455	95% Student's-t UCL
Recreational Fisherman	EU8	Fish	Strontium	0.624	95% KM (t) UCL
Recreational Fisherman	EU8	Fish	Thallium	--	All non-detect
Recreational Fisherman	EU8	Fish	Zinc	10.08	95% Student's-t UCL
Recreational Fisherman	EU8	Sediment	Arsenic	154.4	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU8	Sediment	Cadmium	3.722	95% Approximate Gamma UCL
Recreational Fisherman	EU8	Sediment	Chromium	3.284	95% KM (t) UCL
Recreational Fisherman	EU8	Sediment	Chromium(III)	3.0	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU8	Sediment	Chromium(VI)	0.33	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU8	Sediment	Cobalt	17.99	95% Adjusted Gamma UCL
Recreational Fisherman	EU8	Sediment	Copper	258.5	95% H-UCL
Recreational Fisherman	EU8	Sediment	Iron	61175	95% Modified-t UCL
Recreational Fisherman	EU8	Sediment	Manganese	1925	95% Approximate Gamma UCL
Recreational Fisherman	EU8	Sediment	Thallium	0.184	95% KM Approximate Gamma UCL
Recreational Fisherman	EU8	Sediment	Zinc	1349	95% H-UCL
Recreational Fisherman	EU8	Surface Water	Aluminum	3.351	KM H-UCL
Recreational Fisherman	EU8	Surface Water	Antimony	--	All non-detect
Recreational Fisherman	EU8	Surface Water	Arsenic	0.002388	95% KM Approximate Gamma UCL
Recreational Fisherman	EU8	Surface Water	Beryllium	0.000165	95% KM (t) UCL
Recreational Fisherman	EU8	Surface Water	Cadmium	0.002103	95% KM (Chebyshev) UCL
Recreational Fisherman	EU8	Surface Water	Chromium	0.0004	Low detection frequency; value shown is the maximum detected concentration.
Recreational Fisherman	EU8	Surface Water	Chromium(III)	0.00036	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU8	Surface Water	Chromium(VI)	0.000040	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU8	Surface Water	Cobalt	0.007073	95% KM Approximate Gamma UCL
Recreational Fisherman	EU8	Surface Water	Copper	0.04624	95% KM (Chebyshev) UCL
Recreational Fisherman	EU8	Surface Water	Iron	3.21	95% KM (Chebyshev) UCL
Recreational Fisherman	EU8	Surface Water	Manganese	0.62	95% KM (Chebyshev) UCL
Recreational Fisherman	EU8	Surface Water	Strontium	0.683	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU8	Surface Water	Thallium	0.000911	95% KM (t) UCL
Recreational Fisherman	EU8	Surface Water	Zinc	0.8436	95% KM (Chebyshev) UCL

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
Recreational Fisherman	EU9	Fish	Aluminum	--	All non-detect
Recreational Fisherman	EU9	Fish	Antimony	--	All non-detect
Recreational Fisherman	EU9	Fish	Arsenic	--	All non-detect
Recreational Fisherman	EU9	Fish	Beryllium	--	All non-detect
Recreational Fisherman	EU9	Fish	Cadmium	0.0814	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Recreational Fisherman	EU9	Fish	Chromium	1.267	95% Student's-t UCL
Recreational Fisherman	EU9	Fish	Chromium(III)	1.1	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU9	Fish	Chromium(VI)	0.13	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU9	Fish	Copper	0.583	95% Student's-t UCL
Recreational Fisherman	EU9	Fish	Iron	--	All non-detect
Recreational Fisherman	EU9	Fish	Manganese	0.362	95% KM (t) UCL
Recreational Fisherman	EU9	Fish	Mercury	0.0253	95% Student's-t UCL
Recreational Fisherman	EU9	Fish	Strontium	0.712	95% Student's-t UCL
Recreational Fisherman	EU9	Fish	Thallium	--	All non-detect
Recreational Fisherman	EU9	Fish	Zinc	18.06	95% Student's-t UCL
Recreational Fisherman	EU9	Sediment	Arsenic	37.57	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU9	Sediment	Cadmium	12.4	95% Approximate Gamma UCL
Recreational Fisherman	EU9	Sediment	Chromium	5.569	95% Student's-t UCL
Recreational Fisherman	EU9	Sediment	Chromium(III)	5.0	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU9	Sediment	Chromium(VI)	0.56	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU9	Sediment	Cobalt	12.5	95% Student's-t UCL
Recreational Fisherman	EU9	Sediment	Copper	600.8	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU9	Sediment	Iron	27782	95% Student's-t UCL
Recreational Fisherman	EU9	Sediment	Manganese	13530	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU9	Sediment	Zinc	2938	95% KM (Chebyshev) UCL
Recreational Fisherman	EU9	Sediment	Thallium	18.31	95% Approximate Gamma UCL
Recreational Fisherman	EU9	Surface Water	Aluminum	0.3209	KM H-UCL
Recreational Fisherman	EU9	Surface Water	Antimony	0.00504	Low detection frequency; value shown is the maximum detected concentration.
Recreational Fisherman	EU9	Surface Water	Arsenic	0.000206	95% KM Approximate Gamma UCL
Recreational Fisherman	EU9	Surface Water	Beryllium	0.00032	95% KM (t) UCL
Recreational Fisherman	EU9	Surface Water	Cadmium	0.002184	95% KM (Chebyshev) UCL
Recreational Fisherman	EU9	Surface Water	Chromium	0.0018	Low detection frequency; value shown is the maximum detected concentration.
Recreational Fisherman	EU9	Surface Water	Chromium(III)	0.0016	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU9	Surface Water	Chromium(VI)	0.00018	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Recreational Fisherman	EU9	Surface Water	Cobalt	0.00047	95% KM (t) UCL
Recreational Fisherman	EU9	Surface Water	Copper	0.015	KM H-UCL
Recreational Fisherman	EU9	Surface Water	Iron	0.62	95% KM (Chebyshev) UCL
Recreational Fisherman	EU9	Surface Water	Manganese	2.2	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU9	Surface Water	Strontium	0.42	95% Chebyshev (Mean, Sd) UCL
Recreational Fisherman	EU9	Surface Water	Thallium	0.0017	KM H-UCL
Recreational Fisherman	EU9	Surface Water	Zinc	1.0	95% KM (Chebyshev) UCL
Road Worker	EU1	Air	Antimony	--	Samples were not analyzed for this chemical.
Road Worker	EU1	Air	Arsenic	--	All non-detect
Road Worker	EU1	Air	Cadmium	--	Samples were not analyzed for this chemical.
Road Worker	EU1	Air	Chromium	0.00023	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU1	Air	Chromium(III)	0.000206	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU1	Air	Chromium(VI)	0.00	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU1	Air	Cobalt	--	Samples were not analyzed for this chemical.
Road Worker	EU1	Air	Iron	--	Samples were not analyzed for this chemical.
Road Worker	EU1	Air	Manganese	0.00019	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU1	Air	Thallium	--	Samples were not analyzed for this chemical.
Road Worker	EU1	Air	Zinc	--	Samples were not analyzed for this chemical.
Road Worker	EU1	Soil-Roadway	Antimony	14.36	95% H-UCL
Road Worker	EU1	Soil-Roadway	Arsenic	79.51	95% Adjusted Gamma UCL
Road Worker	EU1	Soil-Roadway	Cadmium	4.23	95% Adjusted Gamma UCL
Road Worker	EU1	Soil-Roadway	Chromium	5.739	95% Adjusted Gamma UCL
Road Worker	EU1	Soil-Roadway	Chromium(III)	5.2	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU1	Soil-Roadway	Chromium(VI)	0.57	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU1	Soil-Roadway	Cobalt	11.92	95% H-UCL
Road Worker	EU1	Soil-Roadway	Iron	31137	95% Student's-t UCL
Road Worker	EU1	Soil-Roadway	Manganese	7799	95% Chebyshev (Mean, Sd) UCL
Road Worker	EU1	Soil-Roadway	Thallium	0.948	95% H-UCL
Road Worker	EU1	Soil-Roadway	Zinc	1075	95% Adjusted Gamma UCL
Road Worker	EU2	Air	Antimony	--	Samples were not analyzed for this chemical.
Road Worker	EU2	Air	Arsenic	--	All non-detect
Road Worker	EU2	Air	Cadmium	--	Samples were not analyzed for this chemical.
Road Worker	EU2	Air	Chromium	0.00023	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU2	Air	Chromium(III)	0.000206	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU2	Air	Chromium(VI)	0.00	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU2	Air	Cobalt	--	Samples were not analyzed for this chemical.
Road Worker	EU2	Air	Iron	--	Samples were not analyzed for this chemical.
Road Worker	EU2	Air	Manganese	0.00019	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU2	Air	Thallium	--	Samples were not analyzed for this chemical.
Road Worker	EU2	Air	Zinc	--	Samples were not analyzed for this chemical.

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS
Bonita Peak Mining District

Receptor	Exposure Unit	Meda Type	Chemical Name	Exposure Point Concentration (EPC)	
				Value	Comments
Road Worker	EU2	Soil-Roadway	Antimony	3.78	95% Chebyshev (Mean, Sd) UCL
Road Worker	EU2	Soil-Roadway	Arsenic	34.28	95% Adjusted Gamma UCL
Road Worker	EU2	Soil-Roadway	Cadmium	7.882	95% Chebyshev (Mean, Sd) UCL
Road Worker	EU2	Soil-Roadway	Chromium	4.65	95% Student's-t UCL
Road Worker	EU2	Soil-Roadway	Chromium(III)	4.2	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU2	Soil-Roadway	Chromium(VI)	0.47	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU2	Soil-Roadway	Cobalt	6.801	95% Student's-t UCL
Road Worker	EU2	Soil-Roadway	Iron	25070	95% Student's-t UCL
Road Worker	EU2	Soil-Roadway	Manganese	2439	95% Adjusted Gamma UCL
Road Worker	EU2	Soil-Roadway	Thallium	0.206	KM H-UCL
Road Worker	EU2	Soil-Roadway	Zinc	1983	95% Chebyshev (Mean, Sd) UCL
Road Worker	EU3	Air	Antimony	--	Samples were not analyzed for this chemical.
Road Worker	EU3	Air	Arsenic	--	All non-detect
Road Worker	EU3	Air	Cadmium	--	Samples were not analyzed for this chemical.
Road Worker	EU3	Air	Chromium	0.00024	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU3	Air	Chromium(III)	0.000212	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU3	Air	Chromium(VI)	0.00	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU3	Air	Cobalt	--	Samples were not analyzed for this chemical.
Road Worker	EU3	Air	Iron	--	Samples were not analyzed for this chemical.
Road Worker	EU3	Air	Manganese	0.00047	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU3	Air	Thallium	--	Samples were not analyzed for this chemical.
Road Worker	EU3	Air	Zinc	--	Samples were not analyzed for this chemical.
Road Worker	EU3	Soil-Roadway	Antimony	1.733	95% Student's-t UCL
Road Worker	EU3	Soil-Roadway	Arsenic	19.2	95% Student's-t UCL
Road Worker	EU3	Soil-Roadway	Cadmium	1.583	95% Student's-t UCL
Road Worker	EU3	Soil-Roadway	Chromium	6.907	95% Student's-t UCL
Road Worker	EU3	Soil-Roadway	Chromium(III)	6.2	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU3	Soil-Roadway	Chromium(VI)	0.69	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU3	Soil-Roadway	Cobalt	8.091	95% Student's-t UCL
Road Worker	EU3	Soil-Roadway	Iron	121632	95% Chebyshev (Mean, Sd) UCL
Road Worker	EU3	Soil-Roadway	Manganese	936	95% Student's-t UCL
Road Worker	EU3	Soil-Roadway	Thallium	0.205	95% H-UCL
Road Worker	EU3	Soil-Roadway	Zinc	658.7	95% Student's-t UCL
Road Worker	EU4	Air	Antimony	--	Samples were not analyzed for this chemical.
Road Worker	EU4	Air	Arsenic	--	All non-detect
Road Worker	EU4	Air	Cadmium	--	Samples were not analyzed for this chemical.
Road Worker	EU4	Air	Chromium	0.00024	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU4	Air	Chromium(III)	0.000218	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU4	Air	Chromium(VI)	0.00	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU4	Air	Cobalt	--	Samples were not analyzed for this chemical.
Road Worker	EU4	Air	Iron	--	Samples were not analyzed for this chemical.
Road Worker	EU4	Air	Manganese	0.000056	UCL exceeded maximum conc; value shown is UCL. 95% Student's-t UCL
Road Worker	EU4	Air	Thallium	--	Samples were not analyzed for this chemical.
Road Worker	EU4	Air	Zinc	--	Samples were not analyzed for this chemical.
Road Worker	EU4	Soil-Roadway	Antimony	0.662	95% KM (t) UCL
Road Worker	EU4	Soil-Roadway	Arsenic	15.39	95% Student's-t UCL
Road Worker	EU4	Soil-Roadway	Cadmium	64.84	UCL exceeded maximum conc; value shown is UCL. 99% Chebyshev(Mean, Sd) UCL
Road Worker	EU4	Soil-Roadway	Chromium	7.4	95% H-UCL
Road Worker	EU4	Soil-Roadway	Chromium(III)	6.7	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU4	Soil-Roadway	Chromium(VI)	0.74	calculated using assumed 90:10 ratio (chromium III: chromium VI)
Road Worker	EU4	Soil-Roadway	Cobalt	20.25	95% Adjusted Gamma UCL
Road Worker	EU4	Soil-Roadway	Iron	31333	95% Student's-t UCL
Road Worker	EU4	Soil-Roadway	Manganese	19809	UCL exceeded maximum conc; value shown is UCL. 99% Chebyshev(Mean, Sd) UCL
Road Worker	EU4	Soil-Roadway	Thallium	0.11	95% KM (t) UCL
Road Worker	EU4	Soil-Roadway	Zinc	5972	UCL exceeded maximum conc; value shown is UCL. 99% Chebyshev(Mean, Sd) UCL
ATV Guide	EU5a	Air	Aluminum	0.0141	Average concentration for following rider air.
ATV Guide	EU5a	Air	Antimony	--	Samples were not analyzed for this chemical.
ATV Guide	EU5a	Air	Arsenic	--	All non-detect
ATV Guide	EU5a	Air	Beryllium	--	All non-detect
ATV Guide	EU5a	Air	Cadmium	--	All non-detect
ATV Guide	EU5a	Air	Calcium	0.0086	Average concentration for following rider air.
ATV Guide	EU5a	Air	Chromium	--	All non-detect
ATV Guide	EU5a	Air	Chromium(III)	--	All non-detect
ATV Guide	EU5a	Air	Chromium(VI)	--	All non-detect
ATV Guide	EU5a	Air	Cobalt	--	Samples were not analyzed for this chemical.
ATV Guide	EU5a	Air	Copper	--	All non-detect
ATV Guide	EU5a	Air	Iron	0.0146	Average concentration for following rider air.
ATV Guide	EU5a	Air	Lead	--	All non-detect
ATV Guide	EU5a	Air	Manganese	0.00076	Average concentration for following rider air.
ATV Guide	EU5a	Air	Nickel	0.000080	Average concentration for following rider air.
ATV Guide	EU5a	Air	Selenium	--	All non-detect
ATV Guide	EU5a	Air	Silver	--	All non-detect
ATV Guide	EU5a	Air	Sodium	0.014	Average concentration for following rider air.
ATV Guide	EU5a	Air	Strontium	--	Samples were not analyzed for this chemical.
ATV Guide	EU5a	Air	Thallium	--	Samples were not analyzed for this chemical.
ATV Guide	EU5a	Air	Zinc	0.00021	Average concentration for following rider air.

Units:
Surface Water = mg/L
Soil = mg/kg
Sediment = mg/kg
Fish = mg/kg
Air = µg/m^3

mg = milligram
µg = microgram
kg = kilogram
L = liter
m = meter

TABLE 4-11

***IN VITRO* BIOACCESSIBILTY OF ARSENIC IN SITE SOIL SAMPLES**

Bonita Peak Mining District

Sample Type	Sample Number	Soil Arsenic Concentration (mg/kg)	IVBA (as fraction)	RBA* (as fraction)
Campgrounds	A8M5-5872	17	0	0.03
	A8M5-5873	114	0	0.03
	A8M5-5874	81	0.04	0.06
	A8M5-5875	60	0.13	0.14
			Average	***0.07***
Roadway	MH1F62	22	0.11	0.11
	MH1F63	36	0.07	0.08
	MH1F64	74	0.09	0.10
	MH1F65	285	0.08	0.09
	MH1F66	66	0	0.03
	MH1F67	168	0.02	0.04
			Average	***0.08***
Waste Rock	MH1F68	151	0	0.04
	MH1F69	10	0	0.03
	MH1F70	10	0	0.03
	MH1F71	137	0.06	0.07
	MH1F72	31	0	0.03
	MH1F73	235	0.03	0.05
	MH1F74	77	0.01	0.04
	MH1F75	80	0.01	0.04
	MH1F76	102	0.05	0.07
	MH1F77	139	0.01	0.04
	MH1F78	171	0	0.03
	MH1F79	184	0.02	0.05
	MH1F80	3,338	0.05	0.07
	MH1F81	18,320	0.05	0.07
	MH1F82	1,647	0.07	0.08
	MH1F83	107	0.03	0.06
	MH1F84	111	0.03	0.06
	MH1F85	326	0.06	0.08
			Average RBA (%)	***0.05***

* RBA(%) = 0.79 x IVBA(%) + 3.0

Average across all media	***0.06***

Notes:

IVBA = *in vitro* bioaccessibility

mg/kg = milligrams per kilogram

RBA = relative bioavailability (*in vivo*)

TABLE 4-12
TOXICITY VALUES
Bonita Peak Mining District

Analyte[1]	Oral Exposure						Inhalation Exposure						GI_{ABS}
	Non Cancer			Cancer			Non Cancer			Cancer			
	RfD (mg/kg day)	Key	Target Organ	SF (mg/kg day)$^{-1}$	Key	Cancer WOE	RfC (mg/m^3)	Key	Target Organ	IUR (µg/m^3)$^{-1}$	Key	Cancer WOE	
Aluminum	1	P	Neurological				0.005	P	Neurological				1
Antimony	0.0004	I	Longevity/Blood										0.15
Arsenic	0.0003	I	Skin	1.5	I	A	0.000015	C	Developmental/ Cardiovascular System/CNS/Lung/Skin	0.0043	I	A	1
Barium	0.2	I	Kidney				0.0005	H	Fetus				0.07
Beryllium	0.002	I	Intestine				0.00002	I	Lung	0.0024	I	A	0.007
Cadmium (Diet)	0.001	I	Kidney				0.00001	A	Kidney	0.0018	I	A	0.025
Cadmium (Water)	0.0005	I	Kidney				0.00001	A	Kidney	0.0018	I	A	0.05
Chromium (III)	1.5	I	GI Tract										0.013
Chromium (VI)[4]	0.003	I	GI Tract	0.5	C	NA	0.0001	I	Lung	0.084	S	A[5]	0.025
Cobalt	0.0003	P	Thyroid				0.000006	P	Respiratory System/ Lung	0.009	P	NA	1
Copper	0.04	H	GI Tract										1
Iron	0.7	P	GI Tract										1
Manganese (Non-Diet)	0.047	I[3]	CNS				0.00005	I	CNS				0.04
Manganese (Diet)	0.14	I	CNS				0.00005	I	CNS				1
Mercury	0.0003	I	Immune System				0.0003	I, S	Nervous System				0.07
Molybdenum	0.005	I	Urinary System										1
Nickel	0.02	I	Body and Organ Weight				0.00009	A	Respiratory System	0.00026	C	NA	0.04
Selenium	0.005	I	Nervous System/ Blood/Skin				0.02	C	Liver/Cardiovascular System/Nervous System				1
Silver	0.005	I	Skin										0.04
Strontium	0.6	I	Musculoskeletal										1
Thallium	0.00001	X	Skin/Hair										1
Vanadium	0.005	A, S	Kidney				0.0001	A	Respiratory System				0.026
Zinc	0.3	I	Blood/Immune										1

Source: EPA RSL table, November 2018 (EPA 2018b)

Notes:

[1] Lead is not included in this summary because it is evaluated in a different manner (see Section 5).

[2] RfD/RfC values and target organs for hydrogen cyanide and cyanide salts have been used as surrogate values for cyanide.

[3] The RfD for manganese in soil and water (4.7E-02 mg/kg-day) is based on the oral RfD of 1.4E-01 mg/kg-day in the diet. In accordance with recommendations in IRIS, for application to exposures from soil or water, the RfD was adjusted by dividing by a modifying factor of 3.

[4] Chromium has a mutagenic mode of action (see Section 4.2.1.2).

[5] IRIS IUR adjusted based on an assumed Cr(VI) to Cr(III) ratio of 1:6 (i.e., multiplied by 7).

Key Sources:

A = ATSDR
C = California EPA
H = HEAST
I = IRIS
P = PPRTV
S = see RSL User Guide, Section 5
X = PPRTV Appendix

Links to toxicity value databases:

IRIS http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList
EPA RSLs https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017
PPRTV https://hhpprtv.ornl.gov/
HEAST nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=200172JM.TXT
ATSDR https://www.atsdr.cdc.gov/toxprofiles/index.asp
CalEPA https://oehha.ca.gov/chemicals

(µg/m^3)$^{-1}$ = (risk) per micrograms per cubic meter of air
(mg/kg-day)$^{-1}$ = (risk) per milligrams per kilograms of body weight per day
CNS = central nervous system
EPA = U.S. Environmental Protection Agency
GI = gastrointestinal
GI_{ABS} = fraction of contaminant absorbed in gastrointestinal tract
IUR = inhalation unit risk
mg/kg-day = milligrams per kilograms of body weight per day
mg/m^3 = milligrams per cubic meter of air
NA = not available
RfC = reference concentration
RfD = reference dose
RSL = Regional Screening Level
SF = oral slope factor
WOE = weight of evidence

TABLE 4-13
SUMMARY OF ESTIMATED REASONABLE MAXIMUM EXPOSURE RISKS FOR NON-LEAD COPCs
Bonita Peak Mining District

Exposed Population	Exposed Location	Exposure Medium	Exposure Route and Pathway	Non Cancer HI	Excess Cancer Risk
ATV Guide	EU5a	Roadway Soil	Soil Inhalation	3E-01	0E+00
		Roadway Soil	Incidental Soil Ingestion	3E-02	2E-07
		Total		3E-01	2E-07
ATV Rider	EU5b	Roadway Soil	Soil Inhalation	9E-01	1E-06
		Roadway Soil	Incidental Soil Ingestion	1E-01	5E-07
		Total		1E+00	2E-06
Hiker	EU1	Overbank/WR	Incidental Soil Ingestion	2E-01	6E-06
	EU2	Overbank/WR	Incidental Soil Ingestion	1E-01	3E-06
	EU3	Overbank/WR	Incidental Soil Ingestion	8E-02	3E-06
	EU4	Overbank/WR	Incidental Soil Ingestion	1E-01	1E-05
Camper - USFS Campground	EU6	SW	Incidental SW Ingestion	9E-03	NC
		GW	Ingestion of GW (as drinking water)	2E-04	1E-07
		Sediment	Incidental Sed Ingestion	4E-02	6E-08
		Campground Soil	Incidental Soil Ingestion	5E-02	1E-07
		Total		1E-01	3E-07
Camper - Dispersed	EU7	SW	Incidental SW Ingestion	4E-03	9E-09
		SW	Ingestion of SW (as drinking water)	9E-01	2E-06
		Sediment	Incidental Sed Ingestion	1E-01	1E-07
		Campground Soil	Incidental Soil Ingestion	2E-01	5E-07
		Total		1E+00	3E-06
Fisherman	EU8	SW	Incidental SW Ingestion	3E-03	2E-08
		Sediment	Incidental Sed Ingestion	8E-02	1E-06
		Fish Tissue	Fish Ingestion	3E-01	3E-05
		Total		4E-01	3E-05
	EU9	SW	Incidental SW Ingestion	6E-03	3E-09
		Sediment	Incidental Sed Ingestion	7E-01	3E-07
		Fish Tissue	Fish Ingestion	5E-02	5E-06
		Total		8E-01	6E-06
Hunter	EU1	Grouse Tissue	Ingestion of Grouse	1E-02	3E-06
		Deer Tissue	Ingestion of Deer	2E-01	2E-05
		Overbank/WR	Incidental Soil Ingestion	5E-02	2E-06
		Total		3E-01	3E-05
	EU2	Grouse Tissue	Ingestion of Grouse	1E-02	3E-06
		Deer Tissue	Ingestion of Deer	2E-01	2E-05
		Overbank/WR	Incidental Soil Ingestion	5E-02	9E-07
		Total		3E-01	3E-05
	EU3	Grouse Tissue	Ingestion of Grouse	1E-02	3E-06
		Deer Tissue	Ingestion of Deer	2E-01	2E-05
		Overbank/WR	Incidental Soil Ingestion	3E-02	1E-06
		Total		3E-01	3E-05
	EU4	Grouse Tissue	Ingestion of Grouse	1E-02	3E-06
		Deer Tissue	Ingestion of Deer	2E-01	2E-05
		Overbank/WR	Incidental Soil Ingestion	4E-02	4E-06
		Total		3E-01	3E-05

TABLE 4-13

SUMMARY OF ESTIMATED REASONABLE MAXIMUM EXPOSURE RISKS FOR NON-LEAD COPCs

Bonita Peak Mining District

Exposed Population	Exposed Location	Exposure Medium	Exposure Route and Pathway	Non Cancer HI	Excess Cancer Risk
Road Worker	EU1	Roadway Air	Soil Inhalation	4E-01	3E-05
		Roadway Soil	Incidental Soil Ingestion	6E-01	2E-06
		Total		1E+00	3E-05
	EU2	Roadway Air	Soil Inhalation	4E-01	3E-05
		Roadway Soil	Incidental Soil Ingestion	2E-01	7E-07
		Total		6E-01	3E-05
	EU3	Roadway Air	Soil Inhalation	9E-01	3E-05
		Roadway Soil	Incidental Soil Ingestion	3E-01	4E-07
		Total		1E+00	3E-05
	EU4	Roadway Air	Soil Inhalation	1E-01	3E-05
		Roadway Soil	Incidental Soil Ingestion	1E+00	4E-07
		Total		1E+00	3E-05

Notes:

NC = all carcinogenic COPCs in surface water were non-detect

COPC = chemical of potential concern
EU = exposure unit
GW = groundwater
Mn = manganese
NC = non calculated
RME = reasonable maximum exposure
Sed = sediment
SW = surface water
Tl = thallium
WR = waste rock

TABLE 4-14
COMPARISON OF RME EXPOSURE PARAMETERS FOR CAMPERS, HUNTERS, AND HIKERS
Bonita Peak Mining District

Exposure Pathway	Exposure Input Parameter	Units	Camper		Hunter			Hiker		
			Value	Source	Value	Source	Ratio	Value	Source	Ratio
General	Body weight (older child)	kg	44	[3, a]	44	[3, a]		44	[3, a]	
	Body weight (adult)	kg	80	[4]	80	[4]		80	[4]	
	Exposure frequency	days/yr	56	[5, b]	20	[5, b]		64	[5, b]	
	Exposure duration (older child)	yr	10	[4, g]	10	[4, g]		10	[4, g]	
	Exposure duration (adult)	yr	10	[4, g]	10	[4, g]		10	[4, g]	
	Averaging Time, Cancer	yr	70	[2]	70	[2]		70	[2]	
	Averaging Time, Noncancer	yr	20	[2]	20	[2]		20	[2]	
Incidental Ingestion of Sediment	Ingestion rate	mg/day	100	[5]	50	[5]		50	[5]	
	Conversion factor	kg/mg	1E-06		1E-06			1E-06		
	HIF (noncancer)	**kg/kg-d**	**2.7E-07**		**4.8E-08**		**0.2**	**1.5E-07**		**0.6**
	HIF (cancer)	**kg/kg-d**	**7.7E-08**		**1.4E-08**			**4.4E-08**		
Incidental Ingestion of Surface Water	Ingestion rate	mL/hr	7.1	[3, e]	7.1	[3, e]		7.1	[3, e]	
	Exposure time	hr/d	1.5	[5]	0.75	[5]		0.75	[5]	
	Conversion factor	L/mL	1E-03		1E-03			1E-03		
	HIF (noncancer)	**L/kg-d**	**2.9E-05**		**5.1E-06**		**0.2**	**1.6E-05**		**0.6**
	HIF (cancer)	**L/kg-d**	**8.2E-06**		**1.5E-06**			**4.7E-06**		

Values that differ between the receptors are shaded grey.
Ratios are based on a comparison of the hunter to the camper and the hiker to the camper.

Sources:

[1] USEPA 1991. Standard Default Exposure Factors. OSWER Directive 9285.6-03.
[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.
[3] USEPA 2011. Exposure Factors Handbook.
[4] USEPA 2014. OSWER Directive 9200.1-120. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Parameters.
[5] Professional judgement
[6] USEPA 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
[7] U.S.F.S. Guidelines for the San Juan National Forest.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.
[b] Assumes exposure occurs over the course of four months (roughly Memorial Day to Labor Day) at a frequency of 14 days/month for an RME camper. Assumes exposure occurs over the course of 16 weeks (roughly Memorial Day to Labor Day) at a frequency of 4 days/week for the hiker. Value is an assumed value for the hunter.
[c] Assumes CTE value is half of the RME value.
[d] Assumes RME soil ingestion by a camper is twice that of a resident.
[e] Incidental ingestion from splashing or hand-to-face contact during wading assumed to be 10% of USEPA (1989) recommended default incidentally ingested during swimming.
[f] Table 3-5, USEPA 2011.
[g] An older child is assumed to be between 6 and 16 years old, an adult is assumed to be 16 years and older.

HIF = human intake factor
RME = reasonable maximum exposure
kg = kilogram
yr = year
mg = milligram
d = day
mL = milliliter
hr = hour
L = liter

TABLE 4-15
DETECTION LIMIT ADEQUACY EVALUATION FOR NON-DETECT CHEMICALS - EVALUATION OF RISK
Bonita Peak Mining District

Ingestion of Groundwater as Drinking Water (Camper USFS EU6)

Chemical of Potential Concern	Cwater (mg/L)	RBA (unitless)	Non Cancer Hazard							Cancer Risk						
			HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d) [1]	Risk
			Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Arsenic	3.75E-02	1.0	1.69E-03	6.39E-04	6.3E-05	2.4E-05	8.7E-05	3.00E-04	2E-01	4.83E-04	1.83E-05	1.8E-05	6.8E-07	1.9E-05	1.50E+00	3E-05

Notes:
All concentration inputs are based on one-half the average method detection limit.

-- = not calculated
Cwater = water concentration
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
L = liter
m = meter
mg = milligram
NA = not available
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor

TABLE 4-16
DETECTION LIMIT ADEQUACY EVALUATION FOR NON-DETECT COPCS - EVALUATION OF RISK
Bonita Peak Mining District

Panel A. Inhalation Caused by Human Disturbance (ATV Guide EU5a)

Chemical of Potential Concern	Cair (mg/m^3)	RBA (unitless)	Non Cancer Hazard				Cancer Risk			
			TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Arsenic	9.50E-04	1.0	1.97E-02	1.87E-05	1.50E-05	1E+00	5.64E-03	5.4E-03	4.30E-03	2E-05
Cadmium	2.88E-05	1.0	1.97E-02	5.68E-07	1.00E-05	6E-02	5.64E-03	1.6E-04	1.80E-03	3E-07
Chromium(III)	4.30E-04	1.0	1.97E-02	8.49E-06	NA	--	5.64E-03	2.4E-03	NA	--
Chromium(VI)	4.78E-05	1.0	1.97E-02	9.43E-07	1.00E-04	9E-03	5.64E-03	2.7E-04	8.40E-02	2E-05

Panel B. Incidental Ingestion of Surface Water (Camper USFS EU6)

Chemical of Potential Concern	Cwater (mg/L)	RBA (unitless)	Non Cancer Hazard							Cancer Risk						
			HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d) [1]	Risk
			Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Antimony	1.07E+00	1.0	7.20E-06	3.13E-06	7.7E-06	3.4E-06	1.1E-05	4.00E-04	2E-02	2.06E-06	8.95E-08	2.2E-06	9.6E-08	2.3E-06	NA	--
Beryllium	8.60E-01	1.0	7.20E-06	3.13E-06	6.2E-06	2.7E-06	8.9E-06	2.00E-03	3E-03	2.06E-06	8.95E-08	1.8E-06	7.7E-08	1.8E-06	NA	--
Chromium(III)	1.93E+00	1.0	7.20E-06	3.13E-06	1.4E-05	6.0E-06	2.0E-05	1.50E+00	9E-06	2.06E-06	8.95E-08	4.0E-06	1.7E-07	4.1E-06	NA	--
Chromium(VI)	2.15E-01	1.0	7.20E-06	3.13E-06	1.5E-06	6.7E-07	2.2E-06	3.00E-03	5E-04	2.06E-06	8.95E-08	4.4E-07	1.9E-08	4.6E-07	5.00E-01	#REF!
Copper	1.08E+00	1.0	7.20E-06	3.13E-06	7.7E-06	3.4E-06	1.1E-05	4.00E-02	2E-04	2.06E-06	8.95E-08	2.2E-06	9.6E-08	2.3E-06	NA	--

Panel C. Incidental Ingestion of Sediment (Camper USFS EU6)

Chemical of Potential Concern	Csediment (mg/kg)	RBA (unitless)	Non Cancer Hazard							Cancer Risk						
			HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d) [1]	Risk
			Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Thallium	6.88E-02	1.0	6.76E-08	6.39E-08	4.6E-09	4.4E-09	9.0E-09	1.00E-05	5E-04	1.93E-08	1.83E-09	1.3E-09	1.3E-10	1.5E-09	NA	--

Panel D. Incidental Ingestion of Surface Water (Fisherman EU8)

Chemical of Potential Concern	Cwater (mg/L)	RBA (unitless)	RME Non Cancer Risk				RME Cancer Risk			
			HIFNC (L/kg d)	DI (L/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)	DI (L/kg d)	Oral SF (mg/kg d) [1]	Risk
Antimony	1.04E+00	1.0	2.06E-05	2.1E-05	4.00E-04	5E-02	5.87E-06	6.1E-06	NA	--

Panel E. Fish Ingestion (Fisherman EU8)

Chemical of Potential Concern	Cfish (mg/kg)	RBA (unitless)	RME Non Cancer Risk				RME Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Aluminum	1.11E+00	1.0	1.45E-04	1.6E-04	1.00E+00	2E-04	4.15E-05	4.6E-05	NA	--
Antimony	2.78E-02	1.0	1.45E-04	4.0E-06	4.00E-04	1E-02	4.15E-05	1.2E-06	NA	--
Beryllium	5.56E-02	1.0	1.45E-04	8.1E-06	2.00E-03	4E-03	4.15E-05	2.3E-06	NA	--
Iron	5.57E+00	1.0	1.45E-04	8.1E-04	7.00E-01	1E-03	4.15E-05	2.3E-04	NA	--
Manganese	1.11E-01	1.0	1.45E-04	1.6E-05	1.40E-01	1E-04	4.15E-05	4.6E-06	NA	--
Thallium	5.57E-02	1.0	1.45E-04	8.1E-06	1.00E-05	8E-01	4.15E-05	2.3E-06	NA	--

Panel F. Fish Ingestion (Fisherman EU9)

Chemical of Potential Concern	Cfish (mg/kg)	RBA (unitless)	RME Non Cancer Risk				RME Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Aluminum	9.92E-01	1.0	1.45E-04	1.4E-04	1.00E+00	1E-04	4.15E-05	4.1E-05	NA	--
Antimony	2.48E-02	1.0	1.45E-04	3.6E-06	4.00E-04	9E-03	4.15E-05	1.0E-06	NA	--
Arsenic	2.48E-02	1.0	1.45E-04	3.6E-06	3.00E-04	1E-02	4.15E-05	1.0E-06	1.50E+00	2E-06
Beryllium	4.94E-02	1.0	1.45E-04	7.2E-06	2.00E-03	4E-03	4.15E-05	2.1E-06	NA	--
Iron	4.96E+00	1.0	1.45E-04	7.2E-04	7.00E-01	1E-03	4.15E-05	2.1E-04	NA	--
Thallium	4.96E-02	1.0	1.45E-04	7.2E-06	1.00E-05	7E-01	4.15E-05	2.1E-06	NA	--

Panel G. Game Ingestion (Hunter) - Grouse

Chemical of Potential Concern	Ctissue (mg/kg)	RBA (unitless)	RME Non Cancer Risk				RME Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	3.46E-02	1.0	1.37E-04	4.7E-06	4.00E-04	1E-02	3.91E-05	1.4E-06	NA	--
Arsenic	3.46E-02	1.0	1.37E-04	4.7E-06	3.00E-04	2E-02	3.91E-05	1.4E-06	1.50E+00	2E-06
Cobalt	6.91E-03	1.0	1.37E-04	9.5E-07	3.00E-04	3E-03	3.91E-05	2.7E-07	NA	--
Iron	6.91E+00	1.0	1.37E-04	9.5E-04	7.00E-01	1E-03	3.91E-05	2.7E-04	NA	--
Manganese	1.39E-01	1.0	1.37E-04	1.9E-05	2.40E-02	8E-04	3.91E-05	5.4E-06	NA	--
Mercury	6.30E-03	1.0	1.37E-04	8.6E-07	3.00E-04	3E-03	3.91E-05	2.5E-07	NA	--
Thallium	6.91E-02	1.0	1.37E-04	9.5E-06	1.00E-05	9E-01	3.91E-05	2.7E-06	NA	--

TABLE 4-16
DETECTION LIMIT ADEQUACY EVALUATION FOR NON-DETECT COPCS - EVALUATION OF RISK
Bonita Peak Mining District

Panel H. Game Ingestion (Hunter) - Deer

Chemical of Potential Concern	Ctissue (mg/kg)	RBA (unitless)	RME Non Cancer Risk				RME Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	3.24E-02	1.0	1.10E-03	3.5E-05	4.00E-04	9E-02	3.13E-04	1.0E-05	NA	--
Arsenic	3.24E-02	1.0	1.10E-03	3.5E-05	3.00E-04	1E-01	3.13E-04	1.0E-05	1.50E+00	2E-05
Cadmium	6.48E-03	1.0	1.10E-03	7.1E-06	1.00E-03	7E-03	3.13E-04	2.0E-06	NA	--
Cobalt	6.48E-03	1.0	1.10E-03	7.1E-06	3.00E-04	2E-02	3.13E-04	2.0E-06	NA	--
Mercury	8.08E-03	1.0	1.10E-03	8.8E-06	3.00E-04	3E-02	3.13E-04	2.5E-06	NA	--
Thallium	6.48E-02	1.0	1.10E-03	7.1E-05	1.00E-05	7E+00	3.13E-04	2.0E-05	NA	--

Panel I. Inhalation Caused by Human Disturbance (Road Worker)

Chemical of Potential Concern	Cair (mg/m^3)	RBA (unitless)	Non Cancer Hazard				Cancer Risk			
			TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC $(\mu g/m^3)$	iUR $(\mu g/m^3)^{-1}$	Risk
Arsenic	4.71E-03	1.0	9.13E-02	4.30E-04	1.50E-05	3E+01	1.30E-02	6.1E-02	4.30E-03	3E-04

Notes:

All concentration inputs are based on one-half the average method detection limit.
Shaded values indicate risks are above EPA guidelines.
The toxicity values for chromium were assumed to be a 6:1 ratio of trivalent and hexavalent chromium.

-- = not calculated
Csed = sediment concentration
Cwater = water concentration
d = day
DI = dietary intake
EU = exposure unit
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
L = liter
m = meter
mg = milligram
NA = not available
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor

TABLE 4-17
COMPARISON OF SOIL SAMPLES SIEVED TO 2 mm AND 250 µm
Bonita Peak Mining District

Chemical	R^2	Ratio 2 mm:250 µm				
		Campground	Roadway	Waste Rock	All	Campground & Roadway
Aluminum	0.97	0.93	0.91	0.81	0.88	0.93
Antimony	0.87	0.86	0.86	1.00	0.90	0.82
Arsenic	1.0	0.79	0.77	0.77	0.77	0.78
Barium	0.93	0.90	0.78	0.80	0.81	0.83
Beryllium	0.19	0.91	0.88	1.77	1.17	0.88
Cadmium	0.97	0.89	0.70	1.32	0.92	0.75
Calcium	0.87	1.06	0.98	0.98	0.99	1.01
Chromium	0.63	0.82	0.80	0.77	0.80	0.80
Cobalt	0.86	0.92	0.88	0.99	0.92	0.90
Copper	0.96	0.89	0.74	0.81	0.78	0.76
Iron	0.99	0.87	0.90	0.75	0.85	0.91
Lead	0.98	0.86	0.80	0.77	0.80	0.77
Magnesium	0.95	1.04	1.06	0.94	1.02	1.08
Manganese	0.91	0.98	0.88	1.35	1.05	0.92
Mercury	0.81	0.99	0.96	0.70	0.88	0.97
Molybdenum	0.91	0.87	0.79	0.85	0.82	0.81
Nickel	0.74	0.91	0.87	0.78	0.85	0.88
Selenium	0.95	0.97	0.86	0.84	0.87	0.87
Silver	0.91	0.82	0.66	0.92	0.77	0.67
Thallium	0.98	0.85	0.82	0.92	0.85	0.81
Vanadium	0.86	0.91	0.87	0.87	0.87	0.88
Zinc	0.98	0.83	0.88	0.81	0.85	0.88

Notes:
& = and
µm = micron
mm = millimeter

TABLE 5-1
IEUBK INPUT PARAMETERS
Bonita Peak Mining District

Panel A. Age-Independent Values

Parameter	Value	Basis
Soil concentration (mg/kg)	EU-specific[a]	Mean of measured surface soil samples for EU. Background is set equal to 100 mg/kg (upland reference mean concentration).
Indoor dust concentration (mg/kg)	Cdust = 0.7*Csoil	EPA Region 8 Lead Strategy (EPA 2017)
Drinking water concentration (µg/L)	EU-specific[a]	Mean of measured surface water samples for EU. Background is set equal to 0.9 µg/L.[b]
Outdoor air concentration (µg/m^3)	0.1	IEUBK default (EPA 1994)
Indoor air concentration (µg/m^3)	30% of outdoors	IEUBK default (EPA 1994)
AF(water)	0.50	IEUBK default (EPA 1994)
AF(diet)	0.50	IEUBK default (EPA 1994)
RBA	0.54	Site-specific average campgrounds
AF(soil,dust)	0.27	AF(soil) = AF(water) x RBA
AF(air)	0.32	IEUBK default (EPA 1994)
Fraction of soil + dust that is soil	0.45	IEUBK default (EPA 1994)
GSD	1.6	IEUBK default (EPA 1994)
Maternal blood lead concentration (µg/dL)	0.6	EPA Region 8 Lead Strategy (EPA 2017f)

Panel B. Age-Dependent Values[b]

	Air		Diet	Water	Residential Soil and Dust
Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Dietary Intake (µg lead/day)	Water Intake (L/day)	Total Intake (g/day)
0-1	1.0	3.22	2.66	0.4	0.086
1-2	2.0	4.97	5.03	0.43	0.094
2-3	3.0	6.09	5.21	0.51	0.067
3-4	4.0	6.95	5.58	0.54	0.063
4-5	4.0	7.68	5.64	0.57	0.067
5-6	4.0	8.32	6.04	0.6	0.052
6-7	4.0	8.89	5.95	0.63	0.055

Notes:
[a] C(adjusted) = C(site) · (EF/365) + C(background) · (365-EF)/365
[b] Values are based on EPA Region 8 Lead Strategy (EPA 2017).
[c] Values are based on the average of the geomean intake rates for boys and girls as reported in Child-Specific Exposure Factors Table 5-6. The geomean value for age 5-6 years old was assumed to be equal to the geomean for ages 4-5 years old.

µg/day = micrograms per day
µg/dL = micrograms per deciliter
µg/m^3 = micrograms per cubic meter
AF = absorption fraction
Cdust = dust concentration
Csoil = soil concentration
EU = exposure unit
IEUBK = Integrated Exposure Uptake Biokinetic
L/day = liter per day
m^3/day = cubic meter/day
mg/day = milligram per day
mg/kg = milligram per kilogram
NA = not available
RBA = relative bioavailability

TABLE 5-2
***IN VITRO* BIOACCESSIBILTY OF LEAD IN SITE SOIL SAMPLES**
Bonita Peak Mining District

Sample Type	Sample Number	Lead Concentration (mg/kg)	IVBA (as fraction)	RBA* (as fraction)
Campground	A8M5-5872	3,273	0.55	0.45
	A8M5-5873	17,450	0.45	0.37
	A8M5-5874	61,037	0.71	0.59
	A8M5-5875	10,416	0.89	0.75
			Average	***0.54***
Roadway	MH1F62	71	0.40	0.32
	MH1F63	6,016	0.61	0.51
	MH1F64	1,896	0.23	0.18
	MH1F65	10,112	0.013	0
	MH1F66	151	0.10	0.06
	MH1F67	7,396	0.17	0.12
			Average	***0.20***
Waste Rock	MH1F68	13,283	0.051	0.02
	MH1F69	6,874	0.31	0.24
	MH1F70	6,537	0.30	0.23
	MH1F71	26,608	0.62	0.51
	MH1F72	1,976	0.19	0.14
	MH1F73	17,214	0.34	0.27
	MH1F74	10,947	0.086	0.05
	MH1F75	22,985	0.58	0.48
	MH1F76	5,904	0.61	0.51
	MH1F77	1,875	0.15	0.10
	MH1F78	3,633	0.093	0.05
	MH1F79	6,672	0.41	0.33
	MH1F80	4,401	0.15	0.11
	MH1F81	1,980	0.05	0.02
	MH1F82	7,278	0.09	0.05
	MH1F83	26,082	0.58	0.48
	MH1F84	27,946	0.62	0.51
	MH1F85	7,338	0.030	0
			Average	***0.23***

*RBA = 0.878 x IVBA - 0.028

Average across all media	***0.27***

Notes:
IVBA = *In vitro* bioaccessibility
mg/kg = milligrams per kilogram
RBA = Relative bioavailability (*in vivo*)

TABLE 5-3
ADULT LEAD MODEL INPUT PARAMETERS
Bonita Peak Mining District

Basic Equations
PbB(mother) = PbB0 + BKSF*∑[Csitemedia*IRsitemedia*AFsitemedia*EF/365]
PbB(fetus) = PbB(mother) * Ratio

Parameter	Units	ATV Guide	ATV Rider	Camper (Dispersed)	Hiker				Fisherman		Hunter				Road Worker				Source	Notes
		EU5a	EU5b	EU7	EU1	EU2	EU3	EU4	EU8	EU9	EU1	EU2	EU3	EU4	EU1	EU2	EU3	EU4		
PbB0	µg/dL	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	NHANES 2009-2014	
BKSF	µg/dL per µg/day	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	USEPA 2003a	USEPA default recommendation
Ratio	µg/dL per µg/dL	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	USEPA 2003a	USEPA default recommendation
GSD	--	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	NHANES 2009-2014	
Soil Concentration	µg/g	337	1769	386	2607	2747	1616	1408			2607	2747	1616	1408	1724	2504	167	489	Site-specific	Mean, adjusted for fine/bulk fraction
Soil Ingestion Rate	g/day	0.100	0.100	0.100	0.050	0.050	0.050	0.050							0.165	0.165	0.165	0.165	Professional judgment	CTE exposure parameter
AF Soil	--	0.040	0.040	0.108	0.102	0.102	0.102	0.102			0.102	0.102	0.102	0.102	0.040	0.040	0.040	0.040	ALM Guidance (2003)	0.2 (default) * (site-specific RBA)
PEF	g/m^3		5.60E-04																Appendix C	
Riding time factor	unitless	0.5	0.5																Survey local guides/professional judgment	
Area Use factor	unitless	0.4	1																Survey local guides	
Breathing Rate	m^3/hr	2.4	2.4												2.4	2.4	2.4	2.4	USEPA 1997	Mean breathing rate for moderate and heavy activities
Cair	$µg/m^3$	4.87E-01	estimated												2E-02	2E-02	7E-02	5E-03	Measured (Road Worker, ATV Guide); Estimated (ATV	Mean for following rider
Exposure Time	hrs/day	4	4												6	6	6	6	Professional judgment	
AF Air	--	0.32	0.32												0.32	0.32	0.32	0.32	IEUBK default	
Csediment	µg/g			907					716	2152									Site-specific	Mean
IRsediment	g/day			0.100					0.050	0.050									Professional judgment	CTE exposure parameter
AF Sediment	--			0.108					0.108	0.108									ALM Guidance (2003)	0.2 (default) * 0.22 (site-specific RBA)
Cwater	µg/L			9.6					34	6.3									Site-specific	Mean
IR (drinking water)	L/day			1.4															Professional judgment	CTE exposure parameter
IR (incidental)	L/day			0.0021					0.0021	0.0021									Professional judgment	CTE exposure parameter
AF Water	--			0.20					0.20	0.20									ALM Guidance (2003)	
Cfish tissue	µg/g								0.037	0.022									Site-specific	Mean
IR Fish	g/day								1.2	1.2									Professional judgment	ingestion rate * fraction site
EF	days/year								350	350										
AF Fish	--								0.20	0.20									ALM Guidance (2003)	
Cdeer tissue	µg/g										0.012	0.012	0.012	0.012					Site-specific	Mean
IR Deer Tissue	g/day										16	16	16	16					Professional judgment	CTE exposure parameter
EF	days/year										350	350	350	350						
AF Deer Tissue	--										0.20	0.20	0.20	0.20					ALM Guidance (2003)	
Cgrouse tissue	µg/g										0.077	0.077	0.077	0.077					Site-specific	Mean
IR Grouse Tissue	g/day										8	8	8	8					Professional judgment	CTE exposure parameter
EF	days/year										350	350	350	350						
AF Grouse Tissue	--										0.20	0.20	0.20	0.20					ALM Guidance (2003)	
Exposure Frequency (all pathways, but fish/deer/grouse ingestion)	days/year	32	16	14	32	32	32	32	30	30	10	10	10	10	100	100	100	100	Professional judgment	CTE exposure parameter

Notes:
Cells shaded grey indicate the pathway is incomplete for the receptor.

µg = microgram
AF = absorption fraction
ATV = all terrain vehicle
BKSF = biokinetic slope factor
C = concentration
CTE = central tendency exposure
dL = deciliter
EF = exposure frequency
EU = exposure unit
g = gram
GSD = geometric standard deviation
hr = hour
IEUBK = Integrated Exposure Uptake Biokinetic Model
IR = ingestion rate
L = liter
m^3 = cubic meter
NHANES = National Health and Nutrition Examination Survey
PbB = blood lead level
PbB0 = baseline blood lead level
PEF = particulate emission factor
RBA = relative bioavailability
USEPA = United States Environmental Protection Agency

TABLE 5-4
EVALUATION OF RISK FROM LEAD USING THE IEUBK MODEL
Bonita Peak Mining District

EU/Receptor		Adjusted [a,b] Soil Conc (mg/kg)	Adjusted [a] Water Conc (µg/L)	Probability Distribution (% Above Target Blood Lead)		
				Target Blood Lead 5 µg/dL	Target Blood Lead 8 µg/dL	Target Blood Lead 10 µg/dL
EU6	Camper - Campground	103	0.88	1	0.05	0.008
EU7	Camper - Dispersed	418	1.2	22	4	1

[a] C(adjusted) = C(site) · (EF/365) + C(background) · (365-EF)/365
[b] bulk soil concentration was adjusted based on the bulk/fine regression

C = concentration
EF = exposure frequency
IEUBK = Integrated Exposure Uptake Biokinetic
µg/dL = micrograms per deciliter
µg/L = micrograms per liter
mg/kg = milligram per kilogram
% = percent

greater than 5%

TABLE 5-5
EVALUATION OF RISK FROM LEAD USING THE ADULT LEAD MODEL
Bonita Peak Mining District

Panel A. Recreational Receptors

Parameter	ATV Guide	ATV Rider	Camper (Dispersed)	Hiker				Fisherman		Hunter			
	EU5a	EU5b	EU7	EU1	EU2	EU3	EU4	EU8	EU9	EU1	EU2	EU3	EU4
GM PbB(mother) (µg/dL)	0.66	0.75	0.9	1.07	1.09	0.89	0.85	0.73	0.98	0.7	0.7	0.7	0.7
mu	-0.419	-0.287	-0.16	0.063	0.09	-0.12	-0.16	-0.31	-0.016	-0.4	-0.4	-0.4	-0.4
sigma	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
P10 (fetus)	0.00008%	0.0002%	0.0006%	0.003%	0.004%	0.0009%	0.0006%	0.0002%	0.002%	0.00008%	0.00008%	0.00008%	0.00008%
P8 (fetus)	0.0005%	0.001%	0.003%	0.02%	0.02%	0.004%	0.003%	0.001%	0.009%	0.0005%	0.0005%	0.0005%	0.0005%
P5 (fetus)	0.01%	0.03%	0.07%	0.2%	0.3%	0.09%	0.1%	0.03%	0.2%	0.01%	0.01%	0.01%	0.01%

Panel B. Occupational Receptors

Parameter	Road Worker				
	EU1	EU2	EU3	EU4	All [a]
GM PbB(mother) (µg/dL)	1.86	2.42	0.76	0.96	
mu	0.62	0.88	-0.277	-0.05	
sigma	0.59	0.59	0.59	0.59	
P10 (fetus)	0.1%	0.5%	0.0002%	0.002%	0.1%
P8 (fetus)	0.4%	1%	0.001%	0.01%	0.4%
P5 (fetus)	3%	8%	0.04%	0.1%	3%

[a] = Area-weighted values are based on an assumed approximate road length (in miles) of 6 for EU1, 7 for EU2, 8 for EU3, 7.5 for EU4.

µg/dL = micrograms per deciliter
EU = exposure unit
GM = geometric mean
PbB = blood lead level
TWA = time-weighted average

greater than 5%

TABLE 5-6

EVALUATION OF RISK FROM LEAD USING THE ADULT LEAD MODEL FOR INDIVIDUAL DISPERSED CAMPSITES

Bonita Peak Mining District

Basic Equations

PbB(mother) = PbB0 + BKSF*∑[Csitemedia*IRsitemedia*AFsitemedia*EF/365]

PbB(fetus) = PbB(mother) * Ratio

Parameter	Units	CMP2	CMP3	CMP4	CMP5	CMP7	CMP8	CMP9	CMP10	CMP11	CMP12	CMP13	CMP15	CMP15A	Source	Notes
PbB0	µg/dL	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	NHANES 2009-2014	
BKSF	µg/dL per µg/day	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	USEPA 2003a	USEPA default recommendation
Ratio	µg/dL per µg/dL	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	USEPA 2003a	USEPA default recommendation
GSD	--	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	NHANES 2009-2014	
Soil Concentration	µg/g	3592	33086	62499	200	12254	1919	1935	74	474	257	100	635	1010	Campsite-specific	Mean, adjusted for fine/bulk fraction [b]
Csoil/Bkg	µg/g	66	66	66	66	66	66	66	66	66	66	66	66	66	Site-specific	Mean
Soil Ingestion Rate	g/day	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	Professional judgment	CTE exposure parameter
RBA	--	0.45	0.37	0.59	0.54	0.75	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	Site-specific	Location-specific or average
AF Soil	--	0.09	0.074	0.118	0.11	0.15	0.11	0.108	0.11	0.11	0.11	0.11	0.11	0.11	ALM Guidance (2003)	0.2 (default) * (site-specific RBA) [a]
Csediment	µg/g	907	907	907	907	907	907	907	907	907	907	907	907	907	Site-specific	Mean
IRsediment	g/day	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	Professional judgment	CTE exposure parameter
AF Sediment	--	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	ALM Guidance (2003)	0.2 (default) * 0.22 (site-specific RBA)
Cwater	µg/L	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	Site-specific	Mean
IR (drinking water)	L/day	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	Professional judgment	CTE exposure parameter
IR (incidental)	L/day	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	0.0021	Professional judgment	CTE exposure parameter
AF Water	--	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	ALM Guidance (2003)	
Exposure Frequency	days/year	14	14	14	14	14	14	14	14	14	14	14	14	14	Professional judgment	CTE exposure parameter

Parameter	Units	CMP2	CMP3	CMP4	CMP5	CMP7	CMP8	CMP9	CMP10	CMP11	CMP12	CMP13	CMP15	CMP15A
GM PbB(mother)	µg/dL	1.290	4.555	12.130	0.825	3.614	1.110	1.113	0.804	0.870	0.834	0.808	0.897	0.959
mu		0.254	1.516	2.496	-0.192	1.285	0.105	0.107	-0.218	-0.139	-0.181	-0.213	-0.109	-0.041
sigma		0.588	0.588	0.588	0.588	0.588	0.588	0.588	0.588	0.588	0.588	0.588	0.588	0.588
P10 (fetus)		0.01%	6%	56%	0.0005%	3%	0.004%	0.00%	0.0004%	0.001%	0.0005%	0.0004%	0.001%	0.002%
P8 (fetus)		0.1%	13%	70%	0.003%	6%	0.02%	0.02%	0.002%	0.004%	0.003%	0.002%	0.005%	0.008%
P5 (fetus)		1%	37%	91%	0.06%	23%	0.3%	0%	0.05%	0.08%	0.06%	0.05%	0.1%	0.1%

Notes:

[a] Campsite-specific RBA was used in calculations when available; the average RBA across campsites was used when a campsite-specific value was not available.

[b] CMP10 and CMP13 the bulk fraction concentation was not adjusted to be based on the fine fraction using the regression because it would result in a negative concentration.

µg = microgram

AF = absorption fraction

BKSF = biokinetic slope factor

C = concentration

CTE = central tendency exposure

dL = deciliter

EF = exposure frequency

g = gram

GM = geometric mean

GSD = geometric standard deviation

hr = hour

IEUBK = Integrated Exposure Uptake Biokinetic Model

IR = ingestion rate

m^3 = cubic meter

NHANES = National Health and Nutrition Examination Survey

PbB = blood lead level

PbB0 = baseline blood lead level

PEF = particulate emission factor

RBA = relative bioavailability

USEPA = United States Environmental Protection Agency

greater than 5%

TABLE 5-7
STATISTICAL COMPARISON OF SITE AND BACKROUND DATASETS FOR LEAD
Bonita Peak Mining Distict

Media Type	Background Data Source	EU	p value	Conclusion with Alpha 0.05
Soil	Site-Specific Upland Reference Soil Samples	EU5a - Roadway Soil in the Alpine Loop	1	Do Not Reject H0, Conclude Sample 1 >= Sample 2
		EU1-4, EU5b - All Roadway Soil	1	Do Not Reject H0, Conclude Sample 1 >= Sample 2
	Smith et al.	EU5a - Roadway Soil in the Alpine Loop	1	Do Not Reject H0, Conclude Sample 1 >= Sample 2
		EU1-4, EU5b - All Roadway Soil	1	Do Not Reject H0, Conclude Sample 1 >= Sample 2

Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L. 2013. Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19 p., https://pubs.usgs.gov/ds/801/. State of Colorado, restricted to forested upland locations.

Notes:
Form 2 (Sample 1 = Site, Sample 2 = Reference)
H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

">=" = greater than or equal to
ATV = all terrain vehicle
COPC = chemical of potential concern
EU = exposure unit
H0 = null hypothesis
vs. = versus

TABLE 5-8
EVALUATION OF RISK FOR THE ROAD WORKER FROM LEAD USING THE ADULT LEAD MODEL FOR BACKGROUND DATASETS
Bonita Peak Mining District

Basic Equations
PbB(fetus) = PbB(mother) * Ratio
PbB(mother) = PbB0 + BKSF*∑[Csitemedia*IRsitemedia*AFsitemedia*EF/365]

Parameter	Units	Road Worker (soil only)	Source	Notes
PbB0	µg/dL	0.6	NHANES 2009-2014	
BKSF	µg/dL per µg/day	0.4	USEPA 2003a	USEPA default recommendation
Ratio	µg/dL per µg/dL	0.9	USEPA 2003a	USEPA default recommendation
GSD	--	1.8	NHANES 2009-2014	
Csoil	µg/g	100	Site-specific	Mean
IRsoil	g/day	0.165	Professional judgment	CTE exposure parameter
AFsoil	--	0.044	ALM Guidance (2003)	0.2 (default) * 0.22 (site-specific RBA)
PEF	g/m^3		Appendix C	
Riding time factor	unitless		Professional judgment	
Area use factor	unitless		Professional judgment	
BR	m^3/hr	2.4	USEPA 1997	Mean breathing rate for moderate and heavy activities
Cair	$µg/m^3$	2E-02	Site-specific (road worker); Estimated (ATV Rider)	Mean
ET	hrs/day	6	Professional judgment	
AFair	--	0.32	IEUBK default	
Csed/Site	µg/g		Site-specific	Mean
Irsed	g/day		Professional judgment	CTE exposure parameter
Afsed	--		IEUBK default soil	0.2 (default) * 0.25 (RBA)
CwaterSite	µg/L		Site-specific	Mean
Irwater (drinking water)	L/day		Professional judgment	CTE exposure parameter
Irwater (incidental)	L/day		Professional judgment	CTE exposure parameter
Afwater	--			Assumes same ratio of AF(water) to AF(soil) as IEUBK
Cfish	µg/g		Site-specific	Mean
IRFish	g/day		Professional judgment	ingestion rate * fraction site
Exposure Freq	days/year			
AFFish	--		ALM Guidance (2003)	
Exposure Frequency (all pathways, but fish ingestion)	days/year	100	Professional judgment	CTE exposure parameter

Parameter	Units	Road Worker
GM PbB(mother) (µg/dL)	µg/dL	0.690
mu		-0.371
sigma		0.588
P10 (fetus)		0.00011%
P8 (fetus)		0.0007%
P5 (fetus)		0.02%

Notes:
Cells shaded grey indicate the pathway is incomplete for the receptor

µg = microgram
AF = absorption fraction
BKSF = biokinetic slope factor
C = concentration
CTE = central tendency exposure
dL = deciliter
EF = exposure frequency
g = gram
GM = geometric mean
GSD = geometric standard deviation
hr = hour
IEUBK = Integrated Exposure Uptake Biokinetic Mode
IR = ingestion rate
m^3 = cubic meter
NHANES = National Health and Nutrition Examination Survey
PbB = blood lead level
PbB0 = baseline blood lead level
PEF = particulate emission factor
RBA = relative bioavailability
USEPA = United States Environmental Protection Agency

TABLE 6-1
ACUTE LEAD SCREENING LEVELS
Bonita Peak Mining District

Panel A. Dispersed Campsite Soil (RBA = 0.54)

Scenario	2-Day Exposure	14-Day Exposure
Scenario 1	2,594	1,331
Scenario 2	596	306

Panel B. Waste Rock (RBA = 0.23)

Scenario	2-Day Exposure	14-Day Exposure
Scenario 1	6,090	3,125
Scenario 2	1,400	719

Notes:
mg/kg = milligrams per kilogram
RBA = relative bioavailability

TABLE 6-2
ACUTE ARSENIC SCREENING LEVELS
Bonita Peak Mining District

Panel A. Dispersed Campsite Soil (RBA = 0.07)

Scenario	2-Day Exposure	14-Day Exposure
Scenario 1	1,216	174
Scenario 2	280	40

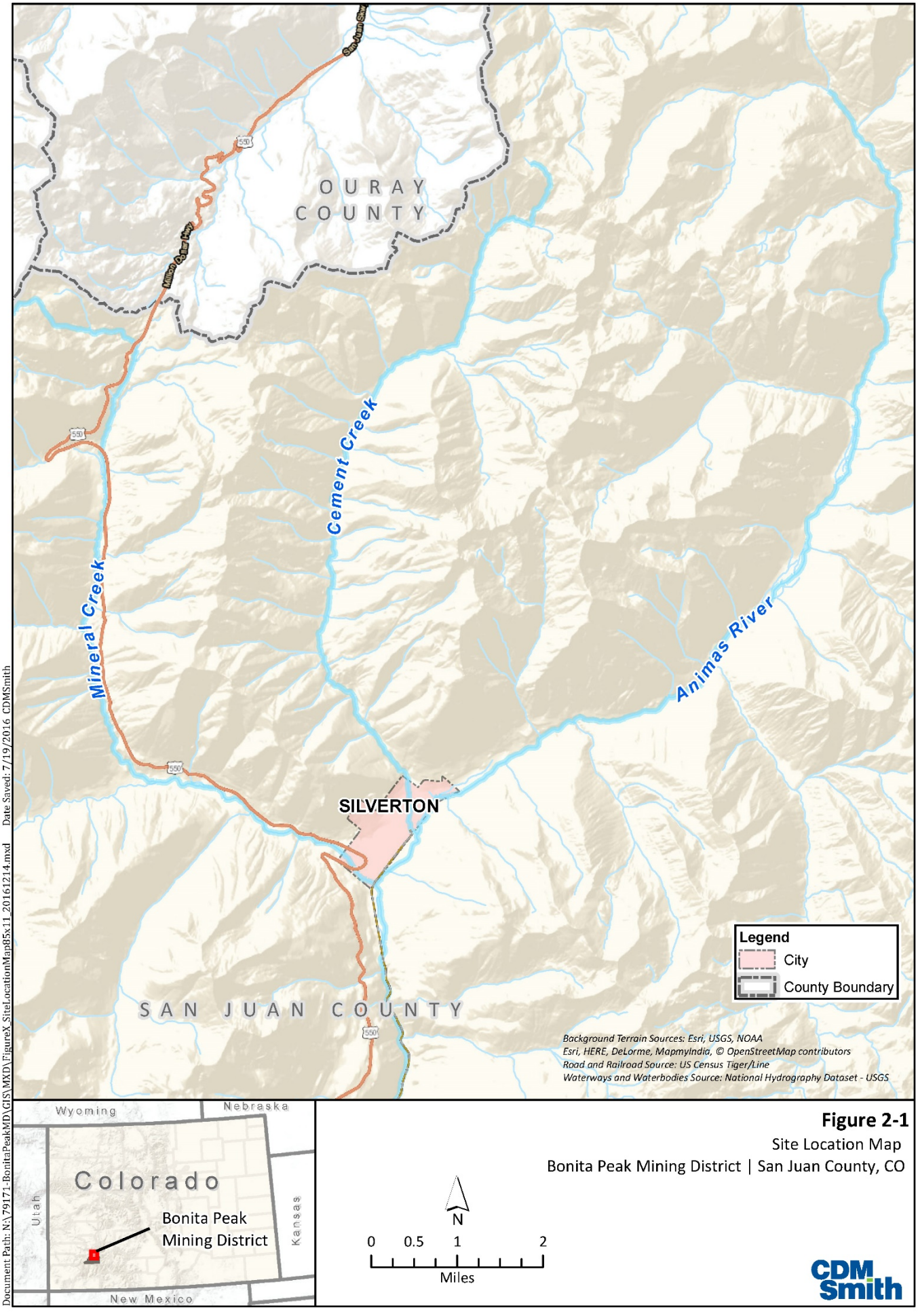
Panel B. Waste Rock (RBA = 0.05)

Scenario	2-Day Exposure	14-Day Exposure
Scenario 1	1,703	243
Scenario 2	393	56

Notes:
mg/kg = milligrams per kilogram
RBA = relative bioavailability

Figures

This page intentionally left blank.



Document Path: N:\79171-BonitaPeakMD\GIS\MXD\FigureX_SiteLocationMap85x11_20161214.mxd Date Saved: 7/19/2016 CDMSmith

Figure 2-1

Site Location Map

Bonita Peak Mining District | San Juan County, CO

CDM Smith

BEN BUTLER MINE
DEWITT MINE
LONDON MINE
BOSTON MINE
RED CLOUD MINE
VERMILLION MINE
FRISCO/BAGLEY TUNNEL
COLUMBUS MINE
SUNBANK GROUP MINE
MOUNTAIN QUEEN MINE
SUNNYSIDE MINE POOL STUDY AREA
SUNNYSIDE MINE
CLIPPER MINE
BEN FRANKLIN MINE
TERRY TUNNEL
SILVER WING MINE
TOM MOORE MINE
SENATOR MINE
EUREKA FLUVIAL TAILINGS
FOREST QUEEN MINE
KITTIMACK TAILINGS
HOWARDSVILLE COLO GOLDFIELDS TAILINGS
LITTLE NATION MINE
MAYFLOWER TAILINGS (MAYFLOWER MILL REPOSITORIES #1-#4)
AMY TUNNEL
ASPEN MINE
PRIDE OF THE WEST MINE

Seigal Mountain
Denver Hill
Weed Mountain
Houghton Mountain
Cinnamon Cr
Cinnamon Mountain
Tuttle Mountain
Brown Mountain
California Mountain
Treasure Mountain
Hanson Peak
Eureka Mountain
Bonita Peak
Emery Peak
Niagara Peak
Crown Mountain
McMillan Peak
Storm Peak
Tower Mountain
Dome Mountain
Middle Mountain
Macomber Peak
Galena Mountain
King Solomon Mountain
Hazelton Mountain
Round Mountain
Little Giant Peak
Canby Mountain
Green Mountain
Kendall Mountain
Kendall Peak
Sugarloaf
Red Mountain Number 1
Red Mountain Number 2
Red Mountain Number 3
Silverton

Letcher Cr
Moose Cr
Silver Cr
Uncompahgre River
Red Mountain Cr
Willers Cr
West Fork Animas River
Placer Gulch
Picayune Gulch
Picayune Gulch
N Fork Cement Cr
Cement Creek
Minnehaha Cr
S Fork Cement Cr
M Fork Cement Cr
S Fork Animas River
Porcupine Gulch
Arrastra Cr
Cunningham Cr
Mineral Creek
Animas River
Deer Park Cr
Cr Co Rd 33A
Royal Tiger Cr
Mountaineer Cr
Rio Grande

35 52 110 25 5 26 19 11 10 53 55 51 9 2 34A 34 20 32 6 31 33 24 23 2a 4 3

OURAY COUNTY
HINSDALE COUNTY
SAN MIGUEL COUNTY
SAN JUAN COUNTY

N
0 0.5 1
1 in = 0.9 miles
Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Soil Locations
- Campground Soil
- Overbank Soil
- Upland Reference Soil
- Roadway Soil
- Waste Rock/Floodplain Soil
- Mine Location
- Mountain Peak
- County Road
- Forest Service Road
- Road
- Highway
- Streams

Figure 2-2
Soil Media Sample Locations in the Animas River Watershed Area

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\Projects\79171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 2-2_HHRA_Soils-AnimasArea.mxd Date Saved: 2019-04-23 Author: FOSTERML CDMSmith

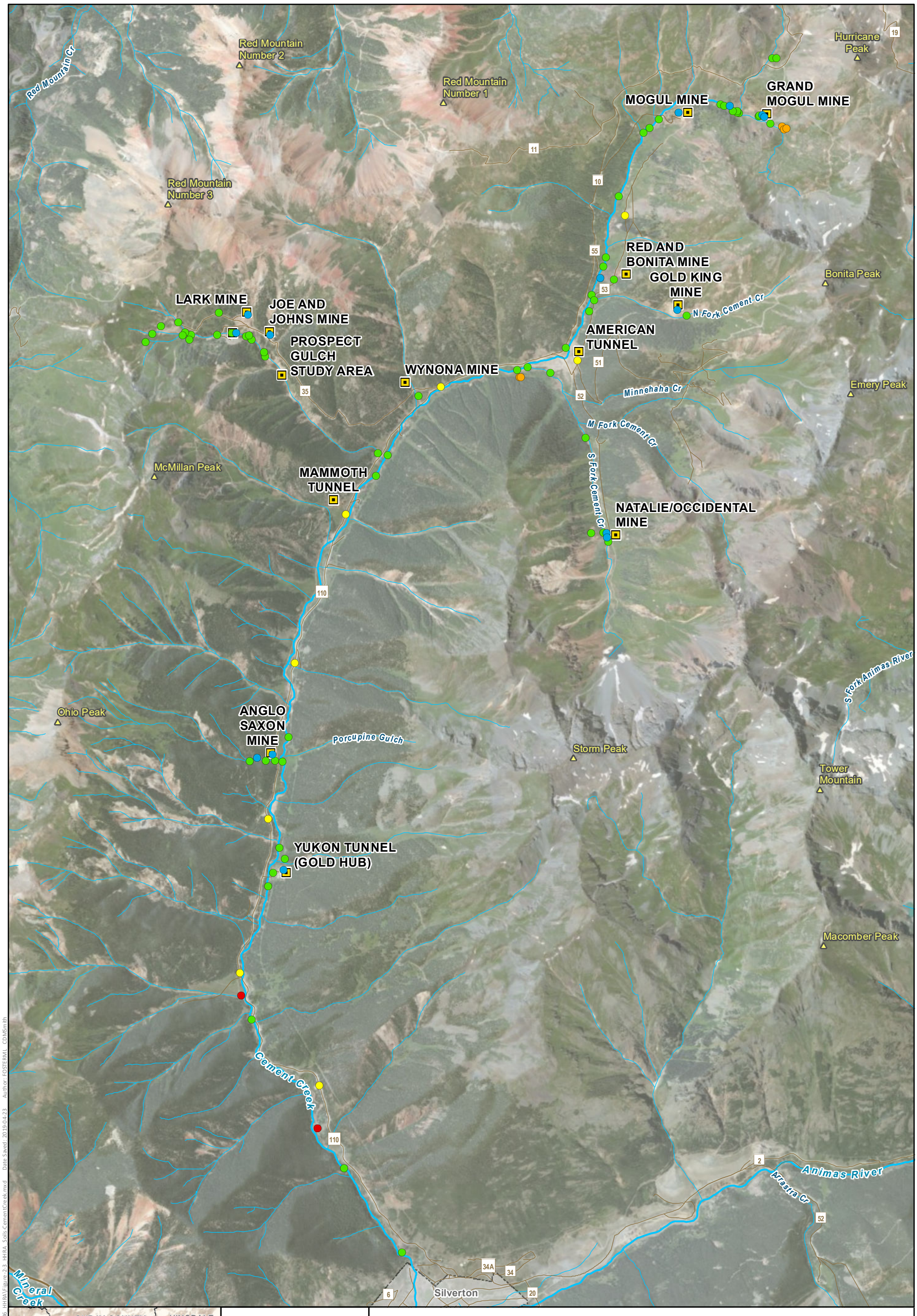


Figure 2-3
Soil Media Sample Locations in the Cement Creek Watershed Area

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

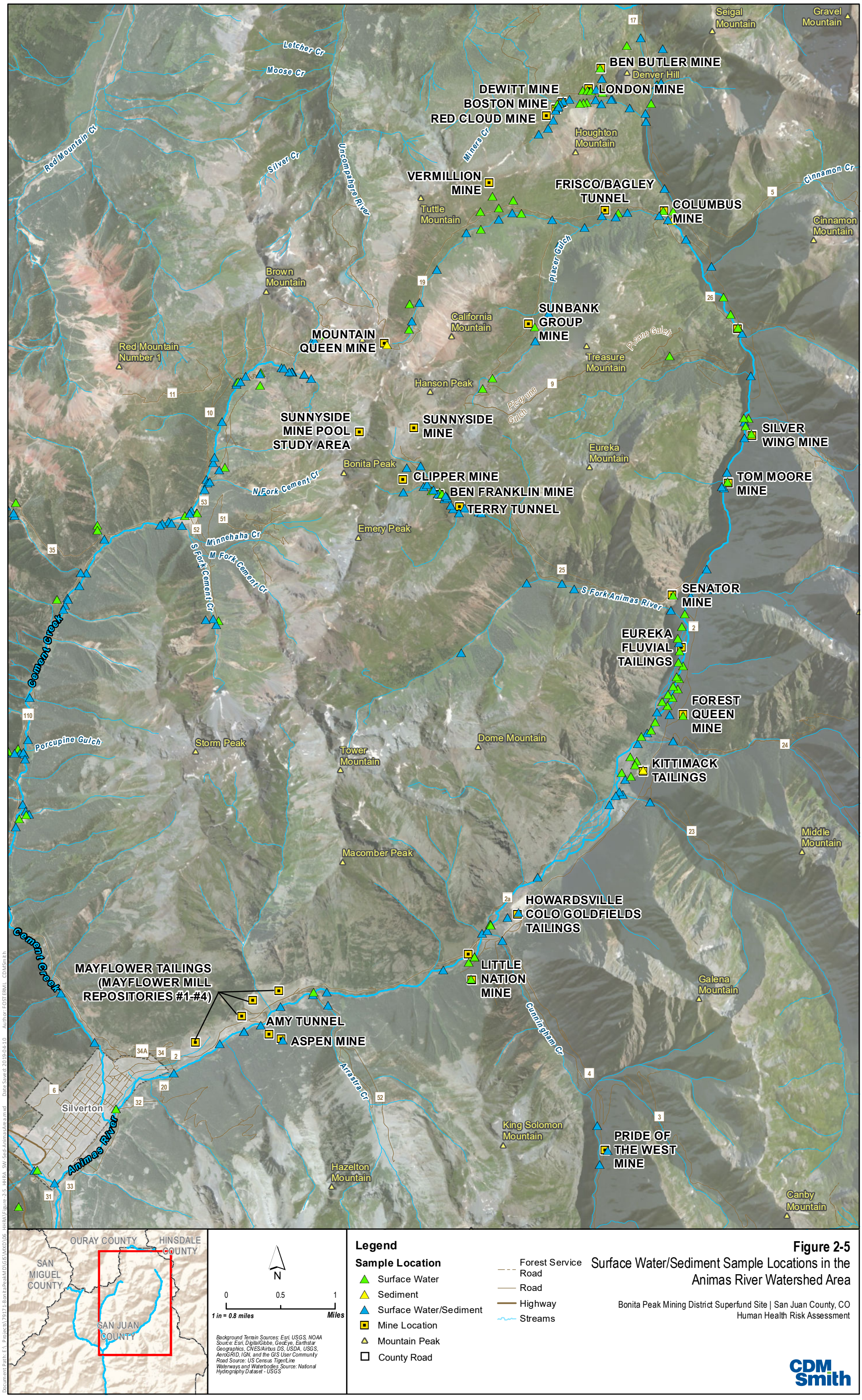
Document Path: E:_Projects\179171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure_2-3_HHRA_Soils-CementCreek.mxd Date Saved: 2019-04-23 Author: FOSTERML CDMSmith

Figure 2-4
Soil Media Sample Locations in the Mineral Creek Watershed Area

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\Projects\79171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 2-4_HHRA_Soils-MineralCreek.mxd Date Saved: 2019-04-22 Author: FOSTERML CDMSmith


Seigal Mountain
Gravel Mountain
Letcher Cr
Moose Cr
BEN BUTLER MINE
Denver Hill
DEWITT MINE
LONDON MINE
BOSTON MINE
RED CLOUD MINE
Houghton Mountain
Red Mountain Cr
Silver Cr
Uncompahgre River
Miners Cr
VERMILLION MINE
FRISCO/BAGLEY TUNNEL
Cinnamon Cr
Tuttle Mountain
COLUMBUS MINE
Cinnamon Mountain
Placer Gulch
Brown Mountain
SUNBANK GROUP MINE
California Mountain
MOUNTAIN QUEEN MINE
Red Mountain Number 1
Picayune Gulch
Treasure Mountain
Hanson Peak
SUNNYSIDE MINE POOL STUDY AREA
SUNNYSIDE MINE
SILVER WING MINE
Eureka Mountain
Bonita Peak
CLIPPER MINE
TOM MOORE MINE
N Fork Cement Cr
BEN FRANKLIN MINE
TERRY TUNNEL
Emery Peak
Minnehaha Cr
S Fork Cement Cr
M Fork Cement Cr
S Fork Animas River
SENATOR MINE
Cement Creek
EUREKA FLUVIAL TAILINGS
FOREST QUEEN MINE
Porcupine Gulch
Storm Peak
Tower Mountain
Dome Mountain
KITTIMACK TAILINGS
Middle Mountain
Macomber Peak
HOWARDSVILLE COLO GOLDFIELDS TAILINGS
LITTLE NATION MINE
MAYFLOWER TAILINGS (MAYFLOWER MILL REPOSITORIES #1-#4)
Galena Mountain
Cunningham Cr
AMY TUNNEL
ASPEN MINE
Arrastra Cr
Silverton
King Solomon Mountain
PRIDE OF THE WEST MINE
Animas River
Hazelton Mountain
Canby Mountain
OURAY COUNTY
HINSDALE COUNTY
SAN MIGUEL COUNTY
SAN JUAN COUNTY
N
0
0.5
1
1 in = 0.8 miles
Miles
Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS
Legend
Sample Location
Surface Water
Sediment
Surface Water/Sediment
Mine Location
Mountain Peak
County Road
Forest Service Road
Road
Highway
Streams
Figure 2-5
Surface Water/Sediment Sample Locations in the Animas River Watershed Area
Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment
CDM Smith
Document Path: E:\Projects\79171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 2-5_HHRA_SW-Sed-AnimasArea.mxd Date Saved: 2019-04-10 Author: FOSTERML CDMSmith

Red Mountain Number 2
Red Mountain Number 1
Red Mountain Number 3
MOUNTAIN QUEEN MINE
Hurricane Peak
MOGUL MINE
GRAND MOGUL MINE
SUNNYSIDE MINE POOL STUDY AREA
RED AND BONITA MINE
GOLD KING MINE
Bonita Peak
LARK MINE
JOE AND JOHNS MINE
PROSPECT GULCH STUDY AREA
AMERICAN TUNNEL
WYNONA MINE
Cement Creek
Emery Peak
McMillan Peak
MAMMOTH TUNNEL
NATALIE/OCCIDENTAL MINE
Ohio Peak
ANGLO SAXON MINE
Storm Peak
Tower Mountain
YUKON TUNNEL (GOLD HUB)
Macomber Peak
MAYFLOWER MILL REPOSITORY #1
MAYFLOWER MILL REPOSITORY #2
MAYFLOWER MILL REPOSITORY #3
MAYFLOWER MILL REPOSITORY #4
Animas River
ASPEN MINE
AMY TUNNEL
Mineral Creek
Silverton
19
11
10
53
55
51
52
35
110
2
6
20
34
34A

OURAY COUNTY
HINSDALE COUNTY
SAN MIGUEL COUNTY
SAN JUAN COUNTY

N

0 0.25 0.5

1 in = 0.5 miles Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Sample Location

- Surface Water
- Sediment
- Surface Water/Sediment
- Mine Location
- Mountain Peak
- County Road

- Road
- Highway
- Streams

Figure 2-6
Surface Water/Sediment Sample Locations in the Cement Creek Watershed Area

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

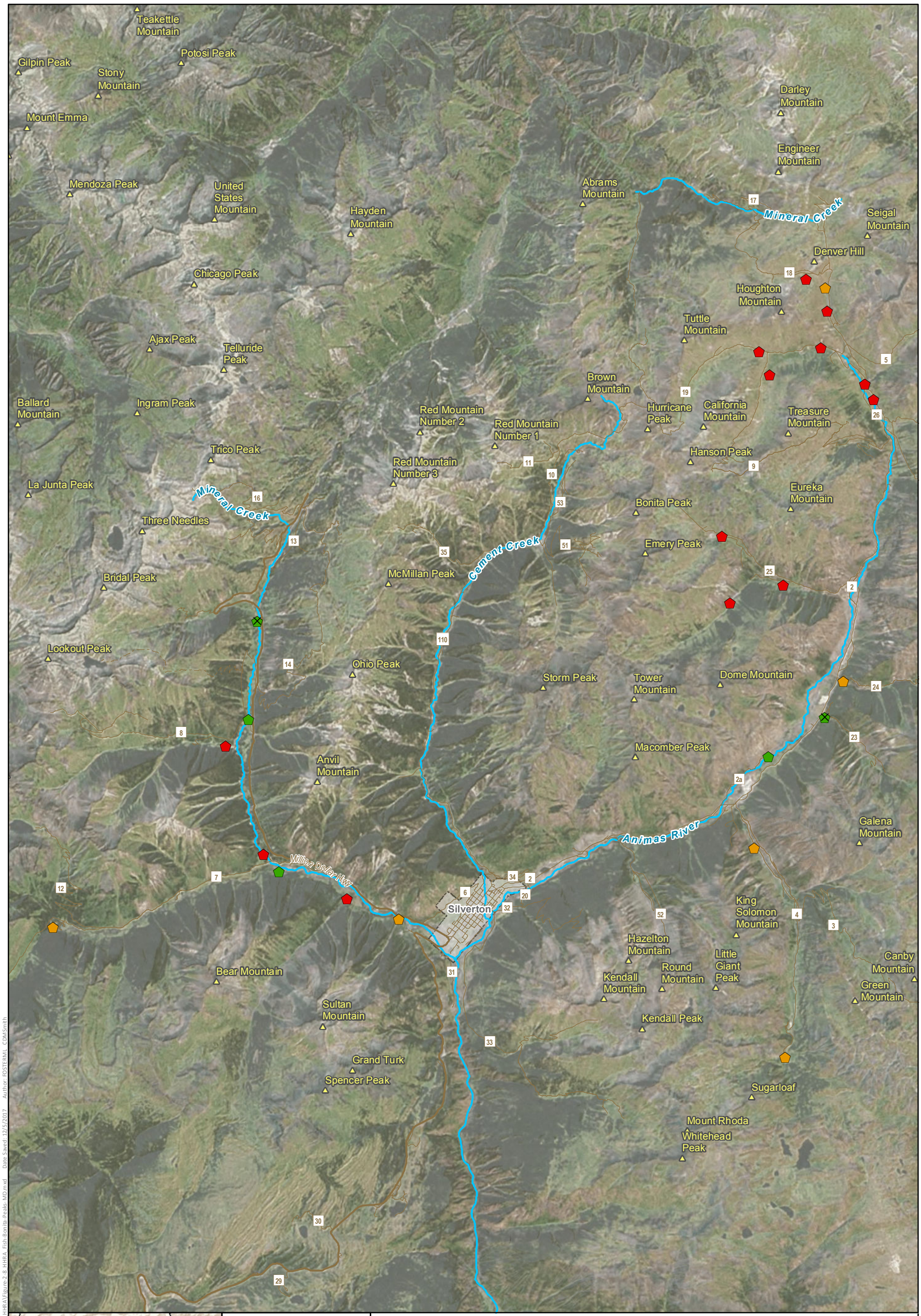
Document Path: E:\Projects\79171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure_2-6_HHRA_SW-Sed-CementCreek.mxd Date Saved: 2019-04-10 Author: FOSTERML CDMSmith

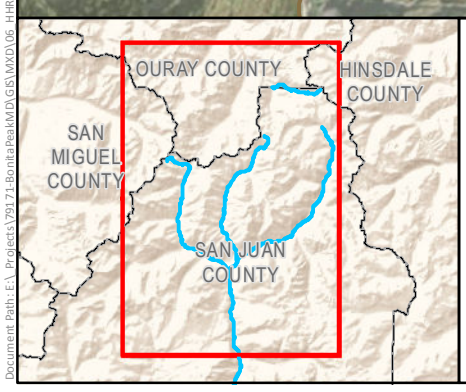
Figure 2-7
Surface Water/Sediment Sample Locations in the Mineral Creek Watershed Area

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\...Project\379171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure_2-7_HHRA_SW_Sed-MineralCreek.mxd Date Saved: 2019-04-10 Author: FOSTERML CDMSmith





N

0 0.25 0.5

1 in = 1.36 miles *Miles*

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Fish Sample Locations

- Fish captured and tissue collected
- Fish captured and tissue not collected
- Fish not captured
- Reference Location

- Mountain Peak
- Forest Service Road
- Road
- Highway
- Streams
- County Road

Figure 2-8
Fish Sample Locations

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\...Projects\79171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 2-8_HHRA_Fish-Bonita-Peaks-MD.mxd Date Saved: 12/5/2017 Author: FOSTERML CDMSmith

Ophir
Ophir
Iron Spring
Howard Fork
Lookout Peak
Columbine Lake
Mill Cr
Crystal Lake
8
PARADISE MINE
M Fork Mineral Cr
South Lookout Peak
Ulysses S Grant Peak
Clear Lake
Clear Cr
Waterfall Cr
Island Lake
Ice Lake
Pilot Knob
12
7
Golden Horn
S Mineral Creek Rd
Fuller Lake
Vermilion Peak
Fuller Peak
7
Porcupine Cr
Cataract Gr
Beattie Peak
BANDORA MINE
S Mineral Creek Rd
S Fork Mineral Cr
Twin Sisters
Lime Cr
Rolling Mountain

OURAY COUNTY
HINSDALE COUNTY
SAN MIGUEL COUNTY
SAN JUAN COUNTY

N

0 0.25 0.5

1 in = 0.5 miles Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Game Sample Locations

- Deer Tissue
- Grouse Tissue

- Mine Location
- Mountain Peak
- Forest Service Road
- Road
- Streams
- County Road

Figure 2-9
Game Sample Locations

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\Projects\79171-BonitaPeakMD\GIS\MXD\06-HHRA\Figure 2-9_HHRA_Game-Bonita-Peaks-MD.mxd Date Saved: 12/1/2017 Author: FOSTERML CDMSmith

Gilpin Peak
Potosi Peak
Stony Mountain
Dolly Varden Mountain
Darley Mountain
Mount Emma
Greenback Mountain
Engineer Mountain
Mendoza Peak
United States Mountain
Abrams Mountain
Hayden Mountain
Mineral Creek
Seigal Mountain
Gravel Mountain
Denver Hill
Chicago Peak
Weed Mountain
Houghton Mountain
Telluride
Tuttle Mountain
Ajax Peak
Telluride Peak
Cinnamon Mountain
Brown Mountain
Ballard Mountain
Ingram Peak
Red Mountain Number 2
Hurricane Peak
Treasure Mountain
Red Mountain Number 1
California Mountain
Trico Peak
Hanson Peak
Red Mountain Number 3
La Junta Peak
Eureka Mountain
Wasatch Mountain
Bonita Peak
Three Needles
Emery Peak
McMillan Peak
Bridal Peak
Crown Mountain
Lookout Peak
Ohio Peak
Storm Peak
Tower Mountain
Dome Mountain
Middle Mountain
South Lookout Peak
Macomber Peak
Anvil Mountain
Cement Creek
Animas River
Galena Mountain
Mineral Creek
Silverton
Million Dollar Hwy
King Solomon Mountain
Hazelton Mountain
Little Giant Peak
Canby Mountain
Bear Mountain
Kendall Mountain
Round Mountain
Green Mountain
Sultan Mountain
Kendall Peak
Grand Turk
Spencer Peak
Twin Sisters
Sugarloaf
Mount Rhoda
Whitehead Peak
Snowdon Peak
Needle Mountains Peak Two
Needle Mountains Peak Three
Needle Mountains Peak One
White Dome
Hunchback Mountain
Electric Peak
Big Giant Creek Rd
Lime Creek Rd
OURAY COUNTY
HINSDALE COUNTY
SAN MIGUEL COUNTY
SAN JUAN COUNTY
N
0 0.5 1
1 in = 1.5 miles
Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend
- Air Sample Locations
- Mountain Peak
- Forest Service Road
- Road
- Highway
- Streams
- County Road

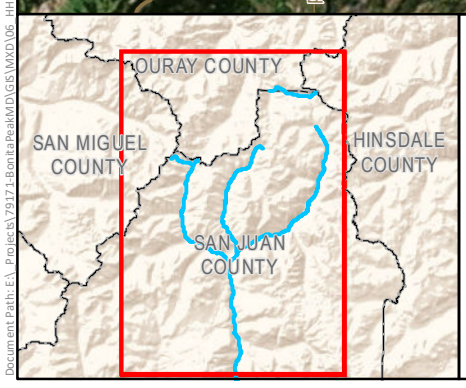
Figure 2-10
Roadway Worker Air Sample Locations

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:_Projects\791.71-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 2-10_HHRA_Air_Bonita-Peak-MD.mxd Date Saved: 12/5/2017 Author: FOSTERML CDMSmith

Gilpin Peak
Potosi Peak
Stony Mountain
Dolly Varden Mountain
Darley Mountain
Mount Emma
Greenback Mountain
Engineer Mountain
Mendoza Peak
United States Mountain
Hayden Mountain
Abrams Mountain
Mineral Creek
17
Seigal Mountain
Gravel Mountain
Denver Hill
18
Chicago Peak
Weed Mountain
Houghton Mountain
Telluride
Tuttle Mountain
5
Ajax Peak
Telluride Peak
Cinnamon Mountain
Brown Mountain
19
Ballard Mountain
Ingram Peak
Red Mountain Number 2
Red Mountain Number 1
Hurricane Peak
California Mountain
Treasure Mountain
26
Telluride
Telluride
Telluride
Trico Peak
Red Mountain Number 3
11
10
Hanson Peak
9
La Junta Peak
Wasatch Mountain
16
Mineral Creek
53
Bonita Peak
Eureka Mountain
Three Needles
13
35
Cement Creek
51
Emery Peak
Bridal Peak
McMillan Peak
25
2
Crown Mountain
110
Lookout Peak
14
Ohio Peak
Storm Peak
Tower Mountain
Dome Mountain
24
South Lookout Peak
8
Anvil Mountain
Macomber Peak
Animas River
23
Middle Mountain
2a
Galena Mountain
7
Mineral Creek
12
6
34
2
Silverton
20
32
Million Dollar Hwy
52
King Solomon Mountain
4
3
Hazelton Mountain
Canby Mountain
Bear Mountain
31
Kendall Mountain
Round Mountain
Little Giant Peak
Green Mountain
Sultan Mountain
Kendall Peak
33
Grand Turk
Twin Sisters
Spencer Peak
Sugarloaf
Mount Rhoda
Whitehead Peak
30
29
Engineer Pass / Lake City Rd
1
Snowdon Peak
Needle Mountains Peak Two
Needle Mountains Peak Three
Needle Mountains Peak One
White Dome
Hunchback Mountain
Electric Peak



N

0 0.5 1

1 in = 1.5 miles Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

- Mountain Peak
- ATV ABS Route – Alpine Loop
- ATV ABS Route - Remote Roadway
- Forest Service Road
- Road
- Highway
- County Road

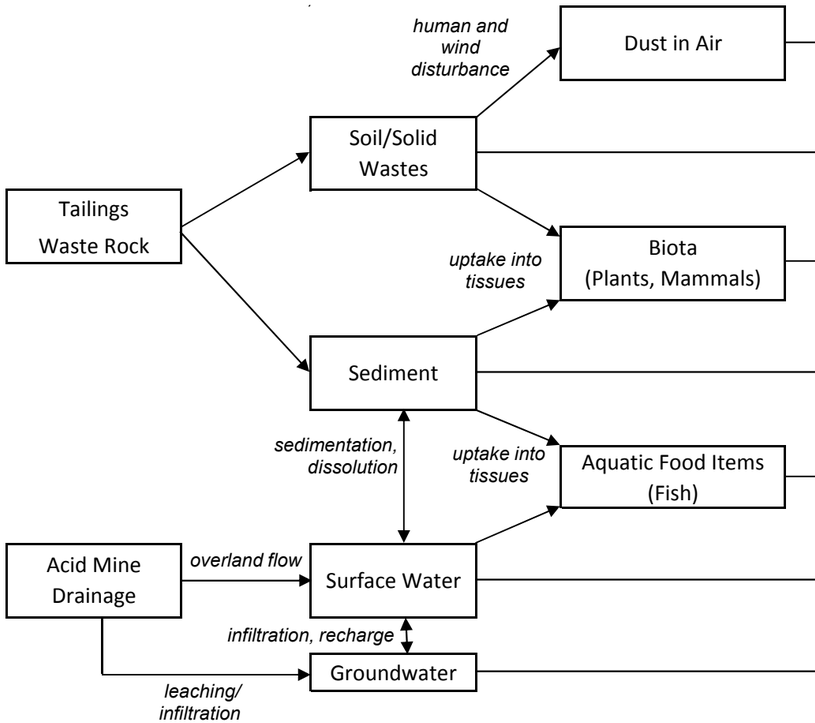
Figure 2-11
ATV ABS Sampling Routes

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\...Projects\79171-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 2-11_ATV_ABS_SamplingRoutes.mxd Date Saved: 2019-04-17 Author: FOSTERMI, CDMSmith

FIGURE 3-1
CONCEPTUAL SITE MODEL
Bonita Peak Mining District



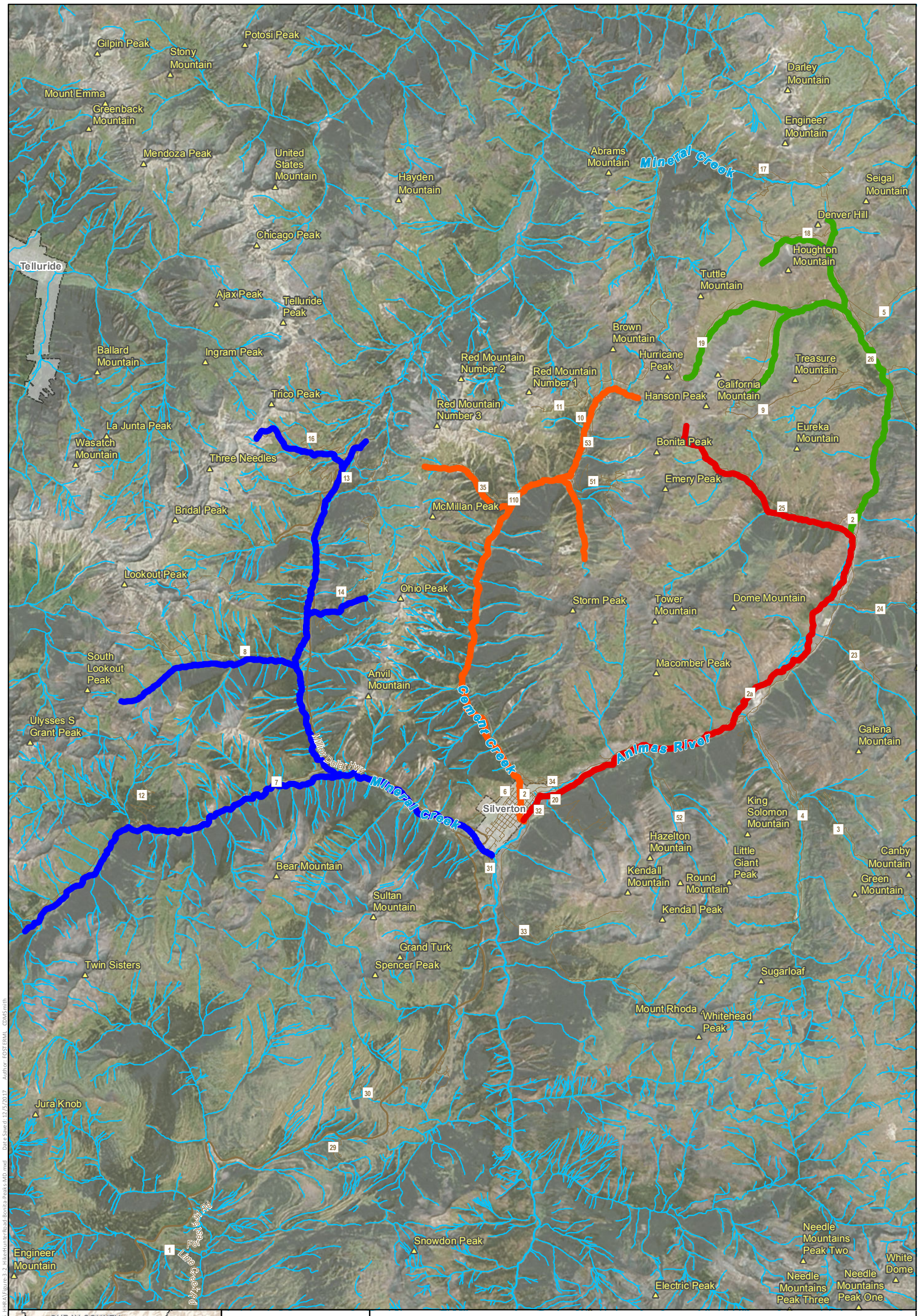
Potential Sources	Transport Mechanisms/Potentially Impacted Environmental Media	Exposure Routes	ATV Guide/Rider	Hiker	Camper - USFS	Camper - Dispersed	Recreational Fisherman	Hunter	Road Worker
			Adult	Adult	Adult and Child	Adult and Child	Adult	Adult	Adult
	Dust in Air	Inhalation	● / X[1]	X	X	X	X	X	●
		Dermal Contact	X	X	X	X	X	X	X
	Soil/Solid Wastes	Ingestion	●	●	●	●		●[7]	●
		Dermal Contact	X	X	X	X		X	X
	Biota (Plants, Mammals)	Ingestion						●[2]	
		Direct Contact							
	Sediment	Ingestion		X[6]	●	●	●	X[6]	
		Direct Contact		X	X	X	X	X	
	Aquatic Food Items (Fish)	Ingestion					●		
	Surface Water	Ingestion		X[6]	●[3]	●[4]	●[5]	X[6]	
		Direct Contact		X	X	X	X	X	
	Groundwater	Ingestion			●[3]	●[4]			

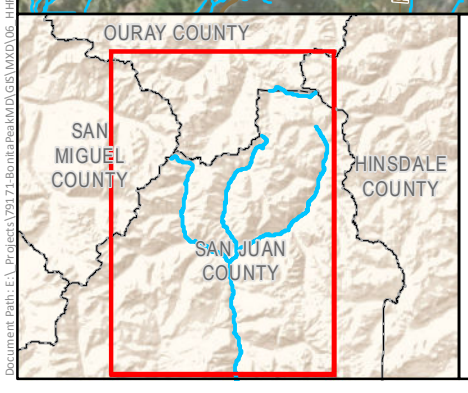
Legend:

●	Pathway complete and may be significant, quantitatively evaluated.
X	Pathway complete, judged to be minor compared to other exposure pathways, evaluated in the uncertainy evaluation.
	Pathway not complete.

Notes:
1) Human disturbance may be significant, wind disturbance is judged to be minor.
2) Ingestion of wild game (deer and grouse).
3) Groundwater is used as a drinking water source for the USFS campground, surface water is evaluated for incidental ingestion.
4) Surface water is used as a drinking water source for dispersed camping and is evaluated for incidental ingestion.
5) Incidental ingestion of surface water while fishing, surface water is not anticipated to be used as a drinking water source.
6) Pathway will be evaluated semi-quantitatively relative to other receptors in the risk assessment.
7) Pathway will not evaluated using the Adult Lead Model because the minimum exposure frequency and duration is not met for intermittent exposure.

ATV - all terrain vehicle
USFS - United States Forest Service





N

0 0.5 1

1 in = 1.5 miles Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Exposure Units for Hiker, Hunter, and County Road Worker

- EU1
- EU2
- EU3
- EU4
- Mountain Peak
- County Road
- Forest Service Road
- Road
- Highway
- Streams

Figure 3-2
Exposure Units for the Hiker, Hunter, and County Road Worker

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:\Projects\72971-BonitaPeak\MXD\GIS\MXD\06_HHRA\Figure-3_2_HikerHunterRoad-BonitaPeaks-MD.mxd Date Saved: 12/5/2017 Author: FOSTERM CDMSmith

Gilpin Peak
Potosi Peak
Stony Mountain
Dolly Varden Mountain
Darley Mountain
Mount Emma
Greenback Mountain
Engineer Mountain
Mendoza Peak
United States Mountain
Abrams Mountain
Hayden Mountain
Mineral Creek
Seigal Mountain
Gravel Mountain
Denver Hill
Chicago Peak
Weed Mountain
Houghton Mountain
Telluride
Tuttle Mountain
Ajax Peak
Telluride Peak
Cinnamon Mountain
Brown Mountain
Ballard Mountain
Ingram Peak
Red Mountain Number 2
Red Mountain Number 1
Hurricane Peak
Treasure Mountain
Telluride
Telluride
Telluride
Cement Creek
California Mountain
Trico Peak
Hanson Peak
Red Mountain Number 3
La Junta Peak
Eureka Mountain
Wasatch Mountain
Bonita Peak
Three Needles
Emery Peak
Bridal Peak
McMillan Peak
Crown Mountain
Lookout Peak
Ohio Peak
Storm Peak
Tower Mountain
Dome Mountain
Middle Mountain
South Lookout Peak
Macomber Peak
Anvil Mountain
Animas River
Galena Mountain
Mineral Creek
Silverton
Million Dollar Hwy
King Solomon Mountain
Canby Mountain
Hazelton Mountain
Little Giant Peak
Kendall Mountain
Round Mountain
Green Mountain
Bear Mountain
Sultan Mountain
Kendall Peak
Grand Turk
Spencer Peak
Twin Sisters
Sugarloaf
Mount Rhoda
Whitehead Peak
Forest Service Road 787
Lime Creek Rd
Snowdon Peak
Needle Mountains Peak Two
Needle Mountains Peak Three
Needle Mountains Peak One
White Dome
Hunchback Mountain
Electric Peak

OURAY COUNTY
SAN MIGUEL COUNTY
HINSDALE COUNTY
SAN JUAN COUNTY

N

0 0.5 1
1 in = 1.5 miles
Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

- Exposure Unit 5a - ATV Guide (Alpine Loop)
- Exposure Unit 5b - ATV Rec Rider
- Mountain Peak
- County Road
- Forest Service Road
- Road
- Highway
- Streams

Figure 3-3
Exposure Units for the ATV Guide and ATV Recreational Rider

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:_Projects\791\71-BonitaPeak\MD\GIS\MXD\06_HHRA\Figure-3-3_HHRA_ATV-Bonita-Peaks-MD.mxd Date Saved: 12/5/2017 Author: FOSTERML CD\MSmith

Gilpin Peak
Potosi Peak
Stony Mountain
Darley Mountain
Mount Emma
Greenback Mountain
Engineer Mountain
Mendoza Peak
United States Mountain
Abrams Mountain
Hayden Mountain
Mineral Creek
Seigal Mountain
Denver Hill
Chicago Peak
Houghton Mountain
Telluride
Tuttle Mountain
Ajax Peak
Telluride Peak
CMP8
Brown Mountain
Ballard Mountain
Ingram Peak
Red Mountain Number 2
Hurricane Peak
Treasure Mountain
CMP7
Red Mountain Number 1
California Mountain
Trico Peak
Hanson Peak
Red Mountain Number 3
La Junta Peak
Wasatch Mountain
Eureka Mountain
Three Needles
Bonita Peak
Bridal Peak
McMillan Peak
Cement Creek
Emery Peak
Million Dollar Hwy
Lookout Peak
Ohio Peak
Storm Peak
Tower Mountain
Dome Mountain
CMP5
Animas River
South Lookout Peak
Macomber Peak
Middle Mountain
Anvil Mountain
CMP10
Ulysses S Grant Peak
CMP9
CMP4
CMP3
Galena Mountain
CMP2
CMP12
CMP11
Mineral Creek
CMP13
Silverton
King Solomon Mountain
CMP14
Hazelton Mountain
Little Giant Peak
Canby Mountain
Bear Mountain
Kendall Mountain
Round Mountain
Green Mountain
CMP15A
Sultan Mountain
Kendall Peak
CMP15
Grand Turk
Twin Sisters
Spencer Peak
Sugarloaf
Mount Rhoda
Whitehead Peak
Jura Knob
Snowdon Peak
Needle Mountains Peak Two
Engineer Mountain
Forest Service Road 861
Electric Peak
White Dome
Needle Mountains Peak One

OURAY COUNTY
SAN MIGUEL COUNTY
HINSDALE COUNTY
SAN JUAN COUNTY

N
0 0.5 1
1 in = 1.5 miles
Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

- Exposure Unit 6 - U.S. Forest Service Campground
- Exposure Unit 7 - Dispersed Backcountry Campsite Locations
- Mountain Peak
- County Road
- Forest Service Road
- Road
- Highway
- Streams

Figure 3-4
Exposure Units for Campers

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

Document Path: E:_Project\791 71-Bonita Peak\MXD\GIS\MXD\06_HHRA\Figure 3-4_HHRA_Campers-Bonita-Peaks-MD.mxd Date Saved: 12/5/2017 Author: FOSTERML CDMSmith

Houghton Mountain
Tuttle Mountain
Telluride Peak
Brown Mountain
Animas River
Red Mountain Number 2
Red Mountain Number 1
Hurricane Peak
California Mountain
Treasure Mountain
Picayune Gulch
Trico Peak
Hanson Peak
Picayune Gulch
Red Mountain Number 3
Eureka Mountain
Bonita Peak
Mineral Creek
Cement Creek
Emery Peak
McMillan Peak
South Fork Animas River
Ohio Peak
Storm Peak
Tower Mountain
Dome Mountain
Macomber Peak
Anvil Mountain
Animas River
Galena Mountain
Silverton
Million Dollar Hwy
King Solomon Mountain
Hazelton Mountain
Little Giant Peak
Bear Mountain
Round Mountain
Kendall Mountain
Green Mountain
Sultan Mountain
Kendall Peak
Grand Turk
Spencer Peak
Sugarloaf
Mount Rhoda
Whitehead Peak

OURAY COUNTY
SAN MIGUEL COUNTY
HINSDALE COUNTY
SAN JUAN COUNTY

N
0 0.5 1
1 in = 1 miles
Miles

Background Terrain Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Legend

Exposure Units for Fisherman
- Exposure Unit 8 - Mineral Creek
- Exposure Unit 9 - Animas River
- Mountain Peak
- County Road
- Forest Service Road
- Road
- Highway
- Streams

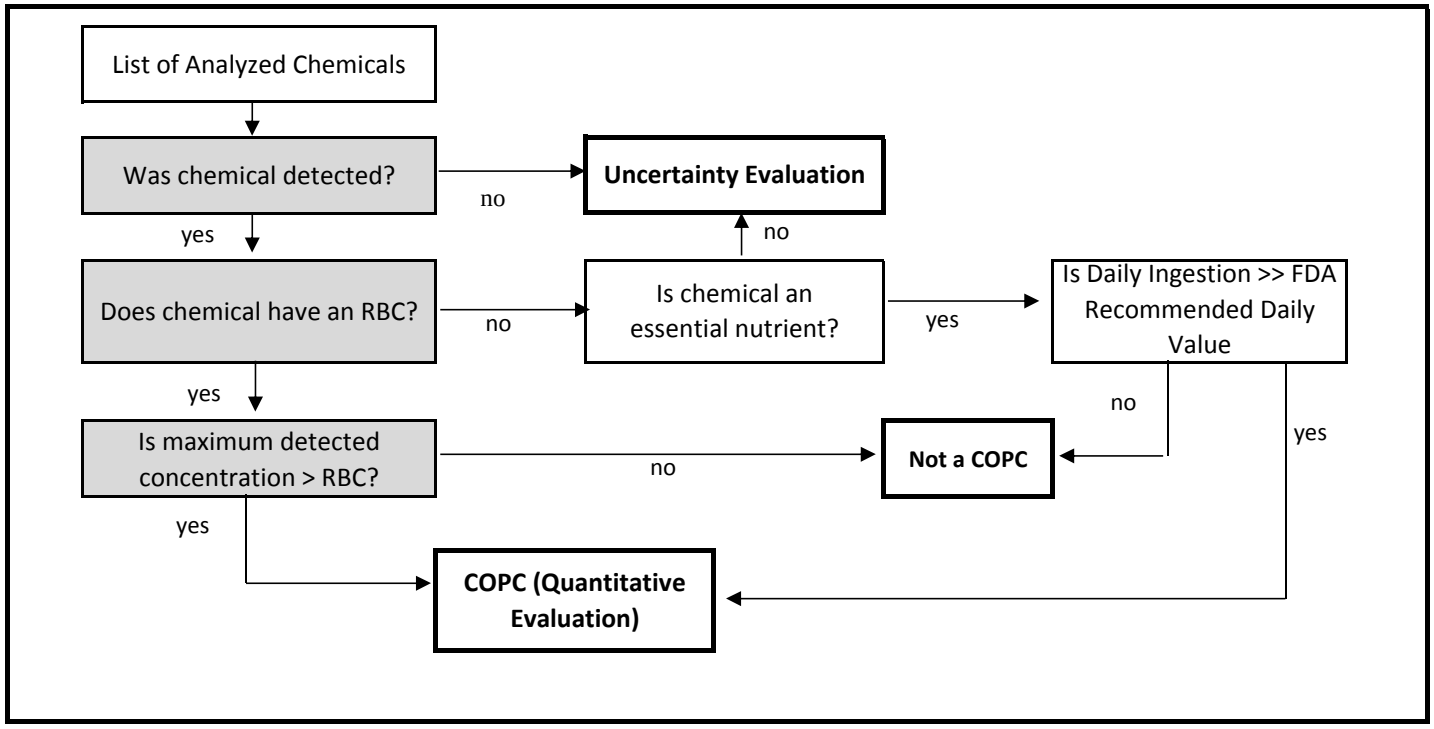
Figure 3-5
Exposure Units for the Recreational Fisherman

Bonita Peak Mining District Superfund Site | San Juan County, CO
Human Health Risk Assessment

CDM Smith

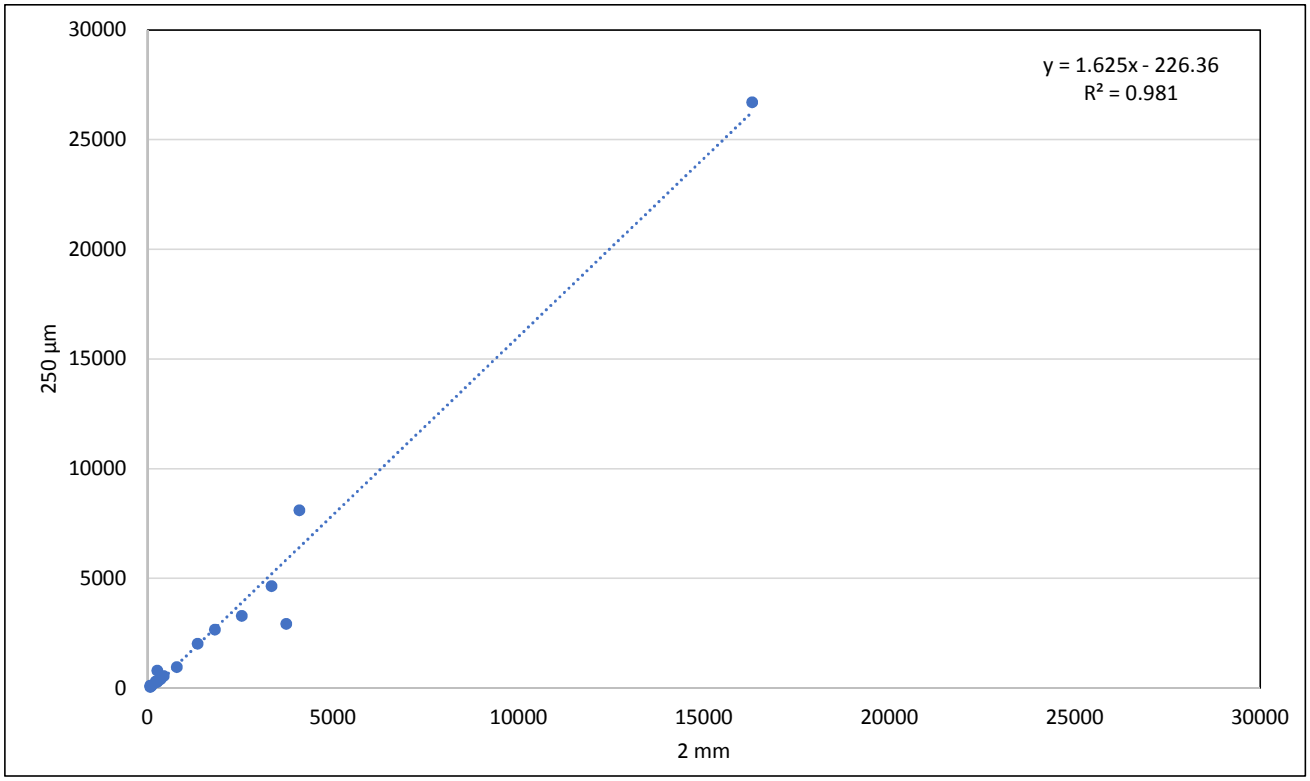
Document Path: E:_Projects\791714-BonitaPeakMD\GIS\MXD\06_HHRA\Figure 3-5_HHRA_Fisherman-Bonita-Peaks-MD.mxd Date Saved: 12/5/2017 Author: FOSTERML CDMSmith

FIGURE 3-6
COPC SELECTION PROCEDURE
Bonita Peak Mining District



Notes:
COPC = chemical of potential concern
FDA = Food and Drug Administration
RBC = Risk-based concentration

FIGURE 5-1
REGRESSION ANALYSIS OF LEAD SOIL SAMPLES SIEVED TO 2-mm AND 250-µm
Bonita Peak Mining District

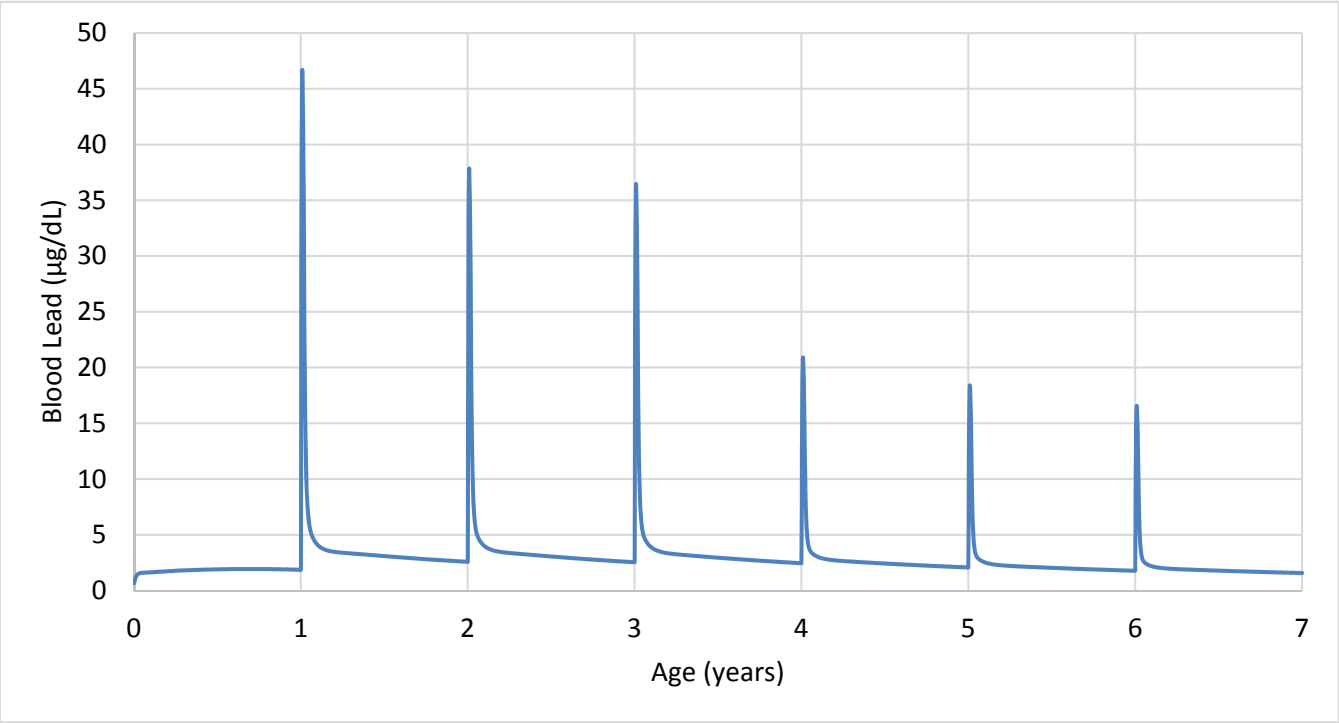


Notes:
µm = micrometer
mm = millimeter

FIGURE 5-2

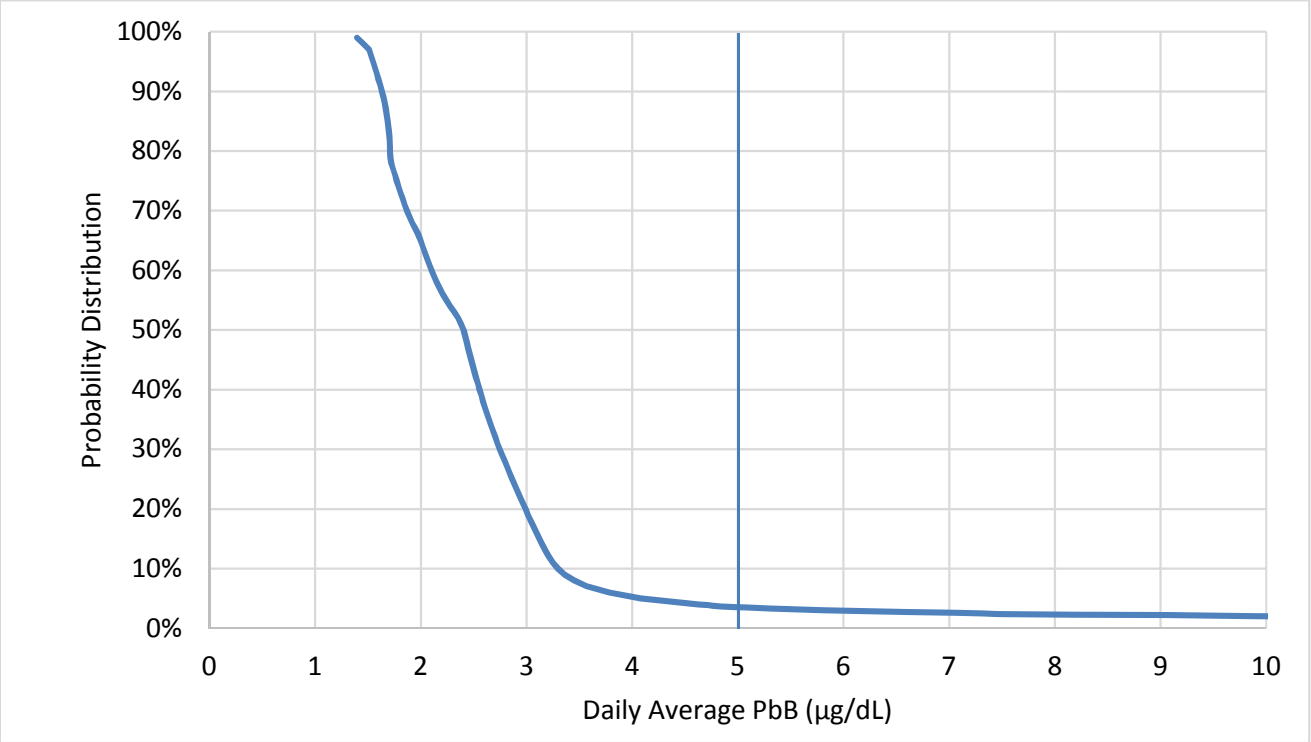
ALL AGES LEAD MODEL - PREDICTED BLOOD LEAD LEVELS FOR A CHILD (DISPERSED CAMPSITE)

Bonita Peak Mining District



µg/dL = micrograms per deciliter

FIGURE 5-3
ALL AGES LEAD MODEL - PROBABILTY DISTRIBUTION OF BLOOD LEAD LEVELS FOR A CHILD (DISPERSED CAMPSITE)
Bonita Peak Mining District



µg/dL = micrograms per deciliter
% = percent

Notes:
Cutoff = 5 µg/dL
% Above = 3.5%
Age Range = 12-72 months

Appendix A

Bonita Peak Mining District Scribe Database

(see Microsoft Access file attached within PDF)

This page intentionally left blank.

Appendix B

ProUCL Output Files

This page intentionally left blank.

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.111/20/2017 12:29:03 PM										
5	From File	BPMD_HHRA_AirInput.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	umber of Bootstrap Operations	2000										
9												
10	**Result (eu2_arsenic)**											
11												
12	**General Statistics**											
13	Total Number of Observations	3				Number of Distinct Observations	2					
14	Number of Detects	0				Number of Non-Detects	3					
15	Number of Distinct Detects	0				Number of Distinct Non-Detects	2					
16												
17	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
18	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
19	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
20												
21	**The data set for variable Result (eu2_arsenic) was not processed!**											
22												
23												
24												
25	**Result (eu2_chromium)**											
26												
27	**General Statistics**											
28	Total Number of Observations	3				Number of Distinct Observations	3					
29						Number of Missing Observations	0					
30	Minimum	0.19				Mean	0.203					
31	Maximum	0.22				Median	0.2					
32	SD	0.0153				Std. Error of Mean	0.00882					
33	Coefficient of Variation	0.0751				Skewness	0.935					
34												
35	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
36	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
37	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
38	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
39												
40	**Normal GOF Test**											
41	Shapiro Wilk Test Statistic	0.964				**Shapiro Wilk GOF Test**						
42	5% Shapiro Wilk Critical Value	0.767				Data appear Normal at 5% Significance Level						
43	Lilliefors Test Statistic	0.253				**Lilliefors GOF Test**						
44	5% Lilliefors Critical Value	0.425				Data appear Normal at 5% Significance Level						
45	**Data appear Normal at 5% Significance Level**											
46												
47	**Assuming Normal Distribution**											
48	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
49	95% Student's-t UCL	0.229				95% Adjusted-CLT UCL (Chen-1995)	0.223					
50						95% Modified-t UCL (Johnson-1978)	0.23					
51												
52	**Gamma GOF Test**											
53	**Not Enough Data to Perform GOF Test**											
54												
55	**Gamma Statistics**											
56	k hat (MLE)	269.4				k star (bias corrected MLE)	N/A					
57	Theta hat (MLE)	7.5472E-4				Theta star (bias corrected MLE)	N/A					
58	nu hat (MLE)	1617				nu star (bias corrected)	N/A					
59	MLE Mean (bias corrected)	N/A				MLE Sd (bias corrected)	N/A					
60						Approximate Chi Square Value (0.05)	N/A					
61	Adjusted Level of Significance	N/A				Adjusted Chi Square Value	N/A					
62												
63	**Assuming Gamma Distribution**											
64	95% Approximate Gamma UCL (use when n>=50))	N/A				95% Adjusted Gamma UCL (use when n<50)	N/A					
65												
66	**Lognormal GOF Test**											
67	Shapiro Wilk Test Statistic	0.971				**Shapiro Wilk Lognormal GOF Test**						

68				5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level						
69				Lilliefors Test Statistic	0.245	**Lilliefors Lognormal GOF Test**						
70				5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level						
71	**Data appear Lognormal at 5% Significance Level**											
72												
73	**Lognormal Statistics**											
74				Minimum of Logged Data	-1.661	Mean of logged Data	-1.595					
75				Maximum of Logged Data	-1.514	SD of logged Data	0.0744					
76												
77	**Assuming Lognormal Distribution**											
78				95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	0.23					
79				95% Chebyshev (MVUE) UCL	0.241	97.5% Chebyshev (MVUE) UCL	0.258					
80				99% Chebyshev (MVUE) UCL	0.29							
81												
82	**Nonparametric Distribution Free UCL Statistics**											
83	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
84												
85	**Nonparametric Distribution Free UCLs**											
86				95% CLT UCL	0.218	95% Jackknife UCL	0.229					
87				95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A					
88				95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A					
89				95% BCA Bootstrap UCL	N/A							
90				90% Chebyshev(Mean, Sd) UCL	0.23	95% Chebyshev(Mean, Sd) UCL	0.242					
91				97.5% Chebyshev(Mean, Sd) UCL	0.258	99% Chebyshev(Mean, Sd) UCL	0.291					
92												
93	**Suggested UCL to Use**											
94				95% Student's-t UCL	0.229							
95												
96	**Recommended UCL exceeds the maximum observation**											
97												
98	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
99	Recommendations are based upon data size, data distribution, and skewness.											
100	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
101	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
102												
103												
104	**Result (eu2_lead)**											
105												
106	**General Statistics**											
107				Total Number of Observations	3	Number of Distinct Observations	3					
108						Number of Missing Observations	0					
109				Minimum	0.015	Mean	0.0207					
110				Maximum	0.024	Median	0.023					
111				SD	0.00493	Std. Error of Mean	0.00285					
112				Coefficient of Variation	0.239	Skewness	-1.652					
113												
114	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
115	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
116	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
117	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
118												
119	**Normal GOF Test**											
120				Shapiro Wilk Test Statistic	0.832	**Shapiro Wilk GOF Test**						
121				5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level						
122				Lilliefors Test Statistic	0.349	**Lilliefors GOF Test**						
123				5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level						
124	**Data appear Normal at 5% Significance Level**											
125												
126	**Assuming Normal Distribution**											
127	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
128				95% Student's-t UCL	0.029	95% Adjusted-CLT UCL (Chen-1995)	0.0224					
129						95% Modified-t UCL (Johnson-1978)	0.0285					
130												
131	**Gamma GOF Test**											
132	**Not Enough Data to Perform GOF Test**											
133												
134	**Gamma Statistics**											

135					k hat (MLE)	23.61				k star (bias corrected MLE)		N/A
136					Theta hat (MLE)	8.7516E-4				Theta star (bias corrected MLE)		N/A
137					nu hat (MLE)	141.7				nu star (bias corrected)		N/A
138					MLE Mean (bias corrected)	N/A				MLE Sd (bias corrected)		N/A
139										Approximate Chi Square Value (0.05)		N/A
140					Adjusted Level of Significance	N/A				Adjusted Chi Square Value		N/A
141												
142					**Assuming Gamma Distribution**							
143				95% Approximate Gamma UCL (use when n>=50))		N/A				95% Adjusted Gamma UCL (use when n<50)		N/A
144												
145					**Lognormal GOF Test**							
146					Shapiro Wilk Test Statistic	0.817				**Shapiro Wilk Lognormal GOF Test**		
147					5% Shapiro Wilk Critical Value	0.767				Data appear Lognormal at 5% Significance Level		
148					Lilliefors Test Statistic	0.356				**Lilliefors Lognormal GOF Test**		
149					5% Lilliefors Critical Value	0.425				Data appear Lognormal at 5% Significance Level		
150					**Data appear Lognormal at 5% Significance Level**							
151												
152					**Lognormal Statistics**							
153					Minimum of Logged Data	-4.2				Mean of logged Data		-3.901
154					Maximum of Logged Data	-3.73				SD of logged Data		0.26
155												
156					**Assuming Lognormal Distribution**							
157					95% H-UCL	0.0417				90% Chebyshev (MVUE) UCL		0.0299
158					95% Chebyshev (MVUE) UCL	0.0341				97.5% Chebyshev (MVUE) UCL		0.0399
159					99% Chebyshev (MVUE) UCL	0.0513						
160												
161					**Nonparametric Distribution Free UCL Statistics**							
162					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
163												
164					**Nonparametric Distribution Free UCLs**							
165					95% CLT UCL	0.0254				95% Jackknife UCL		0.029
166					95% Standard Bootstrap UCL	N/A				95% Bootstrap-t UCL		N/A
167					95% Hall's Bootstrap UCL	N/A				95% Percentile Bootstrap UCL		N/A
168					95% BCA Bootstrap UCL	N/A						
169					90% Chebyshev(Mean, Sd) UCL	0.0292				95% Chebyshev(Mean, Sd) UCL		0.0331
170					97.5% Chebyshev(Mean, Sd) UCL	0.0385				99% Chebyshev(Mean, Sd) UCL		0.049
171												
172					**Suggested UCL to Use**							
173					95% Student's-t UCL	0.029						
174												
175					**Recommended UCL exceeds the maximum observation**							
176												
177	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
178	Recommendations are based upon data size, data distribution, and skewness.											
179	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
180	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
181												
182	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
183	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
184												
185												
186	**Result (eu2_manganese)**											
187												
188					**General Statistics**							
189					Total Number of Observations	3				Number of Distinct Observations		3
190										Number of Missing Observations		0
191					Minimum	0.069				Mean		0.116
192					Maximum	0.15				Median		0.13
193					SD	0.0422				Std. Error of Mean		0.0244
194					Coefficient of Variation	0.363				Skewness		-1.305
195												
196	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
197	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
198	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
199	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
200												
201	**Normal GOF Test**											

202				Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk GOF Test**						
203				5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level						
204				Lilliefors Test Statistic	0.294	**Lilliefors GOF Test**						
205				5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level						
206				**Data appear Normal at 5% Significance Level**								
207												
208				**Assuming Normal Distribution**								
209				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
210				95% Student's-t UCL	0.187			95% Adjusted-CLT UCL (Chen-1995)	0.137			
211								95% Modified-t UCL (Johnson-1978)	0.184			
212												
213				**Gamma GOF Test**								
214				**Not Enough Data to Perform GOF Test**								
215												
216				**Gamma Statistics**								
217				k hat (MLE)	9.712			k star (bias corrected MLE)	N/A			
218				Theta hat (MLE)	0.012			Theta star (bias corrected MLE)	N/A			
219				nu hat (MLE)	58.27			nu star (bias corrected)	N/A			
220				MLE Mean (bias corrected)	N/A			MLE Sd (bias corrected)	N/A			
221								Approximate Chi Square Value (0.05)	N/A			
222				Adjusted Level of Significance	N/A			Adjusted Chi Square Value	N/A			
223												
224				**Assuming Gamma Distribution**								
225				95% Approximate Gamma UCL (use when n>=50))	N/A			95% Adjusted Gamma UCL (use when n<50)	N/A			
226												
227				**Lognormal GOF Test**								
228				Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk Lognormal GOF Test**						
229				5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level						
230				Lilliefors Test Statistic	0.32	**Lilliefors Lognormal GOF Test**						
231				5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level						
232				**Data appear Lognormal at 5% Significance Level**								
233												
234				**Lognormal Statistics**								
235				Minimum of Logged Data	-2.674			Mean of logged Data	-2.204			
236				Maximum of Logged Data	-1.897			SD of logged Data	0.413			
237												
238				**Assuming Lognormal Distribution**								
239				95% H-UCL	0.579			90% Chebyshev (MVUE) UCL	0.199			
240				95% Chebyshev (MVUE) UCL	0.236			97.5% Chebyshev (MVUE) UCL	0.287			
241				99% Chebyshev (MVUE) UCL	0.388							
242												
243				**Nonparametric Distribution Free UCL Statistics**								
244				**Data appear to follow a Discernible Distribution at 5% Significance Level**								
245												
246				**Nonparametric Distribution Free UCLs**								
247				95% CLT UCL	0.156			95% Jackknife UCL	0.187			
248				95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A			
249				95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A			
250				95% BCA Bootstrap UCL	N/A							
251				90% Chebyshev(Mean, Sd) UCL	0.189			95% Chebyshev(Mean, Sd) UCL	0.223			
252				97.5% Chebyshev(Mean, Sd) UCL	0.268			99% Chebyshev(Mean, Sd) UCL	0.359			
253												
254				**Suggested UCL to Use**								
255				95% Student's-t UCL	0.187							
256												
257				**Recommended UCL exceeds the maximum observation**								
258												
259	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
260	Recommendations are based upon data size, data distribution, and skewness.											
261	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
262	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
263												
264	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
265	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
266												
267	**Result (eu3_arsenic)**											
268												

269	**General Statistics**											
270					Total Number of Observations	3			Number of Distinct Observations	1		
271					Number of Detects	0			Number of Non-Detects	3		
272					Number of Distinct Detects	0			Number of Distinct Non-Detects	1		
273												
274	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
275	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
276	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
277												
278	**The data set for variable Result (eu3_arsenic) was not processed!**											
279												
280												
281												
282	**Result (eu3_chromium)**											
283												
284	**General Statistics**											
285					Total Number of Observations	3			Number of Distinct Observations	3		
286									Number of Missing Observations	0		
287					Minimum	0.17			Mean	0.193		
288					Maximum	0.22			Median	0.19		
289					SD	0.0252			Std. Error of Mean	0.0145		
290					Coefficient of Variation	0.13			Skewness	0.586		
291												
292	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
293	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
294	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
295	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
296												
297	**Normal GOF Test**											
298					Shapiro Wilk Test Statistic	0.987			**Shapiro Wilk GOF Test**			
299					5% Shapiro Wilk Critical Value	0.767			Data appear Normal at 5% Significance Level			
300					Lilliefors Test Statistic	0.219			**Lilliefors GOF Test**			
301					5% Lilliefors Critical Value	0.425			Data appear Normal at 5% Significance Level			
302	**Data appear Normal at 5% Significance Level**											
303												
304	**Assuming Normal Distribution**											
305					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
306					95% Student's-t UCL	0.236			95% Adjusted-CLT UCL (Chen-1995)	0.222		
307									95% Modified-t UCL (Johnson-1978)	0.237		
308												
309	**Gamma GOF Test**											
310	**Not Enough Data to Perform GOF Test**											
311												
312	**Gamma Statistics**											
313					k hat (MLE)	89.47			k star (bias corrected MLE)	N/A		
314					Theta hat (MLE)	0.00216			Theta star (bias corrected MLE)	N/A		
315					nu hat (MLE)	536.8			nu star (bias corrected)	N/A		
316					MLE Mean (bias corrected)	N/A			MLE Sd (bias corrected)	N/A		
317									Approximate Chi Square Value (0.05)	N/A		
318					Adjusted Level of Significance	N/A			Adjusted Chi Square Value	N/A		
319												
320	**Assuming Gamma Distribution**											
321	95% Approximate Gamma UCL (use when n>=50))					N/A			95% Adjusted Gamma UCL (use when n<50)	N/A		
322												
323	**Lognormal GOF Test**											
324					Shapiro Wilk Test Statistic	0.994			**Shapiro Wilk Lognormal GOF Test**			
325					5% Shapiro Wilk Critical Value	0.767			Data appear Lognormal at 5% Significance Level			
326					Lilliefors Test Statistic	0.203			**Lilliefors Lognormal GOF Test**			
327					5% Lilliefors Critical Value	0.425			Data appear Lognormal at 5% Significance Level			
328	**Data appear Lognormal at 5% Significance Level**											
329												
330	**Lognormal Statistics**											
331					Minimum of Logged Data	-1.772			Mean of logged Data	-1.649		
332					Maximum of Logged Data	-1.514			SD of logged Data	0.129		
333												
334	**Assuming Lognormal Distribution**											
335					95% H-UCL	0.252			90% Chebyshev (MVUE) UCL	0.237		

336				95% Chebyshev (MVUE) UCL	0.256			97.5% Chebyshev (MVUE) UCL	0.283			
337				99% Chebyshev (MVUE) UCL	0.337							
338												
339					**Nonparametric Distribution Free UCL Statistics**							
340					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
341												
342					**Nonparametric Distribution Free UCLs**							
343				95% CLT UCL	0.217			95% Jackknife UCL	0.236			
344				95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A			
345				95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A			
346				95% BCA Bootstrap UCL	N/A							
347				90% Chebyshev(Mean, Sd) UCL	0.237			95% Chebyshev(Mean, Sd) UCL	0.257			
348				97.5% Chebyshev(Mean, Sd) UCL	0.284			99% Chebyshev(Mean, Sd) UCL	0.338			
349												
350					**Suggested UCL to Use**							
351				95% Student's-t UCL	0.236							
352												
353					**Recommended UCL exceeds the maximum observation**							
354												
355	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
356	Recommendations are based upon data size, data distribution, and skewness.											
357	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
358	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
359												
360	**Result (eu3_lead)**											
361												
362					**General Statistics**							
363				Total Number of Observations	3			Number of Distinct Observations	3			
364				Number of Detects	2			Number of Non-Detects	1			
365				Number of Distinct Detects	2			Number of Distinct Non-Detects	1			
366				Minimum Detect	0.026			Minimum Non-Detect	0.0094			
367				Maximum Detect	0.19			Maximum Non-Detect	0.0094			
368				Variance Detects	0.0134			Percent Non-Detects	33.33%			
369				Mean Detects	0.108			SD Detects	0.116			
370				Median Detects	0.108			CV Detects	1.074			
371				Skewness Detects	N/A			Kurtosis Detects	N/A			
372				Mean of Logged Detects	-2.655			SD of Logged Detects	1.406			
373												
374					**Warning: Data set has only 2 Detected Values.**							
375					**This is not enough to compute meaningful or reliable statistics and estimates.**							
376												
377												
378					**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
379					**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
380					**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
381					**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
382												
383					**Normal GOF Test on Detects Only**							
384					**Not Enough Data to Perform GOF Test**							
385												
386					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
387				KM Mean	0.0751			KM Standard Error of Mean	0.0665			
388				KM SD	0.0815			95% KM (BCA) UCL	N/A			
389				95% KM (t) UCL	0.269			95% KM (Percentile Bootstrap) UCL	N/A			
390				95% KM (z) UCL	0.185			95% KM Bootstrap t UCL	N/A			
391				90% KM Chebyshev UCL	0.275			95% KM Chebyshev UCL	0.365			
392				97.5% KM Chebyshev UCL	0.491			99% KM Chebyshev UCL	0.737			
393												
394					**Gamma GOF Tests on Detected Observations Only**							
395					**Not Enough Data to Perform GOF Test**							
396												
397					**Gamma Statistics on Detected Data Only**							
398				k hat (MLE)	1.305			k star (bias corrected MLE)	N/A			
399				Theta hat (MLE)	0.0827			Theta star (bias corrected MLE)	N/A			
400				nu hat (MLE)	5.222			nu star (bias corrected)	N/A			
401				Mean (detects)	0.108							
402												

403	**Estimates of Gamma Parameters using KM Estimates**											
404					Mean (KM)	0.0751			SD (KM)	0.0815		
405					Variance (KM)	0.00664			SE of Mean (KM)	0.0665		
406					k hat (KM)	0.85			k star (KM)	N/A		
407					nu hat (KM)	5.099			nu star (KM)	N/A		
408					theta hat (KM)	0.0884			theta star (KM)	N/A		
409					80% gamma percentile (KM)	N/A			90% gamma percentile (KM)	N/A		
410					95% gamma percentile (KM)	N/A			99% gamma percentile (KM)	N/A		
411												
412	**Gamma Kaplan-Meier (KM) Statistics**											
413									Adjusted Level of Significance (β)	0.00136		
414					Approximate Chi Square Value (N/A, α)	N/A			Adjusted Chi Square Value (N/A, β)	N/A		
415	5% Gamma Approximate KM-UCL (use when n>=50)					N/A			95% Gamma Adjusted KM-UCL (use when n<50)	N/A		
416												
417	**Lognormal GOF Test on Detected Observations Only**											
418	**Not Enough Data to Perform GOF Test**											
419												
420	**Lognormal ROS Statistics Using Imputed Non-Detects**											
421					Mean in Original Scale	0.0723			Mean in Log Scale	-4.161		
422					SD in Original Scale	0.103			SD in Log Scale	2.791		
423					95% t UCL (assumes normality of ROS data)	0.245			95% Percentile Bootstrap UCL	N/A		
424					95% BCA Bootstrap UCL	N/A			95% Bootstrap t UCL	N/A		
425					95% H-UCL (Log ROS)	1.501E+31						
426												
427	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
428					KM Mean (logged)	-3.326			KM Geo Mean	0.0359		
429					KM SD (logged)	1.249			95% Critical H Value (KM-Log)	16.31		
430					KM Standard Error of Mean (logged)	1.019			95% H-UCL (KM -Log)	140468		
431					KM SD (logged)	1.249			95% Critical H Value (KM-Log)	16.31		
432					KM Standard Error of Mean (logged)	1.019						
433												
434	**DL/2 Statistics**											
435	**DL/2 Normal**								**DL/2 Log-Transformed**			
436					Mean in Original Scale	0.0736			Mean in Log Scale	-3.557		
437					SD in Original Scale	0.101			SD in Log Scale	1.851		
438					95% t UCL (Assumes normality)	0.245			95% H-Stat UCL	9.070E+12		
439	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
440												
441	**Nonparametric Distribution Free UCL Statistics**											
442	**Data do not follow a Discernible Distribution at 5% Significance Level**											
443												
444	**Suggested UCL to Use**											
445					95% KM (Chebyshev) UCL	0.365						
446	**Warning: Recommended UCL exceeds the maximum observation**											
447												
448	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
449	Recommendations are based upon data size, data distribution, and skewness.											
450	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
451	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
452												
453												
454	**Result (eu3_manganese)**											
455												
456	**General Statistics**											
457					Total Number of Observations	3			Number of Distinct Observations	3		
458									Number of Missing Observations	0		
459					Minimum	0.022			Mean	0.144		
460					Maximum	0.37			Median	0.041		
461					SD	0.196			Std. Error of Mean	0.113		
462					Coefficient of Variation	1.356			Skewness	1.714		
463												
464	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
465	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
466	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
467	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
468												
469	**Normal GOF Test**											

470				Shapiro Wilk Test Statistic	0.791	**Shapiro Wilk GOF Test**						
471				5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level						
472				Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**						
473				5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level						
474	**Data appear Normal at 5% Significance Level**											
475												
476	**Assuming Normal Distribution**											
477	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
478				95% Student's-t UCL	0.474	95% Adjusted-CLT UCL (Chen-1995)					0.45	
479						95% Modified-t UCL (Johnson-1978)					0.493	
480												
481	**Gamma GOF Test**											
482	**Not Enough Data to Perform GOF Test**											
483												
484	**Gamma Statistics**											
485				k hat (MLE)	0.809	k star (bias corrected MLE)					N/A	
486				Theta hat (MLE)	0.178	Theta star (bias corrected MLE)					N/A	
487				nu hat (MLE)	4.853	nu star (bias corrected)					N/A	
488				MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)					N/A	
489						Approximate Chi Square Value (0.05)					N/A	
490				Adjusted Level of Significance	N/A	Adjusted Chi Square Value					N/A	
491												
492	**Assuming Gamma Distribution**											
493	95% Approximate Gamma UCL (use when n>=50))				N/A	95% Adjusted Gamma UCL (use when n<50)					N/A	
494												
495	**Lognormal GOF Test**											
496				Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk Lognormal GOF Test**						
497				5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level						
498				Lilliefors Test Statistic	0.305	**Lilliefors Lognormal GOF Test**						
499				5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level						
500	**Data appear Lognormal at 5% Significance Level**											
501												
502	**Lognormal Statistics**											
503				Minimum of Logged Data	-3.817	Mean of logged Data					-2.668	
504				Maximum of Logged Data	-0.994	SD of logged Data					1.483	
505												
506	**Assuming Lognormal Distribution**											
507				95% H-UCL	1.387E+8	90% Chebyshev (MVUE) UCL					0.398	
508				95% Chebyshev (MVUE) UCL	0.519	97.5% Chebyshev (MVUE) UCL					0.687	
509				99% Chebyshev (MVUE) UCL	1.017							
510												
511	**Nonparametric Distribution Free UCL Statistics**											
512	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
513												
514	**Nonparametric Distribution Free UCLs**											
515				95% CLT UCL	0.33	95% Jackknife UCL					0.474	
516				95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL					N/A	
517				95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL					N/A	
518				95% BCA Bootstrap UCL	N/A							
519				90% Chebyshev(Mean, Sd) UCL	0.483	95% Chebyshev(Mean, Sd) UCL					0.637	
520				97.5% Chebyshev(Mean, Sd) UCL	0.85	99% Chebyshev(Mean, Sd) UCL					1.268	
521												
522	**Suggested UCL to Use**											
523				95% Student's-t UCL	0.474							
524												
525	**Recommended UCL exceeds the maximum observation**											
526												
527	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
528	Recommendations are based upon data size, data distribution, and skewness.											
529	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
530	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
531												
532	**Result (eu4_arsenic)**											
533												
534	**General Statistics**											
535				Total Number of Observations	3	Number of Distinct Observations					2	
536				Number of Detects	0	Number of Non-Detects					3	

537				Number of Distinct Detects		0				Number of Distinct Non-Detects		2
538												
539	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
540	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
541	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
542												
543	**The data set for variable Result (eu4_arsenic) was not processed!**											
544												
545												
546												
547	**Result (eu4_chromium)**											
548												
549	**General Statistics**											
550				Total Number of Observations		3				Number of Distinct Observations		3
551										Number of Missing Observations		0
552				Minimum		0.2				Mean		0.217
553				Maximum		0.23				Median		0.22
554				SD		0.0153				Std. Error of Mean		0.00882
555				Coefficient of Variation		0.0705				Skewness		-0.935
556												
557	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
558	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
559	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
560	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
561												
562	**Normal GOF Test**											
563				Shapiro Wilk Test Statistic		0.964				**Shapiro Wilk GOF Test**		
564				5% Shapiro Wilk Critical Value		0.767				Data appear Normal at 5% Significance Level		
565				Lilliefors Test Statistic		0.253				**Lilliefors GOF Test**		
566				5% Lilliefors Critical Value		0.425				Data appear Normal at 5% Significance Level		
567	**Data appear Normal at 5% Significance Level**											
568												
569	**Assuming Normal Distribution**											
570				**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**		
571				95% Student's-t UCL		0.242				95% Adjusted-CLT UCL (Chen-1995)		0.226
572										95% Modified-t UCL (Johnson-1978)		0.242
573												
574	**Gamma GOF Test**											
575	**Not Enough Data to Perform GOF Test**											
576												
577	**Gamma Statistics**											
578				k hat (MLE)		296.8				k star (bias corrected MLE)		N/A
579				Theta hat (MLE)		7.2990E-4				Theta star (bias corrected MLE)		N/A
580				nu hat (MLE)		1781				nu star (bias corrected)		N/A
581				MLE Mean (bias corrected)		N/A				MLE Sd (bias corrected)		N/A
582										Approximate Chi Square Value (0.05)		N/A
583				Adjusted Level of Significance		N/A				Adjusted Chi Square Value		N/A
584												
585	**Assuming Gamma Distribution**											
586				95% Approximate Gamma UCL (use when n>=50))		N/A				95% Adjusted Gamma UCL (use when n<50)		N/A
587												
588	**Lognormal GOF Test**											
589				Shapiro Wilk Test Statistic		0.958				**Shapiro Wilk Lognormal GOF Test**		
590				5% Shapiro Wilk Critical Value		0.767				Data appear Lognormal at 5% Significance Level		
591				Lilliefors Test Statistic		0.26				**Lilliefors Lognormal GOF Test**		
592				5% Lilliefors Critical Value		0.425				Data appear Lognormal at 5% Significance Level		
593	**Data appear Lognormal at 5% Significance Level**											
594												
595	**Lognormal Statistics**											
596				Minimum of Logged Data		-1.609				Mean of logged Data		-1.531
597				Maximum of Logged Data		-1.47				SD of logged Data		0.0714
598												
599	**Assuming Lognormal Distribution**											
600				95% H-UCL		N/A				90% Chebyshev (MVUE) UCL		0.243
601				95% Chebyshev (MVUE) UCL		0.256				97.5% Chebyshev (MVUE) UCL		0.272
602				99% Chebyshev (MVUE) UCL		0.305						
603												

604	**Nonparametric Distribution Free UCL Statistics**											
605	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
606												
607	**Nonparametric Distribution Free UCLs**											
608					95% CLT UCL	0.231			95% Jackknife UCL	0.242		
609					95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A		
610					95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A		
611					95% BCA Bootstrap UCL	N/A						
612					90% Chebyshev(Mean, Sd) UCL	0.243			95% Chebyshev(Mean, Sd) UCL	0.255		
613					97.5% Chebyshev(Mean, Sd) UCL	0.272			99% Chebyshev(Mean, Sd) UCL	0.304		
614												
615	**Suggested UCL to Use**											
616					95% Student's-t UCL	0.242						
617												
618	**Recommended UCL exceeds the maximum observation**											
619												
620	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
621	Recommendations are based upon data size, data distribution, and skewness.											
622	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
623	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
624												
625	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
626	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
627												
628	**Result (eu4_lead)**											
629												
630	**General Statistics**											
631					Total Number of Observations	3			Number of Distinct Observations	2		
632					Number of Detects	0			Number of Non-Detects	3		
633					Number of Distinct Detects	0			Number of Distinct Non-Detects	2		
634												
635	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
636	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
637	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
638												
639	**The data set for variable Result (eu4_lead) was not processed!**											
640												
641												
642												
643	**Result (eu4_manganese)**											
644												
645	**General Statistics**											
646					Total Number of Observations	3			Number of Distinct Observations	3		
647									Number of Missing Observations	0		
648					Minimum	0.032			Mean	0.0417		
649					Maximum	0.047			Median	0.046		
650					SD	0.00839			Std. Error of Mean	0.00484		
651					Coefficient of Variation	0.201			Skewness	-1.704		
652												
653	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
654	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
655	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
656	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
657												
658	**Normal GOF Test**											
659					Shapiro Wilk Test Statistic	0.8			**Shapiro Wilk GOF Test**			
660					5% Shapiro Wilk Critical Value	0.767			Data appear Normal at 5% Significance Level			
661					Lilliefors Test Statistic	0.364			**Lilliefors GOF Test**			
662					5% Lilliefors Critical Value	0.425			Data appear Normal at 5% Significance Level			
663	**Data appear Normal at 5% Significance Level**											
664												
665	**Assuming Normal Distribution**											
666	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
667					95% Student's-t UCL	0.0558			95% Adjusted-CLT UCL (Chen-1995)	0.0445		
668									95% Modified-t UCL (Johnson-1978)	0.055		
669												
670	**Gamma GOF Test**											

671	**Not Enough Data to Perform GOF Test**											
672												
673	**Gamma Statistics**											
674					k hat (MLE)	33.81			k star (bias corrected MLE)	N/A		
675					Theta hat (MLE)	0.00123			Theta star (bias corrected MLE)	N/A		
676					nu hat (MLE)	202.9			nu star (bias corrected)	N/A		
677					MLE Mean (bias corrected)	N/A			MLE Sd (bias corrected)	N/A		
678									Approximate Chi Square Value (0.05)	N/A		
679					Adjusted Level of Significance	N/A			Adjusted Chi Square Value	N/A		
680												
681	**Assuming Gamma Distribution**											
682	95% Approximate Gamma UCL (use when n>=50))					N/A			95% Adjusted Gamma UCL (use when n<50)	N/A		
683												
684	**Lognormal GOF Test**											
685					Shapiro Wilk Test Statistic	0.792			**Shapiro Wilk Lognormal GOF Test**			
686					5% Shapiro Wilk Critical Value	0.767			Data appear Lognormal at 5% Significance Level			
687					Lilliefors Test Statistic	0.368			**Lilliefors Lognormal GOF Test**			
688					5% Lilliefors Critical Value	0.425			Data appear Lognormal at 5% Significance Level			
689	**Data appear Lognormal at 5% Significance Level**											
690												
691	**Lognormal Statistics**											
692					Minimum of Logged Data	-3.442			Mean of logged Data	-3.193		
693					Maximum of Logged Data	-3.058			SD of logged Data	0.216		
694												
695	**Assuming Lognormal Distribution**											
696					95% H-UCL	0.0707			90% Chebyshev (MVUE) UCL	0.0572		
697					95% Chebyshev (MVUE) UCL	0.0642			97.5% Chebyshev (MVUE) UCL	0.074		
698					99% Chebyshev (MVUE) UCL	0.0931						
699												
700	**Nonparametric Distribution Free UCL Statistics**											
701	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
702												
703	**Nonparametric Distribution Free UCLs**											
704					95% CLT UCL	0.0496			95% Jackknife UCL	0.0558		
705					95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A		
706					95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A		
707					95% BCA Bootstrap UCL	N/A						
708					90% Chebyshev(Mean, Sd) UCL	0.0562			95% Chebyshev(Mean, Sd) UCL	0.0628		
709					97.5% Chebyshev(Mean, Sd) UCL	0.0719			99% Chebyshev(Mean, Sd) UCL	0.0898		
710												
711	**Suggested UCL to Use**											
712					95% Student's-t UCL	0.0558						
713												
714	**Recommended UCL exceeds the maximum observation**											
715												
716	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
717	Recommendations are based upon data size, data distribution, and skewness.											
718	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
719	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
720												
721	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
722	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
723												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.12/8/2019 4:22:18 PM										
5	From File	BPMD_HHRA_ATVGuide_SoilInput.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10												
11	**Result (eua_antimony_soil-road)**											
12												
13	**General Statistics**											
14	Total Number of Observations			36			Number of Distinct Observations					33
15							Number of Missing Observations					0
16	Minimum			0.35			Mean					1.344
17	Maximum			6.02			Median					0.68
18	SD			1.516			Std. Error of Mean					0.253
19	Coefficient of Variation			1.128			Skewness					2.19
20												
21	**Normal GOF Test**											
22	Shapiro Wilk Test Statistic			0.652			**Shapiro Wilk GOF Test**					
23	5% Shapiro Wilk Critical Value			0.935			Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic			0.286			**Lilliefors GOF Test**					
25	5% Lilliefors Critical Value			0.145			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			1.771			95% Adjusted-CLT UCL (Chen-1995)					1.858
31							95% Modified-t UCL (Johnson-1978)					1.786
32												
33	**Gamma GOF Test**											
34	A-D Test Statistic			2.378			**Anderson-Darling Gamma GOF Test**					
35	5% A-D Critical Value			0.769			Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic			0.202			**Kolmogorov-Smirnov Gamma GOF Test**					
37	5% K-S Critical Value			0.15			Data Not Gamma Distributed at 5% Significance Level					
38	**Data Not Gamma Distributed at 5% Significance Level**											
39												
40	**Gamma Statistics**											
41	k hat (MLE)			1.379			k star (bias corrected MLE)					1.283
42	Theta hat (MLE)			0.974			Theta star (bias corrected MLE)					1.048
43	nu hat (MLE)			99.31			nu star (bias corrected)					92.37
44	MLE Mean (bias corrected)			1.344			MLE Sd (bias corrected)					1.187
45							Approximate Chi Square Value (0.05)					71.21
46	Adjusted Level of Significance			0.0428			Adjusted Chi Square Value					70.36
47												
48	**Assuming Gamma Distribution**											
49	95% Approximate Gamma UCL (use when n>=50))			1.744			95% Adjusted Gamma UCL (use when n<50)					1.764
50												
51	**Lognormal GOF Test**											
52	Shapiro Wilk Test Statistic			0.878			**Shapiro Wilk Lognormal GOF Test**					
53	5% Shapiro Wilk Critical Value			0.935			Data Not Lognormal at 5% Significance Level					
54	Lilliefors Test Statistic			0.155			**Lilliefors Lognormal GOF Test**					
55	5% Lilliefors Critical Value			0.145			Data Not Lognormal at 5% Significance Level					
56	**Data Not Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59	Minimum of Logged Data			-1.05			Mean of logged Data					-0.109
60	Maximum of Logged Data			1.795			SD of logged Data					0.831
61												
62	**Assuming Lognormal Distribution**											
63	95% H-UCL			1.726			90% Chebyshev (MVUE) UCL					1.832
64	95% Chebyshev (MVUE) UCL			2.095			97.5% Chebyshev (MVUE) UCL					2.46
65	99% Chebyshev (MVUE) UCL			3.177								
66												
67	**Nonparametric Distribution Free UCL Statistics**											

68	**Data do not follow a Discernible Distribution (0.05)**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	1.76			95% Jackknife UCL	1.771		
72					95% Standard Bootstrap UCL	1.754			95% Bootstrap-t UCL	1.938		
73					95% Hall's Bootstrap UCL	1.8			95% Percentile Bootstrap UCL	1.781		
74					95% BCA Bootstrap UCL	1.881						
75					90% Chebyshev(Mean, Sd) UCL	2.102			95% Chebyshev(Mean, Sd) UCL	2.445		
76					97.5% Chebyshev(Mean, Sd) UCL	2.922			99% Chebyshev(Mean, Sd) UCL	3.858		
77												
78	**Suggested UCL to Use**											
79					95% Chebyshev (Mean, Sd) UCL	2.445						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
85												
86												
87	**Result (eua_arsenic_soil-road)**											
88												
89	**General Statistics**											
90					Total Number of Observations	36			Number of Distinct Observations	35		
91									Number of Missing Observations	0		
92					Minimum	3.19			Mean	19.95		
93					Maximum	106			Median	19.3		
94					SD	17.25			Std. Error of Mean	2.874		
95					Coefficient of Variation	0.864			Skewness	3.65		
96												
97	**Normal GOF Test**											
98					Shapiro Wilk Test Statistic	0.659			**Shapiro Wilk GOF Test**			
99					5% Shapiro Wilk Critical Value	0.935			Data Not Normal at 5% Significance Level			
100					Lilliefors Test Statistic	0.209			**Lilliefors GOF Test**			
101					5% Lilliefors Critical Value	0.145			Data Not Normal at 5% Significance Level			
102	**Data Not Normal at 5% Significance Level**											
103												
104	**Assuming Normal Distribution**											
105					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
106					95% Student's-t UCL	24.81			95% Adjusted-CLT UCL (Chen-1995)	26.55		
107									95% Modified-t UCL (Johnson-1978)	25.1		
108												
109	**Gamma GOF Test**											
110					A-D Test Statistic	0.646			**Anderson-Darling Gamma GOF Test**			
111					5% A-D Critical Value	0.759			Detected data appear Gamma Distributed at 5% Significance Lev			
112					K-S Test Statistic	0.126			**Kolmogorov-Smirnov Gamma GOF Test**			
113					5% K-S Critical Value	0.149			Detected data appear Gamma Distributed at 5% Significance Lev			
114	**Detected data appear Gamma Distributed at 5% Significance Level**											
115												
116	**Gamma Statistics**											
117					k hat (MLE)	2.172			k star (bias corrected MLE)	2.009		
118					Theta hat (MLE)	9.187			Theta star (bias corrected MLE)	9.93		
119					nu hat (MLE)	156.4			nu star (bias corrected)	144.7		
120					MLE Mean (bias corrected)	19.95			MLE Sd (bias corrected)	14.08		
121									Approximate Chi Square Value (0.05)	117.9		
122					Adjusted Level of Significance	0.0428			Adjusted Chi Square Value	116.8		
123												
124	**Assuming Gamma Distribution**											
125					95% Approximate Gamma UCL (use when n>=50)	24.49			95% Adjusted Gamma UCL (use when n<50)	24.72		
126												
127	**Lognormal GOF Test**											
128					Shapiro Wilk Test Statistic	0.956			**Shapiro Wilk Lognormal GOF Test**			
129					5% Shapiro Wilk Critical Value	0.935			Data appear Lognormal at 5% Significance Level			
130					Lilliefors Test Statistic	0.156			**Lilliefors Lognormal GOF Test**			
131					5% Lilliefors Critical Value	0.145			Data Not Lognormal at 5% Significance Level			
132	**Data appear Approximate Lognormal at 5% Significance Level**											
133												
134	**Lognormal Statistics**											

135				Minimum of Logged Data	1.16				Mean of logged Data	2.746		
136				Maximum of Logged Data	4.663				SD of logged Data	0.716		
137												
138				**Assuming Lognormal Distribution**								
139				95% H-UCL	25.92				90% Chebyshev (MVUE) UCL	27.74		
140				95% Chebyshev (MVUE) UCL	31.27				97.5% Chebyshev (MVUE) UCL	36.16		
141				99% Chebyshev (MVUE) UCL	45.78							
142												
143				**Nonparametric Distribution Free UCL Statistics**								
144				**Data appear to follow a Discernible Distribution at 5% Significance Level**								
145												
146				**Nonparametric Distribution Free UCLs**								
147				95% CLT UCL	24.68				95% Jackknife UCL	24.81		
148				95% Standard Bootstrap UCL	24.63				95% Bootstrap-t UCL	27.98		
149				95% Hall's Bootstrap UCL	46.73				95% Percentile Bootstrap UCL	25.34		
150				95% BCA Bootstrap UCL	27							
151				90% Chebyshev(Mean, Sd) UCL	28.58				95% Chebyshev(Mean, Sd) UCL	32.48		
152				97.5% Chebyshev(Mean, Sd) UCL	37.9				99% Chebyshev(Mean, Sd) UCL	48.55		
153												
154				**Suggested UCL to Use**								
155				95% Adjusted Gamma UCL	24.72							
156												
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	Recommendations are based upon data size, data distribution, and skewness.											
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
161												
162												
163	**Result (eua_cadmium_soil-road)**											
164												
165				**General Statistics**								
166				Total Number of Observations	36				Number of Distinct Observations	31		
167									Number of Missing Observations	0		
168				Minimum	0.291				Mean	1.48		
169				Maximum	6.06				Median	1.025		
170				SD	1.269				Std. Error of Mean	0.212		
171				Coefficient of Variation	0.858				Skewness	2.321		
172												
173				**Normal GOF Test**								
174				Shapiro Wilk Test Statistic	0.743				**Shapiro Wilk GOF Test**			
175				5% Shapiro Wilk Critical Value	0.935				Data Not Normal at 5% Significance Level			
176				Lilliefors Test Statistic	0.195				**Lilliefors GOF Test**			
177				5% Lilliefors Critical Value	0.145				Data Not Normal at 5% Significance Level			
178				**Data Not Normal at 5% Significance Level**								
179												
180				**Assuming Normal Distribution**								
181				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
182				95% Student's-t UCL	1.837				95% Adjusted-CLT UCL (Chen-1995)	1.915		
183									95% Modified-t UCL (Johnson-1978)	1.851		
184												
185				**Gamma GOF Test**								
186				A-D Test Statistic	0.696				**Anderson-Darling Gamma GOF Test**			
187				5% A-D Critical Value	0.759				Detected data appear Gamma Distributed at 5% Significance Lev			
188				K-S Test Statistic	0.116				**Kolmogorov-Smirnov Gamma GOF Test**			
189				5% K-S Critical Value	0.149				Detected data appear Gamma Distributed at 5% Significance Lev			
190				**Detected data appear Gamma Distributed at 5% Significance Level**								
191												
192				**Gamma Statistics**								
193				k hat (MLE)	2.041				k star (bias corrected MLE)	1.889		
194				Theta hat (MLE)	0.725				Theta star (bias corrected MLE)	0.783		
195				nu hat (MLE)	146.9				nu star (bias corrected)	136		
196				MLE Mean (bias corrected)	1.48				MLE Sd (bias corrected)	1.077		
197									Approximate Chi Square Value (0.05)	110.1		
198				Adjusted Level of Significance	0.0428				Adjusted Chi Square Value	109		
199												
200				**Assuming Gamma Distribution**								
201				95% Approximate Gamma UCL (use when n>=50)	1.828				95% Adjusted Gamma UCL (use when n<50)	1.846		

202												
203	**Lognormal GOF Test**											
204					Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**					
205					5% Shapiro Wilk Critical Value	0.935	Data appear Lognormal at 5% Significance Level					
206					Lilliefors Test Statistic	0.0732	**Lilliefors Lognormal GOF Test**					
207					5% Lilliefors Critical Value	0.145	Data appear Lognormal at 5% Significance Level					
208	**Data appear Lognormal at 5% Significance Level**											
209												
210	**Lognormal Statistics**											
211					Minimum of Logged Data	-1.234	Mean of logged Data	0.127				
212					Maximum of Logged Data	1.802	SD of logged Data	0.716				
213												
214	**Assuming Lognormal Distribution**											
215					95% H-UCL	1.891	90% Chebyshev (MVUE) UCL	2.024				
216					95% Chebyshev (MVUE) UCL	2.281	97.5% Chebyshev (MVUE) UCL	2.638				
217					99% Chebyshev (MVUE) UCL	3.34						
218												
219	**Nonparametric Distribution Free UCL Statistics**											
220	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
221												
222	**Nonparametric Distribution Free UCLs**											
223					95% CLT UCL	1.828	95% Jackknife UCL	1.837				
224					95% Standard Bootstrap UCL	1.825	95% Bootstrap-t UCL	2.063				
225					95% Hall's Bootstrap UCL	2.235	95% Percentile Bootstrap UCL	1.842				
226					95% BCA Bootstrap UCL	1.954						
227					90% Chebyshev(Mean, Sd) UCL	2.114	95% Chebyshev(Mean, Sd) UCL	2.402				
228					97.5% Chebyshev(Mean, Sd) UCL	2.801	99% Chebyshev(Mean, Sd) UCL	3.585				
229												
230	**Suggested UCL to Use**											
231					95% Adjusted Gamma UCL	1.846						
232												
233	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
234	Recommendations are based upon data size, data distribution, and skewness.											
235	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
236	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
237												
238												
239	**Result (eua_chromium_soil-road)**											
240												
241	**General Statistics**											
242					Total Number of Observations	36	Number of Distinct Observations	29				
243							Number of Missing Observations	0				
244					Minimum	2.27	Mean	4.925				
245					Maximum	8.4	Median	5.03				
246					SD	1.435	Std. Error of Mean	0.239				
247					Coefficient of Variation	0.291	Skewness	0.242				
248												
249	**Normal GOF Test**											
250					Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk GOF Test**					
251					5% Shapiro Wilk Critical Value	0.935	Data appear Normal at 5% Significance Level					
252					Lilliefors Test Statistic	0.087	**Lilliefors GOF Test**					
253					5% Lilliefors Critical Value	0.145	Data appear Normal at 5% Significance Level					
254	**Data appear Normal at 5% Significance Level**											
255												
256	**Assuming Normal Distribution**											
257	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
258					95% Student's-t UCL	5.329	95% Adjusted-CLT UCL (Chen-1995)	5.328				
259							95% Modified-t UCL (Johnson-1978)	5.33				
260												
261	**Gamma GOF Test**											
262					A-D Test Statistic	0.224	**Anderson-Darling Gamma GOF Test**					
263					5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Lev					
264					K-S Test Statistic	0.0861	**Kolmogorov-Smirnov Gamma GOF Test**					
265					5% K-S Critical Value	0.147	Detected data appear Gamma Distributed at 5% Significance Lev					
266	**Detected data appear Gamma Distributed at 5% Significance Level**											
267												
268	**Gamma Statistics**											

269					k hat (MLE)	11.53				k star (bias corrected MLE)		10.59
270					Theta hat (MLE)	0.427				Theta star (bias corrected MLE)		0.465
271					nu hat (MLE)	830.2				nu star (bias corrected)		762.4
272					MLE Mean (bias corrected)	4.925				MLE Sd (bias corrected)		1.513
273										Approximate Chi Square Value (0.05)		699.3
274					Adjusted Level of Significance	0.0428				Adjusted Chi Square Value		696.6
275												
276					**Assuming Gamma Distribution**							
277				95% Approximate Gamma UCL (use when n>=50))		5.369				95% Adjusted Gamma UCL (use when n<50)		5.39
278												
279					**Lognormal GOF Test**							
280					Shapiro Wilk Test Statistic	0.971				**Shapiro Wilk Lognormal GOF Test**		
281					5% Shapiro Wilk Critical Value	0.935				Data appear Lognormal at 5% Significance Level		
282					Lilliefors Test Statistic	0.101				**Lilliefors Lognormal GOF Test**		
283					5% Lilliefors Critical Value	0.145				Data appear Lognormal at 5% Significance Level		
284					**Data appear Lognormal at 5% Significance Level**							
285												
286					**Lognormal Statistics**							
287					Minimum of Logged Data	0.82				Mean of logged Data		1.55
288					Maximum of Logged Data	2.128				SD of logged Data		0.308
289												
290					**Assuming Lognormal Distribution**							
291					95% H-UCL	5.424				90% Chebyshev (MVUE) UCL		5.709
292					95% Chebyshev (MVUE) UCL	6.06				97.5% Chebyshev (MVUE) UCL		6.546
293					99% Chebyshev (MVUE) UCL	7.502						
294												
295					**Nonparametric Distribution Free UCL Statistics**							
296					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
297												
298					**Nonparametric Distribution Free UCLs**							
299					95% CLT UCL	5.318				95% Jackknife UCL		5.329
300					95% Standard Bootstrap UCL	5.312				95% Bootstrap-t UCL		5.32
301					95% Hall's Bootstrap UCL	5.343				95% Percentile Bootstrap UCL		5.31
302					95% BCA Bootstrap UCL	5.298						
303					90% Chebyshev(Mean, Sd) UCL	5.642				95% Chebyshev(Mean, Sd) UCL		5.967
304					97.5% Chebyshev(Mean, Sd) UCL	6.418				99% Chebyshev(Mean, Sd) UCL		7.304
305												
306					**Suggested UCL to Use**							
307					95% Student's-t UCL	5.329						
308												
309	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
310	Recommendations are based upon data size, data distribution, and skewness.											
311	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
312	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
313												
314												
315	**Result (eua_cobalt_soil-road)**											
316												
317					**General Statistics**							
318					Total Number of Observations	36				Number of Distinct Observations		27
319										Number of Missing Observations		0
320					Minimum	2.98				Mean		6.087
321					Maximum	11.7				Median		6.1
322					SD	1.623				Std. Error of Mean		0.271
323					Coefficient of Variation	0.267				Skewness		1.036
324												
325					**Normal GOF Test**							
326					Shapiro Wilk Test Statistic	0.936				**Shapiro Wilk GOF Test**		
327					5% Shapiro Wilk Critical Value	0.935				Data appear Normal at 5% Significance Level		
328					Lilliefors Test Statistic	0.127				**Lilliefors GOF Test**		
329					5% Lilliefors Critical Value	0.145				Data appear Normal at 5% Significance Level		
330					**Data appear Normal at 5% Significance Level**							
331												
332					**Assuming Normal Distribution**							
333					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
334					95% Student's-t UCL	6.544				95% Adjusted-CLT UCL (Chen-1995)		6.582
335										95% Modified-t UCL (Johnson-1978)		6.552

336												
337	**Gamma GOF Test**											
338					A-D Test Statistic	0.405	**Anderson-Darling Gamma GOF Test**					
339					5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Lev					
340					K-S Test Statistic	0.103	**Kolmogorov-Smirnov Gamma GOF Test**					
341					5% K-S Critical Value	0.147	Detected data appear Gamma Distributed at 5% Significance Lev					
342	**Detected data appear Gamma Distributed at 5% Significance Level**											
343												
344	**Gamma Statistics**											
345					k hat (MLE)	15.11	k star (bias corrected MLE)	13.87				
346					Theta hat (MLE)	0.403	Theta star (bias corrected MLE)	0.439				
347					nu hat (MLE)	1088	nu star (bias corrected)	998.8				
348					MLE Mean (bias corrected)	6.087	MLE Sd (bias corrected)	1.634				
349							Approximate Chi Square Value (0.05)	926.5				
350					Adjusted Level of Significance	0.0428	Adjusted Chi Square Value	923.3				
351												
352	**Assuming Gamma Distribution**											
353	95% Approximate Gamma UCL (use when n>=50))					6.562	95% Adjusted Gamma UCL (use when n<50)	6.584				
354												
355	**Lognormal GOF Test**											
356					Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**					
357					5% Shapiro Wilk Critical Value	0.935	Data appear Lognormal at 5% Significance Level					
358					Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**					
359					5% Lilliefors Critical Value	0.145	Data appear Lognormal at 5% Significance Level					
360	**Data appear Lognormal at 5% Significance Level**											
361												
362	**Lognormal Statistics**											
363					Minimum of Logged Data	1.092	Mean of logged Data	1.773				
364					Maximum of Logged Data	2.46	SD of logged Data	0.264				
365												
366	**Assuming Lognormal Distribution**											
367					95% H-UCL	6.593	90% Chebyshev (MVUE) UCL	6.902				
368					95% Chebyshev (MVUE) UCL	7.27	97.5% Chebyshev (MVUE) UCL	7.782				
369					99% Chebyshev (MVUE) UCL	8.786						
370												
371	**Nonparametric Distribution Free UCL Statistics**											
372	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
373												
374	**Nonparametric Distribution Free UCLs**											
375					95% CLT UCL	6.532	95% Jackknife UCL	6.544				
376					95% Standard Bootstrap UCL	6.519	95% Bootstrap-t UCL	6.615				
377					95% Hall's Bootstrap UCL	6.645	95% Percentile Bootstrap UCL	6.541				
378					95% BCA Bootstrap UCL	6.581						
379					90% Chebyshev(Mean, Sd) UCL	6.898	95% Chebyshev(Mean, Sd) UCL	7.266				
380					97.5% Chebyshev(Mean, Sd) UCL	7.776	99% Chebyshev(Mean, Sd) UCL	8.778				
381												
382	**Suggested UCL to Use**											
383					95% Student's-t UCL	6.544						
384												
385	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
386	Recommendations are based upon data size, data distribution, and skewness.											
387	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
388	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
389												
390												
391	**Result (eua_iron_soil-road)**											
392												
393	**General Statistics**											
394					Total Number of Observations	36	Number of Distinct Observations	35				
395							Number of Missing Observations	0				
396					Minimum	10400	Mean	28031				
397					Maximum	175000	Median	23250				
398					SD	27240	Std. Error of Mean	4540				
399					Coefficient of Variation	0.972	Skewness	4.849				
400												
401	**Normal GOF Test**											
402					Shapiro Wilk Test Statistic	0.434	**Shapiro Wilk GOF Test**					

403				5% Shapiro Wilk Critical Value	0.935	Data Not Normal at 5% Significance Level						
404				Lilliefors Test Statistic	0.366	**Lilliefors GOF Test**						
405				5% Lilliefors Critical Value	0.145	Data Not Normal at 5% Significance Level						
406	**Data Not Normal at 5% Significance Level**											
407												
408	**Assuming Normal Distribution**											
409	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
410				95% Student's-t UCL	35701	95% Adjusted-CLT UCL (Chen-1995)	39419					
411						95% Modified-t UCL (Johnson-1978)	36313					
412												
413	**Gamma GOF Test**											
414				A-D Test Statistic	3.28	**Anderson-Darling Gamma GOF Test**						
415				5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level						
416				K-S Test Statistic	0.262	**Kolmogorov-Smirnov Gamma GOF Test**						
417				5% K-S Critical Value	0.148	Data Not Gamma Distributed at 5% Significance Level						
418	**Data Not Gamma Distributed at 5% Significance Level**											
419												
420	**Gamma Statistics**											
421				k hat (MLE)	3.039	k star (bias corrected MLE)	2.804					
422				Theta hat (MLE)	9223	Theta star (bias corrected MLE)	9995					
423				nu hat (MLE)	218.8	nu star (bias corrected)	201.9					
424				MLE Mean (bias corrected)	28031	MLE Sd (bias corrected)	16738					
425						Approximate Chi Square Value (0.05)	170					
426				Adjusted Level of Significance	0.0428	Adjusted Chi Square Value	168.7					
427												
428	**Assuming Gamma Distribution**											
429	95% Approximate Gamma UCL (use when n>=50))				33286	95% Adjusted Gamma UCL (use when n<50)	33547					
430												
431	**Lognormal GOF Test**											
432				Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk Lognormal GOF Test**						
433				5% Shapiro Wilk Critical Value	0.935	Data Not Lognormal at 5% Significance Level						
434				Lilliefors Test Statistic	0.195	**Lilliefors Lognormal GOF Test**						
435				5% Lilliefors Critical Value	0.145	Data Not Lognormal at 5% Significance Level						
436	**Data Not Lognormal at 5% Significance Level**											
437												
438	**Lognormal Statistics**											
439				Minimum of Logged Data	9.25	Mean of logged Data	10.07					
440				Maximum of Logged Data	12.07	SD of logged Data	0.494					
441												
442	**Assuming Lognormal Distribution**											
443				95% H-UCL	31228	90% Chebyshev (MVUE) UCL	33388					
444				95% Chebyshev (MVUE) UCL	36494	97.5% Chebyshev (MVUE) UCL	40805					
445				99% Chebyshev (MVUE) UCL	49274							
446												
447	**Nonparametric Distribution Free UCL Statistics**											
448	**Data do not follow a Discernible Distribution (0.05)**											
449												
450	**Nonparametric Distribution Free UCLs**											
451				95% CLT UCL	35498	95% Jackknife UCL	35701					
452				95% Standard Bootstrap UCL	35428	95% Bootstrap-t UCL	55356					
453				95% Hall's Bootstrap UCL	71180	95% Percentile Bootstrap UCL	36375					
454				95% BCA Bootstrap UCL	42069							
455				90% Chebyshev(Mean, Sd) UCL	41651	95% Chebyshev(Mean, Sd) UCL	47820					
456				97.5% Chebyshev(Mean, Sd) UCL	56383	99% Chebyshev(Mean, Sd) UCL	73204					
457												
458	**Suggested UCL to Use**											
459				95% Student's-t UCL	35701	or 95% Modified-t UCL	36313					
460												
461	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
462	Recommendations are based upon data size, data distribution, and skewness.											
463	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
464	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
465												
466												
467	**Result (eua_manganese_soil-road)**											
468												
469	**General Statistics**											

470	Total Number of Observations				36	Number of Distinct Observations						34
471						Number of Missing Observations						0
472	Minimum				424	Mean						1353
473	Maximum				8990	Median						873.5
474	SD				1455	Std. Error of Mean						242.4
475	Coefficient of Variation				1.075	Skewness						4.41
476												
477	**Normal GOF Test**											
478	Shapiro Wilk Test Statistic				0.52	**Shapiro Wilk GOF Test**						
479	5% Shapiro Wilk Critical Value				0.935	Data Not Normal at 5% Significance Level						
480	Lilliefors Test Statistic				0.273	**Lilliefors GOF Test**						
481	5% Lilliefors Critical Value				0.145	Data Not Normal at 5% Significance Level						
482	**Data Not Normal at 5% Significance Level**											
483												
484	**Assuming Normal Distribution**											
485	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
486	95% Student's-t UCL				1763	95% Adjusted-CLT UCL (Chen-1995)						1942
487						95% Modified-t UCL (Johnson-1978)						1792
488												
489	**Gamma GOF Test**											
490	A-D Test Statistic				1.982	**Anderson-Darling Gamma GOF Test**						
491	5% A-D Critical Value				0.758	Data Not Gamma Distributed at 5% Significance Level						
492	K-S Test Statistic				0.181	**Kolmogorov-Smirnov Gamma GOF Test**						
493	5% K-S Critical Value				0.149	Data Not Gamma Distributed at 5% Significance Level						
494	**Data Not Gamma Distributed at 5% Significance Level**											
495												
496	**Gamma Statistics**											
497	k hat (MLE)				2.209	k star (bias corrected MLE)						2.044
498	Theta hat (MLE)				612.5	Theta star (bias corrected MLE)						662.1
499	nu hat (MLE)				159.1	nu star (bias corrected)						147.2
500	MLE Mean (bias corrected)				1353	MLE Sd (bias corrected)						946.5
501						Approximate Chi Square Value (0.05)						120.1
502	Adjusted Level of Significance				0.0428	Adjusted Chi Square Value						119
503												
504	**Assuming Gamma Distribution**											
505	95% Approximate Gamma UCL (use when n>=50))				1658	95% Adjusted Gamma UCL (use when n<50)						1673
506												
507	**Lognormal GOF Test**											
508	Shapiro Wilk Test Statistic				0.907	**Shapiro Wilk Lognormal GOF Test**						
509	5% Shapiro Wilk Critical Value				0.935	Data Not Lognormal at 5% Significance Level						
510	Lilliefors Test Statistic				0.145	**Lilliefors Lognormal GOF Test**						
511	5% Lilliefors Critical Value				0.145	Data appear Lognormal at 5% Significance Level						
512	**Data appear Approximate Lognormal at 5% Significance Level**											
513												
514	**Lognormal Statistics**											
515	Minimum of Logged Data				6.05	Mean of logged Data						6.967
516	Maximum of Logged Data				9.104	SD of logged Data						0.61
517												
518	**Assuming Lognormal Distribution**											
519	95% H-UCL				1571	90% Chebyshev (MVUE) UCL						1685
520	95% Chebyshev (MVUE) UCL				1872	97.5% Chebyshev (MVUE) UCL						2133
521	99% Chebyshev (MVUE) UCL				2644							
522												
523	**Nonparametric Distribution Free UCL Statistics**											
524	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
525												
526	**Nonparametric Distribution Free UCLs**											
527	95% CLT UCL				1752	95% Jackknife UCL						1763
528	95% Standard Bootstrap UCL				1754	95% Bootstrap-t UCL						2278
529	95% Hall's Bootstrap UCL				3291	95% Percentile Bootstrap UCL						1798
530	95% BCA Bootstrap UCL				2110							
531	90% Chebyshev(Mean, Sd) UCL				2080	95% Chebyshev(Mean, Sd) UCL						2410
532	97.5% Chebyshev(Mean, Sd) UCL				2867	99% Chebyshev(Mean, Sd) UCL						3765
533												
534	**Suggested UCL to Use**											
535	95% H-UCL				1571							
536												

537	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
538	Recommendations are based upon data size, data distribution, and skewness.											
539	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
540	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
541												
542	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
543	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
544	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
545	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
546												
547	**Result (eua_thallium_soil-road)**											
548												
549	**General Statistics**											
550						Total Number of Observations	36			Number of Distinct Observations	22	
551						Number of Detects	29			Number of Non-Detects	7	
552						Number of Distinct Detects	17			Number of Distinct Non-Detects	5	
553						Minimum Detect	0.06			Minimum Non-Detect	0.499	
554						Maximum Detect	0.95			Maximum Non-Detect	0.506	
555						Variance Detects	0.0276			Percent Non-Detects	19.44%	
556						Mean Detects	0.171			SD Detects	0.166	
557						Median Detects	0.13			CV Detects	0.971	
558						Skewness Detects	3.994			Kurtosis Detects	18.22	
559						Mean of Logged Detects	-1.978			SD of Logged Detects	0.578	
560												
561	**Normal GOF Test on Detects Only**											
562						Shapiro Wilk Test Statistic	0.538			**Shapiro Wilk GOF Test**		
563						5% Shapiro Wilk Critical Value	0.926			Detected Data Not Normal at 5% Significance Level		
564						Lilliefors Test Statistic	0.304			**Lilliefors GOF Test**		
565						5% Lilliefors Critical Value	0.161			Detected Data Not Normal at 5% Significance Level		
566	**Detected Data Not Normal at 5% Significance Level**											
567												
568	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
569						KM Mean	0.166			KM Standard Error of Mean	0.0262	
570						KM SD	0.15			95% KM (BCA) UCL	0.212	
571						95% KM (t) UCL	0.21			95% KM (Percentile Bootstrap) UCL	0.216	
572						95% KM (z) UCL	0.209			95% KM Bootstrap t UCL	0.258	
573						90% KM Chebyshev UCL	0.244			95% KM Chebyshev UCL	0.28	
574						97.5% KM Chebyshev UCL	0.329			99% KM Chebyshev UCL	0.427	
575												
576	**Gamma GOF Tests on Detected Observations Only**											
577						A-D Test Statistic	1.535			**Anderson-Darling GOF Test**		
578						5% A-D Critical Value	0.755			Detected Data Not Gamma Distributed at 5% Significance Level		
579						K-S Test Statistic	0.19			**Kolmogorov-Smirnov GOF**		
580						5% K-S Critical Value	0.164			Detected Data Not Gamma Distributed at 5% Significance Level		
581	**Detected Data Not Gamma Distributed at 5% Significance Level**											
582												
583	**Gamma Statistics on Detected Data Only**											
584						k hat (MLE)	2.505			k star (bias corrected MLE)	2.269	
585						Theta hat (MLE)	0.0683			Theta star (bias corrected MLE)	0.0755	
586						nu hat (MLE)	145.3			nu star (bias corrected)	131.6	
587						Mean (detects)	0.171					
588												
589	**Gamma ROS Statistics using Imputed Non-Detects**											
590	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
591	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)											
592	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
593	This is especially true when the sample size is small.											
594	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
595						Minimum	0.06			Mean	0.165	
596						Maximum	0.95			Median	0.133	
597						SD	0.15			CV	0.912	
598						k hat (MLE)	2.874			k star (bias corrected MLE)	2.653	
599						Theta hat (MLE)	0.0574			Theta star (bias corrected MLE)	0.0622	
600						nu hat (MLE)	206.9			nu star (bias corrected)	191	
601						Adjusted Level of Significance (β)	0.0428					
602						Approximate Chi Square Value (191.00, α)	160			Adjusted Chi Square Value (191.00, β)	158.7	
603						95% Gamma Approximate UCL (use when n>=50)	0.197			95% Gamma Adjusted UCL (use when n<50)	0.199	

604												
605						**Estimates of Gamma Parameters using KM Estimates**							
606						Mean (KM)	0.166				SD (KM)	0.15
607						Variance (KM)	0.0226				SE of Mean (KM)	0.0262
608						k hat (KM)	1.215				k star (KM)	1.132
609						nu hat (KM)	87.47				nu star (KM)	81.51
610						theta hat (KM)	0.136				theta star (KM)	0.146
611						80% gamma percentile (KM)	0.264				90% gamma percentile (KM)	0.37
612						95% gamma percentile (KM)	0.475				99% gamma percentile (KM)	0.718
613												
614						**Gamma Kaplan-Meier (KM) Statistics**							
615						Approximate Chi Square Value (81.51, α)	61.71				Adjusted Chi Square Value (81.51, β)	60.92
616					5% Gamma Approximate KM-UCL (use when n>=50)		0.219				95% Gamma Adjusted KM-UCL (use when n<50)	0.222
617												
618						**Lognormal GOF Test on Detected Observations Only**							
619						Shapiro Wilk Test Statistic	0.898				**Shapiro Wilk GOF Test**	
620						5% Shapiro Wilk Critical Value	0.926				Detected Data Not Lognormal at 5% Significance Level	
621						Lilliefors Test Statistic	0.132				**Lilliefors GOF Test**	
622						5% Lilliefors Critical Value	0.161				Detected Data appear Lognormal at 5% Significance Level	
623						**Detected Data appear Approximate Lognormal at 5% Significance Level**						
624												
625						**Lognormal ROS Statistics Using Imputed Non-Detects**						
626						Mean in Original Scale	0.164				Mean in Log Scale	-1.984
627						SD in Original Scale	0.15				SD in Log Scale	0.524
628						95% t UCL (assumes normality of ROS data)	0.206				95% Percentile Bootstrap UCL	0.211
629						95% BCA Bootstrap UCL	0.236				95% Bootstrap t UCL	0.267
630						95% H-UCL (Log ROS)	0.187					
631												
632						**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**						
633						KM Mean (logged)	-1.991				KM Geo Mean	0.137
634						KM SD (logged)	0.547				95% Critical H Value (KM-Log)	1.946
635						KM Standard Error of Mean (logged)	0.0999				95% H-UCL (KM -Log)	0.19
636						KM SD (logged)	0.547				95% Critical H Value (KM-Log)	1.946
637						KM Standard Error of Mean (logged)	0.0999					
638												
639						**DL/2 Statistics**						
640						**DL/2 Normal**					**DL/2 Log-Transformed**	
641						Mean in Original Scale	0.187				Mean in Log Scale	-1.862
642						SD in Original Scale	0.152				SD in Log Scale	0.57
643						95% t UCL (Assumes normality)	0.229				95% H-Stat UCL	0.221
644						**DL/2 is not a recommended method, provided for comparisons and historical reasons**						
645												
646						**Nonparametric Distribution Free UCL Statistics**						
647						**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**						
648												
649						**Suggested UCL to Use**						
650						KM H-UCL	0.19					
651												
652	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
653	Recommendations are based upon data size, data distribution, and skewness.											
654	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
655	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
656												
657												
658	**Result (eua_zinc_soil-road)**											
659												
660						**General Statistics**						
661						Total Number of Observations	36				Number of Distinct Observations	36
662											Number of Missing Observations	0
663						Minimum	130				Mean	455.1
664						Maximum	2120				Median	282.5
665						SD	408.1				Std. Error of Mean	68.01
666						Coefficient of Variation	0.897				Skewness	2.481
667												
668						**Normal GOF Test**						
669						Shapiro Wilk Test Statistic	0.709				**Shapiro Wilk GOF Test**	
670						5% Shapiro Wilk Critical Value	0.935				Data Not Normal at 5% Significance Level	

671				Lilliefors Test Statistic	0.221	**Lilliefors GOF Test**						
672				5% Lilliefors Critical Value	0.145	Data Not Normal at 5% Significance Level						
673	**Data Not Normal at 5% Significance Level**											
674												
675	**Assuming Normal Distribution**											
676	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
677				95% Student's-t UCL	570	95% Adjusted-CLT UCL (Chen-1995)	597					
678						95% Modified-t UCL (Johnson-1978)	574.7					
679												
680	**Gamma GOF Test**											
681				A-D Test Statistic	1.74	**Anderson-Darling Gamma GOF Test**						
682				5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level						
683				K-S Test Statistic	0.173	**Kolmogorov-Smirnov Gamma GOF Test**						
684				5% K-S Critical Value	0.149	Data Not Gamma Distributed at 5% Significance Level						
685	**Data Not Gamma Distributed at 5% Significance Level**											
686												
687	**Gamma Statistics**											
688				k hat (MLE)	2.078	k star (bias corrected MLE)	1.924					
689				Theta hat (MLE)	218.9	Theta star (bias corrected MLE)	236.5					
690				nu hat (MLE)	149.7	nu star (bias corrected)	138.5					
691				MLE Mean (bias corrected)	455.1	MLE Sd (bias corrected)	328.1					
692						Approximate Chi Square Value (0.05)	112.3					
693				Adjusted Level of Significance	0.0428	Adjusted Chi Square Value	111.2					
694												
695	**Assuming Gamma Distribution**											
696	95% Approximate Gamma UCL (use when n>=50))				561.2	95% Adjusted Gamma UCL (use when n<50)	566.6					
697												
698	**Lognormal GOF Test**											
699				Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk Lognormal GOF Test**						
700				5% Shapiro Wilk Critical Value	0.935	Data Not Lognormal at 5% Significance Level						
701				Lilliefors Test Statistic	0.152	**Lilliefors Lognormal GOF Test**						
702				5% Lilliefors Critical Value	0.145	Data Not Lognormal at 5% Significance Level						
703	**Data Not Lognormal at 5% Significance Level**											
704												
705	**Lognormal Statistics**											
706				Minimum of Logged Data	4.868	Mean of logged Data	5.861					
707				Maximum of Logged Data	7.659	SD of logged Data	0.676					
708												
709	**Assuming Lognormal Distribution**											
710				95% H-UCL	557.8	90% Chebyshev (MVUE) UCL	597.9					
711				95% Chebyshev (MVUE) UCL	670.3	97.5% Chebyshev (MVUE) UCL	771					
712				99% Chebyshev (MVUE) UCL	968.6							
713												
714	**Nonparametric Distribution Free UCL Statistics**											
715	**Data do not follow a Discernible Distribution (0.05)**											
716												
717	**Nonparametric Distribution Free UCLs**											
718				95% CLT UCL	566.9	95% Jackknife UCL	570					
719				95% Standard Bootstrap UCL	563.8	95% Bootstrap-t UCL	616.6					
720				95% Hall's Bootstrap UCL	658.9	95% Percentile Bootstrap UCL	573.2					
721				95% BCA Bootstrap UCL	599							
722				90% Chebyshev(Mean, Sd) UCL	659.1	95% Chebyshev(Mean, Sd) UCL	751.5					
723				97.5% Chebyshev(Mean, Sd) UCL	879.8	99% Chebyshev(Mean, Sd) UCL	1132					
724												
725	**Suggested UCL to Use**											
726				95% Chebyshev (Mean, Sd) UCL	751.5							
727												
728	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
729	Recommendations are based upon data size, data distribution, and skewness.											
730	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
731	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
732												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.12/4/2019 11:44:03 AM										
5	From File	BPMD_HHRA_ATVRec_SoilInput.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10	**Result (eu5b_antimony_soil-road)**											
11												
12	**General Statistics**											
13	Total Number of Observations	85	Number of Distinct Observations	70								
14	Number of Detects	84	Number of Non-Detects	1								
15	Number of Distinct Detects	70	Number of Distinct Non-Detects	1								
16	Minimum Detect	0.21	Minimum Non-Detect	1.1								
17	Maximum Detect	187	Maximum Non-Detect	1.1								
18	Variance Detects	493.8	Percent Non-Detects	1.176%								
19	Mean Detects	5.638	SD Detects	22.22								
20	Median Detects	1	CV Detects	3.942								
21	Skewness Detects	7.155	Kurtosis Detects	55.75								
22	Mean of Logged Detects	0.331	SD of Logged Detects	1.249								
23												
24	**Normal GOF Test on Detects Only**											
25	Shapiro Wilk Test Statistic	0.252	**Normal GOF Test on Detected Observations Only**									
26	5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level									
27	Lilliefors Test Statistic	0.41	**Lilliefors GOF Test**									
28	5% Lilliefors Critical Value	0.0968	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	5.579	KM Standard Error of Mean	2.397								
33	KM SD	21.97	95% KM (BCA) UCL	10.51								
34	95% KM (t) UCL	9.565	95% KM (Percentile Bootstrap) UCL	9.919								
35	95% KM (z) UCL	9.521	95% KM Bootstrap t UCL	20.35								
36	90% KM Chebyshev UCL	12.77	95% KM Chebyshev UCL	16.03								
37	97.5% KM Chebyshev UCL	20.55	99% KM Chebyshev UCL	29.43								
38												
39	**Gamma GOF Tests on Detected Observations Only**											
40	A-D Test Statistic	10.59	**Anderson-Darling GOF Test**									
41	5% A-D Critical Value	0.828	Detected Data Not Gamma Distributed at 5% Significance Level									
42	K-S Test Statistic	0.243	**Kolmogorov-Smirnov GOF**									
43	5% K-S Critical Value	0.104	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)	0.46	k star (bias corrected MLE)	0.452								
48	Theta hat (MLE)	12.25	Theta star (bias corrected MLE)	12.48								
49	nu hat (MLE)	77.31	nu star (bias corrected)	75.88								
50	Mean (detects)	5.638										
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	5.571								
59	Maximum	187	Median	1								
60	SD	22.1	CV	3.966								
61	k hat (MLE)	0.447	k star (bias corrected MLE)	0.439								
62	Theta hat (MLE)	12.45	Theta star (bias corrected MLE)	12.68								
63	nu hat (MLE)	76.06	nu star (bias corrected)	74.71								
64	Adjusted Level of Significance (β)	0.0472										
65	Approximate Chi Square Value (74.71, α)	55.8	Adjusted Chi Square Value (74.71, β)	55.52								
66	95% Gamma Approximate UCL (use when n>=50)	7.459	95% Gamma Adjusted UCL (use when n<50)	7.497								
67												

68	**Estimates of Gamma Parameters using KM Estimates**											
69						Mean (KM)	5.579			SD (KM)	21.97	
70						Variance (KM)	482.5			SE of Mean (KM)	2.397	
71						k hat (KM)	0.0645			k star (KM)	0.0701	
72						nu hat (KM)	10.97			nu star (KM)	11.91	
73						theta hat (KM)	86.48			theta star (KM)	79.61	
74						80% gamma percentile (KM)	2.003			90% gamma percentile (KM)	12.05	
75						95% gamma percentile (KM)	32.09			99% gamma percentile (KM)	105.1	
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78						Approximate Chi Square Value (11.91, α)	5.169			Adjusted Chi Square Value (11.91, β)	5.093	
79					5% Gamma Approximate KM-UCL (use when n>=50)		12.86			95% Gamma Adjusted KM-UCL (use when n<50)	13.05	
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82						Shapiro Wilk Approximate Test Statistic	0.886			**Shapiro Wilk GOF Test**		
83						5% Shapiro Wilk P Value	1.4545E-8			Detected Data Not Lognormal at 5% Significance Level		
84						Lilliefors Test Statistic	0.146			**Lilliefors GOF Test**		
85						5% Lilliefors Critical Value	0.0968			Detected Data Not Lognormal at 5% Significance Level		
86	**Detected Data Not Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89						Mean in Original Scale	5.579			Mean in Log Scale	0.322	
90						SD in Original Scale	22.1			SD in Log Scale	1.244	
91						95% t UCL (assumes normality of ROS data)	9.565			95% Percentile Bootstrap UCL	9.751	
92						95% BCA Bootstrap UCL	13.1			95% Bootstrap t UCL	20.8	
93						95% H-UCL (Log ROS)	4.194					
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96						KM Mean (logged)	0.321			KM Geo Mean	1.378	
97						KM SD (logged)	1.239			95% Critical H Value (KM-Log)	2.478	
98						KM Standard Error of Mean (logged)	0.135			95% H-UCL (KM -Log)	4.149	
99						KM SD (logged)	1.239			95% Critical H Value (KM-Log)	2.478	
100						KM Standard Error of Mean (logged)	0.135					
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**									**DL/2 Log-Transformed**		
104						Mean in Original Scale	5.578			Mean in Log Scale	0.32	
105						SD in Original Scale	22.1			SD in Log Scale	1.246	
106						95% t UCL (Assumes normality)	9.564			95% H-Stat UCL	4.195	
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	16.03					
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 statisticia											
119												
120												
121	**Result (eu5b_arsenic_soil-road)**											
122												
123	**General Statistics**											
124						Total Number of Observations	85			Number of Distinct Observations	82	
125										Number of Missing Observations	0	
126						Minimum	3.19			Mean	39.72	
127						Maximum	259			Median	27.2	
128						SD	40.48			Std. Error of Mean	4.391	
129						Coefficient of Variation	1.019			Skewness	2.655	
130												
131	**Normal GOF Test**											
132						Shapiro Wilk Test Statistic	0.762			**Shapiro Wilk GOF Test**		
133						5% Shapiro Wilk P Value	0			Data Not Normal at 5% Significance Level		
134						Lilliefors Test Statistic	0.183			**Lilliefors GOF Test**		

135				5% Lilliefors Critical Value	0.0962	Data Not Normal at 5% Significance Level						
136	**Data Not Normal at 5% Significance Level**											
137												
138	**Assuming Normal Distribution**											
139	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
140				95% Student's-t UCL	47.03	95% Adjusted-CLT UCL (Chen-1995)	48.3					
141						95% Modified-t UCL (Johnson-1978)	47.24					
142												
143	**Gamma GOF Test**											
144				A-D Test Statistic	0.694	**Anderson-Darling Gamma GOF Test**						
145				5% A-D Critical Value	0.775	Detected data appear Gamma Distributed at 5% Significance Lev						
146				K-S Test Statistic	0.0823	**Kolmogorov-Smirnov Gamma GOF Test**						
147				5% K-S Critical Value	0.0992	Detected data appear Gamma Distributed at 5% Significance Lev						
148	**Detected data appear Gamma Distributed at 5% Significance Level**											
149												
150	**Gamma Statistics**											
151				k hat (MLE)	1.3	k star (bias corrected MLE)	1.262					
152				Theta hat (MLE)	30.55	Theta star (bias corrected MLE)	31.47					
153				nu hat (MLE)	221	nu star (bias corrected)	214.6					
154				MLE Mean (bias corrected)	39.72	MLE Sd (bias corrected)	35.36					
155						Approximate Chi Square Value (0.05)	181.7					
156				Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	181.2					
157												
158	**Assuming Gamma Distribution**											
159	95% Approximate Gamma UCL (use when n>=50)				46.92	95% Adjusted Gamma UCL (use when n<50)	47.05					
160												
161	**Lognormal GOF Test**											
162				Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**						
163				5% Shapiro Wilk P Value	0.329	Data appear Lognormal at 5% Significance Level						
164				Lilliefors Test Statistic	0.0619	**Lilliefors Lognormal GOF Test**						
165				5% Lilliefors Critical Value	0.0962	Data appear Lognormal at 5% Significance Level						
166	**Data appear Lognormal at 5% Significance Level**											
167												
168	**Lognormal Statistics**											
169				Minimum of Logged Data	1.16	Mean of logged Data	3.25					
170				Maximum of Logged Data	5.557	SD of logged Data	0.964					
171												
172	**Assuming Lognormal Distribution**											
173				95% H-UCL	51.77	90% Chebyshev (MVUE) UCL	55.85					
174				95% Chebyshev (MVUE) UCL	62.7	97.5% Chebyshev (MVUE) UCL	72.2					
175				99% Chebyshev (MVUE) UCL	90.87							
176												
177	**Nonparametric Distribution Free UCL Statistics**											
178	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
179												
180	**Nonparametric Distribution Free UCLs**											
181				95% CLT UCL	46.95	95% Jackknife UCL	47.03					
182				95% Standard Bootstrap UCL	47.01	95% Bootstrap-t UCL	48.97					
183				95% Hall's Bootstrap UCL	49.84	95% Percentile Bootstrap UCL	46.73					
184				95% BCA Bootstrap UCL	47.53							
185				90% Chebyshev(Mean, Sd) UCL	52.9	95% Chebyshev(Mean, Sd) UCL	58.86					
186				97.5% Chebyshev(Mean, Sd) UCL	67.15	99% Chebyshev(Mean, Sd) UCL	83.41					
187												
188	**Suggested UCL to Use**											
189				95% Approximate Gamma UCL	46.92							
190												
191	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
192	Recommendations are based upon data size, data distribution, and skewness.											
193	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
194	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
195												
196												
197	**Result (eu5b_cadmium_soil-road)**											
198												
199	**General Statistics**											
200				Total Number of Observations	85	Number of Distinct Observations	70					
201						Number of Missing Observations	0					

202					Minimum	0.045				Mean		3.393
203					Maximum	41.5				Median		1.6
204					SD	5.941				Std. Error of Mean		0.644
205					Coefficient of Variation	1.751				Skewness		4.2
206												
207					**Normal GOF Test**							
208					Shapiro Wilk Test Statistic	0.536			**Shapiro Wilk GOF Test**			
209					5% Shapiro Wilk P Value	0			Data Not Normal at 5% Significance Level			
210					Lilliefors Test Statistic	0.311			**Lilliefors GOF Test**			
211					5% Lilliefors Critical Value	0.0962			Data Not Normal at 5% Significance Level			
212					**Data Not Normal at 5% Significance Level**							
213												
214					**Assuming Normal Distribution**							
215					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
216					95% Student's-t UCL	4.465			95% Adjusted-CLT UCL (Chen-1995)			4.767
217									95% Modified-t UCL (Johnson-1978)			4.514
218												
219					**Gamma GOF Test**							
220					A-D Test Statistic	2.327			**Anderson-Darling Gamma GOF Test**			
221					5% A-D Critical Value	0.795			Data Not Gamma Distributed at 5% Significance Level			
222					K-S Test Statistic	0.158			**Kolmogorov-Smirnov Gamma GOF Test**			
223					5% K-S Critical Value	0.101			Data Not Gamma Distributed at 5% Significance Level			
224					**Data Not Gamma Distributed at 5% Significance Level**							
225												
226					**Gamma Statistics**							
227					k hat (MLE)	0.73			k star (bias corrected MLE)			0.712
228					Theta hat (MLE)	4.651			Theta star (bias corrected MLE)			4.768
229					nu hat (MLE)	124			nu star (bias corrected)			121
230					MLE Mean (bias corrected)	3.393			MLE Sd (bias corrected)			4.022
231									Approximate Chi Square Value (0.05)			96.58
232					Adjusted Level of Significance	0.0472			Adjusted Chi Square Value			96.21
233												
234					**Assuming Gamma Distribution**							
235					95% Approximate Gamma UCL (use when n>=50))	4.251			95% Adjusted Gamma UCL (use when n<50)			4.267
236												
237					**Lognormal GOF Test**							
238					Shapiro Wilk Test Statistic	0.979			**Shapiro Wilk Lognormal GOF Test**			
239					5% Shapiro Wilk P Value	0.51			Data appear Lognormal at 5% Significance Level			
240					Lilliefors Test Statistic	0.0771			**Lilliefors Lognormal GOF Test**			
241					5% Lilliefors Critical Value	0.0962			Data appear Lognormal at 5% Significance Level			
242					**Data appear Lognormal at 5% Significance Level**							
243												
244					**Lognormal Statistics**							
245					Minimum of Logged Data	-3.101			Mean of logged Data			0.398
246					Maximum of Logged Data	3.726			SD of logged Data			1.317
247												
248					**Assuming Lognormal Distribution**							
249					95% H-UCL	5.12			90% Chebyshev (MVUE) UCL			5.427
250					95% Chebyshev (MVUE) UCL	6.31			97.5% Chebyshev (MVUE) UCL			7.535
251					99% Chebyshev (MVUE) UCL	9.941						
252												
253					**Nonparametric Distribution Free UCL Statistics**							
254					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
255												
256					**Nonparametric Distribution Free UCLs**							
257					95% CLT UCL	4.453			95% Jackknife UCL			4.465
258					95% Standard Bootstrap UCL	4.436			95% Bootstrap-t UCL			5.039
259					95% Hall's Bootstrap UCL	5.312			95% Percentile Bootstrap UCL			4.517
260					95% BCA Bootstrap UCL	4.803						
261					90% Chebyshev(Mean, Sd) UCL	5.326			95% Chebyshev(Mean, Sd) UCL			6.202
262					97.5% Chebyshev(Mean, Sd) UCL	7.417			99% Chebyshev(Mean, Sd) UCL			9.805
263												
264					**Suggested UCL to Use**							
265					95% H-UCL	5.12						
266												
267	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
268	Recommendations are based upon data size, data distribution, and skewness.											

269	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
270	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
271												
272	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
273	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
274	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
275	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
276												
277												
278	**Result (eu5b_chromium_soil-road)**											
279												
280	**General Statistics**											
281							Total Number of Observations	85			Number of Distinct Observations	51
282											Number of Missing Observations	0
283							Minimum	2.2			Mean	4.782
284							Maximum	15.7			Median	4.6
285							SD	2.051			Std. Error of Mean	0.222
286							Coefficient of Variation	0.429			Skewness	2.032
287												
288	**Normal GOF Test**											
289							Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk GOF Test**			
290							5% Shapiro Wilk P Value	2.401E-10	Data Not Normal at 5% Significance Level			
291							Lilliefors Test Statistic	0.105	**Lilliefors GOF Test**			
292							5% Lilliefors Critical Value	0.0962	Data Not Normal at 5% Significance Level			
293	**Data Not Normal at 5% Significance Level**											
294												
295	**Assuming Normal Distribution**											
296	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
297							95% Student's-t UCL	5.152			95% Adjusted-CLT UCL (Chen-1995)	5.201
298											95% Modified-t UCL (Johnson-1978)	5.161
299												
300	**Gamma GOF Test**											
301							A-D Test Statistic	0.516	**Anderson-Darling Gamma GOF Test**			
302							5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Lev			
303							K-S Test Statistic	0.0724	**Kolmogorov-Smirnov Gamma GOF Test**			
304							5% K-S Critical Value	0.0971	Detected data appear Gamma Distributed at 5% Significance Lev			
305	**Detected data appear Gamma Distributed at 5% Significance Level**											
306												
307	**Gamma Statistics**											
308							k hat (MLE)	6.659			k star (bias corrected MLE)	6.432
309							Theta hat (MLE)	0.718			Theta star (bias corrected MLE)	0.744
310							nu hat (MLE)	1132			nu star (bias corrected)	1093
311							MLE Mean (bias corrected)	4.782			MLE Sd (bias corrected)	1.886
312											Approximate Chi Square Value (0.05)	1018
313							Adjusted Level of Significance	0.0472			Adjusted Chi Square Value	1016
314												
315	**Assuming Gamma Distribution**											
316							95% Approximate Gamma UCL (use when n>=50)	5.139			95% Adjusted Gamma UCL (use when n<50)	5.145
317												
318	**Lognormal GOF Test**											
319							Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**			
320							5% Shapiro Wilk P Value	0.162	Data appear Lognormal at 5% Significance Level			
321							Lilliefors Test Statistic	0.0773	**Lilliefors Lognormal GOF Test**			
322							5% Lilliefors Critical Value	0.0962	Data appear Lognormal at 5% Significance Level			
323	**Data appear Lognormal at 5% Significance Level**											
324												
325	**Lognormal Statistics**											
326							Minimum of Logged Data	0.788			Mean of logged Data	1.488
327							Maximum of Logged Data	2.754			SD of logged Data	0.388
328												
329	**Assuming Lognormal Distribution**											
330							95% H-UCL	5.149			90% Chebyshev (MVUE) UCL	5.393
331							95% Chebyshev (MVUE) UCL	5.675			97.5% Chebyshev (MVUE) UCL	6.067
332							99% Chebyshev (MVUE) UCL	6.836				
333												
334	**Nonparametric Distribution Free UCL Statistics**											
335	**Data appear to follow a Discernible Distribution at 5% Significance Level**											

	Nonparametric Distribution Free UCLs	
95% CLT UCL	5.148	95% Jackknife UCL 5.152
95% Standard Bootstrap UCL	5.157	95% Bootstrap-t UCL 5.208
95% Hall's Bootstrap UCL	5.257	95% Percentile Bootstrap UCL 5.153
95% BCA Bootstrap UCL	5.19	
90% Chebyshev(Mean, Sd) UCL	5.45	95% Chebyshev(Mean, Sd) UCL 5.752
97.5% Chebyshev(Mean, Sd) UCL	6.172	99% Chebyshev(Mean, Sd) UCL 6.996
	Suggested UCL to Use	
95% Approximate Gamma UCL	5.139	

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 statisticia

Result (eu5b_cobalt_soil-road)

	General Statistics		
Total Number of Observations	85	Number of Distinct Observations	63
		Number of Missing Observations	0
Minimum	1.5	Mean	7.787
Maximum	43.6	Median	6.4
SD	5.837	Std. Error of Mean	0.633
Coefficient of Variation	0.75	Skewness	3.569
	Normal GOF Test		
Shapiro Wilk Test Statistic	0.678	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0962	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	8.84	95% Adjusted-CLT UCL (Chen-1995)	9.09
		95% Modified-t UCL (Johnson-1978)	8.881
	Gamma GOF Test		
A-D Test Statistic	2.49	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.163	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0976	Data Not Gamma Distributed at 5% Significance Level	
	Data Not Gamma Distributed at 5% Significance Level		
	Gamma Statistics		
k hat (MLE)	3.15	k star (bias corrected MLE)	3.046
Theta hat (MLE)	2.472	Theta star (bias corrected MLE)	2.556
nu hat (MLE)	535.4	nu star (bias corrected)	517.9
MLE Mean (bias corrected)	7.787	MLE Sd (bias corrected)	4.461
		Approximate Chi Square Value (0.05)	466.1
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	465.3
	Assuming Gamma Distribution		
95% Approximate Gamma UCL (use when n>=50))	8.652	95% Adjusted Gamma UCL (use when n<50)	8.667
	Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.126	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0962	Data Not Lognormal at 5% Significance Level	
	Data appear Approximate Lognormal at 5% Significance Level		
	Lognormal Statistics		
Minimum of Logged Data	0.405	Mean of logged Data	1.885

403					Maximum of Logged Data	3.775				SD of logged Data	0.546	
404												
405					**Assuming Lognormal Distribution**							
406					95% H-UCL	8.551				90% Chebyshev (MVUE) UCL	9.076	
407					95% Chebyshev (MVUE) UCL	9.73				97.5% Chebyshev (MVUE) UCL	10.64	
408					99% Chebyshev (MVUE) UCL	12.42						
409												
410					**Nonparametric Distribution Free UCL Statistics**							
411					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
412												
413					**Nonparametric Distribution Free UCLs**							
414					95% CLT UCL	8.828				95% Jackknife UCL	8.84	
415					95% Standard Bootstrap UCL	8.815				95% Bootstrap-t UCL	9.366	
416					95% Hall's Bootstrap UCL	9.671				95% Percentile Bootstrap UCL	8.878	
417					95% BCA Bootstrap UCL	8.996						
418					90% Chebyshev(Mean, Sd) UCL	9.686				95% Chebyshev(Mean, Sd) UCL	10.55	
419					97.5% Chebyshev(Mean, Sd) UCL	11.74				99% Chebyshev(Mean, Sd) UCL	14.09	
420												
421					**Suggested UCL to Use**							
422					95% H-UCL	8.551						
423												
424	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
425	Recommendations are based upon data size, data distribution, and skewness.											
426	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
427	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
428												
429	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
430	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
431	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
432	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
433												
434												
435	**Result (eu5b_iron_soil-road)**											
436												
437					**General Statistics**							
438					Total Number of Observations	85				Number of Distinct Observations	74	
439										Number of Missing Observations	0	
440					Minimum	10400				Mean	28131	
441					Maximum	175000				Median	24500	
442					SD	19068				Std. Error of Mean	2068	
443					Coefficient of Variation	0.678				Skewness	5.789	
444												
445					**Normal GOF Test**							
446					Shapiro Wilk Test Statistic	0.532				**Shapiro Wilk GOF Test**		
447					5% Shapiro Wilk P Value	0				Data Not Normal at 5% Significance Level		
448					Lilliefors Test Statistic	0.265				**Lilliefors GOF Test**		
449					5% Lilliefors Critical Value	0.0962				Data Not Normal at 5% Significance Level		
450					**Data Not Normal at 5% Significance Level**							
451												
452					**Assuming Normal Distribution**							
453					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
454					95% Student's-t UCL	31570				95% Adjusted-CLT UCL (Chen-1995)	32920	
455										95% Modified-t UCL (Johnson-1978)	31787	
456												
457					**Gamma GOF Test**							
458					A-D Test Statistic	3.502				**Anderson-Darling Gamma GOF Test**		
459					5% A-D Critical Value	0.755				Data Not Gamma Distributed at 5% Significance Level		
460					K-S Test Statistic	0.181				**Kolmogorov-Smirnov Gamma GOF Test**		
461					5% K-S Critical Value	0.0972				Data Not Gamma Distributed at 5% Significance Level		
462					**Data Not Gamma Distributed at 5% Significance Level**							
463												
464					**Gamma Statistics**							
465					k hat (MLE)	5.01				k star (bias corrected MLE)	4.841	
466					Theta hat (MLE)	5614				Theta star (bias corrected MLE)	5810	
467					nu hat (MLE)	851.8				nu star (bias corrected)	823	
468					MLE Mean (bias corrected)	28131				MLE Sd (bias corrected)	12785	
469										Approximate Chi Square Value (0.05)	757.5	

470				Adjusted Level of Significance	0.0472				Adjusted Chi Square Value	756.4		
471												
472					**Assuming Gamma Distribution**							
473			95% Approximate Gamma UCL (use when n>=50))		30566			95% Adjusted Gamma UCL (use when n<50)		30609		
474												
475					**Lognormal GOF Test**							
476				Shapiro Wilk Test Statistic	0.919			**Shapiro Wilk Lognormal GOF Test**				
477				5% Shapiro Wilk P Value	1.3121E-5			Data Not Lognormal at 5% Significance Level				
478				Lilliefors Test Statistic	0.136			**Lilliefors Lognormal GOF Test**				
479				5% Lilliefors Critical Value	0.0962			Data Not Lognormal at 5% Significance Level				
480					**Data Not Lognormal at 5% Significance Level**							
481												
482					**Lognormal Statistics**							
483				Minimum of Logged Data	9.25				Mean of logged Data	10.14		
484				Maximum of Logged Data	12.07				SD of logged Data	0.404		
485												
486					**Assuming Lognormal Distribution**							
487				95% H-UCL	29797				90% Chebyshev (MVUE) UCL	31253		
488				95% Chebyshev (MVUE) UCL	32951				97.5% Chebyshev (MVUE) UCL	35307		
489				99% Chebyshev (MVUE) UCL	39935							
490												
491					**Nonparametric Distribution Free UCL Statistics**							
492					**Data do not follow a Discernible Distribution (0.05)**							
493												
494					**Nonparametric Distribution Free UCLs**							
495				95% CLT UCL	31533				95% Jackknife UCL	31570		
496				95% Standard Bootstrap UCL	31507				95% Bootstrap-t UCL	34819		
497				95% Hall's Bootstrap UCL	46717				95% Percentile Bootstrap UCL	31867		
498				95% BCA Bootstrap UCL	33529							
499				90% Chebyshev(Mean, Sd) UCL	34335				95% Chebyshev(Mean, Sd) UCL	37146		
500				97.5% Chebyshev(Mean, Sd) UCL	41047				99% Chebyshev(Mean, Sd) UCL	48709		
501												
502					**Suggested UCL to Use**							
503				95% Student's-t UCL	31570				or 95% Modified-t UCL	31787		
504												
505	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
506	Recommendations are based upon data size, data distribution, and skewness.											
507	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
508	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
509												
510												
511	**Result (eu5b_lead_soil-road)**											
512												
513					**General Statistics**							
514				Total Number of Observations	85				Number of Distinct Observations	83		
515									Number of Missing Observations	0		
516				Minimum	13.7				Mean	1228		
517				Maximum	18300				Median	344		
518				SD	2852				Std. Error of Mean	309.3		
519				Coefficient of Variation	2.322				Skewness	4.206		
520												
521					**Normal GOF Test**							
522				Shapiro Wilk Test Statistic	0.448			**Shapiro Wilk GOF Test**				
523				5% Shapiro Wilk P Value	0			Data Not Normal at 5% Significance Level				
524				Lilliefors Test Statistic	0.335			**Lilliefors GOF Test**				
525				5% Lilliefors Critical Value	0.0962			Data Not Normal at 5% Significance Level				
526					**Data Not Normal at 5% Significance Level**							
527												
528					**Assuming Normal Distribution**							
529				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
530				95% Student's-t UCL	1742				95% Adjusted-CLT UCL (Chen-1995)	1887		
531									95% Modified-t UCL (Johnson-1978)	1766		
532												
533					**Gamma GOF Test**							
534				A-D Test Statistic	4.996				**Anderson-Darling Gamma GOF Test**			
535				5% A-D Critical Value	0.817				Data Not Gamma Distributed at 5% Significance Level			
536				K-S Test Statistic	0.211				**Kolmogorov-Smirnov Gamma GOF Test**			

537				5% K-S Critical Value	0.102	Data Not Gamma Distributed at 5% Significance Level						
538	**Data Not Gamma Distributed at 5% Significance Level**											
539												
540	**Gamma Statistics**											
541				k hat (MLE)	0.516			k star (bias corrected MLE)	0.506			
542				Theta hat (MLE)	2378			Theta star (bias corrected MLE)	2427			
543				nu hat (MLE)	87.77			nu star (bias corrected)	86			
544				MLE Mean (bias corrected)	1228			MLE Sd (bias corrected)	1726			
545								Approximate Chi Square Value (0.05)	65.63			
546				Adjusted Level of Significance	0.0472			Adjusted Chi Square Value	65.32			
547												
548	**Assuming Gamma Distribution**											
549	95% Approximate Gamma UCL (use when n>=50))				1609			95% Adjusted Gamma UCL (use when n<50)	1617			
550												
551	**Lognormal GOF Test**											
552				Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**						
553				5% Shapiro Wilk P Value	0.205	Data appear Lognormal at 5% Significance Level						
554				Lilliefors Test Statistic	0.0813	**Lilliefors Lognormal GOF Test**						
555				5% Lilliefors Critical Value	0.0962	Data appear Lognormal at 5% Significance Level						
556	**Data appear Lognormal at 5% Significance Level**											
557												
558	**Lognormal Statistics**											
559				Minimum of Logged Data	2.617			Mean of logged Data	5.889			
560				Maximum of Logged Data	9.815			SD of logged Data	1.469			
561												
562	**Assuming Lognormal Distribution**											
563				95% H-UCL	1646			90% Chebyshev (MVUE) UCL	1711			
564				95% Chebyshev (MVUE) UCL	2017			97.5% Chebyshev (MVUE) UCL	2442			
565				99% Chebyshev (MVUE) UCL	3276							
566												
567	**Nonparametric Distribution Free UCL Statistics**											
568	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
569												
570	**Nonparametric Distribution Free UCLs**											
571				95% CLT UCL	1737			95% Jackknife UCL	1742			
572				95% Standard Bootstrap UCL	1739			95% Bootstrap-t UCL	2029			
573				95% Hall's Bootstrap UCL	2006			95% Percentile Bootstrap UCL	1778			
574				95% BCA Bootstrap UCL	1891							
575				90% Chebyshev(Mean, Sd) UCL	2156			95% Chebyshev(Mean, Sd) UCL	2576			
576				97.5% Chebyshev(Mean, Sd) UCL	3159			99% Chebyshev(Mean, Sd) UCL	4305			
577												
578	**Suggested UCL to Use**											
579				95% H-UCL	1646							
580												
581	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
582	Recommendations are based upon data size, data distribution, and skewness.											
583	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
584	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
585												
586	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
587	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
588	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
589	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
590												
591												
592	**Result (eu5b_manganese_soil-road)**											
593												
594	**General Statistics**											
595				Total Number of Observations	85			Number of Distinct Observations	79			
596								Number of Missing Observations	0			
597				Minimum	182			Mean	2382			
598				Maximum	27800			Median	1180			
599				SD	4329			Std. Error of Mean	469.6			
600				Coefficient of Variation	1.818			Skewness	4.809			
601												
602	**Normal GOF Test**											
603				Shapiro Wilk Test Statistic	0.432	**Shapiro Wilk GOF Test**						

604				5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level						
605				Lilliefors Test Statistic	0.307	**Lilliefors GOF Test**						
606				5% Lilliefors Critical Value	0.0962	Data Not Normal at 5% Significance Level						
607	**Data Not Normal at 5% Significance Level**											
608												
609	**Assuming Normal Distribution**											
610	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
611				95% Student's-t UCL	3163	95% Adjusted-CLT UCL (Chen-1995)	3416					
612						95% Modified-t UCL (Johnson-1978)	3204					
613												
614	**Gamma GOF Test**											
615				A-D Test Statistic	5.162	**Anderson-Darling Gamma GOF Test**						
616				5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level						
617				K-S Test Statistic	0.191	**Kolmogorov-Smirnov Gamma GOF Test**						
618				5% K-S Critical Value	0.0998	Data Not Gamma Distributed at 5% Significance Level						
619	**Data Not Gamma Distributed at 5% Significance Level**											
620												
621	**Gamma Statistics**											
622				k hat (MLE)	1.011	k star (bias corrected MLE)	0.984					
623				Theta hat (MLE)	2355	Theta star (bias corrected MLE)	2422					
624				nu hat (MLE)	172	nu star (bias corrected)	167.2					
625				MLE Mean (bias corrected)	2382	MLE Sd (bias corrected)	2402					
626						Approximate Chi Square Value (0.05)	138.3					
627				Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	137.9					
628												
629	**Assuming Gamma Distribution**											
630	95% Approximate Gamma UCL (use when n>=50))				2880	95% Adjusted Gamma UCL (use when n<50)	2889					
631												
632	**Lognormal GOF Test**											
633				Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**						
634				5% Shapiro Wilk P Value	0.00254	Data Not Lognormal at 5% Significance Level						
635				Lilliefors Test Statistic	0.104	**Lilliefors Lognormal GOF Test**						
636				5% Lilliefors Critical Value	0.0962	Data Not Lognormal at 5% Significance Level						
637	**Data Not Lognormal at 5% Significance Level**											
638												
639	**Lognormal Statistics**											
640				Minimum of Logged Data	5.204	Mean of logged Data	7.206					
641				Maximum of Logged Data	10.23	SD of logged Data	0.919					
642												
643	**Assuming Lognormal Distribution**											
644				95% H-UCL	2554	90% Chebyshev (MVUE) UCL	2755					
645				95% Chebyshev (MVUE) UCL	3078	97.5% Chebyshev (MVUE) UCL	3527					
646				99% Chebyshev (MVUE) UCL	4408							
647												
648	**Nonparametric Distribution Free UCL Statistics**											
649	**Data do not follow a Discernible Distribution (0.05)**											
650												
651	**Nonparametric Distribution Free UCLs**											
652				95% CLT UCL	3154	95% Jackknife UCL	3163					
653				95% Standard Bootstrap UCL	3169	95% Bootstrap-t UCL	4173					
654				95% Hall's Bootstrap UCL	6568	95% Percentile Bootstrap UCL	3212					
655				95% BCA Bootstrap UCL	3401							
656				90% Chebyshev(Mean, Sd) UCL	3791	95% Chebyshev(Mean, Sd) UCL	4429					
657				97.5% Chebyshev(Mean, Sd) UCL	5314	99% Chebyshev(Mean, Sd) UCL	7054					
658												
659	**Suggested UCL to Use**											
660				95% Chebyshev (Mean, Sd) UCL	4429							
661												
662	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
663	Recommendations are based upon data size, data distribution, and skewness.											
664	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
665	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
666												
667	**Result (eu5b_thallium_soil-road)**											
668												
669	**General Statistics**											
670				Total Number of Observations	84	Number of Distinct Observations	51					

671				Number of Detects	74				Number of Non-Detects	10		
672				Number of Distinct Detects	44				Number of Distinct Non-Detects	7		
673				Minimum Detect	0.044				Minimum Non-Detect	0.038		
674				Maximum Detect	2.8				Maximum Non-Detect	0.506		
675				Variance Detects	0.316				Percent Non-Detects	11.9%		
676				Mean Detects	0.385				SD Detects	0.562		
677				Median Detects	0.185				CV Detects	1.457		
678				Skewness Detects	3.042				Kurtosis Detects	9.438		
679				Mean of Logged Detects	-1.512				SD of Logged Detects	0.956		
680												
681				**Normal GOF Test on Detects Only**								
682				Shapiro Wilk Test Statistic	0.568				**Normal GOF Test on Detected Observations Only**			
683				5% Shapiro Wilk P Value	0				Detected Data Not Normal at 5% Significance Level			
684				Lilliefors Test Statistic	0.276				**Lilliefors GOF Test**			
685				5% Lilliefors Critical Value	0.103				Detected Data Not Normal at 5% Significance Level			
686				**Detected Data Not Normal at 5% Significance Level**								
687												
688				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
689				KM Mean	0.36				KM Standard Error of Mean	0.0584		
690				KM SD	0.53				95% KM (BCA) UCL	0.46		
691				95% KM (t) UCL	0.457				95% KM (Percentile Bootstrap) UCL	0.463		
692				95% KM (z) UCL	0.456				95% KM Bootstrap t UCL	0.495		
693				90% KM Chebyshev UCL	0.535				95% KM Chebyshev UCL	0.614		
694				97.5% KM Chebyshev UCL	0.724				99% KM Chebyshev UCL	0.94		
695												
696				**Gamma GOF Tests on Detected Observations Only**								
697				A-D Test Statistic	4.168				**Anderson-Darling GOF Test**			
698				5% A-D Critical Value	0.78				Detected Data Not Gamma Distributed at 5% Significance Level			
699				K-S Test Statistic	0.205				**Kolmogorov-Smirnov GOF**			
700				5% K-S Critical Value	0.107				Detected Data Not Gamma Distributed at 5% Significance Level			
701				**Detected Data Not Gamma Distributed at 5% Significance Level**								
702												
703				**Gamma Statistics on Detected Data Only**								
704				k hat (MLE)	1.029				k star (bias corrected MLE)	0.996		
705				Theta hat (MLE)	0.375				Theta star (bias corrected MLE)	0.387		
706				nu hat (MLE)	152.3				nu star (bias corrected)	147.5		
707				Mean (detects)	0.385							
708												
709				**Gamma ROS Statistics using Imputed Non-Detects**								
710				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
711				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)								
712				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
713				This is especially true when the sample size is small.								
714				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
715				Minimum	0.01				Mean	0.355		
716				Maximum	2.8				Median	0.18		
717				SD	0.535				CV	1.508		
718				k hat (MLE)	0.932				k star (bias corrected MLE)	0.907		
719				Theta hat (MLE)	0.38				Theta star (bias corrected MLE)	0.391		
720				nu hat (MLE)	156.6				nu star (bias corrected)	152.4		
721				Adjusted Level of Significance (β)	0.0471							
722				Approximate Chi Square Value (152.36, α)	124.8				Adjusted Chi Square Value (152.36, β)	124.4		
723				95% Gamma Approximate UCL (use when n>=50)	0.433				95% Gamma Adjusted UCL (use when n<50)	0.434		
724												
725				**Estimates of Gamma Parameters using KM Estimates**								
726				Mean (KM)	0.36				SD (KM)	0.53		
727				Variance (KM)	0.281				SE of Mean (KM)	0.0584		
728				k hat (KM)	0.461				k star (KM)	0.452		
729				nu hat (KM)	77.39				nu star (KM)	75.96		
730				theta hat (KM)	0.781				theta star (KM)	0.795		
731				80% gamma percentile (KM)	0.587				90% gamma percentile (KM)	0.993		
732				95% gamma percentile (KM)	1.431				99% gamma percentile (KM)	2.521		
733												
734				**Gamma Kaplan-Meier (KM) Statistics**								
735				Approximate Chi Square Value (75.96, α)	56.89				Adjusted Chi Square Value (75.96, β)	56.6		
736				5% Gamma Approximate KM-UCL (use when n>=50)	0.48				95% Gamma Adjusted KM-UCL (use when n<50)	0.483		
737												

738	**Lognormal GOF Test on Detected Observations Only**											
739				Shapiro Wilk Approximate Test Statistic		0.931	**Shapiro Wilk GOF Test**					
740				5% Shapiro Wilk P Value		5.6713E-4	Detected Data Not Lognormal at 5% Significance Level					
741				Lilliefors Test Statistic		0.136	**Lilliefors GOF Test**					
742				5% Lilliefors Critical Value		0.103	Detected Data Not Lognormal at 5% Significance Level					
743	**Detected Data Not Lognormal at 5% Significance Level**											
744												
745	**Lognormal ROS Statistics Using Imputed Non-Detects**											
746				Mean in Original Scale		0.359	Mean in Log Scale					-1.571
747				SD in Original Scale		0.532	SD in Log Scale					0.945
748				95% t UCL (assumes normality of ROS data)		0.455	95% Percentile Bootstrap UCL					0.467
749				95% BCA Bootstrap UCL		0.476	95% Bootstrap t UCL					0.493
750				95% H-UCL (Log ROS)		0.408						
751												
752	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
753				KM Mean (logged)		-1.572	KM Geo Mean					0.208
754				KM SD (logged)		0.939	95% Critical H Value (KM-Log)					2.18
755				KM Standard Error of Mean (logged)		0.106	95% H-UCL (KM -Log)					0.404
756				KM SD (logged)		0.939	95% Critical H Value (KM-Log)					2.18
757				KM Standard Error of Mean (logged)		0.106						
758												
759	**DL/2 Statistics**											
760				**DL/2 Normal**			**DL/2 Log-Transformed**					
761				Mean in Original Scale		0.367	Mean in Log Scale					-1.528
762				SD in Original Scale		0.53	SD in Log Scale					0.937
763				95% t UCL (Assumes normality)		0.463	95% H-Stat UCL					0.421
764	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
765												
766	**Nonparametric Distribution Free UCL Statistics**											
767	**Data do not follow a Discernible Distribution at 5% Significance Level**											
768												
769	**Suggested UCL to Use**											
770				95% KM (Chebyshev) UCL		0.614						
771												
772	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
773	Recommendations are based upon data size, data distribution, and skewness.											
774	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
775	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
776												
777												
778	**Result (eu5b_zinc_soil-road)**											
779												
780	**General Statistics**											
781				Total Number of Observations		85	Number of Distinct Observations					84
782							Number of Missing Observations					0
783				Minimum		26.8	Mean					812.9
784				Maximum		6270	Median					412
785				SD		1169	Std. Error of Mean					126.7
786				Coefficient of Variation		1.437	Skewness					3.087
787												
788	**Normal GOF Test**											
789				Shapiro Wilk Test Statistic		0.597	**Shapiro Wilk GOF Test**					
790				5% Shapiro Wilk P Value		0	Data Not Normal at 5% Significance Level					
791				Lilliefors Test Statistic		0.251	**Lilliefors GOF Test**					
792				5% Lilliefors Critical Value		0.0962	Data Not Normal at 5% Significance Level					
793	**Data Not Normal at 5% Significance Level**											
794												
795	**Assuming Normal Distribution**											
796				**95% Normal UCL**			**95% UCLs (Adjusted for Skewness)**					
797				95% Student's-t UCL		1024	95% Adjusted-CLT UCL (Chen-1995)					1067
798							95% Modified-t UCL (Johnson-1978)					1031
799												
800	**Gamma GOF Test**											
801				A-D Test Statistic		2.249	**Anderson-Darling Gamma GOF Test**					
802				5% A-D Critical Value		0.785	Data Not Gamma Distributed at 5% Significance Level					
803				K-S Test Statistic		0.112	**Kolmogorov-Smirnov Gamma GOF Test**					
804				5% K-S Critical Value		0.1	Data Not Gamma Distributed at 5% Significance Level					

805	**Data Not Gamma Distributed at 5% Significance Level**											
806												
807	**Gamma Statistics**											
808						k hat (MLE)	0.934			k star (bias corrected MLE)	0.909	
809						Theta hat (MLE)	870.6			Theta star (bias corrected MLE)	894.7	
810						nu hat (MLE)	158.7			nu star (bias corrected)	154.5	
811						MLE Mean (bias corrected)	812.9			MLE Sd (bias corrected)	852.8	
812										Approximate Chi Square Value (0.05)	126.7	
813						Adjusted Level of Significance	0.0472			Adjusted Chi Square Value	126.3	
814												
815	**Assuming Gamma Distribution**											
816					95% Approximate Gamma UCL (use when n>=50))		990.8			95% Adjusted Gamma UCL (use when n<50)	994.2	
817												
818	**Lognormal GOF Test**											
819						Shapiro Wilk Test Statistic	0.982			**Shapiro Wilk Lognormal GOF Test**		
820						5% Shapiro Wilk P Value	0.661			Data appear Lognormal at 5% Significance Level		
821						Lilliefors Test Statistic	0.0488			**Lilliefors Lognormal GOF Test**		
822						5% Lilliefors Critical Value	0.0962			Data appear Lognormal at 5% Significance Level		
823	**Data appear Lognormal at 5% Significance Level**											
824												
825	**Lognormal Statistics**											
826						Minimum of Logged Data	3.288			Mean of logged Data	6.077	
827						Maximum of Logged Data	8.744			SD of logged Data	1.1	
828												
829	**Assuming Lognormal Distribution**											
830						95% H-UCL	1056			90% Chebyshev (MVUE) UCL	1136	
831						95% Chebyshev (MVUE) UCL	1293			97.5% Chebyshev (MVUE) UCL	1511	
832						99% Chebyshev (MVUE) UCL	1940					
833												
834	**Nonparametric Distribution Free UCL Statistics**											
835	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
836												
837	**Nonparametric Distribution Free UCLs**											
838						95% CLT UCL	1021			95% Jackknife UCL	1024	
839						95% Standard Bootstrap UCL	1018			95% Bootstrap-t UCL	1099	
840						95% Hall's Bootstrap UCL	1076			95% Percentile Bootstrap UCL	1027	
841						95% BCA Bootstrap UCL	1062					
842						90% Chebyshev(Mean, Sd) UCL	1193			95% Chebyshev(Mean, Sd) UCL	1365	
843						97.5% Chebyshev(Mean, Sd) UCL	1604			99% Chebyshev(Mean, Sd) UCL	2074	
844												
845	**Suggested UCL to Use**											
846						95% H-UCL	1056					
847												
848	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
849	Recommendations are based upon data size, data distribution, and skewness.											
850	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
851	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
852												
853	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
854	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
855	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
856	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
857												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.13/21/2019 10:06:00 AM										
5	From File	BPMD_HHRA_CMP_SoilInput_v2.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10	**Result (eu7_antimony)**											
11												
12	**General Statistics**											
13	Total Number of Observations	13			Number of Distinct Observations	12						
14	Number of Detects	12			Number of Non-Detects	1						
15	Number of Distinct Detects	12			Number of Distinct Non-Detects	1						
16	Minimum Detect	0.57			Minimum Non-Detect	1.2						
17	Maximum Detect	77.6			Maximum Non-Detect	1.2						
18	Variance Detects	531.5			Percent Non-Detects	7.692%						
19	Mean Detects	12.9			SD Detects	23.05						
20	Median Detects	1.595			CV Detects	1.787						
21	Skewness Detects	2.376			Kurtosis Detects	5.916						
22	Mean of Logged Detects	1.14			SD of Logged Detects	1.723						
23												
24	**Normal GOF Test on Detects Only**											
25	Shapiro Wilk Test Statistic	0.616			**Shapiro Wilk GOF Test**							
26	5% Shapiro Wilk Critical Value	0.859			Detected Data Not Normal at 5% Significance Level							
27	Lilliefors Test Statistic	0.351			**Lilliefors GOF Test**							
28	5% Lilliefors Critical Value	0.243			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	11.96			KM Standard Error of Mean	6.215						
33	KM SD	21.45			95% KM (BCA) UCL	22.09						
34	95% KM (t) UCL	23.04			95% KM (Percentile Bootstrap) UCL	23.1						
35	95% KM (z) UCL	22.18			95% KM Bootstrap t UCL	36.89						
36	90% KM Chebyshev UCL	30.61			95% KM Chebyshev UCL	39.05						
37	97.5% KM Chebyshev UCL	50.77			99% KM Chebyshev UCL	73.8						
38												
39	**Gamma GOF Tests on Detected Observations Only**											
40	A-D Test Statistic	1.226			**Anderson-Darling GOF Test**							
41	5% A-D Critical Value	0.794			Detected Data Not Gamma Distributed at 5% Significance Level							
42	K-S Test Statistic	0.348			**Kolmogorov-Smirnov GOF**							
43	5% K-S Critical Value	0.26			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)	0.455			k star (bias corrected MLE)	0.397						
48	Theta hat (MLE)	28.35			Theta star (bias corrected MLE)	32.5						
49	nu hat (MLE)	10.92			nu star (bias corrected)	9.524						
50	Mean (detects)	12.9										
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	11.91						
59	Maximum	77.6			Median	1.4						
60	SD	22.36			CV	1.878						
61	k hat (MLE)	0.374			k star (bias corrected MLE)	0.339						
62	Theta hat (MLE)	31.84			Theta star (bias corrected MLE)	35.13						
63	nu hat (MLE)	9.724			nu star (bias corrected)	8.813						
64	Adjusted Level of Significance (β)	0.0301										
65	Approximate Chi Square Value (8.81, α)	3.215			Adjusted Chi Square Value (8.81, β)	2.751						
66	95% Gamma Approximate UCL (use when n>=50)	32.64			95% Gamma Adjusted UCL (use when n<50)	38.14						
67												

68	**Estimates of Gamma Parameters using KM Estimates**											
69						Mean (KM)	11.96			SD (KM)	21.45	
70						Variance (KM)	460.3			SE of Mean (KM)	6.215	
71						k hat (KM)	0.311			k star (KM)	0.29	
72						nu hat (KM)	8.081			nu star (KM)	7.55	
73						theta hat (KM)	38.48			theta star (KM)	41.19	
74						80% gamma percentile (KM)	18.19			90% gamma percentile (KM)	35.41	
75						95% gamma percentile (KM)	55.29			99% gamma percentile (KM)	107.2	
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78						Approximate Chi Square Value (7.55, α)	2.477			Adjusted Chi Square Value (7.55, β)	2.083	
79	5% Gamma Approximate KM-UCL (use when n>=50)						36.45			95% Gamma Adjusted KM-UCL (use when n<50)	43.35	
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82						Shapiro Wilk Test Statistic	0.838			**Shapiro Wilk GOF Test**		
83						5% Shapiro Wilk Critical Value	0.859			Detected Data Not Lognormal at 5% Significance Level		
84						Lilliefors Test Statistic	0.288			**Lilliefors GOF Test**		
85						5% Lilliefors Critical Value	0.243			Detected Data Not Lognormal at 5% Significance Level		
86	**Detected Data Not Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89						Mean in Original Scale	11.95			Mean in Log Scale	1.011	
90						SD in Original Scale	22.34			SD in Log Scale	1.714	
91						95% t UCL (assumes normality of ROS data)	22.99			95% Percentile Bootstrap UCL	23.48	
92						95% BCA Bootstrap UCL	27.61			95% Bootstrap t UCL	37.03	
93						95% H-UCL (Log ROS)	93.95					
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96						KM Mean (logged)	1.026			KM Geo Mean	2.79	
97						KM SD (logged)	1.634			95% Critical H Value (KM-Log)	4.027	
98						KM Standard Error of Mean (logged)	0.474			95% H-UCL (KM -Log)	70.86	
99						KM SD (logged)	1.634			95% Critical H Value (KM-Log)	4.027	
100						KM Standard Error of Mean (logged)	0.474					
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**									**DL/2 Log-Transformed**		
104						Mean in Original Scale	11.95			Mean in Log Scale	1.013	
105						SD in Original Scale	22.33			SD in Log Scale	1.712	
106						95% t UCL (Assumes normality)	22.99			95% H-Stat UCL	93.31	
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						975% KM (Chebyshev) UCL	50.77					
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 statisticia											
119												
120												
121	**Result (eu7_arsenic)**											
122												
123	**General Statistics**											
124						Total Number of Observations	13			Number of Distinct Observations	13	
125										Number of Missing Observations	0	
126						Minimum	7.7			Mean	33.69	
127						Maximum	73.5			Median	29.5	
128						SD	22.6			Std. Error of Mean	6.267	
129						Coefficient of Variation	0.671			Skewness	0.695	
130												
131	**Normal GOF Test**											
132						Shapiro Wilk Test Statistic	0.899			**Shapiro Wilk GOF Test**		
133						5% Shapiro Wilk Critical Value	0.866			Data appear Normal at 5% Significance Level		
134						Lilliefors Test Statistic	0.175			**Lilliefors GOF Test**		

135				5% Lilliefors Critical Value	0.234	Data appear Normal at 5% Significance Level						
136	**Data appear Normal at 5% Significance Level**											
137												
138	**Assuming Normal Distribution**											
139	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
140				95% Student's-t UCL	44.86	95% Adjusted-CLT UCL (Chen-1995)						45.29
141						95% Modified-t UCL (Johnson-1978)						45.06
142												
143	**Gamma GOF Test**											
144				A-D Test Statistic	0.291	**Anderson-Darling Gamma GOF Test**						
145				5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Lev						
146				K-S Test Statistic	0.14	**Kolmogorov-Smirnov Gamma GOF Test**						
147				5% K-S Critical Value	0.239	Detected data appear Gamma Distributed at 5% Significance Lev						
148	**Detected data appear Gamma Distributed at 5% Significance Level**											
149												
150	**Gamma Statistics**											
151				k hat (MLE)	2.308	k star (bias corrected MLE)						1.827
152				Theta hat (MLE)	14.6	Theta star (bias corrected MLE)						18.44
153				nu hat (MLE)	60.01	nu star (bias corrected)						47.5
154				MLE Mean (bias corrected)	33.69	MLE Sd (bias corrected)						24.93
155						Approximate Chi Square Value (0.05)						32.68
156				Adjusted Level of Significance	0.0301	Adjusted Chi Square Value						30.93
157												
158	**Assuming Gamma Distribution**											
159	95% Approximate Gamma UCL (use when n>=50))				48.97	95% Adjusted Gamma UCL (use when n<50)						51.73
160												
161	**Lognormal GOF Test**											
162				Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**						
163				5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level						
164				Lilliefors Test Statistic	0.132	**Lilliefors Lognormal GOF Test**						
165				5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level						
166	**Data appear Lognormal at 5% Significance Level**											
167												
168	**Lognormal Statistics**											
169				Minimum of Logged Data	2.041	Mean of logged Data						3.285
170				Maximum of Logged Data	4.297	SD of logged Data						0.737
171												
172	**Assuming Lognormal Distribution**											
173				95% H-UCL	58.74	90% Chebyshev (MVUE) UCL						56.21
174				95% Chebyshev (MVUE) UCL	66.19	97.5% Chebyshev (MVUE) UCL						80.04
175				99% Chebyshev (MVUE) UCL	107.2							
176												
177	**Nonparametric Distribution Free UCL Statistics**											
178	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
179												
180	**Nonparametric Distribution Free UCLs**											
181				95% CLT UCL	44	95% Jackknife UCL						44.86
182				95% Standard Bootstrap UCL	43.64	95% Bootstrap-t UCL						46.85
183				95% Hall's Bootstrap UCL	46.33	95% Percentile Bootstrap UCL						43.87
184				95% BCA Bootstrap UCL	44.58							
185				90% Chebyshev(Mean, Sd) UCL	52.49	95% Chebyshev(Mean, Sd) UCL						61.01
186				97.5% Chebyshev(Mean, Sd) UCL	72.83	99% Chebyshev(Mean, Sd) UCL						96.05
187												
188	**Suggested UCL to Use**											
189				95% Student's-t UCL	44.86							
190												
191	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
192	Recommendations are based upon data size, data distribution, and skewness.											
193	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
194	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
195												
196												
197	**Result (eu7_cadmium)**											
198												
199	**General Statistics**											
200				Total Number of Observations	13	Number of Distinct Observations						13
201						Number of Missing Observations						0

202					Minimum	0.18				Mean		6.208
203					Maximum	23.8				Median		1.62
204					SD	7.955				Std. Error of Mean		2.206
205					Coefficient of Variation	1.281				Skewness		1.418
206												
207					**Normal GOF Test**							
208					Shapiro Wilk Test Statistic	0.756	**Shapiro Wilk GOF Test**					
209					5% Shapiro Wilk Critical Value	0.866	Data Not Normal at 5% Significance Level					
210					Lilliefors Test Statistic	0.272	**Lilliefors GOF Test**					
211					5% Lilliefors Critical Value	0.234	Data Not Normal at 5% Significance Level					
212					**Data Not Normal at 5% Significance Level**							
213												
214					**Assuming Normal Distribution**							
215					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
216					95% Student's-t UCL	10.14				95% Adjusted-CLT UCL (Chen-1995)		10.77
217										95% Modified-t UCL (Johnson-1978)		10.29
218												
219					**Gamma GOF Test**							
220					A-D Test Statistic	0.547	**Anderson-Darling Gamma GOF Test**					
221					5% A-D Critical Value	0.776	Detected data appear Gamma Distributed at 5% Significance Lev					
222					K-S Test Statistic	0.218	**Kolmogorov-Smirnov Gamma GOF Test**					
223					5% K-S Critical Value	0.247	Detected data appear Gamma Distributed at 5% Significance Lev					
224					**Detected data appear Gamma Distributed at 5% Significance Level**							
225												
226					**Gamma Statistics**							
227					k hat (MLE)	0.672				k star (bias corrected MLE)		0.568
228					Theta hat (MLE)	9.241				Theta star (bias corrected MLE)		10.93
229					nu hat (MLE)	17.47				nu star (bias corrected)		14.77
230					MLE Mean (bias corrected)	6.208				MLE Sd (bias corrected)		8.237
231										Approximate Chi Square Value (0.05)		7.102
232					Adjusted Level of Significance	0.0301				Adjusted Chi Square Value		6.358
233												
234					**Assuming Gamma Distribution**							
235					95% Approximate Gamma UCL (use when n>=50)	12.91				95% Adjusted Gamma UCL (use when n<50)		14.42
236												
237					**Lognormal GOF Test**							
238					Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk Lognormal GOF Test**					
239					5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level					
240					Lilliefors Test Statistic	0.153	**Lilliefors Lognormal GOF Test**					
241					5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level					
242					**Data appear Lognormal at 5% Significance Level**							
243												
244					**Lognormal Statistics**							
245					Minimum of Logged Data	-1.715				Mean of logged Data		0.921
246					Maximum of Logged Data	3.17				SD of logged Data		1.504
247												
248					**Assuming Lognormal Distribution**							
249					95% H-UCL	40.35				90% Chebyshev (MVUE) UCL		15.96
250					95% Chebyshev (MVUE) UCL	20.17				97.5% Chebyshev (MVUE) UCL		26.01
251					99% Chebyshev (MVUE) UCL	37.47						
252												
253					**Nonparametric Distribution Free UCL Statistics**							
254					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
255												
256					**Nonparametric Distribution Free UCLs**							
257					95% CLT UCL	9.838				95% Jackknife UCL		10.14
258					95% Standard Bootstrap UCL	9.757				95% Bootstrap-t UCL		12.07
259					95% Hall's Bootstrap UCL	10.68				95% Percentile Bootstrap UCL		9.917
260					95% BCA Bootstrap UCL	10.48						
261					90% Chebyshev(Mean, Sd) UCL	12.83				95% Chebyshev(Mean, Sd) UCL		15.83
262					97.5% Chebyshev(Mean, Sd) UCL	19.99				99% Chebyshev(Mean, Sd) UCL		28.16
263												
264					**Suggested UCL to Use**							
265					95% Adjusted Gamma UCL	14.42						
266												
267	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
268	Recommendations are based upon data size, data distribution, and skewness.											

269	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
270	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
271												
272												
273	**Result (eu7_chromium)**											
274												
275	**General Statistics**											
276	Total Number of Observations				13		Number of Distinct Observations				13	
277							Number of Missing Observations				0	
278	Minimum				1.36		Mean				5.84	
279	Maximum				11.2		Median				4.7	
280	SD				3.092		Std. Error of Mean				0.858	
281	Coefficient of Variation				0.53		Skewness				0.439	
282												
283	**Normal GOF Test**											
284	Shapiro Wilk Test Statistic				0.943		**Shapiro Wilk GOF Test**					
285	5% Shapiro Wilk Critical Value				0.866		Data appear Normal at 5% Significance Level					
286	Lilliefors Test Statistic				0.182		**Lilliefors GOF Test**					
287	5% Lilliefors Critical Value				0.234		Data appear Normal at 5% Significance Level					
288	**Data appear Normal at 5% Significance Level**											
289												
290	**Assuming Normal Distribution**											
291	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
292	95% Student's-t UCL				7.369		95% Adjusted-CLT UCL (Chen-1995)				7.362	
293							95% Modified-t UCL (Johnson-1978)				7.386	
294												
295	**Gamma GOF Test**											
296	A-D Test Statistic				0.234		**Anderson-Darling Gamma GOF Test**					
297	5% A-D Critical Value				0.738		Detected data appear Gamma Distributed at 5% Significance Lev					
298	K-S Test Statistic				0.152		**Kolmogorov-Smirnov Gamma GOF Test**					
299	5% K-S Critical Value				0.238		Detected data appear Gamma Distributed at 5% Significance Lev					
300	**Detected data appear Gamma Distributed at 5% Significance Level**											
301												
302	**Gamma Statistics**											
303	k hat (MLE)				3.465		k star (bias corrected MLE)				2.717	
304	Theta hat (MLE)				1.685		Theta star (bias corrected MLE)				2.15	
305	nu hat (MLE)				90.09		nu star (bias corrected)				70.64	
306	MLE Mean (bias corrected)				5.84		MLE Sd (bias corrected)				3.543	
307							Approximate Chi Square Value (0.05)				52.29	
308	Adjusted Level of Significance				0.0301		Adjusted Chi Square Value				50.04	
309												
310	**Assuming Gamma Distribution**											
311	95% Approximate Gamma UCL (use when n>=50))				7.889		95% Adjusted Gamma UCL (use when n<50)				8.243	
312												
313	**Lognormal GOF Test**											
314	Shapiro Wilk Test Statistic				0.951		**Shapiro Wilk Lognormal GOF Test**					
315	5% Shapiro Wilk Critical Value				0.866		Data appear Lognormal at 5% Significance Level					
316	Lilliefors Test Statistic				0.161		**Lilliefors Lognormal GOF Test**					
317	5% Lilliefors Critical Value				0.234		Data appear Lognormal at 5% Significance Level					
318	**Data appear Lognormal at 5% Significance Level**											
319												
320	**Lognormal Statistics**											
321	Minimum of Logged Data				0.307		Mean of logged Data				1.614	
322	Maximum of Logged Data				2.416		SD of logged Data				0.607	
323												
324	**Assuming Lognormal Distribution**											
325	95% H-UCL				8.944		90% Chebyshev (MVUE) UCL				9.049	
326	95% Chebyshev (MVUE) UCL				10.46		97.5% Chebyshev (MVUE) UCL				12.41	
327	99% Chebyshev (MVUE) UCL				16.25							
328												
329	**Nonparametric Distribution Free UCL Statistics**											
330	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
331												
332	**Nonparametric Distribution Free UCLs**											
333	95% CLT UCL				7.251		95% Jackknife UCL				7.369	
334	95% Standard Bootstrap UCL				7.188		95% Bootstrap-t UCL				7.584	
335	95% Hall's Bootstrap UCL				7.304		95% Percentile Bootstrap UCL				7.185	

336				95% BCA Bootstrap UCL	7.268							
337				90% Chebyshev(Mean, Sd) UCL	8.413				95% Chebyshev(Mean, Sd) UCL			9.579
338				97.5% Chebyshev(Mean, Sd) UCL	11.2				99% Chebyshev(Mean, Sd) UCL			14.37
339												
340					**Suggested UCL to Use**							
341				95% Student's-t UCL	7.369							
342												
343	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
344	Recommendations are based upon data size, data distribution, and skewness.											
345	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
346	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician											
347												
348												
349	**Result (eu7_cobalt)**											
350												
351					**General Statistics**							
352				Total Number of Observations	12				Number of Distinct Observations			12
353									Number of Missing Observations			0
354				Minimum	1.51				Mean			7.475
355				Maximum	29.7				Median			5.6
356				SD	7.504				Std. Error of Mean			2.166
357				Coefficient of Variation	1.004				Skewness			2.707
358												
359					**Normal GOF Test**							
360				Shapiro Wilk Test Statistic	0.668				**Shapiro Wilk GOF Test**			
361				5% Shapiro Wilk Critical Value	0.859				Data Not Normal at 5% Significance Level			
362				Lilliefors Test Statistic	0.27				**Lilliefors GOF Test**			
363				5% Lilliefors Critical Value	0.243				Data Not Normal at 5% Significance Level			
364					**Data Not Normal at 5% Significance Level**							
365												
366					**Assuming Normal Distribution**							
367					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
368				95% Student's-t UCL	11.37				95% Adjusted-CLT UCL (Chen-1995)			12.85
369									95% Modified-t UCL (Johnson-1978)			11.65
370												
371					**Gamma GOF Test**							
372				A-D Test Statistic	0.493				**Anderson-Darling Gamma GOF Test**			
373				5% A-D Critical Value	0.743				Detected data appear Gamma Distributed at 5% Significance Lev			
374				K-S Test Statistic	0.177				**Kolmogorov-Smirnov Gamma GOF Test**			
375				5% K-S Critical Value	0.249				Detected data appear Gamma Distributed at 5% Significance Lev			
376					**Detected data appear Gamma Distributed at 5% Significance Level**							
377												
378					**Gamma Statistics**							
379				k hat (MLE)	1.786				k star (bias corrected MLE)			1.395
380				Theta hat (MLE)	4.185				Theta star (bias corrected MLE)			5.358
381				nu hat (MLE)	42.87				nu star (bias corrected)			33.48
382				MLE Mean (bias corrected)	7.475				MLE Sd (bias corrected)			6.329
383									Approximate Chi Square Value (0.05)			21.25
384				Adjusted Level of Significance	0.029				Adjusted Chi Square Value			19.78
385												
386					**Assuming Gamma Distribution**							
387				95% Approximate Gamma UCL (use when n>=50)	11.78				95% Adjusted Gamma UCL (use when n<50)			12.66
388												
389					**Lognormal GOF Test**							
390				Shapiro Wilk Test Statistic	0.964				**Shapiro Wilk Lognormal GOF Test**			
391				5% Shapiro Wilk Critical Value	0.859				Data appear Lognormal at 5% Significance Level			
392				Lilliefors Test Statistic	0.139				**Lilliefors Lognormal GOF Test**			
393				5% Lilliefors Critical Value	0.243				Data appear Lognormal at 5% Significance Level			
394					**Data appear Lognormal at 5% Significance Level**							
395												
396					**Lognormal Statistics**							
397				Minimum of Logged Data	0.412				Mean of logged Data			1.706
398				Maximum of Logged Data	3.391				SD of logged Data			0.775
399												
400					**Assuming Lognormal Distribution**							
401				95% H-UCL	13.44				90% Chebyshev (MVUE) UCL			12.3
402				95% Chebyshev (MVUE) UCL	14.6				97.5% Chebyshev (MVUE) UCL			17.8

403				99% Chebyshev (MVUE) UCL	24.08							
404												
405				**Nonparametric Distribution Free UCL Statistics**								
406				**Data appear to follow a Discernible Distribution at 5% Significance Level**								
407												
408				**Nonparametric Distribution Free UCLs**								
409				95% CLT UCL	11.04				95% Jackknife UCL	11.37		
410				95% Standard Bootstrap UCL	10.93				95% Bootstrap-t UCL	16.54		
411				95% Hall's Bootstrap UCL	25.8				95% Percentile Bootstrap UCL	11.28		
412				95% BCA Bootstrap UCL	12.88							
413				90% Chebyshev(Mean, Sd) UCL	13.97				95% Chebyshev(Mean, Sd) UCL	16.92		
414				97.5% Chebyshev(Mean, Sd) UCL	21				99% Chebyshev(Mean, Sd) UCL	29.03		
415												
416				**Suggested UCL to Use**								
417				95% Adjusted Gamma UCL	12.66							
418												
419	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
420	Recommendations are based upon data size, data distribution, and skewness.											
421	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
422	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
423												
424												
425	**Result (eu7_iron)**											
426												
427				**General Statistics**								
428				Total Number of Observations	13				Number of Distinct Observations	13		
429									Number of Missing Observations	0		
430				Minimum	14400				Mean	28831		
431				Maximum	48100				Median	25200		
432				SD	10675				Std. Error of Mean	2961		
433				Coefficient of Variation	0.37				Skewness	0.502		
434												
435				**Normal GOF Test**								
436				Shapiro Wilk Test Statistic	0.938				**Shapiro Wilk GOF Test**			
437				5% Shapiro Wilk Critical Value	0.866				Data appear Normal at 5% Significance Level			
438				Lilliefors Test Statistic	0.172				**Lilliefors GOF Test**			
439				5% Lilliefors Critical Value	0.234				Data appear Normal at 5% Significance Level			
440				**Data appear Normal at 5% Significance Level**								
441												
442				**Assuming Normal Distribution**								
443				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
444				95% Student's-t UCL	34108				95% Adjusted-CLT UCL (Chen-1995)	34141		
445									95% Modified-t UCL (Johnson-1978)	34176		
446												
447				**Gamma GOF Test**								
448				A-D Test Statistic	0.276				**Anderson-Darling Gamma GOF Test**			
449				5% A-D Critical Value	0.735				Detected data appear Gamma Distributed at 5% Significance Lev			
450				K-S Test Statistic	0.138				**Kolmogorov-Smirnov Gamma GOF Test**			
451				5% K-S Critical Value	0.237				Detected data appear Gamma Distributed at 5% Significance Lev			
452				**Detected data appear Gamma Distributed at 5% Significance Level**								
453												
454				**Gamma Statistics**								
455				k hat (MLE)	7.963				k star (bias corrected MLE)	6.177		
456				Theta hat (MLE)	3620				Theta star (bias corrected MLE)	4668		
457				nu hat (MLE)	207				nu star (bias corrected)	160.6		
458				MLE Mean (bias corrected)	28831				MLE Sd (bias corrected)	11600		
459									Approximate Chi Square Value (0.05)	132.3		
460				Adjusted Level of Significance	0.0301				Adjusted Chi Square Value	128.6		
461												
462				**Assuming Gamma Distribution**								
463				95% Approximate Gamma UCL (use when n>=50))	34998				95% Adjusted Gamma UCL (use when n<50)	35993		
464												
465				**Lognormal GOF Test**								
466				Shapiro Wilk Test Statistic	0.962				**Shapiro Wilk Lognormal GOF Test**			
467				5% Shapiro Wilk Critical Value	0.866				Data appear Lognormal at 5% Significance Level			
468				Lilliefors Test Statistic	0.134				**Lilliefors Lognormal GOF Test**			
469				5% Lilliefors Critical Value	0.234				Data appear Lognormal at 5% Significance Level			

470	**Data appear Lognormal at 5% Significance Level**											
471												
472	**Lognormal Statistics**											
473						Minimum of Logged Data	9.575			Mean of logged Data	10.21	
474						Maximum of Logged Data	10.78			SD of logged Data	0.375	
475												
476	**Assuming Lognormal Distribution**											
477						95% H-UCL	35953			90% Chebyshev (MVUE) UCL	37998	
478						95% Chebyshev (MVUE) UCL	42143			97.5% Chebyshev (MVUE) UCL	47895	
479						99% Chebyshev (MVUE) UCL	59194					
480												
481	**Nonparametric Distribution Free UCL Statistics**											
482	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
483												
484	**Nonparametric Distribution Free UCLs**											
485						95% CLT UCL	33701			95% Jackknife UCL	34108	
486						95% Standard Bootstrap UCL	33613			95% Bootstrap-t UCL	35002	
487						95% Hall's Bootstrap UCL	34368			95% Percentile Bootstrap UCL	33492	
488						95% BCA Bootstrap UCL	33762					
489						90% Chebyshev(Mean, Sd) UCL	37713			95% Chebyshev(Mean, Sd) UCL	41736	
490						97.5% Chebyshev(Mean, Sd) UCL	47320			99% Chebyshev(Mean, Sd) UCL	58289	
491												
492	**Suggested UCL to Use**											
493						95% Student's-t UCL	34108					
494												
495	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
496	Recommendations are based upon data size, data distribution, and skewness.											
497	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
498	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
499												
500												
501	**Result (eu7_manganese)**											
502												
503	**General Statistics**											
504						Total Number of Observations	13			Number of Distinct Observations	13	
505										Number of Missing Observations	0	
506						Minimum	165			Mean	1659	
507						Maximum	9030			Median	829	
508						SD	2356			Std. Error of Mean	653.3	
509						Coefficient of Variation	1.42			Skewness	2.936	
510												
511	**Normal GOF Test**											
512						Shapiro Wilk Test Statistic	0.604			**Shapiro Wilk GOF Test**		
513						5% Shapiro Wilk Critical Value	0.866			Data Not Normal at 5% Significance Level		
514						Lilliefors Test Statistic	0.294			**Lilliefors GOF Test**		
515						5% Lilliefors Critical Value	0.234			Data Not Normal at 5% Significance Level		
516	**Data Not Normal at 5% Significance Level**											
517												
518	**Assuming Normal Distribution**											
519	**95% Normal UCL**									**95% UCLs (Adjusted for Skewness)**		
520						95% Student's-t UCL	2823			95% Adjusted-CLT UCL (Chen-1995)	3302	
521										95% Modified-t UCL (Johnson-1978)	2912	
522												
523	**Gamma GOF Test**											
524						A-D Test Statistic	0.573			**Anderson-Darling Gamma GOF Test**		
525						5% A-D Critical Value	0.759			Detected data appear Gamma Distributed at 5% Significance Lev		
526						K-S Test Statistic	0.22			**Kolmogorov-Smirnov Gamma GOF Test**		
527						5% K-S Critical Value	0.243			Detected data appear Gamma Distributed at 5% Significance Lev		
528	**Detected data appear Gamma Distributed at 5% Significance Level**											
529												
530	**Gamma Statistics**											
531						k hat (MLE)	0.979			k star (bias corrected MLE)	0.804	
532						Theta hat (MLE)	1695			Theta star (bias corrected MLE)	2063	
533						nu hat (MLE)	25.44			nu star (bias corrected)	20.91	
534						MLE Mean (bias corrected)	1659			MLE Sd (bias corrected)	1850	
535										Approximate Chi Square Value (0.05)	11.52	
536						Adjusted Level of Significance	0.0301			Adjusted Chi Square Value	10.54	

537												
538						**Assuming Gamma Distribution**							
539					95% Approximate Gamma UCL (use when n>=50)		3010			95% Adjusted Gamma UCL (use when n<50)		3290
540												
541						**Lognormal GOF Test**							
542						Shapiro Wilk Test Statistic	0.967			**Shapiro Wilk Lognormal GOF Test**		
543						5% Shapiro Wilk Critical Value	0.866			Data appear Lognormal at 5% Significance Level		
544						Lilliefors Test Statistic	0.143			**Lilliefors Lognormal GOF Test**		
545						5% Lilliefors Critical Value	0.234			Data appear Lognormal at 5% Significance Level		
546						**Data appear Lognormal at 5% Significance Level**							
547												
548						**Lognormal Statistics**							
549						Minimum of Logged Data	5.106			Mean of logged Data		6.822
550						Maximum of Logged Data	9.108			SD of logged Data		1.089
551												
552						**Assuming Lognormal Distribution**							
553						95% H-UCL	4267			90% Chebyshev (MVUE) UCL		3087
554						95% Chebyshev (MVUE) UCL	3780			97.5% Chebyshev (MVUE) UCL		4742
555						99% Chebyshev (MVUE) UCL	6633					
556												
557						**Nonparametric Distribution Free UCL Statistics**							
558						**Data appear to follow a Discernible Distribution at 5% Significance Level**							
559												
560						**Nonparametric Distribution Free UCLs**							
561						95% CLT UCL	2733			95% Jackknife UCL		2823
562						95% Standard Bootstrap UCL	2681			95% Bootstrap-t UCL		4807
563						95% Hall's Bootstrap UCL	6606			95% Percentile Bootstrap UCL		2767
564						95% BCA Bootstrap UCL	3447					
565						90% Chebyshev(Mean, Sd) UCL	3619			95% Chebyshev(Mean, Sd) UCL		4506
566						97.5% Chebyshev(Mean, Sd) UCL	5739			99% Chebyshev(Mean, Sd) UCL		8159
567												
568						**Suggested UCL to Use**							
569						95% Adjusted Gamma UCL	3290					
570												
571	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
572	Recommendations are based upon data size, data distribution, and skewness.											
573	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
574	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
575												
576	**Result (eu7_thallium)**											
577												
578						**General Statistics**							
579						Total Number of Observations	12			Number of Distinct Observations		11
580						Number of Detects	9			Number of Non-Detects		3
581						Number of Distinct Detects	8			Number of Distinct Non-Detects		3
582						Minimum Detect	0.086			Minimum Non-Detect		0.494
583						Maximum Detect	0.634			Maximum Non-Detect		0.979
584						Variance Detects	0.0371			Percent Non-Detects		25%
585						Mean Detects	0.247			SD Detects		0.193
586						Median Detects	0.18			CV Detects		0.781
587						Skewness Detects	1.468			Kurtosis Detects		0.989
588						Mean of Logged Detects	-1.627			SD of Logged Detects		0.687
589												
590						**Normal GOF Test on Detects Only**							
591						Shapiro Wilk Test Statistic	0.781			**Shapiro Wilk GOF Test**		
592						5% Shapiro Wilk Critical Value	0.829			Detected Data Not Normal at 5% Significance Level		
593						Lilliefors Test Statistic	0.302			**Lilliefors GOF Test**		
594						5% Lilliefors Critical Value	0.274			Detected Data Not Normal at 5% Significance Level		
595						**Detected Data Not Normal at 5% Significance Level**							
596												
597						**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
598						KM Mean	0.23			KM Standard Error of Mean		0.0548
599						KM SD	0.17			95% KM (BCA) UCL		0.331
600						95% KM (t) UCL	0.328			95% KM (Percentile Bootstrap) UCL		0.319
601						95% KM (z) UCL	0.32			95% KM Bootstrap t UCL		0.481
602						90% KM Chebyshev UCL	0.394			95% KM Chebyshev UCL		0.469
603						97.5% KM Chebyshev UCL	0.572			99% KM Chebyshev UCL		0.775

604												
605	**Gamma GOF Tests on Detected Observations Only**											
606					A-D Test Statistic	0.564	**Anderson-Darling GOF Test**					
607					5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Lev					
608					K-S Test Statistic	0.26	**Kolmogorov-Smirnov GOF**					
609					5% K-S Critical Value	0.282	Detected data appear Gamma Distributed at 5% Significance Lev					
610	**Detected data appear Gamma Distributed at 5% Significance Level**											
611												
612	**Gamma Statistics on Detected Data Only**											
613					k hat (MLE)	2.354	k star (bias corrected MLE)	1.643				
614					Theta hat (MLE)	0.105	Theta star (bias corrected MLE)	0.15				
615					nu hat (MLE)	42.36	nu star (bias corrected)	29.58				
616					Mean (detects)	0.247						
617												
618	**Gamma ROS Statistics using Imputed Non-Detects**											
619	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
620	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)											
621	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
622	This is especially true when the sample size is small.											
623	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
624					Minimum	0.086	Mean	0.228				
625					Maximum	0.634	Median	0.169				
626					SD	0.168	CV	0.737				
627					k hat (MLE)	2.882	k star (bias corrected MLE)	2.217				
628					Theta hat (MLE)	0.0791	Theta star (bias corrected MLE)	0.103				
629					nu hat (MLE)	69.17	nu star (bias corrected)	53.21				
630					Adjusted Level of Significance (β)	0.029						
631					Approximate Chi Square Value (53.21, α)	37.45	Adjusted Chi Square Value (53.21, β)	35.44				
632					95% Gamma Approximate UCL (use when n>=50)	0.324	95% Gamma Adjusted UCL (use when n<50)	0.342				
633												
634	**Estimates of Gamma Parameters using KM Estimates**											
635					Mean (KM)	0.23	SD (KM)	0.17				
636					Variance (KM)	0.0288	SE of Mean (KM)	0.0548				
637					k hat (KM)	1.837	k star (KM)	1.433				
638					nu hat (KM)	44.09	nu star (KM)	34.4				
639					theta hat (KM)	0.125	theta star (KM)	0.16				
640					80% gamma percentile (KM)	0.357	90% gamma percentile (KM)	0.484				
641					95% gamma percentile (KM)	0.608	99% gamma percentile (KM)	0.888				
642												
643	**Gamma Kaplan-Meier (KM) Statistics**											
644					Approximate Chi Square Value (34.40, α)	21.99	Adjusted Chi Square Value (34.40, β)	20.48				
645	5% Gamma Approximate KM-UCL (use when n>=50)					0.36	95% Gamma Adjusted KM-UCL (use when n<50)	0.386				
646												
647	**Lognormal GOF Test on Detected Observations Only**											
648					Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk GOF Test**					
649					5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level					
650					Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**					
651					5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level					
652	**Detected Data appear Lognormal at 5% Significance Level**											
653												
654	**Lognormal ROS Statistics Using Imputed Non-Detects**											
655					Mean in Original Scale	0.226	Mean in Log Scale	-1.671				
656					SD in Original Scale	0.168	SD in Log Scale	0.593				
657					95% t UCL (assumes normality of ROS data)	0.314	95% Percentile Bootstrap UCL	0.309				
658					95% BCA Bootstrap UCL	0.341	95% Bootstrap t UCL	0.498				
659					95% H-UCL (Log ROS)	0.336						
660												
661	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
662					KM Mean (logged)	-1.682	KM Geo Mean	0.186				
663					KM SD (logged)	0.616	95% Critical H Value (KM-Log)	2.293				
664					KM Standard Error of Mean (logged)	0.204	95% H-UCL (KM -Log)	0.344				
665					KM SD (logged)	0.616	95% Critical H Value (KM-Log)	2.293				
666					KM Standard Error of Mean (logged)	0.204						
667												
668	**DL/2 Statistics**											
669	**DL/2 Normal**						**DL/2 Log-Transformed**					
670					Mean in Original Scale	0.267	Mean in Log Scale	-1.511				

671				SD in Original Scale	0.179				SD in Log Scale	0.644		
672				95% t UCL (Assumes normality)	0.36				95% H-Stat UCL	0.427		
673	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
674												
675	**Nonparametric Distribution Free UCL Statistics**											
676	**Detected Data appear Gamma Distributed at 5% Significance Level**											
677												
678	**Suggested UCL to Use**											
679				95% KM Adjusted Gamma UCL	0.386				95% GROS Adjusted Gamma UCL	0.342		
680												
681	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
682	Recommendations are based upon data size, data distribution, and skewness.											
683	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
684	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
685												
686												
687	**Result (eu7_zinc)**											
688												
689	**General Statistics**											
690				Total Number of Observations	13				Number of Distinct Observations	13		
691									Number of Missing Observations	0		
692				Minimum	74.3				Mean	1135		
693				Maximum	5410				Median	540		
694				SD	1456				Std. Error of Mean	403.9		
695				Coefficient of Variation	1.283				Skewness	2.489		
696												
697	**Normal GOF Test**											
698				Shapiro Wilk Test Statistic	0.672				**Shapiro Wilk GOF Test**			
699				5% Shapiro Wilk Critical Value	0.866				Data Not Normal at 5% Significance Level			
700				Lilliefors Test Statistic	0.322				**Lilliefors GOF Test**			
701				5% Lilliefors Critical Value	0.234				Data Not Normal at 5% Significance Level			
702	**Data Not Normal at 5% Significance Level**											
703												
704	**Assuming Normal Distribution**											
705				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
706				95% Student's-t UCL	1855				95% Adjusted-CLT UCL (Chen-1995)	2097		
707									95% Modified-t UCL (Johnson-1978)	1901		
708												
709	**Gamma GOF Test**											
710				A-D Test Statistic	0.48				**Anderson-Darling Gamma GOF Test**			
711				5% A-D Critical Value	0.757				Detected data appear Gamma Distributed at 5% Significance Lev			
712				K-S Test Statistic	0.209				**Kolmogorov-Smirnov Gamma GOF Test**			
713				5% K-S Critical Value	0.243				Detected data appear Gamma Distributed at 5% Significance Lev			
714	**Detected data appear Gamma Distributed at 5% Significance Level**											
715												
716	**Gamma Statistics**											
717				k hat (MLE)	1.024				k star (bias corrected MLE)	0.839		
718				Theta hat (MLE)	1108				Theta star (bias corrected MLE)	1352		
719				nu hat (MLE)	26.64				nu star (bias corrected)	21.82		
720				MLE Mean (bias corrected)	1135				MLE Sd (bias corrected)	1239		
721									Approximate Chi Square Value (0.05)	12.21		
722				Adjusted Level of Significance	0.0301				Adjusted Chi Square Value	11.19		
723												
724	**Assuming Gamma Distribution**											
725				95% Approximate Gamma UCL (use when n>=50)	2029				95% Adjusted Gamma UCL (use when n<50)	2213		
726												
727	**Lognormal GOF Test**											
728				Shapiro Wilk Test Statistic	0.98				**Shapiro Wilk Lognormal GOF Test**			
729				5% Shapiro Wilk Critical Value	0.866				Data appear Lognormal at 5% Significance Level			
730				Lilliefors Test Statistic	0.137				**Lilliefors Lognormal GOF Test**			
731				5% Lilliefors Critical Value	0.234				Data appear Lognormal at 5% Significance Level			
732	**Data appear Lognormal at 5% Significance Level**											
733												
734	**Lognormal Statistics**											
735				Minimum of Logged Data	4.308				Mean of logged Data	6.472		
736				Maximum of Logged Data	8.596				SD of logged Data	1.102		
737												

	A	B	C	D	E	F	G	H	I	J	K	L
738	**Assuming Lognormal Distribution**											
739					95% H-UCL	3109			90% Chebyshev (MVUE) UCL			2217
740					95% Chebyshev (MVUE) UCL	2718			97.5% Chebyshev (MVUE) UCL			3414
741					99% Chebyshev (MVUE) UCL	4780						
742												
743	**Nonparametric Distribution Free UCL Statistics**											
744	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
745												
746	**Nonparametric Distribution Free UCLs**											
747					95% CLT UCL	1799			95% Jackknife UCL			1855
748					95% Standard Bootstrap UCL	1770			95% Bootstrap-t UCL			3301
749					95% Hall's Bootstrap UCL	4800			95% Percentile Bootstrap UCL			1822
750					95% BCA Bootstrap UCL	2146						
751					90% Chebyshev(Mean, Sd) UCL	2347			95% Chebyshev(Mean, Sd) UCL			2896
752					97.5% Chebyshev(Mean, Sd) UCL	3657			99% Chebyshev(Mean, Sd) UCL			5154
753												
754	**Suggested UCL to Use**											
755					95% Adjusted Gamma UCL	2213						
756												
757	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
758	Recommendations are based upon data size, data distribution, and skewness.											
759	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
760	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
761												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.112/4/2017 3:22:53 PM										
5	From File	BPMD_HHRA_FishInput_v3.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10	**Result (eu8_aluminum)**											
11												
12	**General Statistics**											
13	Total Number of Observations	8					Number of Distinct Observations	8				
14	Number of Detects	0					Number of Non-Detects	8				
15	Number of Distinct Detects	0					Number of Distinct Non-Detects	8				
16												
17	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
18	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
19	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
20												
21	**The data set for variable Result (eu8_aluminum) was not processed!**											
22												
23												
24	**Result (eu8_antimony)**											
25												
26	**General Statistics**											
27	Total Number of Observations	8					Number of Distinct Observations	8				
28	Number of Detects	0					Number of Non-Detects	8				
29	Number of Distinct Detects	0					Number of Distinct Non-Detects	8				
30												
31	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
32	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
33	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
34												
35	**The data set for variable Result (eu8_antimony) was not processed!**											
36												
37												
38	**Result (eu8_arsenic)**											
39												
40	**General Statistics**											
41	Total Number of Observations	8					Number of Distinct Observations	8				
42	Number of Detects	7					Number of Non-Detects	1				
43	Number of Distinct Detects	7					Number of Distinct Non-Detects	1				
44	Minimum Detect	0.0632					Minimum Non-Detect	0.0607				
45	Maximum Detect	0.546					Maximum Non-Detect	0.0607				
46	Variance Detects	0.04					Percent Non-Detects	12.5%				
47	Mean Detects	0.323					SD Detects	0.2				
48	Median Detects	0.301					CV Detects	0.62				
49	Skewness Detects	-0.326					Kurtosis Detects	-1.731				
50	Mean of Logged Detects	-1.403					SD of Logged Detects	0.905				
51												
52	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
53	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
54	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
55	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
56												
57	**Normal GOF Test on Detects Only**											
58	Shapiro Wilk Test Statistic	0.88					**Shapiro Wilk GOF Test**					
59	5% Shapiro Wilk Critical Value	0.803					Detected Data appear Normal at 5% Significance Level					
60	Lilliefors Test Statistic	0.218					**Lilliefors GOF Test**					
61	5% Lilliefors Critical Value	0.304					Detected Data appear Normal at 5% Significance Level					
62	**Detected Data appear Normal at 5% Significance Level**											
63												
64	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
65	KM Mean	0.29					KM Standard Error of Mean	0.0739				
66	KM SD	0.194					95% KM (BCA) UCL	0.388				
67	95% KM (t) UCL	0.43					95% KM (Percentile Bootstrap) UCL	0.402				

68				95% KM (z) UCL	0.412			95% KM Bootstrap t UCL	0.429			
69				90% KM Chebyshev UCL	0.512			95% KM Chebyshev UCL	0.612			
70				97.5% KM Chebyshev UCL	0.752			99% KM Chebyshev UCL	1.025			
71												
72				**Gamma GOF Tests on Detected Observations Only**								
73				A-D Test Statistic	0.597	**Anderson-Darling GOF Test**						
74				5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Lev						
75				K-S Test Statistic	0.24	**Kolmogorov-Smirnov GOF**						
76				5% K-S Critical Value	0.315	Detected data appear Gamma Distributed at 5% Significance Lev						
77				**Detected data appear Gamma Distributed at 5% Significance Level**								
78												
79				**Gamma Statistics on Detected Data Only**								
80				k hat (MLE)	1.991			k star (bias corrected MLE)	1.233			
81				Theta hat (MLE)	0.162			Theta star (bias corrected MLE)	0.262			
82				nu hat (MLE)	27.88			nu star (bias corrected)	17.27			
83				Mean (detects)	0.323							
84												
85				**Gamma ROS Statistics using Imputed Non-Detects**								
86				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
87				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)								
88				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
89				This is especially true when the sample size is small.								
90				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
91				Minimum	0.0158			Mean	0.284			
92				Maximum	0.546			Median	0.292			
93				SD	0.215			CV	0.755			
94				k hat (MLE)	1.162			k star (bias corrected MLE)	0.81			
95				Theta hat (MLE)	0.245			Theta star (bias corrected MLE)	0.351			
96				nu hat (MLE)	18.6			nu star (bias corrected)	12.96			
97				Adjusted Level of Significance (β)	0.0195							
98				Approximate Chi Square Value (12.96, α)	5.865			Adjusted Chi Square Value (12.96, β)	4.714			
99				95% Gamma Approximate UCL (use when n>=50)	0.628			95% Gamma Adjusted UCL (use when n<50)	0.782			
100												
101				**Estimates of Gamma Parameters using KM Estimates**								
102				Mean (KM)	0.29			SD (KM)	0.194			
103				Variance (KM)	0.0375			SE of Mean (KM)	0.0739			
104				k hat (KM)	2.243			k star (KM)	1.485			
105				nu hat (KM)	35.89			nu star (KM)	23.76			
106				theta hat (KM)	0.129			theta star (KM)	0.195			
107				80% gamma percentile (KM)	0.449			90% gamma percentile (KM)	0.606			
108				95% gamma percentile (KM)	0.758			99% gamma percentile (KM)	1.101			
109												
110				**Gamma Kaplan-Meier (KM) Statistics**								
111				Approximate Chi Square Value (23.76, α)	13.67			Adjusted Chi Square Value (23.76, β)	11.78			
112	5% Gamma Approximate KM-UCL (use when n>=50)				0.504			95% Gamma Adjusted KM-UCL (use when n<50)	0.585			
113												
114				**Lognormal GOF Test on Detected Observations Only**								
115				Shapiro Wilk Test Statistic	0.81	**Shapiro Wilk GOF Test**						
116				5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level						
117				Lilliefors Test Statistic	0.277	**Lilliefors GOF Test**						
118				5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level						
119				**Detected Data appear Lognormal at 5% Significance Level**								
120												
121				**Lognormal ROS Statistics Using Imputed Non-Detects**								
122				Mean in Original Scale	0.286			Mean in Log Scale	-1.661			
123				SD in Original Scale	0.212			SD in Log Scale	1.112			
124				95% t UCL (assumes normality of ROS data)	0.428			95% Percentile Bootstrap UCL	0.401			
125				95% BCA Bootstrap UCL	0.403			95% Bootstrap t UCL	0.429			
126				95% H-UCL (Log ROS)	1.674							
127												
128				**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**								
129				KM Mean (logged)	-1.578			KM Geo Mean	0.206			
130				KM SD (logged)	0.91			95% Critical H Value (KM-Log)	3.208			
131				KM Standard Error of Mean (logged)	0.348			95% H-UCL (KM -Log)	0.942			
132				KM SD (logged)	0.91			95% Critical H Value (KM-Log)	3.208			
133				KM Standard Error of Mean (logged)	0.348							
134												

135	**DL/2 Statistics**											
136	**DL/2 Normal**						**DL/2 Log-Transformed**					
137					Mean in Original Scale	0.286				Mean in Log Scale	-1.664	
138					SD in Original Scale	0.212				SD in Log Scale	1.118	
139					95% t UCL (Assumes normality)	0.428				95% H-Stat UCL	1.703	
140	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
141												
142	**Nonparametric Distribution Free UCL Statistics**											
143	**Detected Data appear Normal Distributed at 5% Significance Level**											
144												
145	**Suggested UCL to Use**											
146					95% KM (t) UCL	0.43						
147												
148	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
149	Recommendations are based upon data size, data distribution, and skewness.											
150	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
151	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
152												
153	**Result (eu8_beryllium)**											
154												
155	**General Statistics**											
156					Total Number of Observations	8				Number of Distinct Observations	8	
157					Number of Detects	0				Number of Non-Detects	8	
158					Number of Distinct Detects	0				Number of Distinct Non-Detects	8	
159												
160	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
161	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
162	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
163												
164	**The data set for variable Result (eu8_beryllium) was not processed!**											
165												
166												
167												
168	**Result (eu8_cadmium)**											
169												
170	**General Statistics**											
171					Total Number of Observations	8				Number of Distinct Observations	8	
172										Number of Missing Observations	0	
173					Minimum	0.0141				Mean	0.0332	
174					Maximum	0.0637				Median	0.0285	
175					SD	0.0173				Std. Error of Mean	0.00612	
176					Coefficient of Variation	0.522				Skewness	0.746	
177												
178	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
179	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
180	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
181	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
182												
183	**Normal GOF Test**											
184					Shapiro Wilk Test Statistic	0.921	**Shapiro Wilk GOF Test**					
185					5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level					
186					Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**					
187					5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level					
188	**Data appear Normal at 5% Significance Level**											
189												
190	**Assuming Normal Distribution**											
191	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
192					95% Student's-t UCL	0.0448				95% Adjusted-CLT UCL (Chen-1995)	0.045	
193										95% Modified-t UCL (Johnson-1978)	0.0451	
194												
195	**Gamma GOF Test**											
196					A-D Test Statistic	0.253	**Anderson-Darling Gamma GOF Test**					
197					5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Lev					
198					K-S Test Statistic	0.173	**Kolmogorov-Smirnov Gamma GOF Test**					
199					5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Lev					
200	**Detected data appear Gamma Distributed at 5% Significance Level**											
201												

202	**Gamma Statistics**											
203						k hat (MLE)	4.317	k star (bias corrected MLE)				2.781
204						Theta hat (MLE)	0.00769	Theta star (bias corrected MLE)				0.0119
205						nu hat (MLE)	69.07	nu star (bias corrected)				44.5
206						MLE Mean (bias corrected)	0.0332	MLE Sd (bias corrected)				0.0199
207								Approximate Chi Square Value (0.05)				30.2
208						Adjusted Level of Significance	0.0195	Adjusted Chi Square Value				27.25
209												
210	**Assuming Gamma Distribution**											
211	95% Approximate Gamma UCL (use when n>=50))						0.0489	95% Adjusted Gamma UCL (use when n<50)				0.0542
212												
213	**Lognormal GOF Test**											
214						Shapiro Wilk Test Statistic	0.961	**Shapiro Wilk Lognormal GOF Test**				
215						5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level				
216						Lilliefors Test Statistic	0.15	**Lilliefors Lognormal GOF Test**				
217						5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level				
218	**Data appear Lognormal at 5% Significance Level**											
219												
220	**Lognormal Statistics**											
221						Minimum of Logged Data	-4.259	Mean of logged Data				-3.526
222						Maximum of Logged Data	-2.754	SD of logged Data				0.528
223												
224	**Assuming Lognormal Distribution**											
225						95% H-UCL	0.0546	90% Chebyshev (MVUE) UCL				0.052
226						95% Chebyshev (MVUE) UCL	0.0605	97.5% Chebyshev (MVUE) UCL				0.0723
227						99% Chebyshev (MVUE) UCL	0.0955					
228												
229	**Nonparametric Distribution Free UCL Statistics**											
230	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
231												
232	**Nonparametric Distribution Free UCLs**											
233						95% CLT UCL	0.0433	95% Jackknife UCL				0.0448
234						95% Standard Bootstrap UCL	0.0426	95% Bootstrap-t UCL				0.0481
235						95% Hall's Bootstrap UCL	0.0439	95% Percentile Bootstrap UCL				0.0426
236						95% BCA Bootstrap UCL	0.0438					
237						90% Chebyshev(Mean, Sd) UCL	0.0516	95% Chebyshev(Mean, Sd) UCL				0.0599
238						97.5% Chebyshev(Mean, Sd) UCL	0.0714	99% Chebyshev(Mean, Sd) UCL				0.0941
239												
240	**Suggested UCL to Use**											
241						95% Student's-t UCL	0.0448					
242												
243	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
244	Recommendations are based upon data size, data distribution, and skewness.											
245	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
246	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
247												
248												
249	**Result (eu8_chromium)**											
250												
251	**General Statistics**											
252						Total Number of Observations	8	Number of Distinct Observations				8
253								Number of Missing Observations				0
254						Minimum	0.687	Mean				0.819
255						Maximum	0.894	Median				0.825
256						SD	0.0618	Std. Error of Mean				0.0219
257						Coefficient of Variation	0.0755	Skewness				-1.443
258												
259	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
260	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
261	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
262	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
263												
264	**Normal GOF Test**											
265						Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk GOF Test**				
266						5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level				
267						Lilliefors Test Statistic	0.263	**Lilliefors GOF Test**				
268						5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level				

	A	B	C	D	E	F	G	H	I	J	K	L
269	**Data appear Normal at 5% Significance Level**											
270												
271	**Assuming Normal Distribution**											
272	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
273	95% Student's-t UCL					0.861	95% Adjusted-CLT UCL (Chen-1995)					0.843
274							95% Modified-t UCL (Johnson-1978)					0.859
275												
276	**Gamma GOF Test**											
277	A-D Test Statistic					0.537	**Anderson-Darling Gamma GOF Test**					
278	5% A-D Critical Value					0.715	Detected data appear Gamma Distributed at 5% Significance Lev					
279	K-S Test Statistic					0.267	**Kolmogorov-Smirnov Gamma GOF Test**					
280	5% K-S Critical Value					0.294	Detected data appear Gamma Distributed at 5% Significance Lev					
281	**Detected data appear Gamma Distributed at 5% Significance Level**											
282												
283	**Gamma Statistics**											
284	k hat (MLE)					188.5	k star (bias corrected MLE)					117.9
285	Theta hat (MLE)					0.00435	Theta star (bias corrected MLE)					0.00695
286	nu hat (MLE)					3016	nu star (bias corrected)					1887
287	MLE Mean (bias corrected)					0.819	MLE Sd (bias corrected)					0.0754
288							Approximate Chi Square Value (0.05)					1787
289	Adjusted Level of Significance					0.0195	Adjusted Chi Square Value					1762
290												
291	**Assuming Gamma Distribution**											
292	95% Approximate Gamma UCL (use when n>=50))					0.865	95% Adjusted Gamma UCL (use when n<50)					0.877
293												
294	**Lognormal GOF Test**											
295	Shapiro Wilk Test Statistic					0.851	**Shapiro Wilk Lognormal GOF Test**					
296	5% Shapiro Wilk Critical Value					0.818	Data appear Lognormal at 5% Significance Level					
297	Lilliefors Test Statistic					0.28	**Lilliefors Lognormal GOF Test**					
298	5% Lilliefors Critical Value					0.283	Data appear Lognormal at 5% Significance Level					
299	**Data appear Lognormal at 5% Significance Level**											
300												
301	**Lognormal Statistics**											
302	Minimum of Logged Data					-0.376	Mean of logged Data					-0.202
303	Maximum of Logged Data					-0.112	SD of logged Data					0.0792
304												
305	**Assuming Lognormal Distribution**											
306	95% H-UCL					N/A	90% Chebyshev (MVUE) UCL					0.888
307	95% Chebyshev (MVUE) UCL					0.919	97.5% Chebyshev (MVUE) UCL					0.962
308	99% Chebyshev (MVUE) UCL					1.047						
309												
310	**Nonparametric Distribution Free UCL Statistics**											
311	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
312												
313	**Nonparametric Distribution Free UCLs**											
314	95% CLT UCL					0.855	95% Jackknife UCL					0.861
315	95% Standard Bootstrap UCL					0.852	95% Bootstrap-t UCL					0.85
316	95% Hall's Bootstrap UCL					0.848	95% Percentile Bootstrap UCL					0.849
317	95% BCA Bootstrap UCL					0.845						
318	90% Chebyshev(Mean, Sd) UCL					0.885	95% Chebyshev(Mean, Sd) UCL					0.914
319	97.5% Chebyshev(Mean, Sd) UCL					0.956	99% Chebyshev(Mean, Sd) UCL					1.037
320												
321	**Suggested UCL to Use**											
322	95% Student's-t UCL					0.861						
323												
324	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
325	Recommendations are based upon data size, data distribution, and skewness.											
326	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
327	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
328												
329	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
330	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
331												
332												
333	**Result (eu8_copper)**											
334												
335	**General Statistics**											

336					Total Number of Observations	8				Number of Distinct Observations		8
337										Number of Missing Observations		0
338					Minimum	0.361				Mean		0.481
339					Maximum	0.642				Median		0.463
340					SD	0.0832				Std. Error of Mean		0.0294
341					Coefficient of Variation	0.173				Skewness		0.852
342												
343	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
344	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
345	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
346	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
347												
348	**Normal GOF Test**											
349					Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk GOF Test**					
350					5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level					
351					Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**					
352					5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level					
353	**Data appear Normal at 5% Significance Level**											
354												
355	**Assuming Normal Distribution**											
356	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
357					95% Student's-t UCL	0.537				95% Adjusted-CLT UCL (Chen-1995)		0.539
358										95% Modified-t UCL (Johnson-1978)		0.538
359												
360	**Gamma GOF Test**											
361					A-D Test Statistic	0.359	**Anderson-Darling Gamma GOF Test**					
362					5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Lev					
363					K-S Test Statistic	0.205	**Kolmogorov-Smirnov Gamma GOF Test**					
364					5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Lev					
365	**Detected data appear Gamma Distributed at 5% Significance Level**											
366												
367	**Gamma Statistics**											
368					k hat (MLE)	39.85				k star (bias corrected MLE)		24.99
369					Theta hat (MLE)	0.0121				Theta star (bias corrected MLE)		0.0193
370					nu hat (MLE)	637.6				nu star (bias corrected)		399.9
371					MLE Mean (bias corrected)	0.481				MLE Sd (bias corrected)		0.0963
372										Approximate Chi Square Value (0.05)		354.5
373					Adjusted Level of Significance	0.0195				Adjusted Chi Square Value		343.7
374												
375	**Assuming Gamma Distribution**											
376	95% Approximate Gamma UCL (use when n>=50))					0.543				95% Adjusted Gamma UCL (use when n<50)		0.56
377												
378	**Lognormal GOF Test**											
379					Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**					
380					5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level					
381					Lilliefors Test Statistic	0.197	**Lilliefors Lognormal GOF Test**					
382					5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level					
383	**Data appear Lognormal at 5% Significance Level**											
384												
385	**Lognormal Statistics**											
386					Minimum of Logged Data	-1.018				Mean of logged Data		-0.744
387					Maximum of Logged Data	-0.444				SD of logged Data		0.169
388												
389	**Assuming Lognormal Distribution**											
390					95% H-UCL	0.544				90% Chebyshev (MVUE) UCL		0.567
391					95% Chebyshev (MVUE) UCL	0.606				97.5% Chebyshev (MVUE) UCL		0.66
392					99% Chebyshev (MVUE) UCL	0.767						
393												
394	**Nonparametric Distribution Free UCL Statistics**											
395	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
396												
397	**Nonparametric Distribution Free UCLs**											
398					95% CLT UCL	0.53				95% Jackknife UCL		0.537
399					95% Standard Bootstrap UCL	0.526				95% Bootstrap-t UCL		0.559
400					95% Hall's Bootstrap UCL	0.937				95% Percentile Bootstrap UCL		0.527
401					95% BCA Bootstrap UCL	0.537						
402					90% Chebyshev(Mean, Sd) UCL	0.569				95% Chebyshev(Mean, Sd) UCL		0.609

403				97.5% Chebyshev(Mean, Sd) UCL	0.665			99% Chebyshev(Mean, Sd) UCL	0.774			
404												
405				**Suggested UCL to Use**								
406				95% Student's-t UCL	0.537							
407												
408	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
409	Recommendations are based upon data size, data distribution, and skewness.											
410	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
411	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
412												
413	**Result (eu8_iron)**											
414												
415	**General Statistics**											
416				Total Number of Observations	8			Number of Distinct Observations	8			
417				Number of Detects	0			Number of Non-Detects	8			
418				Number of Distinct Detects	0			Number of Distinct Non-Detects	8			
419												
420	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
421	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
422	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
423												
424	**The data set for variable Result (eu8_iron) was not processed!**											
425												
426												
427												
428	**Result (eu8_lead)**											
429												
430	**General Statistics**											
431				Total Number of Observations	8			Number of Distinct Observations	8			
432								Number of Missing Observations	0			
433				Minimum	0.0108			Mean	0.0368			
434				Maximum	0.0685			Median	0.0413			
435				SD	0.0224			Std. Error of Mean	0.00793			
436				Coefficient of Variation	0.61			Skewness	-0.0436			
437												
438	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
439	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
440	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
441	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
442												
443	**Normal GOF Test**											
444				Shapiro Wilk Test Statistic	0.891			**Shapiro Wilk GOF Test**				
445				5% Shapiro Wilk Critical Value	0.818			Data appear Normal at 5% Significance Level				
446				Lilliefors Test Statistic	0.217			**Lilliefors GOF Test**				
447				5% Lilliefors Critical Value	0.283			Data appear Normal at 5% Significance Level				
448	**Data appear Normal at 5% Significance Level**											
449												
450	**Assuming Normal Distribution**											
451	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
452				95% Student's-t UCL	0.0518			95% Adjusted-CLT UCL (Chen-1995)	0.0497			
453								95% Modified-t UCL (Johnson-1978)	0.0518			
454												
455	**Gamma GOF Test**											
456				A-D Test Statistic	0.603			**Anderson-Darling Gamma GOF Test**				
457				5% A-D Critical Value	0.723			Detected data appear Gamma Distributed at 5% Significance Lev				
458				K-S Test Statistic	0.243			**Kolmogorov-Smirnov Gamma GOF Test**				
459				5% K-S Critical Value	0.297			Detected data appear Gamma Distributed at 5% Significance Lev				
460	**Detected data appear Gamma Distributed at 5% Significance Level**											
461												
462	**Gamma Statistics**											
463				k hat (MLE)	2.406			k star (bias corrected MLE)	1.587			
464				Theta hat (MLE)	0.0153			Theta star (bias corrected MLE)	0.0232			
465				nu hat (MLE)	38.5			nu star (bias corrected)	25.4			
466				MLE Mean (bias corrected)	0.0368			MLE Sd (bias corrected)	0.0292			
467								Approximate Chi Square Value (0.05)	14.92			
468				Adjusted Level of Significance	0.0195			Adjusted Chi Square Value	12.93			
469												

470	**Assuming Gamma Distribution**											
471	95% Approximate Gamma UCL (use when n>=50))				0.0626	95% Adjusted Gamma UCL (use when n<50)					0.0722	
472												
473	**Lognormal GOF Test**											
474	Shapiro Wilk Test Statistic				0.839	**Shapiro Wilk Lognormal GOF Test**						
475	5% Shapiro Wilk Critical Value				0.818	Data appear Lognormal at 5% Significance Level						
476	Lilliefors Test Statistic				0.24	**Lilliefors Lognormal GOF Test**						
477	5% Lilliefors Critical Value				0.283	Data appear Lognormal at 5% Significance Level						
478	**Data appear Lognormal at 5% Significance Level**											
479												
480	**Lognormal Statistics**											
481	Minimum of Logged Data				-4.528	Mean of logged Data					-3.525	
482	Maximum of Logged Data				-2.682	SD of logged Data					0.767	
483												
484	**Assuming Lognormal Distribution**											
485	95% H-UCL				0.091	90% Chebyshev (MVUE) UCL					0.0692	
486	95% Chebyshev (MVUE) UCL				0.0834	97.5% Chebyshev (MVUE) UCL					0.103	
487	99% Chebyshev (MVUE) UCL				0.142							
488												
489	**Nonparametric Distribution Free UCL Statistics**											
490	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
491												
492	**Nonparametric Distribution Free UCLs**											
493	95% CLT UCL				0.0498	95% Jackknife UCL					0.0518	
494	95% Standard Bootstrap UCL				0.0484	95% Bootstrap-t UCL					0.0503	
495	95% Hall's Bootstrap UCL				0.0478	95% Percentile Bootstrap UCL					0.0495	
496	95% BCA Bootstrap UCL				0.0491							
497	90% Chebyshev(Mean, Sd) UCL				0.0606	95% Chebyshev(Mean, Sd) UCL					0.0713	
498	97.5% Chebyshev(Mean, Sd) UCL				0.0863	99% Chebyshev(Mean, Sd) UCL					0.116	
499												
500	**Suggested UCL to Use**											
501	95% Student's-t UCL				0.0518							
502												
503	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
504	Recommendations are based upon data size, data distribution, and skewness.											
505	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
506	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
507												
508	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
509	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
510												
511	**Result (eu8_manganese)**											
512												
513	**General Statistics**											
514	Total Number of Observations				8	Number of Distinct Observations					8	
515	Number of Detects				0	Number of Non-Detects					8	
516	Number of Distinct Detects				0	Number of Distinct Non-Detects					8	
517												
518	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
519	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
520	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
521												
522	**The data set for variable Result (eu8_manganese) was not processed!**											
523												
524												
525												
526	**Result (eu8_mercury)**											
527												
528	**General Statistics**											
529	Total Number of Observations				8	Number of Distinct Observations					8	
530						Number of Missing Observations					0	
531	Minimum				0.0239	Mean					0.0381	
532	Maximum				0.0582	Median					0.0369	
533	SD				0.011	Std. Error of Mean					0.0039	
534	Coefficient of Variation				0.289	Skewness					0.673	
535												
536	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											

	A	B	C	D	E	F	G	H	I	J	K	L
537	guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.											
538	For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).											
539	Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1											
540												
541	Normal GOF Test											
542	Shapiro Wilk Test Statistic					0.942	Shapiro Wilk GOF Test					
543	5% Shapiro Wilk Critical Value					0.818	Data appear Normal at 5% Significance Level					
544	Lilliefors Test Statistic					0.216	Lilliefors GOF Test					
545	5% Lilliefors Critical Value					0.283	Data appear Normal at 5% Significance Level					
546	Data appear Normal at 5% Significance Level											
547												
548	Assuming Normal Distribution											
549	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
550	95% Student's-t UCL					0.0455	95% Adjusted-CLT UCL (Chen-1995)					0.0455
551							95% Modified-t UCL (Johnson-1978)					0.0457
552												
553	Gamma GOF Test											
554	A-D Test Statistic					0.264	Anderson-Darling Gamma GOF Test					
555	5% A-D Critical Value					0.715	Detected data appear Gamma Distributed at 5% Significance Lev					
556	K-S Test Statistic					0.178	Kolmogorov-Smirnov Gamma GOF Test					
557	5% K-S Critical Value					0.294	Detected data appear Gamma Distributed at 5% Significance Lev					
558	Detected data appear Gamma Distributed at 5% Significance Level											
559												
560	Gamma Statistics											
561	k hat (MLE)					14.03	k star (bias corrected MLE)					8.851
562	Theta hat (MLE)					0.00272	Theta star (bias corrected MLE)					0.00431
563	nu hat (MLE)					224.5	nu star (bias corrected)					141.6
564	MLE Mean (bias corrected)					0.0381	MLE Sd (bias corrected)					0.0128
565							Approximate Chi Square Value (0.05)					115.1
566	Adjusted Level of Significance					0.0195	Adjusted Chi Square Value					109.1
567												
568	Assuming Gamma Distribution											
569	95% Approximate Gamma UCL (use when n>=50))					0.0469	95% Adjusted Gamma UCL (use when n<50)					0.0495
570												
571	Lognormal GOF Test											
572	Shapiro Wilk Test Statistic					0.962	Shapiro Wilk Lognormal GOF Test					
573	5% Shapiro Wilk Critical Value					0.818	Data appear Lognormal at 5% Significance Level					
574	Lilliefors Test Statistic					0.18	Lilliefors Lognormal GOF Test					
575	5% Lilliefors Critical Value					0.283	Data appear Lognormal at 5% Significance Level					
576	Data appear Lognormal at 5% Significance Level											
577												
578	Lognormal Statistics											
579	Minimum of Logged Data					-3.735	Mean of logged Data					-3.303
580	Maximum of Logged Data					-2.844	SD of logged Data					0.287
581												
582	Assuming Lognormal Distribution											
583	95% H-UCL					0.0478	90% Chebyshev (MVUE) UCL					0.0498
584	95% Chebyshev (MVUE) UCL					0.0551	97.5% Chebyshev (MVUE) UCL					0.0624
585	99% Chebyshev (MVUE) UCL					0.0768						
586												
587	Nonparametric Distribution Free UCL Statistics											
588	Data appear to follow a Discernible Distribution at 5% Significance Level											
589												
590	Nonparametric Distribution Free UCLs											
591	95% CLT UCL					0.0445	95% Jackknife UCL					0.0455
592	95% Standard Bootstrap UCL					0.0441	95% Bootstrap-t UCL					0.048
593	95% Hall's Bootstrap UCL					0.0548	95% Percentile Bootstrap UCL					0.0443
594	95% BCA Bootstrap UCL					0.0448						
595	90% Chebyshev(Mean, Sd) UCL					0.0498	95% Chebyshev(Mean, Sd) UCL					0.0551
596	97.5% Chebyshev(Mean, Sd) UCL					0.0625	99% Chebyshev(Mean, Sd) UCL					0.0769
597												
598	Suggested UCL to Use											
599	95% Student's-t UCL					0.0455						
600												
601	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
602	Recommendations are based upon data size, data distribution, and skewness.											
603	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

	A	B	C	D	E	F	G	H	I	J	K	L
604	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
605												
606	**Result (eu8_strontium)**											
607												
608	**General Statistics**											
609	Total Number of Observations					8	Number of Distinct Observations					8
610	Number of Detects					7	Number of Non-Detects					1
611	Number of Distinct Detects					7	Number of Distinct Non-Detects					1
612	Minimum Detect					0.272	Minimum Non-Detect					0.215
613	Maximum Detect					0.893	Maximum Non-Detect					0.215
614	Variance Detects					0.0611	Percent Non-Detects					12.5%
615	Mean Detects					0.491	SD Detects					0.247
616	Median Detects					0.357	CV Detects					0.504
617	Skewness Detects					0.746	Kurtosis Detects					-1.151
618	Mean of Logged Detects					-0.817	SD of Logged Detects					0.49
619												
620	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
621	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
622	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
623	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
624												
625	**Normal GOF Test on Detects Only**											
626	Shapiro Wilk Test Statistic					0.846	**Shapiro Wilk GOF Test**					
627	5% Shapiro Wilk Critical Value					0.803	Detected Data appear Normal at 5% Significance Level					
628	Lilliefors Test Statistic					0.277	**Lilliefors GOF Test**					
629	5% Lilliefors Critical Value					0.304	Detected Data appear Normal at 5% Significance Level					
630	**Detected Data appear Normal at 5% Significance Level**											
631												
632	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
633	KM Mean					0.456	KM Standard Error of Mean					0.0889
634	KM SD					0.233	95% KM (BCA) UCL					0.61
635	95% KM (t) UCL					0.624	95% KM (Percentile Bootstrap) UCL					0.6
636	95% KM (z) UCL					0.602	95% KM Bootstrap t UCL					0.69
637	90% KM Chebyshev UCL					0.723	95% KM Chebyshev UCL					0.843
638	97.5% KM Chebyshev UCL					1.011	99% KM Chebyshev UCL					1.34
639												
640	**Gamma GOF Tests on Detected Observations Only**											
641	A-D Test Statistic					0.577	**Anderson-Darling GOF Test**					
642	5% A-D Critical Value					0.71	Detected data appear Gamma Distributed at 5% Significance Lev					
643	K-S Test Statistic					0.268	**Kolmogorov-Smirnov GOF**					
644	5% K-S Critical Value					0.313	Detected data appear Gamma Distributed at 5% Significance Lev					
645	**Detected data appear Gamma Distributed at 5% Significance Level**											
646												
647	**Gamma Statistics on Detected Data Only**											
648	k hat (MLE)					4.905	k star (bias corrected MLE)					2.898
649	Theta hat (MLE)					0.1	Theta star (bias corrected MLE)					0.169
650	nu hat (MLE)					68.67	nu star (bias corrected)					40.57
651	Mean (detects)					0.491						
652												
653	**Gamma ROS Statistics using Imputed Non-Detects**											
654	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
655	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)											
656	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
657	This is especially true when the sample size is small.											
658	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
659	Minimum					0.0211	Mean					0.432
660	Maximum					0.893	Median					0.327
661	SD					0.283	CV					0.655
662	k hat (MLE)					1.543	k star (bias corrected MLE)					1.047
663	Theta hat (MLE)					0.28	Theta star (bias corrected MLE)					0.412
664	nu hat (MLE)					24.68	nu star (bias corrected)					16.76
665	Adjusted Level of Significance (β)					0.0195						
666	Approximate Chi Square Value (16.76, α)					8.501	Adjusted Chi Square Value (16.76, β)					7.065
667	95% Gamma Approximate UCL (use when n>=50)					0.852	95% Gamma Adjusted UCL (use when n<50)					1.025
668												
669	**Estimates of Gamma Parameters using KM Estimates**											
670	Mean (KM)					0.456	SD (KM)					0.233

671					Variance (KM)	0.0541				SE of Mean (KM)		0.0889
672					k hat (KM)	3.844				k star (KM)		2.486
673					nu hat (KM)	61.5				nu star (KM)		39.77
674					theta hat (KM)	0.119				theta star (KM)		0.184
675					80% gamma percentile (KM)	0.665				90% gamma percentile (KM)		0.844
676					95% gamma percentile (KM)	1.012				99% gamma percentile (KM)		1.38
677												
678					**Gamma Kaplan-Meier (KM) Statistics**							
679					Approximate Chi Square Value (39.77, α)	26.32				Adjusted Chi Square Value (39.77, β)		23.59
680				5% Gamma Approximate KM-UCL (use when n>=50)		0.689				95% Gamma Adjusted KM-UCL (use when n<50)		0.769
681												
682					**Lognormal GOF Test on Detected Observations Only**							
683					Shapiro Wilk Test Statistic	0.858				**Shapiro Wilk GOF Test**		
684					5% Shapiro Wilk Critical Value	0.803				Detected Data appear Lognormal at 5% Significance Level		
685					Lilliefors Test Statistic	0.239				**Lilliefors GOF Test**		
686					5% Lilliefors Critical Value	0.304				Detected Data appear Lognormal at 5% Significance Level		
687					**Detected Data appear Lognormal at 5% Significance Level**							
688												
689					**Lognormal ROS Statistics Using Imputed Non-Detects**							
690					Mean in Original Scale	0.446				Mean in Log Scale		-0.966
691					SD in Original Scale	0.261				SD in Log Scale		0.619
692					95% t UCL (assumes normality of ROS data)	0.621				95% Percentile Bootstrap UCL		0.591
693					95% BCA Bootstrap UCL	0.603				95% Bootstrap t UCL		0.666
694					95% H-UCL (Log ROS)	0.841						
695												
696					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
697					KM Mean (logged)	-0.907				KM Geo Mean		0.404
698					KM SD (logged)	0.487				95% Critical H Value (KM-Log)		2.332
699					KM Standard Error of Mean (logged)	0.186				95% H-UCL (KM -Log)		0.698
700					KM SD (logged)	0.487				95% Critical H Value (KM-Log)		2.332
701					KM Standard Error of Mean (logged)	0.186						
702												
703					**DL/2 Statistics**							
704					**DL/2 Normal**					**DL/2 Log-Transformed**		
705					Mean in Original Scale	0.443				Mean in Log Scale		-0.994
706					SD in Original Scale	0.266				SD in Log Scale		0.675
707					95% t UCL (Assumes normality)	0.621				95% H-Stat UCL		0.921
708					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
709												
710					**Nonparametric Distribution Free UCL Statistics**							
711					**Detected Data appear Normal Distributed at 5% Significance Level**							
712												
713					**Suggested UCL to Use**							
714					95% KM (t) UCL	0.624						
715												
716	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
717	Recommendations are based upon data size, data distribution, and skewness.											
718	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
719	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
720												
721	**Result (eu8_thallium)**											
722												
723					**General Statistics**							
724					Total Number of Observations	8				Number of Distinct Observations		8
725					Number of Detects	0				Number of Non-Detects		8
726					Number of Distinct Detects	0				Number of Distinct Non-Detects		8
727												
728	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
729	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
730	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
731												
732	**The data set for variable Result (eu8_thallium) was not processed!**											
733												
734												
735												
736	**Result (eu8_zinc)**											
737												

738	**General Statistics**											
739					Total Number of Observations	8				Number of Distinct Observations		8
740										Number of Missing Observations		0
741					Minimum	6.192				Mean		8.639
742					Maximum	13.21				Median		8.386
743					SD	2.154				Std. Error of Mean		0.761
744					Coefficient of Variation	0.249				Skewness		1.345
745												
746	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
747	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
748	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
749	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
750												
751	**Normal GOF Test**											
752					Shapiro Wilk Test Statistic	0.859				**Shapiro Wilk GOF Test**		
753					5% Shapiro Wilk Critical Value	0.818				Data appear Normal at 5% Significance Level		
754					Lilliefors Test Statistic	0.276				**Lilliefors GOF Test**		
755					5% Lilliefors Critical Value	0.283				Data appear Normal at 5% Significance Level		
756	**Data appear Normal at 5% Significance Level**											
757												
758	**Assuming Normal Distribution**											
759					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
760					95% Student's-t UCL	10.08				95% Adjusted-CLT UCL (Chen-1995)		10.28
761										95% Modified-t UCL (Johnson-1978)		10.14
762												
763	**Gamma GOF Test**											
764					A-D Test Statistic	0.455				**Anderson-Darling Gamma GOF Test**		
765					5% A-D Critical Value	0.716				Detected data appear Gamma Distributed at 5% Significance Lev		
766					K-S Test Statistic	0.238				**Kolmogorov-Smirnov Gamma GOF Test**		
767					5% K-S Critical Value	0.294				Detected data appear Gamma Distributed at 5% Significance Lev		
768	**Detected data appear Gamma Distributed at 5% Significance Level**											
769												
770	**Gamma Statistics**											
771					k hat (MLE)	20.35				k star (bias corrected MLE)		12.8
772					Theta hat (MLE)	0.425				Theta star (bias corrected MLE)		0.675
773					nu hat (MLE)	325.6				nu star (bias corrected)		204.8
774					MLE Mean (bias corrected)	8.639				MLE Sd (bias corrected)		2.414
775										Approximate Chi Square Value (0.05)		172.7
776					Adjusted Level of Significance	0.0195				Adjusted Chi Square Value		165.2
777												
778	**Assuming Gamma Distribution**											
779	95% Approximate Gamma UCL (use when n>=50))					10.25				95% Adjusted Gamma UCL (use when n<50)		10.71
780												
781	**Lognormal GOF Test**											
782					Shapiro Wilk Test Statistic	0.911				**Shapiro Wilk Lognormal GOF Test**		
783					5% Shapiro Wilk Critical Value	0.818				Data appear Lognormal at 5% Significance Level		
784					Lilliefors Test Statistic	0.232				**Lilliefors Lognormal GOF Test**		
785					5% Lilliefors Critical Value	0.283				Data appear Lognormal at 5% Significance Level		
786	**Data appear Lognormal at 5% Significance Level**											
787												
788	**Lognormal Statistics**											
789					Minimum of Logged Data	1.823				Mean of logged Data		2.132
790					Maximum of Logged Data	2.581				SD of logged Data		0.234
791												
792	**Assuming Lognormal Distribution**											
793					95% H-UCL	10.31				90% Chebyshev (MVUE) UCL		10.77
794					95% Chebyshev (MVUE) UCL	11.75				97.5% Chebyshev (MVUE) UCL		13.09
795					99% Chebyshev (MVUE) UCL	15.74						
796												
797	**Nonparametric Distribution Free UCL Statistics**											
798	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
799												
800	**Nonparametric Distribution Free UCLs**											
801					95% CLT UCL	9.891				95% Jackknife UCL		10.08
802					95% Standard Bootstrap UCL	9.775				95% Bootstrap-t UCL		10.52
803					95% Hall's Bootstrap UCL	16.67				95% Percentile Bootstrap UCL		9.923
804					95% BCA Bootstrap UCL	10.18						

805				90% Chebyshev(Mean, Sd) UCL	10.92			95% Chebyshev(Mean, Sd) UCL	11.96			
806				97.5% Chebyshev(Mean, Sd) UCL	13.39			99% Chebyshev(Mean, Sd) UCL	16.21			
807												
808					Suggested UCL to Use							
809				95% Student's-t UCL	10.08							
810												
811	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
812	Recommendations are based upon data size, data distribution, and skewness.											
813	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
814	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
815												
816												
817	Result (eu9_aluminum)											
818												
819					General Statistics							
820				Total Number of Observations	5			Number of Distinct Observations	5			
821				Number of Detects	0			Number of Non-Detects	5			
822				Number of Distinct Detects	0			Number of Distinct Non-Detects	5			
823												
824	Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!											
825	Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!											
826	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
827												
828	The data set for variable Result (eu9_aluminum) was not processed!											
829												
830												
831	Result (eu9_antimony)											
832												
833					General Statistics							
834				Total Number of Observations	5			Number of Distinct Observations	5			
835				Number of Detects	0			Number of Non-Detects	5			
836				Number of Distinct Detects	0			Number of Distinct Non-Detects	5			
837												
838	Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!											
839	Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!											
840	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
841												
842	The data set for variable Result (eu9_antimony) was not processed!											
843												
844												
845	Result (eu9_arsenic)											
846												
847					General Statistics							
848				Total Number of Observations	5			Number of Distinct Observations	5			
849				Number of Detects	0			Number of Non-Detects	5			
850				Number of Distinct Detects	0			Number of Distinct Non-Detects	5			
851												
852	Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!											
853	Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!											
854	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
855												
856	The data set for variable Result (eu9_arsenic) was not processed!											
857												
858												
859	Result (eu9_beryllium)											
860												
861					General Statistics							
862				Total Number of Observations	5			Number of Distinct Observations	5			
863				Number of Detects	0			Number of Non-Detects	5			
864				Number of Distinct Detects	0			Number of Distinct Non-Detects	5			
865												
866	Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!											
867	Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!											
868	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
869												
870	The data set for variable Result (eu9_beryllium) was not processed!											
871												

Result (eu9_cadmium)

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.019	Mean	0.0541
Maximum	0.0802	Median	0.067
SD	0.0286	Std. Error of Mean	0.0128
Coefficient of Variation	0.53	Skewness	-0.535

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.839	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0814	95% Adjusted-CLT UCL (Chen-1995)	0.0719
		95% Modified-t UCL (Johnson-1978)	0.0809

Gamma GOF Test

A-D Test Statistic	0.555	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Lev	
K-S Test Statistic	0.322	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Lev	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.445	k star (bias corrected MLE)	1.511
Theta hat (MLE)	0.0157	Theta star (bias corrected MLE)	0.0358
nu hat (MLE)	34.45	nu star (bias corrected)	15.11
MLE Mean (bias corrected)	0.0541	MLE Sd (bias corrected)	0.044
		Approximate Chi Square Value (0.05)	7.341
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	5.149

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.111	95% Adjusted Gamma UCL (use when n<50)	0.159

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.826	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.31	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.961	Mean of logged Data	-3.069
Maximum of Logged Data	-2.523	SD of logged Data	0.661

Assuming Lognormal Distribution

95% H-UCL	0.184	90% Chebyshev (MVUE) UCL	0.103
95% Chebyshev (MVUE) UCL	0.125	97.5% Chebyshev (MVUE) UCL	0.155
99% Chebyshev (MVUE) UCL	0.214		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

939				95% CLT UCL	0.0752			95% Jackknife UCL	0.0814			
940				95% Standard Bootstrap UCL	0.0731			95% Bootstrap-t UCL	0.0779			
941				95% Hall's Bootstrap UCL	0.0648			95% Percentile Bootstrap UCL	0.0735			
942				95% BCA Bootstrap UCL	0.0697							
943				90% Chebyshev(Mean, Sd) UCL	0.0925			95% Chebyshev(Mean, Sd) UCL	0.11			
944				97.5% Chebyshev(Mean, Sd) UCL	0.134			99% Chebyshev(Mean, Sd) UCL	0.182			
945												
946				**Suggested UCL to Use**								
947				95% Student's-t UCL	0.0814							
948												
949				**Recommended UCL exceeds the maximum observation**								
950												
951	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
952	Recommendations are based upon data size, data distribution, and skewness.											
953	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
954	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
955												
956	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
957	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
958												
959												
960	**Result (eu9_chromium)**											
961												
962				**General Statistics**								
963				Total Number of Observations	5			Number of Distinct Observations	5			
964								Number of Missing Observations	0			
965				Minimum	0.801			Mean	0.991			
966				Maximum	1.48			Median	0.832			
967				SD	0.29			Std. Error of Mean	0.13			
968				Coefficient of Variation	0.293			Skewness	1.711			
969												
970	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
971	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
972	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
973	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
974												
975				**Normal GOF Test**								
976				Shapiro Wilk Test Statistic	0.762			**Shapiro Wilk GOF Test**				
977				5% Shapiro Wilk Critical Value	0.762			Data Not Normal at 5% Significance Level				
978				Lilliefors Test Statistic	0.307			**Lilliefors GOF Test**				
979				5% Lilliefors Critical Value	0.343			Data appear Normal at 5% Significance Level				
980				**Data appear Approximate Normal at 5% Significance Level**								
981												
982				**Assuming Normal Distribution**								
983				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
984				95% Student's-t UCL	1.267			95% Adjusted-CLT UCL (Chen-1995)	1.31			
985								95% Modified-t UCL (Johnson-1978)	1.284			
986												
987				**Gamma GOF Test**								
988				A-D Test Statistic	0.637			**Anderson-Darling Gamma GOF Test**				
989				5% A-D Critical Value	0.679			Detected data appear Gamma Distributed at 5% Significance Lev				
990				K-S Test Statistic	0.331			**Kolmogorov-Smirnov Gamma GOF Test**				
991				5% K-S Critical Value	0.357			Detected data appear Gamma Distributed at 5% Significance Lev				
992				**Detected data appear Gamma Distributed at 5% Significance Level**								
993												
994				**Gamma Statistics**								
995				k hat (MLE)	16.97			k star (bias corrected MLE)	6.92			
996				Theta hat (MLE)	0.0584			Theta star (bias corrected MLE)	0.143			
997				nu hat (MLE)	169.7			nu star (bias corrected)	69.2			
998				MLE Mean (bias corrected)	0.991			MLE Sd (bias corrected)	0.377			
999								Approximate Chi Square Value (0.05)	51.05			
1000				Adjusted Level of Significance	0.0086			Adjusted Chi Square Value	44.31			
1001												
1002				**Assuming Gamma Distribution**								
1003	95% Approximate Gamma UCL (use when n>=50))				1.343			95% Adjusted Gamma UCL (use when n<50)	1.547			
1004												
1005				**Lognormal GOF Test**								

1006					Shapiro Wilk Test Statistic	0.792	**Shapiro Wilk Lognormal GOF Test**					
1007					5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level					
1008					Lilliefors Test Statistic	0.309	**Lilliefors Lognormal GOF Test**					
1009					5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level					
1010					**Data appear Lognormal at 5% Significance Level**							
1011												
1012					**Lognormal Statistics**							
1013					Minimum of Logged Data	-0.222	Mean of logged Data	-0.0393				
1014					Maximum of Logged Data	0.392	SD of logged Data	0.263				
1015												
1016					**Assuming Lognormal Distribution**							
1017					95% H-UCL	1.351	90% Chebyshev (MVUE) UCL	1.336				
1018					95% Chebyshev (MVUE) UCL	1.494	97.5% Chebyshev (MVUE) UCL	1.713				
1019					99% Chebyshev (MVUE) UCL	2.142						
1020												
1021					**Nonparametric Distribution Free UCL Statistics**							
1022					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1023												
1024					**Nonparametric Distribution Free UCLs**							
1025					95% CLT UCL	1.204	95% Jackknife UCL	1.267				
1026					95% Standard Bootstrap UCL	1.176	95% Bootstrap-t UCL	4.287				
1027					95% Hall's Bootstrap UCL	3.832	95% Percentile Bootstrap UCL	1.209				
1028					95% BCA Bootstrap UCL	1.256						
1029					90% Chebyshev(Mean, Sd) UCL	1.38	95% Chebyshev(Mean, Sd) UCL	1.556				
1030					97.5% Chebyshev(Mean, Sd) UCL	1.801	99% Chebyshev(Mean, Sd) UCL	2.281				
1031												
1032					**Suggested UCL to Use**							
1033					95% Student's-t UCL	1.267						
1034												
1035					When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test							
1036					When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL							
1037												
1038	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1039	Recommendations are based upon data size, data distribution, and skewness.											
1040	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1041	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1042												
1043												
1044	**Result (eu9_copper)**											
1045												
1046					**General Statistics**							
1047					Total Number of Observations	5	Number of Distinct Observations	5				
1048							Number of Missing Observations	0				
1049					Minimum	0.364	Mean	0.47				
1050					Maximum	0.672	Median	0.439				
1051					SD	0.119	Std. Error of Mean	0.0533				
1052					Coefficient of Variation	0.253	Skewness	1.676				
1053												
1054	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1055	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1056	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1057	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1058												
1059					**Normal GOF Test**							
1060					Shapiro Wilk Test Statistic	0.841	**Shapiro Wilk GOF Test**					
1061					5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level					
1062					Lilliefors Test Statistic	0.313	**Lilliefors GOF Test**					
1063					5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level					
1064					**Data appear Normal at 5% Significance Level**							
1065												
1066					**Assuming Normal Distribution**							
1067					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
1068					95% Student's-t UCL	0.583	95% Adjusted-CLT UCL (Chen-1995)	0.6				
1069							95% Modified-t UCL (Johnson-1978)	0.59				
1070												
1071					**Gamma GOF Test**							
1072					A-D Test Statistic	0.428	**Anderson-Darling Gamma GOF Test**					

1073				5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Lev						
1074				K-S Test Statistic	0.287	**Kolmogorov-Smirnov Gamma GOF Test**						
1075				5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Lev						
1076	**Detected data appear Gamma Distributed at 5% Significance Level**											
1077												
1078	**Gamma Statistics**											
1079				k hat (MLE)	22.12			k star (bias corrected MLE)	8.983			
1080				Theta hat (MLE)	0.0212			Theta star (bias corrected MLE)	0.0523			
1081				nu hat (MLE)	221.2			nu star (bias corrected)	89.83			
1082				MLE Mean (bias corrected)	0.47			MLE Sd (bias corrected)	0.157			
1083								Approximate Chi Square Value (0.05)	68.97			
1084				Adjusted Level of Significance	0.0086			Adjusted Chi Square Value	61.03			
1085												
1086	**Assuming Gamma Distribution**											
1087	95% Approximate Gamma UCL (use when n>=50))				0.612			95% Adjusted Gamma UCL (use when n<50)	0.692			
1088												
1089	**Lognormal GOF Test**											
1090				Shapiro Wilk Test Statistic	0.898	**Shapiro Wilk Lognormal GOF Test**						
1091				5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level						
1092				Lilliefors Test Statistic	0.275	**Lilliefors Lognormal GOF Test**						
1093				5% Lilliefors Critical Value	0.343	Data appear Lognormal at 5% Significance Level						
1094	**Data appear Lognormal at 5% Significance Level**											
1095												
1096	**Lognormal Statistics**											
1097				Minimum of Logged Data	-1.011			Mean of logged Data	-0.778			
1098				Maximum of Logged Data	-0.398			SD of logged Data	0.232			
1099												
1100	**Assuming Lognormal Distribution**											
1101				95% H-UCL	0.613			90% Chebyshev (MVUE) UCL	0.615			
1102				95% Chebyshev (MVUE) UCL	0.681			97.5% Chebyshev (MVUE) UCL	0.772			
1103				99% Chebyshev (MVUE) UCL	0.952							
1104												
1105	**Nonparametric Distribution Free UCL Statistics**											
1106	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1107												
1108	**Nonparametric Distribution Free UCLs**											
1109				95% CLT UCL	0.557			95% Jackknife UCL	0.583			
1110				95% Standard Bootstrap UCL	0.548			95% Bootstrap-t UCL	0.695			
1111				95% Hall's Bootstrap UCL	0.978			95% Percentile Bootstrap UCL	0.564			
1112				95% BCA Bootstrap UCL	0.573							
1113				90% Chebyshev(Mean, Sd) UCL	0.63			95% Chebyshev(Mean, Sd) UCL	0.702			
1114				97.5% Chebyshev(Mean, Sd) UCL	0.802			99% Chebyshev(Mean, Sd) UCL	1			
1115												
1116	**Suggested UCL to Use**											
1117				95% Student's-t UCL	0.583							
1118												
1119	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1120	Recommendations are based upon data size, data distribution, and skewness.											
1121	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1122	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1123												
1124	**Result (eu9_iron)**											
1125												
1126	**General Statistics**											
1127				Total Number of Observations	5			Number of Distinct Observations	5			
1128				Number of Detects	0			Number of Non-Detects	5			
1129				Number of Distinct Detects	0			Number of Distinct Non-Detects	5			
1130												
1131	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1132	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1133	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1134												
1135	**The data set for variable Result (eu9_iron) was not processed!**											
1136												
1137												
1138	**Result (eu9_lead)**											
1139												

1140	**General Statistics**											
1141					Total Number of Observations	5			Number of Distinct Observations	5		
1142					Number of Detects	4			Number of Non-Detects	1		
1143					Number of Distinct Detects	4			Number of Distinct Non-Detects	1		
1144					Minimum Detect	0.0119			Minimum Non-Detect	0.0101		
1145					Maximum Detect	0.0609			Maximum Non-Detect	0.0101		
1146					Variance Detects	5.3731E-4			Percent Non-Detects	20%		
1147					Mean Detects	0.0264			SD Detects	0.0232		
1148					Median Detects	0.0164			CV Detects	0.878		
1149					Skewness Detects	1.918			Kurtosis Detects	3.717		
1150					Mean of Logged Detects	-3.867			SD of Logged Detects	0.735		
1151												
1152	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1153	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1154	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1155	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1156												
1157	**Normal GOF Test on Detects Only**											
1158					Shapiro Wilk Test Statistic	0.735			**Shapiro Wilk GOF Test**			
1159					5% Shapiro Wilk Critical Value	0.748			Detected Data Not Normal at 5% Significance Level			
1160					Lilliefors Test Statistic	0.384			**Lilliefors GOF Test**			
1161					5% Lilliefors Critical Value	0.375			Detected Data Not Normal at 5% Significance Level			
1162	**Detected Data Not Normal at 5% Significance Level**											
1163												
1164	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1165					KM Mean	0.0231			KM Standard Error of Mean	0.00987		
1166					KM SD	0.0191			95% KM (BCA) UCL	N/A		
1167					95% KM (t) UCL	0.0442			95% KM (Percentile Bootstrap) UCL	N/A		
1168					95% KM (z) UCL	0.0394			95% KM Bootstrap t UCL	N/A		
1169					90% KM Chebyshev UCL	0.0527			95% KM Chebyshev UCL	0.0661		
1170					97.5% KM Chebyshev UCL	0.0847			99% KM Chebyshev UCL	0.121		
1171												
1172	**Gamma GOF Tests on Detected Observations Only**											
1173					A-D Test Statistic	0.569			**Anderson-Darling GOF Test**			
1174					5% A-D Critical Value	0.66			Detected data appear Gamma Distributed at 5% Significance Lev			
1175					K-S Test Statistic	0.362			**Kolmogorov-Smirnov GOF**			
1176					5% K-S Critical Value	0.397			Detected data appear Gamma Distributed at 5% Significance Lev			
1177	**Detected data appear Gamma Distributed at 5% Significance Level**											
1178												
1179	**Gamma Statistics on Detected Data Only**											
1180					k hat (MLE)	2.301			k star (bias corrected MLE)	0.742		
1181					Theta hat (MLE)	0.0115			Theta star (bias corrected MLE)	0.0356		
1182					nu hat (MLE)	18.4			nu star (bias corrected)	5.934		
1183					Mean (detects)	0.0264						
1184												
1185	**Gamma ROS Statistics using Imputed Non-Detects**											
1186	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1187	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)											
1188	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1189	This is especially true when the sample size is small.											
1190	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1191					Minimum	0.01			Mean	0.0231		
1192					Maximum	0.0609			Median	0.0143		
1193					SD	0.0214			CV	0.924		
1194					k hat (MLE)	2.17			k star (bias corrected MLE)	1.001		
1195					Theta hat (MLE)	0.0107			Theta star (bias corrected MLE)	0.0231		
1196					nu hat (MLE)	21.7			nu star (bias corrected)	10.01		
1197					Adjusted Level of Significance (β)	0.0086						
1198					Approximate Chi Square Value (10.01, α)	3.951			Adjusted Chi Square Value (10.01, β)	2.474		
1199					95% Gamma Approximate UCL (use when n>=50)	0.0586			95% Gamma Adjusted UCL (use when n<50)	N/A		
1200												
1201	**Estimates of Gamma Parameters using KM Estimates**											
1202					Mean (KM)	0.0231			SD (KM)	0.0191		
1203					Variance (KM)	3.6500E-4			SE of Mean (KM)	0.00987		
1204					k hat (KM)	1.467			k star (KM)	0.72		
1205					nu hat (KM)	14.67			nu star (KM)	7.2		
1206					theta hat (KM)	0.0158			theta star (KM)	0.0321		

1207				80% gamma percentile (KM)		0.038			90% gamma percentile (KM)			0.0577
1208				95% gamma percentile (KM)		0.078			99% gamma percentile (KM)			0.126
1209												
1210						**Gamma Kaplan-Meier (KM) Statistics**							
1211				Approximate Chi Square Value (7.20, α)		2.281			Adjusted Chi Square Value (7.20, β)			1.263
1212	5% Gamma Approximate KM-UCL (use when n>=50)					0.073	95% Gamma Adjusted KM-UCL (use when n<50)					0.132
1213												
1214						**Lognormal GOF Test on Detected Observations Only**							
1215				Shapiro Wilk Test Statistic		0.839	**Shapiro Wilk GOF Test**					
1216				5% Shapiro Wilk Critical Value		0.748	Detected Data appear Lognormal at 5% Significance Level					
1217				Lilliefors Test Statistic		0.317	**Lilliefors GOF Test**					
1218				5% Lilliefors Critical Value		0.375	Detected Data appear Lognormal at 5% Significance Level					
1219						**Detected Data appear Lognormal at 5% Significance Level**							
1220												
1221						**Lognormal ROS Statistics Using Imputed Non-Detects**							
1222				Mean in Original Scale		0.0218	Mean in Log Scale					-4.238
1223				SD in Original Scale		0.0226	SD in Log Scale					1.046
1224				95% t UCL (assumes normality of ROS data)		0.0433	95% Percentile Bootstrap UCL					0.0396
1225				95% BCA Bootstrap UCL		0.0426	95% Bootstrap t UCL					0.0808
1226				95% H-UCL (Log ROS)		0.361						
1227												
1228						**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1229				KM Mean (logged)		-4.013	KM Geo Mean					0.0181
1230				KM SD (logged)		0.64	95% Critical H Value (KM-Log)					3.433
1231				KM Standard Error of Mean (logged)		0.331	95% H-UCL (KM -Log)					0.0666
1232				KM SD (logged)		0.64	95% Critical H Value (KM-Log)					3.433
1233				KM Standard Error of Mean (logged)		0.331						
1234												
1235						**DL/2 Statistics**							
1236				**DL/2 Normal**			**DL/2 Log-Transformed**					
1237				Mean in Original Scale		0.0221	Mean in Log Scale					-4.152
1238				SD in Original Scale		0.0222	SD in Log Scale					0.9
1239				95% t UCL (Assumes normality)		0.0433	95% H-Stat UCL					0.177
1240						**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1241												
1242						**Nonparametric Distribution Free UCL Statistics**							
1243						**Detected Data appear Gamma Distributed at 5% Significance Level**							
1244												
1245						**Suggested UCL to Use**							
1246				95% KM Bootstrap t UCL		N/A	d KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					0.132
1247												
1248	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1249	Recommendations are based upon data size, data distribution, and skewness.											
1250	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1251	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1252												
1253	**Result (eu9_manganese)**											
1254												
1255						**General Statistics**							
1256				Total Number of Observations		5	Number of Distinct Observations					5
1257				Number of Detects		3	Number of Non-Detects					2
1258				Number of Distinct Detects		3	Number of Distinct Non-Detects					2
1259				Minimum Detect		0.182	Minimum Non-Detect					0.2
1260				Maximum Detect		0.42	Maximum Non-Detect					0.207
1261				Variance Detects		0.0142	Percent Non-Detects					40%
1262				Mean Detects		0.298	SD Detects					0.119
1263				Median Detects		0.291	CV Detects					0.4
1264				Skewness Detects		0.248	Kurtosis Detects					N/A
1265				Mean of Logged Detects		-1.268	SD of Logged Detects					0.419
1266												
1267						**Warning: Data set has only 3 Detected Values.**							
1268						**This is not enough to compute meaningful or reliable statistics and estimates.**							
1269												
1270												
1271						**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
1272						**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
1273						**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							

1274	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1275												
1276	**Normal GOF Test on Detects Only**											
1277					Shapiro Wilk Test Statistic	0.998	**Shapiro Wilk GOF Test**					
1278					5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level					
1279					Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**					
1280					5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level					
1281	**Detected Data appear Normal at 5% Significance Level**											
1282												
1283	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1284					KM Mean	0.251	KM Standard Error of Mean	0.0517				
1285					KM SD	0.0944	95% KM (BCA) UCL	N/A				
1286					95% KM (t) UCL	0.362	95% KM (Percentile Bootstrap) UCL	N/A				
1287					95% KM (z) UCL	0.336	95% KM Bootstrap t UCL	N/A				
1288					90% KM Chebyshev UCL	0.407	95% KM Chebyshev UCL	0.477				
1289					97.5% KM Chebyshev UCL	0.574	99% KM Chebyshev UCL	0.766				
1290												
1291	**Gamma GOF Tests on Detected Observations Only**											
1292	**Not Enough Data to Perform GOF Test**											
1293												
1294	**Gamma Statistics on Detected Data Only**											
1295					k hat (MLE)	8.96	k star (bias corrected MLE)	N/A				
1296					Theta hat (MLE)	0.0332	Theta star (bias corrected MLE)	N/A				
1297					nu hat (MLE)	53.76	nu star (bias corrected)	N/A				
1298					Mean (detects)	0.298						
1299												
1300	**Gamma ROS Statistics using Imputed Non-Detects**											
1301	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1302	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)											
1303	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1304	This is especially true when the sample size is small.											
1305	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1306					Minimum	0.171	Mean	0.247				
1307					Maximum	0.42	Median	0.182				
1308					SD	0.109	CV	0.441				
1309					k hat (MLE)	7.409	k star (bias corrected MLE)	3.097				
1310					Theta hat (MLE)	0.0334	Theta star (bias corrected MLE)	0.0798				
1311					nu hat (MLE)	74.09	nu star (bias corrected)	30.97				
1312					Adjusted Level of Significance (β)	0.0086						
1313					Approximate Chi Square Value (30.97, α)	19.26	Adjusted Chi Square Value (30.97, β)	15.36				
1314					95% Gamma Approximate UCL (use when n>=50)	0.398	95% Gamma Adjusted UCL (use when n<50)	N/A				
1315												
1316	**Estimates of Gamma Parameters using KM Estimates**											
1317					Mean (KM)	0.251	SD (KM)	0.0944				
1318					Variance (KM)	0.00891	SE of Mean (KM)	0.0517				
1319					k hat (KM)	7.102	k star (KM)	2.974				
1320					nu hat (KM)	71.02	nu star (KM)	29.74				
1321					theta hat (KM)	0.0354	theta star (KM)	0.0846				
1322					80% gamma percentile (KM)	0.359	90% gamma percentile (KM)	0.447				
1323					95% gamma percentile (KM)	0.529	99% gamma percentile (KM)	0.707				
1324												
1325	**Gamma Kaplan-Meier (KM) Statistics**											
1326					Approximate Chi Square Value (29.74, α)	18.29	Adjusted Chi Square Value (29.74, β)	14.51				
1327	5% Gamma Approximate KM-UCL (use when n>=50)					0.409	95% Gamma Adjusted KM-UCL (use when n<50)	0.516				
1328												
1329	**Lognormal GOF Test on Detected Observations Only**											
1330					Shapiro Wilk Test Statistic	0.995	**Shapiro Wilk GOF Test**					
1331					5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level					
1332					Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**					
1333					5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level					
1334	**Detected Data appear Lognormal at 5% Significance Level**											
1335												
1336	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1337					Mean in Original Scale	0.25	Mean in Log Scale	-1.451				
1338					SD in Original Scale	0.107	SD in Log Scale	0.388				
1339					95% t UCL (assumes normality of ROS data)	0.352	95% Percentile Bootstrap UCL	N/A				
1340					95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A				

1341				95% H-UCL (Log ROS)	0.42							
1342												
1343	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1344				KM Mean (logged)	-1.442				KM Geo Mean	0.236		
1345				KM SD (logged)	0.34				95% Critical H Value (KM-Log)	2.497		
1346				KM Standard Error of Mean (logged)	0.186				95% H-UCL (KM -Log)	0.383		
1347				KM SD (logged)	0.34				95% Critical H Value (KM-Log)	2.497		
1348				KM Standard Error of Mean (logged)	0.186							
1349												
1350	**DL/2 Statistics**											
1351				**DL/2 Normal**					**DL/2 Log-Transformed**			
1352				Mean in Original Scale	0.219				Mean in Log Scale	-1.675		
1353				SD in Original Scale	0.137				SD in Log Scale	0.631		
1354				95% t UCL (Assumes normality)	0.35				95% H-Stat UCL	0.669		
1355	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1356												
1357	**Nonparametric Distribution Free UCL Statistics**											
1358	**Detected Data appear Normal Distributed at 5% Significance Level**											
1359												
1360	**Suggested UCL to Use**											
1361				95% KM (t) UCL	0.362							
1362												
1363	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1364	Recommendations are based upon data size, data distribution, and skewness.											
1365	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1366	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1367												
1368												
1369	**Result (eu9_mercury)**											
1370												
1371	**General Statistics**											
1372				Total Number of Observations	5				Number of Distinct Observations	5		
1373									Number of Missing Observations	0		
1374				Minimum	0.0149				Mean	0.021		
1375				Maximum	0.0266				Median	0.0214		
1376				SD	0.00449				Std. Error of Mean	0.00201		
1377				Coefficient of Variation	0.214				Skewness	-0.225		
1378												
1379	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1380	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1381	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1382	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1383												
1384	**Normal GOF Test**											
1385				Shapiro Wilk Test Statistic	0.994	**Shapiro Wilk GOF Test**						
1386				5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level						
1387				Lilliefors Test Statistic	0.135	**Lilliefors GOF Test**						
1388				5% Lilliefors Critical Value	0.343	Data appear Normal at 5% Significance Level						
1389	**Data appear Normal at 5% Significance Level**											
1390												
1391	**Assuming Normal Distribution**											
1392				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
1393				95% Student's-t UCL	0.0253				95% Adjusted-CLT UCL (Chen-1995)	0.0241		
1394									95% Modified-t UCL (Johnson-1978)	0.0252		
1395												
1396	**Gamma GOF Test**											
1397				A-D Test Statistic	0.185	**Anderson-Darling Gamma GOF Test**						
1398				5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Lev						
1399				K-S Test Statistic	0.164	**Kolmogorov-Smirnov Gamma GOF Test**						
1400				5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Lev						
1401	**Detected data appear Gamma Distributed at 5% Significance Level**											
1402												
1403	**Gamma Statistics**											
1404				k hat (MLE)	26.07				k star (bias corrected MLE)	10.56		
1405				Theta hat (MLE)	8.0532E-4				Theta star (bias corrected MLE)	0.00199		
1406				nu hat (MLE)	260.7				nu star (bias corrected)	105.6		
1407				MLE Mean (bias corrected)	0.021				MLE Sd (bias corrected)	0.00646		

1408												Approximate Chi Square Value (0.05)	82.91
1409						Adjusted Level of Significance	0.0086					Adjusted Chi Square Value	74.14
1410													
1411						**Assuming Gamma Distribution**								
1412						95% Approximate Gamma UCL (use when n>=50))	0.0268					95% Adjusted Gamma UCL (use when n<50)	0.0299
1413													
1414						**Lognormal GOF Test**								
1415						Shapiro Wilk Test Statistic	0.978					**Shapiro Wilk Lognormal GOF Test**	
1416						5% Shapiro Wilk Critical Value	0.762					Data appear Lognormal at 5% Significance Level	
1417						Lilliefors Test Statistic	0.167					**Lilliefors Lognormal GOF Test**	
1418						5% Lilliefors Critical Value	0.343					Data appear Lognormal at 5% Significance Level	
1419						**Data appear Lognormal at 5% Significance Level**								
1420													
1421						**Lognormal Statistics**								
1422						Minimum of Logged Data	-4.206					Mean of logged Data	-3.883
1423						Maximum of Logged Data	-3.627					SD of logged Data	0.223
1424													
1425						**Assuming Lognormal Distribution**								
1426						95% H-UCL	0.0271					90% Chebyshev (MVUE) UCL	0.0273
1427						95% Chebyshev (MVUE) UCL	0.0301					97.5% Chebyshev (MVUE) UCL	0.0341
1428						99% Chebyshev (MVUE) UCL	0.0418						
1429													
1430						**Nonparametric Distribution Free UCL Statistics**								
1431						**Data appear to follow a Discernible Distribution at 5% Significance Level**								
1432													
1433						**Nonparametric Distribution Free UCLs**								
1434						95% CLT UCL	0.0243					95% Jackknife UCL	0.0253
1435						95% Standard Bootstrap UCL	0.0239					95% Bootstrap-t UCL	0.0248
1436						95% Hall's Bootstrap UCL	0.0243					95% Percentile Bootstrap UCL	0.0239
1437						95% BCA Bootstrap UCL	0.0237						
1438						90% Chebyshev(Mean, Sd) UCL	0.027					95% Chebyshev(Mean, Sd) UCL	0.0297
1439						97.5% Chebyshev(Mean, Sd) UCL	0.0335					99% Chebyshev(Mean, Sd) UCL	0.041
1440													
1441						**Suggested UCL to Use**								
1442						95% Student's-t UCL	0.0253						
1443													
1444	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1445	Recommendations are based upon data size, data distribution, and skewness.												
1446	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1447	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia												
1448													
1449	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**												
1450	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**												
1451													
1452													
1453	**Result (eu9_strontium)**												
1454													
1455						**General Statistics**								
1456						Total Number of Observations	5					Number of Distinct Observations	5
1457												Number of Missing Observations	0
1458						Minimum	0.309					Mean	0.484
1459						Maximum	0.898					Median	0.374
1460						SD	0.239					Std. Error of Mean	0.107
1461						Coefficient of Variation	0.495					Skewness	1.903
1462													
1463	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**												
1464	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**												
1465	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**												
1466	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**												
1467													
1468						**Normal GOF Test**								
1469						Shapiro Wilk Test Statistic	0.766					**Shapiro Wilk GOF Test**	
1470						5% Shapiro Wilk Critical Value	0.762					Data appear Normal at 5% Significance Level	
1471						Lilliefors Test Statistic	0.312					**Lilliefors GOF Test**	
1472						5% Lilliefors Critical Value	0.343					Data appear Normal at 5% Significance Level	
1473						**Data appear Normal at 5% Significance Level**								
1474													

	A	B	C	D	E	F	G	H	I	J	K	L
1475	**Assuming Normal Distribution**											
1476	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1477	95% Student's-t UCL					0.712	95% Adjusted-CLT UCL (Chen-1995)					0.757
1478							95% Modified-t UCL (Johnson-1978)					0.727
1479												
1480	**Gamma GOF Test**											
1481	A-D Test Statistic					0.551	**Anderson-Darling Gamma GOF Test**					
1482	5% A-D Critical Value					0.68	Detected data appear Gamma Distributed at 5% Significance Lev					
1483	K-S Test Statistic					0.289	**Kolmogorov-Smirnov Gamma GOF Test**					
1484	5% K-S Critical Value					0.358	Detected data appear Gamma Distributed at 5% Significance Lev					
1485	**Detected data appear Gamma Distributed at 5% Significance Level**											
1486												
1487	**Gamma Statistics**											
1488	k hat (MLE)					6.508	k star (bias corrected MLE)					2.737
1489	Theta hat (MLE)					0.0743	Theta star (bias corrected MLE)					0.177
1490	nu hat (MLE)					65.08	nu star (bias corrected)					27.37
1491	MLE Mean (bias corrected)					0.484	MLE Sd (bias corrected)					0.292
1492							Approximate Chi Square Value (0.05)					16.44
1493	Adjusted Level of Significance					0.0086	Adjusted Chi Square Value					12.88
1494												
1495	**Assuming Gamma Distribution**											
1496	95% Approximate Gamma UCL (use when n>=50))					0.805	95% Adjusted Gamma UCL (use when n<50)					1.027
1497												
1498	**Lognormal GOF Test**											
1499	Shapiro Wilk Test Statistic					0.854	**Shapiro Wilk Lognormal GOF Test**					
1500	5% Shapiro Wilk Critical Value					0.762	Data appear Lognormal at 5% Significance Level					
1501	Lilliefors Test Statistic					0.263	**Lilliefors Lognormal GOF Test**					
1502	5% Lilliefors Critical Value					0.343	Data appear Lognormal at 5% Significance Level					
1503	**Data appear Lognormal at 5% Significance Level**											
1504												
1505	**Lognormal Statistics**											
1506	Minimum of Logged Data					-1.173	Mean of logged Data					-0.805
1507	Maximum of Logged Data					-0.108	SD of logged Data					0.419
1508												
1509	**Assuming Lognormal Distribution**											
1510	95% H-UCL					0.861	90% Chebyshev (MVUE) UCL					0.747
1511	95% Chebyshev (MVUE) UCL					0.868	97.5% Chebyshev (MVUE) UCL					1.037
1512	99% Chebyshev (MVUE) UCL					1.368						
1513												
1514	**Nonparametric Distribution Free UCL Statistics**											
1515	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1516												
1517	**Nonparametric Distribution Free UCLs**											
1518	95% CLT UCL					0.66	95% Jackknife UCL					0.712
1519	95% Standard Bootstrap UCL					0.638	95% Bootstrap-t UCL					1.574
1520	95% Hall's Bootstrap UCL					1.788	95% Percentile Bootstrap UCL					0.673
1521	95% BCA Bootstrap UCL					0.706						
1522	90% Chebyshev(Mean, Sd) UCL					0.805	95% Chebyshev(Mean, Sd) UCL					0.95
1523	97.5% Chebyshev(Mean, Sd) UCL					1.152	99% Chebyshev(Mean, Sd) UCL					1.548
1524												
1525	**Suggested UCL to Use**											
1526	95% Student's-t UCL					0.712						
1527												
1528	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1529	Recommendations are based upon data size, data distribution, and skewness.											
1530	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1531	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1532												
1533	**Result (eu9_thallium)**											
1534												
1535	**General Statistics**											
1536	Total Number of Observations					5	Number of Distinct Observations					5
1537	Number of Detects					0	Number of Non-Detects					5
1538	Number of Distinct Detects					0	Number of Distinct Non-Detects					5
1539												
1540	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1541	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											

	A	B	C	D	E	F	G	H	I	J	K	L
1542	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1543												
1544	**The data set for variable Result (eu9_thallium) was not processed!**											
1545												
1546												
1547												
1548	**Result (eu9_zinc)**											
1549												
1550	**General Statistics**											
1551	Total Number of Observations					5		Number of Distinct Observations				5
1552								Number of Missing Observations				0
1553	Minimum					9.315		Mean				13.49
1554	Maximum					21.2		Median				11.42
1555	SD					4.794		Std. Error of Mean				2.144
1556	Coefficient of Variation					0.355		Skewness				1.341
1557												
1558	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1559	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1560	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1561	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1562												
1563	**Normal GOF Test**											
1564	Shapiro Wilk Test Statistic					0.874		**Shapiro Wilk GOF Test**				
1565	5% Shapiro Wilk Critical Value					0.762		Data appear Normal at 5% Significance Level				
1566	Lilliefors Test Statistic					0.267		**Lilliefors GOF Test**				
1567	5% Lilliefors Critical Value					0.343		Data appear Normal at 5% Significance Level				
1568	**Data appear Normal at 5% Significance Level**											
1569												
1570	**Assuming Normal Distribution**											
1571	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
1572	95% Student's-t UCL					18.06		95% Adjusted-CLT UCL (Chen-1995)				18.39
1573								95% Modified-t UCL (Johnson-1978)				18.28
1574												
1575	**Gamma GOF Test**											
1576	A-D Test Statistic					0.351		**Anderson-Darling Gamma GOF Test**				
1577	5% A-D Critical Value					0.679		Detected data appear Gamma Distributed at 5% Significance Lev				
1578	K-S Test Statistic					0.27		**Kolmogorov-Smirnov Gamma GOF Test**				
1579	5% K-S Critical Value					0.358		Detected data appear Gamma Distributed at 5% Significance Lev				
1580	**Detected data appear Gamma Distributed at 5% Significance Level**											
1581												
1582	**Gamma Statistics**											
1583	k hat (MLE)					11.19		k star (bias corrected MLE)				4.608
1584	Theta hat (MLE)					1.206		Theta star (bias corrected MLE)				2.927
1585	nu hat (MLE)					111.9		nu star (bias corrected)				46.08
1586	MLE Mean (bias corrected)					13.49		MLE Sd (bias corrected)				6.284
1587								Approximate Chi Square Value (0.05)				31.51
1588	Adjusted Level of Significance					0.0086		Adjusted Chi Square Value				26.35
1589												
1590	**Assuming Gamma Distribution**											
1591	95% Approximate Gamma UCL (use when n>=50))					19.73		95% Adjusted Gamma UCL (use when n<50)				23.59
1592												
1593	**Lognormal GOF Test**											
1594	Shapiro Wilk Test Statistic					0.925		**Shapiro Wilk Lognormal GOF Test**				
1595	5% Shapiro Wilk Critical Value					0.762		Data appear Lognormal at 5% Significance Level				
1596	Lilliefors Test Statistic					0.244		**Lilliefors Lognormal GOF Test**				
1597	5% Lilliefors Critical Value					0.343		Data appear Lognormal at 5% Significance Level				
1598	**Data appear Lognormal at 5% Significance Level**											
1599												
1600	**Lognormal Statistics**											
1601	Minimum of Logged Data					2.232		Mean of logged Data				2.557
1602	Maximum of Logged Data					3.054		SD of logged Data				0.328
1603												
1604	**Assuming Lognormal Distribution**											
1605	95% H-UCL					20.38		90% Chebyshev (MVUE) UCL				19.35
1606	95% Chebyshev (MVUE) UCL					22.02		97.5% Chebyshev (MVUE) UCL				25.73
1607	99% Chebyshev (MVUE) UCL					33.01						
1608												

	A	B	C	D	E	F	G	H	I	J	K	L
1609	**Nonparametric Distribution Free UCL Statistics**											
1610	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1611												
1612	**Nonparametric Distribution Free UCLs**											
1613					95% CLT UCL	17.02			95% Jackknife UCL	18.06		
1614					95% Standard Bootstrap UCL	16.57			95% Bootstrap-t UCL	29.24		
1615					95% Hall's Bootstrap UCL	40.13			95% Percentile Bootstrap UCL	16.75		
1616					95% BCA Bootstrap UCL	17.82						
1617					90% Chebyshev(Mean, Sd) UCL	19.92			95% Chebyshev(Mean, Sd) UCL	22.84		
1618					97.5% Chebyshev(Mean, Sd) UCL	26.88			99% Chebyshev(Mean, Sd) UCL	34.82		
1619												
1620	**Suggested UCL to Use**											
1621					95% Student's-t UCL	18.06						
1622												
1623	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1624	Recommendations are based upon data size, data distribution, and skewness.											
1625	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1626	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1627												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2019 2:17:36 PM
From File	BPMD_HHRA_GameInput_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
mber of Bootstrap Operations	2000

Result (deermuscle_antimony)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	8

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 Result (deermuscle_antimony) was not processed!

Result (deermuscle_arsenic)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	8

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 Result (deermuscle_arsenic) was not processed!

Result (deermuscle_cadmium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
Number of Detects	0	Number of Non-Detects	8
Number of Distinct Detects	0	Number of Distinct Non-Detects	8

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 Result (deermuscle_cadmium) was not processed!

Result (deermuscle_chromium)

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.668	Mean	0.748
Maximum	0.796	Median	0.752
SD	0.0419	Std. Error of Mean	0.0148
Coefficient of Variation	0.056	Skewness	-0.933

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

68	**Normal GOF Test**											
69					Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**					
70					5% Shapiro Wilk Critical Value	0.818	Data appear Normal at 5% Significance Level					
71					Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**					
72					5% Lilliefors Critical Value	0.283	Data appear Normal at 5% Significance Level					
73	**Data appear Normal at 5% Significance Level**											
74												
75	**Assuming Normal Distribution**											
76	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
77					95% Student's-t UCL	0.776	95% Adjusted-CLT UCL (Chen-1995)	0.767				
78							95% Modified-t UCL (Johnson-1978)	0.775				
79												
80	**Gamma GOF Test**											
81					A-D Test Statistic	0.301	**Anderson-Darling Gamma GOF Test**					
82					5% A-D Critical Value	0.715	Detected data appear Gamma Distributed at 5% Significance Lev					
83					K-S Test Statistic	0.205	**Kolmogorov-Smirnov Gamma GOF Test**					
84					5% K-S Critical Value	0.294	Detected data appear Gamma Distributed at 5% Significance Lev					
85	**Detected data appear Gamma Distributed at 5% Significance Level**											
86												
87	**Gamma Statistics**											
88					k hat (MLE)	354.1	k star (bias corrected MLE)	221.4				
89					Theta hat (MLE)	0.00211	Theta star (bias corrected MLE)	0.00338				
90					nu hat (MLE)	5665	nu star (bias corrected)	3542				
91					MLE Mean (bias corrected)	0.748	MLE Sd (bias corrected)	0.0503				
92							Approximate Chi Square Value (0.05)	3405				
93					Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	3370				
94												
95	**Assuming Gamma Distribution**											
96	95% Approximate Gamma UCL (use when n>=50))					0.778	95% Adjusted Gamma UCL (use when n<50)	0.786				
97												
98	**Lognormal GOF Test**											
99					Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk Lognormal GOF Test**					
100					5% Shapiro Wilk Critical Value	0.818	Data appear Lognormal at 5% Significance Level					
101					Lilliefors Test Statistic	0.211	**Lilliefors Lognormal GOF Test**					
102					5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level					
103	**Data appear Lognormal at 5% Significance Level**											
104												
105	**Lognormal Statistics**											
106					Minimum of Logged Data	-0.403	Mean of logged Data	-0.292				
107					Maximum of Logged Data	-0.228	SD of logged Data	0.0573				
108												
109	**Assuming Lognormal Distribution**											
110					95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	0.793				
111					95% Chebyshev (MVUE) UCL	0.814	97.5% Chebyshev (MVUE) UCL	0.842				
112					99% Chebyshev (MVUE) UCL	0.898						
113												
114	**Nonparametric Distribution Free UCL Statistics**											
115	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
116												
117	**Nonparametric Distribution Free UCLs**											
118					95% CLT UCL	0.772	95% Jackknife UCL	0.776				
119					95% Standard Bootstrap UCL	0.771	95% Bootstrap-t UCL	0.772				
120					95% Hall's Bootstrap UCL	0.768	95% Percentile Bootstrap UCL	0.77				
121					95% BCA Bootstrap UCL	0.767						
122					90% Chebyshev(Mean, Sd) UCL	0.792	95% Chebyshev(Mean, Sd) UCL	0.812				
123					97.5% Chebyshev(Mean, Sd) UCL	0.84	99% Chebyshev(Mean, Sd) UCL	0.895				
124												
125	**Suggested UCL to Use**											
126					95% Student's-t UCL	0.776						
127												
128	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
129	Recommendations are based upon data size, data distribution, and skewness.											
130	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
131	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
132												
133	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
134	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											

135												
136	**Result (deermuscle_cobalt)**											
137												
138						**General Statistics**						
139						Total Number of Observations	8			Number of Distinct Observations	8	
140						Number of Detects	0			Number of Non-Detects	8	
141						Number of Distinct Detects	0			Number of Distinct Non-Detects	8	
142												
143						**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**						
144						**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**						
145	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
146												
147						**The data set for variable Result (deermuscle_cobalt) was not processed!**						
148												
149												
150												
151	**Result (deermuscle_iron)**											
152												
153						**General Statistics**						
154						Total Number of Observations	8			Number of Distinct Observations	8	
155										Number of Missing Observations	0	
156						Minimum	14.55			Mean	24.74	
157						Maximum	35.22			Median	23.99	
158						SD	7.052			Std. Error of Mean	2.493	
159						Coefficient of Variation	0.285			Skewness	0.353	
160												
161						**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**						
162						**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**						
163						**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**						
164						**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**						
165												
166						**Normal GOF Test**						
167						Shapiro Wilk Test Statistic	0.938			**Shapiro Wilk GOF Test**		
168						5% Shapiro Wilk Critical Value	0.818			Data appear Normal at 5% Significance Level		
169						Lilliefors Test Statistic	0.215			**Lilliefors GOF Test**		
170						5% Lilliefors Critical Value	0.283			Data appear Normal at 5% Significance Level		
171						**Data appear Normal at 5% Significance Level**						
172												
173						**Assuming Normal Distribution**						
174						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
175						95% Student's-t UCL	29.46			95% Adjusted-CLT UCL (Chen-1995)	29.17	
176										95% Modified-t UCL (Johnson-1978)	29.51	
177												
178						**Gamma GOF Test**						
179						A-D Test Statistic	0.265			**Anderson-Darling Gamma GOF Test**		
180						5% A-D Critical Value	0.715			Detected data appear Gamma Distributed at 5% Significance Lev		
181						K-S Test Statistic	0.178			**Kolmogorov-Smirnov Gamma GOF Test**		
182						5% K-S Critical Value	0.294			Detected data appear Gamma Distributed at 5% Significance Lev		
183						**Detected data appear Gamma Distributed at 5% Significance Level**						
184												
185						**Gamma Statistics**						
186						k hat (MLE)	13.86			k star (bias corrected MLE)	8.747	
187						Theta hat (MLE)	1.784			Theta star (bias corrected MLE)	2.828	
188						nu hat (MLE)	221.8			nu star (bias corrected)	140	
189						MLE Mean (bias corrected)	24.74			MLE Sd (bias corrected)	8.364	
190										Approximate Chi Square Value (0.05)	113.6	
191						Adjusted Level of Significance	0.0195			Adjusted Chi Square Value	107.6	
192												
193						**Assuming Gamma Distribution**						
194						95% Approximate Gamma UCL (use when n>=50))	30.47			95% Adjusted Gamma UCL (use when n<50)	32.17	
195												
196						**Lognormal GOF Test**						
197						Shapiro Wilk Test Statistic	0.954			**Shapiro Wilk Lognormal GOF Test**		
198						5% Shapiro Wilk Critical Value	0.818			Data appear Lognormal at 5% Significance Level		
199						Lilliefors Test Statistic	0.167			**Lilliefors Lognormal GOF Test**		
200						5% Lilliefors Critical Value	0.283			Data appear Lognormal at 5% Significance Level		
201						**Data appear Lognormal at 5% Significance Level**						

202												
203						**Lognormal Statistics**						
204						Minimum of Logged Data	2.677			Mean of logged Data	3.172	
205						Maximum of Logged Data	3.562			SD of logged Data	0.292	
206												
207						**Assuming Lognormal Distribution**						
208						95% H-UCL	31.2			90% Chebyshev (MVUE) UCL	32.45	
209						95% Chebyshev (MVUE) UCL	35.93			97.5% Chebyshev (MVUE) UCL	40.77	
210						99% Chebyshev (MVUE) UCL	50.28					
211												
212						**Nonparametric Distribution Free UCL Statistics**						
213						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
214												
215						**Nonparametric Distribution Free UCLs**						
216						95% CLT UCL	28.84			95% Jackknife UCL	29.46	
217						95% Standard Bootstrap UCL	28.51			95% Bootstrap-t UCL	30.55	
218						95% Hall's Bootstrap UCL	32.96			95% Percentile Bootstrap UCL	28.5	
219						95% BCA Bootstrap UCL	28.83					
220						90% Chebyshev(Mean, Sd) UCL	32.22			95% Chebyshev(Mean, Sd) UCL	35.6	
221						97.5% Chebyshev(Mean, Sd) UCL	40.31			99% Chebyshev(Mean, Sd) UCL	49.55	
222												
223						**Suggested UCL to Use**						
224						95% Student's-t UCL	29.46					
225												
226	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
227	Recommendations are based upon data size, data distribution, and skewness.											
228	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
229	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
230												
231	**Result (deermuscle_manganese)**											
232												
233						**General Statistics**						
234						Total Number of Observations	8			Number of Distinct Observations	8	
235						Number of Detects	2			Number of Non-Detects	6	
236						Number of Distinct Detects	2			Number of Distinct Non-Detects	6	
237						Minimum Detect	0.284			Minimum Non-Detect	0.235	
238						Maximum Detect	0.345			Maximum Non-Detect	0.292	
239						Variance Detects	0.00183			Percent Non-Detects	75%	
240						Mean Detects	0.315			SD Detects	0.0428	
241						Median Detects	0.315			CV Detects	0.136	
242						Skewness Detects	N/A			Kurtosis Detects	N/A	
243						Mean of Logged Detects	-1.161			SD of Logged Detects	0.137	
244												
245	**Warning: Data set has only 2 Detected Values.**											
246	**This is not enough to compute meaningful or reliable statistics and estimates.**											
247												
248												
249	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
250	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
251	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
252	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
253												
254	**Normal GOF Test on Detects Only**											
255	**Not Enough Data to Perform GOF Test**											
256												
257	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
258						KM Mean	0.256			KM Standard Error of Mean	0.0193	
259						KM SD	0.0379			95% KM (BCA) UCL	N/A	
260						95% KM (t) UCL	0.292			95% KM (Percentile Bootstrap) UCL	N/A	
261						95% KM (z) UCL	0.288			95% KM Bootstrap t UCL	N/A	
262						90% KM Chebyshev UCL	0.314			95% KM Chebyshev UCL	0.34	
263						97.5% KM Chebyshev UCL	0.376			99% KM Chebyshev UCL	0.448	
264												
265	**Gamma GOF Tests on Detected Observations Only**											
266	**Not Enough Data to Perform GOF Test**											
267												
268	**Gamma Statistics on Detected Data Only**											

269					k hat (MLE)	107.7			k star (bias corrected MLE)			N/A
270					Theta hat (MLE)	0.00292			Theta star (bias corrected MLE)			N/A
271					nu hat (MLE)	430.6			nu star (bias corrected)			N/A
272					Mean (detects)	0.315						
273												
274					**Estimates of Gamma Parameters using KM Estimates**							
275					Mean (KM)	0.256			SD (KM)			0.0379
276					Variance (KM)	0.00143			SE of Mean (KM)			0.0193
277					k hat (KM)	45.65			k star (KM)			28.61
278					nu hat (KM)	730.4			nu star (KM)			457.8
279					theta hat (KM)	0.00561			theta star (KM)			0.00894
280					80% gamma percentile (KM)	0.295			90% gamma percentile (KM)			0.319
281					95% gamma percentile (KM)	0.339			99% gamma percentile (KM)			0.38
282												
283					**Gamma Kaplan-Meier (KM) Statistics**							
284									Adjusted Level of Significance (β)			0.0195
285					Approximate Chi Square Value (457.84, α)	409.2			Adjusted Chi Square Value (457.84, β)			397.5
286	5% Gamma Approximate KM-UCL (use when n>=50)					0.286			95% Gamma Adjusted KM-UCL (use when n<50)			0.295
287												
288					**Lognormal GOF Test on Detected Observations Only**							
289					**Not Enough Data to Perform GOF Test**							
290												
291					**Lognormal ROS Statistics Using Imputed Non-Detects**							
292					Mean in Original Scale	0.232			Mean in Log Scale			-1.479
293					SD in Original Scale	0.0535			SD in Log Scale			0.204
294					95% t UCL (assumes normality of ROS data)	0.268			95% Percentile Bootstrap UCL			N/A
295					95% BCA Bootstrap UCL	N/A			95% Bootstrap t UCL			N/A
296					95% H-UCL (Log ROS)	0.27						
297												
298					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
299					KM Mean (logged)	-1.373			KM Geo Mean			0.253
300					KM SD (logged)	0.134			95% Critical H Value (KM-Log)			1.879
301					KM Standard Error of Mean (logged)	0.0686			95% H-UCL (KM -Log)			0.281
302					KM SD (logged)	0.134			95% Critical H Value (KM-Log)			1.879
303					KM Standard Error of Mean (logged)	0.0686						
304												
305					**DL/2 Statistics**							
306					**DL/2 Normal**				**DL/2 Log-Transformed**			
307					Mean in Original Scale	0.177			Mean in Log Scale			-1.814
308					SD in Original Scale	0.0868			SD in Log Scale			0.412
309					95% t UCL (Assumes normality)	0.235			95% H-Stat UCL			0.25
310					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
311												
312					**Nonparametric Distribution Free UCL Statistics**							
313					**Data do not follow a Discernible Distribution at 5% Significance Level**							
314												
315					**Suggested UCL to Use**							
316					95% KM (t) UCL	0.292			KM H-UCL			0.281
317					95% KM (BCA) UCL	N/A						
318					**Warning: One or more Recommended UCL(s) not available!**							
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 statisticia											
324												
325	**Result (deermuscle_mercury)**											
326												
327					**General Statistics**							
328					Total Number of Observations	8			Number of Distinct Observations			8
329					Number of Detects	0			Number of Non-Detects			8
330					Number of Distinct Detects	0			Number of Distinct Non-Detects			8
331												
332	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
333	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
334	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
335												

336	**The data set for variable Result (deermuscle_mercury) was not processed!**											
337												
338												
339	**Result (deermuscle_thallium)**											
340												
341	**General Statistics**											
342						Total Number of Observations	8			Number of Distinct Observations	8	
343						Number of Detects	0			Number of Non-Detects	8	
344						Number of Distinct Detects	0			Number of Distinct Non-Detects	8	
345												
346	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
347	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
348	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
349												
350	**The data set for variable Result (deermuscle_thallium) was not processed!**											
351												
352												
353												
354	**Result (deermuscle_zinc)**											
355												
356	**General Statistics**											
357						Total Number of Observations	8			Number of Distinct Observations	8	
358										Number of Missing Observations	0	
359						Minimum	12.93			Mean	30.05	
360						Maximum	64.64			Median	24.85	
361						SD	16.1			Std. Error of Mean	5.694	
362						Coefficient of Variation	0.536			Skewness	1.653	
363												
364	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
365	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
366	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
367	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
368												
369	**Normal GOF Test**											
370						Shapiro Wilk Test Statistic	0.832			**Shapiro Wilk GOF Test**		
371						5% Shapiro Wilk Critical Value	0.818			Data appear Normal at 5% Significance Level		
372						Lilliefors Test Statistic	0.291			**Lilliefors GOF Test**		
373						5% Lilliefors Critical Value	0.283			Data Not Normal at 5% Significance Level		
374	**Data appear Approximate Normal at 5% Significance Level**											
375												
376	**Assuming Normal Distribution**											
377						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
378						95% Student's-t UCL	40.84			95% Adjusted-CLT UCL (Chen-1995)	42.97	
379										95% Modified-t UCL (Johnson-1978)	41.39	
380												
381	**Gamma GOF Test**											
382						A-D Test Statistic	0.42			**Anderson-Darling Gamma GOF Test**		
383						5% A-D Critical Value	0.719			)etected data appear Gamma Distributed at 5% Significance Lev		
384						K-S Test Statistic	0.239			**Kolmogorov-Smirnov Gamma GOF Test**		
385						5% K-S Critical Value	0.295			)etected data appear Gamma Distributed at 5% Significance Lev		
386	**Detected data appear Gamma Distributed at 5% Significance Level**											
387												
388	**Gamma Statistics**											
389						k hat (MLE)	4.871			k star (bias corrected MLE)	3.128	
390						Theta hat (MLE)	6.169			Theta star (bias corrected MLE)	9.607	
391						nu hat (MLE)	77.94			nu star (bias corrected)	50.04	
392						MLE Mean (bias corrected)	30.05			MLE Sd (bias corrected)	16.99	
393										Approximate Chi Square Value (0.05)	34.8	
394						Adjusted Level of Significance	0.0195			Adjusted Chi Square Value	31.62	
395												
396	**Assuming Gamma Distribution**											
397						95% Approximate Gamma UCL (use when n>=50))	43.21			95% Adjusted Gamma UCL (use when n<50)	47.56	
398												
399	**Lognormal GOF Test**											
400						Shapiro Wilk Test Statistic	0.948			**Shapiro Wilk Lognormal GOF Test**		
401						5% Shapiro Wilk Critical Value	0.818			Data appear Lognormal at 5% Significance Level		
402						Lilliefors Test Statistic	0.209			**Lilliefors Lognormal GOF Test**		

403					5% Lilliefors Critical Value	0.283	Data appear Lognormal at 5% Significance Level					
404	**Data appear Lognormal at 5% Significance Level**											
405												
406	**Lognormal Statistics**											
407					Minimum of Logged Data	2.56	Mean of logged Data	3.297				
408					Maximum of Logged Data	4.169	SD of logged Data	0.479				
409												
410	**Assuming Lognormal Distribution**											
411					95% H-UCL	46.1	90% Chebyshev (MVUE) UCL	45.13				
412					95% Chebyshev (MVUE) UCL	52.06	97.5% Chebyshev (MVUE) UCL	61.67				
413					99% Chebyshev (MVUE) UCL	80.56						
414												
415	**Nonparametric Distribution Free UCL Statistics**											
416	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
417												
418	**Nonparametric Distribution Free UCLs**											
419					95% CLT UCL	39.41	95% Jackknife UCL	40.84				
420					95% Standard Bootstrap UCL	38.9	95% Bootstrap-t UCL	55.33				
421					95% Hall's Bootstrap UCL	98.73	95% Percentile Bootstrap UCL	39.67				
422					95% BCA Bootstrap UCL	43.26						
423					90% Chebyshev(Mean, Sd) UCL	47.13	95% Chebyshev(Mean, Sd) UCL	54.87				
424					97.5% Chebyshev(Mean, Sd) UCL	65.61	99% Chebyshev(Mean, Sd) UCL	86.7				
425												
426	**Suggested UCL to Use**											
427					95% Student's-t UCL	40.84						
428												
429	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
430	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
431												
432	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
433	Recommendations are based upon data size, data distribution, and skewness.											
434	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
435	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
436												
437	**Result (deerorgan_antimony)**											
438												
439	**General Statistics**											
440					Total Number of Observations	8	Number of Distinct Observations	8				
441					Number of Detects	0	Number of Non-Detects	8				
442					Number of Distinct Detects	0	Number of Distinct Non-Detects	8				
443												
444	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
445	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
446	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
447												
448	**The data set for variable Result (deerorgan_antimony) was not processed!**											
449												
450												
451	**Result (deerorgan_arsenic)**											
452												
453	**General Statistics**											
454					Total Number of Observations	8	Number of Distinct Observations	8				
455					Number of Detects	0	Number of Non-Detects	8				
456					Number of Distinct Detects	0	Number of Distinct Non-Detects	8				
457												
458	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
459	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
460	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
461												
462	**The data set for variable Result (deerorgan_arsenic) was not processed!**											
463												
464												
465	**Result (deerorgan_cadmium)**											
466												
467	**General Statistics**											
468					Total Number of Observations	8	Number of Distinct Observations	8				
469					Number of Detects	4	Number of Non-Detects	4				

470					Number of Distinct Detects	4				Number of Distinct Non-Detects		4
471					Minimum Detect	0.0604				Minimum Non-Detect		0.0118
472					Maximum Detect	1.954				Maximum Non-Detect		0.0418
473					Variance Detects	0.809				Percent Non-Detects		50%
474					Mean Detects	0.613				SD Detects		0.9
475					Median Detects	0.219				CV Detects		1.467
476					Skewness Detects	1.925				Kurtosis Detects		3.736
477					Mean of Logged Detects	-1.333				SD of Logged Detects		1.489
478												
479					**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
480					**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
481					**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
482					**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
483												
484					**Normal GOF Test on Detects Only**							
485					Shapiro Wilk Test Statistic	0.728				**Shapiro Wilk GOF Test**		
486					5% Shapiro Wilk Critical Value	0.748				Detected Data Not Normal at 5% Significance Level		
487					Lilliefors Test Statistic	0.385				**Lilliefors GOF Test**		
488					5% Lilliefors Critical Value	0.375				Detected Data Not Normal at 5% Significance Level		
489					**Detected Data Not Normal at 5% Significance Level**							
490												
491					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
492					KM Mean	0.312				KM Standard Error of Mean		0.256
493					KM SD	0.628				95% KM (BCA) UCL		N/A
494					95% KM (t) UCL	0.798				95% KM (Percentile Bootstrap) UCL		N/A
495					95% KM (z) UCL	0.734				95% KM Bootstrap t UCL		N/A
496					90% KM Chebyshev UCL	1.081				95% KM Chebyshev UCL		1.429
497					97.5% KM Chebyshev UCL	1.913				99% KM Chebyshev UCL		2.862
498												
499					**Gamma GOF Tests on Detected Observations Only**							
500					A-D Test Statistic	0.393				**Anderson-Darling GOF Test**		
501					5% A-D Critical Value	0.672				Detected data appear Gamma Distributed at 5% Significance Lev		
502					K-S Test Statistic	0.297				**Kolmogorov-Smirnov GOF**		
503					5% K-S Critical Value	0.406				Detected data appear Gamma Distributed at 5% Significance Lev		
504					**Detected data appear Gamma Distributed at 5% Significance Level**							
505												
506					**Gamma Statistics on Detected Data Only**							
507					k hat (MLE)	0.714				k star (bias corrected MLE)		0.345
508					Theta hat (MLE)	0.858				Theta star (bias corrected MLE)		1.776
509					nu hat (MLE)	5.714				nu star (bias corrected)		2.762
510					Mean (detects)	0.613						
511												
512					**Gamma ROS Statistics using Imputed Non-Detects**							
513					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
514					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)							
515					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
516					This is especially true when the sample size is small.							
517					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
518					Minimum	0.01				Mean		0.312
519					Maximum	1.954				Median		0.0352
520					SD	0.671				CV		2.155
521					k hat (MLE)	0.37				k star (bias corrected MLE)		0.314
522					Theta hat (MLE)	0.843				Theta star (bias corrected MLE)		0.991
523					nu hat (MLE)	5.915				nu star (bias corrected)		5.03
524					Adjusted Level of Significance (β)	0.0195						
525					Approximate Chi Square Value (5.03, α)	1.166				Adjusted Chi Square Value (5.03, β)		0.765
526					95% Gamma Approximate UCL (use when n>=50)	1.344				95% Gamma Adjusted UCL (use when n<50)		N/A
527												
528					**Estimates of Gamma Parameters using KM Estimates**							
529					Mean (KM)	0.312				SD (KM)		0.628
530					Variance (KM)	0.394				SE of Mean (KM)		0.256
531					k hat (KM)	0.248				k star (KM)		0.238
532					nu hat (KM)	3.967				nu star (KM)		3.812
533					theta hat (KM)	1.26				theta star (KM)		1.311
534					80% gamma percentile (KM)	0.446				90% gamma percentile (KM)		0.941
535					95% gamma percentile (KM)	1.534				99% gamma percentile (KM)		3.124
536												

537	**Gamma Kaplan-Meier (KM) Statistics**											
538	Approximate Chi Square Value (3.81, α)					0.649	Adjusted Chi Square Value (3.81, β)					0.392
539	5% Gamma Approximate KM-UCL (use when n>=50)					1.836	95% Gamma Adjusted KM-UCL (use when n<50)					3.039
540												
541	**Lognormal GOF Test on Detected Observations Only**											
542	Shapiro Wilk Test Statistic					0.959	**Shapiro Wilk GOF Test**					
543	5% Shapiro Wilk Critical Value					0.748	Detected Data appear Lognormal at 5% Significance Level					
544	Lilliefors Test Statistic					0.213	**Lilliefors GOF Test**					
545	5% Lilliefors Critical Value					0.375	Detected Data appear Lognormal at 5% Significance Level					
546	**Detected Data appear Lognormal at 5% Significance Level**											
547												
548	**Lognormal ROS Statistics Using Imputed Non-Detects**											
549	Mean in Original Scale					0.308	Mean in Log Scale					-3.674
550	SD in Original Scale					0.673	SD in Log Scale					2.685
551	95% t UCL (assumes normality of ROS data)					0.759	95% Percentile Bootstrap UCL					0.751
552	95% BCA Bootstrap UCL					0.995	95% Bootstrap t UCL					4.097
553	95% H-UCL (Log ROS)					3461						
554												
555	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
556	KM Mean (logged)					-2.886	KM Geo Mean					0.0558
557	KM SD (logged)					1.801	95% Critical H Value (KM-Log)					5.573
558	KM Standard Error of Mean (logged)					0.735	95% H-UCL (KM -Log)					12.53
559	KM SD (logged)					1.801	95% Critical H Value (KM-Log)					5.573
560	KM Standard Error of Mean (logged)					0.735						
561												
562	**DL/2 Statistics**											
563	**DL/2 Normal**						**DL/2 Log-Transformed**					
564	Mean in Original Scale					0.313	Mean in Log Scale					-2.934
565	SD in Original Scale					0.671	SD in Log Scale					2.019
566	95% t UCL (Assumes normality)					0.762	95% H-Stat UCL					45.88
567	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
568												
569	**Nonparametric Distribution Free UCL Statistics**											
570	**Detected Data appear Gamma Distributed at 5% Significance Level**											
571												
572	**Suggested UCL to Use**											
573	95% KM Bootstrap t UCL					N/A	d KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					3.039
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 statisticia											
579												
580	**Result (deerorgan_chromium)**											
581												
582	**General Statistics**											
583	Total Number of Observations					8	Number of Distinct Observations					8
584	Number of Detects					7	Number of Non-Detects					1
585	Number of Distinct Detects					7	Number of Distinct Non-Detects					1
586	Minimum Detect					0.446	Minimum Non-Detect					0.418
587	Maximum Detect					0.967	Maximum Non-Detect					0.418
588	Variance Detects					0.0398	Percent Non-Detects					12.5%
589	Mean Detects					0.656	SD Detects					0.199
590	Median Detects					0.602	CV Detects					0.304
591	Skewness Detects					0.842	Kurtosis Detects					-0.864
592	Mean of Logged Detects					-0.459	SD of Logged Detects					0.291
593												
594	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
595	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
596	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
597	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
598												
599	**Normal GOF Test on Detects Only**											
600	Shapiro Wilk Test Statistic					0.883	**Shapiro Wilk GOF Test**					
601	5% Shapiro Wilk Critical Value					0.803	Detected Data appear Normal at 5% Significance Level					
602	Lilliefors Test Statistic					0.247	**Lilliefors GOF Test**					
603	5% Lilliefors Critical Value					0.304	Detected Data appear Normal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
604	**Detected Data appear Normal at 5% Significance Level**											
605												
606	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
607					KM Mean	0.626			KM Standard Error of Mean	0.0724		
608					KM SD	0.19			95% KM (BCA) UCL	0.751		
609					95% KM (t) UCL	0.763			95% KM (Percentile Bootstrap) UCL	0.744		
610					95% KM (z) UCL	0.745			95% KM Bootstrap t UCL	0.858		
611					90% KM Chebyshev UCL	0.843			95% KM Chebyshev UCL	0.942		
612					97.5% KM Chebyshev UCL	1.079			99% KM Chebyshev UCL	1.347		
613												
614	**Gamma GOF Tests on Detected Observations Only**											
615					A-D Test Statistic	0.379			**Anderson-Darling GOF Test**			
616					5% A-D Critical Value	0.708			Detected data appear Gamma Distributed at 5% Significance Lev			
617					K-S Test Statistic	0.215			**Kolmogorov-Smirnov GOF**			
618					5% K-S Critical Value	0.312			Detected data appear Gamma Distributed at 5% Significance Lev			
619	**Detected data appear Gamma Distributed at 5% Significance Level**											
620												
621	**Gamma Statistics on Detected Data Only**											
622					k hat (MLE)	13.57			k star (bias corrected MLE)	7.85		
623					Theta hat (MLE)	0.0483			Theta star (bias corrected MLE)	0.0835		
624					nu hat (MLE)	190			nu star (bias corrected)	109.9		
625					Mean (detects)	0.656						
626												
627	**Gamma ROS Statistics using Imputed Non-Detects**											
628	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
629	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)											
630	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
631	This is especially true when the sample size is small.											
632	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
633					Minimum	0.233			Mean	0.603		
634					Maximum	0.967			Median	0.576		
635					SD	0.238			CV	0.394		
636					k hat (MLE)	6.566			k star (bias corrected MLE)	4.187		
637					Theta hat (MLE)	0.0918			Theta star (bias corrected MLE)	0.144		
638					nu hat (MLE)	105.1			nu star (bias corrected)	67		
639					Adjusted Level of Significance (β)	0.0195						
640					Approximate Chi Square Value (67.00, α)	49.16			Adjusted Chi Square Value (67.00, β)	45.32		
641					95% Gamma Approximate UCL (use when n>=50)	0.822			95% Gamma Adjusted UCL (use when n<50)	0.891		
642												
643	**Estimates of Gamma Parameters using KM Estimates**											
644					Mean (KM)	0.626			SD (KM)	0.19		
645					Variance (KM)	0.036			SE of Mean (KM)	0.0724		
646					k hat (KM)	10.89			k star (KM)	6.889		
647					nu hat (KM)	174.2			nu star (KM)	110.2		
648					theta hat (KM)	0.0575			theta star (KM)	0.0909		
649					80% gamma percentile (KM)	0.813			90% gamma percentile (KM)	0.945		
650					95% gamma percentile (KM)	1.063			99% gamma percentile (KM)	1.31		
651												
652	**Gamma Kaplan-Meier (KM) Statistics**											
653					Approximate Chi Square Value (110.23, α)	87			Adjusted Chi Square Value (110.23, β)	81.79		
654	5% Gamma Approximate KM-UCL (use when n>=50)					0.793			95% Gamma Adjusted KM-UCL (use when n<50)	0.844		
655												
656	**Lognormal GOF Test on Detected Observations Only**											
657					Shapiro Wilk Test Statistic	0.924			**Shapiro Wilk GOF Test**			
658					5% Shapiro Wilk Critical Value	0.803			Detected Data appear Lognormal at 5% Significance Level			
659					Lilliefors Test Statistic	0.198			**Lilliefors GOF Test**			
660					5% Lilliefors Critical Value	0.304			Detected Data appear Lognormal at 5% Significance Level			
661	**Detected Data appear Lognormal at 5% Significance Level**											
662												
663	**Lognormal ROS Statistics Using Imputed Non-Detects**											
664					Mean in Original Scale	0.612			Mean in Log Scale	-0.55		
665					SD in Original Scale	0.222			SD in Log Scale	0.371		
666					95% t UCL (assumes normality of ROS data)	0.761			95% Percentile Bootstrap UCL	0.742		
667					95% BCA Bootstrap UCL	0.745			95% Bootstrap t UCL	0.816		
668					95% H-UCL (Log ROS)	0.836						
669												
670	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											

671				KM Mean (logged)	-0.511				KM Geo Mean	0.6		
672				KM SD (logged)	0.286				95% Critical H Value (KM-Log)	2.041		
673				KM Standard Error of Mean (logged)	0.109				95% H-UCL (KM -Log)	0.78		
674				KM SD (logged)	0.286				95% Critical H Value (KM-Log)	2.041		
675				KM Standard Error of Mean (logged)	0.109							
676												
677					**DL/2 Statistics**							
678				**DL/2 Normal**					**DL/2 Log-Transformed**			
679				Mean in Original Scale	0.6				Mean in Log Scale	-0.597		
680				SD in Original Scale	0.243				SD in Log Scale	0.475		
681				95% t UCL (Assumes normality)	0.763				95% H-Stat UCL	0.932		
682					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
683												
684					**Nonparametric Distribution Free UCL Statistics**							
685					**Detected Data appear Normal Distributed at 5% Significance Level**							
686												
687					**Suggested UCL to Use**							
688				95% KM (t) UCL	0.763							
689												
690	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
691	Recommendations are based upon data size, data distribution, and skewness.											
692	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
693	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
694												
695	**Result (deerorgan_cobalt)**											
696												
697					**General Statistics**							
698				Total Number of Observations	8				Number of Distinct Observations	8		
699				Number of Detects	4				Number of Non-Detects	4		
700				Number of Distinct Detects	4				Number of Distinct Non-Detects	4		
701				Minimum Detect	0.0115				Minimum Non-Detect	0.0118		
702				Maximum Detect	0.0509				Maximum Non-Detect	0.0418		
703				Variance Detects	3.2798E-4				Percent Non-Detects	50%		
704				Mean Detects	0.0307				SD Detects	0.0181		
705				Median Detects	0.0303				CV Detects	0.589		
706				Skewness Detects	0.0924				Kurtosis Detects	-3.468		
707				Mean of Logged Detects	-3.639				SD of Logged Detects	0.677		
708												
709					**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
710					**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
711					**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
712					**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
713												
714					**Normal GOF Test on Detects Only**							
715				Shapiro Wilk Test Statistic	0.944				**Shapiro Wilk GOF Test**			
716				5% Shapiro Wilk Critical Value	0.748				Detected Data appear Normal at 5% Significance Level			
717				Lilliefors Test Statistic	0.222				**Lilliefors GOF Test**			
718				5% Lilliefors Critical Value	0.375				Detected Data appear Normal at 5% Significance Level			
719					**Detected Data appear Normal at 5% Significance Level**							
720												
721					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
722				KM Mean	0.0222				KM Standard Error of Mean	0.00624		
723				KM SD	0.0147				95% KM (BCA) UCL	N/A		
724				95% KM (t) UCL	0.034				95% KM (Percentile Bootstrap) UCL	N/A		
725				95% KM (z) UCL	0.0325				95% KM Bootstrap t UCL	N/A		
726				90% KM Chebyshev UCL	0.0409				95% KM Chebyshev UCL	0.0494		
727				97.5% KM Chebyshev UCL	0.0612				99% KM Chebyshev UCL	0.0843		
728												
729					**Gamma GOF Tests on Detected Observations Only**							
730				A-D Test Statistic	0.287				**Anderson-Darling GOF Test**			
731				5% A-D Critical Value	0.659				Detected data appear Gamma Distributed at 5% Significance Lev			
732				K-S Test Statistic	0.259				**Kolmogorov-Smirnov GOF**			
733				5% K-S Critical Value	0.396				Detected data appear Gamma Distributed at 5% Significance Lev			
734					**Detected data appear Gamma Distributed at 5% Significance Level**							
735												
736					**Gamma Statistics on Detected Data Only**							
737				k hat (MLE)	3.341				k star (bias corrected MLE)	1.002		

738					Theta hat (MLE)	0.0092				Theta star (bias corrected MLE)		0.0307
739					nu hat (MLE)	26.73				nu star (bias corrected)		8.016
740					Mean (detects)	0.0307						
741												
742					**Gamma ROS Statistics using Imputed Non-Detects**							
743					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
744					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)							
745					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
746					This is especially true when the sample size is small.							
747					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
748					Minimum	0.0103				Mean		0.0217
749					Maximum	0.0509				Median		0.0151
750					SD	0.0154				CV		0.71
751					k hat (MLE)	2.878				k star (bias corrected MLE)		1.882
752					Theta hat (MLE)	0.00755				Theta star (bias corrected MLE)		0.0115
753					nu hat (MLE)	46.04				nu star (bias corrected)		30.11
754					Adjusted Level of Significance (β)	0.0195						
755					Approximate Chi Square Value (30.11, α)	18.58				Adjusted Chi Square Value (30.11, β)		16.33
756					95% Gamma Approximate UCL (use when n>=50)	0.0352				95% Gamma Adjusted UCL (use when n<50)		N/A
757												
758					**Estimates of Gamma Parameters using KM Estimates**							
759					Mean (KM)	0.0222				SD (KM)		0.0147
760					Variance (KM)	2.1469E-4				SE of Mean (KM)		0.00624
761					k hat (KM)	2.3				k star (KM)		1.521
762					nu hat (KM)	36.8				nu star (KM)		24.33
763					theta hat (KM)	0.00966				theta star (KM)		0.0146
764					80% gamma percentile (KM)	0.0343				90% gamma percentile (KM)		0.0461
765					95% gamma percentile (KM)	0.0576				99% gamma percentile (KM)		0.0835
766												
767					**Gamma Kaplan-Meier (KM) Statistics**							
768					Approximate Chi Square Value (24.33, α)	14.1				Adjusted Chi Square Value (24.33, β)		12.18
769					5% Gamma Approximate KM-UCL (use when n>=50)	0.0383				95% Gamma Adjusted KM-UCL (use when n<50)		0.0444
770												
771					**Lognormal GOF Test on Detected Observations Only**							
772					Shapiro Wilk Test Statistic	0.942				**Shapiro Wilk GOF Test**		
773					5% Shapiro Wilk Critical Value	0.748				Detected Data appear Lognormal at 5% Significance Level		
774					Lilliefors Test Statistic	0.238				**Lilliefors GOF Test**		
775					5% Lilliefors Critical Value	0.375				Detected Data appear Lognormal at 5% Significance Level		
776					**Detected Data appear Lognormal at 5% Significance Level**							
777												
778					**Lognormal ROS Statistics Using Imputed Non-Detects**							
779					Mean in Original Scale	0.0219				Mean in Log Scale		-3.993
780					SD in Original Scale	0.0152				SD in Log Scale		0.592
781					95% t UCL (assumes normality of ROS data)	0.0321				95% Percentile Bootstrap UCL		0.0307
782					95% BCA Bootstrap UCL	0.0323				95% Bootstrap t UCL		0.063
783					95% H-UCL (Log ROS)	0.0386						
784												
785					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
786					KM Mean (logged)	-3.993				KM Geo Mean		0.0184
787					KM SD (logged)	0.584				95% Critical H Value (KM-Log)		2.504
788					KM Standard Error of Mean (logged)	0.253				95% H-UCL (KM -Log)		0.038
789					KM SD (logged)	0.584				95% Critical H Value (KM-Log)		2.504
790					KM Standard Error of Mean (logged)	0.253						
791												
792					**DL/2 Statistics**							
793					**DL/2 Normal**					**DL/2 Log-Transformed**		
794					Mean in Original Scale	0.0217				Mean in Log Scale		-4.087
795					SD in Original Scale	0.0161				SD in Log Scale		0.789
796					95% t UCL (Assumes normality)	0.0325				95% H-Stat UCL		0.0549
797					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
798												
799					**Nonparametric Distribution Free UCL Statistics**							
800					**Detected Data appear Normal Distributed at 5% Significance Level**							
801												
802					**Suggested UCL to Use**							
803					95% KM (t) UCL	0.034						
804												

805	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
806	Recommendations are based upon data size, data distribution, and skewness.											
807	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
808	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
809												
810	**Result (deerorgan_iron)**											
811												
812	**General Statistics**											
813	Total Number of Observations				8			Number of Distinct Observations				8
814	Number of Detects				7			Number of Non-Detects				1
815	Number of Distinct Detects				7			Number of Distinct Non-Detects				1
816	Minimum Detect				28.06			Minimum Non-Detect				41.81
817	Maximum Detect				122.5			Maximum Non-Detect				41.81
818	Variance Detects				1067			Percent Non-Detects				12.5%
819	Mean Detects				54.61			SD Detects				32.66
820	Median Detects				42.99			CV Detects				0.598
821	Skewness Detects				1.885			Kurtosis Detects				3.658
822	Mean of Logged Detects				3.881			SD of Logged Detects				0.498
823												
824	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
825	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
826	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
827	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
828												
829	**Normal GOF Test on Detects Only**											
830	Shapiro Wilk Test Statistic				0.786			**Shapiro Wilk GOF Test**				
831	5% Shapiro Wilk Critical Value				0.803			Detected Data Not Normal at 5% Significance Level				
832	Lilliefors Test Statistic				0.294			**Lilliefors GOF Test**				
833	5% Lilliefors Critical Value				0.304			Detected Data appear Normal at 5% Significance Level				
834	**Detected Data appear Approximate Normal at 5% Significance Level**											
835												
836	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
837	KM Mean				51.95			KM Standard Error of Mean				11.17
838	KM SD				29.19			95% KM (BCA) UCL				72.29
839	95% KM (t) UCL				73.11			95% KM (Percentile Bootstrap) UCL				70.74
840	95% KM (z) UCL				70.32			95% KM Bootstrap t UCL				118.4
841	90% KM Chebyshev UCL				85.45			95% KM Chebyshev UCL				100.6
842	97.5% KM Chebyshev UCL				121.7			99% KM Chebyshev UCL				163.1
843												
844	**Gamma GOF Tests on Detected Observations Only**											
845	A-D Test Statistic				0.459			**Anderson-Darling GOF Test**				
846	5% A-D Critical Value				0.71			Detected data appear Gamma Distributed at 5% Significance Lev				
847	K-S Test Statistic				0.254			**Kolmogorov-Smirnov GOF**				
848	5% K-S Critical Value				0.313			Detected data appear Gamma Distributed at 5% Significance Lev				
849	**Detected data appear Gamma Distributed at 5% Significance Level**											
850												
851	**Gamma Statistics on Detected Data Only**											
852	k hat (MLE)				4.347			k star (bias corrected MLE)				2.579
853	Theta hat (MLE)				12.56			Theta star (bias corrected MLE)				21.17
854	nu hat (MLE)				60.86			nu star (bias corrected)				36.11
855	Mean (detects)				54.61							
856												
857	**Gamma ROS Statistics using Imputed Non-Detects**											
858	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
859	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)											
860	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
861	This is especially true when the sample size is small.											
862	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
863	Minimum				27.98			Mean				51.28
864	Maximum				122.5			Median				40.88
865	SD				31.67			CV				0.618
866	k hat (MLE)				4.154			k star (bias corrected MLE)				2.679
867	Theta hat (MLE)				12.35			Theta star (bias corrected MLE)				19.14
868	nu hat (MLE)				66.46			nu star (bias corrected)				42.87
869	Adjusted Level of Significance (β)				0.0195							
870	Approximate Chi Square Value (42.87, α)				28.86			Adjusted Chi Square Value (42.87, β)				25.98
871	95% Gamma Approximate UCL (use when n>=50)				76.18			95% Gamma Adjusted UCL (use when n<50)				84.61

872												
873	**Estimates of Gamma Parameters using KM Estimates**											
874					Mean (KM)	51.95				SD (KM)	29.19	
875					Variance (KM)	851.9				SE of Mean (KM)	11.17	
876					k hat (KM)	3.168				k star (KM)	2.063	
877					nu hat (KM)	50.69				nu star (KM)	33.01	
878					theta hat (KM)	16.4				theta star (KM)	25.18	
879					80% gamma percentile (KM)	77.49				90% gamma percentile (KM)	100.3	
880					95% gamma percentile (KM)	122				99% gamma percentile (KM)	170.1	
881												
882	**Gamma Kaplan-Meier (KM) Statistics**											
883					Approximate Chi Square Value (33.01, α)	20.88				Adjusted Chi Square Value (33.01, β)	18.48	
884	5% Gamma Approximate KM-UCL (use when n>=50)					82.15				95% Gamma Adjusted KM-UCL (use when n<50)	92.83	
885												
886	**Lognormal GOF Test on Detected Observations Only**											
887					Shapiro Wilk Test Statistic	0.919				**Shapiro Wilk GOF Test**		
888					5% Shapiro Wilk Critical Value	0.803				Detected Data appear Lognormal at 5% Significance Level		
889					Lilliefors Test Statistic	0.221				**Lilliefors GOF Test**		
890					5% Lilliefors Critical Value	0.304				Detected Data appear Lognormal at 5% Significance Level		
891	**Detected Data appear Lognormal at 5% Significance Level**											
892												
893	**Lognormal ROS Statistics Using Imputed Non-Detects**											
894					Mean in Original Scale	51.77				Mean in Log Scale	3.828	
895					SD in Original Scale	31.29				SD in Log Scale	0.484	
896					95% t UCL (assumes normality of ROS data)	72.73				95% Percentile Bootstrap UCL	70.3	
897					95% BCA Bootstrap UCL	76.06				95% Bootstrap t UCL	115.5	
898					95% H-UCL (Log ROS)	79.17						
899												
900	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
901					KM Mean (logged)	3.833				KM Geo Mean	46.2	
902					KM SD (logged)	0.452				95% Critical H Value (KM-Log)	2.275	
903					KM Standard Error of Mean (logged)	0.174				95% H-UCL (KM -Log)	75.45	
904					KM SD (logged)	0.452				95% Critical H Value (KM-Log)	2.275	
905					KM Standard Error of Mean (logged)	0.174						
906												
907	**DL/2 Statistics**											
908					**DL/2 Normal**					**DL/2 Log-Transformed**		
909					Mean in Original Scale	50.4				Mean in Log Scale	3.776	
910					SD in Original Scale	32.5				SD in Log Scale	0.548	
911					95% t UCL (Assumes normality)	72.17				95% H-Stat UCL	84.07	
912	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
913												
914	**Nonparametric Distribution Free UCL Statistics**											
915	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**											
916												
917	**Suggested UCL to Use**											
918					95% KM (t) UCL	73.11						
919												
920	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
921	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
922												
923	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
924	Recommendations are based upon data size, data distribution, and skewness.											
925	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
926	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
927												
928	**Result (deerorgan_manganese)**											
929												
930	**General Statistics**											
931					Total Number of Observations	8				Number of Distinct Observations	8	
932					Number of Detects	6				Number of Non-Detects	2	
933					Number of Distinct Detects	6				Number of Distinct Non-Detects	2	
934					Minimum Detect	0.238				Minimum Non-Detect	0.711	
935					Maximum Detect	3.7				Maximum Non-Detect	0.835	
936					Variance Detects	1.931				Percent Non-Detects	25%	
937					Mean Detects	1.706				SD Detects	1.389	
938					Median Detects	1.412				CV Detects	0.815	

939					Skewness Detects	0.561				Kurtosis Detects		-1.355
940					Mean of Logged Detects	0.143				SD of Logged Detects		1.075
941												
942	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
943	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
944	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
945	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
946												
947	**Normal GOF Test on Detects Only**											
948					Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**					
949					5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level					
950					Lilliefors Test Statistic	0.231	**Lilliefors GOF Test**					
951					5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level					
952	**Detected Data appear Normal at 5% Significance Level**											
953												
954	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
955					KM Mean	1.364				KM Standard Error of Mean		0.484
956					KM SD	1.248				95% KM (BCA) UCL		2.209
957					95% KM (t) UCL	2.282				95% KM (Percentile Bootstrap) UCL		2.146
958					95% KM (z) UCL	2.161				95% KM Bootstrap t UCL		2.89
959					90% KM Chebyshev UCL	2.817				95% KM Chebyshev UCL		3.476
960					97.5% KM Chebyshev UCL	4.389				99% KM Chebyshev UCL		6.183
961												
962	**Gamma GOF Tests on Detected Observations Only**											
963					A-D Test Statistic	0.275	**Anderson-Darling GOF Test**					
964					5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Lev					
965					K-S Test Statistic	0.181	**Kolmogorov-Smirnov GOF**					
966					5% K-S Critical Value	0.338	Detected data appear Gamma Distributed at 5% Significance Lev					
967	**Detected data appear Gamma Distributed at 5% Significance Level**											
968												
969	**Gamma Statistics on Detected Data Only**											
970					k hat (MLE)	1.422				k star (bias corrected MLE)		0.822
971					Theta hat (MLE)	1.199				Theta star (bias corrected MLE)		2.075
972					nu hat (MLE)	17.06				nu star (bias corrected)		9.866
973					Mean (detects)	1.706						
974												
975	**Gamma ROS Statistics using Imputed Non-Detects**											
976	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
977	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)											
978	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
979	This is especially true when the sample size is small.											
980	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
981					Minimum	0.238				Mean		1.345
982					Maximum	3.7				Median		0.893
983					SD	1.351				CV		1.004
984					k hat (MLE)	1.095				k star (bias corrected MLE)		0.768
985					Theta hat (MLE)	1.229				Theta star (bias corrected MLE)		1.753
986					nu hat (MLE)	17.52				nu star (bias corrected)		12.28
987					Adjusted Level of Significance (β)	0.0195						
988					Approximate Chi Square Value (12.28, α)	5.412				Adjusted Chi Square Value (12.28, β)		4.316
989					95% Gamma Approximate UCL (use when n>=50)	3.053				95% Gamma Adjusted UCL (use when n<50)		3.828
990												
991	**Estimates of Gamma Parameters using KM Estimates**											
992					Mean (KM)	1.364				SD (KM)		1.248
993					Variance (KM)	1.558				SE of Mean (KM)		0.484
994					k hat (KM)	1.195				k star (KM)		0.83
995					nu hat (KM)	19.11				nu star (KM)		13.28
996					theta hat (KM)	1.142				theta star (KM)		1.644
997					80% gamma percentile (KM)	2.225				90% gamma percentile (KM)		3.288
998					95% gamma percentile (KM)	4.368				99% gamma percentile (KM)		6.911
999												
1000	**Gamma Kaplan-Meier (KM) Statistics**											
1001					Approximate Chi Square Value (13.28, α)	6.082				Adjusted Chi Square Value (13.28, β)		4.905
1002	5% Gamma Approximate KM-UCL (use when n>=50)					2.98				95% Gamma Adjusted KM-UCL (use when n<50)		3.694
1003												
1004	**Lognormal GOF Test on Detected Observations Only**											
1005					Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**					

1006					5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level					
1007					Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**					
1008					5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level					
1009					**Detected Data appear Lognormal at 5% Significance Level**							
1010												
1011					**Lognormal ROS Statistics Using Imputed Non-Detects**							
1012					Mean in Original Scale	1.367	Mean in Log Scale	-0.154				
1013					SD in Original Scale	1.331	SD in Log Scale	1.062				
1014					95% t UCL (assumes normality of ROS data)	2.259	95% Percentile Bootstrap UCL	2.161				
1015					95% BCA Bootstrap UCL	2.264	95% Bootstrap t UCL	2.919				
1016					95% H-UCL (Log ROS)	6.337						
1017												
1018					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1019					KM Mean (logged)	-0.174	KM Geo Mean	0.841				
1020					KM SD (logged)	1.023	95% Critical H Value (KM-Log)	3.483				
1021					KM Standard Error of Mean (logged)	0.405	95% H-UCL (KM -Log)	5.455				
1022					KM SD (logged)	1.023	95% Critical H Value (KM-Log)	3.483				
1023					KM Standard Error of Mean (logged)	0.405						
1024												
1025					**DL/2 Statistics**							
1026					**DL/2 Normal**		**DL/2 Log-Transformed**					
1027					Mean in Original Scale	1.376	Mean in Log Scale	-0.131				
1028					SD in Original Scale	1.324	SD in Log Scale	1.041				
1029					95% t UCL (Assumes normality)	2.262	95% H-Stat UCL	6.047				
1030					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1031												
1032					**Nonparametric Distribution Free UCL Statistics**							
1033					**Detected Data appear Normal Distributed at 5% Significance Level**							
1034												
1035					**Suggested UCL to Use**							
1036					95% KM (t) UCL	2.282						
1037												
1038	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1039	Recommendations are based upon data size, data distribution, and skewness.											
1040	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1041	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1042												
1043	**Result (deerorgan_mercury)**											
1044												
1045					**General Statistics**							
1046					Total Number of Observations	8	Number of Distinct Observations	8				
1047					Number of Detects	3	Number of Non-Detects	5				
1048					Number of Distinct Detects	3	Number of Distinct Non-Detects	5				
1049					Minimum Detect	0.017	Minimum Non-Detect	0.0125				
1050					Maximum Detect	0.0491	Maximum Non-Detect	0.0373				
1051					Variance Detects	2.5825E-4	Percent Non-Detects	62.5%				
1052					Mean Detects	0.0327	SD Detects	0.0161				
1053					Median Detects	0.0319	CV Detects	0.492				
1054					Skewness Detects	0.209	Kurtosis Detects	N/A				
1055					Mean of Logged Detects	-3.511	SD of Logged Detects	0.534				
1056												
1057					**Warning: Data set has only 3 Detected Values.**							
1058					**This is not enough to compute meaningful or reliable statistics and estimates.**							
1059												
1060												
1061					**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
1062					**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
1063					**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
1064					**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
1065												
1066					**Normal GOF Test on Detects Only**							
1067					Shapiro Wilk Test Statistic	0.998	**Shapiro Wilk GOF Test**					
1068					5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level					
1069					Lilliefors Test Statistic	0.185	**Lilliefors GOF Test**					
1070					5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level					
1071					**Detected Data appear Normal at 5% Significance Level**							
1072												

1073	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1074					KM Mean	0.0212			KM Standard Error of Mean	0.00582		
1075					KM SD	0.0127			95% KM (BCA) UCL	N/A		
1076					95% KM (t) UCL	0.0323			95% KM (Percentile Bootstrap) UCL	N/A		
1077					95% KM (z) UCL	0.0308			95% KM Bootstrap t UCL	N/A		
1078					90% KM Chebyshev UCL	0.0387			95% KM Chebyshev UCL	0.0466		
1079					97.5% KM Chebyshev UCL	0.0576			99% KM Chebyshev UCL	0.0791		
1080												
1081	**Gamma GOF Tests on Detected Observations Only**											
1082	**Not Enough Data to Perform GOF Test**											
1083												
1084	**Gamma Statistics on Detected Data Only**											
1085					k hat (MLE)	5.721			k star (bias corrected MLE)	N/A		
1086					Theta hat (MLE)	0.00571			Theta star (bias corrected MLE)	N/A		
1087					nu hat (MLE)	34.33			nu star (bias corrected)	N/A		
1088					Mean (detects)	0.0327						
1089												
1090	**Gamma ROS Statistics using Imputed Non-Detects**											
1091	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1092	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)											
1093	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1094	This is especially true when the sample size is small.											
1095	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1096					Minimum	0.01			Mean	0.0185		
1097					Maximum	0.0491			Median	0.01		
1098					SD	0.0145			CV	0.786		
1099					k hat (MLE)	2.594			k star (bias corrected MLE)	1.704		
1100					Theta hat (MLE)	0.00713			Theta star (bias corrected MLE)	0.0109		
1101					nu hat (MLE)	41.5			nu star (bias corrected)	27.27		
1102					Adjusted Level of Significance (β)	0.0195						
1103					Approximate Chi Square Value (27.27, α)	16.36			Adjusted Chi Square Value (27.27, β)	14.27		
1104					95% Gamma Approximate UCL (use when n>=50)	0.0308			95% Gamma Adjusted UCL (use when n<50)	N/A		
1105												
1106	**Estimates of Gamma Parameters using KM Estimates**											
1107					Mean (KM)	0.0212			SD (KM)	0.0127		
1108					Variance (KM)	1.6066E-4			SE of Mean (KM)	0.00582		
1109					k hat (KM)	2.807			k star (KM)	1.837		
1110					nu hat (KM)	44.91			nu star (KM)	29.4		
1111					theta hat (KM)	0.00757			theta star (KM)	0.0116		
1112					80% gamma percentile (KM)	0.0321			90% gamma percentile (KM)	0.0421		
1113					95% gamma percentile (KM)	0.0517			99% gamma percentile (KM)	0.0732		
1114												
1115	**Gamma Kaplan-Meier (KM) Statistics**											
1116					Approximate Chi Square Value (29.40, α)	18.02			Adjusted Chi Square Value (29.40, β)	15.81		
1117	5% Gamma Approximate KM-UCL (use when n>=50)					0.0346			95% Gamma Adjusted KM-UCL (use when n<50)	0.0395		
1118												
1119	**Lognormal GOF Test on Detected Observations Only**											
1120					Shapiro Wilk Test Statistic	0.988			**Shapiro Wilk GOF Test**			
1121					5% Shapiro Wilk Critical Value	0.767			Detected Data appear Lognormal at 5% Significance Level			
1122					Lilliefors Test Statistic	0.216			**Lilliefors GOF Test**			
1123					5% Lilliefors Critical Value	0.425			Detected Data appear Lognormal at 5% Significance Level			
1124	**Detected Data appear Lognormal at 5% Significance Level**											
1125												
1126	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1127					Mean in Original Scale	0.0186			Mean in Log Scale	-4.193		
1128					SD in Original Scale	0.0145			SD in Log Scale	0.654		
1129					95% t UCL (assumes normality of ROS data)	0.0284			95% Percentile Bootstrap UCL	0.0269		
1130					95% BCA Bootstrap UCL	0.0296			95% Bootstrap t UCL	0.0526		
1131					95% H-UCL (Log ROS)	0.0359						
1132												
1133	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1134					KM Mean (logged)	-3.995			KM Geo Mean	0.0184		
1135					KM SD (logged)	0.505			95% Critical H Value (KM-Log)	2.362		
1136					KM Standard Error of Mean (logged)	0.238			95% H-UCL (KM -Log)	0.0328		
1137					KM SD (logged)	0.505			95% Critical H Value (KM-Log)	2.362		
1138					KM Standard Error of Mean (logged)	0.238						
1139												

1140	**DL/2 Statistics**											
1141	**DL/2 Normal**						**DL/2 Log-Transformed**					
1142					Mean in Original Scale	0.0193				Mean in Log Scale	-4.201	
1143					SD in Original Scale	0.0148				SD in Log Scale	0.769	
1144					95% t UCL (Assumes normality)	0.0293				95% H-Stat UCL	0.0466	
1145	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1146												
1147	**Nonparametric Distribution Free UCL Statistics**											
1148	**Detected Data appear Normal Distributed at 5% Significance Level**											
1149												
1150	**Suggested UCL to Use**											
1151					95% KM (t) UCL	0.0323						
1152												
1153	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1154	Recommendations are based upon data size, data distribution, and skewness.											
1155	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1156	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1157												
1158	**Result (deerorgan_thallium)**											
1159												
1160	**General Statistics**											
1161					Total Number of Observations	8				Number of Distinct Observations	8	
1162					Number of Detects	0				Number of Non-Detects	8	
1163					Number of Distinct Detects	0				Number of Distinct Non-Detects	8	
1164												
1165	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1166	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1167	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1168												
1169	**The data set for variable Result (deerorgan_thallium) was not processed!**											
1170												
1171												
1172												
1173	**Result (deerorgan_zinc)**											
1174												
1175	**General Statistics**											
1176					Total Number of Observations	7				Number of Distinct Observations	7	
1177										Number of Missing Observations	0	
1178					Minimum	5.938				Mean	19	
1179					Maximum	33.74				Median	16.39	
1180					SD	9.92				Std. Error of Mean	3.75	
1181					Coefficient of Variation	0.522				Skewness	0.588	
1182												
1183	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1184	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1185	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1186	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1187												
1188	**Normal GOF Test**											
1189					Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**					
1190					5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level					
1191					Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**					
1192					5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level					
1193	**Data appear Normal at 5% Significance Level**											
1194												
1195	**Assuming Normal Distribution**											
1196	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1197					95% Student's-t UCL	26.29				95% Adjusted-CLT UCL (Chen-1995)	26.06	
1198										95% Modified-t UCL (Johnson-1978)	26.43	
1199												
1200	**Gamma GOF Test**											
1201					A-D Test Statistic	0.397	**Anderson-Darling Gamma GOF Test**					
1202					5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Lev					
1203					K-S Test Statistic	0.24	**Kolmogorov-Smirnov Gamma GOF Test**					
1204					5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Lev					
1205	**Detected data appear Gamma Distributed at 5% Significance Level**											
1206												

1207	**Gamma Statistics**											
1208					k hat (MLE)	3.979		k star (bias corrected MLE)	2.369			
1209					Theta hat (MLE)	4.776		Theta star (bias corrected MLE)	8.022			
1210					nu hat (MLE)	55.7		nu star (bias corrected)	33.16			
1211					MLE Mean (bias corrected)	19		MLE Sd (bias corrected)	12.35			
1212								Approximate Chi Square Value (0.05)	21			
1213					Adjusted Level of Significance	0.0158		Adjusted Chi Square Value	18.13			
1214												
1215	**Assuming Gamma Distribution**											
1216	95% Approximate Gamma UCL (use when n>=50))					30.02		95% Adjusted Gamma UCL (use when n<50)	34.76			
1217												
1218	**Lognormal GOF Test**											
1219					Shapiro Wilk Test Statistic	0.911		**Shapiro Wilk Lognormal GOF Test**				
1220					5% Shapiro Wilk Critical Value	0.803		Data appear Lognormal at 5% Significance Level				
1221					Lilliefors Test Statistic	0.206		**Lilliefors Lognormal GOF Test**				
1222					5% Lilliefors Critical Value	0.304		Data appear Lognormal at 5% Significance Level				
1223	**Data appear Lognormal at 5% Significance Level**											
1224												
1225	**Lognormal Statistics**											
1226					Minimum of Logged Data	1.781		Mean of logged Data	2.814			
1227					Maximum of Logged Data	3.519		SD of logged Data	0.58			
1228												
1229	**Assuming Lognormal Distribution**											
1230					95% H-UCL	36.74		90% Chebyshev (MVUE) UCL	31.9			
1231					95% Chebyshev (MVUE) UCL	37.66		97.5% Chebyshev (MVUE) UCL	45.64			
1232					99% Chebyshev (MVUE) UCL	61.32						
1233												
1234	**Nonparametric Distribution Free UCL Statistics**											
1235	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1236												
1237	**Nonparametric Distribution Free UCLs**											
1238					95% CLT UCL	25.17		95% Jackknife UCL	26.29			
1239					95% Standard Bootstrap UCL	24.63		95% Bootstrap-t UCL	31.57			
1240					95% Hall's Bootstrap UCL	107		95% Percentile Bootstrap UCL	25.12			
1241					95% BCA Bootstrap UCL	25.54						
1242					90% Chebyshev(Mean, Sd) UCL	30.25		95% Chebyshev(Mean, Sd) UCL	35.35			
1243					97.5% Chebyshev(Mean, Sd) UCL	42.42		99% Chebyshev(Mean, Sd) UCL	56.31			
1244												
1245	**Suggested UCL to Use**											
1246					95% Student's-t UCL	26.29						
1247												
1248	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1249	Recommendations are based upon data size, data distribution, and skewness.											
1250	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1251	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1252												
1253	**Result (grousemuscle_antimony)**											
1254												
1255	**General Statistics**											
1256					Total Number of Observations	3		Number of Distinct Observations	3			
1257					Number of Detects	0		Number of Non-Detects	3			
1258					Number of Distinct Detects	0		Number of Distinct Non-Detects	3			
1259												
1260	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1261	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1262	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1263												
1264	**The data set for variable Result (grousemuscle_antimony) was not processed!**											
1265												
1266												
1267	**Result (grousemuscle_arsenic)**											
1268												
1269	**General Statistics**											
1270					Total Number of Observations	3		Number of Distinct Observations	3			
1271					Number of Detects	0		Number of Non-Detects	3			
1272					Number of Distinct Detects	0		Number of Distinct Non-Detects	3			
1273												

1274	Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!											
1275	Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!											
1276	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
1277												
1278	The data set for variable Result (grousemuscle_arsenic) was not processed!											
1279												
1280												
1281	Result (grousemuscle_cadmium)											
1282												
1283	General Statistics											
1284						Total Number of Observations	3			Number of Distinct Observations	3	
1285						Number of Detects	1			Number of Non-Detects	2	
1286						Number of Distinct Detects	1			Number of Distinct Non-Detects	2	
1287												
1288	Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!											
1289	gested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, B											
1290												
1291	The data set for variable Result (grousemuscle_cadmium) was not processed!											
1292												
1293												
1294												
1295	Result (grousemuscle_chromium)											
1296												
1297	General Statistics											
1298						Total Number of Observations	3			Number of Distinct Observations	3	
1299										Number of Missing Observations	0	
1300						Minimum	0.811			Mean	0.842	
1301						Maximum	0.871			Median	0.844	
1302						SD	0.0299			Std. Error of Mean	0.0173	
1303						Coefficient of Variation	0.0355			Skewness	-0.259	
1304												
1305	Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use											
1306	guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.											
1307	For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).											
1308	Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1											
1309												
1310	Normal GOF Test											
1311						Shapiro Wilk Test Statistic	0.997			Shapiro Wilk GOF Test		
1312						5% Shapiro Wilk Critical Value	0.767			Data appear Normal at 5% Significance Level		
1313						Lilliefors Test Statistic	0.19			Lilliefors GOF Test		
1314						5% Lilliefors Critical Value	0.425			Data appear Normal at 5% Significance Level		
1315	Data appear Normal at 5% Significance Level											
1316												
1317	Assuming Normal Distribution											
1318						95% Normal UCL				95% UCLs (Adjusted for Skewness)		
1319						95% Student's-t UCL	0.892			95% Adjusted-CLT UCL (Chen-1995)	0.868	
1320										95% Modified-t UCL (Johnson-1978)	0.892	
1321												
1322	Gamma GOF Test											
1323	Not Enough Data to Perform GOF Test											
1324												
1325	Gamma Statistics											
1326						k hat (MLE)	1185			k star (bias corrected MLE)	N/A	
1327						Theta hat (MLE)	7.1025E-4			Theta star (bias corrected MLE)	N/A	
1328						nu hat (MLE)	7113			nu star (bias corrected)	N/A	
1329						MLE Mean (bias corrected)	N/A			MLE Sd (bias corrected)	N/A	
1330										Approximate Chi Square Value (0.05)	N/A	
1331						Adjusted Level of Significance	N/A			Adjusted Chi Square Value	N/A	
1332												
1333	Assuming Gamma Distribution											
1334						95% Approximate Gamma UCL (use when n>=50))	N/A			95% Adjusted Gamma UCL (use when n<50)	N/A	
1335												
1336	Lognormal GOF Test											
1337						Shapiro Wilk Test Statistic	0.996			Shapiro Wilk Lognormal GOF Test		
1338						5% Shapiro Wilk Critical Value	0.767			Data appear Lognormal at 5% Significance Level		
1339						Lilliefors Test Statistic	0.194			Lilliefors Lognormal GOF Test		
1340						5% Lilliefors Critical Value	0.425			Data appear Lognormal at 5% Significance Level		

1341	**Data appear Lognormal at 5% Significance Level**											
1342												
1343	**Lognormal Statistics**											
1344							Minimum of Logged Data	-0.209			Mean of logged Data	-0.172
1345							Maximum of Logged Data	-0.138			SD of logged Data	0.0356
1346												
1347	**Assuming Lognormal Distribution**											
1348							95% H-UCL	N/A			90% Chebyshev (MVUE) UCL	0.894
1349							95% Chebyshev (MVUE) UCL	0.917			97.5% Chebyshev (MVUE) UCL	0.95
1350							99% Chebyshev (MVUE) UCL	1.014				
1351												
1352	**Nonparametric Distribution Free UCL Statistics**											
1353	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1354												
1355	**Nonparametric Distribution Free UCLs**											
1356							95% CLT UCL	0.87			95% Jackknife UCL	0.892
1357							95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A
1358							95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A
1359							95% BCA Bootstrap UCL	N/A				
1360							90% Chebyshev(Mean, Sd) UCL	0.894			95% Chebyshev(Mean, Sd) UCL	0.917
1361							97.5% Chebyshev(Mean, Sd) UCL	0.95			99% Chebyshev(Mean, Sd) UCL	1.014
1362												
1363	**Suggested UCL to Use**											
1364							95% Student's-t UCL	0.892				
1365												
1366	**Recommended UCL exceeds the maximum observation**											
1367												
1368	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1369	Recommendations are based upon data size, data distribution, and skewness.											
1370	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1371	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1372												
1373	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
1374	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
1375												
1376	**Result (grousemuscle_cobalt)**											
1377												
1378	**General Statistics**											
1379							Total Number of Observations	3			Number of Distinct Observations	3
1380							Number of Detects	0			Number of Non-Detects	3
1381							Number of Distinct Detects	0			Number of Distinct Non-Detects	3
1382												
1383	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1384	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1385	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1386												
1387	**The data set for variable Result (grousemuscle_cobalt) was not processed!**											
1388												
1389												
1390	**Result (grousemuscle_iron)**											
1391												
1392	**General Statistics**											
1393							Total Number of Observations	3			Number of Distinct Observations	3
1394							Number of Detects	0			Number of Non-Detects	3
1395							Number of Distinct Detects	0			Number of Distinct Non-Detects	3
1396												
1397	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1398	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1399	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1400												
1401	**The data set for variable Result (grousemuscle_iron) was not processed!**											
1402												
1403												
1404	**Result (grousemuscle_manganese)**											
1405												
1406	**General Statistics**											
1407							Total Number of Observations	3			Number of Distinct Observations	3

1408				Number of Detects	0				Number of Non-Detects	3		
1409				Number of Distinct Detects	0				Number of Distinct Non-Detects	3		
1410												
1411	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1412	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1413	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1414												
1415	**The data set for variable Result (grousemuscle_manganese) was not processed!**											
1416												
1417												
1418	**Result (grousemuscle_mercury)**											
1419												
1420	**General Statistics**											
1421				Total Number of Observations	3				Number of Distinct Observations	3		
1422				Number of Detects	0				Number of Non-Detects	3		
1423				Number of Distinct Detects	0				Number of Distinct Non-Detects	3		
1424												
1425	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1426	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1427	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1428												
1429	**The data set for variable Result (grousemuscle_mercury) was not processed!**											
1430												
1431												
1432	**Result (grousemuscle_thallium)**											
1433												
1434	**General Statistics**											
1435				Total Number of Observations	3				Number of Distinct Observations	3		
1436				Number of Detects	0				Number of Non-Detects	3		
1437				Number of Distinct Detects	0				Number of Distinct Non-Detects	3		
1438												
1439	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1440	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1441	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1442												
1443	**The data set for variable Result (grousemuscle_thallium) was not processed!**											
1444												
1445												
1446												
1447	**Result (grousemuscle_zinc)**											
1448												
1449	**General Statistics**											
1450				Total Number of Observations	3				Number of Distinct Observations	3		
1451									Number of Missing Observations	0		
1452				Minimum	4.824				Mean	4.859		
1453				Maximum	4.895				Median	4.859		
1454				SD	0.0355				Std. Error of Mean	0.0205		
1455				Coefficient of Variation	0.00731				Skewness	0.00845		
1456												
1457	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1458	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1459	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1460	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1461												
1462	**Normal GOF Test**											
1463				Shapiro Wilk Test Statistic	1				**Shapiro Wilk GOF Test**			
1464				5% Shapiro Wilk Critical Value	0.767				Data appear Normal at 5% Significance Level			
1465				Lilliefors Test Statistic	0.175				**Lilliefors GOF Test**			
1466				5% Lilliefors Critical Value	0.425				Data appear Normal at 5% Significance Level			
1467	**Data appear Normal at 5% Significance Level**											
1468												
1469	**Assuming Normal Distribution**											
1470				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
1471				95% Student's-t UCL	4.919				95% Adjusted-CLT UCL (Chen-1995)	4.893		
1472									95% Modified-t UCL (Johnson-1978)	4.919		
1473												
1474	**Gamma GOF Test**											

1475	**Not Enough Data to Perform GOF Test**											
1476												
1477	**Gamma Statistics**											
1478						k hat (MLE)	28107			k star (bias corrected MLE)	N/A	
1479						Theta hat (MLE)	1.7289E-4			Theta star (bias corrected MLE)	N/A	
1480						nu hat (MLE)	168639			nu star (bias corrected)	N/A	
1481						MLE Mean (bias corrected)	N/A			MLE Sd (bias corrected)	N/A	
1482										Approximate Chi Square Value (0.05)	N/A	
1483						Adjusted Level of Significance	N/A			Adjusted Chi Square Value	N/A	
1484												
1485	**Assuming Gamma Distribution**											
1486					95% Approximate Gamma UCL (use when n>=50))		N/A		95% Adjusted Gamma UCL (use when n<50)		N/A	
1487												
1488	**Lognormal GOF Test**											
1489						Shapiro Wilk Test Statistic	1		**Shapiro Wilk Lognormal GOF Test**			
1490						5% Shapiro Wilk Critical Value	0.767		Data appear Lognormal at 5% Significance Level			
1491						Lilliefors Test Statistic	0.175		**Lilliefors Lognormal GOF Test**			
1492						5% Lilliefors Critical Value	0.425		Data appear Lognormal at 5% Significance Level			
1493	**Data appear Lognormal at 5% Significance Level**											
1494												
1495	**Lognormal Statistics**											
1496						Minimum of Logged Data	1.574			Mean of logged Data	1.581	
1497						Maximum of Logged Data	1.588			SD of logged Data	0.00731	
1498												
1499	**Assuming Lognormal Distribution**											
1500						95% H-UCL	N/A			90% Chebyshev (MVUE) UCL	4.921	
1501						95% Chebyshev (MVUE) UCL	4.949			97.5% Chebyshev (MVUE) UCL	4.987	
1502						99% Chebyshev (MVUE) UCL	5.063					
1503												
1504	**Nonparametric Distribution Free UCL Statistics**											
1505	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1506												
1507	**Nonparametric Distribution Free UCLs**											
1508						95% CLT UCL	4.893			95% Jackknife UCL	4.919	
1509						95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A	
1510						95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A	
1511						95% BCA Bootstrap UCL	N/A					
1512						90% Chebyshev(Mean, Sd) UCL	4.921			95% Chebyshev(Mean, Sd) UCL	4.949	
1513						97.5% Chebyshev(Mean, Sd) UCL	4.987			99% Chebyshev(Mean, Sd) UCL	5.063	
1514												
1515	**Suggested UCL to Use**											
1516						95% Student's-t UCL	4.919					
1517												
1518	**Recommended UCL exceeds the maximum observation**											
1519												
1520	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1521	Recommendations are based upon data size, data distribution, and skewness.											
1522	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1523	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1524												
1525	**Result (grouseorgan_antimony)**											
1526												
1527	**General Statistics**											
1528						Total Number of Observations	9			Number of Distinct Observations	9	
1529						Number of Detects	0			Number of Non-Detects	9	
1530						Number of Distinct Detects	0			Number of Distinct Non-Detects	9	
1531												
1532	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1533	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1534	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1535												
1536	**The data set for variable Result (grouseorgan_antimony) was not processed!**											
1537												
1538												
1539	**Result (grouseorgan_arsenic)**											
1540												
1541	**General Statistics**											

1542				Total Number of Observations	9				Number of Distinct Observations	9		
1543				Number of Detects	0				Number of Non-Detects	9		
1544				Number of Distinct Detects	0				Number of Distinct Non-Detects	9		
1545												
1546	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
1547	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
1548	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
1549												
1550	**The data set for variable Result (grouseorgan_arsenic) was not processed!**											
1551												
1552												
1553	**Result (grouseorgan_cadmium)**											
1554												
1555	**General Statistics**											
1556				Total Number of Observations	9				Number of Distinct Observations	9		
1557				Number of Detects	8				Number of Non-Detects	1		
1558				Number of Distinct Detects	8				Number of Distinct Non-Detects	1		
1559				Minimum Detect	0.0215				Minimum Non-Detect	0.0102		
1560				Maximum Detect	5.29				Maximum Non-Detect	0.0102		
1561				Variance Detects	4.325				Percent Non-Detects	11.11%		
1562				Mean Detects	1.62				SD Detects	2.08		
1563				Median Detects	0.823				CV Detects	1.284		
1564				Skewness Detects	1.334				Kurtosis Detects	0.0632		
1565				Mean of Logged Detects	-0.728				SD of Logged Detects	2.114		
1566												
1567	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1568	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1569	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1570	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1571												
1572	**Normal GOF Test on Detects Only**											
1573				Shapiro Wilk Test Statistic	0.746	**Shapiro Wilk GOF Test**						
1574				5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level						
1575				Lilliefors Test Statistic	0.352	**Lilliefors GOF Test**						
1576				5% Lilliefors Critical Value	0.283	Detected Data Not Normal at 5% Significance Level						
1577	**Detected Data Not Normal at 5% Significance Level**											
1578												
1579	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1580				KM Mean	1.441				KM Standard Error of Mean	0.678		
1581				KM SD	1.903				95% KM (BCA) UCL	2.504		
1582				95% KM (t) UCL	2.702				95% KM (Percentile Bootstrap) UCL	2.528		
1583				95% KM (z) UCL	2.556				95% KM Bootstrap t UCL	5.832		
1584				90% KM Chebyshev UCL	3.475				95% KM Chebyshev UCL	4.396		
1585				97.5% KM Chebyshev UCL	5.675				99% KM Chebyshev UCL	8.187		
1586												
1587	**Gamma GOF Tests on Detected Observations Only**											
1588				A-D Test Statistic	0.361	**Anderson-Darling GOF Test**						
1589				5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Lev						
1590				K-S Test Statistic	0.17	**Kolmogorov-Smirnov GOF**						
1591				5% K-S Critical Value	0.309	Detected data appear Gamma Distributed at 5% Significance Lev						
1592	**Detected data appear Gamma Distributed at 5% Significance Level**											
1593												
1594	**Gamma Statistics on Detected Data Only**											
1595				k hat (MLE)	0.521				k star (bias corrected MLE)	0.409		
1596				Theta hat (MLE)	3.107				Theta star (bias corrected MLE)	3.958		
1597				nu hat (MLE)	8.343				nu star (bias corrected)	6.548		
1598				Mean (detects)	1.62							
1599												
1600	**Gamma ROS Statistics using Imputed Non-Detects**											
1601	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1602	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)											
1603	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1604	This is especially true when the sample size is small.											
1605	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1606				Minimum	0.01				Mean	1.441		
1607				Maximum	5.29				Median	0.76		
1608				SD	2.018				CV	1.4		

1609					k hat (MLE)	0.427				k star (bias corrected MLE)		0.359
1610					Theta hat (MLE)	3.373				Theta star (bias corrected MLE)		4.015
1611					nu hat (MLE)	7.69				nu star (bias corrected)		6.46
1612					Adjusted Level of Significance (β)	0.0231						
1613					Approximate Chi Square Value (6.46, α)	1.879				Adjusted Chi Square Value (6.46, β)		1.405
1614					95% Gamma Approximate UCL (use when n>=50)	4.953				95% Gamma Adjusted UCL (use when n<50)		6.625
1615												
1616					**Estimates of Gamma Parameters using KM Estimates**							
1617					Mean (KM)	1.441				SD (KM)		1.903
1618					Variance (KM)	3.62				SE of Mean (KM)		0.678
1619					k hat (KM)	0.574				k star (KM)		0.457
1620					nu hat (KM)	10.33				nu star (KM)		8.218
1621					theta hat (KM)	2.512				theta star (KM)		3.156
1622					80% gamma percentile (KM)	2.354				90% gamma percentile (KM)		3.971
1623					95% gamma percentile (KM)	5.717				99% gamma percentile (KM)		10.05
1624												
1625					**Gamma Kaplan-Meier (KM) Statistics**							
1626					Approximate Chi Square Value (8.22, α)	2.862				Adjusted Chi Square Value (8.22, β)		2.239
1627				5% Gamma Approximate KM-UCL (use when n>=50)		4.138				95% Gamma Adjusted KM-UCL (use when n<50)		5.29
1628												
1629					**Lognormal GOF Test on Detected Observations Only**							
1630					Shapiro Wilk Test Statistic	0.871				**Shapiro Wilk GOF Test**		
1631					5% Shapiro Wilk Critical Value	0.818				Detected Data appear Lognormal at 5% Significance Level		
1632					Lilliefors Test Statistic	0.21				**Lilliefors GOF Test**		
1633					5% Lilliefors Critical Value	0.283				Detected Data appear Lognormal at 5% Significance Level		
1634					**Detected Data appear Lognormal at 5% Significance Level**							
1635												
1636					**Lognormal ROS Statistics Using Imputed Non-Detects**							
1637					Mean in Original Scale	1.44				Mean in Log Scale		-1.282
1638					SD in Original Scale	2.019				SD in Log Scale		2.584
1639					95% t UCL (assumes normality of ROS data)	2.691				95% Percentile Bootstrap UCL		2.532
1640					95% BCA Bootstrap UCL	2.848				95% Bootstrap t UCL		6.071
1641					95% H-UCL (Log ROS)	5841						
1642												
1643					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1644					KM Mean (logged)	-1.156				KM Geo Mean		0.315
1645					KM SD (logged)	2.224				95% Critical H Value (KM-Log)		6.293
1646					KM Standard Error of Mean (logged)	0.792				95% H-UCL (KM -Log)		524.9
1647					KM SD (logged)	2.224				95% Critical H Value (KM-Log)		6.293
1648					KM Standard Error of Mean (logged)	0.792						
1649												
1650					**DL/2 Statistics**							
1651					**DL/2 Normal**					**DL/2 Log-Transformed**		
1652					Mean in Original Scale	1.44				Mean in Log Scale		-1.233
1653					SD in Original Scale	2.018				SD in Log Scale		2.492
1654					95% t UCL (Assumes normality)	2.692				95% H-Stat UCL		3099
1655					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1656												
1657					**Nonparametric Distribution Free UCL Statistics**							
1658					**Detected Data appear Gamma Distributed at 5% Significance Level**							
1659												
1660					**Suggested UCL to Use**							
1661					95% KM Bootstrap t UCL	5.832				d KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)		5.29
1662												
1663	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1664	Recommendations are based upon data size, data distribution, and skewness.											
1665	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1666	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1667												
1668												
1669	**Result (grouseorgan_chromium)**											
1670												
1671					**General Statistics**							
1672					Total Number of Observations	9				Number of Distinct Observations		9
1673										Number of Missing Observations		0
1674					Minimum	0.625				Mean		0.691
1675					Maximum	0.778				Median		0.668

1676					SD	0.0593				Std. Error of Mean		0.0198
1677					Coefficient of Variation	0.0858				Skewness		0.563
1678												
1679					**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
1680					**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
1681					**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
1682					**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
1683												
1684					**Normal GOF Test**							
1685					Shapiro Wilk Test Statistic	0.86	**Shapiro Wilk GOF Test**					
1686					5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level					
1687					Lilliefors Test Statistic	0.212	**Lilliefors GOF Test**					
1688					5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level					
1689					**Data appear Normal at 5% Significance Level**							
1690												
1691					**Assuming Normal Distribution**							
1692					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
1693					95% Student's-t UCL	0.728	95% Adjusted-CLT UCL (Chen-1995)					0.728
1694							95% Modified-t UCL (Johnson-1978)					0.729
1695												
1696					**Gamma GOF Test**							
1697					A-D Test Statistic	0.623	**Anderson-Darling Gamma GOF Test**					
1698					5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Lev					
1699					K-S Test Statistic	0.218	**Kolmogorov-Smirnov Gamma GOF Test**					
1700					5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Lev					
1701					**Detected data appear Gamma Distributed at 5% Significance Level**							
1702												
1703					**Gamma Statistics**							
1704					k hat (MLE)	156.3	k star (bias corrected MLE)					104.3
1705					Theta hat (MLE)	0.00442	Theta star (bias corrected MLE)					0.00663
1706					nu hat (MLE)	2813	nu star (bias corrected)					1877
1707					MLE Mean (bias corrected)	0.691	MLE Sd (bias corrected)					0.0677
1708							Approximate Chi Square Value (0.05)					1777
1709					Adjusted Level of Significance	0.0231	Adjusted Chi Square Value					1756
1710												
1711					**Assuming Gamma Distribution**							
1712					95% Approximate Gamma UCL (use when n>=50))	0.73	95% Adjusted Gamma UCL (use when n<50)					0.739
1713												
1714					**Lognormal GOF Test**							
1715					Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk Lognormal GOF Test**					
1716					5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level					
1717					Lilliefors Test Statistic	0.204	**Lilliefors Lognormal GOF Test**					
1718					5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level					
1719					**Data appear Lognormal at 5% Significance Level**							
1720												
1721					**Lognormal Statistics**							
1722					Minimum of Logged Data	-0.47	Mean of logged Data					-0.372
1723					Maximum of Logged Data	-0.252	SD of logged Data					0.0845
1724												
1725					**Assuming Lognormal Distribution**							
1726					95% H-UCL	N/A	90% Chebyshev (MVUE) UCL					0.75
1727					95% Chebyshev (MVUE) UCL	0.776	97.5% Chebyshev (MVUE) UCL					0.813
1728					99% Chebyshev (MVUE) UCL	0.885						
1729												
1730					**Nonparametric Distribution Free UCL Statistics**							
1731					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1732												
1733					**Nonparametric Distribution Free UCLs**							
1734					95% CLT UCL	0.724	95% Jackknife UCL					0.728
1735					95% Standard Bootstrap UCL	0.722	95% Bootstrap-t UCL					0.734
1736					95% Hall's Bootstrap UCL	0.717	95% Percentile Bootstrap UCL					0.723
1737					95% BCA Bootstrap UCL	0.727						
1738					90% Chebyshev(Mean, Sd) UCL	0.751	95% Chebyshev(Mean, Sd) UCL					0.778
1739					97.5% Chebyshev(Mean, Sd) UCL	0.815	99% Chebyshev(Mean, Sd) UCL					0.888
1740												
1741					**Suggested UCL to Use**							
1742					95% Student's-t UCL	0.728						

	A	B	C	D	E	F	G	H	I	J	K	L
1743												
1744	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1745	Recommendations are based upon data size, data distribution, and skewness.											
1746	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1747	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1748												
1749												
1750	**Result (grouseorgan_cobalt)**											
1751												
1752	**General Statistics**											
1753	Total Number of Observations					9	Number of Distinct Observations					9
1754							Number of Missing Observations					0
1755	Minimum					0.0149	Mean					0.0282
1756	Maximum					0.0671	Median					0.0194
1757	SD					0.0174	Std. Error of Mean					0.00579
1758	Coefficient of Variation					0.617	Skewness					1.637
1759												
1760	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1761	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1762	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1763	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1764												
1765	**Normal GOF Test**											
1766	Shapiro Wilk Test Statistic					0.792	**Shapiro Wilk GOF Test**					
1767	5% Shapiro Wilk Critical Value					0.829	Data Not Normal at 5% Significance Level					
1768	Lilliefors Test Statistic					0.249	**Lilliefors GOF Test**					
1769	5% Lilliefors Critical Value					0.274	Data appear Normal at 5% Significance Level					
1770	**Data appear Approximate Normal at 5% Significance Level**											
1771												
1772	**Assuming Normal Distribution**											
1773	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1774	95% Student's-t UCL					0.039	95% Adjusted-CLT UCL (Chen-1995)					0.0411
1775							95% Modified-t UCL (Johnson-1978)					0.0395
1776												
1777	**Gamma GOF Test**											
1778	A-D Test Statistic					0.601	**Anderson-Darling Gamma GOF Test**					
1779	5% A-D Critical Value					0.725	Detected data appear Gamma Distributed at 5% Significance Lev					
1780	K-S Test Statistic					0.251	**Kolmogorov-Smirnov Gamma GOF Test**					
1781	5% K-S Critical Value					0.281	Detected data appear Gamma Distributed at 5% Significance Lev					
1782	**Detected data appear Gamma Distributed at 5% Significance Level**											
1783												
1784	**Gamma Statistics**											
1785	k hat (MLE)					3.811	k star (bias corrected MLE)					2.615
1786	Theta hat (MLE)					0.00739	Theta star (bias corrected MLE)					0.0108
1787	nu hat (MLE)					68.6	nu star (bias corrected)					47.07
1788	MLE Mean (bias corrected)					0.0282	MLE Sd (bias corrected)					0.0174
1789							Approximate Chi Square Value (0.05)					32.32
1790	Adjusted Level of Significance					0.0231	Adjusted Chi Square Value					29.77
1791												
1792	**Assuming Gamma Distribution**											
1793	95% Approximate Gamma UCL (use when n>=50))					0.041	95% Adjusted Gamma UCL (use when n<50)					0.0446
1794												
1795	**Lognormal GOF Test**											
1796	Shapiro Wilk Test Statistic					0.875	**Shapiro Wilk Lognormal GOF Test**					
1797	5% Shapiro Wilk Critical Value					0.829	Data appear Lognormal at 5% Significance Level					
1798	Lilliefors Test Statistic					0.229	**Lilliefors Lognormal GOF Test**					
1799	5% Lilliefors Critical Value					0.274	Data appear Lognormal at 5% Significance Level					
1800	**Data appear Lognormal at 5% Significance Level**											
1801												
1802	**Lognormal Statistics**											
1803	Minimum of Logged Data					-4.203	Mean of logged Data					-3.706
1804	Maximum of Logged Data					-2.702	SD of logged Data					0.528
1805												
1806	**Assuming Lognormal Distribution**											
1807	95% H-UCL					0.0432	90% Chebyshev (MVUE) UCL					0.0427
1808	95% Chebyshev (MVUE) UCL					0.0494	97.5% Chebyshev (MVUE) UCL					0.0588
1809	99% Chebyshev (MVUE) UCL					0.0772						

1810												
1811	**Nonparametric Distribution Free UCL Statistics**											
1812	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1813												
1814	**Nonparametric Distribution Free UCLs**											
1815						95% CLT UCL	0.0377				95% Jackknife UCL	0.039
1816						95% Standard Bootstrap UCL	0.037				95% Bootstrap-t UCL	0.0478
1817						95% Hall's Bootstrap UCL	0.0449				95% Percentile Bootstrap UCL	0.0378
1818						95% BCA Bootstrap UCL	0.0414					
1819						90% Chebyshev(Mean, Sd) UCL	0.0456				95% Chebyshev(Mean, Sd) UCL	0.0534
1820						97.5% Chebyshev(Mean, Sd) UCL	0.0643				99% Chebyshev(Mean, Sd) UCL	0.0858
1821												
1822	**Suggested UCL to Use**											
1823						95% Student's-t UCL	0.039					
1824												
1825	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1826	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1827												
1828	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1829	Recommendations are based upon data size, data distribution, and skewness.											
1830	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1831	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1832												
1833												
1834	**Result (grouseorgan_iron)**											
1835												
1836	**General Statistics**											
1837						Total Number of Observations	9				Number of Distinct Observations	9
1838											Number of Missing Observations	0
1839						Minimum	45.65				Mean	148.9
1840						Maximum	376.5				Median	58.21
1841						SD	137.9				Std. Error of Mean	45.97
1842						Coefficient of Variation	0.926				Skewness	0.917
1843												
1844	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1845	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1846	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1847	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1848												
1849	**Normal GOF Test**											
1850						Shapiro Wilk Test Statistic	0.731				**Shapiro Wilk GOF Test**	
1851						5% Shapiro Wilk Critical Value	0.829				Data Not Normal at 5% Significance Level	
1852						Lilliefors Test Statistic	0.335				**Lilliefors GOF Test**	
1853						5% Lilliefors Critical Value	0.274				Data Not Normal at 5% Significance Level	
1854	**Data Not Normal at 5% Significance Level**											
1855												
1856	**Assuming Normal Distribution**											
1857	**95% Normal UCL**										**95% UCLs (Adjusted for Skewness)**	
1858						95% Student's-t UCL	234.4				95% Adjusted-CLT UCL (Chen-1995)	239.5
1859											95% Modified-t UCL (Johnson-1978)	236.7
1860												
1861	**Gamma GOF Test**											
1862						A-D Test Statistic	1.103				**Anderson-Darling Gamma GOF Test**	
1863						5% A-D Critical Value	0.735				Data Not Gamma Distributed at 5% Significance Level	
1864						K-S Test Statistic	0.311				**Kolmogorov-Smirnov Gamma GOF Test**	
1865						5% K-S Critical Value	0.284				Data Not Gamma Distributed at 5% Significance Level	
1866	**Data Not Gamma Distributed at 5% Significance Level**											
1867												
1868	**Gamma Statistics**											
1869						k hat (MLE)	1.467				k star (bias corrected MLE)	1.052
1870						Theta hat (MLE)	101.5				Theta star (bias corrected MLE)	141.5
1871						nu hat (MLE)	26.4				nu star (bias corrected)	18.94
1872						MLE Mean (bias corrected)	148.9				MLE Sd (bias corrected)	145.2
1873											Approximate Chi Square Value (0.05)	10.07
1874						Adjusted Level of Significance	0.0231				Adjusted Chi Square Value	8.74
1875												
1876	**Assuming Gamma Distribution**											

1877	95% Approximate Gamma UCL (use when n>=50))					280	95% Adjusted Gamma UCL (use when n<50)					322.6
1878												
1879	**Lognormal GOF Test**											
1880	Shapiro Wilk Test Statistic					0.779	**Shapiro Wilk Lognormal GOF Test**					
1881	5% Shapiro Wilk Critical Value					0.829	Data Not Lognormal at 5% Significance Level					
1882	Lilliefors Test Statistic					0.289	**Lilliefors Lognormal GOF Test**					
1883	5% Lilliefors Critical Value					0.274	Data Not Lognormal at 5% Significance Level					
1884	**Data Not Lognormal at 5% Significance Level**											
1885												
1886	**Lognormal Statistics**											
1887	Minimum of Logged Data					3.821	Mean of logged Data					4.625
1888	Maximum of Logged Data					5.931	SD of logged Data					0.899
1889												
1890	**Assuming Lognormal Distribution**											
1891	95% H-UCL					399	90% Chebyshev (MVUE) UCL					278.4
1892	95% Chebyshev (MVUE) UCL					339.2	97.5% Chebyshev (MVUE) UCL					423.5
1893	99% Chebyshev (MVUE) UCL					589						
1894												
1895	**Nonparametric Distribution Free UCL Statistics**											
1896	**Data do not follow a Discernible Distribution (0.05)**											
1897												
1898	**Nonparametric Distribution Free UCLs**											
1899	95% CLT UCL					224.5	95% Jackknife UCL					234.4
1900	95% Standard Bootstrap UCL					219.4	95% Bootstrap-t UCL					259
1901	95% Hall's Bootstrap UCL					196.3	95% Percentile Bootstrap UCL					223.7
1902	95% BCA Bootstrap UCL					229						
1903	90% Chebyshev(Mean, Sd) UCL					286.8	95% Chebyshev(Mean, Sd) UCL					349.3
1904	97.5% Chebyshev(Mean, Sd) UCL					435.9	99% Chebyshev(Mean, Sd) UCL					606.2
1905												
1906	**Suggested UCL to Use**											
1907	95% Chebyshev (Mean, Sd) UCL					349.3						
1908												
1909	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1910	Recommendations are based upon data size, data distribution, and skewness.											
1911	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1912	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1913												
1914	**Result (grouseorgan_manganese)**											
1915												
1916	**General Statistics**											
1917	Total Number of Observations					9	Number of Distinct Observations					9
1918							Number of Missing Observations					0
1919	Minimum					0.439	Mean					3.75
1920	Maximum					11.97	Median					3.119
1921	SD					3.838	Std. Error of Mean					1.279
1922	Coefficient of Variation					1.024	Skewness					1.475
1923												
1924	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1925	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1926	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1927	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1928												
1929	**Normal GOF Test**											
1930	Shapiro Wilk Test Statistic					0.829	**Shapiro Wilk GOF Test**					
1931	5% Shapiro Wilk Critical Value					0.829	Data appear Normal at 5% Significance Level					
1932	Lilliefors Test Statistic					0.271	**Lilliefors GOF Test**					
1933	5% Lilliefors Critical Value					0.274	Data appear Normal at 5% Significance Level					
1934	**Data appear Normal at 5% Significance Level**											
1935												
1936	**Assuming Normal Distribution**											
1937	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1938	95% Student's-t UCL					6.129	95% Adjusted-CLT UCL (Chen-1995)					6.527
1939							95% Modified-t UCL (Johnson-1978)					6.234
1940												
1941	**Gamma GOF Test**											
1942	A-D Test Statistic					0.26	**Anderson-Darling Gamma GOF Test**					
1943	5% A-D Critical Value					0.742	Detected data appear Gamma Distributed at 5% Significance Lev					

1944				K-S Test Statistic	0.146	**Kolmogorov-Smirnov Gamma GOF Test**						
1945				5% K-S Critical Value	0.286	Detected data appear Gamma Distributed at 5% Significance Lev						
1946	**Detected data appear Gamma Distributed at 5% Significance Level**											
1947												
1948	**Gamma Statistics**											
1949				k hat (MLE)	1.094	k star (bias corrected MLE)	0.803					
1950				Theta hat (MLE)	3.429	Theta star (bias corrected MLE)	4.669					
1951				nu hat (MLE)	19.68	nu star (bias corrected)	14.46					
1952				MLE Mean (bias corrected)	3.75	MLE Sd (bias corrected)	4.184					
1953						Approximate Chi Square Value (0.05)	6.885					
1954				Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	5.819					
1955												
1956	**Assuming Gamma Distribution**											
1957	95% Approximate Gamma UCL (use when n>=50))				7.874	95% Adjusted Gamma UCL (use when n<50)	9.316					
1958												
1959	**Lognormal GOF Test**											
1960				Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**						
1961				5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level						
1962				Lilliefors Test Statistic	0.17	**Lilliefors Lognormal GOF Test**						
1963				5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level						
1964	**Data appear Lognormal at 5% Significance Level**											
1965												
1966	**Lognormal Statistics**											
1967				Minimum of Logged Data	-0.823	Mean of logged Data	0.799					
1968				Maximum of Logged Data	2.483	SD of logged Data	1.159					
1969												
1970	**Assuming Lognormal Distribution**											
1971				95% H-UCL	19.06	90% Chebyshev (MVUE) UCL	8.627					
1972				95% Chebyshev (MVUE) UCL	10.76	97.5% Chebyshev (MVUE) UCL	13.72					
1973				99% Chebyshev (MVUE) UCL	19.54							
1974												
1975	**Nonparametric Distribution Free UCL Statistics**											
1976	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1977												
1978	**Nonparametric Distribution Free UCLs**											
1979				95% CLT UCL	5.855	95% Jackknife UCL	6.129					
1980				95% Standard Bootstrap UCL	5.723	95% Bootstrap-t UCL	8.627					
1981				95% Hall's Bootstrap UCL	18.5	95% Percentile Bootstrap UCL	5.895					
1982				95% BCA Bootstrap UCL	6.41							
1983				90% Chebyshev(Mean, Sd) UCL	7.588	95% Chebyshev(Mean, Sd) UCL	9.327					
1984				97.5% Chebyshev(Mean, Sd) UCL	11.74	99% Chebyshev(Mean, Sd) UCL	16.48					
1985												
1986	**Suggested UCL to Use**											
1987				95% Student's-t UCL	6.129							
1988												
1989	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1990	Recommendations are based upon data size, data distribution, and skewness.											
1991	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1992	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1993												
1994	**Result (grouseorgan_mercury)**											
1995												
1996	**General Statistics**											
1997				Total Number of Observations	9	Number of Distinct Observations	9					
1998				Number of Detects	1	Number of Non-Detects	8					
1999				Number of Distinct Detects	1	Number of Distinct Non-Detects	8					
2000												
2001	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
2002	**gested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, B**											
2003												
2004	**The data set for variable Result (grouseorgan_mercury) was not processed!**											
2005												
2006												
2007	**Result (grouseorgan_thallium)**											
2008												
2009	**General Statistics**											
2010				Total Number of Observations	9	Number of Distinct Observations	9					

2011					Number of Detects	0					Number of Non-Detects	9
2012					Number of Distinct Detects	0					Number of Distinct Non-Detects	9
2013												
2014	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
2015	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
2016	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
2017												
2018	**The data set for variable Result (grouseorgan_thallium) was not processed!**											
2019												
2020												
2021												
2022	**Result (grouseorgan_zinc)**											
2023												
2024	**General Statistics**											
2025					Total Number of Observations	9					Number of Distinct Observations	9
2026											Number of Missing Observations	0
2027					Minimum	22.85					Mean	26.68
2028					Maximum	33.41					Median	25.57
2029					SD	3.943					Std. Error of Mean	1.314
2030					Coefficient of Variation	0.148					Skewness	0.709
2031												
2032	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2033	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2034	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2035	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2036												
2037	**Normal GOF Test**											
2038					Shapiro Wilk Test Statistic	0.868	**Shapiro Wilk GOF Test**					
2039					5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level					
2040					Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**					
2041					5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level					
2042	**Data appear Normal at 5% Significance Level**											
2043												
2044	**Assuming Normal Distribution**											
2045	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
2046					95% Student's-t UCL	29.13					95% Adjusted-CLT UCL (Chen-1995)	29.17
2047											95% Modified-t UCL (Johnson-1978)	29.18
2048												
2049	**Gamma GOF Test**											
2050					A-D Test Statistic	0.566	**Anderson-Darling Gamma GOF Test**					
2051					5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Lev					
2052					K-S Test Statistic	0.25	**Kolmogorov-Smirnov Gamma GOF Test**					
2053					5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Lev					
2054	**Detected data appear Gamma Distributed at 5% Significance Level**											
2055												
2056	**Gamma Statistics**											
2057					k hat (MLE)	53.74					k star (bias corrected MLE)	35.9
2058					Theta hat (MLE)	0.497					Theta star (bias corrected MLE)	0.743
2059					nu hat (MLE)	967.2					nu star (bias corrected)	646.2
2060					MLE Mean (bias corrected)	26.68					MLE Sd (bias corrected)	4.453
2061											Approximate Chi Square Value (0.05)	588.2
2062					Adjusted Level of Significance	0.0231					Adjusted Chi Square Value	576.5
2063												
2064	**Assuming Gamma Distribution**											
2065	95% Approximate Gamma UCL (use when n>=50))					29.31					95% Adjusted Gamma UCL (use when n<50)	29.91
2066												
2067	**Lognormal GOF Test**											
2068					Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk Lognormal GOF Test**					
2069					5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level					
2070					Lilliefors Test Statistic	0.237	**Lilliefors Lognormal GOF Test**					
2071					5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level					
2072	**Data appear Lognormal at 5% Significance Level**											
2073												
2074	**Lognormal Statistics**											
2075					Minimum of Logged Data	3.129					Mean of logged Data	3.275
2076					Maximum of Logged Data	3.509					SD of logged Data	0.143
2077												

	A	B	C	D	E	F	G	H	I	J	K	L
2078	**Assuming Lognormal Distribution**											
2079					95% H-UCL	29.35			90% Chebyshev (MVUE) UCL			30.51
2080					95% Chebyshev (MVUE) UCL	32.25			97.5% Chebyshev (MVUE) UCL			34.65
2081					99% Chebyshev (MVUE) UCL	39.39						
2082												
2083	**Nonparametric Distribution Free UCL Statistics**											
2084	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2085												
2086	**Nonparametric Distribution Free UCLs**											
2087					95% CLT UCL	28.84			95% Jackknife UCL			29.13
2088					95% Standard Bootstrap UCL	28.74			95% Bootstrap-t UCL			29.69
2089					95% Hall's Bootstrap UCL	28.7			95% Percentile Bootstrap UCL			28.86
2090					95% BCA Bootstrap UCL	29.1						
2091					90% Chebyshev(Mean, Sd) UCL	30.62			95% Chebyshev(Mean, Sd) UCL			32.41
2092					97.5% Chebyshev(Mean, Sd) UCL	34.89			99% Chebyshev(Mean, Sd) UCL			39.76
2093												
2094	**Suggested UCL to Use**											
2095					95% Student's-t UCL	29.13						
2096												
2097	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2098	Recommendations are based upon data size, data distribution, and skewness.											
2099	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2100	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2101												

UCL Statistics for Data Sets with Non-Detects		
User Selected Options		
Date/Time of Computation	ProUCL 5.12/11/2019 10:35:43 AM	
From File	BPMD_HHRA_HikerHunter_SoilInput_v3.xls	
Full Precision	OFF	
Confidence Coefficient	95%	
mber of Bootstrap Operations	2000	
Result (eu1_antimony_overbank)		
General Statistics		
Total Number of Observations	29	Number of Distinct Observations 27
Number of Detects	18	Number of Non-Detects 11
Number of Distinct Detects	16	Number of Distinct Non-Detects 11
Minimum Detect	0.67	Minimum Non-Detect 0.032
Maximum Detect	12	Maximum Non-Detect 0.071
Variance Detects	8.251	Percent Non-Detects 37.93%
Mean Detects	4.737	SD Detects 2.872
Median Detects	4.15	CV Detects 0.606
Skewness Detects	1.032	Kurtosis Detects 1.238
Mean of Logged Detects	1.358	SD of Logged Detects 0.699
Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	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	2.952	KM Standard Error of Mean 0.606
KM SD	3.17	95% KM (BCA) UCL 3.927
95% KM (t) UCL	3.983	95% KM (Percentile Bootstrap) UCL 3.97
95% KM (z) UCL	3.949	95% KM Bootstrap t UCL 4.117
90% KM Chebyshev UCL	4.77	95% KM Chebyshev UCL 5.593
97.5% KM Chebyshev UCL	6.735	99% KM Chebyshev UCL 8.979
Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.199	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Lev
K-S Test Statistic	0.108	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Lev
Detected data appear Gamma Distributed at 5% Significance Level		
Gamma Statistics on Detected Data Only		
k hat (MLE)	2.692	k star (bias corrected MLE) 2.28
Theta hat (MLE)	1.76	Theta star (bias corrected MLE) 2.077
nu hat (MLE)	96.91	nu star (bias corrected) 82.09
Mean (detects)	4.737	
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 2.944
Maximum	12	Median 1.9
SD	3.234	CV 1.098
k hat (MLE)	0.341	k star (bias corrected MLE) 0.328
Theta hat (MLE)	8.646	Theta star (bias corrected MLE) 8.968
nu hat (MLE)	19.75	nu star (bias corrected) 19.04
Adjusted Level of Significance (β)	0.0407	
Approximate Chi Square Value (19.04, α)	10.15	Adjusted Chi Square Value (19.04, β) 9.76
95% Gamma Approximate UCL (use when n>=50)	5.525	95% Gamma Adjusted UCL (use when n<50) 5.744

68	**Estimates of Gamma Parameters using KM Estimates**											
69						Mean (KM)	2.952				SD (KM)	3.17
70						Variance (KM)	10.05				SE of Mean (KM)	0.606
71						k hat (KM)	0.867				k star (KM)	0.801
72						nu hat (KM)	50.31				nu star (KM)	46.44
73						theta hat (KM)	3.404				theta star (KM)	3.687
74						80% gamma percentile (KM)	4.825				90% gamma percentile (KM)	7.178
75						95% gamma percentile (KM)	9.575				99% gamma percentile (KM)	15.23
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78						Approximate Chi Square Value (46.44, α)	31.8				Adjusted Chi Square Value (46.44, β)	31.08
79						5% Gamma Approximate KM-UCL (use when n>=50)	4.311				95% Gamma Adjusted KM-UCL (use when n<50)	4.412
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82						Shapiro Wilk Test Statistic	0.951				**Shapiro Wilk GOF Test**	
83						5% Shapiro Wilk Critical Value	0.897				Detected Data appear Lognormal at 5% Significance Level	
84						Lilliefors Test Statistic	0.151				**Lilliefors GOF Test**	
85						5% Lilliefors Critical Value	0.202				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	3.241				Mean in Log Scale	0.755
90						SD in Original Scale	2.967				SD in Log Scale	0.956
91						95% t UCL (assumes normality of ROS data)	4.178				95% Percentile Bootstrap UCL	4.135
92						95% BCA Bootstrap UCL	4.251				95% Bootstrap t UCL	4.343
93						95% H-UCL (Log ROS)	5.197					
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96						KM Mean (logged)	-0.462				KM Geo Mean	0.63
97						KM SD (logged)	2.39				95% Critical H Value (KM-Log)	4.535
98						KM Standard Error of Mean (logged)	0.457				95% H-UCL (KM -Log)	84.91
99						KM SD (logged)	2.39				95% Critical H Value (KM-Log)	4.535
100						KM Standard Error of Mean (logged)	0.457					
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**										**DL/2 Log-Transformed**	
104						Mean in Original Scale	2.949				Mean in Log Scale	-0.59
105						SD in Original Scale	3.229				SD in Log Scale	2.599
106						95% t UCL (Assumes normality)	3.969				95% H-Stat UCL	178.1
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 Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113						95% KM (t) UCL	3.983					
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 statisticia											
119												
120												
121	**Result (eu1_antimony_waste rock)**											
122												
123	**General Statistics**											
124						Total Number of Observations	29				Number of Distinct Observations	28
125											Number of Missing Observations	0
126						Minimum	0.57				Mean	74.49
127						Maximum	332				Median	27.5
128						SD	91.41				Std. Error of Mean	16.97
129						Coefficient of Variation	1.227				Skewness	1.615
130												
131	**Normal GOF Test**											
132						Shapiro Wilk Test Statistic	0.758				**Shapiro Wilk GOF Test**	
133						5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level	
134						Lilliefors Test Statistic	0.214				**Lilliefors GOF Test**	

135				5% Lilliefors Critical Value		0.161	Data Not Normal at 5% Significance Level					
136	**Data Not Normal at 5% Significance Level**											
137												
138	**Assuming Normal Distribution**											
139	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
140				95% Student's-t UCL		103.4	95% Adjusted-CLT UCL (Chen-1995)					107.8
141							95% Modified-t UCL (Johnson-1978)					104.2
142												
143	**Gamma GOF Test**											
144				A-D Test Statistic		0.655	**Anderson-Darling Gamma GOF Test**					
145				5% A-D Critical Value		0.786	Detected data appear Gamma Distributed at 5% Significance Lev					
146				K-S Test Statistic		0.141	**Kolmogorov-Smirnov Gamma GOF Test**					
147				5% K-S Critical Value		0.169	Detected data appear Gamma Distributed at 5% Significance Lev					
148	**Detected data appear Gamma Distributed at 5% Significance Level**											
149												
150	**Gamma Statistics**											
151				k hat (MLE)		0.728	k star (bias corrected MLE)					0.675
152				Theta hat (MLE)		102.4	Theta star (bias corrected MLE)					110.3
153				nu hat (MLE)		42.2	nu star (bias corrected)					39.17
154				MLE Mean (bias corrected)		74.49	MLE Sd (bias corrected)					90.65
155							Approximate Chi Square Value (0.05)					25.83
156				Adjusted Level of Significance		0.0407	Adjusted Chi Square Value					25.18
157												
158	**Assuming Gamma Distribution**											
159	95% Approximate Gamma UCL (use when n>=50)					112.9	95% Adjusted Gamma UCL (use when n<50)					115.8
160												
161	**Lognormal GOF Test**											
162				Shapiro Wilk Test Statistic		0.951	**Shapiro Wilk Lognormal GOF Test**					
163				5% Shapiro Wilk Critical Value		0.926	Data appear Lognormal at 5% Significance Level					
164				Lilliefors Test Statistic		0.112	**Lilliefors Lognormal GOF Test**					
165				5% Lilliefors Critical Value		0.161	Data appear Lognormal at 5% Significance Level					
166	**Data appear Lognormal at 5% Significance Level**											
167												
168	**Lognormal Statistics**											
169				Minimum of Logged Data		-0.562	Mean of logged Data					3.484
170				Maximum of Logged Data		5.805	SD of logged Data					1.467
171												
172	**Assuming Lognormal Distribution**											
173				95% H-UCL		225.8	90% Chebyshev (MVUE) UCL					180.2
174				95% Chebyshev (MVUE) UCL		221.5	97.5% Chebyshev (MVUE) UCL					278.8
175				99% Chebyshev (MVUE) UCL		391.3						
176												
177	**Nonparametric Distribution Free UCL Statistics**											
178	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
179												
180	**Nonparametric Distribution Free UCLs**											
181				95% CLT UCL		102.4	95% Jackknife UCL					103.4
182				95% Standard Bootstrap UCL		101.8	95% Bootstrap-t UCL					112.3
183				95% Hall's Bootstrap UCL		109.2	95% Percentile Bootstrap UCL					103.2
184				95% BCA Bootstrap UCL		106.8						
185				90% Chebyshev(Mean, Sd) UCL		125.4	95% Chebyshev(Mean, Sd) UCL					148.5
186				97.5% Chebyshev(Mean, Sd) UCL		180.5	99% Chebyshev(Mean, Sd) UCL					243.4
187												
188	**Suggested UCL to Use**											
189				95% Adjusted Gamma UCL		115.8						
190												
191	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
192	Recommendations are based upon data size, data distribution, and skewness.											
193	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
194	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
195												
196												
197	**Result (eu1_arsenic_overbank)**											
198												
199	**General Statistics**											
200				Total Number of Observations		29	Number of Distinct Observations					28
201							Number of Missing Observations					0

202					Minimum	16.3				Mean		63.33
203					Maximum	176				Median		55.4
204					SD	35.73				Std. Error of Mean		6.634
205					Coefficient of Variation	0.564				Skewness		1.362
206												
207					**Normal GOF Test**							
208					Shapiro Wilk Test Statistic	0.876			**Shapiro Wilk GOF Test**			
209					5% Shapiro Wilk Critical Value	0.926			Data Not Normal at 5% Significance Level			
210					Lilliefors Test Statistic	0.225			**Lilliefors GOF Test**			
211					5% Lilliefors Critical Value	0.161			Data Not Normal at 5% Significance Level			
212					**Data Not Normal at 5% Significance Level**							
213												
214					**Assuming Normal Distribution**							
215					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
216					95% Student's-t UCL	74.61			95% Adjusted-CLT UCL (Chen-1995)			76.03
217									95% Modified-t UCL (Johnson-1978)			74.89
218												
219					**Gamma GOF Test**							
220					A-D Test Statistic	0.505			**Anderson-Darling Gamma GOF Test**			
221					5% A-D Critical Value	0.751			Detected data appear Gamma Distributed at 5% Significance Lev			
222					K-S Test Statistic	0.159			**Kolmogorov-Smirnov Gamma GOF Test**			
223					5% K-S Critical Value	0.164			Detected data appear Gamma Distributed at 5% Significance Lev			
224					**Detected data appear Gamma Distributed at 5% Significance Level**							
225												
226					**Gamma Statistics**							
227					k hat (MLE)	3.761			k star (bias corrected MLE)			3.395
228					Theta hat (MLE)	16.84			Theta star (bias corrected MLE)			18.65
229					nu hat (MLE)	218.2			nu star (bias corrected)			196.9
230					MLE Mean (bias corrected)	63.33			MLE Sd (bias corrected)			34.37
231									Approximate Chi Square Value (0.05)			165.4
232					Adjusted Level of Significance	0.0407			Adjusted Chi Square Value			163.7
233												
234					**Assuming Gamma Distribution**							
235					95% Approximate Gamma UCL (use when n>=50)	75.37			95% Adjusted Gamma UCL (use when n<50)			76.16
236												
237					**Lognormal GOF Test**							
238					Shapiro Wilk Test Statistic	0.979			**Shapiro Wilk Lognormal GOF Test**			
239					5% Shapiro Wilk Critical Value	0.926			Data appear Lognormal at 5% Significance Level			
240					Lilliefors Test Statistic	0.124			**Lilliefors Lognormal GOF Test**			
241					5% Lilliefors Critical Value	0.161			Data appear Lognormal at 5% Significance Level			
242					**Data appear Lognormal at 5% Significance Level**							
243												
244					**Lognormal Statistics**							
245					Minimum of Logged Data	2.791			Mean of logged Data			4.01
246					Maximum of Logged Data	5.17			SD of logged Data			0.534
247												
248					**Assuming Lognormal Distribution**							
249					95% H-UCL	77.61			90% Chebyshev (MVUE) UCL			82.98
250					95% Chebyshev (MVUE) UCL	91.92			97.5% Chebyshev (MVUE) UCL			104.3
251					99% Chebyshev (MVUE) UCL	128.7						
252												
253					**Nonparametric Distribution Free UCL Statistics**							
254					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
255												
256					**Nonparametric Distribution Free UCLs**							
257					95% CLT UCL	74.24			95% Jackknife UCL			74.61
258					95% Standard Bootstrap UCL	73.95			95% Bootstrap-t UCL			77.34
259					95% Hall's Bootstrap UCL	77.96			95% Percentile Bootstrap UCL			74.47
260					95% BCA Bootstrap UCL	75.72						
261					90% Chebyshev(Mean, Sd) UCL	83.23			95% Chebyshev(Mean, Sd) UCL			92.25
262					97.5% Chebyshev(Mean, Sd) UCL	104.8			99% Chebyshev(Mean, Sd) UCL			129.3
263												
264					**Suggested UCL to Use**							
265					95% Adjusted Gamma UCL	76.16						
266												
267	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
268	Recommendations are based upon data size, data distribution, and skewness.											

	A	B	C	D	E	F	G	H	I	J	K	L
269	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
270	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
271												
272												
273	**Result (eu1_arsenic_waste rock)**											
274												
275	**General Statistics**											
276	Total Number of Observations					29		Number of Distinct Observations				28
277								Number of Missing Observations				0
278	Minimum					30.4		Mean				209.8
279	Maximum					729		Median				150
280	SD					166.6		Std. Error of Mean				30.93
281	Coefficient of Variation					0.794		Skewness				2.129
282												
283	**Normal GOF Test**											
284	Shapiro Wilk Test Statistic					0.736		**Shapiro Wilk GOF Test**				
285	5% Shapiro Wilk Critical Value					0.926		Data Not Normal at 5% Significance Level				
286	Lilliefors Test Statistic					0.24		**Lilliefors GOF Test**				
287	5% Lilliefors Critical Value					0.161		Data Not Normal at 5% Significance Level				
288	**Data Not Normal at 5% Significance Level**											
289												
290	**Assuming Normal Distribution**											
291	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
292	95% Student's-t UCL					262.4		95% Adjusted-CLT UCL (Chen-1995)				273.7
293								95% Modified-t UCL (Johnson-1978)				264.5
294												
295	**Gamma GOF Test**											
296	A-D Test Statistic					1.097		**Anderson-Darling Gamma GOF Test**				
297	5% A-D Critical Value					0.756		Data Not Gamma Distributed at 5% Significance Level				
298	K-S Test Statistic					0.179		**Kolmogorov-Smirnov Gamma GOF Test**				
299	5% K-S Critical Value					0.164		Data Not Gamma Distributed at 5% Significance Level				
300	**Data Not Gamma Distributed at 5% Significance Level**											
301												
302	**Gamma Statistics**											
303	k hat (MLE)					2.378		k star (bias corrected MLE)				2.155
304	Theta hat (MLE)					88.24		Theta star (bias corrected MLE)				97.37
305	nu hat (MLE)					137.9		nu star (bias corrected)				125
306	MLE Mean (bias corrected)					209.8		MLE Sd (bias corrected)				142.9
307								Approximate Chi Square Value (0.05)				100.2
308	Adjusted Level of Significance					0.0407		Adjusted Chi Square Value				98.83
309												
310	**Assuming Gamma Distribution**											
311	95% Approximate Gamma UCL (use when n>=50))					261.8		95% Adjusted Gamma UCL (use when n<50)				265.3
312												
313	**Lognormal GOF Test**											
314	Shapiro Wilk Test Statistic					0.945		**Shapiro Wilk Lognormal GOF Test**				
315	5% Shapiro Wilk Critical Value					0.926		Data appear Lognormal at 5% Significance Level				
316	Lilliefors Test Statistic					0.148		**Lilliefors Lognormal GOF Test**				
317	5% Lilliefors Critical Value					0.161		Data appear Lognormal at 5% Significance Level				
318	**Data appear Lognormal at 5% Significance Level**											
319												
320	**Lognormal Statistics**											
321	Minimum of Logged Data					3.414		Mean of logged Data				5.121
322	Maximum of Logged Data					6.592		SD of logged Data				0.662
323												
324	**Assuming Lognormal Distribution**											
325	95% H-UCL					271		90% Chebyshev (MVUE) UCL				288.5
326	95% Chebyshev (MVUE) UCL					325.5		97.5% Chebyshev (MVUE) UCL				377
327	99% Chebyshev (MVUE) UCL					478						
328												
329	**Nonparametric Distribution Free UCL Statistics**											
330	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
331												
332	**Nonparametric Distribution Free UCLs**											
333	95% CLT UCL					260.7		95% Jackknife UCL				262.4
334	95% Standard Bootstrap UCL					259.4		95% Bootstrap-t UCL				288.9
335	95% Hall's Bootstrap UCL					318		95% Percentile Bootstrap UCL				263.8

336					95% BCA Bootstrap UCL	271.4						
337					90% Chebyshev(Mean, Sd) UCL	302.6				95% Chebyshev(Mean, Sd) UCL		344.6
338					97.5% Chebyshev(Mean, Sd) UCL	403				99% Chebyshev(Mean, Sd) UCL		517.6
339												
340					**Suggested UCL to Use**							
341					95% H-UCL	271						
342												
343	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
344	Recommendations are based upon data size, data distribution, and skewness.											
345	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
346	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
347												
348	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
349	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
350	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
351	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
352												
353	**Result (eu1_cadmium_overbank)**											
354												
355	**General Statistics**											
356					Total Number of Observations	29				Number of Distinct Observations		26
357					Number of Detects	27				Number of Non-Detects		2
358					Number of Distinct Detects	24				Number of Distinct Non-Detects		2
359					Minimum Detect	0.68				Minimum Non-Detect		0.052
360					Maximum Detect	216				Maximum Non-Detect		0.053
361					Variance Detects	1674				Percent Non-Detects		6.897%
362					Mean Detects	12.61				SD Detects		40.91
363					Median Detects	3.1				CV Detects		3.245
364					Skewness Detects	5.091				Kurtosis Detects		26.23
365					Mean of Logged Detects	1.273				SD of Logged Detects		1.254
366												
367	**Normal GOF Test on Detects Only**											
368					Shapiro Wilk Test Statistic	0.28				**Shapiro Wilk GOF Test**		
369					5% Shapiro Wilk Critical Value	0.923				Detected Data Not Normal at 5% Significance Level		
370					Lilliefors Test Statistic	0.431				**Lilliefors GOF Test**		
371					5% Lilliefors Critical Value	0.167				Detected Data Not Normal at 5% Significance Level		
372	**Detected Data Not Normal at 5% Significance Level**											
373												
374	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
375					KM Mean	11.74				KM Standard Error of Mean		7.355
376					KM SD	38.87				95% KM (BCA) UCL		26.43
377					95% KM (t) UCL	24.25				95% KM (Percentile Bootstrap) UCL		26.35
378					95% KM (z) UCL	23.84				95% KM Bootstrap t UCL		95.87
379					90% KM Chebyshev UCL	33.81				95% KM Chebyshev UCL		43.8
380					97.5% KM Chebyshev UCL	57.67				99% KM Chebyshev UCL		84.92
381												
382	**Gamma GOF Tests on Detected Observations Only**											
383					A-D Test Statistic	3.04				**Anderson-Darling GOF Test**		
384					5% A-D Critical Value	0.807				Detected Data Not Gamma Distributed at 5% Significance Level		
385					K-S Test Statistic	0.225				**Kolmogorov-Smirnov GOF**		
386					5% K-S Critical Value	0.178				Detected Data Not Gamma Distributed at 5% Significance Level		
387	**Detected Data Not Gamma Distributed at 5% Significance Level**											
388												
389	**Gamma Statistics on Detected Data Only**											
390					k hat (MLE)	0.503				k star (bias corrected MLE)		0.472
391					Theta hat (MLE)	25.06				Theta star (bias corrected MLE)		26.72
392					nu hat (MLE)	27.16				nu star (bias corrected)		25.48
393					Mean (detects)	12.61						
394												
395	**Gamma ROS Statistics using Imputed Non-Detects**											
396	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
397	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)											
398	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
399	This is especially true when the sample size is small.											
400	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
401					Minimum	0.01				Mean		11.74
402					Maximum	216				Median		2.6

403					SD	39.56				CV		3.37
404					k hat (MLE)	0.411				k star (bias corrected MLE)		0.391
405					Theta hat (MLE)	28.58				Theta star (bias corrected MLE)		30
406					nu hat (MLE)	23.82				nu star (bias corrected)		22.69
407					Adjusted Level of Significance (β)	0.0407						
408					Approximate Chi Square Value (22.69, α)	12.86				Adjusted Chi Square Value (22.69, β)		12.41
409					95% Gamma Approximate UCL (use when n>=50)	20.71				95% Gamma Adjusted UCL (use when n<50)		21.45
410												
411					**Estimates of Gamma Parameters using KM Estimates**							
412					Mean (KM)	11.74				SD (KM)		38.87
413					Variance (KM)	1511				SE of Mean (KM)		7.355
414					k hat (KM)	0.0912				k star (KM)		0.105
415					nu hat (KM)	5.292				nu star (KM)		6.078
416					theta hat (KM)	128.7				theta star (KM)		112
417					80% gamma percentile (KM)	8.701				90% gamma percentile (KM)		31.83
418					95% gamma percentile (KM)	67.93				99% gamma percentile (KM)		182.2
419												
420					**Gamma Kaplan-Meier (KM) Statistics**							
421					Approximate Chi Square Value (6.08, α)	1.68				Adjusted Chi Square Value (6.08, β)		1.546
422					5% Gamma Approximate KM-UCL (use when n>=50)	42.48				95% Gamma Adjusted KM-UCL (use when n<50)		46.15
423					95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)							
424												
425					**Lognormal GOF Test on Detected Observations Only**							
426					Shapiro Wilk Test Statistic	0.891				**Shapiro Wilk GOF Test**		
427					5% Shapiro Wilk Critical Value	0.923				Detected Data Not Lognormal at 5% Significance Level		
428					Lilliefors Test Statistic	0.13				**Lilliefors GOF Test**		
429					5% Lilliefors Critical Value	0.167				Detected Data appear Lognormal at 5% Significance Level		
430					**Detected Data appear Approximate Lognormal at 5% Significance Level**							
431												
432					**Lognormal ROS Statistics Using Imputed Non-Detects**							
433					Mean in Original Scale	11.75				Mean in Log Scale		1.077
434					SD in Original Scale	39.55				SD in Log Scale		1.413
435					95% t UCL (assumes normality of ROS data)	24.25				95% Percentile Bootstrap UCL		26.2
436					95% BCA Bootstrap UCL	36.03				95% Bootstrap t UCL		98.54
437					95% H-UCL (Log ROS)	17.85						
438												
439					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
440					KM Mean (logged)	0.981				KM Geo Mean		2.667
441					KM SD (logged)	1.599				95% Critical H Value (KM-Log)		3.294
442					KM Standard Error of Mean (logged)	0.303				95% H-UCL (KM -Log)		25.94
443					KM SD (logged)	1.599				95% Critical H Value (KM-Log)		3.294
444					KM Standard Error of Mean (logged)	0.303						
445												
446					**DL/2 Statistics**							
447					**DL/2 Normal**					**DL/2 Log-Transformed**		
448					Mean in Original Scale	11.74				Mean in Log Scale		0.934
449					SD in Original Scale	39.56				SD in Log Scale		1.751
450					95% t UCL (Assumes normality)	24.23				95% H-Stat UCL		37.8
451					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
452												
453					**Nonparametric Distribution Free UCL Statistics**							
454					**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**							
455												
456					**Suggested UCL to Use**							
457					KM H-UCL	25.94						
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 statisticia											
463												
464												
465	**Result (eu1_cadmium_waste rock)**											
466												
467					**General Statistics**							
468					Total Number of Observations	29				Number of Distinct Observations		28
469										Number of Missing Observations		0

470					Minimum	0.68				Mean		16.6
471					Maximum	95.8				Median		8.6
472					SD	21.33				Std. Error of Mean		3.96
473					Coefficient of Variation	1.285				Skewness		2.518
474												
475					**Normal GOF Test**							
476					Shapiro Wilk Test Statistic	0.701			**Shapiro Wilk GOF Test**			
477					5% Shapiro Wilk Critical Value	0.926			Data Not Normal at 5% Significance Level			
478					Lilliefors Test Statistic	0.228			**Lilliefors GOF Test**			
479					5% Lilliefors Critical Value	0.161			Data Not Normal at 5% Significance Level			
480					**Data Not Normal at 5% Significance Level**							
481												
482					**Assuming Normal Distribution**							
483					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
484					95% Student's-t UCL	23.34			95% Adjusted-CLT UCL (Chen-1995)			25.09
485									95% Modified-t UCL (Johnson-1978)			23.65
486												
487					**Gamma GOF Test**							
488					A-D Test Statistic	0.326			**Anderson-Darling Gamma GOF Test**			
489					5% A-D Critical Value	0.781			Detected data appear Gamma Distributed at 5% Significance Lev			
490					K-S Test Statistic	0.0888			**Kolmogorov-Smirnov Gamma GOF Test**			
491					5% K-S Critical Value	0.169			Detected data appear Gamma Distributed at 5% Significance Lev			
492					**Detected data appear Gamma Distributed at 5% Significance Level**							
493												
494					**Gamma Statistics**							
495					k hat (MLE)	0.828			k star (bias corrected MLE)			0.766
496					Theta hat (MLE)	20.04			Theta star (bias corrected MLE)			21.68
497					nu hat (MLE)	48.04			nu star (bias corrected)			44.41
498					MLE Mean (bias corrected)	16.6			MLE Sd (bias corrected)			18.97
499									Approximate Chi Square Value (0.05)			30.12
500					Adjusted Level of Significance	0.0407			Adjusted Chi Square Value			29.42
501												
502					**Assuming Gamma Distribution**							
503					95% Approximate Gamma UCL (use when n>=50)	24.47			95% Adjusted Gamma UCL (use when n<50)			25.06
504												
505					**Lognormal GOF Test**							
506					Shapiro Wilk Test Statistic	0.969			**Shapiro Wilk Lognormal GOF Test**			
507					5% Shapiro Wilk Critical Value	0.926			Data appear Lognormal at 5% Significance Level			
508					Lilliefors Test Statistic	0.0999			**Lilliefors Lognormal GOF Test**			
509					5% Lilliefors Critical Value	0.161			Data appear Lognormal at 5% Significance Level			
510					**Data appear Lognormal at 5% Significance Level**							
511												
512					**Lognormal Statistics**							
513					Minimum of Logged Data	-0.386			Mean of logged Data			2.096
514					Maximum of Logged Data	4.562			SD of logged Data			1.309
515												
516					**Assuming Lognormal Distribution**							
517					95% H-UCL	39.04			90% Chebyshev (MVUE) UCL			34.39
518					95% Chebyshev (MVUE) UCL	41.72			97.5% Chebyshev (MVUE) UCL			51.89
519					99% Chebyshev (MVUE) UCL	71.86						
520												
521					**Nonparametric Distribution Free UCL Statistics**							
522					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
523												
524					**Nonparametric Distribution Free UCLs**							
525					95% CLT UCL	23.12			95% Jackknife UCL			23.34
526					95% Standard Bootstrap UCL	22.98			95% Bootstrap-t UCL			29
527					95% Hall's Bootstrap UCL	55.78			95% Percentile Bootstrap UCL			23.34
528					95% BCA Bootstrap UCL	25.46						
529					90% Chebyshev(Mean, Sd) UCL	28.48			95% Chebyshev(Mean, Sd) UCL			33.86
530					97.5% Chebyshev(Mean, Sd) UCL	41.33			99% Chebyshev(Mean, Sd) UCL			56
531												
532					**Suggested UCL to Use**							
533					95% Adjusted Gamma UCL	25.06						
534												
535	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
536	Recommendations are based upon data size, data distribution, and skewness.											

	A	B	C	D	E	F	G	H	I	J	K	L
537	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
538	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
539												
540												
541	**Result (eu1_chromium_overbank)**											
542												
543	**General Statistics**											
544	Total Number of Observations					29		Number of Distinct Observations				23
545								Number of Missing Observations				0
546	Minimum					1.7		Mean				4.793
547	Maximum					12		Median				4.7
548	SD					1.988		Std. Error of Mean				0.369
549	Coefficient of Variation					0.415		Skewness				1.508
550												
551	**Normal GOF Test**											
552	Shapiro Wilk Test Statistic					0.888		**Shapiro Wilk GOF Test**				
553	5% Shapiro Wilk Critical Value					0.926		Data Not Normal at 5% Significance Level				
554	Lilliefors Test Statistic					0.134		**Lilliefors GOF Test**				
555	5% Lilliefors Critical Value					0.161		Data appear Normal at 5% Significance Level				
556	**Data appear Approximate Normal at 5% Significance Level**											
557												
558	**Assuming Normal Distribution**											
559	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
560	95% Student's-t UCL					5.421		95% Adjusted-CLT UCL (Chen-1995)				5.511
561								95% Modified-t UCL (Johnson-1978)				5.438
562												
563	**Gamma GOF Test**											
564	A-D Test Statistic					0.38		**Anderson-Darling Gamma GOF Test**				
565	5% A-D Critical Value					0.747		Detected data appear Gamma Distributed at 5% Significance Lev				
566	K-S Test Statistic					0.117		**Kolmogorov-Smirnov Gamma GOF Test**				
567	5% K-S Critical Value					0.163		Detected data appear Gamma Distributed at 5% Significance Lev				
568	**Detected data appear Gamma Distributed at 5% Significance Level**											
569												
570	**Gamma Statistics**											
571	k hat (MLE)					6.495		k star (bias corrected MLE)				5.846
572	Theta hat (MLE)					0.738		Theta star (bias corrected MLE)				0.82
573	nu hat (MLE)					376.7		nu star (bias corrected)				339
574	MLE Mean (bias corrected)					4.793		MLE Sd (bias corrected)				1.982
575								Approximate Chi Square Value (0.05)				297.4
576	Adjusted Level of Significance					0.0407		Adjusted Chi Square Value				295.1
577												
578	**Assuming Gamma Distribution**											
579	95% Approximate Gamma UCL (use when n>=50))					5.465		95% Adjusted Gamma UCL (use when n<50)				5.508
580												
581	**Lognormal GOF Test**											
582	Shapiro Wilk Test Statistic					0.963		**Shapiro Wilk Lognormal GOF Test**				
583	5% Shapiro Wilk Critical Value					0.926		Data appear Lognormal at 5% Significance Level				
584	Lilliefors Test Statistic					0.122		**Lilliefors Lognormal GOF Test**				
585	5% Lilliefors Critical Value					0.161		Data appear Lognormal at 5% Significance Level				
586	**Data appear Lognormal at 5% Significance Level**											
587												
588	**Lognormal Statistics**											
589	Minimum of Logged Data					0.531		Mean of logged Data				1.488
590	Maximum of Logged Data					2.485		SD of logged Data				0.411
591												
592	**Assuming Lognormal Distribution**											
593	95% H-UCL					5.576		90% Chebyshev (MVUE) UCL				5.937
594	95% Chebyshev (MVUE) UCL					6.45		97.5% Chebyshev (MVUE) UCL				7.162
595	99% Chebyshev (MVUE) UCL					8.561						
596												
597	**Nonparametric Distribution Free UCL Statistics**											
598	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
599												
600	**Nonparametric Distribution Free UCLs**											
601	95% CLT UCL					5.4		95% Jackknife UCL				5.421
602	95% Standard Bootstrap UCL					5.394		95% Bootstrap-t UCL				5.536
603	95% Hall's Bootstrap UCL					5.775		95% Percentile Bootstrap UCL				5.376

604					95% BCA Bootstrap UCL	5.434						
605					90% Chebyshev(Mean, Sd) UCL	5.901				95% Chebyshev(Mean, Sd) UCL		6.403
606					97.5% Chebyshev(Mean, Sd) UCL	7.099				99% Chebyshev(Mean, Sd) UCL		8.467
607												
608					**Suggested UCL to Use**							
609					95% Student's-t UCL	5.421						
610												
611	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
612	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
613												
614	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
615	Recommendations are based upon data size, data distribution, and skewness.											
616	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
617	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
618												
619												
620	**Result (eu1_chromium_waste rock)**											
621												
622					**General Statistics**							
623					Total Number of Observations	29				Number of Distinct Observations		21
624										Number of Missing Observations		0
625					Minimum	0.4				Mean		2.287
626					Maximum	7.7				Median		1.6
627					SD	1.852				Std. Error of Mean		0.344
628					Coefficient of Variation	0.81				Skewness		1.446
629												
630					**Normal GOF Test**							
631					Shapiro Wilk Test Statistic	0.829				**Shapiro Wilk GOF Test**		
632					5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level		
633					Lilliefors Test Statistic	0.211				**Lilliefors GOF Test**		
634					5% Lilliefors Critical Value	0.161				Data Not Normal at 5% Significance Level		
635					**Data Not Normal at 5% Significance Level**							
636												
637					**Assuming Normal Distribution**							
638					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
639					95% Student's-t UCL	2.872				95% Adjusted-CLT UCL (Chen-1995)		2.951
640										95% Modified-t UCL (Johnson-1978)		2.888
641												
642					**Gamma GOF Test**							
643					A-D Test Statistic	0.549				**Anderson-Darling Gamma GOF Test**		
644					5% A-D Critical Value	0.758				Detected data appear Gamma Distributed at 5% Significance Lev		
645					K-S Test Statistic	0.142				**Kolmogorov-Smirnov Gamma GOF Test**		
646					5% K-S Critical Value	0.165				Detected data appear Gamma Distributed at 5% Significance Lev		
647					**Detected data appear Gamma Distributed at 5% Significance Level**							
648												
649					**Gamma Statistics**							
650					k hat (MLE)	1.894				k star (bias corrected MLE)		1.721
651					Theta hat (MLE)	1.208				Theta star (bias corrected MLE)		1.329
652					nu hat (MLE)	109.8				nu star (bias corrected)		99.82
653					MLE Mean (bias corrected)	2.287				MLE Sd (bias corrected)		1.743
654										Approximate Chi Square Value (0.05)		77.77
655					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value		76.61
656												
657					**Assuming Gamma Distribution**							
658					95% Approximate Gamma UCL (use when n>=50)	2.936				95% Adjusted Gamma UCL (use when n<50)		2.98
659												
660					**Lognormal GOF Test**							
661					Shapiro Wilk Test Statistic	0.975				**Shapiro Wilk Lognormal GOF Test**		
662					5% Shapiro Wilk Critical Value	0.926				Data appear Lognormal at 5% Significance Level		
663					Lilliefors Test Statistic	0.0914				**Lilliefors Lognormal GOF Test**		
664					5% Lilliefors Critical Value	0.161				Data appear Lognormal at 5% Significance Level		
665					**Data appear Lognormal at 5% Significance Level**							
666												
667					**Lognormal Statistics**							
668					Minimum of Logged Data	-0.916				Mean of logged Data		0.541
669					Maximum of Logged Data	2.041				SD of logged Data		0.772
670												

671	**Assuming Lognormal Distribution**											
672					95% H-UCL	3.192			90% Chebyshev (MVUE) UCL	3.361		
673					95% Chebyshev (MVUE) UCL	3.849			97.5% Chebyshev (MVUE) UCL	4.526		
674					99% Chebyshev (MVUE) UCL	5.856						
675												
676	**Nonparametric Distribution Free UCL Statistics**											
677	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
678												
679	**Nonparametric Distribution Free UCLs**											
680					95% CLT UCL	2.853			95% Jackknife UCL	2.872		
681					95% Standard Bootstrap UCL	2.852			95% Bootstrap-t UCL	3.03		
682					95% Hall's Bootstrap UCL	2.963			95% Percentile Bootstrap UCL	2.902		
683					95% BCA Bootstrap UCL	2.975						
684					90% Chebyshev(Mean, Sd) UCL	3.319			95% Chebyshev(Mean, Sd) UCL	3.786		
685					97.5% Chebyshev(Mean, Sd) UCL	4.435			99% Chebyshev(Mean, Sd) UCL	5.708		
686												
687	**Suggested UCL to Use**											
688					95% Adjusted Gamma UCL	2.98						
689												
690	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
691	Recommendations are based upon data size, data distribution, and skewness.											
692	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
693	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
694												
695												
696	**Result (eu1_cobalt_overbank)**											
697												
698	**General Statistics**											
699					Total Number of Observations	29			Number of Distinct Observations	25		
700									Number of Missing Observations	0		
701					Minimum	2.5			Mean	13.37		
702					Maximum	63.6			Median	8.8		
703					SD	13.98			Std. Error of Mean	2.597		
704					Coefficient of Variation	1.046			Skewness	2.355		
705												
706	**Normal GOF Test**											
707					Shapiro Wilk Test Statistic	0.703			**Shapiro Wilk GOF Test**			
708					5% Shapiro Wilk Critical Value	0.926			Data Not Normal at 5% Significance Level			
709					Lilliefors Test Statistic	0.258			**Lilliefors GOF Test**			
710					5% Lilliefors Critical Value	0.161			Data Not Normal at 5% Significance Level			
711	**Data Not Normal at 5% Significance Level**											
712												
713	**Assuming Normal Distribution**											
714					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
715					95% Student's-t UCL	17.79			95% Adjusted-CLT UCL (Chen-1995)	18.85		
716									95% Modified-t UCL (Johnson-1978)	17.98		
717												
718	**Gamma GOF Test**											
719					A-D Test Statistic	0.973			**Anderson-Darling Gamma GOF Test**			
720					5% A-D Critical Value	0.763			Data Not Gamma Distributed at 5% Significance Level			
721					K-S Test Statistic	0.15			**Kolmogorov-Smirnov Gamma GOF Test**			
722					5% K-S Critical Value	0.165			Detected data appear Gamma Distributed at 5% Significance Lev			
723	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
724												
725	**Gamma Statistics**											
726					k hat (MLE)	1.516			k star (bias corrected MLE)	1.382		
727					Theta hat (MLE)	8.817			Theta star (bias corrected MLE)	9.671		
728					nu hat (MLE)	87.94			nu star (bias corrected)	80.18		
729					MLE Mean (bias corrected)	13.37			MLE Sd (bias corrected)	11.37		
730									Approximate Chi Square Value (0.05)	60.55		
731					Adjusted Level of Significance	0.0407			Adjusted Chi Square Value	59.53		
732												
733	**Assuming Gamma Distribution**											
734					95% Approximate Gamma UCL (use when n>=50)	17.7			95% Adjusted Gamma UCL (use when n<50)	18.01		
735												
736	**Lognormal GOF Test**											
737					Shapiro Wilk Test Statistic	0.962			**Shapiro Wilk Lognormal GOF Test**			

738			5% Shapiro Wilk Critical Value		0.926	Data appear Lognormal at 5% Significance Level						
739			Lilliefors Test Statistic		0.0867	**Lilliefors Lognormal GOF Test**						
740			5% Lilliefors Critical Value		0.161	Data appear Lognormal at 5% Significance Level						
741	**Data appear Lognormal at 5% Significance Level**											
742												
743	**Lognormal Statistics**											
744			Minimum of Logged Data		0.916	Mean of logged Data	2.228					
745			Maximum of Logged Data		4.153	SD of logged Data	0.824					
746												
747	**Assuming Lognormal Distribution**											
748			95% H-UCL		18.54	90% Chebyshev (MVUE) UCL	19.37					
749			95% Chebyshev (MVUE) UCL		22.33	97.5% Chebyshev (MVUE) UCL	26.43					
750			99% Chebyshev (MVUE) UCL		34.49							
751												
752	**Nonparametric Distribution Free UCL Statistics**											
753	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
754												
755	**Nonparametric Distribution Free UCLs**											
756			95% CLT UCL		17.64	95% Jackknife UCL	17.79					
757			95% Standard Bootstrap UCL		17.54	95% Bootstrap-t UCL	20.24					
758			95% Hall's Bootstrap UCL		20.5	95% Percentile Bootstrap UCL	17.78					
759			95% BCA Bootstrap UCL		19.1							
760			90% Chebyshev(Mean, Sd) UCL		21.16	95% Chebyshev(Mean, Sd) UCL	24.69					
761			97.5% Chebyshev(Mean, Sd) UCL		29.59	99% Chebyshev(Mean, Sd) UCL	39.21					
762												
763	**Suggested UCL to Use**											
764			95% Adjusted Gamma UCL		18.01							
765												
766	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
767	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
768												
769	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
770	Recommendations are based upon data size, data distribution, and skewness.											
771	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
772	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
773												
774												
775	**Result (eu1_cobalt_waste rock)**											
776												
777	**General Statistics**											
778			Total Number of Observations		29	Number of Distinct Observations	28					
779						Number of Missing Observations	0					
780			Minimum		0.26	Mean	4.731					
781			Maximum		34.9	Median	1.7					
782			SD		7.789	Std. Error of Mean	1.446					
783			Coefficient of Variation		1.646	Skewness	2.755					
784												
785	**Normal GOF Test**											
786			Shapiro Wilk Test Statistic		0.612	**Shapiro Wilk GOF Test**						
787			5% Shapiro Wilk Critical Value		0.926	Data Not Normal at 5% Significance Level						
788			Lilliefors Test Statistic		0.283	**Lilliefors GOF Test**						
789			5% Lilliefors Critical Value		0.161	Data Not Normal at 5% Significance Level						
790	**Data Not Normal at 5% Significance Level**											
791												
792	**Assuming Normal Distribution**											
793	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
794			95% Student's-t UCL		7.191	95% Adjusted-CLT UCL (Chen-1995)	7.9					
795						95% Modified-t UCL (Johnson-1978)	7.314					
796												
797	**Gamma GOF Test**											
798			A-D Test Statistic		1.168	**Anderson-Darling Gamma GOF Test**						
799			5% A-D Critical Value		0.797	Data Not Gamma Distributed at 5% Significance Level						
800			K-S Test Statistic		0.182	**Kolmogorov-Smirnov Gamma GOF Test**						
801			5% K-S Critical Value		0.171	Data Not Gamma Distributed at 5% Significance Level						
802	**Data Not Gamma Distributed at 5% Significance Level**											
803												
804	**Gamma Statistics**											

805					k hat (MLE)	0.627				k star (bias corrected MLE)		0.585
806					Theta hat (MLE)	7.546				Theta star (bias corrected MLE)		8.086
807					nu hat (MLE)	36.36				nu star (bias corrected)		33.93
808					MLE Mean (bias corrected)	4.731				MLE Sd (bias corrected)		6.185
809										Approximate Chi Square Value (0.05)		21.61
810					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value		21.02
811												
812					**Assuming Gamma Distribution**							
813					95% Approximate Gamma UCL (use when n>=50))	7.428				95% Adjusted Gamma UCL (use when n<50)		7.636
814												
815					**Lognormal GOF Test**							
816					Shapiro Wilk Test Statistic	0.944				**Shapiro Wilk Lognormal GOF Test**		
817					5% Shapiro Wilk Critical Value	0.926				Data appear Lognormal at 5% Significance Level		
818					Lilliefors Test Statistic	0.116				**Lilliefors Lognormal GOF Test**		
819					5% Lilliefors Critical Value	0.161				Data appear Lognormal at 5% Significance Level		
820					**Data appear Lognormal at 5% Significance Level**							
821												
822					**Lognormal Statistics**							
823					Minimum of Logged Data	-1.347				Mean of logged Data		0.575
824					Maximum of Logged Data	3.552				SD of logged Data		1.413
825												
826					**Assuming Lognormal Distribution**							
827					95% H-UCL	10.8				90% Chebyshev (MVUE) UCL		8.939
828					95% Chebyshev (MVUE) UCL	10.94				97.5% Chebyshev (MVUE) UCL		13.71
829					99% Chebyshev (MVUE) UCL	19.16						
830												
831					**Nonparametric Distribution Free UCL Statistics**							
832					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
833												
834					**Nonparametric Distribution Free UCLs**							
835					95% CLT UCL	7.11				95% Jackknife UCL		7.191
836					95% Standard Bootstrap UCL	7.081				95% Bootstrap-t UCL		9.689
837					95% Hall's Bootstrap UCL	8.447				95% Percentile Bootstrap UCL		7.288
838					95% BCA Bootstrap UCL	7.989						
839					90% Chebyshev(Mean, Sd) UCL	9.07				95% Chebyshev(Mean, Sd) UCL		11.03
840					97.5% Chebyshev(Mean, Sd) UCL	13.76				99% Chebyshev(Mean, Sd) UCL		19.12
841												
842					**Suggested UCL to Use**							
843					95% H-UCL	10.8						
844												
845	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
846	Recommendations are based upon data size, data distribution, and skewness.											
847	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
848	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
849												
850	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
851	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
852	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
853	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
854												
855												
856	**Result (eu1_iron_overbank)**											
857												
858					**General Statistics**							
859					Total Number of Observations	29				Number of Distinct Observations		29
860										Number of Missing Observations		0
861					Minimum	13000				Mean		30955
862					Maximum	106000				Median		26000
863					SD	18167				Std. Error of Mean		3373
864					Coefficient of Variation	0.587				Skewness		2.95
865												
866					**Normal GOF Test**							
867					Shapiro Wilk Test Statistic	0.691				**Shapiro Wilk GOF Test**		
868					5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level		
869					Lilliefors Test Statistic	0.218				**Lilliefors GOF Test**		
870					5% Lilliefors Critical Value	0.161				Data Not Normal at 5% Significance Level		
871					**Data Not Normal at 5% Significance Level**							

872												
873	**Assuming Normal Distribution**											
874	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
875	95% Student's-t UCL				36694		95% Adjusted-CLT UCL (Chen-1995)					38478
876							95% Modified-t UCL (Johnson-1978)					37002
877												
878	**Gamma GOF Test**											
879	A-D Test Statistic				1.087		**Anderson-Darling Gamma GOF Test**					
880	5% A-D Critical Value				0.748		Data Not Gamma Distributed at 5% Significance Level					
881	K-S Test Statistic				0.165		**Kolmogorov-Smirnov Gamma GOF Test**					
882	5% K-S Critical Value				0.163		Data Not Gamma Distributed at 5% Significance Level					
883	**Data Not Gamma Distributed at 5% Significance Level**											
884												
885	**Gamma Statistics**											
886	k hat (MLE)				4.808		k star (bias corrected MLE)					4.333
887	Theta hat (MLE)				6439		Theta star (bias corrected MLE)					7144
888	nu hat (MLE)				278.8		nu star (bias corrected)					251.3
889	MLE Mean (bias corrected)				30955		MLE Sd (bias corrected)					14871
890							Approximate Chi Square Value (0.05)					215.6
891	Adjusted Level of Significance				0.0407		Adjusted Chi Square Value					213.6
892												
893	**Assuming Gamma Distribution**											
894	95% Approximate Gamma UCL (use when n>=50))				36081		95% Adjusted Gamma UCL (use when n<50)					36414
895												
896	**Lognormal GOF Test**											
897	Shapiro Wilk Test Statistic				0.931		**Shapiro Wilk Lognormal GOF Test**					
898	5% Shapiro Wilk Critical Value				0.926		Data appear Lognormal at 5% Significance Level					
899	Lilliefors Test Statistic				0.13		**Lilliefors Lognormal GOF Test**					
900	5% Lilliefors Critical Value				0.161		Data appear Lognormal at 5% Significance Level					
901	**Data appear Lognormal at 5% Significance Level**											
902												
903	**Lognormal Statistics**											
904	Minimum of Logged Data				9.473		Mean of logged Data					10.23
905	Maximum of Logged Data				11.57		SD of logged Data					0.438
906												
907	**Assuming Lognormal Distribution**											
908	95% H-UCL				35789		90% Chebyshev (MVUE) UCL					38162
909	95% Chebyshev (MVUE) UCL				41641		97.5% Chebyshev (MVUE) UCL					46470
910	99% Chebyshev (MVUE) UCL				55956							
911												
912	**Nonparametric Distribution Free UCL Statistics**											
913	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
914												
915	**Nonparametric Distribution Free UCLs**											
916	95% CLT UCL				36504		95% Jackknife UCL					36694
917	95% Standard Bootstrap UCL				36413		95% Bootstrap-t UCL					41817
918	95% Hall's Bootstrap UCL				65218		95% Percentile Bootstrap UCL					36759
919	95% BCA Bootstrap UCL				39017							
920	90% Chebyshev(Mean, Sd) UCL				41076		95% Chebyshev(Mean, Sd) UCL					45660
921	97.5% Chebyshev(Mean, Sd) UCL				52022		99% Chebyshev(Mean, Sd) UCL					64521
922												
923	**Suggested UCL to Use**											
924	95% Student's-t UCL				36694		or 95% Modified-t UCL					37002
925	or 95% H-UCL				35789							
926												
927	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
928	Recommendations are based upon data size, data distribution, and skewness.											
929	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
930	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
931												
932	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
933	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
934	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
935	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
936												
937												
938	**Result (eu1_iron_waste rock)**											

939												
940	**General Statistics**											
941	Total Number of Observations				29		Number of Distinct Observations				28	
942							Number of Missing Observations				0	
943	Minimum				14600		Mean				35807	
944	Maximum				102000		Median				33300	
945	SD				16771		Std. Error of Mean				3114	
946	Coefficient of Variation				0.468		Skewness				2.263	
947												
948	**Normal GOF Test**											
949	Shapiro Wilk Test Statistic				0.816		**Shapiro Wilk GOF Test**					
950	5% Shapiro Wilk Critical Value				0.926		Data Not Normal at 5% Significance Level					
951	Lilliefors Test Statistic				0.158		**Lilliefors GOF Test**					
952	5% Lilliefors Critical Value				0.161		Data appear Normal at 5% Significance Level					
953	**Data appear Approximate Normal at 5% Significance Level**											
954												
955	**Assuming Normal Distribution**											
956	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
957	95% Student's-t UCL				41105		95% Adjusted-CLT UCL (Chen-1995)				42328	
958							95% Modified-t UCL (Johnson-1978)				41323	
959												
960	**Gamma GOF Test**											
961	A-D Test Statistic				0.394		**Anderson-Darling Gamma GOF Test**					
962	5% A-D Critical Value				0.747		Detected data appear Gamma Distributed at 5% Significance Lev					
963	K-S Test Statistic				0.0977		**Kolmogorov-Smirnov Gamma GOF Test**					
964	5% K-S Critical Value				0.163		Detected data appear Gamma Distributed at 5% Significance Lev					
965	**Detected data appear Gamma Distributed at 5% Significance Level**											
966												
967	**Gamma Statistics**											
968	k hat (MLE)				6.077		k star (bias corrected MLE)				5.471	
969	Theta hat (MLE)				5892		Theta star (bias corrected MLE)				6545	
970	nu hat (MLE)				352.5		nu star (bias corrected)				317.3	
971	MLE Mean (bias corrected)				35807		MLE Sd (bias corrected)				15308	
972							Approximate Chi Square Value (0.05)				277.1	
973	Adjusted Level of Significance				0.0407		Adjusted Chi Square Value				274.8	
974												
975	**Assuming Gamma Distribution**											
976	95% Approximate Gamma UCL (use when n>=50))				41011		95% Adjusted Gamma UCL (use when n<50)				41346	
977												
978	**Lognormal GOF Test**											
979	Shapiro Wilk Test Statistic				0.973		**Shapiro Wilk Lognormal GOF Test**					
980	5% Shapiro Wilk Critical Value				0.926		Data appear Lognormal at 5% Significance Level					
981	Lilliefors Test Statistic				0.0781		**Lilliefors Lognormal GOF Test**					
982	5% Lilliefors Critical Value				0.161		Data appear Lognormal at 5% Significance Level					
983	**Data appear Lognormal at 5% Significance Level**											
984												
985	**Lognormal Statistics**											
986	Minimum of Logged Data				9.589		Mean of logged Data				10.4	
987	Maximum of Logged Data				11.53		SD of logged Data				0.408	
988												
989	**Assuming Lognormal Distribution**											
990	95% H-UCL				41324		90% Chebyshev (MVUE) UCL				43989	
991	95% Chebyshev (MVUE) UCL				47767		97.5% Chebyshev (MVUE) UCL				53011	
992	99% Chebyshev (MVUE) UCL				63311							
993												
994	**Nonparametric Distribution Free UCL Statistics**											
995	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
996												
997	**Nonparametric Distribution Free UCLs**											
998	95% CLT UCL				40929		95% Jackknife UCL				41105	
999	95% Standard Bootstrap UCL				40852		95% Bootstrap-t UCL				43321	
1000	95% Hall's Bootstrap UCL				49217		95% Percentile Bootstrap UCL				41162	
1001	95% BCA Bootstrap UCL				41879							
1002	90% Chebyshev(Mean, Sd) UCL				45150		95% Chebyshev(Mean, Sd) UCL				49382	
1003	97.5% Chebyshev(Mean, Sd) UCL				55255		99% Chebyshev(Mean, Sd) UCL				66793	
1004												
1005	**Suggested UCL to Use**											

1006				95% Student's-t UCL	41105							
1007												
1008	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1009	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1010												
1011	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1012	Recommendations are based upon data size, data distribution, and skewness.											
1013	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1014	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1015												
1016												
1017	**Result (eu1_manganese_overbank)**											
1018												
1019	**General Statistics**											
1020				Total Number of Observations	29			Number of Distinct Observations	29			
1021								Number of Missing Observations	0			
1022				Minimum	347			Mean	7181			
1023				Maximum	55900			Median	4270			
1024				SD	10699			Std. Error of Mean	1987			
1025				Coefficient of Variation	1.49			Skewness	3.635			
1026												
1027	**Normal GOF Test**											
1028				Shapiro Wilk Test Statistic	0.594			**Shapiro Wilk GOF Test**				
1029				5% Shapiro Wilk Critical Value	0.926			Data Not Normal at 5% Significance Level				
1030				Lilliefors Test Statistic	0.261			**Lilliefors GOF Test**				
1031				5% Lilliefors Critical Value	0.161			Data Not Normal at 5% Significance Level				
1032	**Data Not Normal at 5% Significance Level**											
1033												
1034	**Assuming Normal Distribution**											
1035				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
1036				95% Student's-t UCL	10561			95% Adjusted-CLT UCL (Chen-1995)	11882			
1037								95% Modified-t UCL (Johnson-1978)	10784			
1038												
1039	**Gamma GOF Test**											
1040				A-D Test Statistic	0.43			**Anderson-Darling Gamma GOF Test**				
1041				5% A-D Critical Value	0.781			Detected data appear Gamma Distributed at 5% Significance Lev				
1042				K-S Test Statistic	0.126			**Kolmogorov-Smirnov Gamma GOF Test**				
1043				5% K-S Critical Value	0.169			Detected data appear Gamma Distributed at 5% Significance Lev				
1044	**Detected data appear Gamma Distributed at 5% Significance Level**											
1045												
1046	**Gamma Statistics**											
1047				k hat (MLE)	0.817			k star (bias corrected MLE)	0.756			
1048				Theta hat (MLE)	8787			Theta star (bias corrected MLE)	9503			
1049				nu hat (MLE)	47.4			nu star (bias corrected)	43.83			
1050				MLE Mean (bias corrected)	7181			MLE Sd (bias corrected)	8261			
1051								Approximate Chi Square Value (0.05)	29.65			
1052				Adjusted Level of Significance	0.0407			Adjusted Chi Square Value	28.95			
1053												
1054	**Assuming Gamma Distribution**											
1055				95% Approximate Gamma UCL (use when n>=50)	10617			95% Adjusted Gamma UCL (use when n<50)	10872			
1056												
1057	**Lognormal GOF Test**											
1058				Shapiro Wilk Test Statistic	0.978			**Shapiro Wilk Lognormal GOF Test**				
1059				5% Shapiro Wilk Critical Value	0.926			Data appear Lognormal at 5% Significance Level				
1060				Lilliefors Test Statistic	0.0843			**Lilliefors Lognormal GOF Test**				
1061				5% Lilliefors Critical Value	0.161			Data appear Lognormal at 5% Significance Level				
1062	**Data appear Lognormal at 5% Significance Level**											
1063												
1064	**Lognormal Statistics**											
1065				Minimum of Logged Data	5.849			Mean of logged Data	8.155			
1066				Maximum of Logged Data	10.93			SD of logged Data	1.268			
1067												
1068	**Assuming Lognormal Distribution**											
1069				95% H-UCL	15276			90% Chebyshev (MVUE) UCL	13756			
1070				95% Chebyshev (MVUE) UCL	16625			97.5% Chebyshev (MVUE) UCL	20606			
1071				99% Chebyshev (MVUE) UCL	28427							
1072												

1073	**Nonparametric Distribution Free UCL Statistics**											
1074	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1075												
1076	**Nonparametric Distribution Free UCLs**											
1077					95% CLT UCL	10449			95% Jackknife UCL	10561		
1078					95% Standard Bootstrap UCL	10356			95% Bootstrap-t UCL	13786		
1079					95% Hall's Bootstrap UCL	24020			95% Percentile Bootstrap UCL	10711		
1080					95% BCA Bootstrap UCL	12634						
1081					90% Chebyshev(Mean, Sd) UCL	13141			95% Chebyshev(Mean, Sd) UCL	15841		
1082					97.5% Chebyshev(Mean, Sd) UCL	19588			99% Chebyshev(Mean, Sd) UCL	26948		
1083												
1084	**Suggested UCL to Use**											
1085					95% Adjusted Gamma UCL	10872						
1086												
1087	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1088	Recommendations are based upon data size, data distribution, and skewness.											
1089	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1090	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1091												
1092												
1093	**Result (eu1_manganese_waste rock)**											
1094												
1095	**General Statistics**											
1096					Total Number of Observations	29			Number of Distinct Observations	29		
1097									Number of Missing Observations	0		
1098					Minimum	43			Mean	1504		
1099					Maximum	12800			Median	448		
1100					SD	2747			Std. Error of Mean	510.2		
1101					Coefficient of Variation	1.827			Skewness	3.206		
1102												
1103	**Normal GOF Test**											
1104					Shapiro Wilk Test Statistic	0.555			**Shapiro Wilk GOF Test**			
1105					5% Shapiro Wilk Critical Value	0.926			Data Not Normal at 5% Significance Level			
1106					Lilliefors Test Statistic	0.307			**Lilliefors GOF Test**			
1107					5% Lilliefors Critical Value	0.161			Data Not Normal at 5% Significance Level			
1108	**Data Not Normal at 5% Significance Level**											
1109												
1110	**Assuming Normal Distribution**											
1111					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
1112					95% Student's-t UCL	2372			95% Adjusted-CLT UCL (Chen-1995)	2668		
1113									95% Modified-t UCL (Johnson-1978)	2422		
1114												
1115	**Gamma GOF Test**											
1116					A-D Test Statistic	0.953			**Anderson-Darling Gamma GOF Test**			
1117					5% A-D Critical Value	0.803			Data Not Gamma Distributed at 5% Significance Level			
1118					K-S Test Statistic	0.143			**Kolmogorov-Smirnov Gamma GOF Test**			
1119					5% K-S Critical Value	0.171			Detected data appear Gamma Distributed at 5% Significance Lev			
1120	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
1121												
1122	**Gamma Statistics**											
1123					k hat (MLE)	0.579			k star (bias corrected MLE)	0.542		
1124					Theta hat (MLE)	2598			Theta star (bias corrected MLE)	2775		
1125					nu hat (MLE)	33.57			nu star (bias corrected)	31.43		
1126					MLE Mean (bias corrected)	1504			MLE Sd (bias corrected)	2043		
1127									Approximate Chi Square Value (0.05)	19.62		
1128					Adjusted Level of Significance	0.0407			Adjusted Chi Square Value	19.06		
1129												
1130	**Assuming Gamma Distribution**											
1131					95% Approximate Gamma UCL (use when n>=50)	2409			95% Adjusted Gamma UCL (use when n<50)	2480		
1132												
1133	**Lognormal GOF Test**											
1134					Shapiro Wilk Test Statistic	0.975			**Shapiro Wilk Lognormal GOF Test**			
1135					5% Shapiro Wilk Critical Value	0.926			Data appear Lognormal at 5% Significance Level			
1136					Lilliefors Test Statistic	0.0752			**Lilliefors Lognormal GOF Test**			
1137					5% Lilliefors Critical Value	0.161			Data appear Lognormal at 5% Significance Level			
1138	**Data appear Lognormal at 5% Significance Level**											
1139												

1140	**Lognormal Statistics**											
1141					Minimum of Logged Data	3.761			Mean of logged Data	6.242		
1142					Maximum of Logged Data	9.457			SD of logged Data	1.5		
1143												
1144	**Assuming Lognormal Distribution**											
1145					95% H-UCL	3865			90% Chebyshev (MVUE) UCL	3012		
1146					95% Chebyshev (MVUE) UCL	3711			97.5% Chebyshev (MVUE) UCL	4682		
1147					99% Chebyshev (MVUE) UCL	6587						
1148												
1149	**Nonparametric Distribution Free UCL Statistics**											
1150	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1151												
1152	**Nonparametric Distribution Free UCLs**											
1153					95% CLT UCL	2343			95% Jackknife UCL	2372		
1154					95% Standard Bootstrap UCL	2321			95% Bootstrap-t UCL	3668		
1155					95% Hall's Bootstrap UCL	5969			95% Percentile Bootstrap UCL	2438		
1156					95% BCA Bootstrap UCL	2683						
1157					90% Chebyshev(Mean, Sd) UCL	3034			95% Chebyshev(Mean, Sd) UCL	3728		
1158					97.5% Chebyshev(Mean, Sd) UCL	4690			99% Chebyshev(Mean, Sd) UCL	6580		
1159												
1160	**Suggested UCL to Use**											
1161					95% Adjusted Gamma UCL	2480						
1162												
1163	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1164	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1165												
1166	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1167	Recommendations are based upon data size, data distribution, and skewness.											
1168	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1169	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1170												
1171	**Result (eu1_thallium_overbank)**											
1172												
1173	**General Statistics**											
1174					Total Number of Observations	29			Number of Distinct Observations	20		
1175					Number of Detects	9			Number of Non-Detects	20		
1176					Number of Distinct Detects	7			Number of Distinct Non-Detects	13		
1177					Minimum Detect	0.49			Minimum Non-Detect	0.041		
1178					Maximum Detect	3.3			Maximum Non-Detect	0.18		
1179					Variance Detects	0.724			Percent Non-Detects	68.97%		
1180					Mean Detects	1.246			SD Detects	0.851		
1181					Median Detects	0.79			CV Detects	0.683		
1182					Skewness Detects	2.053			Kurtosis Detects	4.8		
1183					Mean of Logged Detects	0.0622			SD of Logged Detects	0.564		
1184												
1185	**Normal GOF Test on Detects Only**											
1186					Shapiro Wilk Test Statistic	0.751			**Shapiro Wilk GOF Test**			
1187					5% Shapiro Wilk Critical Value	0.829			Detected Data Not Normal at 5% Significance Level			
1188					Lilliefors Test Statistic	0.271			**Lilliefors GOF Test**			
1189					5% Lilliefors Critical Value	0.274			Detected Data appear Normal at 5% Significance Level			
1190	**Detected Data appear Approximate Normal at 5% Significance Level**											
1191												
1192	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1193					KM Mean	0.415			KM Standard Error of Mean	0.141		
1194					KM SD	0.714			95% KM (BCA) UCL	0.699		
1195					95% KM (t) UCL	0.654			95% KM (Percentile Bootstrap) UCL	0.631		
1196					95% KM (z) UCL	0.646			95% KM Bootstrap t UCL	0.768		
1197					90% KM Chebyshev UCL	0.837			95% KM Chebyshev UCL	1.028		
1198					97.5% KM Chebyshev UCL	1.293			99% KM Chebyshev UCL	1.815		
1199												
1200	**Gamma GOF Tests on Detected Observations Only**											
1201					A-D Test Statistic	0.616			**Anderson-Darling GOF Test**			
1202					5% A-D Critical Value	0.726			Detected data appear Gamma Distributed at 5% Significance Lev			
1203					K-S Test Statistic	0.276			**Kolmogorov-Smirnov GOF**			
1204					5% K-S Critical Value	0.281			Detected data appear Gamma Distributed at 5% Significance Lev			
1205	**Detected data appear Gamma Distributed at 5% Significance Level**											
1206												

1207	**Gamma Statistics on Detected Data Only**											
1208					k hat (MLE)	3.334		k star (bias corrected MLE)	2.297			
1209					Theta hat (MLE)	0.374		Theta star (bias corrected MLE)	0.542			
1210					nu hat (MLE)	60.01		nu star (bias corrected)	41.34			
1211					Mean (detects)	1.246						
1212												
1213	**Gamma ROS Statistics using Imputed Non-Detects**											
1214	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1215	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)											
1216	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1217	This is especially true when the sample size is small.											
1218	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1219					Minimum	0.01		Mean	0.393			
1220					Maximum	3.3		Median	0.01			
1221					SD	0.738		CV	1.877			
1222					k hat (MLE)	0.309		k star (bias corrected MLE)	0.3			
1223					Theta hat (MLE)	1.275		Theta star (bias corrected MLE)	1.313			
1224					nu hat (MLE)	17.9		nu star (bias corrected)	17.38			
1225					Adjusted Level of Significance (β)	0.0407						
1226					Approximate Chi Square Value (17.38, α)	8.946		Adjusted Chi Square Value (17.38, β)	8.585			
1227					95% Gamma Approximate UCL (use when n>=50)	0.764		95% Gamma Adjusted UCL (use when n<50)	0.797			
1228												
1229	**Estimates of Gamma Parameters using KM Estimates**											
1230					Mean (KM)	0.415		SD (KM)	0.714			
1231					Variance (KM)	0.51		SE of Mean (KM)	0.141			
1232					k hat (KM)	0.337		k star (KM)	0.325			
1233					nu hat (KM)	19.56		nu star (KM)	18.87			
1234					theta hat (KM)	1.23		theta star (KM)	1.275			
1235					80% gamma percentile (KM)	0.648		90% gamma percentile (KM)	1.211			
1236					95% gamma percentile (KM)	1.848		99% gamma percentile (KM)	3.489			
1237												
1238	**Gamma Kaplan-Meier (KM) Statistics**											
1239					Approximate Chi Square Value (18.87, α)	10.02		Adjusted Chi Square Value (18.87, β)	9.637			
1240	5% Gamma Approximate KM-UCL (use when n>=50)					0.781		95% Gamma Adjusted KM-UCL (use when n<50)	0.812			
1241												
1242	**Lognormal GOF Test on Detected Observations Only**											
1243					Shapiro Wilk Test Statistic	0.908		**Shapiro Wilk GOF Test**				
1244					5% Shapiro Wilk Critical Value	0.829		Detected Data appear Lognormal at 5% Significance Level				
1245					Lilliefors Test Statistic	0.257		**Lilliefors GOF Test**				
1246					5% Lilliefors Critical Value	0.274		Detected Data appear Lognormal at 5% Significance Level				
1247	**Detected Data appear Lognormal at 5% Significance Level**											
1248												
1249	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1250					Mean in Original Scale	0.499		Mean in Log Scale	-1.279			
1251					SD in Original Scale	0.685		SD in Log Scale	1.02			
1252					95% t UCL (assumes normality of ROS data)	0.716		95% Percentile Bootstrap UCL	0.724			
1253					95% BCA Bootstrap UCL	0.787		95% Bootstrap t UCL	0.884			
1254					95% H-UCL (Log ROS)	0.757						
1255												
1256	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1257					KM Mean (logged)	-2.184		KM Geo Mean	0.113			
1258					KM SD (logged)	1.535		95% Critical H Value (KM-Log)	3.199			
1259					KM Standard Error of Mean (logged)	0.302		95% H-UCL (KM -Log)	0.926			
1260					KM SD (logged)	1.535		95% Critical H Value (KM-Log)	3.199			
1261					KM Standard Error of Mean (logged)	0.302						
1262												
1263	**DL/2 Statistics**											
1264	**DL/2 Normal**							**DL/2 Log-Transformed**				
1265					Mean in Original Scale	0.407		Mean in Log Scale	-2.467			
1266					SD in Original Scale	0.731		SD in Log Scale	1.778			
1267					95% t UCL (Assumes normality)	0.638		95% H-Stat UCL	1.367			
1268	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1269												
1270	**Nonparametric Distribution Free UCL Statistics**											
1271	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**											
1272												
1273	**Suggested UCL to Use**											

1274				95% KM (t) UCL	0.654							
1275												
1276	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1277	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1278												
1279	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1280	Recommendations are based upon data size, data distribution, and skewness.											
1281	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1282	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1283												
1284	**Result (eu1_thallium_waste rock)**											
1285												
1286	**General Statistics**											
1287				Total Number of Observations	29			Number of Distinct Observations	22			
1288				Number of Detects	25			Number of Non-Detects	4			
1289				Number of Distinct Detects	21			Number of Distinct Non-Detects	1			
1290				Minimum Detect	0.2			Minimum Non-Detect	0.003			
1291				Maximum Detect	6			Maximum Non-Detect	0.003			
1292				Variance Detects	2.28			Percent Non-Detects	13.79%			
1293				Mean Detects	1.876			SD Detects	1.51			
1294				Median Detects	1.4			CV Detects	0.805			
1295				Skewness Detects	1.408			Kurtosis Detects	1.393			
1296				Mean of Logged Detects	0.335			SD of Logged Detects	0.803			
1297												
1298	**Normal GOF Test on Detects Only**											
1299				Shapiro Wilk Test Statistic	0.835			**Shapiro Wilk GOF Test**				
1300				5% Shapiro Wilk Critical Value	0.918			Detected Data Not Normal at 5% Significance Level				
1301				Lilliefors Test Statistic	0.189			**Lilliefors GOF Test**				
1302				5% Lilliefors Critical Value	0.173			Detected Data Not Normal at 5% Significance Level				
1303	**Detected Data Not Normal at 5% Significance Level**											
1304												
1305	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1306				KM Mean	1.617			KM Standard Error of Mean	0.288			
1307				KM SD	1.518			95% KM (BCA) UCL	2.126			
1308				95% KM (t) UCL	2.107			95% KM (Percentile Bootstrap) UCL	2.112			
1309				95% KM (z) UCL	2.09			95% KM Bootstrap t UCL	2.24			
1310				90% KM Chebyshev UCL	2.48			95% KM Chebyshev UCL	2.871			
1311				97.5% KM Chebyshev UCL	3.414			99% KM Chebyshev UCL	4.479			
1312												
1313	**Gamma GOF Tests on Detected Observations Only**											
1314				A-D Test Statistic	0.52			**Anderson-Darling GOF Test**				
1315				5% A-D Critical Value	0.758			Detected data appear Gamma Distributed at 5% Significance Lev				
1316				K-S Test Statistic	0.139			**Kolmogorov-Smirnov GOF**				
1317				5% K-S Critical Value	0.177			Detected data appear Gamma Distributed at 5% Significance Lev				
1318	**Detected data appear Gamma Distributed at 5% Significance Level**											
1319												
1320	**Gamma Statistics on Detected Data Only**											
1321				k hat (MLE)	1.849			k star (bias corrected MLE)	1.654			
1322				Theta hat (MLE)	1.014			Theta star (bias corrected MLE)	1.134			
1323				nu hat (MLE)	92.45			nu star (bias corrected)	82.69			
1324				Mean (detects)	1.876							
1325												
1326	**Gamma ROS Statistics using Imputed Non-Detects**											
1327	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1328	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)											
1329	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1330	This is especially true when the sample size is small.											
1331	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1332				Minimum	0.01			Mean	1.618			
1333				Maximum	6			Median	1			
1334				SD	1.544			CV	0.954			
1335				k hat (MLE)	0.726			k star (bias corrected MLE)	0.674			
1336				Theta hat (MLE)	2.228			Theta star (bias corrected MLE)	2.401			
1337				nu hat (MLE)	42.12			nu star (bias corrected)	39.1			
1338				Adjusted Level of Significance (β)	0.0407							
1339				Approximate Chi Square Value (39.10, α)	25.77			Adjusted Chi Square Value (39.10, β)	25.13			
1340				95% Gamma Approximate UCL (use when n>=50)	2.455			95% Gamma Adjusted UCL (use when n<50)	2.518			

1341												
1342	**Estimates of Gamma Parameters using KM Estimates**											
1343					Mean (KM)	1.617			SD (KM)	1.518		
1344					Variance (KM)	2.304			SE of Mean (KM)	0.288		
1345					k hat (KM)	1.136			k star (KM)	1.041		
1346					nu hat (KM)	65.86			nu star (KM)	60.38		
1347					theta hat (KM)	1.424			theta star (KM)	1.554		
1348					80% gamma percentile (KM)	2.594			90% gamma percentile (KM)	3.687		
1349					95% gamma percentile (KM)	4.777			99% gamma percentile (KM)	7.299		
1350												
1351	**Gamma Kaplan-Meier (KM) Statistics**											
1352					Approximate Chi Square Value (60.38, α)	43.51			Adjusted Chi Square Value (60.38, β)	42.66		
1353	5% Gamma Approximate KM-UCL (use when n>=50)					2.244			95% Gamma Adjusted KM-UCL (use when n<50)	2.289		
1354												
1355	**Lognormal GOF Test on Detected Observations Only**											
1356					Shapiro Wilk Test Statistic	0.966			**Shapiro Wilk GOF Test**			
1357					5% Shapiro Wilk Critical Value	0.918			Detected Data appear Lognormal at 5% Significance Level			
1358					Lilliefors Test Statistic	0.106			**Lilliefors GOF Test**			
1359					5% Lilliefors Critical Value	0.173			Detected Data appear Lognormal at 5% Significance Level			
1360	**Detected Data appear Lognormal at 5% Significance Level**											
1361												
1362	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1363					Mean in Original Scale	1.649			Mean in Log Scale	0.0811		
1364					SD in Original Scale	1.513			SD in Log Scale	0.989		
1365					95% t UCL (assumes normality of ROS data)	2.126			95% Percentile Bootstrap UCL	2.124		
1366					95% BCA Bootstrap UCL	2.184			95% Bootstrap t UCL	2.25		
1367					95% H-UCL (Log ROS)	2.8						
1368												
1369	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1370					KM Mean (logged)	-0.513			KM Geo Mean	0.599		
1371					KM SD (logged)	2.241			95% Critical H Value (KM-Log)	4.293		
1372					KM Standard Error of Mean (logged)	0.425			95% H-UCL (KM -Log)	45.43		
1373					KM SD (logged)	2.241			95% Critical H Value (KM-Log)	4.293		
1374					KM Standard Error of Mean (logged)	0.425						
1375												
1376	**DL/2 Statistics**											
1377	**DL/2 Normal**								**DL/2 Log-Transformed**			
1378					Mean in Original Scale	1.617			Mean in Log Scale	-0.608		
1379					SD in Original Scale	1.545			SD in Log Scale	2.512		
1380					95% t UCL (Assumes normality)	2.105			95% H-Stat UCL	120.7		
1381	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1382												
1383	**Nonparametric Distribution Free UCL Statistics**											
1384	**Detected Data appear Gamma Distributed at 5% Significance Level**											
1385												
1386	**Suggested UCL to Use**											
1387					95% KM Adjusted Gamma UCL	2.289			95% GROS Adjusted Gamma UCL	2.518		
1388												
1389	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1390	Recommendations are based upon data size, data distribution, and skewness.											
1391	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1392	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1393												
1394												
1395	**Result (eu1_zinc_overbank)**											
1396												
1397	**General Statistics**											
1398					Total Number of Observations	29			Number of Distinct Observations	28		
1399									Number of Missing Observations	0		
1400					Minimum	107			Mean	1766		
1401					Maximum	30200			Median	480		
1402					SD	5499			Std. Error of Mean	1021		
1403					Coefficient of Variation	3.113			Skewness	5.29		
1404												
1405	**Normal GOF Test**											
1406					Shapiro Wilk Test Statistic	0.271			**Shapiro Wilk GOF Test**			
1407					5% Shapiro Wilk Critical Value	0.926			Data Not Normal at 5% Significance Level			

1408					Lilliefors Test Statistic	0.435	**Lilliefors GOF Test**					
1409					5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level					
1410	**Data Not Normal at 5% Significance Level**											
1411												
1412	**Assuming Normal Distribution**											
1413	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1414					95% Student's-t UCL	3504	95% Adjusted-CLT UCL (Chen-1995)	4518				
1415							95% Modified-t UCL (Johnson-1978)	3671				
1416												
1417	**Gamma GOF Test**											
1418					A-D Test Statistic	3.299	**Anderson-Darling Gamma GOF Test**					
1419					5% A-D Critical Value	0.8	Data Not Gamma Distributed at 5% Significance Level					
1420					K-S Test Statistic	0.259	**Kolmogorov-Smirnov Gamma GOF Test**					
1421					5% K-S Critical Value	0.171	Data Not Gamma Distributed at 5% Significance Level					
1422	**Data Not Gamma Distributed at 5% Significance Level**											
1423												
1424	**Gamma Statistics**											
1425					k hat (MLE)	0.602	k star (bias corrected MLE)	0.563				
1426					Theta hat (MLE)	2932	Theta star (bias corrected MLE)	3137				
1427					nu hat (MLE)	34.94	nu star (bias corrected)	32.66				
1428					MLE Mean (bias corrected)	1766	MLE Sd (bias corrected)	2354				
1429							Approximate Chi Square Value (0.05)	20.6				
1430					Adjusted Level of Significance	0.0407	Adjusted Chi Square Value	20.02				
1431												
1432	**Assuming Gamma Distribution**											
1433	95% Approximate Gamma UCL (use when n>=50))					2801	95% Adjusted Gamma UCL (use when n<50)	2881				
1434												
1435	**Lognormal GOF Test**											
1436					Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk Lognormal GOF Test**					
1437					5% Shapiro Wilk Critical Value	0.926	Data Not Lognormal at 5% Significance Level					
1438					Lilliefors Test Statistic	0.117	**Lilliefors Lognormal GOF Test**					
1439					5% Lilliefors Critical Value	0.161	Data appear Lognormal at 5% Significance Level					
1440	**Data appear Approximate Lognormal at 5% Significance Level**											
1441												
1442	**Lognormal Statistics**											
1443					Minimum of Logged Data	4.673	Mean of logged Data	6.452				
1444					Maximum of Logged Data	10.32	SD of logged Data	1.103				
1445												
1446	**Assuming Lognormal Distribution**											
1447					95% H-UCL	1999	90% Chebyshev (MVUE) UCL	1938				
1448					95% Chebyshev (MVUE) UCL	2305	97.5% Chebyshev (MVUE) UCL	2814				
1449					99% Chebyshev (MVUE) UCL	3815						
1450												
1451	**Nonparametric Distribution Free UCL Statistics**											
1452	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1453												
1454	**Nonparametric Distribution Free UCLs**											
1455					95% CLT UCL	3446	95% Jackknife UCL	3504				
1456					95% Standard Bootstrap UCL	3452	95% Bootstrap-t UCL	14238				
1457					95% Hall's Bootstrap UCL	10039	95% Percentile Bootstrap UCL	3827				
1458					95% BCA Bootstrap UCL	4965						
1459					90% Chebyshev(Mean, Sd) UCL	4830	95% Chebyshev(Mean, Sd) UCL	6218				
1460					97.5% Chebyshev(Mean, Sd) UCL	8144	99% Chebyshev(Mean, Sd) UCL	11927				
1461												
1462	**Suggested UCL to Use**											
1463					95% H-UCL	1999						
1464												
1465	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1466	Recommendations are based upon data size, data distribution, and skewness.											
1467	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1468	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1469												
1470	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
1471	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
1472	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
1473	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
1474												

1475												
1476	**Result (eu1_zinc_waste rock)**											
1477												
1478	**General Statistics**											
1479						Total Number of Observations	29				Number of Distinct Observations	29
1480											Number of Missing Observations	0
1481						Minimum	295				Mean	4729
1482						Maximum	20200				Median	2010
1483						SD	5327				Std. Error of Mean	989.2
1484						Coefficient of Variation	1.127				Skewness	1.467
1485												
1486	**Normal GOF Test**											
1487						Shapiro Wilk Test Statistic	0.788	**Shapiro Wilk GOF Test**				
1488						5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level				
1489						Lilliefors Test Statistic	0.268	**Lilliefors GOF Test**				
1490						5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level				
1491	**Data Not Normal at 5% Significance Level**											
1492												
1493	**Assuming Normal Distribution**											
1494						**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**	
1495						95% Student's-t UCL	6412				95% Adjusted-CLT UCL (Chen-1995)	6644
1496											95% Modified-t UCL (Johnson-1978)	6457
1497												
1498	**Gamma GOF Test**											
1499						A-D Test Statistic	0.692	**Anderson-Darling Gamma GOF Test**				
1500						5% A-D Critical Value	0.778	Detected data appear Gamma Distributed at 5% Significance Lev				
1501						K-S Test Statistic	0.152	**Kolmogorov-Smirnov Gamma GOF Test**				
1502						5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Lev				
1503	**Detected data appear Gamma Distributed at 5% Significance Level**											
1504												
1505	**Gamma Statistics**											
1506						k hat (MLE)	0.896				k star (bias corrected MLE)	0.826
1507						Theta hat (MLE)	5277				Theta star (bias corrected MLE)	5723
1508						nu hat (MLE)	51.97				nu star (bias corrected)	47.93
1509						MLE Mean (bias corrected)	4729				MLE Sd (bias corrected)	5202
1510											Approximate Chi Square Value (0.05)	33.04
1511						Adjusted Level of Significance	0.0407				Adjusted Chi Square Value	32.3
1512												
1513	**Assuming Gamma Distribution**											
1514						95% Approximate Gamma UCL (use when n>=50)	6860				95% Adjusted Gamma UCL (use when n<50)	7017
1515												
1516	**Lognormal GOF Test**											
1517						Shapiro Wilk Test Statistic	0.957	**Shapiro Wilk Lognormal GOF Test**				
1518						5% Shapiro Wilk Critical Value	0.926	Data appear Lognormal at 5% Significance Level				
1519						Lilliefors Test Statistic	0.1	**Lilliefors Lognormal GOF Test**				
1520						5% Lilliefors Critical Value	0.161	Data appear Lognormal at 5% Significance Level				
1521	**Data appear Lognormal at 5% Significance Level**											
1522												
1523	**Lognormal Statistics**											
1524						Minimum of Logged Data	5.687				Mean of logged Data	7.809
1525						Maximum of Logged Data	9.913				SD of logged Data	1.223
1526												
1527	**Assuming Lognormal Distribution**											
1528						95% H-UCL	9835				90% Chebyshev (MVUE) UCL	9056
1529						95% Chebyshev (MVUE) UCL	10899				97.5% Chebyshev (MVUE) UCL	13458
1530						99% Chebyshev (MVUE) UCL	18484					
1531												
1532	**Nonparametric Distribution Free UCL Statistics**											
1533	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1534												
1535	**Nonparametric Distribution Free UCLs**											
1536						95% CLT UCL	6356				95% Jackknife UCL	6412
1537						95% Standard Bootstrap UCL	6358				95% Bootstrap-t UCL	6891
1538						95% Hall's Bootstrap UCL	6632				95% Percentile Bootstrap UCL	6355
1539						95% BCA Bootstrap UCL	6547					
1540						90% Chebyshev(Mean, Sd) UCL	7697				95% Chebyshev(Mean, Sd) UCL	9041
1541						97.5% Chebyshev(Mean, Sd) UCL	10907				99% Chebyshev(Mean, Sd) UCL	14572

1542												
1543						**Suggested UCL to Use**						
1544					95% Adjusted Gamma UCL	7017						
1545												
1546	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1547	Recommendations are based upon data size, data distribution, and skewness.											
1548	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1549	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1550												
1551	**Result (eu2_antimony_overbank)**											
1552												
1553	**General Statistics**											
1554					Total Number of Observations	32			Number of Distinct Observations	25		
1555					Number of Detects	21			Number of Non-Detects	11		
1556					Number of Distinct Detects	19			Number of Distinct Non-Detects	6		
1557					Minimum Detect	0.516			Minimum Non-Detect	0.031		
1558					Maximum Detect	26.5			Maximum Non-Detect	0.075		
1559					Variance Detects	37.54			Percent Non-Detects	34.38%		
1560					Mean Detects	4.014			SD Detects	6.127		
1561					Median Detects	2			CV Detects	1.526		
1562					Skewness Detects	3.062			Kurtosis Detects	9.713		
1563					Mean of Logged Detects	0.792			SD of Logged Detects	1.014		
1564												
1565	**Normal GOF Test on Detects Only**											
1566					Shapiro Wilk Test Statistic	0.552			**Shapiro Wilk GOF Test**			
1567					5% Shapiro Wilk Critical Value	0.908			Detected Data Not Normal at 5% Significance Level			
1568					Lilliefors Test Statistic	0.371			**Lilliefors GOF Test**			
1569					5% Lilliefors Critical Value	0.188			Detected Data Not Normal at 5% Significance Level			
1570	**Detected Data Not Normal at 5% Significance Level**											
1571												
1572	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1573					KM Mean	2.645			KM Standard Error of Mean	0.942		
1574					KM SD	5.2			95% KM (BCA) UCL	4.457		
1575					95% KM (t) UCL	4.242			95% KM (Percentile Bootstrap) UCL	4.318		
1576					95% KM (z) UCL	4.194			95% KM Bootstrap t UCL	7.139		
1577					90% KM Chebyshev UCL	5.471			95% KM Chebyshev UCL	6.751		
1578					97.5% KM Chebyshev UCL	8.528			99% KM Chebyshev UCL	12.02		
1579												
1580	**Gamma GOF Tests on Detected Observations Only**											
1581					A-D Test Statistic	1.242			**Anderson-Darling GOF Test**			
1582					5% A-D Critical Value	0.771			Detected Data Not Gamma Distributed at 5% Significance Level			
1583					K-S Test Statistic	0.243			**Kolmogorov-Smirnov GOF**			
1584					5% K-S Critical Value	0.195			Detected Data Not Gamma Distributed at 5% Significance Level			
1585	**Detected Data Not Gamma Distributed at 5% Significance Level**											
1586												
1587	**Gamma Statistics on Detected Data Only**											
1588					k hat (MLE)	0.969			k star (bias corrected MLE)	0.862		
1589					Theta hat (MLE)	4.142			Theta star (bias corrected MLE)	4.655		
1590					nu hat (MLE)	40.7			nu star (bias corrected)	36.22		
1591					Mean (detects)	4.014						
1592												
1593	**Gamma ROS Statistics using Imputed Non-Detects**											
1594	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1595	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)											
1596	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1597	This is especially true when the sample size is small.											
1598	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1599					Minimum	0.01			Mean	2.638		
1600					Maximum	26.5			Median	1.1		
1601					SD	5.287			CV	2.004		
1602					k hat (MLE)	0.333			k star (bias corrected MLE)	0.323		
1603					Theta hat (MLE)	7.913			Theta star (bias corrected MLE)	8.168		
1604					nu hat (MLE)	21.34			nu star (bias corrected)	20.67		
1605					Adjusted Level of Significance (β)	0.0416						
1606					Approximate Chi Square Value (20.67, α)	11.35			Adjusted Chi Square Value (20.67, β)	10.98		
1607					95% Gamma Approximate UCL (use when n>=50)	4.806			95% Gamma Adjusted UCL (use when n<50)	4.968		
1608												

1609	**Estimates of Gamma Parameters using KM Estimates**											
1610					Mean (KM)	2.645				SD (KM)	5.2	
1611					Variance (KM)	27.04				SE of Mean (KM)	0.942	
1612					k hat (KM)	0.259				k star (KM)	0.255	
1613					nu hat (KM)	16.56				nu star (KM)	16.34	
1614					theta hat (KM)	10.22				theta star (KM)	10.36	
1615					80% gamma percentile (KM)	3.87				90% gamma percentile (KM)	7.927	
1616					95% gamma percentile (KM)	12.72				99% gamma percentile (KM)	25.45	
1617												
1618	**Gamma Kaplan-Meier (KM) Statistics**											
1619					Approximate Chi Square Value (16.34, α)	8.202				Adjusted Chi Square Value (16.34, β)	7.894	
1620	5% Gamma Approximate KM-UCL (use when n>=50)					5.269				95% Gamma Adjusted KM-UCL (use when n<50)	5.475	
1621												
1622	**Lognormal GOF Test on Detected Observations Only**											
1623					Shapiro Wilk Test Statistic	0.941				**Shapiro Wilk GOF Test**		
1624					5% Shapiro Wilk Critical Value	0.908				Detected Data appear Lognormal at 5% Significance Level		
1625					Lilliefors Test Statistic	0.153				**Lilliefors GOF Test**		
1626					5% Lilliefors Critical Value	0.188				Detected Data appear Lognormal at 5% Significance Level		
1627	**Detected Data appear Lognormal at 5% Significance Level**											
1628												
1629	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1630					Mean in Original Scale	2.705				Mean in Log Scale	-0.0454	
1631					SD in Original Scale	5.253				SD in Log Scale	1.447	
1632					95% t UCL (assumes normality of ROS data)	4.28				95% Percentile Bootstrap UCL	4.405	
1633					95% BCA Bootstrap UCL	4.985				95% Bootstrap t UCL	7.403	
1634					95% H-UCL (Log ROS)	5.963						
1635												
1636	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1637					KM Mean (logged)	-0.674				KM Geo Mean	0.509	
1638					KM SD (logged)	2.179				95% Critical H Value (KM-Log)	4.107	
1639					KM Standard Error of Mean (logged)	0.395				95% H-UCL (KM -Log)	27.29	
1640					KM SD (logged)	2.179				95% Critical H Value (KM-Log)	4.107	
1641					KM Standard Error of Mean (logged)	0.395						
1642												
1643	**DL/2 Statistics**											
1644	**DL/2 Normal**									**DL/2 Log-Transformed**		
1645					Mean in Original Scale	2.641				Mean in Log Scale	-0.864	
1646					SD in Original Scale	5.286				SD in Log Scale	2.467	
1647					95% t UCL (Assumes normality)	4.225				95% H-Stat UCL	66.77	
1648	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1649												
1650	**Nonparametric Distribution Free UCL Statistics**											
1651	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
1652												
1653	**Suggested UCL to Use**											
1654					KM H-UCL	27.29						
1655												
1656	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1657	Recommendations are based upon data size, data distribution, and skewness.											
1658	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1659	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1660												
1661	**Result (eu2_antimony_waste rock)**											
1662												
1663	**General Statistics**											
1664					Total Number of Observations	53				Number of Distinct Observations	46	
1665					Number of Detects	47				Number of Non-Detects	6	
1666					Number of Distinct Detects	41				Number of Distinct Non-Detects	5	
1667					Minimum Detect	1.4				Minimum Non-Detect	0.494	
1668					Maximum Detect	62.9				Maximum Non-Detect	1.2	
1669					Variance Detects	147.2				Percent Non-Detects	11.32%	
1670					Mean Detects	15.97				SD Detects	12.13	
1671					Median Detects	12.5				CV Detects	0.76	
1672					Skewness Detects	1.755				Kurtosis Detects	4.134	
1673					Mean of Logged Detects	2.495				SD of Logged Detects	0.799	
1674												
1675	**Normal GOF Test on Detects Only**											

1676				Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**						
1677				5% Shapiro Wilk Critical Value	0.946	Detected Data Not Normal at 5% Significance Level						
1678				Lilliefors Test Statistic	0.16	**Lilliefors GOF Test**						
1679				5% Lilliefors Critical Value	0.128	Detected Data Not Normal at 5% Significance Level						
1680				**Detected Data Not Normal at 5% Significance Level**								
1681												
1682				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
1683				KM Mean	14.22	KM Standard Error of Mean	1.711					
1684				KM SD	12.32	95% KM (BCA) UCL	17.13					
1685				95% KM (t) UCL	17.08	95% KM (Percentile Bootstrap) UCL	17					
1686				95% KM (z) UCL	17.03	95% KM Bootstrap t UCL	17.72					
1687				90% KM Chebyshev UCL	19.35	95% KM Chebyshev UCL	21.68					
1688				97.5% KM Chebyshev UCL	24.9	99% KM Chebyshev UCL	31.24					
1689												
1690				**Gamma GOF Tests on Detected Observations Only**								
1691				A-D Test Statistic	0.255	**Anderson-Darling GOF Test**						
1692				5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Lev						
1693				K-S Test Statistic	0.0792	**Kolmogorov-Smirnov GOF**						
1694				5% K-S Critical Value	0.131	Detected data appear Gamma Distributed at 5% Significance Lev						
1695				**Detected data appear Gamma Distributed at 5% Significance Level**								
1696												
1697				**Gamma Statistics on Detected Data Only**								
1698				k hat (MLE)	1.962	k star (bias corrected MLE)	1.851					
1699				Theta hat (MLE)	8.139	Theta star (bias corrected MLE)	8.627					
1700				nu hat (MLE)	184.5	nu star (bias corrected)	174					
1701				Mean (detects)	15.97							
1702												
1703				**Gamma ROS Statistics using Imputed Non-Detects**								
1704				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
1705				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)								
1706				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
1707				This is especially true when the sample size is small.								
1708				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
1709				Minimum	0.01	Mean	14.17					
1710				Maximum	62.9	Median	11					
1711				SD	12.5	CV	0.882					
1712				k hat (MLE)	0.638	k star (bias corrected MLE)	0.615					
1713				Theta hat (MLE)	22.2	Theta star (bias corrected MLE)	23.05					
1714				nu hat (MLE)	67.64	nu star (bias corrected)	65.14					
1715				Adjusted Level of Significance (β)	0.0455							
1716				Approximate Chi Square Value (65.14, α)	47.57	Adjusted Chi Square Value (65.14, β)	47.15					
1717				95% Gamma Approximate UCL (use when n>=50)	19.4	95% Gamma Adjusted UCL (use when n<50)	19.57					
1718												
1719				**Estimates of Gamma Parameters using KM Estimates**								
1720				Mean (KM)	14.22	SD (KM)	12.32					
1721				Variance (KM)	151.8	SE of Mean (KM)	1.711					
1722				k hat (KM)	1.332	k star (KM)	1.269					
1723				nu hat (KM)	141.2	nu star (KM)	134.6					
1724				theta hat (KM)	10.67	theta star (KM)	11.2					
1725				80% gamma percentile (KM)	22.39	90% gamma percentile (KM)	30.87					
1726				95% gamma percentile (KM)	39.2	99% gamma percentile (KM)	58.21					
1727												
1728				**Gamma Kaplan-Meier (KM) Statistics**								
1729				Approximate Chi Square Value (134.56, α)	108.8	Adjusted Chi Square Value (134.56, β)	108.1					
1730				5% Gamma Approximate KM-UCL (use when n>=50)	17.59	95% Gamma Adjusted KM-UCL (use when n<50)	17.7					
1731												
1732				**Lognormal GOF Test on Detected Observations Only**								
1733				Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**						
1734				5% Shapiro Wilk Critical Value	0.946	Detected Data appear Lognormal at 5% Significance Level						
1735				Lilliefors Test Statistic	0.0763	**Lilliefors GOF Test**						
1736				5% Lilliefors Critical Value	0.128	Detected Data appear Lognormal at 5% Significance Level						
1737				**Detected Data appear Lognormal at 5% Significance Level**								
1738												
1739				**Lognormal ROS Statistics Using Imputed Non-Detects**								
1740				Mean in Original Scale	14.41	Mean in Log Scale	2.298					
1741				SD in Original Scale	12.24	SD in Log Scale	0.936					
1742				95% t UCL (assumes normality of ROS data)	17.22	95% Percentile Bootstrap UCL	17.15					

1743				95% BCA Bootstrap UCL	17.61				95% Bootstrap t UCL	18.01		
1744				95% H-UCL (Log ROS)	20.64							
1745												
1746	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1747				KM Mean (logged)	2.133				KM Geo Mean	8.437		
1748				KM SD (logged)	1.258				95% Critical H Value (KM-Log)	2.651		
1749				KM Standard Error of Mean (logged)	0.175				95% H-UCL (KM -Log)	29.55		
1750				KM SD (logged)	1.258				95% Critical H Value (KM-Log)	2.651		
1751				KM Standard Error of Mean (logged)	0.175							
1752												
1753	**DL/2 Statistics**											
1754	**DL/2 Normal**								**DL/2 Log-Transformed**			
1755				Mean in Original Scale	14.2				Mean in Log Scale	2.087		
1756				SD in Original Scale	12.46				SD in Log Scale	1.383		
1757				95% t UCL (Assumes normality)	17.07				95% H-Stat UCL	35.96		
1758	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1759												
1760	**Nonparametric Distribution Free UCL Statistics**											
1761	**Detected Data appear Gamma Distributed at 5% Significance Level**											
1762												
1763	**Suggested UCL to Use**											
1764				95% KM Approximate Gamma UCL	17.59				95% GROS Approximate Gamma UCL	19.4		
1765												
1766	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1767	Recommendations are based upon data size, data distribution, and skewness.											
1768	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1769	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1770												
1771												
1772	**Result (eu2_arsenic_overbank)**											
1773												
1774	**General Statistics**											
1775				Total Number of Observations	34				Number of Distinct Observations	34		
1776									Number of Missing Observations	0		
1777				Minimum	5.1				Mean	34.96		
1778				Maximum	445				Median	20.8		
1779				SD	73.6				Std. Error of Mean	12.62		
1780				Coefficient of Variation	2.105				Skewness	5.549		
1781												
1782	**Normal GOF Test**											
1783				Shapiro Wilk Test Statistic	0.318				**Shapiro Wilk GOF Test**			
1784				5% Shapiro Wilk Critical Value	0.933				Data Not Normal at 5% Significance Level			
1785				Lilliefors Test Statistic	0.384				**Lilliefors GOF Test**			
1786				5% Lilliefors Critical Value	0.15				Data Not Normal at 5% Significance Level			
1787	**Data Not Normal at 5% Significance Level**											
1788												
1789	**Assuming Normal Distribution**											
1790	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
1791				95% Student's-t UCL	56.33				95% Adjusted-CLT UCL (Chen-1995)	68.56		
1792									95% Modified-t UCL (Johnson-1978)	58.33		
1793												
1794	**Gamma GOF Test**											
1795				A-D Test Statistic	2.581				**Anderson-Darling Gamma GOF Test**			
1796				5% A-D Critical Value	0.774				Data Not Gamma Distributed at 5% Significance Level			
1797				K-S Test Statistic	0.203				**Kolmogorov-Smirnov Gamma GOF Test**			
1798				5% K-S Critical Value	0.155				Data Not Gamma Distributed at 5% Significance Level			
1799	**Data Not Gamma Distributed at 5% Significance Level**											
1800												
1801	**Gamma Statistics**											
1802				k hat (MLE)	1.087				k star (bias corrected MLE)	1.011		
1803				Theta hat (MLE)	32.16				Theta star (bias corrected MLE)	34.59		
1804				nu hat (MLE)	73.92				nu star (bias corrected)	68.73		
1805				MLE Mean (bias corrected)	34.96				MLE Sd (bias corrected)	34.78		
1806									Approximate Chi Square Value (0.05)	50.65		
1807				Adjusted Level of Significance	0.0422				Adjusted Chi Square Value	49.88		
1808												
1809	**Assuming Gamma Distribution**											

1810	95% Approximate Gamma UCL (use when n>=50))					47.45	95% Adjusted Gamma UCL (use when n<50)					48.18
1811												
1812	**Lognormal GOF Test**											
1813	Shapiro Wilk Test Statistic					0.909	**Shapiro Wilk Lognormal GOF Test**					
1814	5% Shapiro Wilk Critical Value					0.933	Data Not Lognormal at 5% Significance Level					
1815	Lilliefors Test Statistic					0.108	**Lilliefors Lognormal GOF Test**					
1816	5% Lilliefors Critical Value					0.15	Data appear Lognormal at 5% Significance Level					
1817	**Data appear Approximate Lognormal at 5% Significance Level**											
1818												
1819	**Lognormal Statistics**											
1820	Minimum of Logged Data					1.629	Mean of logged Data					3.028
1821	Maximum of Logged Data					6.098	SD of logged Data					0.827
1822												
1823	**Assuming Lognormal Distribution**											
1824	95% H-UCL					40.23	90% Chebyshev (MVUE) UCL					42.34
1825	95% Chebyshev (MVUE) UCL					48.51	97.5% Chebyshev (MVUE) UCL					57.07
1826	99% Chebyshev (MVUE) UCL					73.89						
1827												
1828	**Nonparametric Distribution Free UCL Statistics**											
1829	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1830												
1831	**Nonparametric Distribution Free UCLs**											
1832	95% CLT UCL					55.73	95% Jackknife UCL					56.33
1833	95% Standard Bootstrap UCL					55.31	95% Bootstrap-t UCL					128.9
1834	95% Hall's Bootstrap UCL					137.3	95% Percentile Bootstrap UCL					58.94
1835	95% BCA Bootstrap UCL					75.02						
1836	90% Chebyshev(Mean, Sd) UCL					72.83	95% Chebyshev(Mean, Sd) UCL					89.99
1837	97.5% Chebyshev(Mean, Sd) UCL					113.8	99% Chebyshev(Mean, Sd) UCL					160.6
1838												
1839	**Suggested UCL to Use**											
1840	95% H-UCL					40.23						
1841												
1842	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1843	Recommendations are based upon data size, data distribution, and skewness.											
1844	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1845	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1846												
1847	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
1848	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
1849	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
1850	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
1851												
1852												
1853	**Result (eu2_arsenic_waste rock)**											
1854												
1855	**General Statistics**											
1856	Total Number of Observations					53	Number of Distinct Observations					52
1857							Number of Missing Observations					0
1858	Minimum					5.5	Mean					35.61
1859	Maximum					128	Median					34.9
1860	SD					21.27	Std. Error of Mean					2.922
1861	Coefficient of Variation					0.597	Skewness					1.623
1862												
1863	**Normal GOF Test**											
1864	Shapiro Wilk Test Statistic					0.872	**Shapiro Wilk GOF Test**					
1865	5% Shapiro Wilk P Value					6.3091E-6	Data Not Normal at 5% Significance Level					
1866	Lilliefors Test Statistic					0.152	**Lilliefors GOF Test**					
1867	5% Lilliefors Critical Value					0.121	Data Not Normal at 5% Significance Level					
1868	**Data Not Normal at 5% Significance Level**											
1869												
1870	**Assuming Normal Distribution**											
1871	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1872	95% Student's-t UCL					40.5	95% Adjusted-CLT UCL (Chen-1995)					41.11
1873							95% Modified-t UCL (Johnson-1978)					40.61
1874												
1875	**Gamma GOF Test**											
1876	A-D Test Statistic					1.855	**Anderson-Darling Gamma GOF Test**					

1877				5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level						
1878				K-S Test Statistic	0.183	**Kolmogorov-Smirnov Gamma GOF Test**						
1879				5% K-S Critical Value	0.123	Data Not Gamma Distributed at 5% Significance Level						
1880	**Data Not Gamma Distributed at 5% Significance Level**											
1881												
1882	**Gamma Statistics**											
1883				k hat (MLE)	2.674	k star (bias corrected MLE)	2.535					
1884				Theta hat (MLE)	13.32	Theta star (bias corrected MLE)	14.05					
1885				nu hat (MLE)	283.4	nu star (bias corrected)	268.7					
1886				MLE Mean (bias corrected)	35.61	MLE Sd (bias corrected)	22.37					
1887						Approximate Chi Square Value (0.05)	231.8					
1888				Adjusted Level of Significance	0.0455	Adjusted Chi Square Value	230.8					
1889												
1890	**Assuming Gamma Distribution**											
1891	95% Approximate Gamma UCL (use when n>=50))				41.29	95% Adjusted Gamma UCL (use when n<50)	41.46					
1892												
1893	**Lognormal GOF Test**											
1894				Shapiro Wilk Test Statistic	0.887	**Shapiro Wilk Lognormal GOF Test**						
1895				5% Shapiro Wilk P Value	3.2085E-5	Data Not Lognormal at 5% Significance Level						
1896				Lilliefors Test Statistic	0.227	**Lilliefors Lognormal GOF Test**						
1897				5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level						
1898	**Data Not Lognormal at 5% Significance Level**											
1899												
1900	**Lognormal Statistics**											
1901				Minimum of Logged Data	1.705	Mean of logged Data	3.374					
1902				Maximum of Logged Data	4.852	SD of logged Data	0.697					
1903												
1904	**Assuming Lognormal Distribution**											
1905				95% H-UCL	45.29	90% Chebyshev (MVUE) UCL	48.67					
1906				95% Chebyshev (MVUE) UCL	53.94	97.5% Chebyshev (MVUE) UCL	61.26					
1907				99% Chebyshev (MVUE) UCL	75.64							
1908												
1909	**Nonparametric Distribution Free UCL Statistics**											
1910	**Data do not follow a Discernible Distribution (0.05)**											
1911												
1912	**Nonparametric Distribution Free UCLs**											
1913				95% CLT UCL	40.42	95% Jackknife UCL	40.5					
1914				95% Standard Bootstrap UCL	40.43	95% Bootstrap-t UCL	41.18					
1915				95% Hall's Bootstrap UCL	41.54	95% Percentile Bootstrap UCL	40.48					
1916				95% BCA Bootstrap UCL	40.87							
1917				90% Chebyshev(Mean, Sd) UCL	44.38	95% Chebyshev(Mean, Sd) UCL	48.35					
1918				97.5% Chebyshev(Mean, Sd) UCL	53.86	99% Chebyshev(Mean, Sd) UCL	64.68					
1919												
1920	**Suggested UCL to Use**											
1921				95% Chebyshev (Mean, Sd) UCL	48.35							
1922												
1923	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1924	Recommendations are based upon data size, data distribution, and skewness.											
1925	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1926	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1927												
1928	**Result (eu2_cadmium_overbank)**											
1929												
1930	**General Statistics**											
1931				Total Number of Observations	34	Number of Distinct Observations	32					
1932				Number of Detects	30	Number of Non-Detects	4					
1933				Number of Distinct Detects	28	Number of Distinct Non-Detects	4					
1934				Minimum Detect	0.55	Minimum Non-Detect	0.044					
1935				Maximum Detect	20.8	Maximum Non-Detect	0.1					
1936				Variance Detects	34.31	Percent Non-Detects	11.76%					
1937				Mean Detects	6.348	SD Detects	5.858					
1938				Median Detects	4.1	CV Detects	0.923					
1939				Skewness Detects	1.016	Kurtosis Detects	0.29					
1940				Mean of Logged Detects	1.326	SD of Logged Detects	1.133					
1941												
1942	**Normal GOF Test on Detects Only**											
1943				Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**						

1944			5% Shapiro Wilk Critical Value		0.927	Detected Data Not Normal at 5% Significance Level						
1945			Lilliefors Test Statistic		0.211	**Lilliefors GOF Test**						
1946			5% Lilliefors Critical Value		0.159	Detected Data Not Normal at 5% Significance Level						
1947			**Detected Data Not Normal at 5% Significance Level**									
1948												
1949			**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**									
1950			KM Mean		5.606	KM Standard Error of Mean						1.008
1951			KM SD		5.778	95% KM (BCA) UCL						7.272
1952			95% KM (t) UCL		7.312	95% KM (Percentile Bootstrap) UCL						7.307
1953			95% KM (z) UCL		7.264	95% KM Bootstrap t UCL						7.611
1954			90% KM Chebyshev UCL		8.63	95% KM Chebyshev UCL						10
1955			97.5% KM Chebyshev UCL		11.9	99% KM Chebyshev UCL						15.63
1956												
1957			**Gamma GOF Tests on Detected Observations Only**									
1958			A-D Test Statistic		0.695	**Anderson-Darling GOF Test**						
1959			5% A-D Critical Value		0.773	Detected data appear Gamma Distributed at 5% Significance Lev						
1960			K-S Test Statistic		0.16	**Kolmogorov-Smirnov GOF**						
1961			5% K-S Critical Value		0.164	Detected data appear Gamma Distributed at 5% Significance Lev						
1962			**Detected data appear Gamma Distributed at 5% Significance Level**									
1963												
1964			**Gamma Statistics on Detected Data Only**									
1965			k hat (MLE)		1.095	k star (bias corrected MLE)						1.008
1966			Theta hat (MLE)		5.798	Theta star (bias corrected MLE)						6.3
1967			nu hat (MLE)		65.69	nu star (bias corrected)						60.46
1968			Mean (detects)		6.348							
1969												
1970			**Gamma ROS Statistics using Imputed Non-Detects**									
1971			GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs									
1972			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)									
1973			For such situations, GROS method may yield incorrect values of UCLs and BTVs									
1974			This is especially true when the sample size is small.									
1975			For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates									
1976			Minimum		0.01	Mean						5.602
1977			Maximum		20.8	Median						2.5
1978			SD		5.869	CV						1.048
1979			k hat (MLE)		0.569	k star (bias corrected MLE)						0.538
1980			Theta hat (MLE)		9.846	Theta star (bias corrected MLE)						10.41
1981			nu hat (MLE)		38.69	nu star (bias corrected)						36.61
1982			Adjusted Level of Significance (β)		0.0422							
1983			Approximate Chi Square Value (36.61, α)		23.76	Adjusted Chi Square Value (36.61, β)						23.25
1984			95% Gamma Approximate UCL (use when n>=50)		8.632	95% Gamma Adjusted UCL (use when n<50)						8.822
1985												
1986			**Estimates of Gamma Parameters using KM Estimates**									
1987			Mean (KM)		5.606	SD (KM)						5.778
1988			Variance (KM)		33.39	SE of Mean (KM)						1.008
1989			k hat (KM)		0.941	k star (KM)						0.878
1990			nu hat (KM)		64	nu star (KM)						59.69
1991			theta hat (KM)		5.956	theta star (KM)						6.387
1992			80% gamma percentile (KM)		9.11	90% gamma percentile (KM)						13.33
1993			95% gamma percentile (KM)		17.59	99% gamma percentile (KM)						27.59
1994												
1995			**Gamma Kaplan-Meier (KM) Statistics**									
1996			Approximate Chi Square Value (59.69, α)		42.92	Adjusted Chi Square Value (59.69, β)						42.22
1997	5% Gamma Approximate KM-UCL (use when n>=50)				7.796	95% Gamma Adjusted KM-UCL (use when n<50)						7.926
1998												
1999			**Lognormal GOF Test on Detected Observations Only**									
2000			Shapiro Wilk Test Statistic		0.925	**Shapiro Wilk GOF Test**						
2001			5% Shapiro Wilk Critical Value		0.927	Detected Data Not Lognormal at 5% Significance Level						
2002			Lilliefors Test Statistic		0.149	**Lilliefors GOF Test**						
2003			5% Lilliefors Critical Value		0.159	Detected Data appear Lognormal at 5% Significance Level						
2004			**Detected Data appear Approximate Lognormal at 5% Significance Level**									
2005												
2006			**Lognormal ROS Statistics Using Imputed Non-Detects**									
2007			Mean in Original Scale		5.637	Mean in Log Scale						1.031
2008			SD in Original Scale		5.836	SD in Log Scale						1.343
2009			95% t UCL (assumes normality of ROS data)		7.331	95% Percentile Bootstrap UCL						7.298
2010			95% BCA Bootstrap UCL		7.515	95% Bootstrap t UCL						7.65

2011				95% H-UCL (Log ROS)	13.59							
2012												
2013	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2014				KM Mean (logged)	0.803				KM Geo Mean	2.232		
2015				KM SD (logged)	1.775				95% Critical H Value (KM-Log)	3.524		
2016				KM Standard Error of Mean (logged)	0.31				95% H-UCL (KM -Log)	32.02		
2017				KM SD (logged)	1.775				95% Critical H Value (KM-Log)	3.524		
2018				KM Standard Error of Mean (logged)	0.31							
2019												
2020	**DL/2 Statistics**											
2021	**DL/2 Normal**								**DL/2 Log-Transformed**			
2022				Mean in Original Scale	5.604				Mean in Log Scale	0.75		
2023				SD in Original Scale	5.867				SD in Log Scale	1.925		
2024				95% t UCL (Assumes normality)	7.307				95% H-Stat UCL	47.46		
2025	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
2026												
2027	**Nonparametric Distribution Free UCL Statistics**											
2028	**Detected Data appear Gamma Distributed at 5% Significance Level**											
2029												
2030	**Suggested UCL to Use**											
2031				95% KM Adjusted Gamma UCL	7.926				95% GROS Adjusted Gamma UCL	8.822		
2032												
2033	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2034	Recommendations are based upon data size, data distribution, and skewness.											
2035	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2036	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2037												
2038												
2039	**Result (eu2_cadmium_waste rock)**											
2040												
2041	**General Statistics**											
2042				Total Number of Observations	53				Number of Distinct Observations	48		
2043									Number of Missing Observations	0		
2044				Minimum	0.86				Mean	13.88		
2045				Maximum	104				Median	11.8		
2046				SD	15.69				Std. Error of Mean	2.155		
2047				Coefficient of Variation	1.13				Skewness	4.013		
2048												
2049	**Normal GOF Test**											
2050				Shapiro Wilk Test Statistic	0.628				**Shapiro Wilk GOF Test**			
2051				5% Shapiro Wilk P Value	3.331E-16				Data Not Normal at 5% Significance Level			
2052				Lilliefors Test Statistic	0.26				**Lilliefors GOF Test**			
2053				5% Lilliefors Critical Value	0.121				Data Not Normal at 5% Significance Level			
2054	**Data Not Normal at 5% Significance Level**											
2055												
2056	**Assuming Normal Distribution**											
2057	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
2058				95% Student's-t UCL	17.49				95% Adjusted-CLT UCL (Chen-1995)	18.69		
2059									95% Modified-t UCL (Johnson-1978)	17.69		
2060												
2061	**Gamma GOF Test**											
2062				A-D Test Statistic	1.189				**Anderson-Darling Gamma GOF Test**			
2063				5% A-D Critical Value	0.773				Data Not Gamma Distributed at 5% Significance Level			
2064				K-S Test Statistic	0.14				**Kolmogorov-Smirnov Gamma GOF Test**			
2065				5% K-S Critical Value	0.125				Data Not Gamma Distributed at 5% Significance Level			
2066	**Data Not Gamma Distributed at 5% Significance Level**											
2067												
2068	**Gamma Statistics**											
2069				k hat (MLE)	1.282				k star (bias corrected MLE)	1.222		
2070				Theta hat (MLE)	10.82				Theta star (bias corrected MLE)	11.36		
2071				nu hat (MLE)	135.9				nu star (bias corrected)	129.6		
2072				MLE Mean (bias corrected)	13.88				MLE Sd (bias corrected)	12.55		
2073									Approximate Chi Square Value (0.05)	104.3		
2074				Adjusted Level of Significance	0.0455				Adjusted Chi Square Value	103.6		
2075												
2076	**Assuming Gamma Distribution**											
2077	95% Approximate Gamma UCL (use when n>=50))				17.25				95% Adjusted Gamma UCL (use when n<50)	17.35		

2078												
2079						**Lognormal GOF Test**						
2080					Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk Lognormal GOF Test**					
2081					5% Shapiro Wilk P Value	0.00332	Data Not Lognormal at 5% Significance Level					
2082					Lilliefors Test Statistic	0.178	**Lilliefors Lognormal GOF Test**					
2083					5% Lilliefors Critical Value	0.121	Data Not Lognormal at 5% Significance Level					
2084					**Data Not Lognormal at 5% Significance Level**							
2085												
2086						**Lognormal Statistics**						
2087					Minimum of Logged Data	-0.151	Mean of logged Data	2.192				
2088					Maximum of Logged Data	4.644	SD of logged Data	1.015				
2089												
2090						**Assuming Lognormal Distribution**						
2091					95% H-UCL	20.82	90% Chebyshev (MVUE) UCL	22.09				
2092					95% Chebyshev (MVUE) UCL	25.41	97.5% Chebyshev (MVUE) UCL	30.01				
2093					99% Chebyshev (MVUE) UCL	39.04						
2094												
2095						**Nonparametric Distribution Free UCL Statistics**						
2096						**Data do not follow a Discernible Distribution (0.05)**						
2097												
2098						**Nonparametric Distribution Free UCLs**						
2099					95% CLT UCL	17.43	95% Jackknife UCL	17.49				
2100					95% Standard Bootstrap UCL	17.29	95% Bootstrap-t UCL	20.46				
2101					95% Hall's Bootstrap UCL	33.63	95% Percentile Bootstrap UCL	17.7				
2102					95% BCA Bootstrap UCL	19.26						
2103					90% Chebyshev(Mean, Sd) UCL	20.35	95% Chebyshev(Mean, Sd) UCL	23.27				
2104					97.5% Chebyshev(Mean, Sd) UCL	27.34	99% Chebyshev(Mean, Sd) UCL	35.32				
2105												
2106						**Suggested UCL to Use**						
2107					95% Chebyshev (Mean, Sd) UCL	23.27						
2108												
2109	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2110	Recommendations are based upon data size, data distribution, and skewness.											
2111	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2112	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2113												
2114												
2115	**Result (eu2_chromium_overbank)**											
2116												
2117						**General Statistics**						
2118					Total Number of Observations	34	Number of Distinct Observations	30				
2119							Number of Missing Observations	0				
2120					Minimum	2.2	Mean	5.192				
2121					Maximum	9.7	Median	4.815				
2122					SD	2.073	Std. Error of Mean	0.356				
2123					Coefficient of Variation	0.399	Skewness	0.549				
2124												
2125						**Normal GOF Test**						
2126					Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk GOF Test**					
2127					5% Shapiro Wilk Critical Value	0.933	Data appear Normal at 5% Significance Level					
2128					Lilliefors Test Statistic	0.102	**Lilliefors GOF Test**					
2129					5% Lilliefors Critical Value	0.15	Data appear Normal at 5% Significance Level					
2130						**Data appear Normal at 5% Significance Level**						
2131												
2132						**Assuming Normal Distribution**						
2133					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
2134					95% Student's-t UCL	5.794	95% Adjusted-CLT UCL (Chen-1995)	5.812				
2135							95% Modified-t UCL (Johnson-1978)	5.799				
2136												
2137						**Gamma GOF Test**						
2138					A-D Test Statistic	0.208	**Anderson-Darling Gamma GOF Test**					
2139					5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Lev					
2140					K-S Test Statistic	0.0742	**Kolmogorov-Smirnov Gamma GOF Test**					
2141					5% K-S Critical Value	0.151	Detected data appear Gamma Distributed at 5% Significance Lev					
2142						**Detected data appear Gamma Distributed at 5% Significance Level**						
2143												
2144						**Gamma Statistics**						

	A	B	C	D	E	F	G	H	I	J	K	L
2145					k hat (MLE)	6.463			k star (bias corrected MLE)			5.913
2146					Theta hat (MLE)	0.803			Theta star (bias corrected MLE)			0.878
2147					nu hat (MLE)	439.5			nu star (bias corrected)			402.1
2148					MLE Mean (bias corrected)	5.192			MLE Sd (bias corrected)			2.135
2149									Approximate Chi Square Value (0.05)			356.6
2150					Adjusted Level of Significance	0.0422			Adjusted Chi Square Value			354.5
2151												
2152					**Assuming Gamma Distribution**							
2153					95% Approximate Gamma UCL (use when n>=50))	5.854			95% Adjusted Gamma UCL (use when n<50)			5.889
2154												
2155					**Lognormal GOF Test**							
2156					Shapiro Wilk Test Statistic	0.969			**Shapiro Wilk Lognormal GOF Test**			
2157					5% Shapiro Wilk Critical Value	0.933			Data appear Lognormal at 5% Significance Level			
2158					Lilliefors Test Statistic	0.0756			**Lilliefors Lognormal GOF Test**			
2159					5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level			
2160					**Data appear Lognormal at 5% Significance Level**							
2161												
2162					**Lognormal Statistics**							
2163					Minimum of Logged Data	0.788			Mean of logged Data			1.568
2164					Maximum of Logged Data	2.272			SD of logged Data			0.41
2165												
2166					**Assuming Lognormal Distribution**							
2167					95% H-UCL	5.963			90% Chebyshev (MVUE) UCL			6.335
2168					95% Chebyshev (MVUE) UCL	6.849			97.5% Chebyshev (MVUE) UCL			7.561
2169					99% Chebyshev (MVUE) UCL	8.959						
2170												
2171					**Nonparametric Distribution Free UCL Statistics**							
2172					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
2173												
2174					**Nonparametric Distribution Free UCLs**							
2175					95% CLT UCL	5.777			95% Jackknife UCL			5.794
2176					95% Standard Bootstrap UCL	5.758			95% Bootstrap-t UCL			5.849
2177					95% Hall's Bootstrap UCL	5.847			95% Percentile Bootstrap UCL			5.774
2178					95% BCA Bootstrap UCL	5.81						
2179					90% Chebyshev(Mean, Sd) UCL	6.259			95% Chebyshev(Mean, Sd) UCL			6.742
2180					97.5% Chebyshev(Mean, Sd) UCL	7.412			99% Chebyshev(Mean, Sd) UCL			8.73
2181												
2182					**Suggested UCL to Use**							
2183					95% Student's-t UCL	5.794						
2184												
2185	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2186	Recommendations are based upon data size, data distribution, and skewness.											
2187	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2188	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2189												
2190	**Result (eu2_chromium_waste rock)**											
2191												
2192					**General Statistics**							
2193					Total Number of Observations	53			Number of Distinct Observations			38
2194					Number of Detects	52			Number of Non-Detects			1
2195					Number of Distinct Detects	37			Number of Distinct Non-Detects			1
2196					Minimum Detect	0.65			Minimum Non-Detect			0.16
2197					Maximum Detect	9.8			Maximum Non-Detect			0.16
2198					Variance Detects	3.232			Percent Non-Detects			1.887%
2199					Mean Detects	4.792			SD Detects			1.798
2200					Median Detects	4.9			CV Detects			0.375
2201					Skewness Detects	0.154			Kurtosis Detects			0.849
2202					Mean of Logged Detects	1.474			SD of Logged Detects			0.489
2203												
2204					**Normal GOF Test on Detects Only**							
2205					Shapiro Wilk Test Statistic	0.968			**Normal GOF Test on Detected Observations Only**			
2206					5% Shapiro Wilk P Value	0.309			Detected Data appear Normal at 5% Significance Level			
2207					Lilliefors Test Statistic	0.116			**Lilliefors GOF Test**			
2208					5% Lilliefors Critical Value	0.122			Detected Data appear Normal at 5% Significance Level			
2209					**Detected Data appear Normal at 5% Significance Level**							
2210												
2211					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							

2212					KM Mean	4.704				KM Standard Error of Mean		0.26
2213					KM SD	1.873				95% KM (BCA) UCL		5.111
2214					95% KM (t) UCL	5.139				95% KM (Percentile Bootstrap) UCL		5.143
2215					95% KM (z) UCL	5.132				95% KM Bootstrap t UCL		5.145
2216					90% KM Chebyshev UCL	5.484				95% KM Chebyshev UCL		5.837
2217					97.5% KM Chebyshev UCL	6.327				99% KM Chebyshev UCL		7.289
2218												
2219					**Gamma GOF Tests on Detected Observations Only**							
2220					A-D Test Statistic	1.658				**Anderson-Darling GOF Test**		
2221					5% A-D Critical Value	0.753				Detected Data Not Gamma Distributed at 5% Significance Level		
2222					K-S Test Statistic	0.174				**Kolmogorov-Smirnov GOF**		
2223					5% K-S Critical Value	0.123				Detected Data Not Gamma Distributed at 5% Significance Level		
2224					**Detected Data Not Gamma Distributed at 5% Significance Level**							
2225												
2226					**Gamma Statistics on Detected Data Only**							
2227					k hat (MLE)	5.54				k star (bias corrected MLE)		5.233
2228					Theta hat (MLE)	0.865				Theta star (bias corrected MLE)		0.916
2229					nu hat (MLE)	576.2				nu star (bias corrected)		544.3
2230					Mean (detects)	4.792						
2231												
2232					**Gamma ROS Statistics using Imputed Non-Detects**							
2233					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
2234					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)							
2235					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
2236					This is especially true when the sample size is small.							
2237					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
2238					Minimum	0.65				Mean		4.73
2239					Maximum	9.8				Median		4.9
2240					SD	1.836				CV		0.388
2241					k hat (MLE)	5.17				k star (bias corrected MLE)		4.89
2242					Theta hat (MLE)	0.915				Theta star (bias corrected MLE)		0.967
2243					nu hat (MLE)	548				nu star (bias corrected)		518.3
2244					Adjusted Level of Significance (β)	0.0455						
2245					Approximate Chi Square Value (518.30, α)	466.5				Adjusted Chi Square Value (518.30, β)		465.1
2246					95% Gamma Approximate UCL (use when n>=50)	5.255				95% Gamma Adjusted UCL (use when n<50)		5.271
2247												
2248					**Estimates of Gamma Parameters using KM Estimates**							
2249					Mean (KM)	4.704				SD (KM)		1.873
2250					Variance (KM)	3.507				SE of Mean (KM)		0.26
2251					k hat (KM)	6.31				k star (KM)		5.965
2252					nu hat (KM)	668.8				nu star (KM)		632.3
2253					theta hat (KM)	0.746				theta star (KM)		0.789
2254					80% gamma percentile (KM)	6.203				90% gamma percentile (KM)		7.279
2255					95% gamma percentile (KM)	8.254				99% gamma percentile (KM)		10.3
2256												
2257					**Gamma Kaplan-Meier (KM) Statistics**							
2258					Approximate Chi Square Value (632.31, α)	575				Adjusted Chi Square Value (632.31, β)		573.5
2259					5% Gamma Approximate KM-UCL (use when n>=50)	5.173				95% Gamma Adjusted KM-UCL (use when n<50)		5.187
2260												
2261					**Lognormal GOF Test on Detected Observations Only**							
2262					Shapiro Wilk Approximate Test Statistic	0.859				**Shapiro Wilk GOF Test**		
2263					5% Shapiro Wilk P Value	1.8945E-6				Detected Data Not Lognormal at 5% Significance Level		
2264					Lilliefors Test Statistic	0.208				**Lilliefors GOF Test**		
2265					5% Lilliefors Critical Value	0.122				Detected Data Not Lognormal at 5% Significance Level		
2266					**Detected Data Not Lognormal at 5% Significance Level**							
2267												
2268					**Lognormal ROS Statistics Using Imputed Non-Detects**							
2269					Mean in Original Scale	4.727				Mean in Log Scale		1.452
2270					SD in Original Scale	1.841				SD in Log Scale		0.51
2271					95% t UCL (assumes normality of ROS data)	5.151				95% Percentile Bootstrap UCL		5.131
2272					95% BCA Bootstrap UCL	5.166				95% Bootstrap t UCL		5.161
2273					95% H-UCL (Log ROS)	5.557						
2274												
2275					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
2276					KM Mean (logged)	1.412				KM Geo Mean		4.102
2277					KM SD (logged)	0.658				95% Critical H Value (KM-Log)		1.994
2278					KM Standard Error of Mean (logged)	0.0912				95% H-UCL (KM -Log)		6.108

2279				KM SD (logged)	0.658			95% Critical H Value (KM-Log)				1.994
2280				KM Standard Error of Mean (logged)	0.0912							
2281												
2282				**DL/2 Statistics**								
2283				**DL/2 Normal**				**DL/2 Log-Transformed**				
2284				Mean in Original Scale	4.703			Mean in Log Scale				1.398
2285				SD in Original Scale	1.894			SD in Log Scale				0.732
2286				95% t UCL (Assumes normality)	5.139			95% H-Stat UCL				6.523
2287				**DL/2 is not a recommended method, provided for comparisons and historical reasons**								
2288												
2289				**Nonparametric Distribution Free UCL Statistics**								
2290				**Detected Data appear Normal Distributed at 5% Significance Level**								
2291												
2292				**Suggested UCL to Use**								
2293				95% KM (t) UCL	5.139							
2294												
2295	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2296	Recommendations are based upon data size, data distribution, and skewness.											
2297	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2298	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2299												
2300												
2301	**Result (eu2_cobalt_overbank)**											
2302												
2303				**General Statistics**								
2304				Total Number of Observations	26			Number of Distinct Observations				24
2305								Number of Missing Observations				0
2306				Minimum	4			Mean				11.34
2307				Maximum	25.1			Median				10.25
2308				SD	5.425			Std. Error of Mean				1.064
2309				Coefficient of Variation	0.478			Skewness				0.849
2310												
2311				**Normal GOF Test**								
2312				Shapiro Wilk Test Statistic	0.934			**Shapiro Wilk GOF Test**				
2313				5% Shapiro Wilk Critical Value	0.92			Data appear Normal at 5% Significance Level				
2314				Lilliefors Test Statistic	0.136			**Lilliefors GOF Test**				
2315				5% Lilliefors Critical Value	0.17			Data appear Normal at 5% Significance Level				
2316				**Data appear Normal at 5% Significance Level**								
2317												
2318				**Assuming Normal Distribution**								
2319				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
2320				95% Student's-t UCL	13.16			95% Adjusted-CLT UCL (Chen-1995)				13.28
2321								95% Modified-t UCL (Johnson-1978)				13.19
2322												
2323				**Gamma GOF Test**								
2324				A-D Test Statistic	0.216			**Anderson-Darling Gamma GOF Test**				
2325				5% A-D Critical Value	0.747			Detected data appear Gamma Distributed at 5% Significance Lev				
2326				K-S Test Statistic	0.0759			**Kolmogorov-Smirnov Gamma GOF Test**				
2327				5% K-S Critical Value	0.172			Detected data appear Gamma Distributed at 5% Significance Lev				
2328				**Detected data appear Gamma Distributed at 5% Significance Level**								
2329												
2330				**Gamma Statistics**								
2331				k hat (MLE)	4.697			k star (bias corrected MLE)				4.181
2332				Theta hat (MLE)	2.414			Theta star (bias corrected MLE)				2.712
2333				nu hat (MLE)	244.2			nu star (bias corrected)				217.4
2334				MLE Mean (bias corrected)	11.34			MLE Sd (bias corrected)				5.545
2335								Approximate Chi Square Value (0.05)				184.3
2336				Adjusted Level of Significance	0.0398			Adjusted Chi Square Value				182.3
2337												
2338				**Assuming Gamma Distribution**								
2339				95% Approximate Gamma UCL (use when n>=50))	13.38			95% Adjusted Gamma UCL (use when n<50)				13.52
2340												
2341				**Lognormal GOF Test**								
2342				Shapiro Wilk Test Statistic	0.976			**Shapiro Wilk Lognormal GOF Test**				
2343				5% Shapiro Wilk Critical Value	0.92			Data appear Lognormal at 5% Significance Level				
2344				Lilliefors Test Statistic	0.0942			**Lilliefors Lognormal GOF Test**				
2345				5% Lilliefors Critical Value	0.17			Data appear Lognormal at 5% Significance Level				

	A	B	C	D	E	F	G	H	I	J	K	L
2346	**Data appear Lognormal at 5% Significance Level**											
2347												
2348	**Lognormal Statistics**											
2349					Minimum of Logged Data	1.386			Mean of logged Data	2.318		
2350					Maximum of Logged Data	3.223			SD of logged Data	0.486		
2351												
2352	**Assuming Lognormal Distribution**											
2353					95% H-UCL	13.82			90% Chebyshev (MVUE) UCL	14.75		
2354					95% Chebyshev (MVUE) UCL	16.28			97.5% Chebyshev (MVUE) UCL	18.41		
2355					99% Chebyshev (MVUE) UCL	22.58						
2356												
2357	**Nonparametric Distribution Free UCL Statistics**											
2358	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2359												
2360	**Nonparametric Distribution Free UCLs**											
2361					95% CLT UCL	13.09			95% Jackknife UCL	13.16		
2362					95% Standard Bootstrap UCL	13.05			95% Bootstrap-t UCL	13.35		
2363					95% Hall's Bootstrap UCL	13.35			95% Percentile Bootstrap UCL	13.19		
2364					95% BCA Bootstrap UCL	13.27						
2365					90% Chebyshev(Mean, Sd) UCL	14.53			95% Chebyshev(Mean, Sd) UCL	15.98		
2366					97.5% Chebyshev(Mean, Sd) UCL	17.98			99% Chebyshev(Mean, Sd) UCL	21.92		
2367												
2368	**Suggested UCL to Use**											
2369					95% Student's-t UCL	13.16						
2370												
2371	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2372	Recommendations are based upon data size, data distribution, and skewness.											
2373	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2374	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2375												
2376	**Result (eu2_cobalt_waste rock)**											
2377												
2378	**General Statistics**											
2379					Total Number of Observations	49			Number of Distinct Observations	42		
2380					Number of Detects	48			Number of Non-Detects	1		
2381					Number of Distinct Detects	41			Number of Distinct Non-Detects	1		
2382					Minimum Detect	0.57			Minimum Non-Detect	0.9		
2383					Maximum Detect	18.9			Maximum Non-Detect	0.9		
2384					Variance Detects	29.08			Percent Non-Detects	2.041%		
2385					Mean Detects	9.431			SD Detects	5.392		
2386					Median Detects	10.6			CV Detects	0.572		
2387					Skewness Detects	-0.129			Kurtosis Detects	-1.243		
2388					Mean of Logged Detects	1.973			SD of Logged Detects	0.877		
2389												
2390	**Normal GOF Test on Detects Only**											
2391					Shapiro Wilk Test Statistic	0.926			**Shapiro Wilk GOF Test**			
2392					5% Shapiro Wilk Critical Value	0.947			Detected Data Not Normal at 5% Significance Level			
2393					Lilliefors Test Statistic	0.123			**Lilliefors GOF Test**			
2394					5% Lilliefors Critical Value	0.127			Detected Data appear Normal at 5% Significance Level			
2395	**Detected Data appear Approximate Normal at 5% Significance Level**											
2396												
2397	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2398					KM Mean	9.251			KM Standard Error of Mean	0.783		
2399					KM SD	5.425			95% KM (BCA) UCL	10.57		
2400					95% KM (t) UCL	10.56			95% KM (Percentile Bootstrap) UCL	10.53		
2401					95% KM (z) UCL	10.54			95% KM Bootstrap t UCL	10.51		
2402					90% KM Chebyshev UCL	11.6			95% KM Chebyshev UCL	12.67		
2403					97.5% KM Chebyshev UCL	14.14			99% KM Chebyshev UCL	17.04		
2404												
2405	**Gamma GOF Tests on Detected Observations Only**											
2406					A-D Test Statistic	1.816			**Anderson-Darling GOF Test**			
2407					5% A-D Critical Value	0.762			Detected Data Not Gamma Distributed at 5% Significance Level			
2408					K-S Test Statistic	0.188			**Kolmogorov-Smirnov GOF**			
2409					5% K-S Critical Value	0.13			Detected Data Not Gamma Distributed at 5% Significance Level			
2410	**Detected Data Not Gamma Distributed at 5% Significance Level**											
2411												
2412	**Gamma Statistics on Detected Data Only**											

2413					k hat (MLE)	1.995			k star (bias corrected MLE)			1.884
2414					Theta hat (MLE)	4.727			Theta star (bias corrected MLE)			5.005
2415					nu hat (MLE)	191.5			nu star (bias corrected)			180.9
2416					Mean (detects)	9.431						
2417												
2418					**Gamma ROS Statistics using Imputed Non-Detects**							
2419					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
2420					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)							
2421					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
2422					This is especially true when the sample size is small.							
2423					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
2424					Minimum	0.57			Mean			9.293
2425					Maximum	18.9			Median			10.6
2426					SD	5.422			CV			0.583
2427					k hat (MLE)	1.959			k star (bias corrected MLE)			1.853
2428					Theta hat (MLE)	4.744			Theta star (bias corrected MLE)			5.016
2429					nu hat (MLE)	192			nu star (bias corrected)			181.5
2430					Adjusted Level of Significance (β)	0.0451						
2431					Approximate Chi Square Value (181.55, α)	151.4			Adjusted Chi Square Value (181.55, β)			150.5
2432					95% Gamma Approximate UCL (use when n>=50)	11.14			95% Gamma Adjusted UCL (use when n<50)			11.21
2433												
2434					**Estimates of Gamma Parameters using KM Estimates**							
2435					Mean (KM)	9.251			SD (KM)			5.425
2436					Variance (KM)	29.44			SE of Mean (KM)			0.783
2437					k hat (KM)	2.907			k star (KM)			2.743
2438					nu hat (KM)	284.9			nu star (KM)			268.8
2439					theta hat (KM)	3.182			theta star (KM)			3.373
2440					80% gamma percentile (KM)	13.34			90% gamma percentile (KM)			16.74
2441					95% gamma percentile (KM)	19.93			99% gamma percentile (KM)			26.87
2442												
2443					**Gamma Kaplan-Meier (KM) Statistics**							
2444					Approximate Chi Square Value (268.82, α)	231.8			Adjusted Chi Square Value (268.82, β)			230.8
2445					5% Gamma Approximate KM-UCL (use when n>=50)	10.73			95% Gamma Adjusted KM-UCL (use when n<50)			10.77
2446												
2447					**Lognormal GOF Test on Detected Observations Only**							
2448					Shapiro Wilk Test Statistic	0.851			**Shapiro Wilk GOF Test**			
2449					5% Shapiro Wilk Critical Value	0.947			Detected Data Not Lognormal at 5% Significance Level			
2450					Lilliefors Test Statistic	0.21			**Lilliefors GOF Test**			
2451					5% Lilliefors Critical Value	0.127			Detected Data Not Lognormal at 5% Significance Level			
2452					**Detected Data Not Lognormal at 5% Significance Level**							
2453												
2454					**Lognormal ROS Statistics Using Imputed Non-Detects**							
2455					Mean in Original Scale	9.265			Mean in Log Scale			1.939
2456					SD in Original Scale	5.46			SD in Log Scale			0.901
2457					95% t UCL (assumes normality of ROS data)	10.57			95% Percentile Bootstrap UCL			10.49
2458					95% BCA Bootstrap UCL	10.51			95% Bootstrap t UCL			10.57
2459					95% H-UCL (Log ROS)	13.94						
2460												
2461					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
2462					KM Mean (logged)	1.923			KM Geo Mean			6.843
2463					KM SD (logged)	0.926			95% Critical H Value (KM-Log)			2.261
2464					KM Standard Error of Mean (logged)	0.134			95% H-UCL (KM -Log)			14.2
2465					KM SD (logged)	0.926			95% Critical H Value (KM-Log)			2.261
2466					KM Standard Error of Mean (logged)	0.134						
2467												
2468					**DL/2 Statistics**							
2469					**DL/2 Normal**				**DL/2 Log-Transformed**			
2470					Mean in Original Scale	9.247			Mean in Log Scale			1.916
2471					SD in Original Scale	5.488			SD in Log Scale			0.954
2472					95% t UCL (Assumes normality)	10.56			95% H-Stat UCL			14.69
2473					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
2474												
2475					**Nonparametric Distribution Free UCL Statistics**							
2476					**Detected Data appear Approximate Normal Distributed at 5% Significance Level**							
2477												
2478					**Suggested UCL to Use**							
2479					95% KM (t) UCL	10.56						

2480												
2481	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
2482	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
2483												
2484	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2485	Recommendations are based upon data size, data distribution, and skewness.											
2486	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2487	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2488												
2489												
2490	**Result (eu2_iron_overbank)**											
2491												
2492	**General Statistics**											
2493						Total Number of Observations	34			Number of Distinct Observations	29	
2494										Number of Missing Observations	0	
2495						Minimum	21800			Mean	36959	
2496						Maximum	67000			Median	33200	
2497						SD	12240			Std. Error of Mean	2099	
2498						Coefficient of Variation	0.331			Skewness	0.922	
2499												
2500	**Normal GOF Test**											
2501						Shapiro Wilk Test Statistic	0.903			**Shapiro Wilk GOF Test**		
2502						5% Shapiro Wilk Critical Value	0.933			Data Not Normal at 5% Significance Level		
2503						Lilliefors Test Statistic	0.142			**Lilliefors GOF Test**		
2504						5% Lilliefors Critical Value	0.15			Data appear Normal at 5% Significance Level		
2505	**Data appear Approximate Normal at 5% Significance Level**											
2506												
2507	**Assuming Normal Distribution**											
2508						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
2509						95% Student's-t UCL	40511			95% Adjusted-CLT UCL (Chen-1995)	40766	
2510										95% Modified-t UCL (Johnson-1978)	40567	
2511												
2512	**Gamma GOF Test**											
2513						A-D Test Statistic	0.636			**Anderson-Darling Gamma GOF Test**		
2514						5% A-D Critical Value	0.748			Detected data appear Gamma Distributed at 5% Significance Lev		
2515						K-S Test Statistic	0.118			**Kolmogorov-Smirnov Gamma GOF Test**		
2516						5% K-S Critical Value	0.151			Detected data appear Gamma Distributed at 5% Significance Lev		
2517	**Detected data appear Gamma Distributed at 5% Significance Level**											
2518												
2519	**Gamma Statistics**											
2520						k hat (MLE)	10.38			k star (bias corrected MLE)	9.482	
2521						Theta hat (MLE)	3561			Theta star (bias corrected MLE)	3898	
2522						nu hat (MLE)	705.7			nu star (bias corrected)	644.7	
2523						MLE Mean (bias corrected)	36959			MLE Sd (bias corrected)	12003	
2524										Approximate Chi Square Value (0.05)	586.8	
2525						Adjusted Level of Significance	0.0422			Adjusted Chi Square Value	584.1	
2526												
2527	**Assuming Gamma Distribution**											
2528						95% Approximate Gamma UCL (use when n>=50))	40606			95% Adjusted Gamma UCL (use when n<50)	40795	
2529												
2530	**Lognormal GOF Test**											
2531						Shapiro Wilk Test Statistic	0.951			**Shapiro Wilk Lognormal GOF Test**		
2532						5% Shapiro Wilk Critical Value	0.933			Data appear Lognormal at 5% Significance Level		
2533						Lilliefors Test Statistic	0.103			**Lilliefors Lognormal GOF Test**		
2534						5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level		
2535	**Data appear Lognormal at 5% Significance Level**											
2536												
2537	**Lognormal Statistics**											
2538						Minimum of Logged Data	9.99			Mean of logged Data	10.47	
2539						Maximum of Logged Data	11.11			SD of logged Data	0.312	
2540												
2541	**Assuming Lognormal Distribution**											
2542						95% H-UCL	40762			90% Chebyshev (MVUE) UCL	42931	
2543						95% Chebyshev (MVUE) UCL	45665			97.5% Chebyshev (MVUE) UCL	49459	
2544						99% Chebyshev (MVUE) UCL	56913					
2545												
2546	**Nonparametric Distribution Free UCL Statistics**											

2547	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2548												
2549	**Nonparametric Distribution Free UCLs**											
2550					95% CLT UCL	40412			95% Jackknife UCL	40511		
2551					95% Standard Bootstrap UCL	40313			95% Bootstrap-t UCL	40968		
2552					95% Hall's Bootstrap UCL	40689			95% Percentile Bootstrap UCL	40409		
2553					95% BCA Bootstrap UCL	40747						
2554					90% Chebyshev(Mean, Sd) UCL	43256			95% Chebyshev(Mean, Sd) UCL	46109		
2555					97.5% Chebyshev(Mean, Sd) UCL	50068			99% Chebyshev(Mean, Sd) UCL	57845		
2556												
2557	**Suggested UCL to Use**											
2558					95% Student's-t UCL	40511						
2559												
2560	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
2561	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
2562												
2563	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2564	Recommendations are based upon data size, data distribution, and skewness.											
2565	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2566	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2567												
2568												
2569	**Result (eu2_iron_waste rock)**											
2570												
2571	**General Statistics**											
2572					Total Number of Observations	53			Number of Distinct Observations	45		
2573									Number of Missing Observations	0		
2574					Minimum	5690			Mean	28340		
2575					Maximum	55100			Median	27900		
2576					SD	9511			Std. Error of Mean	1306		
2577					Coefficient of Variation	0.336			Skewness	0.184		
2578												
2579	**Normal GOF Test**											
2580					Shapiro Wilk Test Statistic	0.948			**Shapiro Wilk GOF Test**			
2581					5% Shapiro Wilk P Value	0.0372			Data Not Normal at 5% Significance Level			
2582					Lilliefors Test Statistic	0.164			**Lilliefors GOF Test**			
2583					5% Lilliefors Critical Value	0.121			Data Not Normal at 5% Significance Level			
2584	**Data Not Normal at 5% Significance Level**											
2585												
2586	**Assuming Normal Distribution**											
2587	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
2588					95% Student's-t UCL	30528			95% Adjusted-CLT UCL (Chen-1995)	30524		
2589									95% Modified-t UCL (Johnson-1978)	30533		
2590												
2591	**Gamma GOF Test**											
2592					A-D Test Statistic	2.046			**Anderson-Darling Gamma GOF Test**			
2593					5% A-D Critical Value	0.752			Data Not Gamma Distributed at 5% Significance Level			
2594					K-S Test Statistic	0.167			**Kolmogorov-Smirnov Gamma GOF Test**			
2595					5% K-S Critical Value	0.122			Data Not Gamma Distributed at 5% Significance Level			
2596	**Data Not Gamma Distributed at 5% Significance Level**											
2597												
2598	**Gamma Statistics**											
2599					k hat (MLE)	7.088			k star (bias corrected MLE)	6.699		
2600					Theta hat (MLE)	3999			Theta star (bias corrected MLE)	4230		
2601					nu hat (MLE)	751.3			nu star (bias corrected)	710.1		
2602					MLE Mean (bias corrected)	28340			MLE Sd (bias corrected)	10950		
2603									Approximate Chi Square Value (0.05)	649.3		
2604					Adjusted Level of Significance	0.0455			Adjusted Chi Square Value	647.6		
2605												
2606	**Assuming Gamma Distribution**											
2607	95% Approximate Gamma UCL (use when n>=50))					30995			95% Adjusted Gamma UCL (use when n<50)	31073		
2608												
2609	**Lognormal GOF Test**											
2610					Shapiro Wilk Test Statistic	0.823			**Shapiro Wilk Lognormal GOF Test**			
2611					5% Shapiro Wilk P Value	2.9362E-8			Data Not Lognormal at 5% Significance Level			
2612					Lilliefors Test Statistic	0.2			**Lilliefors Lognormal GOF Test**			
2613					5% Lilliefors Critical Value	0.121			Data Not Lognormal at 5% Significance Level			

2614	**Data Not Lognormal at 5% Significance Level**											
2615												
2616	**Lognormal Statistics**											
2617						Minimum of Logged Data	8.646		Mean of logged Data		10.18	
2618						Maximum of Logged Data	10.92		SD of logged Data		0.427	
2619												
2620	**Assuming Lognormal Distribution**											
2621						95% H-UCL	32199		90% Chebyshev (MVUE) UCL		34090	
2622						95% Chebyshev (MVUE) UCL	36474		97.5% Chebyshev (MVUE) UCL		39782	
2623						99% Chebyshev (MVUE) UCL	46281					
2624												
2625	**Nonparametric Distribution Free UCL Statistics**											
2626	**Data do not follow a Discernible Distribution (0.05)**											
2627												
2628	**Nonparametric Distribution Free UCLs**											
2629						95% CLT UCL	30489		95% Jackknife UCL		30528	
2630						95% Standard Bootstrap UCL	30472		95% Bootstrap-t UCL		30545	
2631						95% Hall's Bootstrap UCL	30673		95% Percentile Bootstrap UCL		30407	
2632						95% BCA Bootstrap UCL	30502					
2633						90% Chebyshev(Mean, Sd) UCL	32259		95% Chebyshev(Mean, Sd) UCL		34035	
2634						97.5% Chebyshev(Mean, Sd) UCL	36499		99% Chebyshev(Mean, Sd) UCL		41339	
2635												
2636	**Suggested UCL to Use**											
2637						95% Student's-t UCL	30528		or 95% Modified-t UCL		30533	
2638												
2639	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2640	Recommendations are based upon data size, data distribution, and skewness.											
2641	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2642	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2643												
2644												
2645	**Result (eu2_manganese_overbank)**											
2646												
2647	**General Statistics**											
2648						Total Number of Observations	34		Number of Distinct Observations		34	
2649									Number of Missing Observations		0	
2650						Minimum	918		Mean		5927	
2651						Maximum	43000		Median		2535	
2652						SD	7850		Std. Error of Mean		1346	
2653						Coefficient of Variation	1.324		Skewness		3.433	
2654												
2655	**Normal GOF Test**											
2656						Shapiro Wilk Test Statistic	0.619		**Shapiro Wilk GOF Test**			
2657						5% Shapiro Wilk Critical Value	0.933		Data Not Normal at 5% Significance Level			
2658						Lilliefors Test Statistic	0.262		**Lilliefors GOF Test**			
2659						5% Lilliefors Critical Value	0.15		Data Not Normal at 5% Significance Level			
2660	**Data Not Normal at 5% Significance Level**											
2661												
2662	**Assuming Normal Distribution**											
2663	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
2664						95% Student's-t UCL	8206		95% Adjusted-CLT UCL (Chen-1995)		8989	
2665									95% Modified-t UCL (Johnson-1978)		8338	
2666												
2667	**Gamma GOF Test**											
2668						A-D Test Statistic	1.411		**Anderson-Darling Gamma GOF Test**			
2669						5% A-D Critical Value	0.774		Data Not Gamma Distributed at 5% Significance Level			
2670						K-S Test Statistic	0.186		**Kolmogorov-Smirnov Gamma GOF Test**			
2671						5% K-S Critical Value	0.155		Data Not Gamma Distributed at 5% Significance Level			
2672	**Data Not Gamma Distributed at 5% Significance Level**											
2673												
2674	**Gamma Statistics**											
2675						k hat (MLE)	1.071		k star (bias corrected MLE)		0.996	
2676						Theta hat (MLE)	5536		Theta star (bias corrected MLE)		5953	
2677						nu hat (MLE)	72.8		nu star (bias corrected)		67.71	
2678						MLE Mean (bias corrected)	5927		MLE Sd (bias corrected)		5940	
2679									Approximate Chi Square Value (0.05)		49.77	
2680						Adjusted Level of Significance	0.0422		Adjusted Chi Square Value		49.01	

2681												
2682						**Assuming Gamma Distribution**							
2683				95% Approximate Gamma UCL (use when n>=50))		8064			95% Adjusted Gamma UCL (use when n<50)			8189
2684												
2685						**Lognormal GOF Test**							
2686					Shapiro Wilk Test Statistic	0.921			**Shapiro Wilk Lognormal GOF Test**			
2687					5% Shapiro Wilk Critical Value	0.933			Data Not Lognormal at 5% Significance Level			
2688					Lilliefors Test Statistic	0.15			**Lilliefors Lognormal GOF Test**			
2689					5% Lilliefors Critical Value	0.15			Data Not Lognormal at 5% Significance Level			
2690						**Data Not Lognormal at 5% Significance Level**							
2691												
2692						**Lognormal Statistics**							
2693					Minimum of Logged Data	6.822			Mean of logged Data			8.152
2694					Maximum of Logged Data	10.67			SD of logged Data			0.999
2695												
2696						**Assuming Lognormal Distribution**							
2697					95% H-UCL	8747			90% Chebyshev (MVUE) UCL			8924
2698					95% Chebyshev (MVUE) UCL	10431			97.5% Chebyshev (MVUE) UCL			12522
2699					99% Chebyshev (MVUE) UCL	16630						
2700												
2701						**Nonparametric Distribution Free UCL Statistics**							
2702						**Data do not follow a Discernible Distribution (0.05)**							
2703												
2704						**Nonparametric Distribution Free UCLs**							
2705					95% CLT UCL	8142			95% Jackknife UCL			8206
2706					95% Standard Bootstrap UCL	8095			95% Bootstrap-t UCL			10056
2707					95% Hall's Bootstrap UCL	17657			95% Percentile Bootstrap UCL			8261
2708					95% BCA Bootstrap UCL	9329						
2709					90% Chebyshev(Mean, Sd) UCL	9966			95% Chebyshev(Mean, Sd) UCL			11796
2710					97.5% Chebyshev(Mean, Sd) UCL	14335			99% Chebyshev(Mean, Sd) UCL			19323
2711												
2712						**Suggested UCL to Use**							
2713					95% Chebyshev (Mean, Sd) UCL	11796						
2714												
2715	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2716	Recommendations are based upon data size, data distribution, and skewness.											
2717	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2718	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2719												
2720												
2721	**Result (eu2_manganese_waste rock)**											
2722												
2723						**General Statistics**							
2724					Total Number of Observations	52			Number of Distinct Observations			48
2725									Number of Missing Observations			0
2726					Minimum	47.6			Mean			15907
2727					Maximum	61300			Median			14150
2728					SD	15580			Std. Error of Mean			2161
2729					Coefficient of Variation	0.979			Skewness			1.382
2730												
2731						**Normal GOF Test**						
2732					Shapiro Wilk Test Statistic	0.831			**Shapiro Wilk GOF Test**			
2733					5% Shapiro Wilk P Value	9.9488E-8			Data Not Normal at 5% Significance Level			
2734					Lilliefors Test Statistic	0.169			**Lilliefors GOF Test**			
2735					5% Lilliefors Critical Value	0.122			Data Not Normal at 5% Significance Level			
2736						**Data Not Normal at 5% Significance Level**							
2737												
2738						**Assuming Normal Distribution**							
2739					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
2740					95% Student's-t UCL	19526			95% Adjusted-CLT UCL (Chen-1995)			19903
2741									95% Modified-t UCL (Johnson-1978)			19595
2742												
2743						**Gamma GOF Test**							
2744					A-D Test Statistic	1.683			**Anderson-Darling Gamma GOF Test**			
2745					5% A-D Critical Value	0.798			Data Not Gamma Distributed at 5% Significance Level			
2746					K-S Test Statistic	0.198			**Kolmogorov-Smirnov Gamma GOF Test**			
2747					5% K-S Critical Value	0.129			Data Not Gamma Distributed at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
2748	**Data Not Gamma Distributed at 5% Significance Level**											
2749												
2750	**Gamma Statistics**											
2751					k hat (MLE)	0.689			k star (bias corrected MLE)			0.662
2752					Theta hat (MLE)	23083			Theta star (bias corrected MLE)			24022
2753					nu hat (MLE)	71.67			nu star (bias corrected)			68.87
2754					MLE Mean (bias corrected)	15907			MLE Sd (bias corrected)			19548
2755									Approximate Chi Square Value (0.05)			50.76
2756					Adjusted Level of Significance	0.0454			Adjusted Chi Square Value			50.32
2757												
2758	**Assuming Gamma Distribution**											
2759	95% Approximate Gamma UCL (use when n>=50))					21579			95% Adjusted Gamma UCL (use when n<50)			21769
2760												
2761	**Lognormal GOF Test**											
2762					Shapiro Wilk Test Statistic	0.847			**Shapiro Wilk Lognormal GOF Test**			
2763					5% Shapiro Wilk P Value	5.5298E-7			Data Not Lognormal at 5% Significance Level			
2764					Lilliefors Test Statistic	0.255			**Lilliefors Lognormal GOF Test**			
2765					5% Lilliefors Critical Value	0.122			Data Not Lognormal at 5% Significance Level			
2766	**Data Not Lognormal at 5% Significance Level**											
2767												
2768	**Lognormal Statistics**											
2769					Minimum of Logged Data	3.863			Mean of logged Data			8.796
2770					Maximum of Logged Data	11.02			SD of logged Data			1.808
2771												
2772	**Assuming Lognormal Distribution**											
2773					95% H-UCL	78281			90% Chebyshev (MVUE) UCL			64817
2774					95% Chebyshev (MVUE) UCL	79978			97.5% Chebyshev (MVUE) UCL			101019
2775					99% Chebyshev (MVUE) UCL	142352						
2776												
2777	**Nonparametric Distribution Free UCL Statistics**											
2778	**Data do not follow a Discernible Distribution (0.05)**											
2779												
2780	**Nonparametric Distribution Free UCLs**											
2781					95% CLT UCL	19460			95% Jackknife UCL			19526
2782					95% Standard Bootstrap UCL	19439			95% Bootstrap-t UCL			20192
2783					95% Hall's Bootstrap UCL	19961			95% Percentile Bootstrap UCL			19515
2784					95% BCA Bootstrap UCL	19650						
2785					90% Chebyshev(Mean, Sd) UCL	22388			95% Chebyshev(Mean, Sd) UCL			25324
2786					97.5% Chebyshev(Mean, Sd) UCL	29399			99% Chebyshev(Mean, Sd) UCL			37404
2787												
2788	**Suggested UCL to Use**											
2789					95% Chebyshev (Mean, Sd) UCL	25324						
2790												
2791	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2792	Recommendations are based upon data size, data distribution, and skewness.											
2793	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2794	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2795												
2796	**Result (eu2_thallium_overbank)**											
2797												
2798	**General Statistics**											
2799					Total Number of Observations	28			Number of Distinct Observations			19
2800					Number of Detects	4			Number of Non-Detects			24
2801					Number of Distinct Detects	4			Number of Distinct Non-Detects			15
2802					Minimum Detect	0.45			Minimum Non-Detect			0.039
2803					Maximum Detect	1.94			Maximum Non-Detect			1.01
2804					Variance Detects	0.421			Percent Non-Detects			85.71%
2805					Mean Detects	1.385			SD Detects			0.649
2806					Median Detects	1.575			CV Detects			0.468
2807					Skewness Detects	-1.533			Kurtosis Detects			2.745
2808					Mean of Logged Detects	0.193			SD of Logged Detects			0.669
2809												
2810	**Normal GOF Test on Detects Only**											
2811					Shapiro Wilk Test Statistic	0.866			**Shapiro Wilk GOF Test**			
2812					5% Shapiro Wilk Critical Value	0.748			Detected Data appear Normal at 5% Significance Level			
2813					Lilliefors Test Statistic	0.326			**Lilliefors GOF Test**			
2814					5% Lilliefors Critical Value	0.375			Detected Data appear Normal at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
2815	**Detected Data appear Normal at 5% Significance Level**											
2816												
2817	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2818					KM Mean	0.235			KM Standard Error of Mean			0.113
2819					KM SD	0.517			95% KM (BCA) UCL			N/A
2820					95% KM (t) UCL	0.428			95% KM (Percentile Bootstrap) UCL			N/A
2821					95% KM (z) UCL	0.421			95% KM Bootstrap t UCL			N/A
2822					90% KM Chebyshev UCL	0.574			95% KM Chebyshev UCL			0.728
2823					97.5% KM Chebyshev UCL	0.942			99% KM Chebyshev UCL			1.361
2824												
2825	**Gamma GOF Tests on Detected Observations Only**											
2826					A-D Test Statistic	0.584		**Anderson-Darling GOF Test**				
2827					5% A-D Critical Value	0.659		Detected data appear Gamma Distributed at 5% Significance Lev				
2828					K-S Test Statistic	0.384		**Kolmogorov-Smirnov GOF**				
2829					5% K-S Critical Value	0.396		Detected data appear Gamma Distributed at 5% Significance Lev				
2830	**Detected data appear Gamma Distributed at 5% Significance Level**											
2831												
2832	**Gamma Statistics on Detected Data Only**											
2833					k hat (MLE)	3.92			k star (bias corrected MLE)			1.147
2834					Theta hat (MLE)	0.353			Theta star (bias corrected MLE)			1.208
2835					nu hat (MLE)	31.36			nu star (bias corrected)			9.173
2836					Mean (detects)	1.385						
2837												
2838	**Gamma ROS Statistics using Imputed Non-Detects**											
2839	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2840	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)											
2841	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2842	This is especially true when the sample size is small.											
2843	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2844					Minimum	0.01			Mean			0.206
2845					Maximum	1.94			Median			0.01
2846					SD	0.536			CV			2.595
2847					k hat (MLE)	0.295			k star (bias corrected MLE)			0.287
2848					Theta hat (MLE)	0.699			Theta star (bias corrected MLE)			0.718
2849					nu hat (MLE)	16.53			nu star (bias corrected)			16.09
2850					Adjusted Level of Significance (β)	0.0404						
2851					Approximate Chi Square Value (16.09, α)	8.029			Adjusted Chi Square Value (16.09, β)			7.677
2852					95% Gamma Approximate UCL (use when n>=50)	0.414			95% Gamma Adjusted UCL (use when n<50)			N/A
2853												
2854	**Estimates of Gamma Parameters using KM Estimates**											
2855					Mean (KM)	0.235			SD (KM)			0.517
2856					Variance (KM)	0.267			SE of Mean (KM)			0.113
2857					k hat (KM)	0.207			k star (KM)			0.208
2858					nu hat (KM)	11.58			nu star (KM)			11.67
2859					theta hat (KM)	1.137			theta star (KM)			1.127
2860					80% gamma percentile (KM)	0.316			90% gamma percentile (KM)			0.711
2861					95% gamma percentile (KM)	1.198			99% gamma percentile (KM)			2.529
2862												
2863	**Gamma Kaplan-Meier (KM) Statistics**											
2864					Approximate Chi Square Value (11.67, α)	5.01			Adjusted Chi Square Value (11.67, β)			4.742
2865	5% Gamma Approximate KM-UCL (use when n>=50)					0.547			95% Gamma Adjusted KM-UCL (use when n<50)			0.578
2866												
2867	**Lognormal GOF Test on Detected Observations Only**											
2868					Shapiro Wilk Test Statistic	0.772		**Shapiro Wilk GOF Test**				
2869					5% Shapiro Wilk Critical Value	0.748		Detected Data appear Lognormal at 5% Significance Level				
2870					Lilliefors Test Statistic	0.379		**Lilliefors GOF Test**				
2871					5% Lilliefors Critical Value	0.375		Detected Data Not Lognormal at 5% Significance Level				
2872	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
2873												
2874	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2875					Mean in Original Scale	0.265			Mean in Log Scale			-2.294
2876					SD in Original Scale	0.515			SD in Log Scale			1.199
2877					95% t UCL (assumes normality of ROS data)	0.431			95% Percentile Bootstrap UCL			0.435
2878					95% BCA Bootstrap UCL	0.5			95% Bootstrap t UCL			0.521
2879					95% H-UCL (Log ROS)	0.387						
2880												
2881	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											

2882				KM Mean (logged)	-2.731				KM Geo Mean			0.0651
2883				KM SD (logged)	1.235				95% Critical H Value (KM-Log)			2.759
2884				KM Standard Error of Mean (logged)	0.275				95% H-UCL (KM -Log)			0.269
2885				KM SD (logged)	1.235				95% Critical H Value (KM-Log)			2.759
2886				KM Standard Error of Mean (logged)	0.275							
2887												
2888					**DL/2 Statistics**							
2889				**DL/2 Normal**					**DL/2 Log-Transformed**			
2890				Mean in Original Scale	0.302				Mean in Log Scale			-2.695
2891				SD in Original Scale	0.532				SD in Log Scale			1.713
2892				95% t UCL (Assumes normality)	0.473				95% H-Stat UCL			0.912
2893					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
2894												
2895					**Nonparametric Distribution Free UCL Statistics**							
2896					**Detected Data appear Normal Distributed at 5% Significance Level**							
2897												
2898					**Suggested UCL to Use**							
2899				95% KM (t) UCL	0.428							
2900												
2901	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2902	Recommendations are based upon data size, data distribution, and skewness.											
2903	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2904	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2905												
2906	**Result (eu2_thallium_waste rock)**											
2907												
2908					**General Statistics**							
2909				Total Number of Observations	53				Number of Distinct Observations			34
2910				Number of Detects	43				Number of Non-Detects			10
2911				Number of Distinct Detects	25				Number of Distinct Non-Detects			9
2912				Minimum Detect	0.075				Minimum Non-Detect			0.003
2913				Maximum Detect	1.04				Maximum Non-Detect			1
2914				Variance Detects	0.0237				Percent Non-Detects			18.87%
2915				Mean Detects	0.297				SD Detects			0.154
2916				Median Detects	0.29				CV Detects			0.519
2917				Skewness Detects	2.694				Kurtosis Detects			12.42
2918				Mean of Logged Detects	-1.326				SD of Logged Detects			0.486
2919												
2920					**Normal GOF Test on Detects Only**							
2921				Shapiro Wilk Test Statistic	0.791				**Shapiro Wilk GOF Test**			
2922				5% Shapiro Wilk Critical Value	0.943				Detected Data Not Normal at 5% Significance Level			
2923				Lilliefors Test Statistic	0.184				**Lilliefors GOF Test**			
2924				5% Lilliefors Critical Value	0.134				Detected Data Not Normal at 5% Significance Level			
2925					**Detected Data Not Normal at 5% Significance Level**							
2926												
2927					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
2928				KM Mean	0.264				KM Standard Error of Mean			0.0238
2929				KM SD	0.166				95% KM (BCA) UCL			0.302
2930				95% KM (t) UCL	0.304				95% KM (Percentile Bootstrap) UCL			0.306
2931				95% KM (z) UCL	0.303				95% KM Bootstrap t UCL			0.31
2932				90% KM Chebyshev UCL	0.335				95% KM Chebyshev UCL			0.368
2933				97.5% KM Chebyshev UCL	0.412				99% KM Chebyshev UCL			0.5
2934												
2935					**Gamma GOF Tests on Detected Observations Only**							
2936				A-D Test Statistic	0.906				**Anderson-Darling GOF Test**			
2937				5% A-D Critical Value	0.753				Detected Data Not Gamma Distributed at 5% Significance Level			
2938				K-S Test Statistic	0.122				**Kolmogorov-Smirnov GOF**			
2939				5% K-S Critical Value	0.135				Detected data appear Gamma Distributed at 5% Significance Lev			
2940					**Detected data follow Appr. Gamma Distribution at 5% Significance Level**							
2941												
2942					**Gamma Statistics on Detected Data Only**							
2943				k hat (MLE)	4.679				k star (bias corrected MLE)			4.368
2944				Theta hat (MLE)	0.0634				Theta star (bias corrected MLE)			0.0679
2945				nu hat (MLE)	402.4				nu star (bias corrected)			375.7
2946				Mean (detects)	0.297							
2947												
2948					**Gamma ROS Statistics using Imputed Non-Detects**							

	A	B	C	D	E	F	G	H	I	J	K	L
2949	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2950	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)											
2951	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2952	This is especially true when the sample size is small.											
2953	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2954					Minimum	0.0493			Mean			0.27
2955					Maximum	1.04			Median			0.26
2956					SD	0.155			CV			0.574
2957					k hat (MLE)	3.297			k star (bias corrected MLE)			3.123
2958					Theta hat (MLE)	0.0818			Theta star (bias corrected MLE)			0.0863
2959					nu hat (MLE)	349.5			nu star (bias corrected)			331.1
2960					Adjusted Level of Significance (β)	0.0455						
2961					Approximate Chi Square Value (331.07, α)	289.9			Adjusted Chi Square Value (331.07, β)			288.8
2962					95% Gamma Approximate UCL (use when n>=50)	0.308			95% Gamma Adjusted UCL (use when n<50)			0.309
2963												
2964	**Estimates of Gamma Parameters using KM Estimates**											
2965					Mean (KM)	0.264			SD (KM)			0.166
2966					Variance (KM)	0.0276			SE of Mean (KM)			0.0238
2967					k hat (KM)	2.53			k star (KM)			2.399
2968					nu hat (KM)	268.2			nu star (KM)			254.3
2969					theta hat (KM)	0.104			theta star (KM)			0.11
2970					80% gamma percentile (KM)	0.387			90% gamma percentile (KM)			0.493
2971					95% gamma percentile (KM)	0.592			99% gamma percentile (KM)			0.811
2972												
2973	**Gamma Kaplan-Meier (KM) Statistics**											
2974					Approximate Chi Square Value (254.34, α)	218.4			Adjusted Chi Square Value (254.34, β)			217.5
2975	5% Gamma Approximate KM-UCL (use when n>=50)					0.308			95% Gamma Adjusted KM-UCL (use when n<50)			0.309
2976												
2977	**Lognormal GOF Test on Detected Observations Only**											
2978					Shapiro Wilk Test Statistic	0.937			**Shapiro Wilk GOF Test**			
2979					5% Shapiro Wilk Critical Value	0.943			Detected Data Not Lognormal at 5% Significance Level			
2980					Lilliefors Test Statistic	0.139			**Lilliefors GOF Test**			
2981					5% Lilliefors Critical Value	0.134			Detected Data Not Lognormal at 5% Significance Level			
2982	**Detected Data Not Lognormal at 5% Significance Level**											
2983												
2984	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2985					Mean in Original Scale	0.272			Mean in Log Scale			-1.433
2986					SD in Original Scale	0.151			SD in Log Scale			0.528
2987					95% t UCL (assumes normality of ROS data)	0.306			95% Percentile Bootstrap UCL			0.307
2988					95% BCA Bootstrap UCL	0.313			95% Bootstrap t UCL			0.317
2989					95% H-UCL (Log ROS)	0.315						
2990												
2991	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2992					KM Mean (logged)	-1.798			KM Geo Mean			0.166
2993					KM SD (logged)	1.442			95% Critical H Value (KM-Log)			2.88
2994					KM Standard Error of Mean (logged)	0.211			95% H-UCL (KM -Log)			0.833
2995					KM SD (logged)	1.442			95% Critical H Value (KM-Log)			2.88
2996					KM Standard Error of Mean (logged)	0.211						
2997												
2998	**DL/2 Statistics**											
2999	**DL/2 Normal**								**DL/2 Log-Transformed**			
3000					Mean in Original Scale	0.279			Mean in Log Scale			-1.745
3001					SD in Original Scale	0.172			SD in Log Scale			1.507
3002					95% t UCL (Assumes normality)	0.318			95% H-Stat UCL			1.009
3003	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3004												
3005	**Nonparametric Distribution Free UCL Statistics**											
3006	**Detected Data appear Approximate Gamma Distributed at 5% Significance Level**											
3007												
3008	**Suggested UCL to Use**											
3009					95% KM Approximate Gamma UCL	0.308			95% GROS Approximate Gamma UCL			0.308
3010												
3011	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
3012	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
3013												
3014	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3015	Recommendations are based upon data size, data distribution, and skewness.											

	A	B	C	D	E	F	G	H	I	J	K	L
3016	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3017	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3018												
3019												
3020	**Result (eu2_zinc_overbank)**											
3021												
3022	**General Statistics**											
3023					Total Number of Observations	34			Number of Distinct Observations	34		
3024									Number of Missing Observations	0		
3025					Minimum	121			Mean	1409		
3026					Maximum	5370			Median	676.5		
3027					SD	1406			Std. Error of Mean	241.1		
3028					Coefficient of Variation	0.998			Skewness	1.221		
3029												
3030	**Normal GOF Test**											
3031					Shapiro Wilk Test Statistic	0.825			**Shapiro Wilk GOF Test**			
3032					5% Shapiro Wilk Critical Value	0.933			Data Not Normal at 5% Significance Level			
3033					Lilliefors Test Statistic	0.225			**Lilliefors GOF Test**			
3034					5% Lilliefors Critical Value	0.15			Data Not Normal at 5% Significance Level			
3035	**Data Not Normal at 5% Significance Level**											
3036												
3037	**Assuming Normal Distribution**											
3038					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
3039					95% Student's-t UCL	1817			95% Adjusted-CLT UCL (Chen-1995)	1859		
3040									95% Modified-t UCL (Johnson-1978)	1825		
3041												
3042	**Gamma GOF Test**											
3043					A-D Test Statistic	0.885			**Anderson-Darling Gamma GOF Test**			
3044					5% A-D Critical Value	0.774			Data Not Gamma Distributed at 5% Significance Level			
3045					K-S Test Statistic	0.159			**Kolmogorov-Smirnov Gamma GOF Test**			
3046					5% K-S Critical Value	0.155			Data Not Gamma Distributed at 5% Significance Level			
3047	**Data Not Gamma Distributed at 5% Significance Level**											
3048												
3049	**Gamma Statistics**											
3050					k hat (MLE)	1.078			k star (bias corrected MLE)	1.002		
3051					Theta hat (MLE)	1307			Theta star (bias corrected MLE)	1405		
3052					nu hat (MLE)	73.3			nu star (bias corrected)	68.17		
3053					MLE Mean (bias corrected)	1409			MLE Sd (bias corrected)	1407		
3054									Approximate Chi Square Value (0.05)	50.17		
3055					Adjusted Level of Significance	0.0422			Adjusted Chi Square Value	49.4		
3056												
3057	**Assuming Gamma Distribution**											
3058					95% Approximate Gamma UCL (use when n>=50))	1914			95% Adjusted Gamma UCL (use when n<50)	1944		
3059												
3060	**Lognormal GOF Test**											
3061					Shapiro Wilk Test Statistic	0.943			**Shapiro Wilk Lognormal GOF Test**			
3062					5% Shapiro Wilk Critical Value	0.933			Data appear Lognormal at 5% Significance Level			
3063					Lilliefors Test Statistic	0.111			**Lilliefors Lognormal GOF Test**			
3064					5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level			
3065	**Data appear Lognormal at 5% Significance Level**											
3066												
3067	**Lognormal Statistics**											
3068					Minimum of Logged Data	4.796			Mean of logged Data	6.719		
3069					Maximum of Logged Data	8.589			SD of logged Data	1.091		
3070												
3071	**Assuming Lognormal Distribution**											
3072					95% H-UCL	2443			90% Chebyshev (MVUE) UCL	2432		
3073					95% Chebyshev (MVUE) UCL	2871			97.5% Chebyshev (MVUE) UCL	3480		
3074					99% Chebyshev (MVUE) UCL	4677						
3075												
3076	**Nonparametric Distribution Free UCL Statistics**											
3077	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3078												
3079	**Nonparametric Distribution Free UCLs**											
3080					95% CLT UCL	1805			95% Jackknife UCL	1817		
3081					95% Standard Bootstrap UCL	1794			95% Bootstrap-t UCL	1887		
3082					95% Hall's Bootstrap UCL	1865			95% Percentile Bootstrap UCL	1815		

3083					95% BCA Bootstrap UCL	1849						
3084					90% Chebyshev(Mean, Sd) UCL	2132				95% Chebyshev(Mean, Sd) UCL		2460
3085					97.5% Chebyshev(Mean, Sd) UCL	2914				99% Chebyshev(Mean, Sd) UCL		3808
3086												
3087					**Suggested UCL to Use**							
3088					95% H-UCL	2443						
3089												
3090	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3091	Recommendations are based upon data size, data distribution, and skewness.											
3092	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3093	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3094												
3095	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
3096	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
3097	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
3098	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
3099												
3100												
3101	**Result (eu2_zinc_waste rock)**											
3102												
3103					**General Statistics**							
3104					Total Number of Observations	53				Number of Distinct Observations		52
3105										Number of Missing Observations		0
3106					Minimum	127				Mean		2852
3107					Maximum	19900				Median		1840
3108					SD	3889				Std. Error of Mean		534.2
3109					Coefficient of Variation	1.364				Skewness		3.271
3110												
3111					**Normal GOF Test**							
3112					Shapiro Wilk Test Statistic	0.567				**Shapiro Wilk GOF Test**		
3113					5% Shapiro Wilk P Value	0				Data Not Normal at 5% Significance Level		
3114					Lilliefors Test Statistic	0.309				**Lilliefors GOF Test**		
3115					5% Lilliefors Critical Value	0.121				Data Not Normal at 5% Significance Level		
3116					**Data Not Normal at 5% Significance Level**							
3117												
3118					**Assuming Normal Distribution**							
3119					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
3120					95% Student's-t UCL	3746				95% Adjusted-CLT UCL (Chen-1995)		3987
3121										95% Modified-t UCL (Johnson-1978)		3786
3122												
3123					**Gamma GOF Test**							
3124					A-D Test Statistic	2.248				**Anderson-Darling Gamma GOF Test**		
3125					5% A-D Critical Value	0.778				Data Not Gamma Distributed at 5% Significance Level		
3126					K-S Test Statistic	0.181				**Kolmogorov-Smirnov Gamma GOF Test**		
3127					5% K-S Critical Value	0.125				Data Not Gamma Distributed at 5% Significance Level		
3128					**Data Not Gamma Distributed at 5% Significance Level**							
3129												
3130					**Gamma Statistics**							
3131					k hat (MLE)	1.072				k star (bias corrected MLE)		1.024
3132					Theta hat (MLE)	2660				Theta star (bias corrected MLE)		2785
3133					nu hat (MLE)	113.6				nu star (bias corrected)		108.5
3134					MLE Mean (bias corrected)	2852				MLE Sd (bias corrected)		2818
3135										Approximate Chi Square Value (0.05)		85.5
3136					Adjusted Level of Significance	0.0455				Adjusted Chi Square Value		84.93
3137												
3138					**Assuming Gamma Distribution**							
3139					95% Approximate Gamma UCL (use when n>=50))	3621				95% Adjusted Gamma UCL (use when n<50)		3645
3140												
3141					**Lognormal GOF Test**							
3142					Shapiro Wilk Test Statistic	0.936				**Shapiro Wilk Lognormal GOF Test**		
3143					5% Shapiro Wilk P Value	0.0105				Data Not Lognormal at 5% Significance Level		
3144					Lilliefors Test Statistic	0.156				**Lilliefors Lognormal GOF Test**		
3145					5% Lilliefors Critical Value	0.121				Data Not Lognormal at 5% Significance Level		
3146					**Data Not Lognormal at 5% Significance Level**							
3147												
3148					**Lognormal Statistics**							
3149					Minimum of Logged Data	4.844				Mean of logged Data		7.422

3150					Maximum of Logged Data	9.898				SD of logged Data		1.042
3151												
3152					**Assuming Lognormal Distribution**							
3153					95% H-UCL	4047				90% Chebyshev (MVUE) UCL		4281
3154					95% Chebyshev (MVUE) UCL	4937				97.5% Chebyshev (MVUE) UCL		5847
3155					99% Chebyshev (MVUE) UCL	7636						
3156												
3157					**Nonparametric Distribution Free UCL Statistics**							
3158					**Data do not follow a Discernible Distribution (0.05)**							
3159												
3160					**Nonparametric Distribution Free UCLs**							
3161					95% CLT UCL	3731				95% Jackknife UCL		3746
3162					95% Standard Bootstrap UCL	3712				95% Bootstrap-t UCL		4129
3163					95% Hall's Bootstrap UCL	4375				95% Percentile Bootstrap UCL		3782
3164					95% BCA Bootstrap UCL	3997						
3165					90% Chebyshev(Mean, Sd) UCL	4454				95% Chebyshev(Mean, Sd) UCL		5180
3166					97.5% Chebyshev(Mean, Sd) UCL	6188				99% Chebyshev(Mean, Sd) UCL		8167
3167												
3168					**Suggested UCL to Use**							
3169					95% Chebyshev (Mean, Sd) UCL	5180						
3170												
3171	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3172	Recommendations are based upon data size, data distribution, and skewness.											
3173	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3174	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3175												
3176												
3177	**Result (eu3_antimony_overbank)**											
3178												
3179					**General Statistics**							
3180					Total Number of Observations	62				Number of Distinct Observations		48
3181										Number of Missing Observations		0
3182					Minimum	0.086				Mean		2.327
3183					Maximum	7.4				Median		1.73
3184					SD	1.783				Std. Error of Mean		0.226
3185					Coefficient of Variation	0.766				Skewness		1.254
3186												
3187					**Normal GOF Test**							
3188					Shapiro Wilk Test Statistic	0.868				**Shapiro Wilk GOF Test**		
3189					5% Shapiro Wilk P Value	3.1767E-7				Data Not Normal at 5% Significance Level		
3190					Lilliefors Test Statistic	0.165				**Lilliefors GOF Test**		
3191					5% Lilliefors Critical Value	0.112				Data Not Normal at 5% Significance Level		
3192					**Data Not Normal at 5% Significance Level**							
3193												
3194					**Assuming Normal Distribution**							
3195					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
3196					95% Student's-t UCL	2.705				95% Adjusted-CLT UCL (Chen-1995)		2.738
3197										95% Modified-t UCL (Johnson-1978)		2.711
3198												
3199					**Gamma GOF Test**							
3200					A-D Test Statistic	0.327				**Anderson-Darling Gamma GOF Test**		
3201					5% A-D Critical Value	0.766	Detected data appear Gamma Distributed at 5% Significance Lev					
3202					K-S Test Statistic	0.0744				**Kolmogorov-Smirnov Gamma GOF Test**		
3203					5% K-S Critical Value	0.115	Detected data appear Gamma Distributed at 5% Significance Lev					
3204					**Detected data appear Gamma Distributed at 5% Significance Level**							
3205												
3206					**Gamma Statistics**							
3207					k hat (MLE)	1.742				k star (bias corrected MLE)		1.668
3208					Theta hat (MLE)	1.336				Theta star (bias corrected MLE)		1.395
3209					nu hat (MLE)	216				nu star (bias corrected)		206.8
3210					MLE Mean (bias corrected)	2.327				MLE Sd (bias corrected)		1.802
3211										Approximate Chi Square Value (0.05)		174.6
3212					Adjusted Level of Significance	0.0461				Adjusted Chi Square Value		173.9
3213												
3214					**Assuming Gamma Distribution**							
3215					95% Approximate Gamma UCL (use when n>=50)	2.757				95% Adjusted Gamma UCL (use when n<50)		2.769
3216												

	A	B	C	D	E	F	G	H	I	J	K	L
3217	**Lognormal GOF Test**											
3218					Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk Lognormal GOF Test**					
3219					5% Shapiro Wilk P Value	0.0876	Data appear Lognormal at 5% Significance Level					
3220					Lilliefors Test Statistic	0.105	**Lilliefors Lognormal GOF Test**					
3221					5% Lilliefors Critical Value	0.112	Data appear Lognormal at 5% Significance Level					
3222	**Data appear Lognormal at 5% Significance Level**											
3223												
3224	**Lognormal Statistics**											
3225					Minimum of Logged Data	-2.453			Mean of logged Data			0.531
3226					Maximum of Logged Data	2.001			SD of logged Data			0.87
3227												
3228	**Assuming Lognormal Distribution**											
3229					95% H-UCL	3.156			90% Chebyshev (MVUE) UCL			3.397
3230					95% Chebyshev (MVUE) UCL	3.821			97.5% Chebyshev (MVUE) UCL			4.409
3231					99% Chebyshev (MVUE) UCL	5.563						
3232												
3233	**Nonparametric Distribution Free UCL Statistics**											
3234	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3235												
3236	**Nonparametric Distribution Free UCLs**											
3237					95% CLT UCL	2.699			95% Jackknife UCL			2.705
3238					95% Standard Bootstrap UCL	2.704			95% Bootstrap-t UCL			2.773
3239					95% Hall's Bootstrap UCL	2.735			95% Percentile Bootstrap UCL			2.71
3240					95% BCA Bootstrap UCL	2.739						
3241					90% Chebyshev(Mean, Sd) UCL	3.006			95% Chebyshev(Mean, Sd) UCL			3.314
3242					97.5% Chebyshev(Mean, Sd) UCL	3.741			99% Chebyshev(Mean, Sd) UCL			4.58
3243												
3244	**Suggested UCL to Use**											
3245					95% Approximate Gamma UCL	2.757						
3246												
3247	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3248	Recommendations are based upon data size, data distribution, and skewness.											
3249	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3250	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3251												
3252												
3253	**Result (eu3_antimony_waste rock)**											
3254												
3255	**General Statistics**											
3256					Total Number of Observations	14			Number of Distinct Observations			14
3257									Number of Missing Observations			0
3258					Minimum	0.81			Mean			21.27
3259					Maximum	65.8			Median			10.1
3260					SD	24.37			Std. Error of Mean			6.513
3261					Coefficient of Variation	1.146			Skewness			1.126
3262												
3263	**Normal GOF Test**											
3264					Shapiro Wilk Test Statistic	0.773	**Shapiro Wilk GOF Test**					
3265					5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level					
3266					Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**					
3267					5% Lilliefors Critical Value	0.226	Data Not Normal at 5% Significance Level					
3268	**Data Not Normal at 5% Significance Level**											
3269												
3270	**Assuming Normal Distribution**											
3271	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
3272					95% Student's-t UCL	32.8			95% Adjusted-CLT UCL (Chen-1995)			34.07
3273									95% Modified-t UCL (Johnson-1978)			33.13
3274												
3275	**Gamma GOF Test**											
3276					A-D Test Statistic	0.412	**Anderson-Darling Gamma GOF Test**					
3277					5% A-D Critical Value	0.771	Detected data appear Gamma Distributed at 5% Significance Lev					
3278					K-S Test Statistic	0.144	**Kolmogorov-Smirnov Gamma GOF Test**					
3279					5% K-S Critical Value	0.238	Detected data appear Gamma Distributed at 5% Significance Lev					
3280	**Detected data appear Gamma Distributed at 5% Significance Level**											
3281												
3282	**Gamma Statistics**											
3283					k hat (MLE)	0.742			k star (bias corrected MLE)			0.631

3284					Theta hat (MLE)	28.66				Theta star (bias corrected MLE)		33.72
3285					nu hat (MLE)	20.78				nu star (bias corrected)		17.66
3286					MLE Mean (bias corrected)	21.27				MLE Sd (bias corrected)		26.78
3287										Approximate Chi Square Value (0.05)		9.143
3288					Adjusted Level of Significance	0.0312				Adjusted Chi Square Value		8.341
3289												
3290					**Assuming Gamma Distribution**							
3291				95% Approximate Gamma UCL (use when n>=50)		41.07				95% Adjusted Gamma UCL (use when n<50)		45.02
3292												
3293					**Lognormal GOF Test**							
3294					Shapiro Wilk Test Statistic	0.943				**Shapiro Wilk Lognormal GOF Test**		
3295					5% Shapiro Wilk Critical Value	0.874				Data appear Lognormal at 5% Significance Level		
3296					Lilliefors Test Statistic	0.13				**Lilliefors Lognormal GOF Test**		
3297					5% Lilliefors Critical Value	0.226				Data appear Lognormal at 5% Significance Level		
3298					**Data appear Lognormal at 5% Significance Level**							
3299												
3300					**Lognormal Statistics**							
3301					Minimum of Logged Data	-0.211				Mean of logged Data		2.249
3302					Maximum of Logged Data	4.187				SD of logged Data		1.467
3303												
3304					**Assuming Lognormal Distribution**							
3305					95% H-UCL	121.5				90% Chebyshev (MVUE) UCL		56.43
3306					95% Chebyshev (MVUE) UCL	70.99				97.5% Chebyshev (MVUE) UCL		91.2
3307					99% Chebyshev (MVUE) UCL	130.9						
3308												
3309					**Nonparametric Distribution Free UCL Statistics**							
3310					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
3311												
3312					**Nonparametric Distribution Free UCLs**							
3313					95% CLT UCL	31.98				95% Jackknife UCL		32.8
3314					95% Standard Bootstrap UCL	31.76				95% Bootstrap-t UCL		36.46
3315					95% Hall's Bootstrap UCL	30.89				95% Percentile Bootstrap UCL		32.1
3316					95% BCA Bootstrap UCL	33.39						
3317					90% Chebyshev(Mean, Sd) UCL	40.8				95% Chebyshev(Mean, Sd) UCL		49.65
3318					97.5% Chebyshev(Mean, Sd) UCL	61.94				99% Chebyshev(Mean, Sd) UCL		86.07
3319												
3320					**Suggested UCL to Use**							
3321					95% Adjusted Gamma UCL	45.02						
3322												
3323	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3324	Recommendations are based upon data size, data distribution, and skewness.											
3325	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3326	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3327												
3328												
3329	**Result (eu3_arsenic_overbank)**											
3330												
3331					**General Statistics**							
3332					Total Number of Observations	61				Number of Distinct Observations		58
3333										Number of Missing Observations		0
3334					Minimum	7.3				Mean		37.92
3335					Maximum	83.8				Median		36.3
3336					SD	16.51				Std. Error of Mean		2.114
3337					Coefficient of Variation	0.435				Skewness		0.539
3338												
3339					**Normal GOF Test**							
3340					Shapiro Wilk Test Statistic	0.97				**Shapiro Wilk GOF Test**		
3341					5% Shapiro Wilk P Value	0.306				Data appear Normal at 5% Significance Level		
3342					Lilliefors Test Statistic	0.1				**Lilliefors GOF Test**		
3343					5% Lilliefors Critical Value	0.113				Data appear Normal at 5% Significance Level		
3344					**Data appear Normal at 5% Significance Level**							
3345												
3346					**Assuming Normal Distribution**							
3347					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
3348					95% Student's-t UCL	41.45				95% Adjusted-CLT UCL (Chen-1995)		41.55
3349										95% Modified-t UCL (Johnson-1978)		41.47
3350												

3351	**Gamma GOF Test**											
3352					A-D Test Statistic	0.322	**Anderson-Darling Gamma GOF Test**					
3353					5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Lev					
3354					K-S Test Statistic	0.0702	**Kolmogorov-Smirnov Gamma GOF Test**					
3355					5% K-S Critical Value	0.114	Detected data appear Gamma Distributed at 5% Significance Lev					
3356	**Detected data appear Gamma Distributed at 5% Significance Level**											
3357												
3358	**Gamma Statistics**											
3359					k hat (MLE)	4.794	k star (bias corrected MLE)	4.569				
3360					Theta hat (MLE)	7.909	Theta star (bias corrected MLE)	8.299				
3361					nu hat (MLE)	584.9	nu star (bias corrected)	557.4				
3362					MLE Mean (bias corrected)	37.92	MLE Sd (bias corrected)	17.74				
3363							Approximate Chi Square Value (0.05)	503.7				
3364					Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	502.5				
3365												
3366	**Assuming Gamma Distribution**											
3367	95% Approximate Gamma UCL (use when n>=50))					41.97	95% Adjusted Gamma UCL (use when n<50)	42.07				
3368												
3369	**Lognormal GOF Test**											
3370					Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**					
3371					5% Shapiro Wilk P Value	0.0223	Data Not Lognormal at 5% Significance Level					
3372					Lilliefors Test Statistic	0.103	**Lilliefors Lognormal GOF Test**					
3373					5% Lilliefors Critical Value	0.113	Data appear Lognormal at 5% Significance Level					
3374	**Data appear Approximate Lognormal at 5% Significance Level**											
3375												
3376	**Lognormal Statistics**											
3377					Minimum of Logged Data	1.988	Mean of logged Data	3.528				
3378					Maximum of Logged Data	4.428	SD of logged Data	0.5				
3379												
3380	**Assuming Lognormal Distribution**											
3381					95% H-UCL	43.51	90% Chebyshev (MVUE) UCL	46.28				
3382					95% Chebyshev (MVUE) UCL	49.81	97.5% Chebyshev (MVUE) UCL	54.7				
3383					99% Chebyshev (MVUE) UCL	64.32						
3384												
3385	**Nonparametric Distribution Free UCL Statistics**											
3386	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3387												
3388	**Nonparametric Distribution Free UCLs**											
3389					95% CLT UCL	41.4	95% Jackknife UCL	41.45				
3390					95% Standard Bootstrap UCL	41.3	95% Bootstrap-t UCL	41.42				
3391					95% Hall's Bootstrap UCL	41.77	95% Percentile Bootstrap UCL	41.49				
3392					95% BCA Bootstrap UCL	41.8						
3393					90% Chebyshev(Mean, Sd) UCL	44.26	95% Chebyshev(Mean, Sd) UCL	47.13				
3394					97.5% Chebyshev(Mean, Sd) UCL	51.12	99% Chebyshev(Mean, Sd) UCL	58.95				
3395												
3396	**Suggested UCL to Use**											
3397					95% Student's-t UCL	41.45						
3398												
3399	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3400	Recommendations are based upon data size, data distribution, and skewness.											
3401	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3402	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3403												
3404												
3405	**Result (eu3_arsenic_waste rock)**											
3406												
3407	**General Statistics**											
3408					Total Number of Observations	14	Number of Distinct Observations	14				
3409							Number of Missing Observations	0				
3410					Minimum	22.8	Mean	80.23				
3411					Maximum	223	Median	71.6				
3412					SD	55.63	Std. Error of Mean	14.87				
3413					Coefficient of Variation	0.693	Skewness	1.338				
3414												
3415	**Normal GOF Test**											
3416					Shapiro Wilk Test Statistic	0.879	**Shapiro Wilk GOF Test**					
3417					5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level					

3418					Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**					
3419					5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level					
3420	**Data appear Normal at 5% Significance Level**											
3421												
3422	**Assuming Normal Distribution**											
3423	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
3424					95% Student's-t UCL	106.6	95% Adjusted-CLT UCL (Chen-1995)	110.4				
3425							95% Modified-t UCL (Johnson-1978)	107.4				
3426												
3427	**Gamma GOF Test**											
3428					A-D Test Statistic	0.245	**Anderson-Darling Gamma GOF Test**					
3429					5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Lev					
3430					K-S Test Statistic	0.114	**Kolmogorov-Smirnov Gamma GOF Test**					
3431					5% K-S Critical Value	0.231	Detected data appear Gamma Distributed at 5% Significance Lev					
3432	**Detected data appear Gamma Distributed at 5% Significance Level**											
3433												
3434	**Gamma Statistics**											
3435					k hat (MLE)	2.452	k star (bias corrected MLE)	1.974				
3436					Theta hat (MLE)	32.72	Theta star (bias corrected MLE)	40.64				
3437					nu hat (MLE)	68.65	nu star (bias corrected)	55.27				
3438					MLE Mean (bias corrected)	80.23	MLE Sd (bias corrected)	57.1				
3439							Approximate Chi Square Value (0.05)	39.19				
3440					Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	37.39				
3441												
3442	**Assuming Gamma Distribution**											
3443	95% Approximate Gamma UCL (use when n>=50))					113.2	95% Adjusted Gamma UCL (use when n<50)	118.6				
3444												
3445	**Lognormal GOF Test**											
3446					Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**					
3447					5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level					
3448					Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**					
3449					5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level					
3450	**Data appear Lognormal at 5% Significance Level**											
3451												
3452	**Lognormal Statistics**											
3453					Minimum of Logged Data	3.127	Mean of logged Data	4.167				
3454					Maximum of Logged Data	5.407	SD of logged Data	0.696				
3455												
3456	**Assuming Lognormal Distribution**											
3457					95% H-UCL	128.9	90% Chebyshev (MVUE) UCL	127.7				
3458					95% Chebyshev (MVUE) UCL	149.1	97.5% Chebyshev (MVUE) UCL	178.7				
3459					99% Chebyshev (MVUE) UCL	237						
3460												
3461	**Nonparametric Distribution Free UCL Statistics**											
3462	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3463												
3464	**Nonparametric Distribution Free UCLs**											
3465					95% CLT UCL	104.7	95% Jackknife UCL	106.6				
3466					95% Standard Bootstrap UCL	103.3	95% Bootstrap-t UCL	115.8				
3467					95% Hall's Bootstrap UCL	119.6	95% Percentile Bootstrap UCL	104.6				
3468					95% BCA Bootstrap UCL	109.8						
3469					90% Chebyshev(Mean, Sd) UCL	124.8	95% Chebyshev(Mean, Sd) UCL	145				
3470					97.5% Chebyshev(Mean, Sd) UCL	173.1	99% Chebyshev(Mean, Sd) UCL	228.2				
3471												
3472	**Suggested UCL to Use**											
3473					95% Student's-t UCL	106.6						
3474												
3475	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3476	Recommendations are based upon data size, data distribution, and skewness.											
3477	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3478	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3479												
3480	**Result (eu3_cadmium_overbank)**											
3481												
3482	**General Statistics**											
3483					Total Number of Observations	62	Number of Distinct Observations	48				
3484					Number of Detects	43	Number of Non-Detects	19				

3485					Number of Distinct Detects	37					Number of Distinct Non-Detects	11
3486					Minimum Detect	0.11					Minimum Non-Detect	0.045
3487					Maximum Detect	54.5					Maximum Non-Detect	0.061
3488					Variance Detects	72.02					Percent Non-Detects	30.65%
3489					Mean Detects	3.676					SD Detects	8.486
3490					Median Detects	1.8					CV Detects	2.309
3491					Skewness Detects	5.479					Kurtosis Detects	32.37
3492					Mean of Logged Detects	0.502					SD of Logged Detects	1.177
3493												
3494					**Normal GOF Test on Detects Only**							
3495					Shapiro Wilk Test Statistic	0.363	**Shapiro Wilk GOF Test**					
3496					5% Shapiro Wilk Critical Value	0.943	Detected Data Not Normal at 5% Significance Level					
3497					Lilliefors Test Statistic	0.35	**Lilliefors GOF Test**					
3498					5% Lilliefors Critical Value	0.134	Detected Data Not Normal at 5% Significance Level					
3499					**Detected Data Not Normal at 5% Significance Level**							
3500												
3501					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
3502					KM Mean	2.563	KM Standard Error of Mean	0.923				
3503					KM SD	7.182	95% KM (BCA) UCL	4.464				
3504					95% KM (t) UCL	4.105	95% KM (Percentile Bootstrap) UCL	4.222				
3505					95% KM (z) UCL	4.081	95% KM Bootstrap t UCL	7.777				
3506					90% KM Chebyshev UCL	5.332	95% KM Chebyshev UCL	6.586				
3507					97.5% KM Chebyshev UCL	8.327	99% KM Chebyshev UCL	11.75				
3508												
3509					**Gamma GOF Tests on Detected Observations Only**							
3510					A-D Test Statistic	2.413	**Anderson-Darling GOF Test**					
3511					5% A-D Critical Value	0.79	Detected Data Not Gamma Distributed at 5% Significance Level					
3512					K-S Test Statistic	0.201	**Kolmogorov-Smirnov GOF**					
3513					5% K-S Critical Value	0.14	Detected Data Not Gamma Distributed at 5% Significance Level					
3514					**Detected Data Not Gamma Distributed at 5% Significance Level**							
3515												
3516					**Gamma Statistics on Detected Data Only**							
3517					k hat (MLE)	0.748	k star (bias corrected MLE)	0.712				
3518					Theta hat (MLE)	4.912	Theta star (bias corrected MLE)	5.165				
3519					nu hat (MLE)	64.36	nu star (bias corrected)	61.2				
3520					Mean (detects)	3.676						
3521												
3522					**Gamma ROS Statistics using Imputed Non-Detects**							
3523					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
3524					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)							
3525					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
3526					This is especially true when the sample size is small.							
3527					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
3528					Minimum	0.01	Mean	2.552				
3529					Maximum	54.5	Median	1.05				
3530					SD	7.245	CV	2.838				
3531					k hat (MLE)	0.338	k star (bias corrected MLE)	0.332				
3532					Theta hat (MLE)	7.55	Theta star (bias corrected MLE)	7.677				
3533					nu hat (MLE)	41.92	nu star (bias corrected)	41.22				
3534					Adjusted Level of Significance (β)	0.0461						
3535					Approximate Chi Square Value (41.22, α)	27.51	Adjusted Chi Square Value (41.22, β)	27.24				
3536					95% Gamma Approximate UCL (use when n>=50)	3.825	95% Gamma Adjusted UCL (use when n<50)	3.862				
3537												
3538					**Estimates of Gamma Parameters using KM Estimates**							
3539					Mean (KM)	2.563	SD (KM)	7.182				
3540					Variance (KM)	51.59	SE of Mean (KM)	0.923				
3541					k hat (KM)	0.127	k star (KM)	0.132				
3542					nu hat (KM)	15.79	nu star (KM)	16.36				
3543					theta hat (KM)	20.13	theta star (KM)	19.43				
3544					80% gamma percentile (KM)	2.485	90% gamma percentile (KM)	7.432				
3545					95% gamma percentile (KM)	14.43	99% gamma percentile (KM)	35.31				
3546												
3547					**Gamma Kaplan-Meier (KM) Statistics**							
3548					Approximate Chi Square Value (16.36, α)	8.217	Adjusted Chi Square Value (16.36, β)	8.079				
3549					5% Gamma Approximate KM-UCL (use when n>=50)	5.103	95% Gamma Adjusted KM-UCL (use when n<50)	5.19				
3550												
3551					**Lognormal GOF Test on Detected Observations Only**							

3552					Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk GOF Test**					
3553					5% Shapiro Wilk Critical Value	0.943	Detected Data appear Lognormal at 5% Significance Level					
3554					Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**					
3555					5% Lilliefors Critical Value	0.134	Detected Data appear Lognormal at 5% Significance Level					
3556					**Detected Data appear Lognormal at 5% Significance Level**							
3557												
3558					**Lognormal ROS Statistics Using Imputed Non-Detects**							
3559					Mean in Original Scale	2.59	Mean in Log Scale	-0.289				
3560					SD in Original Scale	7.232	SD in Log Scale	1.56				
3561					95% t UCL (assumes normality of ROS data)	4.124	95% Percentile Bootstrap UCL	4.394				
3562					95% BCA Bootstrap UCL	5.484	95% Bootstrap t UCL	8.326				
3563					95% H-UCL (Log ROS)	4.236						
3564												
3565					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
3566					KM Mean (logged)	-0.602	KM Geo Mean	0.547				
3567					KM SD (logged)	1.923	95% Critical H Value (KM-Log)	3.012				
3568					KM Standard Error of Mean (logged)	0.247	95% H-UCL (KM -Log)	7.297				
3569					KM SD (logged)	1.923	95% Critical H Value (KM-Log)	3.012				
3570					KM Standard Error of Mean (logged)	0.247						
3571												
3572					**DL/2 Statistics**							
3573					**DL/2 Normal**		**DL/2 Log-Transformed**					
3574					Mean in Original Scale	2.557	Mean in Log Scale	-0.777				
3575					SD in Original Scale	7.243	SD in Log Scale	2.172				
3576					95% t UCL (Assumes normality)	4.094	95% H-Stat UCL	12.03				
3577					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
3578												
3579					**Nonparametric Distribution Free UCL Statistics**							
3580					**Detected Data appear Lognormal Distributed at 5% Significance Level**							
3581												
3582					**Suggested UCL to Use**							
3583					KM H-UCL	7.297						
3584												
3585	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3586	Recommendations are based upon data size, data distribution, and skewness.											
3587	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3588	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3589												
3590												
3591	**Result (eu3_cadmium_waste rock)**											
3592												
3593					**General Statistics**							
3594					Total Number of Observations	14	Number of Distinct Observations	14				
3595							Number of Missing Observations	0				
3596					Minimum	0.15	Mean	6.295				
3597					Maximum	20.7	Median	3.9				
3598					SD	7.312	Std. Error of Mean	1.954				
3599					Coefficient of Variation	1.162	Skewness	1.214				
3600												
3601					**Normal GOF Test**							
3602					Shapiro Wilk Test Statistic	0.788	**Shapiro Wilk GOF Test**					
3603					5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level					
3604					Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**					
3605					5% Lilliefors Critical Value	0.226	Data Not Normal at 5% Significance Level					
3606					**Data Not Normal at 5% Significance Level**							
3607												
3608					**Assuming Normal Distribution**							
3609					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
3610					95% Student's-t UCL	9.756	95% Adjusted-CLT UCL (Chen-1995)	10.19				
3611							95% Modified-t UCL (Johnson-1978)	9.861				
3612												
3613					**Gamma GOF Test**							
3614					A-D Test Statistic	0.313	**Anderson-Darling Gamma GOF Test**					
3615					5% A-D Critical Value	0.776	Detected data appear Gamma Distributed at 5% Significance Lev					
3616					K-S Test Statistic	0.156	**Kolmogorov-Smirnov Gamma GOF Test**					
3617					5% K-S Critical Value	0.239	Detected data appear Gamma Distributed at 5% Significance Lev					
3618					**Detected data appear Gamma Distributed at 5% Significance Level**							

3619												
3620						**Gamma Statistics**						
3621						k hat (MLE)	0.686			k star (bias corrected MLE)	0.586	
3622						Theta hat (MLE)	9.179			Theta star (bias corrected MLE)	10.73	
3623						nu hat (MLE)	19.2			nu star (bias corrected)	16.42	
3624						MLE Mean (bias corrected)	6.295			MLE Sd (bias corrected)	8.22	
3625										Approximate Chi Square Value (0.05)	8.26	
3626						Adjusted Level of Significance	0.0312			Adjusted Chi Square Value	7.503	
3627												
3628						**Assuming Gamma Distribution**						
3629						95% Approximate Gamma UCL (use when n>=50)	12.51			95% Adjusted Gamma UCL (use when n<50)	13.78	
3630												
3631						**Lognormal GOF Test**						
3632						Shapiro Wilk Test Statistic	0.945			**Shapiro Wilk Lognormal GOF Test**		
3633						5% Shapiro Wilk Critical Value	0.874			Data appear Lognormal at 5% Significance Level		
3634						Lilliefors Test Statistic	0.145			**Lilliefors Lognormal GOF Test**		
3635						5% Lilliefors Critical Value	0.226			Data appear Lognormal at 5% Significance Level		
3636						**Data appear Lognormal at 5% Significance Level**						
3637												
3638						**Lognormal Statistics**						
3639						Minimum of Logged Data	-1.897			Mean of logged Data	0.956	
3640						Maximum of Logged Data	3.03			SD of logged Data	1.592	
3641												
3642						**Assuming Lognormal Distribution**						
3643						95% H-UCL	50.91			90% Chebyshev (MVUE) UCL	19.06	
3644						95% Chebyshev (MVUE) UCL	24.15			97.5% Chebyshev (MVUE) UCL	31.23	
3645						99% Chebyshev (MVUE) UCL	45.13					
3646												
3647						**Nonparametric Distribution Free UCL Statistics**						
3648						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
3649												
3650						**Nonparametric Distribution Free UCLs**						
3651						95% CLT UCL	9.509			95% Jackknife UCL	9.756	
3652						95% Standard Bootstrap UCL	9.37			95% Bootstrap-t UCL	11.17	
3653						95% Hall's Bootstrap UCL	9.798			95% Percentile Bootstrap UCL	9.494	
3654						95% BCA Bootstrap UCL	10.12					
3655						90% Chebyshev(Mean, Sd) UCL	12.16			95% Chebyshev(Mean, Sd) UCL	14.81	
3656						97.5% Chebyshev(Mean, Sd) UCL	18.5			99% Chebyshev(Mean, Sd) UCL	25.74	
3657												
3658						**Suggested UCL to Use**						
3659						95% Adjusted Gamma UCL	13.78					
3660												
3661	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3662	Recommendations are based upon data size, data distribution, and skewness.											
3663	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3664	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3665												
3666												
3667	**Result (eu3_chromium_overbank)**											
3668												
3669						**General Statistics**						
3670						Total Number of Observations	62			Number of Distinct Observations	46	
3671										Number of Missing Observations	0	
3672						Minimum	0.12			Mean	4.431	
3673						Maximum	11.4			Median	4	
3674						SD	2.061			Std. Error of Mean	0.262	
3675						Coefficient of Variation	0.465			Skewness	0.94	
3676												
3677						**Normal GOF Test**						
3678						Shapiro Wilk Test Statistic	0.949			**Shapiro Wilk GOF Test**		
3679						5% Shapiro Wilk P Value	0.0255			Data Not Normal at 5% Significance Level		
3680						Lilliefors Test Statistic	0.116			**Lilliefors GOF Test**		
3681						5% Lilliefors Critical Value	0.112			Data Not Normal at 5% Significance Level		
3682						**Data Not Normal at 5% Significance Level**						
3683												
3684						**Assuming Normal Distribution**						
3685						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		

3686				95% Student's-t UCL	4.868		95% Adjusted-CLT UCL (Chen-1995)	4.895
3687							95% Modified-t UCL (Johnson-1978)	4.873
3688								
3689				**Gamma GOF Test**				
3690				A-D Test Statistic	0.95	**Anderson-Darling Gamma GOF Test**		
3691				5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level		
3692				K-S Test Statistic	0.115	**Kolmogorov-Smirnov Gamma GOF Test**		
3693				5% K-S Critical Value	0.114	Data Not Gamma Distributed at 5% Significance Level		
3694				**Data Not Gamma Distributed at 5% Significance Level**				
3695								
3696				**Gamma Statistics**				
3697				k hat (MLE)	3.751	k star (bias corrected MLE)	3.58	
3698				Theta hat (MLE)	1.181	Theta star (bias corrected MLE)	1.238	
3699				nu hat (MLE)	465.1	nu star (bias corrected)	444	
3700				MLE Mean (bias corrected)	4.431	MLE Sd (bias corrected)	2.342	
3701						Approximate Chi Square Value (0.05)	396.1	
3702				Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	395	
3703								
3704				**Assuming Gamma Distribution**				
3705				95% Approximate Gamma UCL (use when n>=50))	4.966	95% Adjusted Gamma UCL (use when n<50)	4.98	
3706								
3707				**Lognormal GOF Test**				
3708				Shapiro Wilk Test Statistic	0.803	**Shapiro Wilk Lognormal GOF Test**		
3709				5% Shapiro Wilk P Value	5.393E-11	Data Not Lognormal at 5% Significance Level		
3710				Lilliefors Test Statistic	0.162	**Lilliefors Lognormal GOF Test**		
3711				5% Lilliefors Critical Value	0.112	Data Not Lognormal at 5% Significance Level		
3712				**Data Not Lognormal at 5% Significance Level**				
3713								
3714				**Lognormal Statistics**				
3715				Minimum of Logged Data	-2.12	Mean of logged Data	1.349	
3716				Maximum of Logged Data	2.434	SD of logged Data	0.643	
3717								
3718				**Assuming Lognormal Distribution**				
3719				95% H-UCL	5.571	90% Chebyshev (MVUE) UCL	5.975	
3720				95% Chebyshev (MVUE) UCL	6.543	97.5% Chebyshev (MVUE) UCL	7.331	
3721				99% Chebyshev (MVUE) UCL	8.879			
3722								
3723				**Nonparametric Distribution Free UCL Statistics**				
3724				**Data do not follow a Discernible Distribution (0.05)**				
3725								
3726				**Nonparametric Distribution Free UCLs**				
3727				95% CLT UCL	4.862	95% Jackknife UCL	4.868	
3728				95% Standard Bootstrap UCL	4.853	95% Bootstrap-t UCL	4.909	
3729				95% Hall's Bootstrap UCL	4.897	95% Percentile Bootstrap UCL	4.877	
3730				95% BCA Bootstrap UCL	4.894			
3731				90% Chebyshev(Mean, Sd) UCL	5.216	95% Chebyshev(Mean, Sd) UCL	5.572	
3732				97.5% Chebyshev(Mean, Sd) UCL	6.066	99% Chebyshev(Mean, Sd) UCL	7.036	
3733								
3734				**Suggested UCL to Use**				
3735				95% Chebyshev (Mean, Sd) UCL	5.572			
3736								
3737	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
3738	Recommendations are based upon data size, data distribution, and skewness.							
3739	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
3740	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia							
3741								
3742								
3743	**Result (eu3_chromium_waste rock)**							
3744								
3745				**General Statistics**				
3746				Total Number of Observations	14	Number of Distinct Observations	13	
3747						Number of Missing Observations	0	
3748				Minimum	1.2	Mean	3.429	
3749				Maximum	7.2	Median	3.55	
3750				SD	1.796	Std. Error of Mean	0.48	
3751				Coefficient of Variation	0.524	Skewness	0.649	
3752								

3753	**Normal GOF Test**											
3754					Shapiro Wilk Test Statistic	0.926	**Shapiro Wilk GOF Test**					
3755					5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level					
3756					Lilliefors Test Statistic	0.151	**Lilliefors GOF Test**					
3757					5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level					
3758	**Data appear Normal at 5% Significance Level**											
3759												
3760	**Assuming Normal Distribution**											
3761				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
3762					95% Student's-t UCL	4.279		95% Adjusted-CLT UCL (Chen-1995)	4.307			
3763								95% Modified-t UCL (Johnson-1978)	4.293			
3764												
3765	**Gamma GOF Test**											
3766					A-D Test Statistic	0.385	**Anderson-Darling Gamma GOF Test**					
3767					5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Lev					
3768					K-S Test Statistic	0.156	**Kolmogorov-Smirnov Gamma GOF Test**					
3769					5% K-S Critical Value	0.23	Detected data appear Gamma Distributed at 5% Significance Lev					
3770	**Detected data appear Gamma Distributed at 5% Significance Level**											
3771												
3772	**Gamma Statistics**											
3773					k hat (MLE)	3.742		k star (bias corrected MLE)	2.988			
3774					Theta hat (MLE)	0.916		Theta star (bias corrected MLE)	1.147			
3775					nu hat (MLE)	104.8		nu star (bias corrected)	83.67			
3776					MLE Mean (bias corrected)	3.429		MLE Sd (bias corrected)	1.983			
3777								Approximate Chi Square Value (0.05)	63.58			
3778					Adjusted Level of Significance	0.0312		Adjusted Chi Square Value	61.27			
3779												
3780	**Assuming Gamma Distribution**											
3781	95% Approximate Gamma UCL (use when n>=50))					4.511		95% Adjusted Gamma UCL (use when n<50)	4.682			
3782												
3783	**Lognormal GOF Test**											
3784					Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk Lognormal GOF Test**					
3785					5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level					
3786					Lilliefors Test Statistic	0.17	**Lilliefors Lognormal GOF Test**					
3787					5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level					
3788	**Data appear Lognormal at 5% Significance Level**											
3789												
3790	**Lognormal Statistics**											
3791					Minimum of Logged Data	0.182		Mean of logged Data	1.093			
3792					Maximum of Logged Data	1.974		SD of logged Data	0.568			
3793												
3794	**Assuming Lognormal Distribution**											
3795					95% H-UCL	4.896		90% Chebyshev (MVUE) UCL	5.09			
3796					95% Chebyshev (MVUE) UCL	5.828		97.5% Chebyshev (MVUE) UCL	6.854			
3797					99% Chebyshev (MVUE) UCL	8.868						
3798												
3799	**Nonparametric Distribution Free UCL Statistics**											
3800	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3801												
3802	**Nonparametric Distribution Free UCLs**											
3803					95% CLT UCL	4.218		95% Jackknife UCL	4.279			
3804					95% Standard Bootstrap UCL	4.174		95% Bootstrap-t UCL	4.376			
3805					95% Hall's Bootstrap UCL	4.43		95% Percentile Bootstrap UCL	4.193			
3806					95% BCA Bootstrap UCL	4.236						
3807					90% Chebyshev(Mean, Sd) UCL	4.869		95% Chebyshev(Mean, Sd) UCL	5.521			
3808					97.5% Chebyshev(Mean, Sd) UCL	6.427		99% Chebyshev(Mean, Sd) UCL	8.205			
3809												
3810	**Suggested UCL to Use**											
3811					95% Student's-t UCL	4.279						
3812												
3813	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3814	Recommendations are based upon data size, data distribution, and skewness.											
3815	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3816	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3817												
3818	**Result (eu3_cobalt_overbank)**											
3819												

3820	**General Statistics**											
3821				Total Number of Observations		55			Number of Distinct Observations			46
3822				Number of Detects		53			Number of Non-Detects			2
3823				Number of Distinct Detects		44			Number of Distinct Non-Detects			2
3824				Minimum Detect		0.65			Minimum Non-Detect			0.037
3825				Maximum Detect		39.5			Maximum Non-Detect			0.039
3826				Variance Detects		50.61			Percent Non-Detects			3.636%
3827				Mean Detects		7.415			SD Detects			7.114
3828				Median Detects		4.9			CV Detects			0.959
3829				Skewness Detects		2.528			Kurtosis Detects			8.305
3830				Mean of Logged Detects		1.647			SD of Logged Detects			0.866
3831												
3832	**Normal GOF Test on Detects Only**											
3833				Shapiro Wilk Test Statistic		0.756			**Normal GOF Test on Detected Observations Only**			
3834				5% Shapiro Wilk P Value		3.591E-11			Detected Data Not Normal at 5% Significance Level			
3835				Lilliefors Test Statistic		0.172			**Lilliefors GOF Test**			
3836				5% Lilliefors Critical Value		0.121			Detected Data Not Normal at 5% Significance Level			
3837	**Detected Data Not Normal at 5% Significance Level**											
3838												
3839	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
3840				KM Mean		7.147			KM Standard Error of Mean			0.96
3841				KM SD		7.054			95% KM (BCA) UCL			8.953
3842				95% KM (t) UCL		8.754			95% KM (Percentile Bootstrap) UCL			8.758
3843				95% KM (z) UCL		8.726			95% KM Bootstrap t UCL			9.216
3844				90% KM Chebyshev UCL		10.03			95% KM Chebyshev UCL			11.33
3845				97.5% KM Chebyshev UCL		13.14			99% KM Chebyshev UCL			16.7
3846												
3847	**Gamma GOF Tests on Detected Observations Only**											
3848				A-D Test Statistic		0.485			**Anderson-Darling GOF Test**			
3849				5% A-D Critical Value		0.767			Detected data appear Gamma Distributed at 5% Significance Lev			
3850				K-S Test Statistic		0.097			**Kolmogorov-Smirnov GOF**			
3851				5% K-S Critical Value		0.124			Detected data appear Gamma Distributed at 5% Significance Lev			
3852	**Detected data appear Gamma Distributed at 5% Significance Level**											
3853												
3854	**Gamma Statistics on Detected Data Only**											
3855				k hat (MLE)		1.548			k star (bias corrected MLE)			1.473
3856				Theta hat (MLE)		4.79			Theta star (bias corrected MLE)			5.034
3857				nu hat (MLE)		164.1			nu star (bias corrected)			156.1
3858				Mean (detects)		7.415						
3859												
3860	**Gamma ROS Statistics using Imputed Non-Detects**											
3861	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
3862	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)											
3863	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
3864	This is especially true when the sample size is small.											
3865	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
3866				Minimum		0.01			Mean			7.146
3867				Maximum		39.5			Median			4.9
3868				SD		7.12			CV			0.996
3869				k hat (MLE)		1.05			k star (bias corrected MLE)			1.004
3870				Theta hat (MLE)		6.809			Theta star (bias corrected MLE)			7.114
3871				nu hat (MLE)		115.4			nu star (bias corrected)			110.5
3872				Adjusted Level of Significance (β)		0.0456						
3873				Approximate Chi Square Value (110.48, α)		87.22			Adjusted Chi Square Value (110.48, β)			86.67
3874				95% Gamma Approximate UCL (use when n>=50)		9.051			95% Gamma Adjusted UCL (use when n<50)			9.109
3875												
3876	**Estimates of Gamma Parameters using KM Estimates**											
3877				Mean (KM)		7.147			SD (KM)			7.054
3878				Variance (KM)		49.75			SE of Mean (KM)			0.96
3879				k hat (KM)		1.027			k star (KM)			0.983
3880				nu hat (KM)		112.9			nu star (KM)			108.1
3881				theta hat (KM)		6.962			theta star (KM)			7.273
3882				80% gamma percentile (KM)		11.52			90% gamma percentile (KM)			16.53
3883				95% gamma percentile (KM)		21.54			99% gamma percentile (KM)			33.2
3884												
3885	**Gamma Kaplan-Meier (KM) Statistics**											
3886				Approximate Chi Square Value (108.10, α)		85.1			Adjusted Chi Square Value (108.10, β)			84.55

3887	5% Gamma Approximate KM-UCL (use when n>=50)					9.078	95% Gamma Adjusted KM-UCL (use when n<50)					9.137
3888												
3889	**Lognormal GOF Test on Detected Observations Only**											
3890	Shapiro Wilk Approximate Test Statistic					0.989	**Shapiro Wilk GOF Test**					
3891	5% Shapiro Wilk P Value					0.966	Detected Data appear Lognormal at 5% Significance Level					
3892	Lilliefors Test Statistic					0.0563	**Lilliefors GOF Test**					
3893	5% Lilliefors Critical Value					0.121	Detected Data appear Lognormal at 5% Significance Level					
3894	**Detected Data appear Lognormal at 5% Significance Level**											
3895												
3896	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3897	Mean in Original Scale					7.168	Mean in Log Scale					1.57
3898	SD in Original Scale					7.098	SD in Log Scale					0.939
3899	95% t UCL (assumes normality of ROS data)					8.77	95% Percentile Bootstrap UCL					8.799
3900	95% BCA Bootstrap UCL					8.969	95% Bootstrap t UCL					9.244
3901	95% H-UCL (Log ROS)					9.966						
3902												
3903	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
3904	KM Mean (logged)					1.467	KM Geo Mean					4.337
3905	KM SD (logged)					1.251	95% Critical H Value (KM-Log)					2.703
3906	KM Standard Error of Mean (logged)					0.17	95% H-UCL (KM -Log)					15.03
3907	KM SD (logged)					1.251	95% Critical H Value (KM-Log)					2.703
3908	KM Standard Error of Mean (logged)					0.17						
3909												
3910	**DL/2 Statistics**											
3911	**DL/2 Normal**						**DL/2 Log-Transformed**					
3912	Mean in Original Scale					7.146	Mean in Log Scale					1.443
3913	SD in Original Scale					7.119	SD in Log Scale					1.358
3914	95% t UCL (Assumes normality)					8.753	95% H-Stat UCL					18.02
3915	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3916												
3917	**Nonparametric Distribution Free UCL Statistics**											
3918	**Detected Data appear Gamma Distributed at 5% Significance Level**											
3919												
3920	**Suggested UCL to Use**											
3921	95% KM Approximate Gamma UCL					9.078	95% GROS Approximate Gamma UCL					9.051
3922												
3923	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3924	Recommendations are based upon data size, data distribution, and skewness.											
3925	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3926	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3927												
3928												
3929	**Result (eu3_cobalt_waste rock)**											
3930												
3931	**General Statistics**											
3932	Total Number of Observations					14	Number of Distinct Observations					14
3933							Number of Missing Observations					0
3934	Minimum					0.32	Mean					4.465
3935	Maximum					35.5	Median					1.35
3936	SD					9.124	Std. Error of Mean					2.439
3937	Coefficient of Variation					2.044	Skewness					3.484
3938												
3939	**Normal GOF Test**											
3940	Shapiro Wilk Test Statistic					0.465	**Shapiro Wilk GOF Test**					
3941	5% Shapiro Wilk Critical Value					0.874	Data Not Normal at 5% Significance Level					
3942	Lilliefors Test Statistic					0.36	**Lilliefors GOF Test**					
3943	5% Lilliefors Critical Value					0.226	Data Not Normal at 5% Significance Level					
3944	**Data Not Normal at 5% Significance Level**											
3945												
3946	**Assuming Normal Distribution**											
3947	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
3948	95% Student's-t UCL					8.784	95% Adjusted-CLT UCL (Chen-1995)					10.9
3949							95% Modified-t UCL (Johnson-1978)					9.162
3950												
3951	**Gamma GOF Test**											
3952	A-D Test Statistic					1.059	**Anderson-Darling Gamma GOF Test**					
3953	5% A-D Critical Value					0.779	Data Not Gamma Distributed at 5% Significance Level					

3954					K-S Test Statistic	0.2	**Kolmogorov-Smirnov Gamma GOF Test**					
3955					5% K-S Critical Value	0.239	Detected data appear Gamma Distributed at 5% Significance Lev					
3956	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
3957												
3958	**Gamma Statistics**											
3959					k hat (MLE)	0.657	k star (bias corrected MLE)	0.564				
3960					Theta hat (MLE)	6.799	Theta star (bias corrected MLE)	7.922				
3961					nu hat (MLE)	18.39	nu star (bias corrected)	15.78				
3962					MLE Mean (bias corrected)	4.465	MLE Sd (bias corrected)	5.948				
3963							Approximate Chi Square Value (0.05)	7.808				
3964					Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	7.075				
3965												
3966	**Assuming Gamma Distribution**											
3967	95% Approximate Gamma UCL (use when n>=50)					9.025	95% Adjusted Gamma UCL (use when n<50)	9.959				
3968												
3969	**Lognormal GOF Test**											
3970					Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**					
3971					5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level					
3972					Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**					
3973					5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level					
3974	**Data appear Lognormal at 5% Significance Level**											
3975												
3976	**Lognormal Statistics**											
3977					Minimum of Logged Data	-1.139	Mean of logged Data	0.568				
3978					Maximum of Logged Data	3.57	SD of logged Data	1.249				
3979												
3980	**Assuming Lognormal Distribution**											
3981					95% H-UCL	11.75	90% Chebyshev (MVUE) UCL	7.446				
3982					95% Chebyshev (MVUE) UCL	9.221	97.5% Chebyshev (MVUE) UCL	11.69				
3983					99% Chebyshev (MVUE) UCL	16.53						
3984												
3985	**Nonparametric Distribution Free UCL Statistics**											
3986	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3987												
3988	**Nonparametric Distribution Free UCLs**											
3989					95% CLT UCL	8.476	95% Jackknife UCL	8.784				
3990					95% Standard Bootstrap UCL	8.508	95% Bootstrap-t UCL	24.6				
3991					95% Hall's Bootstrap UCL	23.12	95% Percentile Bootstrap UCL	8.941				
3992					95% BCA Bootstrap UCL	11.69						
3993					90% Chebyshev(Mean, Sd) UCL	11.78	95% Chebyshev(Mean, Sd) UCL	15.09				
3994					97.5% Chebyshev(Mean, Sd) UCL	19.69	99% Chebyshev(Mean, Sd) UCL	28.73				
3995												
3996	**Suggested UCL to Use**											
3997					95% Adjusted Gamma UCL	9.959						
3998												
3999	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
4000	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
4001												
4002	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4003	Recommendations are based upon data size, data distribution, and skewness.											
4004	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4005	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4006												
4007												
4008	**Result (eu3_iron_overbank)**											
4009												
4010	**General Statistics**											
4011					Total Number of Observations	62	Number of Distinct Observations	59				
4012							Number of Missing Observations	0				
4013					Minimum	19900	Mean	47071				
4014					Maximum	292000	Median	40000				
4015					SD	35611	Std. Error of Mean	4523				
4016					Coefficient of Variation	0.757	Skewness	5.541				
4017												
4018	**Normal GOF Test**											
4019					Shapiro Wilk Test Statistic	0.52	**Shapiro Wilk GOF Test**					
4020					5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level					

4021					Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**					
4022					5% Lilliefors Critical Value	0.112	Data Not Normal at 5% Significance Level					
4023	**Data Not Normal at 5% Significance Level**											
4024												
4025	**Assuming Normal Distribution**											
4026	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
4027					95% Student's-t UCL	54625	95% Adjusted-CLT UCL (Chen-1995)	57911				
4028							95% Modified-t UCL (Johnson-1978)	55155				
4029												
4030	**Gamma GOF Test**											
4031					A-D Test Statistic	1.925	**Anderson-Darling Gamma GOF Test**					
4032					5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level					
4033					K-S Test Statistic	0.118	**Kolmogorov-Smirnov Gamma GOF Test**					
4034					5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level					
4035	**Data Not Gamma Distributed at 5% Significance Level**											
4036												
4037	**Gamma Statistics**											
4038					k hat (MLE)	4.197	k star (bias corrected MLE)	4.005				
4039					Theta hat (MLE)	11214	Theta star (bias corrected MLE)	11753				
4040					nu hat (MLE)	520.5	nu star (bias corrected)	496.6				
4041					MLE Mean (bias corrected)	47071	MLE Sd (bias corrected)	23521				
4042							Approximate Chi Square Value (0.05)	445.9				
4043					Adjusted Level of Significance	0.0461	Adjusted Chi Square Value	444.8				
4044												
4045	**Assuming Gamma Distribution**											
4046	95% Approximate Gamma UCL (use when n>=50))					52420	95% Adjusted Gamma UCL (use when n<50)	52554				
4047												
4048	**Lognormal GOF Test**											
4049					Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**					
4050					5% Shapiro Wilk P Value	3.2609E-4	Data Not Lognormal at 5% Significance Level					
4051					Lilliefors Test Statistic	0.075	**Lilliefors Lognormal GOF Test**					
4052					5% Lilliefors Critical Value	0.112	Data appear Lognormal at 5% Significance Level					
4053	**Data appear Approximate Lognormal at 5% Significance Level**											
4054												
4055	**Lognormal Statistics**											
4056					Minimum of Logged Data	9.898	Mean of logged Data	10.64				
4057					Maximum of Logged Data	12.58	SD of logged Data	0.44				
4058												
4059	**Assuming Lognormal Distribution**											
4060					95% H-UCL	50770	90% Chebyshev (MVUE) UCL	53709				
4061					95% Chebyshev (MVUE) UCL	57321	97.5% Chebyshev (MVUE) UCL	62336				
4062					99% Chebyshev (MVUE) UCL	72185						
4063												
4064	**Nonparametric Distribution Free UCL Statistics**											
4065	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
4066												
4067	**Nonparametric Distribution Free UCLs**											
4068					95% CLT UCL	54510	95% Jackknife UCL	54625				
4069					95% Standard Bootstrap UCL	54398	95% Bootstrap-t UCL	62144				
4070					95% Hall's Bootstrap UCL	86074	95% Percentile Bootstrap UCL	55173				
4071					95% BCA Bootstrap UCL	59266						
4072					90% Chebyshev(Mean, Sd) UCL	60639	95% Chebyshev(Mean, Sd) UCL	66784				
4073					97.5% Chebyshev(Mean, Sd) UCL	75314	99% Chebyshev(Mean, Sd) UCL	92070				
4074												
4075	**Suggested UCL to Use**											
4076					95% Student's-t UCL	54625	or 95% Modified-t UCL	55155				
4077					or 95% H-UCL	50770						
4078												
4079	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4080	Recommendations are based upon data size, data distribution, and skewness.											
4081	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4082	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4083												
4084	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
4085	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
4086	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
4087	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											

4088												
4089												
4090	**Result (eu3_iron_waste rock)**											
4091												
4092	**General Statistics**											
4093						Total Number of Observations	14			Number of Distinct Observations	14	
4094										Number of Missing Observations	0	
4095						Minimum	24000			Mean	59014	
4096						Maximum	257000			Median	37050	
4097						SD	59998			Std. Error of Mean	16035	
4098						Coefficient of Variation	1.017			Skewness	3.154	
4099												
4100	**Normal GOF Test**											
4101						Shapiro Wilk Test Statistic	0.566	**Shapiro Wilk GOF Test**				
4102						5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level				
4103						Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**				
4104						5% Lilliefors Critical Value	0.226	Data Not Normal at 5% Significance Level				
4105	**Data Not Normal at 5% Significance Level**											
4106												
4107	**Assuming Normal Distribution**											
4108						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
4109						95% Student's-t UCL	87411			95% Adjusted-CLT UCL (Chen-1995)	99832	
4110										95% Modified-t UCL (Johnson-1978)	89664	
4111												
4112	**Gamma GOF Test**											
4113						A-D Test Statistic	1.188	**Anderson-Darling Gamma GOF Test**				
4114						5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level				
4115						K-S Test Statistic	0.252	**Kolmogorov-Smirnov Gamma GOF Test**				
4116						5% K-S Critical Value	0.231	Data Not Gamma Distributed at 5% Significance Level				
4117	**Data Not Gamma Distributed at 5% Significance Level**											
4118												
4119	**Gamma Statistics**											
4120						k hat (MLE)	2.165			k star (bias corrected MLE)	1.749	
4121						Theta hat (MLE)	27253			Theta star (bias corrected MLE)	33741	
4122						nu hat (MLE)	60.63			nu star (bias corrected)	48.97	
4123						MLE Mean (bias corrected)	59014			MLE Sd (bias corrected)	44623	
4124										Approximate Chi Square Value (0.05)	33.91	
4125						Adjusted Level of Significance	0.0312			Adjusted Chi Square Value	32.25	
4126												
4127	**Assuming Gamma Distribution**											
4128						95% Approximate Gamma UCL (use when n>=50))	85234			95% Adjusted Gamma UCL (use when n<50)	89615	
4129												
4130	**Lognormal GOF Test**											
4131						Shapiro Wilk Test Statistic	0.848	**Shapiro Wilk Lognormal GOF Test**				
4132						5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level				
4133						Lilliefors Test Statistic	0.218	**Lilliefors Lognormal GOF Test**				
4134						5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level				
4135	**Data appear Approximate Lognormal at 5% Significance Level**											
4136												
4137	**Lognormal Statistics**											
4138						Minimum of Logged Data	10.09			Mean of logged Data	10.74	
4139						Maximum of Logged Data	12.46			SD of logged Data	0.633	
4140												
4141	**Assuming Lognormal Distribution**											
4142						95% H-UCL	83648			90% Chebyshev (MVUE) UCL	84645	
4143						95% Chebyshev (MVUE) UCL	97919			97.5% Chebyshev (MVUE) UCL	116343	
4144						99% Chebyshev (MVUE) UCL	152533					
4145												
4146	**Nonparametric Distribution Free UCL Statistics**											
4147	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
4148												
4149	**Nonparametric Distribution Free UCLs**											
4150						95% CLT UCL	85390			95% Jackknife UCL	87411	
4151						95% Standard Bootstrap UCL	85124			95% Bootstrap-t UCL	143564	
4152						95% Hall's Bootstrap UCL	182678			95% Percentile Bootstrap UCL	88357	
4153						95% BCA Bootstrap UCL	105871					
4154						90% Chebyshev(Mean, Sd) UCL	107120			95% Chebyshev(Mean, Sd) UCL	128910	

4155				97.5% Chebyshev(Mean, Sd) UCL	159154				99% Chebyshev(Mean, Sd) UCL	218562		
4156												
4157					**Suggested UCL to Use**							
4158				95% H-UCL	83648							
4159												
4160	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4161	Recommendations are based upon data size, data distribution, and skewness.											
4162	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4163	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4164												
4165	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
4166	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
4167	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
4168	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
4169												
4170												
4171	**Result (eu3_manganese_overbank)**											
4172												
4173					**General Statistics**							
4174				Total Number of Observations	62				Number of Distinct Observations	60		
4175									Number of Missing Observations	0		
4176				Minimum	9				Mean	1992		
4177				Maximum	35900				Median	623.5		
4178				SD	4933				Std. Error of Mean	626.5		
4179				Coefficient of Variation	2.476				Skewness	5.847		
4180												
4181					**Normal GOF Test**							
4182				Shapiro Wilk Test Statistic	0.379				**Shapiro Wilk GOF Test**			
4183				5% Shapiro Wilk P Value	0				Data Not Normal at 5% Significance Level			
4184				Lilliefors Test Statistic	0.344				**Lilliefors GOF Test**			
4185				5% Lilliefors Critical Value	0.112				Data Not Normal at 5% Significance Level			
4186					**Data Not Normal at 5% Significance Level**							
4187												
4188					**Assuming Normal Distribution**							
4189				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
4190				95% Student's-t UCL	3039				95% Adjusted-CLT UCL (Chen-1995)	3520		
4191									95% Modified-t UCL (Johnson-1978)	3116		
4192												
4193					**Gamma GOF Test**							
4194				A-D Test Statistic	2.588				**Anderson-Darling Gamma GOF Test**			
4195				5% A-D Critical Value	0.807				Data Not Gamma Distributed at 5% Significance Level			
4196				K-S Test Statistic	0.167				**Kolmogorov-Smirnov Gamma GOF Test**			
4197				5% K-S Critical Value	0.119				Data Not Gamma Distributed at 5% Significance Level			
4198					**Data Not Gamma Distributed at 5% Significance Level**							
4199												
4200					**Gamma Statistics**							
4201				k hat (MLE)	0.598				k star (bias corrected MLE)	0.58		
4202				Theta hat (MLE)	3333				Theta star (bias corrected MLE)	3438		
4203				nu hat (MLE)	74.12				nu star (bias corrected)	71.86		
4204				MLE Mean (bias corrected)	1992				MLE Sd (bias corrected)	2617		
4205									Approximate Chi Square Value (0.05)	53.34		
4206				Adjusted Level of Significance	0.0461				Adjusted Chi Square Value	52.96		
4207												
4208					**Assuming Gamma Distribution**							
4209				95% Approximate Gamma UCL (use when n>=50))	2684				95% Adjusted Gamma UCL (use when n<50)	2703		
4210												
4211					**Lognormal GOF Test**							
4212				Shapiro Wilk Test Statistic	0.986				**Shapiro Wilk Lognormal GOF Test**			
4213				5% Shapiro Wilk P Value	0.877				Data appear Lognormal at 5% Significance Level			
4214				Lilliefors Test Statistic	0.0587				**Lilliefors Lognormal GOF Test**			
4215				5% Lilliefors Critical Value	0.112				Data appear Lognormal at 5% Significance Level			
4216					**Data appear Lognormal at 5% Significance Level**							
4217												
4218					**Lognormal Statistics**							
4219				Minimum of Logged Data	2.197				Mean of logged Data	6.563		
4220				Maximum of Logged Data	10.49				SD of logged Data	1.39		
4221												

4222	**Assuming Lognormal Distribution**											
4223					95% H-UCL	2836		90% Chebyshev (MVUE) UCL	3063			
4224					95% Chebyshev (MVUE) UCL	3633		97.5% Chebyshev (MVUE) UCL	4422			
4225					99% Chebyshev (MVUE) UCL	5974						
4226												
4227	**Nonparametric Distribution Free UCL Statistics**											
4228	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
4229												
4230	**Nonparametric Distribution Free UCLs**											
4231					95% CLT UCL	3023		95% Jackknife UCL	3039			
4232					95% Standard Bootstrap UCL	2996		95% Bootstrap-t UCL	5252			
4233					95% Hall's Bootstrap UCL	7327		95% Percentile Bootstrap UCL	3102			
4234					95% BCA Bootstrap UCL	3953						
4235					90% Chebyshev(Mean, Sd) UCL	3872		95% Chebyshev(Mean, Sd) UCL	4723			
4236					97.5% Chebyshev(Mean, Sd) UCL	5905		99% Chebyshev(Mean, Sd) UCL	8226			
4237												
4238	**Suggested UCL to Use**											
4239					95% H-UCL	2836						
4240												
4241	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4242	Recommendations are based upon data size, data distribution, and skewness.											
4243	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4244	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4245												
4246	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
4247	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
4248	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
4249	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
4250												
4251												
4252	**Result (eu3_manganese_waste rock)**											
4253												
4254	**General Statistics**											
4255					Total Number of Observations	14		Number of Distinct Observations	14			
4256								Number of Missing Observations	0			
4257					Minimum	136		Mean	789.7			
4258					Maximum	3780		Median	592			
4259					SD	902.6		Std. Error of Mean	241.2			
4260					Coefficient of Variation	1.143		Skewness	3.18			
4261												
4262	**Normal GOF Test**											
4263					Shapiro Wilk Test Statistic	0.577		**Shapiro Wilk GOF Test**				
4264					5% Shapiro Wilk Critical Value	0.874		Data Not Normal at 5% Significance Level				
4265					Lilliefors Test Statistic	0.32		**Lilliefors GOF Test**				
4266					5% Lilliefors Critical Value	0.226		Data Not Normal at 5% Significance Level				
4267	**Data Not Normal at 5% Significance Level**											
4268												
4269	**Assuming Normal Distribution**											
4270	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
4271					95% Student's-t UCL	1217		95% Adjusted-CLT UCL (Chen-1995)	1406			
4272								95% Modified-t UCL (Johnson-1978)	1251			
4273												
4274	**Gamma GOF Test**											
4275					A-D Test Statistic	0.853		**Anderson-Darling Gamma GOF Test**				
4276					5% A-D Critical Value	0.749		Data Not Gamma Distributed at 5% Significance Level				
4277					K-S Test Statistic	0.233		**Kolmogorov-Smirnov Gamma GOF Test**				
4278					5% K-S Critical Value	0.232		Data Not Gamma Distributed at 5% Significance Level				
4279	**Data Not Gamma Distributed at 5% Significance Level**											
4280												
4281	**Gamma Statistics**											
4282					k hat (MLE)	1.655		k star (bias corrected MLE)	1.348			
4283					Theta hat (MLE)	477.1		Theta star (bias corrected MLE)	585.7			
4284					nu hat (MLE)	46.35		nu star (bias corrected)	37.75			
4285					MLE Mean (bias corrected)	789.7		MLE Sd (bias corrected)	680.1			
4286								Approximate Chi Square Value (0.05)	24.68			
4287					Adjusted Level of Significance	0.0312		Adjusted Chi Square Value	23.29			
4288												

4289	**Assuming Gamma Distribution**											
4290	95% Approximate Gamma UCL (use when n>=50))				1208	95% Adjusted Gamma UCL (use when n<50)					1280	
4291												
4292	**Lognormal GOF Test**											
4293	Shapiro Wilk Test Statistic				0.933	**Shapiro Wilk Lognormal GOF Test**						
4294	5% Shapiro Wilk Critical Value				0.874	Data appear Lognormal at 5% Significance Level						
4295	Lilliefors Test Statistic				0.17	**Lilliefors Lognormal GOF Test**						
4296	5% Lilliefors Critical Value				0.226	Data appear Lognormal at 5% Significance Level						
4297	**Data appear Lognormal at 5% Significance Level**											
4298												
4299	**Lognormal Statistics**											
4300	Minimum of Logged Data				4.913	Mean of logged Data					6.34	
4301	Maximum of Logged Data				8.237	SD of logged Data					0.772	
4302												
4303	**Assuming Lognormal Distribution**											
4304	95% H-UCL				1287	90% Chebyshev (MVUE) UCL					1231	
4305	95% Chebyshev (MVUE) UCL				1452	97.5% Chebyshev (MVUE) UCL					1758	
4306	99% Chebyshev (MVUE) UCL				2360							
4307												
4308	**Nonparametric Distribution Free UCL Statistics**											
4309	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
4310												
4311	**Nonparametric Distribution Free UCLs**											
4312	95% CLT UCL				1187	95% Jackknife UCL					1217	
4313	95% Standard Bootstrap UCL				1187	95% Bootstrap-t UCL					1945	
4314	95% Hall's Bootstrap UCL				2798	95% Percentile Bootstrap UCL					1239	
4315	95% BCA Bootstrap UCL				1465							
4316	90% Chebyshev(Mean, Sd) UCL				1513	95% Chebyshev(Mean, Sd) UCL					1841	
4317	97.5% Chebyshev(Mean, Sd) UCL				2296	99% Chebyshev(Mean, Sd) UCL					3190	
4318												
4319	**Suggested UCL to Use**											
4320	95% H-UCL				1287							
4321												
4322	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4323	Recommendations are based upon data size, data distribution, and skewness.											
4324	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4325	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4326												
4327	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
4328	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
4329	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
4330	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
4331												
4332	**Result (eu3_thallium_overbank)**											
4333												
4334	**General Statistics**											
4335	Total Number of Observations				62	Number of Distinct Observations					25	
4336	Number of Detects				1	Number of Non-Detects					61	
4337	Number of Distinct Detects				1	Number of Distinct Non-Detects					24	
4338												
4339	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
4340	**gested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, B**											
4341												
4342	**The data set for variable Result (eu3_thallium_overbank) was not processed!**											
4343												
4344												
4345												
4346	**Result (eu3_thallium_waste rock)**											
4347												
4348	**General Statistics**											
4349	Total Number of Observations				14	Number of Distinct Observations					13	
4350						Number of Missing Observations					0	
4351	Minimum				0.097	Mean					0.355	
4352	Maximum				0.69	Median					0.36	
4353	SD				0.14	Std. Error of Mean					0.0375	
4354	Coefficient of Variation				0.395	Skewness					0.581	
4355												

4356	**Normal GOF Test**											
4357					Shapiro Wilk Test Statistic	0.956	**Shapiro Wilk GOF Test**					
4358					5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level					
4359					Lilliefors Test Statistic	0.155	**Lilliefors GOF Test**					
4360					5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level					
4361	**Data appear Normal at 5% Significance Level**											
4362												
4363	**Assuming Normal Distribution**											
4364				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
4365					95% Student's-t UCL	0.421		95% Adjusted-CLT UCL (Chen-1995)	0.423			
4366								95% Modified-t UCL (Johnson-1978)	0.422			
4367												
4368	**Gamma GOF Test**											
4369					A-D Test Statistic	0.341	**Anderson-Darling Gamma GOF Test**					
4370					5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Lev					
4371					K-S Test Statistic	0.141	**Kolmogorov-Smirnov Gamma GOF Test**					
4372					5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Lev					
4373	**Detected data appear Gamma Distributed at 5% Significance Level**											
4374												
4375	**Gamma Statistics**											
4376					k hat (MLE)	6.021		k star (bias corrected MLE)	4.779			
4377					Theta hat (MLE)	0.0589		Theta star (bias corrected MLE)	0.0742			
4378					nu hat (MLE)	168.6		nu star (bias corrected)	133.8			
4379					MLE Mean (bias corrected)	0.355		MLE Sd (bias corrected)	0.162			
4380								Approximate Chi Square Value (0.05)	108.1			
4381					Adjusted Level of Significance	0.0312		Adjusted Chi Square Value	105			
4382												
4383	**Assuming Gamma Distribution**											
4384	95% Approximate Gamma UCL (use when n>=50))					0.439		95% Adjusted Gamma UCL (use when n<50)	0.452			
4385												
4386	**Lognormal GOF Test**											
4387					Shapiro Wilk Test Statistic	0.908	**Shapiro Wilk Lognormal GOF Test**					
4388					5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level					
4389					Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**					
4390					5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level					
4391	**Data appear Lognormal at 5% Significance Level**											
4392												
4393	**Lognormal Statistics**											
4394					Minimum of Logged Data	-2.333		Mean of logged Data	-1.122			
4395					Maximum of Logged Data	-0.371		SD of logged Data	0.461			
4396												
4397	**Assuming Lognormal Distribution**											
4398					95% H-UCL	0.468		90% Chebyshev (MVUE) UCL	0.495			
4399					95% Chebyshev (MVUE) UCL	0.557		97.5% Chebyshev (MVUE) UCL	0.643			
4400					99% Chebyshev (MVUE) UCL	0.811						
4401												
4402	**Nonparametric Distribution Free UCL Statistics**											
4403	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
4404												
4405	**Nonparametric Distribution Free UCLs**											
4406					95% CLT UCL	0.416		95% Jackknife UCL	0.421			
4407					95% Standard Bootstrap UCL	0.414		95% Bootstrap-t UCL	0.426			
4408					95% Hall's Bootstrap UCL	0.442		95% Percentile Bootstrap UCL	0.419			
4409					95% BCA Bootstrap UCL	0.419						
4410					90% Chebyshev(Mean, Sd) UCL	0.467		95% Chebyshev(Mean, Sd) UCL	0.518			
4411					97.5% Chebyshev(Mean, Sd) UCL	0.589		99% Chebyshev(Mean, Sd) UCL	0.728			
4412												
4413	**Suggested UCL to Use**											
4414					95% Student's-t UCL	0.421						
4415												
4416	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4417	Recommendations are based upon data size, data distribution, and skewness.											
4418	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4419	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4420												
4421												
4422	**Result (eu3_zinc_overbank)**											

4423												
4424						**General Statistics**						
4425						Total Number of Observations	62				Number of Distinct Observations	57
4426											Number of Missing Observations	0
4427						Minimum	18.7				Mean	591.4
4428						Maximum	5560				Median	368.5
4429						SD	978.6				Std. Error of Mean	124.3
4430						Coefficient of Variation	1.655				Skewness	4.183
4431												
4432						**Normal GOF Test**						
4433						Shapiro Wilk Test Statistic	0.499				**Shapiro Wilk GOF Test**	
4434						5% Shapiro Wilk P Value	0				Data Not Normal at 5% Significance Level	
4435						Lilliefors Test Statistic	0.294				**Lilliefors GOF Test**	
4436						5% Lilliefors Critical Value	0.112				Data Not Normal at 5% Significance Level	
4437						**Data Not Normal at 5% Significance Level**						
4438												
4439						**Assuming Normal Distribution**						
4440						**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**	
4441						95% Student's-t UCL	799				95% Adjusted-CLT UCL (Chen-1995)	866.4
4442											95% Modified-t UCL (Johnson-1978)	810
4443												
4444						**Gamma GOF Test**						
4445						A-D Test Statistic	1.357				**Anderson-Darling Gamma GOF Test**	
4446						5% A-D Critical Value	0.789				Data Not Gamma Distributed at 5% Significance Level	
4447						K-S Test Statistic	0.139				**Kolmogorov-Smirnov Gamma GOF Test**	
4448						5% K-S Critical Value	0.117				Data Not Gamma Distributed at 5% Significance Level	
4449						**Data Not Gamma Distributed at 5% Significance Level**						
4450												
4451						**Gamma Statistics**						
4452						k hat (MLE)	0.81				k star (bias corrected MLE)	0.782
4453						Theta hat (MLE)	729.7				Theta star (bias corrected MLE)	756.2
4454						nu hat (MLE)	100.5				nu star (bias corrected)	96.97
4455						MLE Mean (bias corrected)	591.4				MLE Sd (bias corrected)	668.7
4456											Approximate Chi Square Value (0.05)	75.26
4457						Adjusted Level of Significance	0.0461				Adjusted Chi Square Value	74.8
4458												
4459						**Assuming Gamma Distribution**						
4460						95% Approximate Gamma UCL (use when n>=50))	762				95% Adjusted Gamma UCL (use when n<50)	766.6
4461												
4462						**Lognormal GOF Test**						
4463						Shapiro Wilk Test Statistic	0.952				**Shapiro Wilk Lognormal GOF Test**	
4464						5% Shapiro Wilk P Value	0.0337				Data Not Lognormal at 5% Significance Level	
4465						Lilliefors Test Statistic	0.124				**Lilliefors Lognormal GOF Test**	
4466						5% Lilliefors Critical Value	0.112				Data Not Lognormal at 5% Significance Level	
4467						**Data Not Lognormal at 5% Significance Level**						
4468												
4469						**Lognormal Statistics**						
4470						Minimum of Logged Data	2.929				Mean of logged Data	5.651
4471						Maximum of Logged Data	8.623				SD of logged Data	1.259
4472												
4473						**Assuming Lognormal Distribution**						
4474						95% H-UCL	904.8				90% Chebyshev (MVUE) UCL	989.5
4475						95% Chebyshev (MVUE) UCL	1159				97.5% Chebyshev (MVUE) UCL	1394
4476						99% Chebyshev (MVUE) UCL	1857					
4477												
4478						**Nonparametric Distribution Free UCL Statistics**						
4479						**Data do not follow a Discernible Distribution (0.05)**						
4480												
4481						**Nonparametric Distribution Free UCLs**						
4482						95% CLT UCL	795.8				95% Jackknife UCL	799
4483						95% Standard Bootstrap UCL	793.8				95% Bootstrap-t UCL	1072
4484						95% Hall's Bootstrap UCL	1800				95% Percentile Bootstrap UCL	802.5
4485						95% BCA Bootstrap UCL	883.8					
4486						90% Chebyshev(Mean, Sd) UCL	964.2				95% Chebyshev(Mean, Sd) UCL	1133
4487						97.5% Chebyshev(Mean, Sd) UCL	1368				99% Chebyshev(Mean, Sd) UCL	1828
4488												
4489						**Suggested UCL to Use**						

4490				95% Chebyshev (Mean, Sd) UCL	1133							
4491												
4492	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4493	Recommendations are based upon data size, data distribution, and skewness.											
4494	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4495	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4496												
4497												
4498	**Result (eu3_zinc_waste rock)**											
4499												
4500	**General Statistics**											
4501				Total Number of Observations	14			Number of Distinct Observations	14			
4502								Number of Missing Observations	0			
4503				Minimum	223			Mean	4002			
4504				Maximum	17900			Median	942			
4505				SD	5899			Std. Error of Mean	1577			
4506				Coefficient of Variation	1.474			Skewness	1.65			
4507												
4508	**Normal GOF Test**											
4509				Shapiro Wilk Test Statistic	0.694			**Shapiro Wilk GOF Test**				
4510				5% Shapiro Wilk Critical Value	0.874			Data Not Normal at 5% Significance Level				
4511				Lilliefors Test Statistic	0.298			**Lilliefors GOF Test**				
4512				5% Lilliefors Critical Value	0.226			Data Not Normal at 5% Significance Level				
4513	**Data Not Normal at 5% Significance Level**											
4514												
4515	**Assuming Normal Distribution**											
4516				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
4517				95% Student's-t UCL	6794			95% Adjusted-CLT UCL (Chen-1995)	7338			
4518								95% Modified-t UCL (Johnson-1978)	6910			
4519												
4520	**Gamma GOF Test**											
4521				A-D Test Statistic	0.895			**Anderson-Darling Gamma GOF Test**				
4522				5% A-D Critical Value	0.788			Data Not Gamma Distributed at 5% Significance Level				
4523				K-S Test Statistic	0.209			**Kolmogorov-Smirnov Gamma GOF Test**				
4524				5% K-S Critical Value	0.241			Detected data appear Gamma Distributed at 5% Significance Lev				
4525	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
4526												
4527	**Gamma Statistics**											
4528				k hat (MLE)	0.56			k star (bias corrected MLE)	0.488			
4529				Theta hat (MLE)	7143			Theta star (bias corrected MLE)	8204			
4530				nu hat (MLE)	15.69			nu star (bias corrected)	13.66			
4531				MLE Mean (bias corrected)	4002			MLE Sd (bias corrected)	5730			
4532								Approximate Chi Square Value (0.05)	6.338			
4533				Adjusted Level of Significance	0.0312			Adjusted Chi Square Value	5.689			
4534												
4535	**Assuming Gamma Distribution**											
4536				95% Approximate Gamma UCL (use when n>=50)	8624			95% Adjusted Gamma UCL (use when n<50)	9608			
4537												
4538	**Lognormal GOF Test**											
4539				Shapiro Wilk Test Statistic	0.888			**Shapiro Wilk Lognormal GOF Test**				
4540				5% Shapiro Wilk Critical Value	0.874			Data appear Lognormal at 5% Significance Level				
4541				Lilliefors Test Statistic	0.197			**Lilliefors Lognormal GOF Test**				
4542				5% Lilliefors Critical Value	0.226			Data appear Lognormal at 5% Significance Level				
4543	**Data appear Lognormal at 5% Significance Level**											
4544												
4545	**Lognormal Statistics**											
4546				Minimum of Logged Data	5.407			Mean of logged Data	7.18			
4547				Maximum of Logged Data	9.793			SD of logged Data	1.587			
4548												
4549	**Assuming Lognormal Distribution**											
4550				95% H-UCL	25303			90% Chebyshev (MVUE) UCL	9548			
4551				95% Chebyshev (MVUE) UCL	12099			97.5% Chebyshev (MVUE) UCL	15641			
4552				99% Chebyshev (MVUE) UCL	22598							
4553												
4554	**Nonparametric Distribution Free UCL Statistics**											
4555	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
4556												

4557	**Nonparametric Distribution Free UCLs**											
4558					95% CLT UCL	6595			95% Jackknife UCL	6794		
4559					95% Standard Bootstrap UCL	6425			95% Bootstrap-t UCL	9032		
4560					95% Hall's Bootstrap UCL	7110			95% Percentile Bootstrap UCL	6623		
4561					95% BCA Bootstrap UCL	7498						
4562					90% Chebyshev(Mean, Sd) UCL	8732			95% Chebyshev(Mean, Sd) UCL	10874		
4563					97.5% Chebyshev(Mean, Sd) UCL	13848			99% Chebyshev(Mean, Sd) UCL	19690		
4564												
4565	**Suggested UCL to Use**											
4566					95% Adjusted Gamma UCL	9608						
4567												
4568	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
4569	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
4570												
4571	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4572	Recommendations are based upon data size, data distribution, and skewness.											
4573	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4574	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4575												
4576	**Result (eu4_antimony_overbank)**											
4577												
4578	**General Statistics**											
4579					Total Number of Observations	49			Number of Distinct Observations	41		
4580					Number of Detects	41			Number of Non-Detects	8		
4581					Number of Distinct Detects	35			Number of Distinct Non-Detects	6		
4582					Minimum Detect	0.11			Minimum Non-Detect	0.034		
4583					Maximum Detect	9.9			Maximum Non-Detect	0.073		
4584					Variance Detects	3.961			Percent Non-Detects	16.33%		
4585					Mean Detects	1.345			SD Detects	1.99		
4586					Median Detects	0.74			CV Detects	1.48		
4587					Skewness Detects	3.568			Kurtosis Detects	13.12		
4588					Mean of Logged Detects	-0.236			SD of Logged Detects	0.981		
4589												
4590	**Normal GOF Test on Detects Only**											
4591					Shapiro Wilk Test Statistic	0.526			**Shapiro Wilk GOF Test**			
4592					5% Shapiro Wilk Critical Value	0.941			Detected Data Not Normal at 5% Significance Level			
4593					Lilliefors Test Statistic	0.285			**Lilliefors GOF Test**			
4594					5% Lilliefors Critical Value	0.137			Detected Data Not Normal at 5% Significance Level			
4595	**Detected Data Not Normal at 5% Significance Level**											
4596												
4597	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
4598					KM Mean	1.131			KM Standard Error of Mean	0.269		
4599					KM SD	1.862			95% KM (BCA) UCL	1.621		
4600					95% KM (t) UCL	1.583			95% KM (Percentile Bootstrap) UCL	1.635		
4601					95% KM (z) UCL	1.574			95% KM Bootstrap t UCL	2.22		
4602					90% KM Chebyshev UCL	1.939			95% KM Chebyshev UCL	2.305		
4603					97.5% KM Chebyshev UCL	2.813			99% KM Chebyshev UCL	3.811		
4604												
4605	**Gamma GOF Tests on Detected Observations Only**											
4606					A-D Test Statistic	1.684			**Anderson-Darling GOF Test**			
4607					5% A-D Critical Value	0.777			Detected Data Not Gamma Distributed at 5% Significance Level			
4608					K-S Test Statistic	0.172			**Kolmogorov-Smirnov GOF**			
4609					5% K-S Critical Value	0.142			Detected Data Not Gamma Distributed at 5% Significance Level			
4610	**Detected Data Not Gamma Distributed at 5% Significance Level**											
4611												
4612	**Gamma Statistics on Detected Data Only**											
4613					k hat (MLE)	1.075			k star (bias corrected MLE)	1.013		
4614					Theta hat (MLE)	1.251			Theta star (bias corrected MLE)	1.328		
4615					nu hat (MLE)	88.16			nu star (bias corrected)	83.04		
4616					Mean (detects)	1.345						
4617												
4618	**Gamma ROS Statistics using Imputed Non-Detects**											
4619	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
4620	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)											
4621	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
4622	This is especially true when the sample size is small.											
4623	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											

4624					Minimum	0.01				Mean		1.127
4625					Maximum	9.9				Median		0.63
4626					SD	1.884				CV		1.671
4627					k hat (MLE)	0.581				k star (bias corrected MLE)		0.559
4628					Theta hat (MLE)	1.941				Theta star (bias corrected MLE)		2.017
4629					nu hat (MLE)	56.92				nu star (bias corrected)		54.77
4630					Adjusted Level of Significance (β)	0.0451						
4631					Approximate Chi Square Value (54.77, α)	38.76				Adjusted Chi Square Value (54.77, β)		38.35
4632					95% Gamma Approximate UCL (use when n>=50)	1.593				95% Gamma Adjusted UCL (use when n<50)		1.61
4633												
4634					**Estimates of Gamma Parameters using KM Estimates**							
4635					Mean (KM)	1.131				SD (KM)		1.862
4636					Variance (KM)	3.468				SE of Mean (KM)		0.269
4637					k hat (KM)	0.369				k star (KM)		0.36
4638					nu hat (KM)	36.15				nu star (KM)		35.27
4639					theta hat (KM)	3.066				theta star (KM)		3.143
4640					80% gamma percentile (KM)	1.799				90% gamma percentile (KM)		3.252
4641					95% gamma percentile (KM)	4.872				99% gamma percentile (KM)		8.994
4642												
4643					**Gamma Kaplan-Meier (KM) Statistics**							
4644					Approximate Chi Square Value (35.27, α)	22.68				Adjusted Chi Square Value (35.27, β)		22.37
4645	5% Gamma Approximate KM-UCL (use when n>=50)					1.759				95% Gamma Adjusted KM-UCL (use when n<50)		1.783
4646												
4647					**Lognormal GOF Test on Detected Observations Only**							
4648					Shapiro Wilk Test Statistic	0.956				**Shapiro Wilk GOF Test**		
4649					5% Shapiro Wilk Critical Value	0.941				Detected Data appear Lognormal at 5% Significance Level		
4650					Lilliefors Test Statistic	0.0911				**Lilliefors GOF Test**		
4651					5% Lilliefors Critical Value	0.137				Detected Data appear Lognormal at 5% Significance Level		
4652					**Detected Data appear Lognormal at 5% Significance Level**							
4653												
4654					**Lognormal ROS Statistics Using Imputed Non-Detects**							
4655					Mean in Original Scale	1.141				Mean in Log Scale		-0.585
4656					SD in Original Scale	1.876				SD in Log Scale		1.202
4657					95% t UCL (assumes normality of ROS data)	1.59				95% Percentile Bootstrap UCL		1.63
4658					95% BCA Bootstrap UCL	1.784				95% Bootstrap t UCL		2.193
4659					95% H-UCL (Log ROS)	1.791						
4660												
4661					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
4662					KM Mean (logged)	-0.749				KM Geo Mean		0.473
4663					KM SD (logged)	1.462				95% Critical H Value (KM-Log)		2.886
4664					KM Standard Error of Mean (logged)	0.211				95% H-UCL (KM -Log)		2.53
4665					KM SD (logged)	1.462				95% Critical H Value (KM-Log)		2.886
4666					KM Standard Error of Mean (logged)	0.211						
4667												
4668					**DL/2 Statistics**							
4669					**DL/2 Normal**					**DL/2 Log-Transformed**		
4670					Mean in Original Scale	1.129				Mean in Log Scale		-0.834
4671					SD in Original Scale	1.883				SD in Log Scale		1.638
4672					95% t UCL (Assumes normality)	1.58				95% H-Stat UCL		3.471
4673					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
4674												
4675					**Nonparametric Distribution Free UCL Statistics**							
4676					**Detected Data appear Lognormal Distributed at 5% Significance Level**							
4677												
4678					**Suggested UCL to Use**							
4679					KM H-UCL	2.53						
4680												
4681	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4682	Recommendations are based upon data size, data distribution, and skewness.											
4683	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4684	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4685												
4686												
4687	**Result (eu4_antimony_waste rock)**											
4688												
4689					**General Statistics**							
4690					Total Number of Observations	15				Number of Distinct Observations		14

4691								Number of Missing Observations					0
4692						Minimum	0.57				Mean		35.33
4693						Maximum	176				Median		16.8
4694						SD	49.88				Std. Error of Mean		12.88
4695						Coefficient of Variation	1.412				Skewness		2.085
4696													
4697						**Normal GOF Test**							
4698						Shapiro Wilk Test Statistic	0.711	**Shapiro Wilk GOF Test**					
4699						5% Shapiro Wilk Critical Value	0.881	Data Not Normal at 5% Significance Level					
4700						Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**					
4701						5% Lilliefors Critical Value	0.22	Data Not Normal at 5% Significance Level					
4702						**Data Not Normal at 5% Significance Level**							
4703													
4704						**Assuming Normal Distribution**							
4705						**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
4706						95% Student's-t UCL	58.01	95% Adjusted-CLT UCL (Chen-1995)					63.92
4707								95% Modified-t UCL (Johnson-1978)					59.17
4708													
4709						**Gamma GOF Test**							
4710						A-D Test Statistic	0.321	**Anderson-Darling Gamma GOF Test**					
4711						5% A-D Critical Value	0.784	Detected data appear Gamma Distributed at 5% Significance Lev					
4712						K-S Test Statistic	0.147	**Kolmogorov-Smirnov Gamma GOF Test**					
4713						5% K-S Critical Value	0.232	Detected data appear Gamma Distributed at 5% Significance Lev					
4714						**Detected data appear Gamma Distributed at 5% Significance Level**							
4715													
4716						**Gamma Statistics**							
4717						k hat (MLE)	0.62	k star (bias corrected MLE)					0.54
4718						Theta hat (MLE)	57.02	Theta star (bias corrected MLE)					65.41
4719						nu hat (MLE)	18.59	nu star (bias corrected)					16.21
4720						MLE Mean (bias corrected)	35.33	MLE Sd (bias corrected)					48.07
4721								Approximate Chi Square Value (0.05)					8.107
4722						Adjusted Level of Significance	0.0324	Adjusted Chi Square Value					7.411
4723													
4724						**Assuming Gamma Distribution**							
4725						95% Approximate Gamma UCL (use when n>=50)	70.62	95% Adjusted Gamma UCL (use when n<50)					77.26
4726													
4727						**Lognormal GOF Test**							
4728						Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**					
4729						5% Shapiro Wilk Critical Value	0.881	Data appear Lognormal at 5% Significance Level					
4730						Lilliefors Test Statistic	0.104	**Lilliefors Lognormal GOF Test**					
4731						5% Lilliefors Critical Value	0.22	Data appear Lognormal at 5% Significance Level					
4732						**Data appear Lognormal at 5% Significance Level**							
4733													
4734						**Lognormal Statistics**							
4735						Minimum of Logged Data	-0.562	Mean of logged Data					2.572
4736						Maximum of Logged Data	5.17	SD of logged Data					1.619
4737													
4738						**Assuming Lognormal Distribution**							
4739						95% H-UCL	254.6	90% Chebyshev (MVUE) UCL					100.1
4740						95% Chebyshev (MVUE) UCL	126.9	97.5% Chebyshev (MVUE) UCL					164
4741						99% Chebyshev (MVUE) UCL	237						
4742													
4743						**Nonparametric Distribution Free UCL Statistics**							
4744						**Data appear to follow a Discernible Distribution at 5% Significance Level**							
4745													
4746						**Nonparametric Distribution Free UCLs**							
4747						95% CLT UCL	56.51	95% Jackknife UCL					58.01
4748						95% Standard Bootstrap UCL	56	95% Bootstrap-t UCL					87.95
4749						95% Hall's Bootstrap UCL	158.7	95% Percentile Bootstrap UCL					57.59
4750						95% BCA Bootstrap UCL	63.8						
4751						90% Chebyshev(Mean, Sd) UCL	73.97	95% Chebyshev(Mean, Sd) UCL					91.47
4752						97.5% Chebyshev(Mean, Sd) UCL	115.8	99% Chebyshev(Mean, Sd) UCL					163.5
4753													
4754						**Suggested UCL to Use**							
4755						95% Adjusted Gamma UCL	77.26						
4756													
4757	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												

	A	B	C	D	E	F	G	H	I	J	K	L
4758	Recommendations are based upon data size, data distribution, and skewness.											
4759	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4760	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4761												
4762	**Result (eu4_arsenic_overbank)**											
4763												
4764	**General Statistics**											
4765	Total Number of Observations					54		Number of Distinct Observations				51
4766	Number of Detects					53		Number of Non-Detects				1
4767	Number of Distinct Detects					50		Number of Distinct Non-Detects				1
4768	Minimum Detect					3.6		Minimum Non-Detect				0.14
4769	Maximum Detect					831		Maximum Non-Detect				0.14
4770	Variance Detects					13553		Percent Non-Detects				1.852%
4771	Mean Detects					43.38		SD Detects				116.4
4772	Median Detects					17.3		CV Detects				2.684
4773	Skewness Detects					6.268		Kurtosis Detects				42.19
4774	Mean of Logged Detects					2.953		SD of Logged Detects				1.033
4775												
4776	**Normal GOF Test on Detects Only**											
4777	Shapiro Wilk Test Statistic					0.317		**Normal GOF Test on Detected Observations Only**				
4778	5% Shapiro Wilk P Value					0		Detected Data Not Normal at 5% Significance Level				
4779	Lilliefors Test Statistic					0.38		**Lilliefors GOF Test**				
4780	5% Lilliefors Critical Value					0.121		Detected Data Not Normal at 5% Significance Level				
4781	**Detected Data Not Normal at 5% Significance Level**											
4782												
4783	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
4784	KM Mean					42.58		KM Standard Error of Mean				15.72
4785	KM SD					114.4		95% KM (BCA) UCL				72.98
4786	95% KM (t) UCL					68.89		95% KM (Percentile Bootstrap) UCL				71.35
4787	95% KM (z) UCL					68.43		95% KM Bootstrap t UCL				140.1
4788	90% KM Chebyshev UCL					89.73		95% KM Chebyshev UCL				111.1
4789	97.5% KM Chebyshev UCL					140.7		99% KM Chebyshev UCL				198.9
4790												
4791	**Gamma GOF Tests on Detected Observations Only**											
4792	A-D Test Statistic					4.284		**Anderson-Darling GOF Test**				
4793	5% A-D Critical Value					0.794		Detected Data Not Gamma Distributed at 5% Significance Level				
4794	K-S Test Statistic					0.224		**Kolmogorov-Smirnov GOF**				
4795	5% K-S Critical Value					0.127		Detected Data Not Gamma Distributed at 5% Significance Level				
4796	**Detected Data Not Gamma Distributed at 5% Significance Level**											
4797												
4798	**Gamma Statistics on Detected Data Only**											
4799	k hat (MLE)					0.735		k star (bias corrected MLE)				0.706
4800	Theta hat (MLE)					59.02		Theta star (bias corrected MLE)				61.45
4801	nu hat (MLE)					77.91		nu star (bias corrected)				74.83
4802	Mean (detects)					43.38						
4803												
4804	**Gamma ROS Statistics using Imputed Non-Detects**											
4805	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
4806	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)											
4807	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
4808	This is especially true when the sample size is small.											
4809	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
4810	Minimum					0.01		Mean				42.58
4811	Maximum					831		Median				16.9
4812	SD					115.5		CV				2.712
4813	k hat (MLE)					0.651		k star (bias corrected MLE)				0.627
4814	Theta hat (MLE)					65.41		Theta star (bias corrected MLE)				67.89
4815	nu hat (MLE)					70.3		nu star (bias corrected)				67.73
4816	Adjusted Level of Significance (β)					0.0456						
4817	Approximate Chi Square Value (67.73, α)					49.79		Adjusted Chi Square Value (67.73, β)				49.37
4818	95% Gamma Approximate UCL (use when n>=50)					57.92		95% Gamma Adjusted UCL (use when n<50)				58.42
4819												
4820	**Estimates of Gamma Parameters using KM Estimates**											
4821	Mean (KM)					42.58		SD (KM)				114.4
4822	Variance (KM)					13085		SE of Mean (KM)				15.72
4823	k hat (KM)					0.139		k star (KM)				0.143
4824	nu hat (KM)					14.97		nu star (KM)				15.47

4825					theta hat (KM)	307.3				theta star (KM)		297.3
4826					80% gamma percentile (KM)	44.57				90% gamma percentile (KM)		125.4
4827					95% gamma percentile (KM)	236.4				99% gamma percentile (KM)		561.7
4828												
4829					**Gamma Kaplan-Meier (KM) Statistics**							
4830					Approximate Chi Square Value (15.47, α)	7.588				Adjusted Chi Square Value (15.47, β)		7.436
4831	5% Gamma Approximate KM-UCL (use when n>=50)					86.8				95% Gamma Adjusted KM-UCL (use when n<50)		88.57
4832												
4833					**Lognormal GOF Test on Detected Observations Only**							
4834					Shapiro Wilk Approximate Test Statistic	0.933				**Shapiro Wilk GOF Test**		
4835					5% Shapiro Wilk P Value	0.00715				Detected Data Not Lognormal at 5% Significance Level		
4836					Lilliefors Test Statistic	0.0911				**Lilliefors GOF Test**		
4837					5% Lilliefors Critical Value	0.121				Detected Data appear Lognormal at 5% Significance Level		
4838					**Detected Data appear Approximate Lognormal at 5% Significance Level**							
4839												
4840					**Lognormal ROS Statistics Using Imputed Non-Detects**							
4841					Mean in Original Scale	42.6				Mean in Log Scale		2.905
4842					SD in Original Scale	115.5				SD in Log Scale		1.083
4843					95% t UCL (assumes normality of ROS data)	68.91				95% Percentile Bootstrap UCL		69.97
4844					95% BCA Bootstrap UCL	94.81				95% Bootstrap t UCL		145.7
4845					95% H-UCL (Log ROS)	47.12						
4846												
4847					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
4848					KM Mean (logged)	2.862				KM Geo Mean		17.5
4849					KM SD (logged)	1.211				95% Critical H Value (KM-Log)		2.61
4850					KM Standard Error of Mean (logged)	0.166				95% H-UCL (KM -Log)		56.24
4851					KM SD (logged)	1.211				95% Critical H Value (KM-Log)		2.61
4852					KM Standard Error of Mean (logged)	0.166						
4853												
4854					**DL/2 Statistics**							
4855					**DL/2 Normal**					**DL/2 Log-Transformed**		
4856					Mean in Original Scale	42.58				Mean in Log Scale		2.849
4857					SD in Original Scale	115.5				SD in Log Scale		1.277
4858					95% t UCL (Assumes normality)	68.89				95% H-Stat UCL		62.72
4859					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
4860												
4861					**Nonparametric Distribution Free UCL Statistics**							
4862					**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**							
4863												
4864					**Suggested UCL to Use**							
4865					KM H-UCL	56.24						
4866												
4867	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4868	Recommendations are based upon data size, data distribution, and skewness.											
4869	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4870	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4871												
4872												
4873	**Result (eu4_arsenic_waste rock)**											
4874												
4875					**General Statistics**							
4876					Total Number of Observations	15				Number of Distinct Observations		15
4877										Number of Missing Observations		0
4878					Minimum	3.7				Mean		1309
4879					Maximum	13700				Median		108
4880					SD	3536				Std. Error of Mean		913
4881					Coefficient of Variation	2.701				Skewness		3.517
4882												
4883					**Normal GOF Test**							
4884					Shapiro Wilk Test Statistic	0.417				**Shapiro Wilk GOF Test**		
4885					5% Shapiro Wilk Critical Value	0.881				Data Not Normal at 5% Significance Level		
4886					Lilliefors Test Statistic	0.428				**Lilliefors GOF Test**		
4887					5% Lilliefors Critical Value	0.22				Data Not Normal at 5% Significance Level		
4888					**Data Not Normal at 5% Significance Level**							
4889												
4890					**Assuming Normal Distribution**							
4891					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		

4892					95% Student's-t UCL	2917				95% Adjusted-CLT UCL (Chen-1995)			3697
4893										95% Modified-t UCL (Johnson-1978)			3055
4894													
4895					**Gamma GOF Test**								
4896					A-D Test Statistic	2.015				**Anderson-Darling Gamma GOF Test**			
4897					5% A-D Critical Value	0.832				Data Not Gamma Distributed at 5% Significance Level			
4898					K-S Test Statistic	0.408				**Kolmogorov-Smirnov Gamma GOF Test**			
4899					5% K-S Critical Value	0.24				Data Not Gamma Distributed at 5% Significance Level			
4900					**Data Not Gamma Distributed at 5% Significance Level**								
4901													
4902					**Gamma Statistics**								
4903					k hat (MLE)	0.316				k star (bias corrected MLE)			0.298
4904					Theta hat (MLE)	4138				Theta star (bias corrected MLE)			4400
4905					nu hat (MLE)	9.49				nu star (bias corrected)			8.925
4906					MLE Mean (bias corrected)	1309				MLE Sd (bias corrected)			2400
4907										Approximate Chi Square Value (0.05)			3.282
4908					Adjusted Level of Significance	0.0324				Adjusted Chi Square Value			2.874
4909													
4910					**Assuming Gamma Distribution**								
4911					95% Approximate Gamma UCL (use when n>=50))	3560				95% Adjusted Gamma UCL (use when n<50)			4065
4912													
4913					**Lognormal GOF Test**								
4914					Shapiro Wilk Test Statistic	0.887				**Shapiro Wilk Lognormal GOF Test**			
4915					5% Shapiro Wilk Critical Value	0.881				Data appear Lognormal at 5% Significance Level			
4916					Lilliefors Test Statistic	0.294				**Lilliefors Lognormal GOF Test**			
4917					5% Lilliefors Critical Value	0.22				Data Not Lognormal at 5% Significance Level			
4918					**Data appear Approximate Lognormal at 5% Significance Level**								
4919													
4920					**Lognormal Statistics**								
4921					Minimum of Logged Data	1.308				Mean of logged Data			5.016
4922					Maximum of Logged Data	9.525				SD of logged Data			1.994
4923													
4924					**Assuming Lognormal Distribution**								
4925					95% H-UCL	12466				90% Chebyshev (MVUE) UCL			2257
4926					95% Chebyshev (MVUE) UCL	2911				97.5% Chebyshev (MVUE) UCL			3819
4927					99% Chebyshev (MVUE) UCL	5602							
4928													
4929					**Nonparametric Distribution Free UCL Statistics**								
4930					**Data appear to follow a Discernible Distribution at 5% Significance Level**								
4931													
4932					**Nonparametric Distribution Free UCLs**								
4933					95% CLT UCL	2811				95% Jackknife UCL			2917
4934					95% Standard Bootstrap UCL	2743				95% Bootstrap-t UCL			10603
4935					95% Hall's Bootstrap UCL	11148				95% Percentile Bootstrap UCL			3012
4936					95% BCA Bootstrap UCL	3931							
4937					90% Chebyshev(Mean, Sd) UCL	4048				95% Chebyshev(Mean, Sd) UCL			5289
4938					97.5% Chebyshev(Mean, Sd) UCL	7011				99% Chebyshev(Mean, Sd) UCL			10393
4939													
4940					**Suggested UCL to Use**								
4941					99% Chebyshev (Mean, Sd) UCL	10393							
4942													
4943	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
4944	Recommendations are based upon data size, data distribution, and skewness.												
4945	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
4946	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia												
4947													
4948	**Result (eu4_cadmium_overbank)**												
4949													
4950					**General Statistics**								
4951					Total Number of Observations	54				Number of Distinct Observations			38
4952					Number of Detects	39				Number of Non-Detects			15
4953					Number of Distinct Detects	30				Number of Distinct Non-Detects			10
4954					Minimum Detect	0.059				Minimum Non-Detect			0.048
4955					Maximum Detect	44.3				Maximum Non-Detect			0.11
4956					Variance Detects	48.65				Percent Non-Detects			27.78%
4957					Mean Detects	2.256				SD Detects			6.975
4958					Median Detects	1				CV Detects			3.091

4959					Skewness Detects	6.066					Kurtosis Detects	37.45
4960					Mean of Logged Detects	-0.157					SD of Logged Detects	1.186
4961												
4962					**Normal GOF Test on Detects Only**							
4963					Shapiro Wilk Test Statistic	0.264					**Shapiro Wilk GOF Test**	
4964					5% Shapiro Wilk Critical Value	0.939					Detected Data Not Normal at 5% Significance Level	
4965					Lilliefors Test Statistic	0.395					**Lilliefors GOF Test**	
4966					5% Lilliefors Critical Value	0.14					Detected Data Not Normal at 5% Significance Level	
4967					**Detected Data Not Normal at 5% Significance Level**							
4968												
4969					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
4970					KM Mean	1.643					KM Standard Error of Mean	0.818
4971					KM SD	5.934					95% KM (BCA) UCL	3.245
4972					95% KM (t) UCL	3.012					95% KM (Percentile Bootstrap) UCL	3.243
4973					95% KM (z) UCL	2.989					95% KM Bootstrap t UCL	8.743
4974					90% KM Chebyshev UCL	4.097					95% KM Chebyshev UCL	5.209
4975					97.5% KM Chebyshev UCL	6.752					99% KM Chebyshev UCL	9.782
4976												
4977					**Gamma GOF Tests on Detected Observations Only**							
4978					A-D Test Statistic	2.844					**Anderson-Darling GOF Test**	
4979					5% A-D Critical Value	0.8					Detected Data Not Gamma Distributed at 5% Significance Level	
4980					K-S Test Statistic	0.228					**Kolmogorov-Smirnov GOF**	
4981					5% K-S Critical Value	0.148					Detected Data Not Gamma Distributed at 5% Significance Level	
4982					**Detected Data Not Gamma Distributed at 5% Significance Level**							
4983												
4984					**Gamma Statistics on Detected Data Only**							
4985					k hat (MLE)	0.632					k star (bias corrected MLE)	0.6
4986					Theta hat (MLE)	3.572					Theta star (bias corrected MLE)	3.759
4987					nu hat (MLE)	49.27					nu star (bias corrected)	46.81
4988					Mean (detects)	2.256						
4989												
4990					**Gamma ROS Statistics using Imputed Non-Detects**							
4991					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
4992					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)							
4993					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
4994					This is especially true when the sample size is small.							
4995					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
4996					Minimum	0.01					Mean	1.632
4997					Maximum	44.3					Median	0.59
4998					SD	5.992					CV	3.671
4999					k hat (MLE)	0.356					k star (bias corrected MLE)	0.349
5000					Theta hat (MLE)	4.583					Theta star (bias corrected MLE)	4.681
5001					nu hat (MLE)	38.47					nu star (bias corrected)	37.66
5002					Adjusted Level of Significance (β)	0.0456						
5003					Approximate Chi Square Value (37.66, α)	24.61					Adjusted Chi Square Value (37.66, β)	24.32
5004					95% Gamma Approximate UCL (use when n>=50)	2.498					95% Gamma Adjusted UCL (use when n<50)	2.528
5005												
5006					**Estimates of Gamma Parameters using KM Estimates**							
5007					Mean (KM)	1.643					SD (KM)	5.934
5008					Variance (KM)	35.21					SE of Mean (KM)	0.818
5009					k hat (KM)	0.0767					k star (KM)	0.0847
5010					nu hat (KM)	8.28					nu star (KM)	9.153
5011					theta hat (KM)	21.43					theta star (KM)	19.39
5012					80% gamma percentile (KM)	0.871					90% gamma percentile (KM)	4.033
5013					95% gamma percentile (KM)	9.571					99% gamma percentile (KM)	28.31
5014												
5015					**Gamma Kaplan-Meier (KM) Statistics**							
5016					Approximate Chi Square Value (9.15, α)	3.42					Adjusted Chi Square Value (9.15, β)	3.324
5017	5% Gamma Approximate KM-UCL (use when n>=50)					4.398					95% Gamma Adjusted KM-UCL (use when n<50)	4.524
5018												
5019					**Lognormal GOF Test on Detected Observations Only**							
5020					Shapiro Wilk Test Statistic	0.956					**Shapiro Wilk GOF Test**	
5021					5% Shapiro Wilk Critical Value	0.939					Detected Data appear Lognormal at 5% Significance Level	
5022					Lilliefors Test Statistic	0.0994					**Lilliefors GOF Test**	
5023					5% Lilliefors Critical Value	0.14					Detected Data appear Lognormal at 5% Significance Level	
5024					**Detected Data appear Lognormal at 5% Significance Level**							
5025												

	A	B	C	D	E	F	G	H	I	J	K	L
5026	**Lognormal ROS Statistics Using Imputed Non-Detects**											
5027					Mean in Original Scale	1.648			Mean in Log Scale			-0.875
5028					SD in Original Scale	5.988			SD in Log Scale			1.55
5029				95% t UCL (assumes normality of ROS data)		3.013			95% Percentile Bootstrap UCL			3.22
5030					95% BCA Bootstrap UCL	4.096			95% Bootstrap t UCL			8.543
5031					95% H-UCL (Log ROS)	2.65						
5032												
5033	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
5034					KM Mean (logged)	-0.956			KM Geo Mean			0.384
5035					KM SD (logged)	1.628			95% Critical H Value (KM-Log)			3.15
5036					KM Standard Error of Mean (logged)	0.224			95% H-UCL (KM -Log)			2.925
5037					KM SD (logged)	1.628			95% Critical H Value (KM-Log)			3.15
5038					KM Standard Error of Mean (logged)	0.224						
5039												
5040	**DL/2 Statistics**											
5041	**DL/2 Normal**							**DL/2 Log-Transformed**				
5042					Mean in Original Scale	1.638			Mean in Log Scale			-1.098
5043					SD in Original Scale	5.991			SD in Log Scale			1.836
5044				95% t UCL (Assumes normality)		3.003			95% H-Stat UCL			4.271
5045	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
5046												
5047	**Nonparametric Distribution Free UCL Statistics**											
5048	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
5049												
5050	**Suggested UCL to Use**											
5051					KM H-UCL	2.925						
5052												
5053	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5054	Recommendations are based upon data size, data distribution, and skewness.											
5055	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5056	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5057												
5058	**Result (eu4_cadmium_waste rock)**											
5059												
5060	**General Statistics**											
5061					Total Number of Observations	15			Number of Distinct Observations			15
5062					Number of Detects	14			Number of Non-Detects			1
5063					Number of Distinct Detects	14			Number of Distinct Non-Detects			1
5064					Minimum Detect	0.15			Minimum Non-Detect			0.045
5065					Maximum Detect	160			Maximum Non-Detect			0.045
5066					Variance Detects	3225			Percent Non-Detects			6.667%
5067					Mean Detects	30.39			SD Detects			56.79
5068					Median Detects	2.9			CV Detects			1.869
5069					Skewness Detects	1.814			Kurtosis Detects			1.85
5070					Mean of Logged Detects	1.36			SD of Logged Detects			2.246
5071												
5072	**Normal GOF Test on Detects Only**											
5073					Shapiro Wilk Test Statistic	0.582			**Shapiro Wilk GOF Test**			
5074					5% Shapiro Wilk Critical Value	0.874			Detected Data Not Normal at 5% Significance Level			
5075					Lilliefors Test Statistic	0.421			**Lilliefors GOF Test**			
5076					5% Lilliefors Critical Value	0.226			Detected Data Not Normal at 5% Significance Level			
5077	**Detected Data Not Normal at 5% Significance Level**											
5078												
5079	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
5080					KM Mean	28.36			KM Standard Error of Mean			14.31
5081					KM SD	53.41			95% KM (BCA) UCL			54.05
5082					95% KM (t) UCL	53.57			95% KM (Percentile Bootstrap) UCL			51.74
5083					95% KM (z) UCL	51.9			95% KM Bootstrap t UCL			80.14
5084					90% KM Chebyshev UCL	71.29			95% KM Chebyshev UCL			90.74
5085					97.5% KM Chebyshev UCL	117.7			99% KM Chebyshev UCL			170.7
5086												
5087	**Gamma GOF Tests on Detected Observations Only**											
5088					A-D Test Statistic	1.118			**Anderson-Darling GOF Test**			
5089					5% A-D Critical Value	0.826			Detected Data Not Gamma Distributed at 5% Significance Level			
5090					K-S Test Statistic	0.282			**Kolmogorov-Smirnov GOF**			
5091					5% K-S Critical Value	0.247			Detected Data Not Gamma Distributed at 5% Significance Level			
5092	**Detected Data Not Gamma Distributed at 5% Significance Level**											

5093												
5094	**Gamma Statistics on Detected Data Only**											
5095						k hat (MLE)	0.33			k star (bias corrected MLE)		0.307
5096						Theta hat (MLE)	91.94			Theta star (bias corrected MLE)		98.88
5097						nu hat (MLE)	9.253			nu star (bias corrected)		8.604
5098						Mean (detects)	30.39					
5099												
5100	**Gamma ROS Statistics using Imputed Non-Detects**											
5101	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
5102	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)											
5103	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
5104	This is especially true when the sample size is small.											
5105	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
5106						Minimum	0.01			Mean		28.36
5107						Maximum	160			Median		2.5
5108						SD	55.28			CV		1.949
5109						k hat (MLE)	0.291			k star (bias corrected MLE)		0.277
5110						Theta hat (MLE)	97.5			Theta star (bias corrected MLE)		102.3
5111						nu hat (MLE)	8.726			nu star (bias corrected)		8.314
5112						Adjusted Level of Significance (β)	0.0324					
5113						Approximate Chi Square Value (8.31, α)	2.918			Adjusted Chi Square Value (8.31, β)		2.539
5114						95% Gamma Approximate UCL (use when n>=50)	80.8			95% Gamma Adjusted UCL (use when n<50)		92.88
5115												
5116	**Estimates of Gamma Parameters using KM Estimates**											
5117						Mean (KM)	28.36			SD (KM)		53.41
5118						Variance (KM)	2852			SE of Mean (KM)		14.31
5119						k hat (KM)	0.282			k star (KM)		0.27
5120						nu hat (KM)	8.461			nu star (KM)		8.102
5121						theta hat (KM)	100.6			theta star (KM)		105
5122						80% gamma percentile (KM)	42.26			90% gamma percentile (KM)		84.59
5123						95% gamma percentile (KM)	134.1			99% gamma percentile (KM)		264.5
5124												
5125	**Gamma Kaplan-Meier (KM) Statistics**											
5126						Approximate Chi Square Value (8.10, α)	2.794			Adjusted Chi Square Value (8.10, β)		2.425
5127	5% Gamma Approximate KM-UCL (use when n>=50)						82.24			95% Gamma Adjusted KM-UCL (use when n<50)		94.77
5128												
5129	**Lognormal GOF Test on Detected Observations Only**											
5130						Shapiro Wilk Test Statistic	0.931	**Shapiro Wilk GOF Test**				
5131						5% Shapiro Wilk Critical Value	0.874	Detected Data appear Lognormal at 5% Significance Level				
5132						Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**				
5133						5% Lilliefors Critical Value	0.226	Detected Data appear Lognormal at 5% Significance Level				
5134	**Detected Data appear Lognormal at 5% Significance Level**											
5135												
5136	**Lognormal ROS Statistics Using Imputed Non-Detects**											
5137						Mean in Original Scale	28.36			Mean in Log Scale		0.995
5138						SD in Original Scale	55.28			SD in Log Scale		2.585
5139						95% t UCL (assumes normality of ROS data)	53.5			95% Percentile Bootstrap UCL		53.67
5140						95% BCA Bootstrap UCL	56.97			95% Bootstrap t UCL		80.71
5141						95% H-UCL (Log ROS)	3998					
5142												
5143	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
5144						KM Mean (logged)	1.063			KM Geo Mean		2.894
5145						KM SD (logged)	2.369			95% Critical H Value (KM-Log)		5.293
5146						KM Standard Error of Mean (logged)	0.635			95% H-UCL (KM -Log)		1366
5147						KM SD (logged)	2.369			95% Critical H Value (KM-Log)		5.293
5148						KM Standard Error of Mean (logged)	0.635					
5149												
5150	**DL/2 Statistics**											
5151	**DL/2 Normal**							**DL/2 Log-Transformed**				
5152						Mean in Original Scale	28.36			Mean in Log Scale		1.016
5153						SD in Original Scale	55.28			SD in Log Scale		2.541
5154						95% t UCL (Assumes normality)	53.5			95% H-Stat UCL		3213
5155	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
5156												
5157	**Nonparametric Distribution Free UCL Statistics**											
5158	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
5159												

5160	**Suggested UCL to Use**											
5161			99% KM (Chebyshev) UCL		170.7							
5162	**Warning: Recommended UCL exceeds the maximum observation**											
5163												
5164	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5165	Recommendations are based upon data size, data distribution, and skewness.											
5166	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5167	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5168												
5169												
5170	**Result (eu4_chromium_overbank)**											
5171												
5172	**General Statistics**											
5173				Total Number of Observations		54			Number of Distinct Observations			38
5174									Number of Missing Observations			0
5175				Minimum		1.1			Mean			4.239
5176				Maximum		12			Median			4
5177				SD		2.165			Std. Error of Mean			0.295
5178				Coefficient of Variation		0.511			Skewness			1.483
5179												
5180	**Normal GOF Test**											
5181				Shapiro Wilk Test Statistic		0.889			**Shapiro Wilk GOF Test**			
5182				5% Shapiro Wilk P Value		3.3020E-5			Data Not Normal at 5% Significance Level			
5183				Lilliefors Test Statistic		0.175			**Lilliefors GOF Test**			
5184				5% Lilliefors Critical Value		0.12			Data Not Normal at 5% Significance Level			
5185	**Data Not Normal at 5% Significance Level**											
5186												
5187	**Assuming Normal Distribution**											
5188				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
5189				95% Student's-t UCL		4.732			95% Adjusted-CLT UCL (Chen-1995)			4.787
5190									95% Modified-t UCL (Johnson-1978)			4.742
5191												
5192	**Gamma GOF Test**											
5193				A-D Test Statistic		0.387			**Anderson-Darling Gamma GOF Test**			
5194				5% A-D Critical Value		0.754			Detected data appear Gamma Distributed at 5% Significance Lev			
5195				K-S Test Statistic		0.112			**Kolmogorov-Smirnov Gamma GOF Test**			
5196				5% K-S Critical Value		0.121			Detected data appear Gamma Distributed at 5% Significance Lev			
5197	**Detected data appear Gamma Distributed at 5% Significance Level**											
5198												
5199	**Gamma Statistics**											
5200				k hat (MLE)		4.477			k star (bias corrected MLE)			4.24
5201				Theta hat (MLE)		0.947			Theta star (bias corrected MLE)			1
5202				nu hat (MLE)		483.5			nu star (bias corrected)			458
5203				MLE Mean (bias corrected)		4.239			MLE Sd (bias corrected)			2.059
5204									Approximate Chi Square Value (0.05)			409.3
5205				Adjusted Level of Significance		0.0456			Adjusted Chi Square Value			408.1
5206												
5207	**Assuming Gamma Distribution**											
5208				95% Approximate Gamma UCL (use when n>=50)		4.743			95% Adjusted Gamma UCL (use when n<50)			4.757
5209												
5210	**Lognormal GOF Test**											
5211				Shapiro Wilk Test Statistic		0.987			**Shapiro Wilk Lognormal GOF Test**			
5212				5% Shapiro Wilk P Value		0.931			Data appear Lognormal at 5% Significance Level			
5213				Lilliefors Test Statistic		0.0859			**Lilliefors Lognormal GOF Test**			
5214				5% Lilliefors Critical Value		0.12			Data appear Lognormal at 5% Significance Level			
5215	**Data appear Lognormal at 5% Significance Level**											
5216												
5217	**Lognormal Statistics**											
5218				Minimum of Logged Data		0.0953			Mean of logged Data			1.329
5219				Maximum of Logged Data		2.485			SD of logged Data			0.488
5220												
5221	**Assuming Lognormal Distribution**											
5222				95% H-UCL		4.821			90% Chebyshev (MVUE) UCL			5.127
5223				95% Chebyshev (MVUE) UCL		5.528			97.5% Chebyshev (MVUE) UCL			6.085
5224				99% Chebyshev (MVUE) UCL		7.179						
5225												
5226	**Nonparametric Distribution Free UCL Statistics**											

5227	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
5228												
5229	**Nonparametric Distribution Free UCLs**											
5230						95% CLT UCL	4.724			95% Jackknife UCL	4.732	
5231						95% Standard Bootstrap UCL	4.719			95% Bootstrap-t UCL	4.828	
5232						95% Hall's Bootstrap UCL	4.799			95% Percentile Bootstrap UCL	4.731	
5233						95% BCA Bootstrap UCL	4.781					
5234						90% Chebyshev(Mean, Sd) UCL	5.123			95% Chebyshev(Mean, Sd) UCL	5.523	
5235						97.5% Chebyshev(Mean, Sd) UCL	6.079			99% Chebyshev(Mean, Sd) UCL	7.17	
5236												
5237	**Suggested UCL to Use**											
5238						95% Approximate Gamma UCL	4.743					
5239												
5240	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5241	Recommendations are based upon data size, data distribution, and skewness.											
5242	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5243	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5244												
5245												
5246	**Result (eu4_chromium_waste rock)**											
5247												
5248	**General Statistics**											
5249						Total Number of Observations	15			Number of Distinct Observations	14	
5250										Number of Missing Observations	0	
5251						Minimum	1.2			Mean	5.24	
5252						Maximum	16.5			Median	3.9	
5253						SD	3.796			Std. Error of Mean	0.98	
5254						Coefficient of Variation	0.724			Skewness	2.093	
5255												
5256	**Normal GOF Test**											
5257						Shapiro Wilk Test Statistic	0.794			**Shapiro Wilk GOF Test**		
5258						5% Shapiro Wilk Critical Value	0.881			Data Not Normal at 5% Significance Level		
5259						Lilliefors Test Statistic	0.227			**Lilliefors GOF Test**		
5260						5% Lilliefors Critical Value	0.22			Data Not Normal at 5% Significance Level		
5261	**Data Not Normal at 5% Significance Level**											
5262												
5263	**Assuming Normal Distribution**											
5264						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
5265						95% Student's-t UCL	6.966			95% Adjusted-CLT UCL (Chen-1995)	7.418	
5266										95% Modified-t UCL (Johnson-1978)	7.055	
5267												
5268	**Gamma GOF Test**											
5269						A-D Test Statistic	0.336			**Anderson-Darling Gamma GOF Test**		
5270						5% A-D Critical Value	0.745			Detected data appear Gamma Distributed at 5% Significance Lev		
5271						K-S Test Statistic	0.145			**Kolmogorov-Smirnov Gamma GOF Test**		
5272						5% K-S Critical Value	0.224			Detected data appear Gamma Distributed at 5% Significance Lev		
5273	**Detected data appear Gamma Distributed at 5% Significance Level**											
5274												
5275	**Gamma Statistics**											
5276						k hat (MLE)	2.711			k star (bias corrected MLE)	2.213	
5277						Theta hat (MLE)	1.933			Theta star (bias corrected MLE)	2.368	
5278						nu hat (MLE)	81.32			nu star (bias corrected)	66.39	
5279						MLE Mean (bias corrected)	5.24			MLE Sd (bias corrected)	3.522	
5280										Approximate Chi Square Value (0.05)	48.64	
5281						Adjusted Level of Significance	0.0324			Adjusted Chi Square Value	46.77	
5282												
5283	**Assuming Gamma Distribution**											
5284						95% Approximate Gamma UCL (use when n>=50)	7.152			95% Adjusted Gamma UCL (use when n<50)	7.438	
5285												
5286	**Lognormal GOF Test**											
5287						Shapiro Wilk Test Statistic	0.983			**Shapiro Wilk Lognormal GOF Test**		
5288						5% Shapiro Wilk Critical Value	0.881			Data appear Lognormal at 5% Significance Level		
5289						Lilliefors Test Statistic	0.106			**Lilliefors Lognormal GOF Test**		
5290						5% Lilliefors Critical Value	0.22			Data appear Lognormal at 5% Significance Level		
5291	**Data appear Lognormal at 5% Significance Level**											
5292												
5293	**Lognormal Statistics**											

5294					Minimum of Logged Data	0.182				Mean of logged Data		1.461
5295					Maximum of Logged Data	2.803				SD of logged Data		0.639
5296												
5297					**Assuming Lognormal Distribution**							
5298					95% H-UCL	7.731				90% Chebyshev (MVUE) UCL		7.895
5299					95% Chebyshev (MVUE) UCL	9.115				97.5% Chebyshev (MVUE) UCL		10.81
5300					99% Chebyshev (MVUE) UCL	14.13						
5301												
5302					**Nonparametric Distribution Free UCL Statistics**							
5303					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
5304												
5305					**Nonparametric Distribution Free UCLs**							
5306					95% CLT UCL	6.852				95% Jackknife UCL		6.966
5307					95% Standard Bootstrap UCL	6.793				95% Bootstrap-t UCL		8.424
5308					95% Hall's Bootstrap UCL	15.23				95% Percentile Bootstrap UCL		6.793
5309					95% BCA Bootstrap UCL	7.46						
5310					90% Chebyshev(Mean, Sd) UCL	8.181				95% Chebyshev(Mean, Sd) UCL		9.512
5311					97.5% Chebyshev(Mean, Sd) UCL	11.36				99% Chebyshev(Mean, Sd) UCL		14.99
5312												
5313					**Suggested UCL to Use**							
5314					95% Adjusted Gamma UCL	7.438						
5315												
5316	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5317	Recommendations are based upon data size, data distribution, and skewness.											
5318	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5319	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5320												
5321												
5322	**Result (eu4_cobalt_overbank)**											
5323												
5324					**General Statistics**							
5325					Total Number of Observations	48				Number of Distinct Observations		45
5326										Number of Missing Observations		0
5327					Minimum	0.71				Mean		11.96
5328					Maximum	69.8				Median		9.15
5329					SD	13.14				Std. Error of Mean		1.896
5330					Coefficient of Variation	1.099				Skewness		2.765
5331												
5332					**Normal GOF Test**							
5333					Shapiro Wilk Test Statistic	0.667				**Shapiro Wilk GOF Test**		
5334					5% Shapiro Wilk Critical Value	0.947				Data Not Normal at 5% Significance Level		
5335					Lilliefors Test Statistic	0.275				**Lilliefors GOF Test**		
5336					5% Lilliefors Critical Value	0.127				Data Not Normal at 5% Significance Level		
5337					**Data Not Normal at 5% Significance Level**							
5338												
5339					**Assuming Normal Distribution**							
5340					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
5341					95% Student's-t UCL	15.14				95% Adjusted-CLT UCL (Chen-1995)		15.89
5342										95% Modified-t UCL (Johnson-1978)		15.27
5343												
5344					**Gamma GOF Test**							
5345					A-D Test Statistic	1.384				**Anderson-Darling Gamma GOF Test**		
5346					5% A-D Critical Value	0.769				Data Not Gamma Distributed at 5% Significance Level		
5347					K-S Test Statistic	0.161				**Kolmogorov-Smirnov Gamma GOF Test**		
5348					5% K-S Critical Value	0.13				Data Not Gamma Distributed at 5% Significance Level		
5349					**Data Not Gamma Distributed at 5% Significance Level**							
5350												
5351					**Gamma Statistics**							
5352					k hat (MLE)	1.432				k star (bias corrected MLE)		1.356
5353					Theta hat (MLE)	8.352				Theta star (bias corrected MLE)		8.817
5354					nu hat (MLE)	137.5				nu star (bias corrected)		130.2
5355					MLE Mean (bias corrected)	11.96				MLE Sd (bias corrected)		10.27
5356										Approximate Chi Square Value (0.05)		104.9
5357					Adjusted Level of Significance	0.045				Adjusted Chi Square Value		104.2
5358												
5359					**Assuming Gamma Distribution**							
5360	95% Approximate Gamma UCL (use when n>=50))					14.85				95% Adjusted Gamma UCL (use when n<50)		14.95

5361												
5362						**Lognormal GOF Test**						
5363					Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk Lognormal GOF Test**					
5364					5% Shapiro Wilk Critical Value	0.947	Data appear Lognormal at 5% Significance Level					
5365					Lilliefors Test Statistic	0.101	**Lilliefors Lognormal GOF Test**					
5366					5% Lilliefors Critical Value	0.127	Data appear Lognormal at 5% Significance Level					
5367					**Data appear Lognormal at 5% Significance Level**							
5368												
5369						**Lognormal Statistics**						
5370					Minimum of Logged Data	-0.342	Mean of logged Data	2.094				
5371					Maximum of Logged Data	4.246	SD of logged Data	0.869				
5372												
5373						**Assuming Lognormal Distribution**						
5374					95% H-UCL	15.65	90% Chebyshev (MVUE) UCL	16.73				
5375					95% Chebyshev (MVUE) UCL	19	97.5% Chebyshev (MVUE) UCL	22.15				
5376					99% Chebyshev (MVUE) UCL	28.35						
5377												
5378						**Nonparametric Distribution Free UCL Statistics**						
5379						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
5380												
5381						**Nonparametric Distribution Free UCLs**						
5382					95% CLT UCL	15.08	95% Jackknife UCL	15.14				
5383					95% Standard Bootstrap UCL	15.02	95% Bootstrap-t UCL	16.55				
5384					95% Hall's Bootstrap UCL	16.65	95% Percentile Bootstrap UCL	15.28				
5385					95% BCA Bootstrap UCL	16.14						
5386					90% Chebyshev(Mean, Sd) UCL	17.65	95% Chebyshev(Mean, Sd) UCL	20.23				
5387					97.5% Chebyshev(Mean, Sd) UCL	23.8	99% Chebyshev(Mean, Sd) UCL	30.83				
5388												
5389						**Suggested UCL to Use**						
5390					95% H-UCL	15.65						
5391												
5392	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5393	Recommendations are based upon data size, data distribution, and skewness.											
5394	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5395	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5396												
5397	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
5398	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
5399	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
5400	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
5401												
5402												
5403	**Result (eu4_cobalt_waste rock)**											
5404												
5405						**General Statistics**						
5406					Total Number of Observations	15	Number of Distinct Observations	15				
5407							Number of Missing Observations	0				
5408					Minimum	0.71	Mean	13.24				
5409					Maximum	117	Median	4.9				
5410					SD	29.07	Std. Error of Mean	7.505				
5411					Coefficient of Variation	2.195	Skewness	3.717				
5412												
5413						**Normal GOF Test**						
5414					Shapiro Wilk Test Statistic	0.401	**Shapiro Wilk GOF Test**					
5415					5% Shapiro Wilk Critical Value	0.881	Data Not Normal at 5% Significance Level					
5416					Lilliefors Test Statistic	0.426	**Lilliefors GOF Test**					
5417					5% Lilliefors Critical Value	0.22	Data Not Normal at 5% Significance Level					
5418						**Data Not Normal at 5% Significance Level**						
5419												
5420						**Assuming Normal Distribution**						
5421					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
5422					95% Student's-t UCL	26.46	95% Adjusted-CLT UCL (Chen-1995)	33.28				
5423							95% Modified-t UCL (Johnson-1978)	27.66				
5424												
5425						**Gamma GOF Test**						
5426					A-D Test Statistic	1.878	**Anderson-Darling Gamma GOF Test**					
5427					5% A-D Critical Value	0.779	Data Not Gamma Distributed at 5% Significance Level					

5428				K-S Test Statistic	0.327	**Kolmogorov-Smirnov Gamma GOF Test**						
5429				5% K-S Critical Value	0.231	Data Not Gamma Distributed at 5% Significance Level						
5430	**Data Not Gamma Distributed at 5% Significance Level**											
5431												
5432	**Gamma Statistics**											
5433				k hat (MLE)	0.702	k star (bias corrected MLE)	0.606					
5434				Theta hat (MLE)	18.87	Theta star (bias corrected MLE)	21.86					
5435				nu hat (MLE)	21.05	nu star (bias corrected)	18.17					
5436				MLE Mean (bias corrected)	13.24	MLE Sd (bias corrected)	17.01					
5437						Approximate Chi Square Value (0.05)	9.515					
5438				Adjusted Level of Significance	0.0324	Adjusted Chi Square Value	8.752					
5439												
5440	**Assuming Gamma Distribution**											
5441	95% Approximate Gamma UCL (use when n>=50))				25.29	95% Adjusted Gamma UCL (use when n<50)	27.49					
5442												
5443	**Lognormal GOF Test**											
5444				Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk Lognormal GOF Test**						
5445				5% Shapiro Wilk Critical Value	0.881	Data appear Lognormal at 5% Significance Level						
5446				Lilliefors Test Statistic	0.207	**Lilliefors Lognormal GOF Test**						
5447				5% Lilliefors Critical Value	0.22	Data appear Lognormal at 5% Significance Level						
5448	**Data appear Lognormal at 5% Significance Level**											
5449												
5450	**Lognormal Statistics**											
5451				Minimum of Logged Data	-0.342	Mean of logged Data	1.722					
5452				Maximum of Logged Data	4.762	SD of logged Data	1.127					
5453												
5454	**Assuming Lognormal Distribution**											
5455				95% H-UCL	25.69	90% Chebyshev (MVUE) UCL	19.51					
5456				95% Chebyshev (MVUE) UCL	23.86	97.5% Chebyshev (MVUE) UCL	29.89					
5457				99% Chebyshev (MVUE) UCL	41.74							
5458												
5459	**Nonparametric Distribution Free UCL Statistics**											
5460	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
5461												
5462	**Nonparametric Distribution Free UCLs**											
5463				95% CLT UCL	25.59	95% Jackknife UCL	26.46					
5464				95% Standard Bootstrap UCL	24.95	95% Bootstrap-t UCL	133.2					
5465				95% Hall's Bootstrap UCL	89.12	95% Percentile Bootstrap UCL	27.7					
5466				95% BCA Bootstrap UCL	36							
5467				90% Chebyshev(Mean, Sd) UCL	35.76	95% Chebyshev(Mean, Sd) UCL	45.95					
5468				97.5% Chebyshev(Mean, Sd) UCL	60.11	99% Chebyshev(Mean, Sd) UCL	87.92					
5469												
5470	**Suggested UCL to Use**											
5471				95% Chebyshev (Mean, Sd) UCL	45.95							
5472												
5473	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5474	Recommendations are based upon data size, data distribution, and skewness.											
5475	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5476	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5477												
5478												
5479	**Result (eu4_iron_overbank)**											
5480												
5481	**General Statistics**											
5482				Total Number of Observations	54	Number of Distinct Observations	54					
5483						Number of Missing Observations	0					
5484				Minimum	12100	Mean	54226					
5485				Maximum	317000	Median	41850					
5486				SD	46689	Std. Error of Mean	6354					
5487				Coefficient of Variation	0.861	Skewness	3.866					
5488												
5489	**Normal GOF Test**											
5490				Shapiro Wilk Test Statistic	0.626	**Shapiro Wilk GOF Test**						
5491				5% Shapiro Wilk P Value	1.110E-16	Data Not Normal at 5% Significance Level						
5492				Lilliefors Test Statistic	0.252	**Lilliefors GOF Test**						
5493				5% Lilliefors Critical Value	0.12	Data Not Normal at 5% Significance Level						
5494	**Data Not Normal at 5% Significance Level**											

5495												
5496						**Assuming Normal Distribution**							
5497					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
5498					95% Student's-t UCL	64862			95% Adjusted-CLT UCL (Chen-1995)	68248		
5499									95% Modified-t UCL (Johnson-1978)	65420		
5500												
5501						**Gamma GOF Test**						
5502					A-D Test Statistic	1.92			**Anderson-Darling Gamma GOF Test**			
5503					5% A-D Critical Value	0.759			Data Not Gamma Distributed at 5% Significance Level			
5504					K-S Test Statistic	0.167			**Kolmogorov-Smirnov Gamma GOF Test**			
5505					5% K-S Critical Value	0.122			Data Not Gamma Distributed at 5% Significance Level			
5506						**Data Not Gamma Distributed at 5% Significance Level**						
5507												
5508						**Gamma Statistics**						
5509					k hat (MLE)	2.694			k star (bias corrected MLE)	2.556		
5510					Theta hat (MLE)	20131			Theta star (bias corrected MLE)	21212		
5511					nu hat (MLE)	290.9			nu star (bias corrected)	276.1		
5512					MLE Mean (bias corrected)	54226			MLE Sd (bias corrected)	33915		
5513									Approximate Chi Square Value (0.05)	238.6		
5514					Adjusted Level of Significance	0.0456			Adjusted Chi Square Value	237.7		
5515												
5516						**Assuming Gamma Distribution**							
5517					95% Approximate Gamma UCL (use when n>=50))	62744			95% Adjusted Gamma UCL (use when n<50)	62995		
5518												
5519						**Lognormal GOF Test**						
5520					Shapiro Wilk Test Statistic	0.958			**Shapiro Wilk Lognormal GOF Test**			
5521					5% Shapiro Wilk P Value	0.111			Data appear Lognormal at 5% Significance Level			
5522					Lilliefors Test Statistic	0.116			**Lilliefors Lognormal GOF Test**			
5523					5% Lilliefors Critical Value	0.12			Data appear Lognormal at 5% Significance Level			
5524						**Data appear Lognormal at 5% Significance Level**							
5525												
5526						**Lognormal Statistics**						
5527					Minimum of Logged Data	9.401			Mean of logged Data	10.7		
5528					Maximum of Logged Data	12.67			SD of logged Data	0.581		
5529												
5530						**Assuming Lognormal Distribution**							
5531					95% H-UCL	61544			90% Chebyshev (MVUE) UCL	65845		
5532					95% Chebyshev (MVUE) UCL	71874			97.5% Chebyshev (MVUE) UCL	80242		
5533					99% Chebyshev (MVUE) UCL	96680						
5534												
5535						**Nonparametric Distribution Free UCL Statistics**							
5536						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
5537												
5538						**Nonparametric Distribution Free UCLs**							
5539					95% CLT UCL	64677			95% Jackknife UCL	64862		
5540					95% Standard Bootstrap UCL	64619			95% Bootstrap-t UCL	71880		
5541					95% Hall's Bootstrap UCL	108782			95% Percentile Bootstrap UCL	65163		
5542					95% BCA Bootstrap UCL	68600						
5543					90% Chebyshev(Mean, Sd) UCL	73287			95% Chebyshev(Mean, Sd) UCL	81920		
5544					97.5% Chebyshev(Mean, Sd) UCL	93904			99% Chebyshev(Mean, Sd) UCL	117443		
5545												
5546						**Suggested UCL to Use**							
5547					95% H-UCL	61544						
5548												
5549	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5550	Recommendations are based upon data size, data distribution, and skewness.											
5551	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5552	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5553												
5554	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
5555	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
5556	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
5557	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
5558												
5559												
5560	**Result (eu4_iron_waste rock)**											
5561												

	A	B	C	D	E	F	G	H	I	J	K	L
5562	**General Statistics**											
5563					Total Number of Observations	15			Number of Distinct Observations			15
5564									Number of Missing Observations			0
5565					Minimum	23500			Mean			78327
5566					Maximum	262000			Median			53800
5567					SD	62193			Std. Error of Mean			16058
5568					Coefficient of Variation	0.794			Skewness			2.185
5569												
5570	**Normal GOF Test**											
5571					Shapiro Wilk Test Statistic	0.739	**Shapiro Wilk GOF Test**					
5572					5% Shapiro Wilk Critical Value	0.881	Data Not Normal at 5% Significance Level					
5573					Lilliefors Test Statistic	0.285	**Lilliefors GOF Test**					
5574					5% Lilliefors Critical Value	0.22	Data Not Normal at 5% Significance Level					
5575	**Data Not Normal at 5% Significance Level**											
5576												
5577	**Assuming Normal Distribution**											
5578	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
5579					95% Student's-t UCL	106610			95% Adjusted-CLT UCL (Chen-1995)			114421
5580									95% Modified-t UCL (Johnson-1978)			108120
5581												
5582	**Gamma GOF Test**											
5583					A-D Test Statistic	0.696	**Anderson-Darling Gamma GOF Test**					
5584					5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Lev					
5585					K-S Test Statistic	0.198	**Kolmogorov-Smirnov Gamma GOF Test**					
5586					5% K-S Critical Value	0.224	Detected data appear Gamma Distributed at 5% Significance Lev					
5587	**Detected data appear Gamma Distributed at 5% Significance Level**											
5588												
5589	**Gamma Statistics**											
5590					k hat (MLE)	2.533			k star (bias corrected MLE)			2.071
5591					Theta hat (MLE)	30920			Theta star (bias corrected MLE)			37821
5592					nu hat (MLE)	76			nu star (bias corrected)			62.13
5593					MLE Mean (bias corrected)	78327			MLE Sd (bias corrected)			54428
5594									Approximate Chi Square Value (0.05)			45
5595					Adjusted Level of Significance	0.0324			Adjusted Chi Square Value			43.21
5596												
5597	**Assuming Gamma Distribution**											
5598	95% Approximate Gamma UCL (use when n>=50)					108143			95% Adjusted Gamma UCL (use when n<50)			112627
5599												
5600	**Lognormal GOF Test**											
5601					Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**					
5602					5% Shapiro Wilk Critical Value	0.881	Data appear Lognormal at 5% Significance Level					
5603					Lilliefors Test Statistic	0.152	**Lilliefors Lognormal GOF Test**					
5604					5% Lilliefors Critical Value	0.22	Data appear Lognormal at 5% Significance Level					
5605	**Data appear Lognormal at 5% Significance Level**											
5606												
5607	**Lognormal Statistics**											
5608					Minimum of Logged Data	10.06			Mean of logged Data			11.06
5609					Maximum of Logged Data	12.48			SD of logged Data			0.632
5610												
5611	**Assuming Lognormal Distribution**											
5612					95% H-UCL	112802			90% Chebyshev (MVUE) UCL			115410
5613					95% Chebyshev (MVUE) UCL	133111			97.5% Chebyshev (MVUE) UCL			157678
5614					99% Chebyshev (MVUE) UCL	205936						
5615												
5616	**Nonparametric Distribution Free UCL Statistics**											
5617	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
5618												
5619	**Nonparametric Distribution Free UCLs**											
5620					95% CLT UCL	104740			95% Jackknife UCL			106610
5621					95% Standard Bootstrap UCL	103548			95% Bootstrap-t UCL			140269
5622					95% Hall's Bootstrap UCL	216558			95% Percentile Bootstrap UCL			107173
5623					95% BCA Bootstrap UCL	114300						
5624					90% Chebyshev(Mean, Sd) UCL	126501			95% Chebyshev(Mean, Sd) UCL			148323
5625					97.5% Chebyshev(Mean, Sd) UCL	178610			99% Chebyshev(Mean, Sd) UCL			238104
5626												
5627	**Suggested UCL to Use**											
5628					95% Adjusted Gamma UCL	112627						

	A	B	C	D	E	F	G	H	I	J	K	L
5629												
5630	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5631	Recommendations are based upon data size, data distribution, and skewness.											
5632	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5633	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5634												
5635												
5636	**Result (eu4_manganese_overbank)**											
5637												
5638	**General Statistics**											
5639					Total Number of Observations	54			Number of Distinct Observations	52		
5640									Number of Missing Observations	0		
5641					Minimum	85.1			Mean	1469		
5642					Maximum	8670			Median	973		
5643					SD	1722			Std. Error of Mean	234.4		
5644					Coefficient of Variation	1.172			Skewness	2.875		
5645												
5646	**Normal GOF Test**											
5647					Shapiro Wilk Test Statistic	0.657			**Shapiro Wilk GOF Test**			
5648					5% Shapiro Wilk P Value	1.887E-15			Data Not Normal at 5% Significance Level			
5649					Lilliefors Test Statistic	0.229			**Lilliefors GOF Test**			
5650					5% Lilliefors Critical Value	0.12			Data Not Normal at 5% Significance Level			
5651	**Data Not Normal at 5% Significance Level**											
5652												
5653	**Assuming Normal Distribution**											
5654					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
5655					95% Student's-t UCL	1861			95% Adjusted-CLT UCL (Chen-1995)	1953		
5656									95% Modified-t UCL (Johnson-1978)	1877		
5657												
5658	**Gamma GOF Test**											
5659					A-D Test Statistic	1.017			**Anderson-Darling Gamma GOF Test**			
5660					5% A-D Critical Value	0.774			Data Not Gamma Distributed at 5% Significance Level			
5661					K-S Test Statistic	0.141			**Kolmogorov-Smirnov Gamma GOF Test**			
5662					5% K-S Critical Value	0.124			Data Not Gamma Distributed at 5% Significance Level			
5663	**Data Not Gamma Distributed at 5% Significance Level**											
5664												
5665	**Gamma Statistics**											
5666					k hat (MLE)	1.242			k star (bias corrected MLE)	1.185		
5667					Theta hat (MLE)	1183			Theta star (bias corrected MLE)	1240		
5668					nu hat (MLE)	134.1			nu star (bias corrected)	128		
5669					MLE Mean (bias corrected)	1469			MLE Sd (bias corrected)	1350		
5670									Approximate Chi Square Value (0.05)	102.8		
5671					Adjusted Level of Significance	0.0456			Adjusted Chi Square Value	102.2		
5672												
5673	**Assuming Gamma Distribution**											
5674	95% Approximate Gamma UCL (use when n>=50))					1828			95% Adjusted Gamma UCL (use when n<50)	1839		
5675												
5676	**Lognormal GOF Test**											
5677					Shapiro Wilk Test Statistic	0.983			**Shapiro Wilk Lognormal GOF Test**			
5678					5% Shapiro Wilk P Value	0.816			Data appear Lognormal at 5% Significance Level			
5679					Lilliefors Test Statistic	0.0867			**Lilliefors Lognormal GOF Test**			
5680					5% Lilliefors Critical Value	0.12			Data appear Lognormal at 5% Significance Level			
5681	**Data appear Lognormal at 5% Significance Level**											
5682												
5683	**Lognormal Statistics**											
5684					Minimum of Logged Data	4.444			Mean of logged Data	6.838		
5685					Maximum of Logged Data	9.068			SD of logged Data	0.956		
5686												
5687	**Assuming Lognormal Distribution**											
5688					95% H-UCL	1986			90% Chebyshev (MVUE) UCL	2119		
5689					95% Chebyshev (MVUE) UCL	2419			97.5% Chebyshev (MVUE) UCL	2836		
5690					99% Chebyshev (MVUE) UCL	3654						
5691												
5692	**Nonparametric Distribution Free UCL Statistics**											
5693	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
5694												
5695	**Nonparametric Distribution Free UCLs**											

5696					95% CLT UCL	1855					95% Jackknife UCL	1861
5697					95% Standard Bootstrap UCL	1855					95% Bootstrap-t UCL	2058
5698					95% Hall's Bootstrap UCL	2059					95% Percentile Bootstrap UCL	1860
5699					95% BCA Bootstrap UCL	1999						
5700					90% Chebyshev(Mean, Sd) UCL	2172					95% Chebyshev(Mean, Sd) UCL	2491
5701					97.5% Chebyshev(Mean, Sd) UCL	2933					99% Chebyshev(Mean, Sd) UCL	3801
5702												
5703					**Suggested UCL to Use**							
5704					95% H-UCL	1986						
5705												
5706	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5707	Recommendations are based upon data size, data distribution, and skewness.											
5708	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5709	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5710												
5711	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
5712	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
5713	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
5714	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
5715												
5716												
5717	**Result (eu4_manganese_waste rock)**											
5718												
5719	**General Statistics**											
5720					Total Number of Observations	15					Number of Distinct Observations	15
5721											Number of Missing Observations	0
5722					Minimum	175					Mean	7431
5723					Maximum	72100					Median	847
5724					SD	18618					Std. Error of Mean	4807
5725					Coefficient of Variation	2.505					Skewness	3.42
5726												
5727	**Normal GOF Test**											
5728					Shapiro Wilk Test Statistic	0.439					**Shapiro Wilk GOF Test**	
5729					5% Shapiro Wilk Critical Value	0.881					Data Not Normal at 5% Significance Level	
5730					Lilliefors Test Statistic	0.421					**Lilliefors GOF Test**	
5731					5% Lilliefors Critical Value	0.22					Data Not Normal at 5% Significance Level	
5732	**Data Not Normal at 5% Significance Level**											
5733												
5734	**Assuming Normal Distribution**											
5735	**95% Normal UCL**										**95% UCLs (Adjusted for Skewness)**	
5736					95% Student's-t UCL	15898					95% Adjusted-CLT UCL (Chen-1995)	19874
5737											95% Modified-t UCL (Johnson-1978)	16606
5738												
5739	**Gamma GOF Test**											
5740					A-D Test Statistic	2.131					**Anderson-Darling Gamma GOF Test**	
5741					5% A-D Critical Value	0.819					Data Not Gamma Distributed at 5% Significance Level	
5742					K-S Test Statistic	0.364					**Kolmogorov-Smirnov Gamma GOF Test**	
5743					5% K-S Critical Value	0.238					Data Not Gamma Distributed at 5% Significance Level	
5744	**Data Not Gamma Distributed at 5% Significance Level**											
5745												
5746	**Gamma Statistics**											
5747					k hat (MLE)	0.377					k star (bias corrected MLE)	0.346
5748					Theta hat (MLE)	19717					Theta star (bias corrected MLE)	21480
5749					nu hat (MLE)	11.31					nu star (bias corrected)	10.38
5750					MLE Mean (bias corrected)	7431					MLE Sd (bias corrected)	12634
5751											Approximate Chi Square Value (0.05)	4.18
5752					Adjusted Level of Significance	0.0324					Adjusted Chi Square Value	3.708
5753												
5754	**Assuming Gamma Distribution**											
5755	95% Approximate Gamma UCL (use when n>=50))					18452					95% Adjusted Gamma UCL (use when n<50)	20803
5756												
5757	**Lognormal GOF Test**											
5758					Shapiro Wilk Test Statistic	0.835					**Shapiro Wilk Lognormal GOF Test**	
5759					5% Shapiro Wilk Critical Value	0.881					Data Not Lognormal at 5% Significance Level	
5760					Lilliefors Test Statistic	0.275					**Lilliefors Lognormal GOF Test**	
5761					5% Lilliefors Critical Value	0.22					Data Not Lognormal at 5% Significance Level	
5762	**Data Not Lognormal at 5% Significance Level**											

5763												
5764						**Lognormal Statistics**						
5765						Minimum of Logged Data	5.165			Mean of logged Data	7.151	
5766						Maximum of Logged Data	11.19			SD of logged Data	1.689	
5767												
5768						**Assuming Lognormal Distribution**						
5769						95% H-UCL	31828			90% Chebyshev (MVUE) UCL	11017	
5770						95% Chebyshev (MVUE) UCL	14014			97.5% Chebyshev (MVUE) UCL	18175	
5771						99% Chebyshev (MVUE) UCL	26348					
5772												
5773						**Nonparametric Distribution Free UCL Statistics**						
5774						**Data do not follow a Discernible Distribution (0.05)**						
5775												
5776						**Nonparametric Distribution Free UCLs**						
5777						95% CLT UCL	15338			95% Jackknife UCL	15898	
5778						95% Standard Bootstrap UCL	14977			95% Bootstrap-t UCL	36379	
5779						95% Hall's Bootstrap UCL	37891			95% Percentile Bootstrap UCL	16108	
5780						95% BCA Bootstrap UCL	21789					
5781						90% Chebyshev(Mean, Sd) UCL	21853			95% Chebyshev(Mean, Sd) UCL	28385	
5782						97.5% Chebyshev(Mean, Sd) UCL	37451			99% Chebyshev(Mean, Sd) UCL	55261	
5783												
5784						**Suggested UCL to Use**						
5785						99% Chebyshev (Mean, Sd) UCL	55261					
5786												
5787	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5788	Recommendations are based upon data size, data distribution, and skewness.											
5789	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5790	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5791												
5792	**Result (eu4_thallium_overbank)**											
5793												
5794						**General Statistics**						
5795						Total Number of Observations	54			Number of Distinct Observations	38	
5796						Number of Detects	17			Number of Non-Detects	37	
5797						Number of Distinct Detects	14			Number of Distinct Non-Detects	24	
5798						Minimum Detect	0.068			Minimum Non-Detect	0.04	
5799						Maximum Detect	0.36			Maximum Non-Detect	1.01	
5800						Variance Detects	0.00735			Percent Non-Detects	68.52%	
5801						Mean Detects	0.148			SD Detects	0.0858	
5802						Median Detects	0.1			CV Detects	0.581	
5803						Skewness Detects	1.403			Kurtosis Detects	1.044	
5804						Mean of Logged Detects	-2.043			SD of Logged Detects	0.501	
5805												
5806						**Normal GOF Test on Detects Only**						
5807						Shapiro Wilk Test Statistic	0.797			**Shapiro Wilk GOF Test**		
5808						5% Shapiro Wilk Critical Value	0.892			Detected Data Not Normal at 5% Significance Level		
5809						Lilliefors Test Statistic	0.24			**Lilliefors GOF Test**		
5810						5% Lilliefors Critical Value	0.207			Detected Data Not Normal at 5% Significance Level		
5811						**Detected Data Not Normal at 5% Significance Level**						
5812												
5813						**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**						
5814						KM Mean	0.0785			KM Standard Error of Mean	0.0106	
5815						KM SD	0.0713			95% KM (BCA) UCL	0.1	
5816						95% KM (t) UCL	0.0963			95% KM (Percentile Bootstrap) UCL	0.097	
5817						95% KM (z) UCL	0.0959			95% KM Bootstrap t UCL	0.103	
5818						90% KM Chebyshev UCL	0.11			95% KM Chebyshev UCL	0.125	
5819						97.5% KM Chebyshev UCL	0.145			99% KM Chebyshev UCL	0.184	
5820												
5821						**Gamma GOF Tests on Detected Observations Only**						
5822						A-D Test Statistic	1.065			**Anderson-Darling GOF Test**		
5823						5% A-D Critical Value	0.743			Detected Data Not Gamma Distributed at 5% Significance Level		
5824						K-S Test Statistic	0.241			**Kolmogorov-Smirnov GOF**		
5825						5% K-S Critical Value	0.21			Detected Data Not Gamma Distributed at 5% Significance Level		
5826						**Detected Data Not Gamma Distributed at 5% Significance Level**						
5827												
5828						**Gamma Statistics on Detected Data Only**						
5829						k hat (MLE)	4.003			k star (bias corrected MLE)	3.335	

5830					Theta hat (MLE)	0.0369				Theta star (bias corrected MLE)		0.0442
5831					nu hat (MLE)	136.1				nu star (bias corrected)		113.4
5832					Mean (detects)	0.148						
5833												
5834					**Gamma ROS Statistics using Imputed Non-Detects**							
5835					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
5836					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)							
5837					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
5838					This is especially true when the sample size is small.							
5839					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
5840					Minimum	0.01				Mean		0.0541
5841					Maximum	0.36				Median		0.01
5842					SD	0.0797				CV		1.471
5843					k hat (MLE)	0.709				k star (bias corrected MLE)		0.682
5844					Theta hat (MLE)	0.0764				Theta star (bias corrected MLE)		0.0794
5845					nu hat (MLE)	76.55				nu star (bias corrected)		73.64
5846					Adjusted Level of Significance (β)	0.0456						
5847					Approximate Chi Square Value (73.64, α)	54.87				Adjusted Chi Square Value (73.64, β)		54.43
5848					95% Gamma Approximate UCL (use when n>=50)	0.0726				95% Gamma Adjusted UCL (use when n<50)		0.0732
5849												
5850					**Estimates of Gamma Parameters using KM Estimates**							
5851					Mean (KM)	0.0785				SD (KM)		0.0713
5852					Variance (KM)	0.00509				SE of Mean (KM)		0.0106
5853					k hat (KM)	1.21				k star (KM)		1.155
5854					nu hat (KM)	130.7				nu star (KM)		124.8
5855					theta hat (KM)	0.0648				theta star (KM)		0.0679
5856					80% gamma percentile (KM)	0.125				90% gamma percentile (KM)		0.174
5857					95% gamma percentile (KM)	0.223				99% gamma percentile (KM)		0.336
5858												
5859					**Gamma Kaplan-Meier (KM) Statistics**							
5860					Approximate Chi Square Value (124.79, α)	99.99				Adjusted Chi Square Value (124.79, β)		99.38
5861					5% Gamma Approximate KM-UCL (use when n>=50)	0.0979				95% Gamma Adjusted KM-UCL (use when n<50)		0.0985
5862												
5863					**Lognormal GOF Test on Detected Observations Only**							
5864					Shapiro Wilk Test Statistic	0.886				**Shapiro Wilk GOF Test**		
5865					5% Shapiro Wilk Critical Value	0.892				Detected Data Not Lognormal at 5% Significance Level		
5866					Lilliefors Test Statistic	0.227				**Lilliefors GOF Test**		
5867					5% Lilliefors Critical Value	0.207				Detected Data Not Lognormal at 5% Significance Level		
5868					**Detected Data Not Lognormal at 5% Significance Level**							
5869												
5870					**Lognormal ROS Statistics Using Imputed Non-Detects**							
5871					Mean in Original Scale	0.069				Mean in Log Scale		-3.024
5872					SD in Original Scale	0.0721				SD in Log Scale		0.779
5873					95% t UCL (assumes normality of ROS data)	0.0854				95% Percentile Bootstrap UCL		0.086
5874					95% BCA Bootstrap UCL	0.0885				95% Bootstrap t UCL		0.0898
5875					95% H-UCL (Log ROS)	0.0825						
5876												
5877					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
5878					KM Mean (logged)	-2.796				KM Geo Mean		0.061
5879					KM SD (logged)	0.632				95% Critical H Value (KM-Log)		1.975
5880					KM Standard Error of Mean (logged)	0.0945				95% H-UCL (KM -Log)		0.0884
5881					KM SD (logged)	0.632				95% Critical H Value (KM-Log)		1.975
5882					KM Standard Error of Mean (logged)	0.0945						
5883												
5884					**DL/2 Statistics**							
5885					**DL/2 Normal**					**DL/2 Log-Transformed**		
5886					Mean in Original Scale	0.117				Mean in Log Scale		-2.829
5887					SD in Original Scale	0.155				SD in Log Scale		1.112
5888					95% t UCL (Assumes normality)	0.152				95% H-Stat UCL		0.16
5889					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
5890												
5891					**Nonparametric Distribution Free UCL Statistics**							
5892					**Data do not follow a Discernible Distribution at 5% Significance Level**							
5893												
5894					**Suggested UCL to Use**							
5895					95% KM (Chebyshev) UCL	0.125						
5896												

	A	B	C	D	E	F	G	H	I	J	K	L
5897	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5898	Recommendations are based upon data size, data distribution, and skewness.											
5899	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5900	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5901												
5902	**Result (eu4_thallium_waste rock)**											
5903												
5904	**General Statistics**											
5905	Total Number of Observations					15		Number of Distinct Observations				15
5906	Number of Detects					13		Number of Non-Detects				2
5907	Number of Distinct Detects					13		Number of Distinct Non-Detects				2
5908	Minimum Detect					0.13		Minimum Non-Detect				0.042
5909	Maximum Detect					3.4		Maximum Non-Detect				0.46
5910	Variance Detects					0.767		Percent Non-Detects				13.33%
5911	Mean Detects					0.563		SD Detects				0.876
5912	Median Detects					0.28		CV Detects				1.556
5913	Skewness Detects					3.296		Kurtosis Detects				11.28
5914	Mean of Logged Detects					-1.074		SD of Logged Detects				0.863
5915												
5916	**Normal GOF Test on Detects Only**											
5917	Shapiro Wilk Test Statistic					0.493		**Shapiro Wilk GOF Test**				
5918	5% Shapiro Wilk Critical Value					0.866		Detected Data Not Normal at 5% Significance Level				
5919	Lilliefors Test Statistic					0.357		**Lilliefors GOF Test**				
5920	5% Lilliefors Critical Value					0.234		Detected Data Not Normal at 5% Significance Level				
5921	**Detected Data Not Normal at 5% Significance Level**											
5922												
5923	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
5924	KM Mean					0.506		KM Standard Error of Mean				0.215
5925	KM SD					0.798		95% KM (BCA) UCL				0.911
5926	95% KM (t) UCL					0.884		95% KM (Percentile Bootstrap) UCL				0.91
5927	95% KM (z) UCL					0.859		95% KM Bootstrap t UCL				2.307
5928	90% KM Chebyshev UCL					1.15		95% KM Chebyshev UCL				1.441
5929	97.5% KM Chebyshev UCL					1.846		99% KM Chebyshev UCL				2.641
5930												
5931	**Gamma GOF Tests on Detected Observations Only**											
5932	A-D Test Statistic					1.423		**Anderson-Darling GOF Test**				
5933	5% A-D Critical Value					0.755		Detected Data Not Gamma Distributed at 5% Significance Level				
5934	K-S Test Statistic					0.278		**Kolmogorov-Smirnov GOF**				
5935	5% K-S Critical Value					0.242		Detected Data Not Gamma Distributed at 5% Significance Level				
5936	**Detected Data Not Gamma Distributed at 5% Significance Level**											
5937												
5938	**Gamma Statistics on Detected Data Only**											
5939	k hat (MLE)					1.138		k star (bias corrected MLE)				0.926
5940	Theta hat (MLE)					0.495		Theta star (bias corrected MLE)				0.608
5941	nu hat (MLE)					29.58		nu star (bias corrected)				24.09
5942	Mean (detects)					0.563						
5943												
5944	**Gamma ROS Statistics using Imputed Non-Detects**											
5945	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
5946	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)											
5947	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
5948	This is especially true when the sample size is small.											
5949	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
5950	Minimum					0.01		Mean				0.497
5951	Maximum					3.4		Median				0.27
5952	SD					0.83		CV				1.668
5953	k hat (MLE)					0.87		k star (bias corrected MLE)				0.74
5954	Theta hat (MLE)					0.572		Theta star (bias corrected MLE)				0.672
5955	nu hat (MLE)					26.1		nu star (bias corrected)				22.21
5956	Adjusted Level of Significance (β)					0.0324						
5957	Approximate Chi Square Value (22.21, α)					12.5		Adjusted Chi Square Value (22.21, β)				11.61
5958	95% Gamma Approximate UCL (use when n>=50)					0.884		95% Gamma Adjusted UCL (use when n<50)				0.952
5959												
5960	**Estimates of Gamma Parameters using KM Estimates**											
5961	Mean (KM)					0.506		SD (KM)				0.798
5962	Variance (KM)					0.637		SE of Mean (KM)				0.215
5963	k hat (KM)					0.402		k star (KM)				0.366

5964					nu hat (KM)	12.07				nu star (KM)		10.99
5965					theta hat (KM)	1.258				theta star (KM)		1.382
5966					80% gamma percentile (KM)	0.807				90% gamma percentile (KM)		1.451
5967					95% gamma percentile (KM)	2.167				99% gamma percentile (KM)		3.986
5968												
5969					**Gamma Kaplan-Meier (KM) Statistics**							
5970					Approximate Chi Square Value (10.99, α)	4.569				Adjusted Chi Square Value (10.99, β)		4.071
5971	5% Gamma Approximate KM-UCL (use when n>=50)					1.217				95% Gamma Adjusted KM-UCL (use when n<50)		1.366
5972												
5973					**Lognormal GOF Test on Detected Observations Only**							
5974					Shapiro Wilk Test Statistic	0.851				**Shapiro Wilk GOF Test**		
5975					5% Shapiro Wilk Critical Value	0.866				Detected Data Not Lognormal at 5% Significance Level		
5976					Lilliefors Test Statistic	0.208				**Lilliefors GOF Test**		
5977					5% Lilliefors Critical Value	0.234				Detected Data appear Lognormal at 5% Significance Level		
5978					**Detected Data appear Approximate Lognormal at 5% Significance Level**							
5979												
5980					**Lognormal ROS Statistics Using Imputed Non-Detects**							
5981					Mean in Original Scale	0.507				Mean in Log Scale		-1.228
5982					SD in Original Scale	0.825				SD in Log Scale		0.939
5983					95% t UCL (assumes normality of ROS data)	0.882				95% Percentile Bootstrap UCL		0.929
5984					95% BCA Bootstrap UCL	1.093				95% Bootstrap t UCL		2.391
5985					95% H-UCL (Log ROS)	0.884						
5986												
5987					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
5988					KM Mean (logged)	-1.249				KM Geo Mean		0.287
5989					KM SD (logged)	0.948				95% Critical H Value (KM-Log)		2.663
5990					KM Standard Error of Mean (logged)	0.258				95% H-UCL (KM -Log)		0.883
5991					KM SD (logged)	0.948				95% Critical H Value (KM-Log)		2.663
5992					KM Standard Error of Mean (logged)	0.258						
5993												
5994					**DL/2 Statistics**							
5995					**DL/2 Normal**					**DL/2 Log-Transformed**		
5996					Mean in Original Scale	0.505				Mean in Log Scale		-1.287
5997					SD in Original Scale	0.826				SD in Log Scale		1.075
5998					95% t UCL (Assumes normality)	0.881				95% H-Stat UCL		1.122
5999					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
6000												
6001					**Nonparametric Distribution Free UCL Statistics**							
6002					**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**							
6003												
6004					**Suggested UCL to Use**							
6005					KM H-UCL	0.883						
6006												
6007	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
6008	Recommendations are based upon data size, data distribution, and skewness.											
6009	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
6010	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
6011												
6012												
6013	**Result (eu4_zinc_overbank)**											
6014												
6015					**General Statistics**							
6016					Total Number of Observations	54				Number of Distinct Observations		54
6017										Number of Missing Observations		0
6018					Minimum	45.1				Mean		387.7
6019					Maximum	5260				Median		173
6020					SD	751.3				Std. Error of Mean		102.2
6021					Coefficient of Variation	1.938				Skewness		5.515
6022												
6023					**Normal GOF Test**							
6024					Shapiro Wilk Test Statistic	0.422				**Shapiro Wilk GOF Test**		
6025					5% Shapiro Wilk P Value	0				Data Not Normal at 5% Significance Level		
6026					Lilliefors Test Statistic	0.324				**Lilliefors GOF Test**		
6027					5% Lilliefors Critical Value	0.12				Data Not Normal at 5% Significance Level		
6028					**Data Not Normal at 5% Significance Level**							
6029												
6030					**Assuming Normal Distribution**							

6031	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
6032				95% Student's-t UCL	558.9				95% Adjusted-CLT UCL (Chen-1995)	637.9		
6033									95% Modified-t UCL (Johnson-1978)	571.7		
6034												
6035	**Gamma GOF Test**											
6036				A-D Test Statistic	2.616		**Anderson-Darling Gamma GOF Test**					
6037				5% A-D Critical Value	0.783		Data Not Gamma Distributed at 5% Significance Level					
6038				K-S Test Statistic	0.155		**Kolmogorov-Smirnov Gamma GOF Test**					
6039				5% K-S Critical Value	0.125		Data Not Gamma Distributed at 5% Significance Level					
6040	**Data Not Gamma Distributed at 5% Significance Level**											
6041												
6042	**Gamma Statistics**											
6043				k hat (MLE)	0.937				k star (bias corrected MLE)	0.897		
6044				Theta hat (MLE)	413.8				Theta star (bias corrected MLE)	432.1		
6045				nu hat (MLE)	101.2				nu star (bias corrected)	96.91		
6046				MLE Mean (bias corrected)	387.7				MLE Sd (bias corrected)	409.3		
6047									Approximate Chi Square Value (0.05)	75.21		
6048				Adjusted Level of Significance	0.0456				Adjusted Chi Square Value	74.68		
6049												
6050	**Assuming Gamma Distribution**											
6051	95% Approximate Gamma UCL (use when n>=50))				499.6				95% Adjusted Gamma UCL (use when n<50)	503.1		
6052												
6053	**Lognormal GOF Test**											
6054				Shapiro Wilk Test Statistic	0.949		**Shapiro Wilk Lognormal GOF Test**					
6055				5% Shapiro Wilk P Value	0.0422		Data Not Lognormal at 5% Significance Level					
6056				Lilliefors Test Statistic	0.106		**Lilliefors Lognormal GOF Test**					
6057				5% Lilliefors Critical Value	0.12		Data appear Lognormal at 5% Significance Level					
6058	**Data appear Approximate Lognormal at 5% Significance Level**											
6059												
6060	**Lognormal Statistics**											
6061				Minimum of Logged Data	3.809				Mean of logged Data	5.34		
6062				Maximum of Logged Data	8.568				SD of logged Data	0.978		
6063												
6064	**Assuming Lognormal Distribution**											
6065				95% H-UCL	458.1				90% Chebyshev (MVUE) UCL	487.7		
6066				95% Chebyshev (MVUE) UCL	558.2				97.5% Chebyshev (MVUE) UCL	656		
6067				99% Chebyshev (MVUE) UCL	848.1							
6068												
6069	**Nonparametric Distribution Free UCL Statistics**											
6070	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
6071												
6072	**Nonparametric Distribution Free UCLs**											
6073				95% CLT UCL	555.9				95% Jackknife UCL	558.9		
6074				95% Standard Bootstrap UCL	554.5				95% Bootstrap-t UCL	812.5		
6075				95% Hall's Bootstrap UCL	1204				95% Percentile Bootstrap UCL	573		
6076				95% BCA Bootstrap UCL	676.8							
6077				90% Chebyshev(Mean, Sd) UCL	694.4				95% Chebyshev(Mean, Sd) UCL	833.4		
6078				97.5% Chebyshev(Mean, Sd) UCL	1026				99% Chebyshev(Mean, Sd) UCL	1405		
6079												
6080	**Suggested UCL to Use**											
6081				95% H-UCL	458.1							
6082												
6083	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
6084	Recommendations are based upon data size, data distribution, and skewness.											
6085	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
6086	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
6087												
6088	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
6089	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
6090	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
6091	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
6092												
6093												
6094	**Result (eu4_zinc_waste rock)**											
6095												
6096	**General Statistics**											
6097				Total Number of Observations	15				Number of Distinct Observations	15		

6098											Number of Missing Observations	0
6099					Minimum	23.6					Mean	7598
6100					Maximum	66800					Median	903
6101					SD	17252					Std. Error of Mean	4454
6102					Coefficient of Variation	2.271					Skewness	3.284
6103												
6104					**Normal GOF Test**							
6105					Shapiro Wilk Test Statistic	0.494					**Shapiro Wilk GOF Test**	
6106					5% Shapiro Wilk Critical Value	0.881					Data Not Normal at 5% Significance Level	
6107					Lilliefors Test Statistic	0.361					**Lilliefors GOF Test**	
6108					5% Lilliefors Critical Value	0.22					Data Not Normal at 5% Significance Level	
6109					**Data Not Normal at 5% Significance Level**							
6110												
6111					**Assuming Normal Distribution**							
6112					**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**	
6113					95% Student's-t UCL	15443					95% Adjusted-CLT UCL (Chen-1995)	18960
6114											95% Modified-t UCL (Johnson-1978)	16073
6115												
6116					**Gamma GOF Test**							
6117					A-D Test Statistic	0.979					**Anderson-Darling Gamma GOF Test**	
6118					5% A-D Critical Value	0.828					Data Not Gamma Distributed at 5% Significance Level	
6119					K-S Test Statistic	0.249					**Kolmogorov-Smirnov Gamma GOF Test**	
6120					5% K-S Critical Value	0.239					Data Not Gamma Distributed at 5% Significance Level	
6121					**Data Not Gamma Distributed at 5% Significance Level**							
6122												
6123					**Gamma Statistics**							
6124					k hat (MLE)	0.335					k star (bias corrected MLE)	0.312
6125					Theta hat (MLE)	22710					Theta star (bias corrected MLE)	24345
6126					nu hat (MLE)	10.04					nu star (bias corrected)	9.362
6127					MLE Mean (bias corrected)	7598					MLE Sd (bias corrected)	13600
6128											Approximate Chi Square Value (0.05)	3.547
6129					Adjusted Level of Significance	0.0324					Adjusted Chi Square Value	3.12
6130												
6131					**Assuming Gamma Distribution**							
6132					95% Approximate Gamma UCL (use when n>=50))	20052					95% Adjusted Gamma UCL (use when n<50)	22802
6133												
6134					**Lognormal GOF Test**							
6135					Shapiro Wilk Test Statistic	0.964					**Shapiro Wilk Lognormal GOF Test**	
6136					5% Shapiro Wilk Critical Value	0.881					Data appear Lognormal at 5% Significance Level	
6137					Lilliefors Test Statistic	0.13					**Lilliefors Lognormal GOF Test**	
6138					5% Lilliefors Critical Value	0.22					Data appear Lognormal at 5% Significance Level	
6139					**Data appear Lognormal at 5% Significance Level**							
6140												
6141					**Lognormal Statistics**							
6142					Minimum of Logged Data	3.161					Mean of logged Data	6.911
6143					Maximum of Logged Data	11.11					SD of logged Data	2.193
6144												
6145					**Assuming Lognormal Distribution**							
6146					95% H-UCL	200866					90% Chebyshev (MVUE) UCL	21849
6147					95% Chebyshev (MVUE) UCL	28380					97.5% Chebyshev (MVUE) UCL	37444
6148					99% Chebyshev (MVUE) UCL	55249						
6149												
6150					**Nonparametric Distribution Free UCL Statistics**							
6151					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
6152												
6153					**Nonparametric Distribution Free UCLs**							
6154					95% CLT UCL	14924					95% Jackknife UCL	15443
6155					95% Standard Bootstrap UCL	14607					95% Bootstrap-t UCL	31845
6156					95% Hall's Bootstrap UCL	38530					95% Percentile Bootstrap UCL	15587
6157					95% BCA Bootstrap UCL	20974						
6158					90% Chebyshev(Mean, Sd) UCL	20961					95% Chebyshev(Mean, Sd) UCL	27014
6159					97.5% Chebyshev(Mean, Sd) UCL	35415					99% Chebyshev(Mean, Sd) UCL	51919
6160												
6161					**Suggested UCL to Use**							
6162					99% Chebyshev (Mean, Sd) UCL	51919						
6163												
6164	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

	A	B	C	D	E	F	G	H	I	J	K	L
6165	Recommendations are based upon data size, data distribution, and skewness.											
6166	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
6167	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
6168												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.12/4/2019 11:15:39 AM										
5	From File	BPMD_HHRA_RoadWayWorker_SoilInput.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10												
11	**Result (eu1_antimony_roadway)**											
12												
13	**General Statistics**											
14	Total Number of Observations			35			Number of Distinct Observations					32
15							Number of Missing Observations					0
16	Minimum			0.34			Mean					11.31
17	Maximum			187			Median					1.9
18	SD			33.79			Std. Error of Mean					5.711
19	Coefficient of Variation			2.987			Skewness					4.608
20												
21	**Normal GOF Test**											
22	Shapiro Wilk Test Statistic			0.354			**Shapiro Wilk GOF Test**					
23	5% Shapiro Wilk Critical Value			0.934			Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic			0.44			**Lilliefors GOF Test**					
25	5% Lilliefors Critical Value			0.148			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			20.97			95% Adjusted-CLT UCL (Chen-1995)					25.46
31							95% Modified-t UCL (Johnson-1978)					21.71
32												
33	**Gamma GOF Test**											
34	A-D Test Statistic			4.491			**Anderson-Darling Gamma GOF Test**					
35	5% A-D Critical Value			0.829			Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic			0.303			**Kolmogorov-Smirnov Gamma GOF Test**					
37	5% K-S Critical Value			0.159			Data Not Gamma Distributed at 5% Significance Level					
38	**Data Not Gamma Distributed at 5% Significance Level**											
39												
40	**Gamma Statistics**											
41	k hat (MLE)			0.424			k star (bias corrected MLE)					0.406
42	Theta hat (MLE)			26.71			Theta star (bias corrected MLE)					27.84
43	nu hat (MLE)			29.65			nu star (bias corrected)					28.44
44	MLE Mean (bias corrected)			11.31			MLE Sd (bias corrected)					17.75
45							Approximate Chi Square Value (0.05)					17.27
46	Adjusted Level of Significance			0.0425			Adjusted Chi Square Value					16.86
47												
48	**Assuming Gamma Distribution**											
49	95% Approximate Gamma UCL (use when n>=50))			18.63			95% Adjusted Gamma UCL (use when n<50)					19.09
50												
51	**Lognormal GOF Test**											
52	Shapiro Wilk Test Statistic			0.879			**Shapiro Wilk Lognormal GOF Test**					
53	5% Shapiro Wilk Critical Value			0.934			Data Not Lognormal at 5% Significance Level					
54	Lilliefors Test Statistic			0.145			**Lilliefors Lognormal GOF Test**					
55	5% Lilliefors Critical Value			0.148			Data appear Lognormal at 5% Significance Level					
56	**Data appear Approximate Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59	Minimum of Logged Data			-1.079			Mean of logged Data					0.887
60	Maximum of Logged Data			5.231			SD of logged Data					1.435
61												
62	**Assuming Lognormal Distribution**											
63	95% H-UCL			14.36			90% Chebyshev (MVUE) UCL					12.37
64	95% Chebyshev (MVUE) UCL			15.05			97.5% Chebyshev (MVUE) UCL					18.79
65	99% Chebyshev (MVUE) UCL			26.11								
66												
67	**Nonparametric Distribution Free UCL Statistics**											

	A	B	C	D	E	F	G	H	I	J	K	L
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	20.71			95% Jackknife UCL			20.97
72					95% Standard Bootstrap UCL	20.6			95% Bootstrap-t UCL			48.9
73					95% Hall's Bootstrap UCL	50.56			95% Percentile Bootstrap UCL			21.26
74					95% BCA Bootstrap UCL	27.15						
75					90% Chebyshev(Mean, Sd) UCL	28.45			95% Chebyshev(Mean, Sd) UCL			36.21
76					97.5% Chebyshev(Mean, Sd) UCL	46.98			99% Chebyshev(Mean, Sd) UCL			68.14
77												
78	**Suggested UCL to Use**											
79					95% H-UCL	14.36						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
85												
86	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
87	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
88	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
89	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
90												
91												
92	**Result (eu1_arsenic_roadway)**											
93												
94	**General Statistics**											
95					Total Number of Observations	35			Number of Distinct Observations			34
96									Number of Missing Observations			0
97					Minimum	8.6			Mean			64.91
98					Maximum	259			Median			54.1
99					SD	47.32			Std. Error of Mean			7.999
100					Coefficient of Variation	0.729			Skewness			2.477
101												
102	**Normal GOF Test**											
103					Shapiro Wilk Test Statistic	0.775			**Shapiro Wilk GOF Test**			
104					5% Shapiro Wilk Critical Value	0.934			Data Not Normal at 5% Significance Level			
105					Lilliefors Test Statistic	0.215			**Lilliefors GOF Test**			
106					5% Lilliefors Critical Value	0.148			Data Not Normal at 5% Significance Level			
107	**Data Not Normal at 5% Significance Level**											
108												
109	**Assuming Normal Distribution**											
110	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
111					95% Student's-t UCL	78.44			95% Adjusted-CLT UCL (Chen-1995)			81.65
112									95% Modified-t UCL (Johnson-1978)			79
113												
114	**Gamma GOF Test**											
115					A-D Test Statistic	0.54			**Anderson-Darling Gamma GOF Test**			
116					5% A-D Critical Value	0.757			Detected data appear Gamma Distributed at 5% Significance Lev			
117					K-S Test Statistic	0.13			**Kolmogorov-Smirnov Gamma GOF Test**			
118					5% K-S Critical Value	0.15			Detected data appear Gamma Distributed at 5% Significance Lev			
119	**Detected data appear Gamma Distributed at 5% Significance Level**											
120												
121	**Gamma Statistics**											
122					k hat (MLE)	2.494			k star (bias corrected MLE)			2.299
123					Theta hat (MLE)	26.03			Theta star (bias corrected MLE)			28.23
124					nu hat (MLE)	174.6			nu star (bias corrected)			161
125					MLE Mean (bias corrected)	64.91			MLE Sd (bias corrected)			42.81
126									Approximate Chi Square Value (0.05)			132.6
127					Adjusted Level of Significance	0.0425			Adjusted Chi Square Value			131.4
128												
129	**Assuming Gamma Distribution**											
130					95% Approximate Gamma UCL (use when n>=50)	78.78			95% Adjusted Gamma UCL (use when n<50)			79.51
131												
132	**Lognormal GOF Test**											
133					Shapiro Wilk Test Statistic	0.95			**Shapiro Wilk Lognormal GOF Test**			
134					5% Shapiro Wilk Critical Value	0.934			Data appear Lognormal at 5% Significance Level			

135					Lilliefors Test Statistic	0.107	**Lilliefors Lognormal GOF Test**					
136					5% Lilliefors Critical Value	0.148	Data appear Lognormal at 5% Significance Level					
137	**Data appear Lognormal at 5% Significance Level**											
138												
139	**Lognormal Statistics**											
140					Minimum of Logged Data	2.152			Mean of logged Data	3.959		
141					Maximum of Logged Data	5.557			SD of logged Data	0.688		
142												
143	**Assuming Lognormal Distribution**											
144					95% H-UCL	85.18			90% Chebyshev (MVUE) UCL	90.74		
145					95% Chebyshev (MVUE) UCL	102			97.5% Chebyshev (MVUE) UCL	117.7		
146					99% Chebyshev (MVUE) UCL	148.4						
147												
148	**Nonparametric Distribution Free UCL Statistics**											
149	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
150												
151	**Nonparametric Distribution Free UCLs**											
152					95% CLT UCL	78.07			95% Jackknife UCL	78.44		
153					95% Standard Bootstrap UCL	77.51			95% Bootstrap-t UCL	84.04		
154					95% Hall's Bootstrap UCL	143.5			95% Percentile Bootstrap UCL	78.89		
155					95% BCA Bootstrap UCL	82.21						
156					90% Chebyshev(Mean, Sd) UCL	88.91			95% Chebyshev(Mean, Sd) UCL	99.78		
157					97.5% Chebyshev(Mean, Sd) UCL	114.9			99% Chebyshev(Mean, Sd) UCL	144.5		
158												
159	**Suggested UCL to Use**											
160					95% Adjusted Gamma UCL	79.51						
161												
162	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
163	Recommendations are based upon data size, data distribution, and skewness.											
164	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
165	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
166												
167												
168	**Result (eu1_cadmium_roadway)**											
169												
170	**General Statistics**											
171					Total Number of Observations	35			Number of Distinct Observations	29		
172									Number of Missing Observations	0		
173					Minimum	0.073			Mean	3.146		
174					Maximum	16.4			Median	2.2		
175					SD	3.238			Std. Error of Mean	0.547		
176					Coefficient of Variation	1.029			Skewness	2.512		
177												
178	**Normal GOF Test**											
179					Shapiro Wilk Test Statistic	0.736	**Shapiro Wilk GOF Test**					
180					5% Shapiro Wilk Critical Value	0.934	Data Not Normal at 5% Significance Level					
181					Lilliefors Test Statistic	0.269	**Lilliefors GOF Test**					
182					5% Lilliefors Critical Value	0.148	Data Not Normal at 5% Significance Level					
183	**Data Not Normal at 5% Significance Level**											
184												
185	**Assuming Normal Distribution**											
186	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
187					95% Student's-t UCL	4.072			95% Adjusted-CLT UCL (Chen-1995)	4.295		
188									95% Modified-t UCL (Johnson-1978)	4.111		
189												
190	**Gamma GOF Test**											
191					A-D Test Statistic	0.683	**Anderson-Darling Gamma GOF Test**					
192					5% A-D Critical Value	0.772	Detected data appear Gamma Distributed at 5% Significance Lev					
193					K-S Test Statistic	0.148	**Kolmogorov-Smirnov Gamma GOF Test**					
194					5% K-S Critical Value	0.152	Detected data appear Gamma Distributed at 5% Significance Lev					
195	**Detected data appear Gamma Distributed at 5% Significance Level**											
196												
197	**Gamma Statistics**											
198					k hat (MLE)	1.219			k star (bias corrected MLE)	1.133		
199					Theta hat (MLE)	2.582			Theta star (bias corrected MLE)	2.776		
200					nu hat (MLE)	85.31			nu star (bias corrected)	79.33		
201					MLE Mean (bias corrected)	3.146			MLE Sd (bias corrected)	2.956		

202									Approximate Chi Square Value (0.05)			59.81
203					Adjusted Level of Significance		0.0425			Adjusted Chi Square Value		59
204												
205						**Assuming Gamma Distribution**							
206				95% Approximate Gamma UCL (use when n>=50)			4.173			95% Adjusted Gamma UCL (use when n<50)		4.23
207												
208						**Lognormal GOF Test**							
209					Shapiro Wilk Test Statistic		0.92			**Shapiro Wilk Lognormal GOF Test**		
210					5% Shapiro Wilk Critical Value		0.934			Data Not Lognormal at 5% Significance Level		
211					Lilliefors Test Statistic		0.183			**Lilliefors Lognormal GOF Test**		
212					5% Lilliefors Critical Value		0.148			Data Not Lognormal at 5% Significance Level		
213						**Data Not Lognormal at 5% Significance Level**							
214												
215						**Lognormal Statistics**							
216					Minimum of Logged Data		-2.617			Mean of logged Data		0.683
217					Maximum of Logged Data		2.797			SD of logged Data		1.107
218												
219						**Assuming Lognormal Distribution**							
220					95% H-UCL		5.974			90% Chebyshev (MVUE) UCL		5.925
221					95% Chebyshev (MVUE) UCL		6.998			97.5% Chebyshev (MVUE) UCL		8.487
222					99% Chebyshev (MVUE) UCL		11.41					
223												
224						**Nonparametric Distribution Free UCL Statistics**							
225						**Data appear to follow a Discernible Distribution at 5% Significance Level**							
226												
227						**Nonparametric Distribution Free UCLs**							
228					95% CLT UCL		4.047			95% Jackknife UCL		4.072
229					95% Standard Bootstrap UCL		4.019			95% Bootstrap-t UCL		4.518
230					95% Hall's Bootstrap UCL		4.789			95% Percentile Bootstrap UCL		4.097
231					95% BCA Bootstrap UCL		4.325					
232					90% Chebyshev(Mean, Sd) UCL		4.788			95% Chebyshev(Mean, Sd) UCL		5.532
233					97.5% Chebyshev(Mean, Sd) UCL		6.564			99% Chebyshev(Mean, Sd) UCL		8.592
234												
235						**Suggested UCL to Use**							
236					95% Adjusted Gamma UCL		4.23					
237												
238	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
239	Recommendations are based upon data size, data distribution, and skewness.											
240	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
241	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
242												
243												
244	**Result (eu1_chromium_roadway)**											
245												
246						**General Statistics**							
247					Total Number of Observations		35			Number of Distinct Observations		25
248										Number of Missing Observations		0
249					Minimum		2.2			Mean		5
250					Maximum		15.7			Median		4.7
251					SD		2.524			Std. Error of Mean		0.427
252					Coefficient of Variation		0.505			Skewness		2.321
253												
254						**Normal GOF Test**							
255					Shapiro Wilk Test Statistic		0.801			**Shapiro Wilk GOF Test**		
256					5% Shapiro Wilk Critical Value		0.934			Data Not Normal at 5% Significance Level		
257					Lilliefors Test Statistic		0.198			**Lilliefors GOF Test**		
258					5% Lilliefors Critical Value		0.148			Data Not Normal at 5% Significance Level		
259						**Data Not Normal at 5% Significance Level**							
260												
261						**Assuming Normal Distribution**							
262						**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**	
263					95% Student's-t UCL		5.721			95% Adjusted-CLT UCL (Chen-1995)		5.88
264										95% Modified-t UCL (Johnson-1978)		5.749
265												
266						**Gamma GOF Test**							
267					A-D Test Statistic		0.71			**Anderson-Darling Gamma GOF Test**		
268					5% A-D Critical Value		0.75			Detected data appear Gamma Distributed at 5% Significance Lev		

269					K-S Test Statistic	0.138	**Kolmogorov-Smirnov Gamma GOF Test**					
270					5% K-S Critical Value	0.149	Detected data appear Gamma Distributed at 5% Significance Lev					
271	**Detected data appear Gamma Distributed at 5% Significance Level**											
272												
273	**Gamma Statistics**											
274					k hat (MLE)	5.237	k star (bias corrected MLE)	4.807				
275					Theta hat (MLE)	0.955	Theta star (bias corrected MLE)	1.04				
276					nu hat (MLE)	366.6	nu star (bias corrected)	336.5				
277					MLE Mean (bias corrected)	5	MLE Sd (bias corrected)	2.281				
278							Approximate Chi Square Value (0.05)	295				
279					Adjusted Level of Significance	0.0425	Adjusted Chi Square Value	293.1				
280												
281	**Assuming Gamma Distribution**											
282	95% Approximate Gamma UCL (use when n>=50)					5.703	95% Adjusted Gamma UCL (use when n<50)	5.739				
283												
284	**Lognormal GOF Test**											
285					Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**					
286					5% Shapiro Wilk Critical Value	0.934	Data appear Lognormal at 5% Significance Level					
287					Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**					
288					5% Lilliefors Critical Value	0.148	Data appear Lognormal at 5% Significance Level					
289	**Data appear Lognormal at 5% Significance Level**											
290												
291	**Lognormal Statistics**											
292					Minimum of Logged Data	0.788	Mean of logged Data	1.511				
293					Maximum of Logged Data	2.754	SD of logged Data	0.44				
294												
295	**Assuming Lognormal Distribution**											
296					95% H-UCL	5.758	90% Chebyshev (MVUE) UCL	6.125				
297					95% Chebyshev (MVUE) UCL	6.646	97.5% Chebyshev (MVUE) UCL	7.369				
298					99% Chebyshev (MVUE) UCL	8.788						
299												
300	**Nonparametric Distribution Free UCL Statistics**											
301	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
302												
303	**Nonparametric Distribution Free UCLs**											
304					95% CLT UCL	5.702	95% Jackknife UCL	5.721				
305					95% Standard Bootstrap UCL	5.7	95% Bootstrap-t UCL	5.996				
306					95% Hall's Bootstrap UCL	6.449	95% Percentile Bootstrap UCL	5.737				
307					95% BCA Bootstrap UCL	5.914						
308					90% Chebyshev(Mean, Sd) UCL	6.28	95% Chebyshev(Mean, Sd) UCL	6.859				
309					97.5% Chebyshev(Mean, Sd) UCL	7.664	99% Chebyshev(Mean, Sd) UCL	9.245				
310												
311	**Suggested UCL to Use**											
312					95% Adjusted Gamma UCL	5.739						
313												
314	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
315	Recommendations are based upon data size, data distribution, and skewness.											
316	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
317	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
318												
319												
320	**Result (eu1_cobalt_roadway)**											
321												
322	**General Statistics**											
323					Total Number of Observations	35	Number of Distinct Observations	31				
324							Number of Missing Observations	0				
325					Minimum	2.7	Mean	9.863				
326					Maximum	43.6	Median	7.6				
327					SD	7.72	Std. Error of Mean	1.305				
328					Coefficient of Variation	0.783	Skewness	2.833				
329												
330	**Normal GOF Test**											
331					Shapiro Wilk Test Statistic	0.713	**Shapiro Wilk GOF Test**					
332					5% Shapiro Wilk Critical Value	0.934	Data Not Normal at 5% Significance Level					
333					Lilliefors Test Statistic	0.225	**Lilliefors GOF Test**					
334					5% Lilliefors Critical Value	0.148	Data Not Normal at 5% Significance Level					
335	**Data Not Normal at 5% Significance Level**											

336												
337	**Assuming Normal Distribution**											
338	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
339					95% Student's-t UCL	12.07				95% Adjusted-CLT UCL (Chen-1995)		12.68
340										95% Modified-t UCL (Johnson-1978)		12.17
341												
342	**Gamma GOF Test**											
343					A-D Test Statistic	1.08	**Anderson-Darling Gamma GOF Test**					
344					5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level					
345					K-S Test Statistic	0.172	**Kolmogorov-Smirnov Gamma GOF Test**					
346					5% K-S Critical Value	0.15	Data Not Gamma Distributed at 5% Significance Level					
347	**Data Not Gamma Distributed at 5% Significance Level**											
348												
349	**Gamma Statistics**											
350					k hat (MLE)	2.72	k star (bias corrected MLE)					2.506
351					Theta hat (MLE)	3.626	Theta star (bias corrected MLE)					3.936
352					nu hat (MLE)	190.4	nu star (bias corrected)					175.4
353					MLE Mean (bias corrected)	9.863	MLE Sd (bias corrected)					6.23
354							Approximate Chi Square Value (0.05)					145.8
355					Adjusted Level of Significance	0.0425	Adjusted Chi Square Value					144.5
356												
357	**Assuming Gamma Distribution**											
358	95% Approximate Gamma UCL (use when n>=50))					11.87	95% Adjusted Gamma UCL (use when n<50)					11.97
359												
360	**Lognormal GOF Test**											
361					Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk Lognormal GOF Test**					
362					5% Shapiro Wilk Critical Value	0.934	Data appear Lognormal at 5% Significance Level					
363					Lilliefors Test Statistic	0.13	**Lilliefors Lognormal GOF Test**					
364					5% Lilliefors Critical Value	0.148	Data appear Lognormal at 5% Significance Level					
365	**Data appear Lognormal at 5% Significance Level**											
366												
367	**Lognormal Statistics**											
368					Minimum of Logged Data	0.993	Mean of logged Data					2.094
369					Maximum of Logged Data	3.775	SD of logged Data					0.596
370												
371	**Assuming Lognormal Distribution**											
372					95% H-UCL	11.92	90% Chebyshev (MVUE) UCL					12.73
373					95% Chebyshev (MVUE) UCL	14.13	97.5% Chebyshev (MVUE) UCL					16.08
374					99% Chebyshev (MVUE) UCL	19.9						
375												
376	**Nonparametric Distribution Free UCL Statistics**											
377	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
378												
379	**Nonparametric Distribution Free UCLs**											
380					95% CLT UCL	12.01	95% Jackknife UCL					12.07
381					95% Standard Bootstrap UCL	11.99	95% Bootstrap-t UCL					13.61
382					95% Hall's Bootstrap UCL	15.27	95% Percentile Bootstrap UCL					12.16
383					95% BCA Bootstrap UCL	13.05						
384					90% Chebyshev(Mean, Sd) UCL	13.78	95% Chebyshev(Mean, Sd) UCL					15.55
385					97.5% Chebyshev(Mean, Sd) UCL	18.01	99% Chebyshev(Mean, Sd) UCL					22.85
386												
387	**Suggested UCL to Use**											
388					95% H-UCL	11.92						
389												
390	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
391	Recommendations are based upon data size, data distribution, and skewness.											
392	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
393	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
394												
395	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
396	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
397	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
398	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
399												
400												
401	**Result (eu1_iron_roadway)**											
402												

403	**General Statistics**											
404					Total Number of Observations	35				Number of Distinct Observations		33
405										Number of Missing Observations		0
406					Minimum	16800				Mean		28146
407					Maximum	60600				Median		25900
408					SD	10194				Std. Error of Mean		1723
409					Coefficient of Variation	0.362				Skewness		1.592
410												
411	**Normal GOF Test**											
412					Shapiro Wilk Test Statistic	0.838	**Shapiro Wilk GOF Test**					
413					5% Shapiro Wilk Critical Value	0.934	Data Not Normal at 5% Significance Level					
414					Lilliefors Test Statistic	0.219	**Lilliefors GOF Test**					
415					5% Lilliefors Critical Value	0.148	Data Not Normal at 5% Significance Level					
416	**Data Not Normal at 5% Significance Level**											
417												
418	**Assuming Normal Distribution**											
419	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
420					95% Student's-t UCL	31059				95% Adjusted-CLT UCL (Chen-1995)		31475
421										95% Modified-t UCL (Johnson-1978)		31137
422												
423	**Gamma GOF Test**											
424					A-D Test Statistic	1.08	**Anderson-Darling Gamma GOF Test**					
425					5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level					
426					K-S Test Statistic	0.171	**Kolmogorov-Smirnov Gamma GOF Test**					
427					5% K-S Critical Value	0.149	Data Not Gamma Distributed at 5% Significance Level					
428	**Data Not Gamma Distributed at 5% Significance Level**											
429												
430	**Gamma Statistics**											
431					k hat (MLE)	9.682				k star (bias corrected MLE)		8.872
432					Theta hat (MLE)	2907				Theta star (bias corrected MLE)		3173
433					nu hat (MLE)	677.8				nu star (bias corrected)		621
434					MLE Mean (bias corrected)	28146				MLE Sd (bias corrected)		9450
435										Approximate Chi Square Value (0.05)		564.2
436					Adjusted Level of Significance	0.0425				Adjusted Chi Square Value		561.6
437												
438	**Assuming Gamma Distribution**											
439	95% Approximate Gamma UCL (use when n>=50))					30980				95% Adjusted Gamma UCL (use when n<50)		31121
440												
441	**Lognormal GOF Test**											
442					Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk Lognormal GOF Test**					
443					5% Shapiro Wilk Critical Value	0.934	Data Not Lognormal at 5% Significance Level					
444					Lilliefors Test Statistic	0.148	**Lilliefors Lognormal GOF Test**					
445					5% Lilliefors Critical Value	0.148	Data appear Lognormal at 5% Significance Level					
446	**Data appear Approximate Lognormal at 5% Significance Level**											
447												
448	**Lognormal Statistics**											
449					Minimum of Logged Data	9.729				Mean of logged Data		10.19
450					Maximum of Logged Data	11.01				SD of logged Data		0.316
451												
452	**Assuming Lognormal Distribution**											
453					95% H-UCL	30958				90% Chebyshev (MVUE) UCL		32597
454					95% Chebyshev (MVUE) UCL	34667				97.5% Chebyshev (MVUE) UCL		37540
455					99% Chebyshev (MVUE) UCL	43183						
456												
457	**Nonparametric Distribution Free UCL Statistics**											
458	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
459												
460	**Nonparametric Distribution Free UCLs**											
461					95% CLT UCL	30980				95% Jackknife UCL		31059
462					95% Standard Bootstrap UCL	30913				95% Bootstrap-t UCL		31940
463					95% Hall's Bootstrap UCL	31969				95% Percentile Bootstrap UCL		31054
464					95% BCA Bootstrap UCL	31666						
465					90% Chebyshev(Mean, Sd) UCL	33315				95% Chebyshev(Mean, Sd) UCL		35656
466					97.5% Chebyshev(Mean, Sd) UCL	38906				99% Chebyshev(Mean, Sd) UCL		45290
467												
468	**Suggested UCL to Use**											
469					95% Student's-t UCL	31059				or 95% Modified-t UCL		31137

470					or 95% H-UCL	30958						
471												
472	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
473	Recommendations are based upon data size, data distribution, and skewness.											
474	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
475	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
476												
477	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
478	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
479	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
480	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
481												
482												
483	**Result (eu1_lead_roadway)**											
484												
485	**General Statistics**											
486					Total Number of Observations	35			Number of Distinct Observations	33		
487									Number of Missing Observations	0		
488					Minimum	35.4			Mean	1200		
489					Maximum	10300			Median	465		
490					SD	2115			Std. Error of Mean	357.5		
491					Coefficient of Variation	1.763			Skewness	3.395		
492												
493	**Normal GOF Test**											
494					Shapiro Wilk Test Statistic	0.528			**Shapiro Wilk GOF Test**			
495					5% Shapiro Wilk Critical Value	0.934			Data Not Normal at 5% Significance Level			
496					Lilliefors Test Statistic	0.306			**Lilliefors GOF Test**			
497					5% Lilliefors Critical Value	0.148			Data Not Normal at 5% Significance Level			
498	**Data Not Normal at 5% Significance Level**											
499												
500	**Assuming Normal Distribution**											
501	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
502					95% Student's-t UCL	1804			95% Adjusted-CLT UCL (Chen-1995)	2007		
503									95% Modified-t UCL (Johnson-1978)	1839		
504												
505	**Gamma GOF Test**											
506					A-D Test Statistic	1.484			**Anderson-Darling Gamma GOF Test**			
507					5% A-D Critical Value	0.79			Data Not Gamma Distributed at 5% Significance Level			
508					K-S Test Statistic	0.186			**Kolmogorov-Smirnov Gamma GOF Test**			
509					5% K-S Critical Value	0.155			Data Not Gamma Distributed at 5% Significance Level			
510	**Data Not Gamma Distributed at 5% Significance Level**											
511												
512	**Gamma Statistics**											
513					k hat (MLE)	0.728			k star (bias corrected MLE)	0.685		
514					Theta hat (MLE)	1648			Theta star (bias corrected MLE)	1752		
515					nu hat (MLE)	50.97			nu star (bias corrected)	47.93		
516					MLE Mean (bias corrected)	1200			MLE Sd (bias corrected)	1450		
517									Approximate Chi Square Value (0.05)	33.04		
518					Adjusted Level of Significance	0.0425			Adjusted Chi Square Value	32.46		
519												
520	**Assuming Gamma Distribution**											
521	95% Approximate Gamma UCL (use when n>=50))					1741			95% Adjusted Gamma UCL (use when n<50)	1772		
522												
523	**Lognormal GOF Test**											
524					Shapiro Wilk Test Statistic	0.979			**Shapiro Wilk Lognormal GOF Test**			
525					5% Shapiro Wilk Critical Value	0.934			Data appear Lognormal at 5% Significance Level			
526					Lilliefors Test Statistic	0.0933			**Lilliefors Lognormal GOF Test**			
527					5% Lilliefors Critical Value	0.148			Data appear Lognormal at 5% Significance Level			
528	**Data appear Lognormal at 5% Significance Level**											
529												
530	**Lognormal Statistics**											
531					Minimum of Logged Data	3.567			Mean of logged Data	6.264		
532					Maximum of Logged Data	9.24			SD of logged Data	1.255		
533												
534	**Assuming Lognormal Distribution**											
535					95% H-UCL	2103			90% Chebyshev (MVUE) UCL	1977		
536					95% Chebyshev (MVUE) UCL	2369			97.5% Chebyshev (MVUE) UCL	2913		

537					99% Chebyshev (MVUE) UCL	3982						
538												
539					**Nonparametric Distribution Free UCL Statistics**							
540					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
541												
542					**Nonparametric Distribution Free UCLs**							
543					95% CLT UCL	1788				95% Jackknife UCL	1804	
544					95% Standard Bootstrap UCL	1777				95% Bootstrap-t UCL	2611	
545					95% Hall's Bootstrap UCL	4355				95% Percentile Bootstrap UCL	1886	
546					95% BCA Bootstrap UCL	2067						
547					90% Chebyshev(Mean, Sd) UCL	2272				95% Chebyshev(Mean, Sd) UCL	2758	
548					97.5% Chebyshev(Mean, Sd) UCL	3432				99% Chebyshev(Mean, Sd) UCL	4757	
549												
550					**Suggested UCL to Use**							
551					95% H-UCL	2103						
552												
553	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
554	Recommendations are based upon data size, data distribution, and skewness.											
555	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
556	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
557												
558	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
559	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
560	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
561	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
562												
563												
564	**Result (eu1_manganese_roadway)**											
565												
566					**General Statistics**							
567					Total Number of Observations	35				Number of Distinct Observations	33	
568										Number of Missing Observations	0	
569					Minimum	237				Mean	3308	
570					Maximum	27800				Median	1550	
571					SD	6095				Std. Error of Mean	1030	
572					Coefficient of Variation	1.842				Skewness	3.735	
573												
574					**Normal GOF Test**							
575					Shapiro Wilk Test Statistic	0.417				**Shapiro Wilk GOF Test**		
576					5% Shapiro Wilk Critical Value	0.934				Data Not Normal at 5% Significance Level		
577					Lilliefors Test Statistic	0.359				**Lilliefors GOF Test**		
578					5% Lilliefors Critical Value	0.148				Data Not Normal at 5% Significance Level		
579					**Data Not Normal at 5% Significance Level**							
580												
581					**Assuming Normal Distribution**							
582					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
583					95% Student's-t UCL	5050				95% Adjusted-CLT UCL (Chen-1995)	5698	
584										95% Modified-t UCL (Johnson-1978)	5159	
585												
586					**Gamma GOF Test**							
587					A-D Test Statistic	3.484				**Anderson-Darling Gamma GOF Test**		
588					5% A-D Critical Value	0.778				Data Not Gamma Distributed at 5% Significance Level		
589					K-S Test Statistic	0.248				**Kolmogorov-Smirnov Gamma GOF Test**		
590					5% K-S Critical Value	0.153				Data Not Gamma Distributed at 5% Significance Level		
591					**Data Not Gamma Distributed at 5% Significance Level**							
592												
593					**Gamma Statistics**							
594					k hat (MLE)	0.953				k star (bias corrected MLE)	0.89	
595					Theta hat (MLE)	3472				Theta star (bias corrected MLE)	3716	
596					nu hat (MLE)	66.7				nu star (bias corrected)	62.32	
597					MLE Mean (bias corrected)	3308				MLE Sd (bias corrected)	3506	
598										Approximate Chi Square Value (0.05)	45.16	
599					Adjusted Level of Significance	0.0425				Adjusted Chi Square Value	44.47	
600												
601					**Assuming Gamma Distribution**							
602					95% Approximate Gamma UCL (use when n>=50))	4565				95% Adjusted Gamma UCL (use when n<50)	4637	
603												

604	**Lognormal GOF Test**											
605					Shapiro Wilk Test Statistic	0.894	**Shapiro Wilk Lognormal GOF Test**					
606					5% Shapiro Wilk Critical Value	0.934	Data Not Lognormal at 5% Significance Level					
607					Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**					
608					5% Lilliefors Critical Value	0.148	Data Not Lognormal at 5% Significance Level					
609	**Data Not Lognormal at 5% Significance Level**											
610												
611	**Lognormal Statistics**											
612					Minimum of Logged Data	5.468	Mean of logged Data	7.495				
613					Maximum of Logged Data	10.23	SD of logged Data	0.928				
614												
615	**Assuming Lognormal Distribution**											
616					95% H-UCL	4034	90% Chebyshev (MVUE) UCL	4178				
617					95% Chebyshev (MVUE) UCL	4839	97.5% Chebyshev (MVUE) UCL	5755				
618					99% Chebyshev (MVUE) UCL	7556						
619												
620	**Nonparametric Distribution Free UCL Statistics**											
621	**Data do not follow a Discernible Distribution (0.05)**											
622												
623	**Nonparametric Distribution Free UCLs**											
624					95% CLT UCL	5003	95% Jackknife UCL	5050				
625					95% Standard Bootstrap UCL	4957	95% Bootstrap-t UCL	10859				
626					95% Hall's Bootstrap UCL	13416	95% Percentile Bootstrap UCL	5153				
627					95% BCA Bootstrap UCL	5756						
628					90% Chebyshev(Mean, Sd) UCL	6399	95% Chebyshev(Mean, Sd) UCL	7799				
629					97.5% Chebyshev(Mean, Sd) UCL	9742	99% Chebyshev(Mean, Sd) UCL	13559				
630												
631	**Suggested UCL to Use**											
632					95% Chebyshev (Mean, Sd) UCL	7799						
633												
634	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
635	Recommendations are based upon data size, data distribution, and skewness.											
636	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
637	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
638												
639												
640	**Result (eu1_thallium_roadway)**											
641												
642	**General Statistics**											
643					Total Number of Observations	35	Number of Distinct Observations	25				
644							Number of Missing Observations	0				
645					Minimum	0.055	Mean	0.634				
646					Maximum	2.8	Median	0.36				
647					SD	0.729	Std. Error of Mean	0.123				
648					Coefficient of Variation	1.15	Skewness	1.988				
649												
650	**Normal GOF Test**											
651					Shapiro Wilk Test Statistic	0.695	**Shapiro Wilk GOF Test**					
652					5% Shapiro Wilk Critical Value	0.934	Data Not Normal at 5% Significance Level					
653					Lilliefors Test Statistic	0.305	**Lilliefors GOF Test**					
654					5% Lilliefors Critical Value	0.148	Data Not Normal at 5% Significance Level					
655	**Data Not Normal at 5% Significance Level**											
656												
657	**Assuming Normal Distribution**											
658	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
659					95% Student's-t UCL	0.843	95% Adjusted-CLT UCL (Chen-1995)	0.881				
660							95% Modified-t UCL (Johnson-1978)	0.85				
661												
662	**Gamma GOF Test**											
663					A-D Test Statistic	1.353	**Anderson-Darling Gamma GOF Test**					
664					5% A-D Critical Value	0.773	Data Not Gamma Distributed at 5% Significance Level					
665					K-S Test Statistic	0.198	**Kolmogorov-Smirnov Gamma GOF Test**					
666					5% K-S Critical Value	0.153	Data Not Gamma Distributed at 5% Significance Level					
667	**Data Not Gamma Distributed at 5% Significance Level**											
668												
669	**Gamma Statistics**											
670					k hat (MLE)	1.154	k star (bias corrected MLE)	1.074				

671					Theta hat (MLE)	0.55				Theta star (bias corrected MLE)		0.59
672					nu hat (MLE)	80.77				nu star (bias corrected)		75.18
673					MLE Mean (bias corrected)	0.634				MLE Sd (bias corrected)		0.612
674										Approximate Chi Square Value (0.05)		56.21
675					Adjusted Level of Significance	0.0425				Adjusted Chi Square Value		55.43
676												
677					**Assuming Gamma Distribution**							
678				95% Approximate Gamma UCL (use when n>=50))		0.848				95% Adjusted Gamma UCL (use when n<50)		0.86
679												
680					**Lognormal GOF Test**							
681					Shapiro Wilk Test Statistic	0.959				**Shapiro Wilk Lognormal GOF Test**		
682					5% Shapiro Wilk Critical Value	0.934				Data appear Lognormal at 5% Significance Level		
683					Lilliefors Test Statistic	0.125				**Lilliefors Lognormal GOF Test**		
684					5% Lilliefors Critical Value	0.148				Data appear Lognormal at 5% Significance Level		
685					**Data appear Lognormal at 5% Significance Level**							
686												
687					**Lognormal Statistics**							
688					Minimum of Logged Data	-2.9				Mean of logged Data		-0.948
689					Maximum of Logged Data	1.03				SD of logged Data		0.983
690												
691					**Assuming Lognormal Distribution**							
692					95% H-UCL	0.948				90% Chebyshev (MVUE) UCL		0.971
693					95% Chebyshev (MVUE) UCL	1.131				97.5% Chebyshev (MVUE) UCL		1.354
694					99% Chebyshev (MVUE) UCL	1.792						
695												
696					**Nonparametric Distribution Free UCL Statistics**							
697					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
698												
699					**Nonparametric Distribution Free UCLs**							
700					95% CLT UCL	0.837				95% Jackknife UCL		0.843
701					95% Standard Bootstrap UCL	0.834				95% Bootstrap-t UCL		0.928
702					95% Hall's Bootstrap UCL	0.871				95% Percentile Bootstrap UCL		0.855
703					95% BCA Bootstrap UCL	0.892						
704					90% Chebyshev(Mean, Sd) UCL	1.004				95% Chebyshev(Mean, Sd) UCL		1.172
705					97.5% Chebyshev(Mean, Sd) UCL	1.404				99% Chebyshev(Mean, Sd) UCL		1.861
706												
707					**Suggested UCL to Use**							
708					95% H-UCL	0.948						
709												
710	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
711	Recommendations are based upon data size, data distribution, and skewness.											
712	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
713	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
714												
715	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
716	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
717	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
718	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
719												
720												
721	**Result (eu1_zinc_roadway)**											
722												
723					**General Statistics**							
724					Total Number of Observations	35				Number of Distinct Observations		35
725										Number of Missing Observations		0
726					Minimum	92.8				Mean		810.1
727					Maximum	6270				Median		622
728					SD	1039				Std. Error of Mean		175.7
729					Coefficient of Variation	1.283				Skewness		4.477
730												
731					**Normal GOF Test**							
732					Shapiro Wilk Test Statistic	0.537				**Shapiro Wilk GOF Test**		
733					5% Shapiro Wilk Critical Value	0.934				Data Not Normal at 5% Significance Level		
734					Lilliefors Test Statistic	0.245				**Lilliefors GOF Test**		
735					5% Lilliefors Critical Value	0.148				Data Not Normal at 5% Significance Level		
736					**Data Not Normal at 5% Significance Level**							
737												

738	**Assuming Normal Distribution**											
739				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
740				95% Student's-t UCL	1107			95% Adjusted-CLT UCL (Chen-1995)	1241			
741								95% Modified-t UCL (Johnson-1978)	1129			
742												
743	**Gamma GOF Test**											
744				A-D Test Statistic	0.607			**Anderson-Darling Gamma GOF Test**				
745				5% A-D Critical Value	0.77			Detected data appear Gamma Distributed at 5% Significance Lev				
746				K-S Test Statistic	0.101			**Kolmogorov-Smirnov Gamma GOF Test**				
747				5% K-S Critical Value	0.152			Detected data appear Gamma Distributed at 5% Significance Lev				
748	**Detected data appear Gamma Distributed at 5% Significance Level**											
749												
750	**Gamma Statistics**											
751				k hat (MLE)	1.328			k star (bias corrected MLE)	1.233			
752				Theta hat (MLE)	610			Theta star (bias corrected MLE)	656.9			
753				nu hat (MLE)	92.97			nu star (bias corrected)	86.33			
754				MLE Mean (bias corrected)	810.1			MLE Sd (bias corrected)	729.5			
755								Approximate Chi Square Value (0.05)	65.91			
756				Adjusted Level of Significance	0.0425			Adjusted Chi Square Value	65.07			
757												
758	**Assuming Gamma Distribution**											
759			95% Approximate Gamma UCL (use when n>=50)		1061			95% Adjusted Gamma UCL (use when n<50)	1075			
760												
761	**Lognormal GOF Test**											
762				Shapiro Wilk Test Statistic	0.955			**Shapiro Wilk Lognormal GOF Test**				
763				5% Shapiro Wilk Critical Value	0.934			Data appear Lognormal at 5% Significance Level				
764				Lilliefors Test Statistic	0.0886			**Lilliefors Lognormal GOF Test**				
765				5% Lilliefors Critical Value	0.148			Data appear Lognormal at 5% Significance Level				
766	**Data appear Lognormal at 5% Significance Level**											
767												
768	**Lognormal Statistics**											
769				Minimum of Logged Data	4.53			Mean of logged Data	6.276			
770				Maximum of Logged Data	8.744			SD of logged Data	0.923			
771												
772	**Assuming Lognormal Distribution**											
773				95% H-UCL	1184			90% Chebyshev (MVUE) UCL	1227			
774				95% Chebyshev (MVUE) UCL	1421			97.5% Chebyshev (MVUE) UCL	1689			
775				99% Chebyshev (MVUE) UCL	2216							
776												
777	**Nonparametric Distribution Free UCL Statistics**											
778	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
779												
780	**Nonparametric Distribution Free UCLs**											
781				95% CLT UCL	1099			95% Jackknife UCL	1107			
782				95% Standard Bootstrap UCL	1093			95% Bootstrap-t UCL	1460			
783				95% Hall's Bootstrap UCL	2297			95% Percentile Bootstrap UCL	1124			
784				95% BCA Bootstrap UCL	1320							
785				90% Chebyshev(Mean, Sd) UCL	1337			95% Chebyshev(Mean, Sd) UCL	1576			
786				97.5% Chebyshev(Mean, Sd) UCL	1907			99% Chebyshev(Mean, Sd) UCL	2558			
787												
788	**Suggested UCL to Use**											
789				95% Adjusted Gamma UCL	1075							
790												
791	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
792	Recommendations are based upon data size, data distribution, and skewness.											
793	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
794	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
795												
796												
797	**Result (eu2_antimony_roadway)**											
798												
799	**General Statistics**											
800				Total Number of Observations	34			Number of Distinct Observations	32			
801								Number of Missing Observations	0			
802				Minimum	0.35			Mean	1.862			
803				Maximum	10.4			Median	0.814			
804				SD	2.566			Std. Error of Mean	0.44			

805	Coefficient of Variation				1.378	Skewness						2.342
806												
807	**Normal GOF Test**											
808	Shapiro Wilk Test Statistic				0.617	**Shapiro Wilk GOF Test**						
809	5% Shapiro Wilk Critical Value				0.933	Data Not Normal at 5% Significance Level						
810	Lilliefors Test Statistic				0.307	**Lilliefors GOF Test**						
811	5% Lilliefors Critical Value				0.15	Data Not Normal at 5% Significance Level						
812	**Data Not Normal at 5% Significance Level**											
813												
814	**Assuming Normal Distribution**											
815	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
816	95% Student's-t UCL				2.607	95% Adjusted-CLT UCL (Chen-1995)						2.774
817						95% Modified-t UCL (Johnson-1978)						2.636
818												
819	**Gamma GOF Test**											
820	A-D Test Statistic				2.628	**Anderson-Darling Gamma GOF Test**						
821	5% A-D Critical Value				0.777	Data Not Gamma Distributed at 5% Significance Level						
822	K-S Test Statistic				0.227	**Kolmogorov-Smirnov Gamma GOF Test**						
823	5% K-S Critical Value				0.155	Data Not Gamma Distributed at 5% Significance Level						
824	**Data Not Gamma Distributed at 5% Significance Level**											
825												
826	**Gamma Statistics**											
827	k hat (MLE)				0.981	k star (bias corrected MLE)						0.914
828	Theta hat (MLE)				1.899	Theta star (bias corrected MLE)						2.038
829	nu hat (MLE)				66.67	nu star (bias corrected)						62.12
830	MLE Mean (bias corrected)				1.862	MLE Sd (bias corrected)						1.948
831						Approximate Chi Square Value (0.05)						45
832	Adjusted Level of Significance				0.0422	Adjusted Chi Square Value						44.27
833												
834	**Assuming Gamma Distribution**											
835	95% Approximate Gamma UCL (use when n>=50))				2.57	95% Adjusted Gamma UCL (use when n<50)						2.612
836												
837	**Lognormal GOF Test**											
838	Shapiro Wilk Test Statistic				0.868	**Shapiro Wilk Lognormal GOF Test**						
839	5% Shapiro Wilk Critical Value				0.933	Data Not Lognormal at 5% Significance Level						
840	Lilliefors Test Statistic				0.151	**Lilliefors Lognormal GOF Test**						
841	5% Lilliefors Critical Value				0.15	Data Not Lognormal at 5% Significance Level						
842	**Data Not Lognormal at 5% Significance Level**											
843												
844	**Lognormal Statistics**											
845	Minimum of Logged Data				-1.05	Mean of logged Data						0.0314
846	Maximum of Logged Data				2.342	SD of logged Data						0.996
847												
848	**Assuming Lognormal Distribution**											
849	95% H-UCL				2.589	90% Chebyshev (MVUE) UCL						2.643
850	95% Chebyshev (MVUE) UCL				3.088	97.5% Chebyshev (MVUE) UCL						3.706
851	99% Chebyshev (MVUE) UCL				4.921							
852												
853	**Nonparametric Distribution Free UCL Statistics**											
854	**Data do not follow a Discernible Distribution (0.05)**											
855												
856	**Nonparametric Distribution Free UCLs**											
857	95% CLT UCL				2.586	95% Jackknife UCL						2.607
858	95% Standard Bootstrap UCL				2.577	95% Bootstrap-t UCL						3.075
859	95% Hall's Bootstrap UCL				2.801	95% Percentile Bootstrap UCL						2.616
860	95% BCA Bootstrap UCL				2.729							
861	90% Chebyshev(Mean, Sd) UCL				3.182	95% Chebyshev(Mean, Sd) UCL						3.78
862	97.5% Chebyshev(Mean, Sd) UCL				4.61	99% Chebyshev(Mean, Sd) UCL						6.241
863												
864	**Suggested UCL to Use**											
865	95% Chebyshev (Mean, Sd) UCL				3.78							
866												
867	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
868	Recommendations are based upon data size, data distribution, and skewness.											
869	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
870	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
871												

872												
873	**Result (eu2_arsenic_roadway)**											
874												
875						**General Statistics**						
876					Total Number of Observations	34			Number of Distinct Observations	34		
877									Number of Missing Observations	0		
878					Minimum	3.19			Mean	25.93		
879					Maximum	106			Median	18.9		
880					SD	25.64			Std. Error of Mean	4.397		
881					Coefficient of Variation	0.989			Skewness	1.948		
882												
883						**Normal GOF Test**						
884					Shapiro Wilk Test Statistic	0.758			**Shapiro Wilk GOF Test**			
885					5% Shapiro Wilk Critical Value	0.933			Data Not Normal at 5% Significance Level			
886					Lilliefors Test Statistic	0.222			**Lilliefors GOF Test**			
887					5% Lilliefors Critical Value	0.15			Data Not Normal at 5% Significance Level			
888						**Data Not Normal at 5% Significance Level**						
889												
890						**Assuming Normal Distribution**						
891						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
892					95% Student's-t UCL	33.37			95% Adjusted-CLT UCL (Chen-1995)	34.73		
893									95% Modified-t UCL (Johnson-1978)	33.61		
894												
895						**Gamma GOF Test**						
896					A-D Test Statistic	0.584			**Anderson-Darling Gamma GOF Test**			
897					5% A-D Critical Value	0.768			Detected data appear Gamma Distributed at 5% Significance Lev			
898					K-S Test Statistic	0.108			**Kolmogorov-Smirnov Gamma GOF Test**			
899					5% K-S Critical Value	0.154			Detected data appear Gamma Distributed at 5% Significance Lev			
900						**Detected data appear Gamma Distributed at 5% Significance Level**						
901												
902						**Gamma Statistics**						
903					k hat (MLE)	1.408			k star (bias corrected MLE)	1.303		
904					Theta hat (MLE)	18.42			Theta star (bias corrected MLE)	19.89		
905					nu hat (MLE)	95.73			nu star (bias corrected)	88.62		
906					MLE Mean (bias corrected)	25.93			MLE Sd (bias corrected)	22.71		
907									Approximate Chi Square Value (0.05)	67.92		
908					Adjusted Level of Significance	0.0422			Adjusted Chi Square Value	67.02		
909												
910						**Assuming Gamma Distribution**						
911					95% Approximate Gamma UCL (use when n>=50)	33.83			95% Adjusted Gamma UCL (use when n<50)	34.28		
912												
913						**Lognormal GOF Test**						
914					Shapiro Wilk Test Statistic	0.974			**Shapiro Wilk Lognormal GOF Test**			
915					5% Shapiro Wilk Critical Value	0.933			Data appear Lognormal at 5% Significance Level			
916					Lilliefors Test Statistic	0.0902			**Lilliefors Lognormal GOF Test**			
917					5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level			
918						**Data appear Lognormal at 5% Significance Level**						
919												
920						**Lognormal Statistics**						
921					Minimum of Logged Data	1.16			Mean of logged Data	2.86		
922					Maximum of Logged Data	4.663			SD of logged Data	0.905		
923												
924						**Assuming Lognormal Distribution**						
925					95% H-UCL	38.02			90% Chebyshev (MVUE) UCL	39.52		
926					95% Chebyshev (MVUE) UCL	45.71			97.5% Chebyshev (MVUE) UCL	54.29		
927					99% Chebyshev (MVUE) UCL	71.15						
928												
929						**Nonparametric Distribution Free UCL Statistics**						
930						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
931												
932						**Nonparametric Distribution Free UCLs**						
933					95% CLT UCL	33.16			95% Jackknife UCL	33.37		
934					95% Standard Bootstrap UCL	33.08			95% Bootstrap-t UCL	35.83		
935					95% Hall's Bootstrap UCL	35.02			95% Percentile Bootstrap UCL	33.41		
936					95% BCA Bootstrap UCL	34.6						
937					90% Chebyshev(Mean, Sd) UCL	39.12			95% Chebyshev(Mean, Sd) UCL	45.09		
938					97.5% Chebyshev(Mean, Sd) UCL	53.39			99% Chebyshev(Mean, Sd) UCL	69.68		

939												
940	**Suggested UCL to Use**											
941					95% Adjusted Gamma UCL	34.28						
942												
943	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
944	Recommendations are based upon data size, data distribution, and skewness.											
945	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
946	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
947												
948												
949	**Result (eu2_cadmium_roadway)**											
950												
951	**General Statistics**											
952					Total Number of Observations	34			Number of Distinct Observations	33		
953									Number of Missing Observations	0		
954					Minimum	0.291			Mean	3.685		
955					Maximum	24.9			Median	1.3		
956					SD	5.615			Std. Error of Mean	0.963		
957					Coefficient of Variation	1.524			Skewness	2.518		
958												
959	**Normal GOF Test**											
960					Shapiro Wilk Test Statistic	0.618			**Shapiro Wilk GOF Test**			
961					5% Shapiro Wilk Critical Value	0.933			Data Not Normal at 5% Significance Level			
962					Lilliefors Test Statistic	0.32			**Lilliefors GOF Test**			
963					5% Lilliefors Critical Value	0.15			Data Not Normal at 5% Significance Level			
964	**Data Not Normal at 5% Significance Level**											
965												
966	**Assuming Normal Distribution**											
967					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
968					95% Student's-t UCL	5.315			95% Adjusted-CLT UCL (Chen-1995)	5.713		
969									95% Modified-t UCL (Johnson-1978)	5.384		
970												
971	**Gamma GOF Test**											
972					A-D Test Statistic	2.123			**Anderson-Darling Gamma GOF Test**			
973					5% A-D Critical Value	0.786			Data Not Gamma Distributed at 5% Significance Level			
974					K-S Test Statistic	0.206			**Kolmogorov-Smirnov Gamma GOF Test**			
975					5% K-S Critical Value	0.157			Data Not Gamma Distributed at 5% Significance Level			
976	**Data Not Gamma Distributed at 5% Significance Level**											
977												
978	**Gamma Statistics**											
979					k hat (MLE)	0.794			k star (bias corrected MLE)	0.744		
980					Theta hat (MLE)	4.641			Theta star (bias corrected MLE)	4.956		
981					nu hat (MLE)	53.99			nu star (bias corrected)	50.56		
982					MLE Mean (bias corrected)	3.685			MLE Sd (bias corrected)	4.274		
983									Approximate Chi Square Value (0.05)	35.23		
984					Adjusted Level of Significance	0.0422			Adjusted Chi Square Value	34.6		
985												
986	**Assuming Gamma Distribution**											
987					95% Approximate Gamma UCL (use when n>=50))	5.288			95% Adjusted Gamma UCL (use when n<50)	5.385		
988												
989	**Lognormal GOF Test**											
990					Shapiro Wilk Test Statistic	0.931			**Shapiro Wilk Lognormal GOF Test**			
991					5% Shapiro Wilk Critical Value	0.933			Data Not Lognormal at 5% Significance Level			
992					Lilliefors Test Statistic	0.152			**Lilliefors Lognormal GOF Test**			
993					5% Lilliefors Critical Value	0.15			Data Not Lognormal at 5% Significance Level			
994	**Data Not Lognormal at 5% Significance Level**											
995												
996	**Lognormal Statistics**											
997					Minimum of Logged Data	-1.234			Mean of logged Data	0.556		
998					Maximum of Logged Data	3.215			SD of logged Data	1.152		
999												
1000	**Assuming Lognormal Distribution**											
1001					95% H-UCL	5.75			90% Chebyshev (MVUE) UCL	5.612		
1002					95% Chebyshev (MVUE) UCL	6.666			97.5% Chebyshev (MVUE) UCL	8.13		
1003					99% Chebyshev (MVUE) UCL	11						
1004												
1005	**Nonparametric Distribution Free UCL Statistics**											

1006	**Data do not follow a Discernible Distribution (0.05)**											
1007												
1008	**Nonparametric Distribution Free UCLs**											
1009					95% CLT UCL	5.269			95% Jackknife UCL	5.315		
1010					95% Standard Bootstrap UCL	5.191			95% Bootstrap-t UCL	6.334		
1011					95% Hall's Bootstrap UCL	5.806			95% Percentile Bootstrap UCL	5.475		
1012					95% BCA Bootstrap UCL	5.785						
1013					90% Chebyshev(Mean, Sd) UCL	6.574			95% Chebyshev(Mean, Sd) UCL	7.882		
1014					97.5% Chebyshev(Mean, Sd) UCL	9.699			99% Chebyshev(Mean, Sd) UCL	13.27		
1015												
1016	**Suggested UCL to Use**											
1017					95% Chebyshev (Mean, Sd) UCL	7.882						
1018												
1019	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1020	Recommendations are based upon data size, data distribution, and skewness.											
1021	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1022	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1023												
1024												
1025	**Result (eu2_chromium_roadway)**											
1026												
1027	**General Statistics**											
1028					Total Number of Observations	34			Number of Distinct Observations	27		
1029									Number of Missing Observations	0		
1030					Minimum	2.27			Mean	4.271		
1031					Maximum	7.3			Median	3.89		
1032					SD	1.305			Std. Error of Mean	0.224		
1033					Coefficient of Variation	0.306			Skewness	0.524		
1034												
1035	**Normal GOF Test**											
1036					Shapiro Wilk Test Statistic	0.938			**Shapiro Wilk GOF Test**			
1037					5% Shapiro Wilk Critical Value	0.933			Data appear Normal at 5% Significance Level			
1038					Lilliefors Test Statistic	0.171			**Lilliefors GOF Test**			
1039					5% Lilliefors Critical Value	0.15			Data Not Normal at 5% Significance Level			
1040	**Data appear Approximate Normal at 5% Significance Level**											
1041												
1042	**Assuming Normal Distribution**											
1043					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
1044					95% Student's-t UCL	4.65			95% Adjusted-CLT UCL (Chen-1995)	4.661		
1045									95% Modified-t UCL (Johnson-1978)	4.653		
1046												
1047	**Gamma GOF Test**											
1048					A-D Test Statistic	0.551			**Anderson-Darling Gamma GOF Test**			
1049					5% A-D Critical Value	0.748			Detected data appear Gamma Distributed at 5% Significance Lev			
1050					K-S Test Statistic	0.138			**Kolmogorov-Smirnov Gamma GOF Test**			
1051					5% K-S Critical Value	0.151			Detected data appear Gamma Distributed at 5% Significance Lev			
1052	**Detected data appear Gamma Distributed at 5% Significance Level**											
1053												
1054	**Gamma Statistics**											
1055					k hat (MLE)	11.31			k star (bias corrected MLE)	10.33		
1056					Theta hat (MLE)	0.378			Theta star (bias corrected MLE)	0.413		
1057					nu hat (MLE)	768.9			nu star (bias corrected)	702.4		
1058					MLE Mean (bias corrected)	4.271			MLE Sd (bias corrected)	1.329		
1059									Approximate Chi Square Value (0.05)	641.9		
1060					Adjusted Level of Significance	0.0422			Adjusted Chi Square Value	639.1		
1061												
1062	**Assuming Gamma Distribution**											
1063					95% Approximate Gamma UCL (use when n>=50))	4.673			95% Adjusted Gamma UCL (use when n<50)	4.694		
1064												
1065	**Lognormal GOF Test**											
1066					Shapiro Wilk Test Statistic	0.962			**Shapiro Wilk Lognormal GOF Test**			
1067					5% Shapiro Wilk Critical Value	0.933			Data appear Lognormal at 5% Significance Level			
1068					Lilliefors Test Statistic	0.119			**Lilliefors Lognormal GOF Test**			
1069					5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level			
1070	**Data appear Lognormal at 5% Significance Level**											
1071												
1072	**Lognormal Statistics**											

1073					Minimum of Logged Data	0.82				Mean of logged Data		1.407
1074					Maximum of Logged Data	1.988				SD of logged Data		0.304
1075												
1076					**Assuming Lognormal Distribution**							
1077					95% H-UCL	4.706				90% Chebyshev (MVUE) UCL		4.952
1078					95% Chebyshev (MVUE) UCL	5.26				97.5% Chebyshev (MVUE) UCL		5.688
1079					99% Chebyshev (MVUE) UCL	6.529						
1080												
1081					**Nonparametric Distribution Free UCL Statistics**							
1082					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1083												
1084					**Nonparametric Distribution Free UCLs**							
1085					95% CLT UCL	4.639				95% Jackknife UCL		4.65
1086					95% Standard Bootstrap UCL	4.641				95% Bootstrap-t UCL		4.678
1087					95% Hall's Bootstrap UCL	4.655				95% Percentile Bootstrap UCL		4.635
1088					95% BCA Bootstrap UCL	4.653						
1089					90% Chebyshev(Mean, Sd) UCL	4.942				95% Chebyshev(Mean, Sd) UCL		5.247
1090					97.5% Chebyshev(Mean, Sd) UCL	5.669				99% Chebyshev(Mean, Sd) UCL		6.498
1091												
1092					**Suggested UCL to Use**							
1093					95% Student's-t UCL	4.65						
1094												
1095	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1096	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1097												
1098	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1099	Recommendations are based upon data size, data distribution, and skewness.											
1100	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1101	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1102												
1103												
1104	**Result (eu2_cobalt_roadway)**											
1105												
1106					**General Statistics**							
1107					Total Number of Observations	34				Number of Distinct Observations		29
1108										Number of Missing Observations		0
1109					Minimum	2.98				Mean		6.214
1110					Maximum	11.1				Median		6.05
1111					SD	2.022				Std. Error of Mean		0.347
1112					Coefficient of Variation	0.325				Skewness		0.628
1113												
1114					**Normal GOF Test**							
1115					Shapiro Wilk Test Statistic	0.957				**Shapiro Wilk GOF Test**		
1116					5% Shapiro Wilk Critical Value	0.933				Data appear Normal at 5% Significance Level		
1117					Lilliefors Test Statistic	0.116				**Lilliefors GOF Test**		
1118					5% Lilliefors Critical Value	0.15				Data appear Normal at 5% Significance Level		
1119					**Data appear Normal at 5% Significance Level**							
1120												
1121					**Assuming Normal Distribution**							
1122					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
1123					95% Student's-t UCL	6.801				95% Adjusted-CLT UCL (Chen-1995)		6.824
1124										95% Modified-t UCL (Johnson-1978)		6.807
1125												
1126					**Gamma GOF Test**							
1127					A-D Test Statistic	0.178				**Anderson-Darling Gamma GOF Test**		
1128					5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Lev					
1129					K-S Test Statistic	0.09				**Kolmogorov-Smirnov Gamma GOF Test**		
1130					5% K-S Critical Value	0.151	Detected data appear Gamma Distributed at 5% Significance Lev					
1131					**Detected data appear Gamma Distributed at 5% Significance Level**							
1132												
1133					**Gamma Statistics**							
1134					k hat (MLE)	9.966				k star (bias corrected MLE)		9.107
1135					Theta hat (MLE)	0.624				Theta star (bias corrected MLE)		0.682
1136					nu hat (MLE)	677.7				nu star (bias corrected)		619.3
1137					MLE Mean (bias corrected)	6.214				MLE Sd (bias corrected)		2.059
1138										Approximate Chi Square Value (0.05)		562.5
1139					Adjusted Level of Significance	0.0422				Adjusted Chi Square Value		559.9

1140												
1141						**Assuming Gamma Distribution**						
1142					95% Approximate Gamma UCL (use when n>=50))	6.841			95% Adjusted Gamma UCL (use when n<50)	6.873		
1143												
1144						**Lognormal GOF Test**						
1145					Shapiro Wilk Test Statistic	0.983	**Shapiro Wilk Lognormal GOF Test**					
1146					5% Shapiro Wilk Critical Value	0.933	Data appear Lognormal at 5% Significance Level					
1147					Lilliefors Test Statistic	0.0711	**Lilliefors Lognormal GOF Test**					
1148					5% Lilliefors Critical Value	0.15	Data appear Lognormal at 5% Significance Level					
1149					**Data appear Lognormal at 5% Significance Level**							
1150												
1151						**Lognormal Statistics**						
1152					Minimum of Logged Data	1.092			Mean of logged Data	1.776		
1153					Maximum of Logged Data	2.407			SD of logged Data	0.326		
1154												
1155						**Assuming Lognormal Distribution**						
1156					95% H-UCL	6.903			90% Chebyshev (MVUE) UCL	7.281		
1157					95% Chebyshev (MVUE) UCL	7.763			97.5% Chebyshev (MVUE) UCL	8.432		
1158					99% Chebyshev (MVUE) UCL	9.746						
1159												
1160						**Nonparametric Distribution Free UCL Statistics**						
1161					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1162												
1163						**Nonparametric Distribution Free UCLs**						
1164					95% CLT UCL	6.784			95% Jackknife UCL	6.801		
1165					95% Standard Bootstrap UCL	6.776			95% Bootstrap-t UCL	6.869		
1166					95% Hall's Bootstrap UCL	6.864			95% Percentile Bootstrap UCL	6.769		
1167					95% BCA Bootstrap UCL	6.831						
1168					90% Chebyshev(Mean, Sd) UCL	7.254			95% Chebyshev(Mean, Sd) UCL	7.725		
1169					97.5% Chebyshev(Mean, Sd) UCL	8.379			99% Chebyshev(Mean, Sd) UCL	9.664		
1170												
1171						**Suggested UCL to Use**						
1172					95% Student's-t UCL	6.801						
1173												
1174	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1175	Recommendations are based upon data size, data distribution, and skewness.											
1176	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1177	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1178												
1179												
1180	**Result (eu2_iron_roadway)**											
1181												
1182						**General Statistics**						
1183					Total Number of Observations	34			Number of Distinct Observations	33		
1184									Number of Missing Observations	0		
1185					Minimum	10400			Mean	22862		
1186					Maximum	49800			Median	22600		
1187					SD	7607			Std. Error of Mean	1305		
1188					Coefficient of Variation	0.333			Skewness	1.158		
1189												
1190						**Normal GOF Test**						
1191					Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**					
1192					5% Shapiro Wilk Critical Value	0.933	Data Not Normal at 5% Significance Level					
1193					Lilliefors Test Statistic	0.0902	**Lilliefors GOF Test**					
1194					5% Lilliefors Critical Value	0.15	Data appear Normal at 5% Significance Level					
1195					**Data appear Approximate Normal at 5% Significance Level**							
1196												
1197						**Assuming Normal Distribution**						
1198					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
1199					95% Student's-t UCL	25070			95% Adjusted-CLT UCL (Chen-1995)	25284		
1200									95% Modified-t UCL (Johnson-1978)	25113		
1201												
1202						**Gamma GOF Test**						
1203					A-D Test Statistic	0.328	**Anderson-Darling Gamma GOF Test**					
1204					5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Lev					
1205					K-S Test Statistic	0.083	**Kolmogorov-Smirnov Gamma GOF Test**					
1206					5% K-S Critical Value	0.151	Detected data appear Gamma Distributed at 5% Significance Lev					

1207	**Detected data appear Gamma Distributed at 5% Significance Level**											
1208												
1209	**Gamma Statistics**											
1210						k hat (MLE)	9.779			k star (bias corrected MLE)	8.935	
1211						Theta hat (MLE)	2338			Theta star (bias corrected MLE)	2559	
1212						nu hat (MLE)	665			nu star (bias corrected)	607.6	
1213						MLE Mean (bias corrected)	22862			MLE Sd (bias corrected)	7648	
1214										Approximate Chi Square Value (0.05)	551.4	
1215						Adjusted Level of Significance	0.0422			Adjusted Chi Square Value	548.8	
1216												
1217	**Assuming Gamma Distribution**											
1218	95% Approximate Gamma UCL (use when n>=50))					25191			95% Adjusted Gamma UCL (use when n<50)		25312	
1219												
1220	**Lognormal GOF Test**											
1221						Shapiro Wilk Test Statistic	0.971			**Shapiro Wilk Lognormal GOF Test**		
1222						5% Shapiro Wilk Critical Value	0.933			Data appear Lognormal at 5% Significance Level		
1223						Lilliefors Test Statistic	0.102			**Lilliefors Lognormal GOF Test**		
1224						5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level		
1225	**Data appear Lognormal at 5% Significance Level**											
1226												
1227	**Lognormal Statistics**											
1228						Minimum of Logged Data	9.25			Mean of logged Data	9.985	
1229						Maximum of Logged Data	10.82			SD of logged Data	0.331	
1230												
1231	**Assuming Lognormal Distribution**											
1232						95% H-UCL	25449			90% Chebyshev (MVUE) UCL	26855	
1233						95% Chebyshev (MVUE) UCL	28654			97.5% Chebyshev (MVUE) UCL	31151	
1234						99% Chebyshev (MVUE) UCL	36056					
1235												
1236	**Nonparametric Distribution Free UCL Statistics**											
1237	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1238												
1239	**Nonparametric Distribution Free UCLs**											
1240						95% CLT UCL	25008			95% Jackknife UCL	25070	
1241						95% Standard Bootstrap UCL	24966			95% Bootstrap-t UCL	25393	
1242						95% Hall's Bootstrap UCL	25723			95% Percentile Bootstrap UCL	25124	
1243						95% BCA Bootstrap UCL	25282					
1244						90% Chebyshev(Mean, Sd) UCL	26775			95% Chebyshev(Mean, Sd) UCL	28548	
1245						97.5% Chebyshev(Mean, Sd) UCL	31009			99% Chebyshev(Mean, Sd) UCL	35842	
1246												
1247	**Suggested UCL to Use**											
1248						95% Student's-t UCL	25070					
1249												
1250	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1251	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1252												
1253	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1254	Recommendations are based upon data size, data distribution, and skewness.											
1255	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1256	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1257												
1258												
1259	**Result (eu2_lead_roadway)**											
1260												
1261	**General Statistics**											
1262						Total Number of Observations	34			Number of Distinct Observations	34	
1263										Number of Missing Observations	0	
1264						Minimum	46.7			Mean	1680	
1265						Maximum	18300			Median	282	
1266						SD	3910			Std. Error of Mean	670.5	
1267						Coefficient of Variation	2.327			Skewness	3.4	
1268												
1269	**Normal GOF Test**											
1270						Shapiro Wilk Test Statistic	0.464			**Shapiro Wilk GOF Test**		
1271						5% Shapiro Wilk Critical Value	0.933			Data Not Normal at 5% Significance Level		
1272						Lilliefors Test Statistic	0.363			**Lilliefors GOF Test**		
1273						5% Lilliefors Critical Value	0.15			Data Not Normal at 5% Significance Level		

	A	B	C	D	E	F	G	H	I	J	K	L
1274	**Data Not Normal at 5% Significance Level**											
1275												
1276	**Assuming Normal Distribution**											
1277	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1278	95% Student's-t UCL				2815		95% Adjusted-CLT UCL (Chen-1995)					3201
1279							95% Modified-t UCL (Johnson-1978)					2880
1280												
1281	**Gamma GOF Test**											
1282	A-D Test Statistic				2.984		**Anderson-Darling Gamma GOF Test**					
1283	5% A-D Critical Value				0.823		Data Not Gamma Distributed at 5% Significance Level					
1284	K-S Test Statistic				0.261		**Kolmogorov-Smirnov Gamma GOF Test**					
1285	5% K-S Critical Value				0.161		Data Not Gamma Distributed at 5% Significance Level					
1286	**Data Not Gamma Distributed at 5% Significance Level**											
1287												
1288	**Gamma Statistics**											
1289	k hat (MLE)				0.447		k star (bias corrected MLE)					0.427
1290	Theta hat (MLE)				3757		Theta star (bias corrected MLE)					3932
1291	nu hat (MLE)				30.4		nu star (bias corrected)					29.05
1292	MLE Mean (bias corrected)				1680		MLE Sd (bias corrected)					2570
1293							Approximate Chi Square Value (0.05)					17.75
1294	Adjusted Level of Significance				0.0422		Adjusted Chi Square Value					17.31
1295												
1296	**Assuming Gamma Distribution**											
1297	95% Approximate Gamma UCL (use when n>=50))				2750		95% Adjusted Gamma UCL (use when n<50)					2819
1298												
1299	**Lognormal GOF Test**											
1300	Shapiro Wilk Test Statistic				0.917		**Shapiro Wilk Lognormal GOF Test**					
1301	5% Shapiro Wilk Critical Value				0.933		Data Not Lognormal at 5% Significance Level					
1302	Lilliefors Test Statistic				0.121		**Lilliefors Lognormal GOF Test**					
1303	5% Lilliefors Critical Value				0.15		Data appear Lognormal at 5% Significance Level					
1304	**Data appear Approximate Lognormal at 5% Significance Level**											
1305												
1306	**Lognormal Statistics**											
1307	Minimum of Logged Data				3.844		Mean of logged Data					5.981
1308	Maximum of Logged Data				9.815		SD of logged Data					1.553
1309												
1310	**Assuming Lognormal Distribution**											
1311	95% H-UCL				3132		90% Chebyshev (MVUE) UCL					2498
1312	95% Chebyshev (MVUE) UCL				3073		97.5% Chebyshev (MVUE) UCL					3870
1313	99% Chebyshev (MVUE) UCL				5437							
1314												
1315	**Nonparametric Distribution Free UCL Statistics**											
1316	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1317												
1318	**Nonparametric Distribution Free UCLs**											
1319	95% CLT UCL				2783		95% Jackknife UCL					2815
1320	95% Standard Bootstrap UCL				2776		95% Bootstrap-t UCL					4586
1321	95% Hall's Bootstrap UCL				6577		95% Percentile Bootstrap UCL					2853
1322	95% BCA Bootstrap UCL				3374							
1323	90% Chebyshev(Mean, Sd) UCL				3692		95% Chebyshev(Mean, Sd) UCL					4603
1324	97.5% Chebyshev(Mean, Sd) UCL				5867		99% Chebyshev(Mean, Sd) UCL					8352
1325												
1326	**Suggested UCL to Use**											
1327	95% Chebyshev (Mean, Sd) UCL				4603							
1328												
1329	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1330	Recommendations are based upon data size, data distribution, and skewness.											
1331	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1332	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1333												
1334												
1335	**Result (eu2_manganese_roadway)**											
1336												
1337	**General Statistics**											
1338	Total Number of Observations				34		Number of Distinct Observations					34
1339							Number of Missing Observations					0
1340	Minimum				477		Mean					1889

1341					Maximum	8990				Median		1170
1342					SD	1891				Std. Error of Mean		324.3
1343					Coefficient of Variation	1.001				Skewness		2.36
1344												
1345					**Normal GOF Test**							
1346					Shapiro Wilk Test Statistic	0.706			**Shapiro Wilk GOF Test**			
1347					5% Shapiro Wilk Critical Value	0.933			Data Not Normal at 5% Significance Level			
1348					Lilliefors Test Statistic	0.233			**Lilliefors GOF Test**			
1349					5% Lilliefors Critical Value	0.15			Data Not Normal at 5% Significance Level			
1350					**Data Not Normal at 5% Significance Level**							
1351												
1352					**Assuming Normal Distribution**							
1353					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
1354					95% Student's-t UCL	2438			95% Adjusted-CLT UCL (Chen-1995)			2563
1355									95% Modified-t UCL (Johnson-1978)			2460
1356												
1357					**Gamma GOF Test**							
1358					A-D Test Statistic	1.425			**Anderson-Darling Gamma GOF Test**			
1359					5% A-D Critical Value	0.764			Data Not Gamma Distributed at 5% Significance Level			
1360					K-S Test Statistic	0.151			**Kolmogorov-Smirnov Gamma GOF Test**			
1361					5% K-S Critical Value	0.153	)etected data appear Gamma Distributed at 5% Significance Lev					
1362					**Detected data follow Appr. Gamma Distribution at 5% Significance Level**							
1363												
1364					**Gamma Statistics**							
1365					k hat (MLE)	1.668			k star (bias corrected MLE)			1.541
1366					Theta hat (MLE)	1132			Theta star (bias corrected MLE)			1226
1367					nu hat (MLE)	113.5			nu star (bias corrected)			104.8
1368					MLE Mean (bias corrected)	1889			MLE Sd (bias corrected)			1522
1369									Approximate Chi Square Value (0.05)			82.16
1370					Adjusted Level of Significance	0.0422			Adjusted Chi Square Value			81.17
1371												
1372					**Assuming Gamma Distribution**							
1373					95% Approximate Gamma UCL (use when n>=50)	2409			95% Adjusted Gamma UCL (use when n<50)			2439
1374												
1375					**Lognormal GOF Test**							
1376					Shapiro Wilk Test Statistic	0.929			**Shapiro Wilk Lognormal GOF Test**			
1377					5% Shapiro Wilk Critical Value	0.933			Data Not Lognormal at 5% Significance Level			
1378					Lilliefors Test Statistic	0.143			**Lilliefors Lognormal GOF Test**			
1379					5% Lilliefors Critical Value	0.15			Data appear Lognormal at 5% Significance Level			
1380					**Data appear Approximate Lognormal at 5% Significance Level**							
1381												
1382					**Lognormal Statistics**							
1383					Minimum of Logged Data	6.168			Mean of logged Data			7.215
1384					Maximum of Logged Data	9.104			SD of logged Data			0.766
1385												
1386					**Assuming Lognormal Distribution**							
1387					95% H-UCL	2442			90% Chebyshev (MVUE) UCL			2587
1388					95% Chebyshev (MVUE) UCL	2942			97.5% Chebyshev (MVUE) UCL			3434
1389					99% Chebyshev (MVUE) UCL	4400						
1390												
1391					**Nonparametric Distribution Free UCL Statistics**							
1392					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1393												
1394					**Nonparametric Distribution Free UCLs**							
1395					95% CLT UCL	2423			95% Jackknife UCL			2438
1396					95% Standard Bootstrap UCL	2413			95% Bootstrap-t UCL			2753
1397					95% Hall's Bootstrap UCL	2829			95% Percentile Bootstrap UCL			2433
1398					95% BCA Bootstrap UCL	2537						
1399					90% Chebyshev(Mean, Sd) UCL	2862			95% Chebyshev(Mean, Sd) UCL			3303
1400					97.5% Chebyshev(Mean, Sd) UCL	3915			99% Chebyshev(Mean, Sd) UCL			5116
1401												
1402					**Suggested UCL to Use**							
1403					95% Adjusted Gamma UCL	2439						
1404												
1405					When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test							
1406					When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL							
1407												

1408	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1409	Recommendations are based upon data size, data distribution, and skewness.											
1410	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1411	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1412												
1413	**Result (eu2_thallium_roadway)**											
1414												
1415	**General Statistics**											
1416	Total Number of Observations	34					Number of Distinct Observations	22				
1417	Number of Detects	25					Number of Non-Detects	9				
1418	Number of Distinct Detects	16					Number of Distinct Non-Detects	6				
1419	Minimum Detect	0.06					Minimum Non-Detect	0.497				
1420	Maximum Detect	0.95					Maximum Non-Detect	0.506				
1421	Variance Detects	0.0286					Percent Non-Detects	26.47%				
1422	Mean Detects	0.186					SD Detects	0.169				
1423	Median Detects	0.15					CV Detects	0.907				
1424	Skewness Detects	4.09					Kurtosis Detects	18.84				
1425	Mean of Logged Detects	-1.869					SD of Logged Detects	0.557				
1426												
1427	**Normal GOF Test on Detects Only**											
1428	Shapiro Wilk Test Statistic	0.523					**Shapiro Wilk GOF Test**					
1429	5% Shapiro Wilk Critical Value	0.918					Detected Data Not Normal at 5% Significance Level					
1430	Lilliefors Test Statistic	0.301					**Lilliefors GOF Test**					
1431	5% Lilliefors Critical Value	0.173					Detected Data Not Normal at 5% Significance Level					
1432	**Detected Data Not Normal at 5% Significance Level**											
1433												
1434	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1435	KM Mean	0.178					KM Standard Error of Mean	0.0263				
1436	KM SD	0.146					95% KM (BCA) UCL	0.221				
1437	95% KM (t) UCL	0.222					95% KM (Percentile Bootstrap) UCL	0.223				
1438	95% KM (z) UCL	0.221					95% KM Bootstrap t UCL	0.268				
1439	90% KM Chebyshev UCL	0.257					95% KM Chebyshev UCL	0.292				
1440	97.5% KM Chebyshev UCL	0.342					99% KM Chebyshev UCL	0.439				
1441												
1442	**Gamma GOF Tests on Detected Observations Only**											
1443	A-D Test Statistic	1.186					**Anderson-Darling GOF Test**					
1444	5% A-D Critical Value	0.752					Detected Data Not Gamma Distributed at 5% Significance Level					
1445	K-S Test Statistic	0.195					**Kolmogorov-Smirnov GOF**					
1446	5% K-S Critical Value	0.176					Detected Data Not Gamma Distributed at 5% Significance Level					
1447	**Detected Data Not Gamma Distributed at 5% Significance Level**											
1448												
1449	**Gamma Statistics on Detected Data Only**											
1450	k hat (MLE)	2.799					k star (bias corrected MLE)	2.49				
1451	Theta hat (MLE)	0.0666					Theta star (bias corrected MLE)	0.0749				
1452	nu hat (MLE)	139.9					nu star (bias corrected)	124.5				
1453	Mean (detects)	0.186										
1454												
1455	**Gamma ROS Statistics using Imputed Non-Detects**											
1456	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1457	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)											
1458	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1459	This is especially true when the sample size is small.											
1460	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1461	Minimum	0.06					Mean	0.178				
1462	Maximum	0.95					Median	0.152				
1463	SD	0.147					CV	0.824				
1464	k hat (MLE)	3.403					k star (bias corrected MLE)	3.122				
1465	Theta hat (MLE)	0.0524					Theta star (bias corrected MLE)	0.0571				
1466	nu hat (MLE)	231.4					nu star (bias corrected)	212.3				
1467	Adjusted Level of Significance (β)	0.0422										
1468	Approximate Chi Square Value (212.32, α)	179.6					Adjusted Chi Square Value (212.32, β)	178.1				
1469	95% Gamma Approximate UCL (use when n>=50)	0.211					95% Gamma Adjusted UCL (use when n<50)	0.212				
1470												
1471	**Estimates of Gamma Parameters using KM Estimates**											
1472	Mean (KM)	0.178					SD (KM)	0.146				
1473	Variance (KM)	0.0213					SE of Mean (KM)	0.0263				
1474	k hat (KM)	1.489					k star (KM)	1.378				

1475					nu hat (KM)	101.3				nu star (KM)		93.68
1476					theta hat (KM)	0.12				theta star (KM)		0.129
1477					80% gamma percentile (KM)	0.278				90% gamma percentile (KM)		0.379
1478					95% gamma percentile (KM)	0.477				99% gamma percentile (KM)		0.701
1479												
1480					**Gamma Kaplan-Meier (KM) Statistics**							
1481					Approximate Chi Square Value (93.68, α)	72.36				Adjusted Chi Square Value (93.68, β)		71.43
1482	5% Gamma Approximate KM-UCL (use when n>=50)					0.231	95% Gamma Adjusted KM-UCL (use when n<50)					0.234
1483												
1484					**Lognormal GOF Test on Detected Observations Only**							
1485					Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**					
1486					5% Shapiro Wilk Critical Value	0.918	Detected Data Not Lognormal at 5% Significance Level					
1487					Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**					
1488					5% Lilliefors Critical Value	0.173	Detected Data appear Lognormal at 5% Significance Level					
1489					**Detected Data appear Approximate Lognormal at 5% Significance Level**							
1490												
1491					**Lognormal ROS Statistics Using Imputed Non-Detects**							
1492					Mean in Original Scale	0.177	Mean in Log Scale					-1.879
1493					SD in Original Scale	0.146	SD in Log Scale					0.486
1494					95% t UCL (assumes normality of ROS data)	0.219	95% Percentile Bootstrap UCL					0.224
1495					95% BCA Bootstrap UCL	0.248	95% Bootstrap t UCL					0.278
1496					95% H-UCL (Log ROS)	0.202						
1497												
1498					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1499					KM Mean (logged)	-1.889	KM Geo Mean					0.151
1500					KM SD (logged)	0.514	95% Critical H Value (KM-Log)					1.95
1501					KM Standard Error of Mean (logged)	0.0998	95% H-UCL (KM -Log)					0.206
1502					KM SD (logged)	0.514	95% Critical H Value (KM-Log)					1.95
1503					KM Standard Error of Mean (logged)	0.0998						
1504												
1505					**DL/2 Statistics**							
1506					**DL/2 Normal**		**DL/2 Log-Transformed**					
1507					Mean in Original Scale	0.204	Mean in Log Scale					-1.74
1508					SD in Original Scale	0.147	SD in Log Scale					0.522
1509					95% t UCL (Assumes normality)	0.246	95% H-Stat UCL					0.24
1510					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1511												
1512					**Nonparametric Distribution Free UCL Statistics**							
1513					**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**							
1514												
1515					**Suggested UCL to Use**							
1516					KM H-UCL	0.206						
1517												
1518	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1519	Recommendations are based upon data size, data distribution, and skewness.											
1520	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1521	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1522												
1523												
1524	**Result (eu2_zinc_roadway)**											
1525												
1526					**General Statistics**							
1527					Total Number of Observations	34	Number of Distinct Observations					34
1528							Number of Missing Observations					0
1529					Minimum	166	Mean					950.3
1530					Maximum	5480	Median					348
1531					SD	1381	Std. Error of Mean					236.9
1532					Coefficient of Variation	1.454	Skewness					2.357
1533												
1534					**Normal GOF Test**							
1535					Shapiro Wilk Test Statistic	0.604	**Shapiro Wilk GOF Test**					
1536					5% Shapiro Wilk Critical Value	0.933	Data Not Normal at 5% Significance Level					
1537					Lilliefors Test Statistic	0.312	**Lilliefors GOF Test**					
1538					5% Lilliefors Critical Value	0.15	Data Not Normal at 5% Significance Level					
1539					**Data Not Normal at 5% Significance Level**							
1540												
1541					**Assuming Normal Distribution**							

1542	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1543				95% Student's-t UCL		1351			95% Adjusted-CLT UCL (Chen-1995)			1442
1544									95% Modified-t UCL (Johnson-1978)			1367
1545												
1546	**Gamma GOF Test**											
1547				A-D Test Statistic		2.885	**Anderson-Darling Gamma GOF Test**					
1548				5% A-D Critical Value		0.781	Data Not Gamma Distributed at 5% Significance Level					
1549				K-S Test Statistic		0.219	**Kolmogorov-Smirnov Gamma GOF Test**					
1550				5% K-S Critical Value		0.156	Data Not Gamma Distributed at 5% Significance Level					
1551	**Data Not Gamma Distributed at 5% Significance Level**											
1552												
1553	**Gamma Statistics**											
1554				k hat (MLE)		0.893			k star (bias corrected MLE)			0.834
1555				Theta hat (MLE)		1064			Theta star (bias corrected MLE)			1140
1556				nu hat (MLE)		60.7			nu star (bias corrected)			56.68
1557				MLE Mean (bias corrected)		950.3			MLE Sd (bias corrected)			1041
1558									Approximate Chi Square Value (0.05)			40.38
1559				Adjusted Level of Significance		0.0422			Adjusted Chi Square Value			39.69
1560												
1561	**Assuming Gamma Distribution**											
1562	95% Approximate Gamma UCL (use when n>=50))					1334			95% Adjusted Gamma UCL (use when n<50)			1357
1563												
1564	**Lognormal GOF Test**											
1565				Shapiro Wilk Test Statistic		0.85	**Shapiro Wilk Lognormal GOF Test**					
1566				5% Shapiro Wilk Critical Value		0.933	Data Not Lognormal at 5% Significance Level					
1567				Lilliefors Test Statistic		0.176	**Lilliefors Lognormal GOF Test**					
1568				5% Lilliefors Critical Value		0.15	Data Not Lognormal at 5% Significance Level					
1569	**Data Not Lognormal at 5% Significance Level**											
1570												
1571	**Lognormal Statistics**											
1572				Minimum of Logged Data		5.112			Mean of logged Data			6.201
1573				Maximum of Logged Data		8.609			SD of logged Data			1.046
1574												
1575	**Assuming Lognormal Distribution**											
1576				95% H-UCL		1345			90% Chebyshev (MVUE) UCL			1356
1577				95% Chebyshev (MVUE) UCL		1593			97.5% Chebyshev (MVUE) UCL			1923
1578				99% Chebyshev (MVUE) UCL		2569						
1579												
1580	**Nonparametric Distribution Free UCL Statistics**											
1581	**Data do not follow a Discernible Distribution (0.05)**											
1582												
1583	**Nonparametric Distribution Free UCLs**											
1584				95% CLT UCL		1340			95% Jackknife UCL			1351
1585				95% Standard Bootstrap UCL		1343			95% Bootstrap-t UCL			1583
1586				95% Hall's Bootstrap UCL		1427			95% Percentile Bootstrap UCL			1379
1587				95% BCA Bootstrap UCL		1495						
1588				90% Chebyshev(Mean, Sd) UCL		1661			95% Chebyshev(Mean, Sd) UCL			1983
1589				97.5% Chebyshev(Mean, Sd) UCL		2430			99% Chebyshev(Mean, Sd) UCL			3307
1590												
1591	**Suggested UCL to Use**											
1592				95% Chebyshev (Mean, Sd) UCL		1983						
1593												
1594	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1595	Recommendations are based upon data size, data distribution, and skewness.											
1596	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1597	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1598												
1599												
1600	**Result (eu3_antimony_roadway)**											
1601												
1602	**General Statistics**											
1603				Total Number of Observations		9			Number of Distinct Observations			9
1604									Number of Missing Observations			0
1605				Minimum		0.36			Mean			1.261
1606				Maximum		2.5			Median			0.89
1607				SD		0.761			Std. Error of Mean			0.254
1608				Coefficient of Variation		0.603			Skewness			0.635

1609												
1610	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1611	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1612	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1613	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1614												
1615	**Normal GOF Test**											
1616	Shapiro Wilk Test Statistic					0.898	**Shapiro Wilk GOF Test**					
1617	5% Shapiro Wilk Critical Value					0.829	Data appear Normal at 5% Significance Level					
1618	Lilliefors Test Statistic					0.243	**Lilliefors GOF Test**					
1619	5% Lilliefors Critical Value					0.274	Data appear Normal at 5% Significance Level					
1620	**Data appear Normal at 5% Significance Level**											
1621												
1622	**Assuming Normal Distribution**											
1623	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1624	95% Student's-t UCL					1.733	95% Adjusted-CLT UCL (Chen-1995)					1.736
1625							95% Modified-t UCL (Johnson-1978)					1.742
1626												
1627	**Gamma GOF Test**											
1628	A-D Test Statistic					0.33	**Anderson-Darling Gamma GOF Test**					
1629	5% A-D Critical Value					0.727	Detected data appear Gamma Distributed at 5% Significance Lev					
1630	K-S Test Statistic					0.202	**Kolmogorov-Smirnov Gamma GOF Test**					
1631	5% K-S Critical Value					0.281	Detected data appear Gamma Distributed at 5% Significance Lev					
1632	**Detected data appear Gamma Distributed at 5% Significance Level**											
1633												
1634	**Gamma Statistics**											
1635	k hat (MLE)					3.035	k star (bias corrected MLE)					2.098
1636	Theta hat (MLE)					0.415	Theta star (bias corrected MLE)					0.601
1637	nu hat (MLE)					54.64	nu star (bias corrected)					37.76
1638	MLE Mean (bias corrected)					1.261	MLE Sd (bias corrected)					0.871
1639							Approximate Chi Square Value (0.05)					24.69
1640	Adjusted Level of Significance					0.0231	Adjusted Chi Square Value					22.48
1641												
1642	**Assuming Gamma Distribution**											
1643	95% Approximate Gamma UCL (use when n>=50))					1.929	95% Adjusted Gamma UCL (use when n<50)					2.118
1644												
1645	**Lognormal GOF Test**											
1646	Shapiro Wilk Test Statistic					0.948	**Shapiro Wilk Lognormal GOF Test**					
1647	5% Shapiro Wilk Critical Value					0.829	Data appear Lognormal at 5% Significance Level					
1648	Lilliefors Test Statistic					0.163	**Lilliefors Lognormal GOF Test**					
1649	5% Lilliefors Critical Value					0.274	Data appear Lognormal at 5% Significance Level					
1650	**Data appear Lognormal at 5% Significance Level**											
1651												
1652	**Lognormal Statistics**											
1653	Minimum of Logged Data					-1.022	Mean of logged Data					0.0583
1654	Maximum of Logged Data					0.916	SD of logged Data					0.642
1655												
1656	**Assuming Lognormal Distribution**											
1657	95% H-UCL					2.307	90% Chebyshev (MVUE) UCL					2.101
1658	95% Chebyshev (MVUE) UCL					2.478	97.5% Chebyshev (MVUE) UCL					3.001
1659	99% Chebyshev (MVUE) UCL					4.029						
1660												
1661	**Nonparametric Distribution Free UCL Statistics**											
1662	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1663												
1664	**Nonparametric Distribution Free UCLs**											
1665	95% CLT UCL					1.678	95% Jackknife UCL					1.733
1666	95% Standard Bootstrap UCL					1.652	95% Bootstrap-t UCL					1.883
1667	95% Hall's Bootstrap UCL					1.647	95% Percentile Bootstrap UCL					1.652
1668	95% BCA Bootstrap UCL					1.694						
1669	90% Chebyshev(Mean, Sd) UCL					2.022	95% Chebyshev(Mean, Sd) UCL					2.366
1670	97.5% Chebyshev(Mean, Sd) UCL					2.845	99% Chebyshev(Mean, Sd) UCL					3.784
1671												
1672	**Suggested UCL to Use**											
1673	95% Student's-t UCL					1.733						
1674												
1675	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

	A	B	C	D	E	F	G	H	I	J	K	L
1676	Recommendations are based upon data size, data distribution, and skewness.											
1677	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1678	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1679												
1680												
1681	**Result (eu3_arsenic_roadway)**											
1682												
1683	**General Statistics**											
1684					Total Number of Observations	9			Number of Distinct Observations	9		
1685									Number of Missing Observations	0		
1686					Minimum	7.2			Mean	16.33		
1687					Maximum	21			Median	18.7		
1688					SD	4.623			Std. Error of Mean	1.541		
1689					Coefficient of Variation	0.283			Skewness	-1.064		
1690												
1691	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1692	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1693	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1694	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1695												
1696	**Normal GOF Test**											
1697					Shapiro Wilk Test Statistic	0.867			**Shapiro Wilk GOF Test**			
1698					5% Shapiro Wilk Critical Value	0.829			Data appear Normal at 5% Significance Level			
1699					Lilliefors Test Statistic	0.251			**Lilliefors GOF Test**			
1700					5% Lilliefors Critical Value	0.274			Data appear Normal at 5% Significance Level			
1701	**Data appear Normal at 5% Significance Level**											
1702												
1703	**Assuming Normal Distribution**											
1704	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
1705					95% Student's-t UCL	19.2			95% Adjusted-CLT UCL (Chen-1995)	18.28		
1706									95% Modified-t UCL (Johnson-1978)	19.11		
1707												
1708	**Gamma GOF Test**											
1709					A-D Test Statistic	0.716			**Anderson-Darling Gamma GOF Test**			
1710					5% A-D Critical Value	0.722			Detected data appear Gamma Distributed at 5% Significance Lev			
1711					K-S Test Statistic	0.267			**Kolmogorov-Smirnov Gamma GOF Test**			
1712					5% K-S Critical Value	0.279			Detected data appear Gamma Distributed at 5% Significance Lev			
1713	**Detected data appear Gamma Distributed at 5% Significance Level**											
1714												
1715	**Gamma Statistics**											
1716					k hat (MLE)	10.87			k star (bias corrected MLE)	7.323		
1717					Theta hat (MLE)	1.502			Theta star (bias corrected MLE)	2.23		
1718					nu hat (MLE)	195.7			nu star (bias corrected)	131.8		
1719					MLE Mean (bias corrected)	16.33			MLE Sd (bias corrected)	6.036		
1720									Approximate Chi Square Value (0.05)	106.3		
1721					Adjusted Level of Significance	0.0231			Adjusted Chi Square Value	101.5		
1722												
1723	**Assuming Gamma Distribution**											
1724					95% Approximate Gamma UCL (use when n>=50))	20.26			95% Adjusted Gamma UCL (use when n<50)	21.22		
1725												
1726	**Lognormal GOF Test**											
1727					Shapiro Wilk Test Statistic	0.806			**Shapiro Wilk Lognormal GOF Test**			
1728					5% Shapiro Wilk Critical Value	0.829			Data Not Lognormal at 5% Significance Level			
1729					Lilliefors Test Statistic	0.255			**Lilliefors Lognormal GOF Test**			
1730					5% Lilliefors Critical Value	0.274			Data appear Lognormal at 5% Significance Level			
1731	**Data appear Approximate Lognormal at 5% Significance Level**											
1732												
1733	**Lognormal Statistics**											
1734					Minimum of Logged Data	1.974			Mean of logged Data	2.747		
1735					Maximum of Logged Data	3.045			SD of logged Data	0.348		
1736												
1737	**Assuming Lognormal Distribution**											
1738					95% H-UCL	21.37			90% Chebyshev (MVUE) UCL	22.22		
1739					95% Chebyshev (MVUE) UCL	24.83			97.5% Chebyshev (MVUE) UCL	28.46		
1740					99% Chebyshev (MVUE) UCL	35.59						
1741												
1742	**Nonparametric Distribution Free UCL Statistics**											

1743	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1744												
1745	**Nonparametric Distribution Free UCLs**											
1746						95% CLT UCL	18.87			95% Jackknife UCL	19.2	
1747						95% Standard Bootstrap UCL	18.76			95% Bootstrap-t UCL	18.59	
1748						95% Hall's Bootstrap UCL	18.33			95% Percentile Bootstrap UCL	18.59	
1749						95% BCA Bootstrap UCL	18.36					
1750						90% Chebyshev(Mean, Sd) UCL	20.96			95% Chebyshev(Mean, Sd) UCL	23.05	
1751						97.5% Chebyshev(Mean, Sd) UCL	25.96			99% Chebyshev(Mean, Sd) UCL	31.67	
1752												
1753	**Suggested UCL to Use**											
1754						95% Student's-t UCL	19.2					
1755												
1756	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1757	Recommendations are based upon data size, data distribution, and skewness.											
1758	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1759	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1760												
1761	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
1762	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
1763												
1764												
1765	**Result (eu3_cadmium_roadway)**											
1766												
1767	**General Statistics**											
1768						Total Number of Observations	9			Number of Distinct Observations	9	
1769										Number of Missing Observations	0	
1770						Minimum	0.36			Mean	1.188	
1771						Maximum	2.1			Median	0.91	
1772						SD	0.638			Std. Error of Mean	0.213	
1773						Coefficient of Variation	0.537			Skewness	0.402	
1774												
1775	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1776	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1777	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1778	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1779												
1780	**Normal GOF Test**											
1781						Shapiro Wilk Test Statistic	0.902			**Shapiro Wilk GOF Test**		
1782						5% Shapiro Wilk Critical Value	0.829			Data appear Normal at 5% Significance Level		
1783						Lilliefors Test Statistic	0.224			**Lilliefors GOF Test**		
1784						5% Lilliefors Critical Value	0.274			Data appear Normal at 5% Significance Level		
1785	**Data appear Normal at 5% Significance Level**											
1786												
1787	**Assuming Normal Distribution**											
1788						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
1789						95% Student's-t UCL	1.583			95% Adjusted-CLT UCL (Chen-1995)	1.568	
1790										95% Modified-t UCL (Johnson-1978)	1.588	
1791												
1792	**Gamma GOF Test**											
1793						A-D Test Statistic	0.335			**Anderson-Darling Gamma GOF Test**		
1794						5% A-D Critical Value	0.726			Detected data appear Gamma Distributed at 5% Significance Lev		
1795						K-S Test Statistic	0.18			**Kolmogorov-Smirnov Gamma GOF Test**		
1796						5% K-S Critical Value	0.281			Detected data appear Gamma Distributed at 5% Significance Lev		
1797	**Detected data appear Gamma Distributed at 5% Significance Level**											
1798												
1799	**Gamma Statistics**											
1800						k hat (MLE)	3.634			k star (bias corrected MLE)	2.497	
1801						Theta hat (MLE)	0.327			Theta star (bias corrected MLE)	0.476	
1802						nu hat (MLE)	65.41			nu star (bias corrected)	44.94	
1803						MLE Mean (bias corrected)	1.188			MLE Sd (bias corrected)	0.752	
1804										Approximate Chi Square Value (0.05)	30.56	
1805						Adjusted Level of Significance	0.0231			Adjusted Chi Square Value	28.08	
1806												
1807	**Assuming Gamma Distribution**											
1808	95% Approximate Gamma UCL (use when n>=50))						1.747			95% Adjusted Gamma UCL (use when n<50)	1.901	
1809												

1810	**Lognormal GOF Test**											
1811					Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk Lognormal GOF Test**					
1812					5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level					
1813					Lilliefors Test Statistic	0.161	**Lilliefors Lognormal GOF Test**					
1814					5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level					
1815	**Data appear Lognormal at 5% Significance Level**											
1816												
1817	**Lognormal Statistics**											
1818					Minimum of Logged Data	-1.022	Mean of logged Data	0.0282				
1819					Maximum of Logged Data	0.742	SD of logged Data	0.591				
1820												
1821	**Assuming Lognormal Distribution**											
1822					95% H-UCL	2.029	90% Chebyshev (MVUE) UCL	1.92				
1823					95% Chebyshev (MVUE) UCL	2.247	97.5% Chebyshev (MVUE) UCL	2.701				
1824					99% Chebyshev (MVUE) UCL	3.592						
1825												
1826	**Nonparametric Distribution Free UCL Statistics**											
1827	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1828												
1829	**Nonparametric Distribution Free UCLs**											
1830					95% CLT UCL	1.538	95% Jackknife UCL	1.583				
1831					95% Standard Bootstrap UCL	1.52	95% Bootstrap-t UCL	1.627				
1832					95% Hall's Bootstrap UCL	1.48	95% Percentile Bootstrap UCL	1.508				
1833					95% BCA Bootstrap UCL	1.562						
1834					90% Chebyshev(Mean, Sd) UCL	1.826	95% Chebyshev(Mean, Sd) UCL	2.115				
1835					97.5% Chebyshev(Mean, Sd) UCL	2.516	99% Chebyshev(Mean, Sd) UCL	3.304				
1836												
1837	**Suggested UCL to Use**											
1838					95% Student's-t UCL	1.583						
1839												
1840	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1841	Recommendations are based upon data size, data distribution, and skewness.											
1842	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1843	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1844												
1845												
1846	**Result (eu3_chromium_roadway)**											
1847												
1848	**General Statistics**											
1849					Total Number of Observations	9	Number of Distinct Observations	8				
1850							Number of Missing Observations	0				
1851					Minimum	4.1	Mean	6.133				
1852					Maximum	8.4	Median	6.4				
1853					SD	1.248	Std. Error of Mean	0.416				
1854					Coefficient of Variation	0.203	Skewness	0.222				
1855												
1856	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1857	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1858	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1859	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1860												
1861	**Normal GOF Test**											
1862					Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk GOF Test**					
1863					5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level					
1864					Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**					
1865					5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level					
1866	**Data appear Normal at 5% Significance Level**											
1867												
1868	**Assuming Normal Distribution**											
1869	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1870					95% Student's-t UCL	6.907	95% Adjusted-CLT UCL (Chen-1995)	6.85				
1871							95% Modified-t UCL (Johnson-1978)	6.912				
1872												
1873	**Gamma GOF Test**											
1874					A-D Test Statistic	0.212	**Anderson-Darling Gamma GOF Test**					
1875					5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Lev					
1876					K-S Test Statistic	0.168	**Kolmogorov-Smirnov Gamma GOF Test**					

1877				5% K-S Critical Value	0.279	)etected data appear Gamma Distributed at 5% Significance Lev						
1878	**Detected data appear Gamma Distributed at 5% Significance Level**											
1879												
1880	**Gamma Statistics**											
1881				k hat (MLE)	26.66			k star (bias corrected MLE)	17.85			
1882				Theta hat (MLE)	0.23			Theta star (bias corrected MLE)	0.344			
1883				nu hat (MLE)	479.8			nu star (bias corrected)	321.2			
1884				MLE Mean (bias corrected)	6.133			MLE Sd (bias corrected)	1.452			
1885								Approximate Chi Square Value (0.05)	280.7			
1886				Adjusted Level of Significance	0.0231			Adjusted Chi Square Value	272.7			
1887												
1888	**Assuming Gamma Distribution**											
1889	95% Approximate Gamma UCL (use when n>=50))				7.019			95% Adjusted Gamma UCL (use when n<50)	7.225			
1890												
1891	**Lognormal GOF Test**											
1892				Shapiro Wilk Test Statistic	0.973			**Shapiro Wilk Lognormal GOF Test**				
1893				5% Shapiro Wilk Critical Value	0.829			Data appear Lognormal at 5% Significance Level				
1894				Lilliefors Test Statistic	0.172			**Lilliefors Lognormal GOF Test**				
1895				5% Lilliefors Critical Value	0.274			Data appear Lognormal at 5% Significance Level				
1896	**Data appear Lognormal at 5% Significance Level**											
1897												
1898	**Lognormal Statistics**											
1899				Minimum of Logged Data	1.411			Mean of logged Data	1.795			
1900				Maximum of Logged Data	2.128			SD of logged Data	0.208			
1901												
1902	**Assuming Lognormal Distribution**											
1903				95% H-UCL	7.081			90% Chebyshev (MVUE) UCL	7.416			
1904				95% Chebyshev (MVUE) UCL	7.996			97.5% Chebyshev (MVUE) UCL	8.801			
1905				99% Chebyshev (MVUE) UCL	10.38							
1906												
1907	**Nonparametric Distribution Free UCL Statistics**											
1908	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1909												
1910	**Nonparametric Distribution Free UCLs**											
1911				95% CLT UCL	6.818			95% Jackknife UCL	6.907			
1912				95% Standard Bootstrap UCL	6.764			95% Bootstrap-t UCL	6.945			
1913				95% Hall's Bootstrap UCL	6.958			95% Percentile Bootstrap UCL	6.756			
1914				95% BCA Bootstrap UCL	6.778							
1915				90% Chebyshev(Mean, Sd) UCL	7.381			95% Chebyshev(Mean, Sd) UCL	7.947			
1916				97.5% Chebyshev(Mean, Sd) UCL	8.731			99% Chebyshev(Mean, Sd) UCL	10.27			
1917												
1918	**Suggested UCL to Use**											
1919				95% Student's-t UCL	6.907							
1920												
1921	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1922	Recommendations are based upon data size, data distribution, and skewness.											
1923	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1924	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1925												
1926												
1927	**Result (eu3_cobalt_roadway)**											
1928												
1929	**General Statistics**											
1930				Total Number of Observations	9			Number of Distinct Observations	9			
1931								Number of Missing Observations	0			
1932				Minimum	4.5			Mean	6.789			
1933				Maximum	11.7			Median	6.4			
1934				SD	2.101			Std. Error of Mean	0.7			
1935				Coefficient of Variation	0.31			Skewness	1.719			
1936												
1937	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
1938	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
1939	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
1940	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
1941												
1942	**Normal GOF Test**											
1943				Shapiro Wilk Test Statistic	0.844			**Shapiro Wilk GOF Test**				

1944	5% Shapiro Wilk Critical Value					0.829	Data appear Normal at 5% Significance Level					
1945	Lilliefors Test Statistic					0.221	**Lilliefors GOF Test**					
1946	5% Lilliefors Critical Value					0.274	Data appear Normal at 5% Significance Level					
1947	**Data appear Normal at 5% Significance Level**											
1948												
1949	**Assuming Normal Distribution**											
1950	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1951	95% Student's-t UCL					8.091	95% Adjusted-CLT UCL (Chen-1995)					8.37
1952							95% Modified-t UCL (Johnson-1978)					8.158
1953												
1954	**Gamma GOF Test**											
1955	A-D Test Statistic					0.382	**Anderson-Darling Gamma GOF Test**					
1956	5% A-D Critical Value					0.721	Detected data appear Gamma Distributed at 5% Significance Lev					
1957	K-S Test Statistic					0.176	**Kolmogorov-Smirnov Gamma GOF Test**					
1958	5% K-S Critical Value					0.279	Detected data appear Gamma Distributed at 5% Significance Lev					
1959	**Detected data appear Gamma Distributed at 5% Significance Level**											
1960												
1961	**Gamma Statistics**											
1962	k hat (MLE)					13.89	k star (bias corrected MLE)					9.337
1963	Theta hat (MLE)					0.489	Theta star (bias corrected MLE)					0.727
1964	nu hat (MLE)					250.1	nu star (bias corrected)					168.1
1965	MLE Mean (bias corrected)					6.789	MLE Sd (bias corrected)					2.222
1966							Approximate Chi Square Value (0.05)					139.1
1967	Adjusted Level of Significance					0.0231	Adjusted Chi Square Value					133.5
1968												
1969	**Assuming Gamma Distribution**											
1970	95% Approximate Gamma UCL (use when n>=50))					8.203	95% Adjusted Gamma UCL (use when n<50)					8.545
1971												
1972	**Lognormal GOF Test**											
1973	Shapiro Wilk Test Statistic					0.935	**Shapiro Wilk Lognormal GOF Test**					
1974	5% Shapiro Wilk Critical Value					0.829	Data appear Lognormal at 5% Significance Level					
1975	Lilliefors Test Statistic					0.168	**Lilliefors Lognormal GOF Test**					
1976	5% Lilliefors Critical Value					0.274	Data appear Lognormal at 5% Significance Level					
1977	**Data appear Lognormal at 5% Significance Level**											
1978												
1979	**Lognormal Statistics**											
1980	Minimum of Logged Data					1.504	Mean of logged Data					1.879
1981	Maximum of Logged Data					2.46	SD of logged Data					0.277
1982												
1983	**Assuming Lognormal Distribution**											
1984	95% H-UCL					8.263	90% Chebyshev (MVUE) UCL					8.658
1985	95% Chebyshev (MVUE) UCL					9.512	97.5% Chebyshev (MVUE) UCL					10.7
1986	99% Chebyshev (MVUE) UCL					13.03						
1987												
1988	**Nonparametric Distribution Free UCL Statistics**											
1989	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1990												
1991	**Nonparametric Distribution Free UCLs**											
1992	95% CLT UCL					7.941	95% Jackknife UCL					8.091
1993	95% Standard Bootstrap UCL					7.88	95% Bootstrap-t UCL					8.846
1994	95% Hall's Bootstrap UCL					13.98	95% Percentile Bootstrap UCL					7.967
1995	95% BCA Bootstrap UCL					8.278						
1996	90% Chebyshev(Mean, Sd) UCL					8.89	95% Chebyshev(Mean, Sd) UCL					9.842
1997	97.5% Chebyshev(Mean, Sd) UCL					11.16	99% Chebyshev(Mean, Sd) UCL					13.76
1998												
1999	**Suggested UCL to Use**											
2000	95% Student's-t UCL					8.091						
2001												
2002	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2003	Recommendations are based upon data size, data distribution, and skewness.											
2004	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2005	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2006												
2007												
2008	**Result (eu3_iron_roadway)**											
2009												
2010	**General Statistics**											

2011					Total Number of Observations	9					Number of Distinct Observations	9	
2012											Number of Missing Observations	0	
2013					Minimum	19900					Mean	49711	
2014					Maximum	175000					Median	30000	
2015					SD	49499					Std. Error of Mean	16500	
2016					Coefficient of Variation	0.996					Skewness	2.519	
2017													
2018	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**												
2019	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**												
2020	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**												
2021	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**												
2022													
2023	**Normal GOF Test**												
2024					Shapiro Wilk Test Statistic	0.611	**Shapiro Wilk GOF Test**						
2025					5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level						
2026					Lilliefors Test Statistic	0.382	**Lilliefors GOF Test**						
2027					5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level						
2028	**Data Not Normal at 5% Significance Level**												
2029													
2030	**Assuming Normal Distribution**												
2031					**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**		
2032					95% Student's-t UCL	80393					95% Adjusted-CLT UCL (Chen-1995)	91653	
2033											95% Modified-t UCL (Johnson-1978)	82702	
2034													
2035	**Gamma GOF Test**												
2036					A-D Test Statistic	1.156	**Anderson-Darling Gamma GOF Test**						
2037					5% A-D Critical Value	0.73	Data Not Gamma Distributed at 5% Significance Level						
2038					K-S Test Statistic	0.347	**Kolmogorov-Smirnov Gamma GOF Test**						
2039					5% K-S Critical Value	0.282	Data Not Gamma Distributed at 5% Significance Level						
2040	**Data Not Gamma Distributed at 5% Significance Level**												
2041													
2042	**Gamma Statistics**												
2043					k hat (MLE)	2.041					k star (bias corrected MLE)	1.435	
2044					Theta hat (MLE)	24355					Theta star (bias corrected MLE)	34646	
2045					nu hat (MLE)	36.74					nu star (bias corrected)	25.83	
2046					MLE Mean (bias corrected)	49711					MLE Sd (bias corrected)	41501	
2047											Approximate Chi Square Value (0.05)	15.25	
2048					Adjusted Level of Significance	0.0231					Adjusted Chi Square Value	13.56	
2049													
2050	**Assuming Gamma Distribution**												
2051					95% Approximate Gamma UCL (use when n>=50))	84211					95% Adjusted Gamma UCL (use when n<50)	94678	
2052													
2053	**Lognormal GOF Test**												
2054					Shapiro Wilk Test Statistic	0.797	**Shapiro Wilk Lognormal GOF Test**						
2055					5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level						
2056					Lilliefors Test Statistic	0.302	**Lilliefors Lognormal GOF Test**						
2057					5% Lilliefors Critical Value	0.274	Data Not Lognormal at 5% Significance Level						
2058	**Data Not Lognormal at 5% Significance Level**												
2059													
2060	**Lognormal Statistics**												
2061					Minimum of Logged Data	9.898					Mean of logged Data	10.55	
2062					Maximum of Logged Data	12.07					SD of logged Data	0.677	
2063													
2064	**Assuming Lognormal Distribution**												
2065					95% H-UCL	89024					90% Chebyshev (MVUE) UCL	78889	
2066					95% Chebyshev (MVUE) UCL	93514					97.5% Chebyshev (MVUE) UCL	113815	
2067					99% Chebyshev (MVUE) UCL	153690							
2068													
2069	**Nonparametric Distribution Free UCL Statistics**												
2070	**Data do not follow a Discernible Distribution (0.05)**												
2071													
2072	**Nonparametric Distribution Free UCLs**												
2073					95% CLT UCL	76851					95% Jackknife UCL	80393	
2074					95% Standard Bootstrap UCL	75890					95% Bootstrap-t UCL	258128	
2075					95% Hall's Bootstrap UCL	245338					95% Percentile Bootstrap UCL	77178	
2076					95% BCA Bootstrap UCL	96422							
2077					90% Chebyshev(Mean, Sd) UCL	99210					95% Chebyshev(Mean, Sd) UCL	121632	

2078					97.5% Chebyshev(Mean, Sd) UCL	152752				99% Chebyshev(Mean, Sd) UCL	213881	
2079												
2080						**Suggested UCL to Use**						
2081					95% Chebyshev (Mean, Sd) UCL	121632						
2082												
2083	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2084	Recommendations are based upon data size, data distribution, and skewness.											
2085	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2086	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2087												
2088												
2089	**Result (eu3_lead_roadway)**											
2090												
2091						**General Statistics**						
2092					Total Number of Observations	9				Number of Distinct Observations	9	
2093										Number of Missing Observations	0	
2094					Minimum	53.6				Mean	241.7	
2095					Maximum	393				Median	279	
2096					SD	131.3				Std. Error of Mean	43.76	
2097					Coefficient of Variation	0.543				Skewness	-0.219	
2098												
2099	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2100	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2101	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2102	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2103												
2104						**Normal GOF Test**						
2105					Shapiro Wilk Test Statistic	0.856				**Shapiro Wilk GOF Test**		
2106					5% Shapiro Wilk Critical Value	0.829				Data appear Normal at 5% Significance Level		
2107					Lilliefors Test Statistic	0.247				**Lilliefors GOF Test**		
2108					5% Lilliefors Critical Value	0.274				Data appear Normal at 5% Significance Level		
2109						**Data appear Normal at 5% Significance Level**						
2110												
2111						**Assuming Normal Distribution**						
2112					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
2113					95% Student's-t UCL	323.1				95% Adjusted-CLT UCL (Chen-1995)	310.3	
2114										95% Modified-t UCL (Johnson-1978)	322.6	
2115												
2116						**Gamma GOF Test**						
2117					A-D Test Statistic	0.693				**Anderson-Darling Gamma GOF Test**		
2118					5% A-D Critical Value	0.727				Detected data appear Gamma Distributed at 5% Significance Lev		
2119					K-S Test Statistic	0.244				**Kolmogorov-Smirnov Gamma GOF Test**		
2120					5% K-S Critical Value	0.281				Detected data appear Gamma Distributed at 5% Significance Lev		
2121						**Detected data appear Gamma Distributed at 5% Significance Level**						
2122												
2123						**Gamma Statistics**						
2124					k hat (MLE)	2.908				k star (bias corrected MLE)	2.013	
2125					Theta hat (MLE)	83.12				Theta star (bias corrected MLE)	120.1	
2126					nu hat (MLE)	52.35				nu star (bias corrected)	36.23	
2127					MLE Mean (bias corrected)	241.7				MLE Sd (bias corrected)	170.4	
2128										Approximate Chi Square Value (0.05)	23.45	
2129					Adjusted Level of Significance	0.0231				Adjusted Chi Square Value	21.31	
2130												
2131						**Assuming Gamma Distribution**						
2132					95% Approximate Gamma UCL (use when n>=50))	373.4				95% Adjusted Gamma UCL (use when n<50)	411	
2133												
2134						**Lognormal GOF Test**						
2135					Shapiro Wilk Test Statistic	0.846				**Shapiro Wilk Lognormal GOF Test**		
2136					5% Shapiro Wilk Critical Value	0.829				Data appear Lognormal at 5% Significance Level		
2137					Lilliefors Test Statistic	0.235				**Lilliefors Lognormal GOF Test**		
2138					5% Lilliefors Critical Value	0.274				Data appear Lognormal at 5% Significance Level		
2139						**Data appear Lognormal at 5% Significance Level**						
2140												
2141						**Lognormal Statistics**						
2142					Minimum of Logged Data	3.982				Mean of logged Data	5.306	
2143					Maximum of Logged Data	5.974				SD of logged Data	0.698	
2144												

2145	**Assuming Lognormal Distribution**											
2146					95% H-UCL	490.6			90% Chebyshev (MVUE) UCL	427.5		
2147					95% Chebyshev (MVUE) UCL	508.2			97.5% Chebyshev (MVUE) UCL	620.3		
2148					99% Chebyshev (MVUE) UCL	840.4						
2149												
2150	**Nonparametric Distribution Free UCL Statistics**											
2151	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2152												
2153	**Nonparametric Distribution Free UCLs**											
2154					95% CLT UCL	313.7			95% Jackknife UCL	323.1		
2155					95% Standard Bootstrap UCL	311.1			95% Bootstrap-t UCL	320.1		
2156					95% Hall's Bootstrap UCL	300.6			95% Percentile Bootstrap UCL	309.4		
2157					95% BCA Bootstrap UCL	312						
2158					90% Chebyshev(Mean, Sd) UCL	373			95% Chebyshev(Mean, Sd) UCL	432.5		
2159					97.5% Chebyshev(Mean, Sd) UCL	515			99% Chebyshev(Mean, Sd) UCL	677.2		
2160												
2161	**Suggested UCL to Use**											
2162					95% Student's-t UCL	323.1						
2163												
2164	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2165	Recommendations are based upon data size, data distribution, and skewness.											
2166	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2167	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2168												
2169	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
2170	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
2171												
2172												
2173	**Result (eu3_manganese_roadway)**											
2174												
2175	**General Statistics**											
2176					Total Number of Observations	9			Number of Distinct Observations	9		
2177									Number of Missing Observations	0		
2178					Minimum	424			Mean	809.1		
2179					Maximum	1180			Median	817		
2180					SD	204.7			Std. Error of Mean	68.23		
2181					Coefficient of Variation	0.253			Skewness	-0.127		
2182												
2183	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2184	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2185	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2186	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2187												
2188	**Normal GOF Test**											
2189					Shapiro Wilk Test Statistic	0.957			**Shapiro Wilk GOF Test**			
2190					5% Shapiro Wilk Critical Value	0.829			Data appear Normal at 5% Significance Level			
2191					Lilliefors Test Statistic	0.175			**Lilliefors GOF Test**			
2192					5% Lilliefors Critical Value	0.274			Data appear Normal at 5% Significance Level			
2193	**Data appear Normal at 5% Significance Level**											
2194												
2195	**Assuming Normal Distribution**											
2196					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
2197					95% Student's-t UCL	936			95% Adjusted-CLT UCL (Chen-1995)	918.2		
2198									95% Modified-t UCL (Johnson-1978)	935.5		
2199												
2200	**Gamma GOF Test**											
2201					A-D Test Statistic	0.377			**Anderson-Darling Gamma GOF Test**			
2202					5% A-D Critical Value	0.721			Detected data appear Gamma Distributed at 5% Significance Lev			
2203					K-S Test Statistic	0.175			**Kolmogorov-Smirnov Gamma GOF Test**			
2204					5% K-S Critical Value	0.279			Detected data appear Gamma Distributed at 5% Significance Lev			
2205	**Detected data appear Gamma Distributed at 5% Significance Level**											
2206												
2207	**Gamma Statistics**											
2208					k hat (MLE)	15.7			k star (bias corrected MLE)	10.54		
2209					Theta hat (MLE)	51.55			Theta star (bias corrected MLE)	76.77		
2210					nu hat (MLE)	282.5			nu star (bias corrected)	189.7		
2211					MLE Mean (bias corrected)	809.1			MLE Sd (bias corrected)	249.2		

2212								Approximate Chi Square Value (0.05)					158.8
2213					Adjusted Level of Significance		0.0231				Adjusted Chi Square Value		152.9
2214													
2215							**Assuming Gamma Distribution**						
2216				95% Approximate Gamma UCL (use when n>=50))			966.3				95% Adjusted Gamma UCL (use when n<50)		1004
2217													
2218							**Lognormal GOF Test**						
2219					Shapiro Wilk Test Statistic		0.905				**Shapiro Wilk Lognormal GOF Test**		
2220					5% Shapiro Wilk Critical Value		0.829				Data appear Lognormal at 5% Significance Level		
2221					Lilliefors Test Statistic		0.196				**Lilliefors Lognormal GOF Test**		
2222					5% Lilliefors Critical Value		0.274				Data appear Lognormal at 5% Significance Level		
2223							**Data appear Lognormal at 5% Significance Level**						
2224													
2225							**Lognormal Statistics**						
2226					Minimum of Logged Data		6.05				Mean of logged Data		6.664
2227					Maximum of Logged Data		7.073				SD of logged Data		0.28
2228													
2229							**Assuming Lognormal Distribution**						
2230					95% H-UCL		992.5				90% Chebyshev (MVUE) UCL		1040
2231					95% Chebyshev (MVUE) UCL		1143				97.5% Chebyshev (MVUE) UCL		1287
2232					99% Chebyshev (MVUE) UCL		1569						
2233													
2234							**Nonparametric Distribution Free UCL Statistics**						
2235							**Data appear to follow a Discernible Distribution at 5% Significance Level**						
2236													
2237							**Nonparametric Distribution Free UCLs**						
2238					95% CLT UCL		921.3				95% Jackknife UCL		936
2239					95% Standard Bootstrap UCL		915.6				95% Bootstrap-t UCL		920.6
2240					95% Hall's Bootstrap UCL		949.1				95% Percentile Bootstrap UCL		911.1
2241					95% BCA Bootstrap UCL		904.7						
2242					90% Chebyshev(Mean, Sd) UCL		1014				95% Chebyshev(Mean, Sd) UCL		1106
2243					97.5% Chebyshev(Mean, Sd) UCL		1235				99% Chebyshev(Mean, Sd) UCL		1488
2244													
2245							**Suggested UCL to Use**						
2246					95% Student's-t UCL		936						
2247													
2248	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
2249	Recommendations are based upon data size, data distribution, and skewness.												
2250	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
2251	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia												
2252													
2253	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**												
2254	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**												
2255													
2256													
2257	**Result (eu3_thallium_roadway)**												
2258													
2259							**General Statistics**						
2260					Total Number of Observations		9				Number of Distinct Observations		8
2261											Number of Missing Observations		0
2262					Minimum		0.073				Mean		0.138
2263					Maximum		0.41				Median		0.096
2264					SD		0.105				Std. Error of Mean		0.0349
2265					Coefficient of Variation		0.759				Skewness		2.707
2266													
2267	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**												
2268	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**												
2269	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**												
2270	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**												
2271													
2272							**Normal GOF Test**						
2273					Shapiro Wilk Test Statistic		0.6				**Shapiro Wilk GOF Test**		
2274					5% Shapiro Wilk Critical Value		0.829				Data Not Normal at 5% Significance Level		
2275					Lilliefors Test Statistic		0.381				**Lilliefors GOF Test**		
2276					5% Lilliefors Critical Value		0.274				Data Not Normal at 5% Significance Level		
2277							**Data Not Normal at 5% Significance Level**						
2278													

2279	**Assuming Normal Distribution**											
2280	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
2281	95% Student's-t UCL				0.203		95% Adjusted-CLT UCL (Chen-1995)					0.229
2282							95% Modified-t UCL (Johnson-1978)					0.208
2283												
2284	**Gamma GOF Test**											
2285	A-D Test Statistic				1.065		**Anderson-Darling Gamma GOF Test**					
2286	5% A-D Critical Value				0.726		Data Not Gamma Distributed at 5% Significance Level					
2287	K-S Test Statistic				0.306		**Kolmogorov-Smirnov Gamma GOF Test**					
2288	5% K-S Critical Value				0.281		Data Not Gamma Distributed at 5% Significance Level					
2289	**Data Not Gamma Distributed at 5% Significance Level**											
2290												
2291	**Gamma Statistics**											
2292	k hat (MLE)				3.408		k star (bias corrected MLE)					2.346
2293	Theta hat (MLE)				0.0405		Theta star (bias corrected MLE)					0.0588
2294	nu hat (MLE)				61.35		nu star (bias corrected)					42.23
2295	MLE Mean (bias corrected)				0.138		MLE Sd (bias corrected)					0.0901
2296							Approximate Chi Square Value (0.05)					28.33
2297	Adjusted Level of Significance				0.0231		Adjusted Chi Square Value					25.96
2298												
2299	**Assuming Gamma Distribution**											
2300	95% Approximate Gamma UCL (use when n>=50))				0.206		95% Adjusted Gamma UCL (use when n<50)					0.225
2301												
2302	**Lognormal GOF Test**											
2303	Shapiro Wilk Test Statistic				0.789		**Shapiro Wilk Lognormal GOF Test**					
2304	5% Shapiro Wilk Critical Value				0.829		Data Not Lognormal at 5% Significance Level					
2305	Lilliefors Test Statistic				0.262		**Lilliefors Lognormal GOF Test**					
2306	5% Lilliefors Critical Value				0.274		Data appear Lognormal at 5% Significance Level					
2307	**Data appear Approximate Lognormal at 5% Significance Level**											
2308												
2309	**Lognormal Statistics**											
2310	Minimum of Logged Data				-2.617		Mean of logged Data					-2.134
2311	Maximum of Logged Data				-0.892		SD of logged Data					0.519
2312												
2313	**Assuming Lognormal Distribution**											
2314	95% H-UCL				0.205		90% Chebyshev (MVUE) UCL					0.203
2315	95% Chebyshev (MVUE) UCL				0.235		97.5% Chebyshev (MVUE) UCL					0.279
2316	99% Chebyshev (MVUE) UCL				0.366							
2317												
2318	**Nonparametric Distribution Free UCL Statistics**											
2319	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2320												
2321	**Nonparametric Distribution Free UCLs**											
2322	95% CLT UCL				0.195		95% Jackknife UCL					0.203
2323	95% Standard Bootstrap UCL				0.192		95% Bootstrap-t UCL					0.351
2324	95% Hall's Bootstrap UCL				0.412		95% Percentile Bootstrap UCL					0.203
2325	95% BCA Bootstrap UCL				0.233							
2326	90% Chebyshev(Mean, Sd) UCL				0.243		95% Chebyshev(Mean, Sd) UCL					0.29
2327	97.5% Chebyshev(Mean, Sd) UCL				0.356		99% Chebyshev(Mean, Sd) UCL					0.485
2328												
2329	**Suggested UCL to Use**											
2330	95% H-UCL				0.205							
2331												
2332	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2333	Recommendations are based upon data size, data distribution, and skewness.											
2334	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2335	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2336												
2337	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
2338	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
2339	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
2340	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
2341												
2342												
2343	**Result (eu3_zinc_roadway)**											
2344												
2345	**General Statistics**											

2346	Total Number of Observations				9	Number of Distinct Observations					9	
2347						Number of Missing Observations					0	
2348	Minimum				130	Mean					468.7	
2349	Maximum				988	Median					380	
2350	SD				306.6	Std. Error of Mean					102.2	
2351	Coefficient of Variation				0.654	Skewness					0.849	
2352												
2353	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2354	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2355	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2356	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2357												
2358	**Normal GOF Test**											
2359	Shapiro Wilk Test Statistic				0.891	**Shapiro Wilk GOF Test**						
2360	5% Shapiro Wilk Critical Value				0.829	Data appear Normal at 5% Significance Level						
2361	Lilliefors Test Statistic				0.19	**Lilliefors GOF Test**						
2362	5% Lilliefors Critical Value				0.274	Data appear Normal at 5% Significance Level						
2363	**Data appear Normal at 5% Significance Level**											
2364												
2365	**Assuming Normal Distribution**											
2366	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
2367	95% Student's-t UCL				658.7	95% Adjusted-CLT UCL (Chen-1995)					667.6	
2368						95% Modified-t UCL (Johnson-1978)					663.5	
2369												
2370	**Gamma GOF Test**											
2371	A-D Test Statistic				0.228	**Anderson-Darling Gamma GOF Test**						
2372	5% A-D Critical Value				0.728	Detected data appear Gamma Distributed at 5% Significance Lev						
2373	K-S Test Statistic				0.144	**Kolmogorov-Smirnov Gamma GOF Test**						
2374	5% K-S Critical Value				0.282	Detected data appear Gamma Distributed at 5% Significance Lev						
2375	**Detected data appear Gamma Distributed at 5% Significance Level**											
2376												
2377	**Gamma Statistics**											
2378	k hat (MLE)				2.655	k star (bias corrected MLE)					1.844	
2379	Theta hat (MLE)				176.6	Theta star (bias corrected MLE)					254.2	
2380	nu hat (MLE)				47.78	nu star (bias corrected)					33.19	
2381	MLE Mean (bias corrected)				468.7	MLE Sd (bias corrected)					345.2	
2382						Approximate Chi Square Value (0.05)					21.02	
2383	Adjusted Level of Significance				0.0231	Adjusted Chi Square Value					19	
2384												
2385	**Assuming Gamma Distribution**											
2386	95% Approximate Gamma UCL (use when n>=50))				740.1	95% Adjusted Gamma UCL (use when n<50)					818.7	
2387												
2388	**Lognormal GOF Test**											
2389	Shapiro Wilk Test Statistic				0.966	**Shapiro Wilk Lognormal GOF Test**						
2390	5% Shapiro Wilk Critical Value				0.829	Data appear Lognormal at 5% Significance Level						
2391	Lilliefors Test Statistic				0.119	**Lilliefors Lognormal GOF Test**						
2392	5% Lilliefors Critical Value				0.274	Data appear Lognormal at 5% Significance Level						
2393	**Data appear Lognormal at 5% Significance Level**											
2394												
2395	**Lognormal Statistics**											
2396	Minimum of Logged Data				4.868	Mean of logged Data					5.95	
2397	Maximum of Logged Data				6.896	SD of logged Data					0.688	
2398												
2399	**Assuming Lognormal Distribution**											
2400	95% H-UCL				914.1	90% Chebyshev (MVUE) UCL					803.3	
2401	95% Chebyshev (MVUE) UCL				953.7	97.5% Chebyshev (MVUE) UCL					1162	
2402	99% Chebyshev (MVUE) UCL				1572							
2403												
2404	**Nonparametric Distribution Free UCL Statistics**											
2405	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2406												
2407	**Nonparametric Distribution Free UCLs**											
2408	95% CLT UCL				636.7	95% Jackknife UCL					658.7	
2409	95% Standard Bootstrap UCL				627.9	95% Bootstrap-t UCL					724.8	
2410	95% Hall's Bootstrap UCL				807.4	95% Percentile Bootstrap UCL					632.1	
2411	95% BCA Bootstrap UCL				657.8							
2412	90% Chebyshev(Mean, Sd) UCL				775.2	95% Chebyshev(Mean, Sd) UCL					914.1	

2413					97.5% Chebyshev(Mean, Sd) UCL	1107				99% Chebyshev(Mean, Sd) UCL	1485	
2414												
2415					**Suggested UCL to Use**							
2416					95% Student's-t UCL	658.7						
2417												
2418	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2419	Recommendations are based upon data size, data distribution, and skewness.											
2420	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2421	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2422												
2423	**Result (eu4_antimony_roadway)**											
2424												
2425	**General Statistics**											
2426	Total Number of Observations					7			Number of Distinct Observations			7
2427	Number of Detects					6			Number of Non-Detects			1
2428	Number of Distinct Detects					6			Number of Distinct Non-Detects			1
2429	Minimum Detect					0.21			Minimum Non-Detect			1.1
2430	Maximum Detect					0.8			Maximum Non-Detect			1.1
2431	Variance Detects					0.0461			Percent Non-Detects			14.29%
2432	Mean Detects					0.492			SD Detects			0.215
2433	Median Detects					0.495			CV Detects			0.437
2434	Skewness Detects					0.129			Kurtosis Detects			-0.69
2435	Mean of Logged Detects					-0.802			SD of Logged Detects			0.489
2436												
2437	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2438	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2439	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2440	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2441												
2442	**Normal GOF Test on Detects Only**											
2443	Shapiro Wilk Test Statistic					0.984			**Shapiro Wilk GOF Test**			
2444	5% Shapiro Wilk Critical Value					0.788			Detected Data appear Normal at 5% Significance Level			
2445	Lilliefors Test Statistic					0.134			**Lilliefors GOF Test**			
2446	5% Lilliefors Critical Value					0.325			Detected Data appear Normal at 5% Significance Level			
2447	**Detected Data appear Normal at 5% Significance Level**											
2448												
2449	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2450	KM Mean					0.492			KM Standard Error of Mean			0.0877
2451	KM SD					0.196			95% KM (BCA) UCL			0.62
2452	95% KM (t) UCL					0.662			95% KM (Percentile Bootstrap) UCL			0.624
2453	95% KM (z) UCL					0.636			95% KM Bootstrap t UCL			0.666
2454	90% KM Chebyshev UCL					0.755			95% KM Chebyshev UCL			0.874
2455	97.5% KM Chebyshev UCL					1.039			99% KM Chebyshev UCL			1.364
2456												
2457	**Gamma GOF Tests on Detected Observations Only**											
2458	A-D Test Statistic					0.197			**Anderson-Darling GOF Test**			
2459	5% A-D Critical Value					0.698			Detected data appear Gamma Distributed at 5% Significance Lev			
2460	K-S Test Statistic					0.181			**Kolmogorov-Smirnov GOF**			
2461	5% K-S Critical Value					0.333			Detected data appear Gamma Distributed at 5% Significance Lev			
2462	**Detected data appear Gamma Distributed at 5% Significance Level**											
2463												
2464	**Gamma Statistics on Detected Data Only**											
2465	k hat (MLE)					5.611			k star (bias corrected MLE)			2.917
2466	Theta hat (MLE)					0.0876			Theta star (bias corrected MLE)			0.169
2467	nu hat (MLE)					67.33			nu star (bias corrected)			35
2468	Mean (detects)					0.492						
2469												
2470	**Gamma ROS Statistics using Imputed Non-Detects**											
2471	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2472	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)											
2473	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2474	This is especially true when the sample size is small.											
2475	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2476	Minimum					0.21			Mean			0.489
2477	Maximum					0.8			Median			0.472
2478	SD					0.196			CV			0.401
2479	k hat (MLE)					6.512			k star (bias corrected MLE)			3.816

2480					Theta hat (MLE)	0.0751				Theta star (bias corrected MLE)		0.128
2481					nu hat (MLE)	91.17				nu star (bias corrected)		53.43
2482				Adjusted Level of Significance (β)		0.0158						
2483				Approximate Chi Square Value (53.43, α)		37.64				Adjusted Chi Square Value (53.43, β)		33.68
2484			95% Gamma Approximate UCL (use when n>=50)			0.694				95% Gamma Adjusted UCL (use when n<50)		0.776
2485												
2486					**Estimates of Gamma Parameters using KM Estimates**							
2487					Mean (KM)	0.492				SD (KM)		0.196
2488					Variance (KM)	0.0384				SE of Mean (KM)		0.0877
2489					k hat (KM)	6.287				k star (KM)		3.688
2490					nu hat (KM)	88.02				nu star (KM)		51.63
2491					theta hat (KM)	0.0782				theta star (KM)		0.133
2492					80% gamma percentile (KM)	0.684				90% gamma percentile (KM)		0.835
2493					95% gamma percentile (KM)	0.974				99% gamma percentile (KM)		1.272
2494												
2495					**Gamma Kaplan-Meier (KM) Statistics**							
2496				Approximate Chi Square Value (51.63, α)		36.13				Adjusted Chi Square Value (51.63, β)		32.26
2497	5% Gamma Approximate KM-UCL (use when n>=50)					0.703				95% Gamma Adjusted KM-UCL (use when n<50)		0.787
2498												
2499					**Lognormal GOF Test on Detected Observations Only**							
2500					Shapiro Wilk Test Statistic	0.96				**Shapiro Wilk GOF Test**		
2501					5% Shapiro Wilk Critical Value	0.788				Detected Data appear Lognormal at 5% Significance Level		
2502					Lilliefors Test Statistic	0.205				**Lilliefors GOF Test**		
2503					5% Lilliefors Critical Value	0.325				Detected Data appear Lognormal at 5% Significance Level		
2504					**Detected Data appear Lognormal at 5% Significance Level**							
2505												
2506					**Lognormal ROS Statistics Using Imputed Non-Detects**							
2507					Mean in Original Scale	0.486				Mean in Log Scale		-0.802
2508					SD in Original Scale	0.197				SD in Log Scale		0.447
2509				95% t UCL (assumes normality of ROS data)		0.63				95% Percentile Bootstrap UCL		0.604
2510					95% BCA Bootstrap UCL	0.607				95% Bootstrap t UCL		0.646
2511					95% H-UCL (Log ROS)	0.761						
2512												
2513					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
2514					KM Mean (logged)	-0.802				KM Geo Mean		0.449
2515					KM SD (logged)	0.447				95% Critical H Value (KM-Log)		2.353
2516				KM Standard Error of Mean (logged)		0.2				95% H-UCL (KM -Log)		0.761
2517					KM SD (logged)	0.447				95% Critical H Value (KM-Log)		2.353
2518				KM Standard Error of Mean (logged)		0.2						
2519												
2520					**DL/2 Statistics**							
2521					**DL/2 Normal**					**DL/2 Log-Transformed**		
2522					Mean in Original Scale	0.5				Mean in Log Scale		-0.773
2523					SD in Original Scale	0.197				SD in Log Scale		0.453
2524					95% t UCL (Assumes normality)	0.645				95% H-Stat UCL		0.793
2525					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
2526												
2527					**Nonparametric Distribution Free UCL Statistics**							
2528					**Detected Data appear Normal Distributed at 5% Significance Level**							
2529												
2530					**Suggested UCL to Use**							
2531					95% KM (t) UCL	0.662						
2532												
2533	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2534	Recommendations are based upon data size, data distribution, and skewness.											
2535	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2536	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2537												
2538												
2539	**Result (eu4_arsenic_roadway)**											
2540												
2541					**General Statistics**							
2542					Total Number of Observations	7				Number of Distinct Observations		7
2543										Number of Missing Observations		0
2544					Minimum	4.1				Mean		10.86
2545					Maximum	23				Median		9.6
2546					SD	6.178				Std. Error of Mean		2.335

2547				Coefficient of Variation	0.569					Skewness	1.316	
2548												
2549				**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**								
2550				**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**								
2551				**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**								
2552				**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**								
2553												
2554				**Normal GOF Test**								
2555				Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk GOF Test**						
2556				5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level						
2557				Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**						
2558				5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level						
2559				**Data appear Normal at 5% Significance Level**								
2560												
2561				**Assuming Normal Distribution**								
2562				**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**						
2563				95% Student's-t UCL	15.39	95% Adjusted-CLT UCL (Chen-1995)	15.94					
2564						95% Modified-t UCL (Johnson-1978)	15.59					
2565												
2566				**Gamma GOF Test**								
2567				A-D Test Statistic	0.273	**Anderson-Darling Gamma GOF Test**						
2568				5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Lev						
2569				K-S Test Statistic	0.18	**Kolmogorov-Smirnov Gamma GOF Test**						
2570				5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Lev						
2571				**Detected data appear Gamma Distributed at 5% Significance Level**								
2572												
2573				**Gamma Statistics**								
2574				k hat (MLE)	3.897	k star (bias corrected MLE)	2.322					
2575				Theta hat (MLE)	2.786	Theta star (bias corrected MLE)	4.675					
2576				nu hat (MLE)	54.56	nu star (bias corrected)	32.51					
2577				MLE Mean (bias corrected)	10.86	MLE Sd (bias corrected)	7.124					
2578						Approximate Chi Square Value (0.05)	20.48					
2579				Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	17.66					
2580												
2581				**Assuming Gamma Distribution**								
2582				95% Approximate Gamma UCL (use when n>=50))	17.24	95% Adjusted Gamma UCL (use when n<50)	19.99					
2583												
2584				**Lognormal GOF Test**								
2585				Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**						
2586				5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level						
2587				Lilliefors Test Statistic	0.214	**Lilliefors Lognormal GOF Test**						
2588				5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level						
2589				**Data appear Lognormal at 5% Significance Level**								
2590												
2591				**Lognormal Statistics**								
2592				Minimum of Logged Data	1.411	Mean of logged Data	2.251					
2593				Maximum of Logged Data	3.135	SD of logged Data	0.564					
2594												
2595				**Assuming Lognormal Distribution**								
2596				95% H-UCL	20.25	90% Chebyshev (MVUE) UCL	17.85					
2597				95% Chebyshev (MVUE) UCL	21.02	97.5% Chebyshev (MVUE) UCL	25.41					
2598				99% Chebyshev (MVUE) UCL	34.04							
2599												
2600				**Nonparametric Distribution Free UCL Statistics**								
2601				**Data appear to follow a Discernible Distribution at 5% Significance Level**								
2602												
2603				**Nonparametric Distribution Free UCLs**								
2604				95% CLT UCL	14.7	95% Jackknife UCL	15.39					
2605				95% Standard Bootstrap UCL	14.47	95% Bootstrap-t UCL	17.21					
2606				95% Hall's Bootstrap UCL	33.78	95% Percentile Bootstrap UCL	14.69					
2607				95% BCA Bootstrap UCL	15.14							
2608				90% Chebyshev(Mean, Sd) UCL	17.86	95% Chebyshev(Mean, Sd) UCL	21.03					
2609				97.5% Chebyshev(Mean, Sd) UCL	25.44	99% Chebyshev(Mean, Sd) UCL	34.09					
2610												
2611				**Suggested UCL to Use**								
2612				95% Student's-t UCL	15.39							
2613												

2614	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2615	Recommendations are based upon data size, data distribution, and skewness.											
2616	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2617	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2618												
2619												
2620	**Result (eu4_cadmium_roadway)**											
2621												
2622	**General Statistics**											
2623						Total Number of Observations	7			Number of Distinct Observations	7	
2624										Number of Missing Observations	0	
2625						Minimum	0.045			Mean	6.047	
2626						Maximum	41.5			Median	0.14	
2627						SD	15.63			Std. Error of Mean	5.909	
2628						Coefficient of Variation	2.585			Skewness	2.646	
2629												
2630	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2631	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2632	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2633	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2634												
2635	**Normal GOF Test**											
2636						Shapiro Wilk Test Statistic	0.458			**Shapiro Wilk GOF Test**		
2637						5% Shapiro Wilk Critical Value	0.803			Data Not Normal at 5% Significance Level		
2638						Lilliefors Test Statistic	0.5			**Lilliefors GOF Test**		
2639						5% Lilliefors Critical Value	0.304			Data Not Normal at 5% Significance Level		
2640	**Data Not Normal at 5% Significance Level**											
2641												
2642	**Assuming Normal Distribution**											
2643						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
2644						95% Student's-t UCL	17.53			95% Adjusted-CLT UCL (Chen-1995)	22.08	
2645										95% Modified-t UCL (Johnson-1978)	18.51	
2646												
2647	**Gamma GOF Test**											
2648						A-D Test Statistic	1.568			**Anderson-Darling Gamma GOF Test**		
2649						5% A-D Critical Value	0.811			Data Not Gamma Distributed at 5% Significance Level		
2650						K-S Test Statistic	0.464			**Kolmogorov-Smirnov Gamma GOF Test**		
2651						5% K-S Critical Value	0.34			Data Not Gamma Distributed at 5% Significance Level		
2652	**Data Not Gamma Distributed at 5% Significance Level**											
2653												
2654	**Gamma Statistics**											
2655						k hat (MLE)	0.231			k star (bias corrected MLE)	0.227	
2656						Theta hat (MLE)	26.19			Theta star (bias corrected MLE)	26.62	
2657						nu hat (MLE)	3.233			nu star (bias corrected)	3.181	
2658						MLE Mean (bias corrected)	6.047			MLE Sd (bias corrected)	12.69	
2659										Approximate Chi Square Value (0.05)	0.428	
2660						Adjusted Level of Significance	0.0158			Adjusted Chi Square Value	0.222	
2661												
2662	**Assuming Gamma Distribution**											
2663						95% Approximate Gamma UCL (use when n>=50))	44.95			95% Adjusted Gamma UCL (use when n<50)	86.75	
2664												
2665	**Lognormal GOF Test**											
2666						Shapiro Wilk Test Statistic	0.706			**Shapiro Wilk Lognormal GOF Test**		
2667						5% Shapiro Wilk Critical Value	0.803			Data Not Lognormal at 5% Significance Level		
2668						Lilliefors Test Statistic	0.332			**Lilliefors Lognormal GOF Test**		
2669						5% Lilliefors Critical Value	0.304			Data Not Lognormal at 5% Significance Level		
2670	**Data Not Lognormal at 5% Significance Level**											
2671												
2672	**Lognormal Statistics**											
2673						Minimum of Logged Data	-3.101			Mean of logged Data	-1.316	
2674						Maximum of Logged Data	3.726			SD of logged Data	2.304	
2675												
2676	**Assuming Lognormal Distribution**											
2677						95% H-UCL	5383			90% Chebyshev (MVUE) UCL	5.661	
2678						95% Chebyshev (MVUE) UCL	7.448			97.5% Chebyshev (MVUE) UCL	9.927	
2679						99% Chebyshev (MVUE) UCL	14.8					
2680												

2681	**Nonparametric Distribution Free UCL Statistics**											
2682	**Data do not follow a Discernible Distribution (0.05)**											
2683												
2684	**Nonparametric Distribution Free UCLs**											
2685					95% CLT UCL	15.77			95% Jackknife UCL	17.53		
2686					95% Standard Bootstrap UCL	14.95			95% Bootstrap-t UCL	2136		
2687					95% Hall's Bootstrap UCL	932.4			95% Percentile Bootstrap UCL	17.85		
2688					95% BCA Bootstrap UCL	23.75						
2689					90% Chebyshev(Mean, Sd) UCL	23.77			95% Chebyshev(Mean, Sd) UCL	31.8		
2690					97.5% Chebyshev(Mean, Sd) UCL	42.95			99% Chebyshev(Mean, Sd) UCL	64.84		
2691												
2692	**Suggested UCL to Use**											
2693					95% Hall's Bootstrap UCL	932.4						
2694												
2695	**Recommended UCL exceeds the maximum observation**											
2696												
2697	**Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL**											
2698												
2699	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2700	Recommendations are based upon data size, data distribution, and skewness.											
2701	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2702	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2703												
2704												
2705	**Result (eu4_chromium_roadway)**											
2706												
2707	**General Statistics**											
2708					Total Number of Observations	7			Number of Distinct Observations	5		
2709									Number of Missing Observations	0		
2710					Minimum	2.6			Mean	4.443		
2711					Maximum	9.6			Median	2.8		
2712					SD	2.59			Std. Error of Mean	0.979		
2713					Coefficient of Variation	0.583			Skewness	1.622		
2714												
2715	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2716	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2717	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2718	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2719												
2720	**Normal GOF Test**											
2721					Shapiro Wilk Test Statistic	0.767			**Shapiro Wilk GOF Test**			
2722					5% Shapiro Wilk Critical Value	0.803			Data Not Normal at 5% Significance Level			
2723					Lilliefors Test Statistic	0.309			**Lilliefors GOF Test**			
2724					5% Lilliefors Critical Value	0.304			Data Not Normal at 5% Significance Level			
2725	**Data Not Normal at 5% Significance Level**											
2726												
2727	**Assuming Normal Distribution**											
2728	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
2729					95% Student's-t UCL	6.345			95% Adjusted-CLT UCL (Chen-1995)	6.694		
2730									95% Modified-t UCL (Johnson-1978)	6.445		
2731												
2732	**Gamma GOF Test**											
2733					A-D Test Statistic	0.717			**Anderson-Darling Gamma GOF Test**			
2734					5% A-D Critical Value	0.71			Data Not Gamma Distributed at 5% Significance Level			
2735					K-S Test Statistic	0.339			**Kolmogorov-Smirnov Gamma GOF Test**			
2736					5% K-S Critical Value	0.313			Data Not Gamma Distributed at 5% Significance Level			
2737	**Data Not Gamma Distributed at 5% Significance Level**											
2738												
2739	**Gamma Statistics**											
2740					k hat (MLE)	4.367			k star (bias corrected MLE)	2.591		
2741					Theta hat (MLE)	1.017			Theta star (bias corrected MLE)	1.715		
2742					nu hat (MLE)	61.13			nu star (bias corrected)	36.27		
2743					MLE Mean (bias corrected)	4.443			MLE Sd (bias corrected)	2.76		
2744									Approximate Chi Square Value (0.05)	23.48		
2745					Adjusted Level of Significance	0.0158			Adjusted Chi Square Value	20.43		
2746												
2747	**Assuming Gamma Distribution**											

2748	95% Approximate Gamma UCL (use when n>=50))					6.861	95% Adjusted Gamma UCL (use when n<50)					7.885
2749												
2750	**Lognormal GOF Test**											
2751	Shapiro Wilk Test Statistic					0.819	**Shapiro Wilk Lognormal GOF Test**					
2752	5% Shapiro Wilk Critical Value					0.803	Data appear Lognormal at 5% Significance Level					
2753	Lilliefors Test Statistic					0.325	**Lilliefors Lognormal GOF Test**					
2754	5% Lilliefors Critical Value					0.304	Data Not Lognormal at 5% Significance Level					
2755	**Data appear Approximate Lognormal at 5% Significance Level**											
2756												
2757	**Lognormal Statistics**											
2758	Minimum of Logged Data					0.956	Mean of logged Data					1.372
2759	Maximum of Logged Data					2.262	SD of logged Data					0.5
2760												
2761	**Assuming Lognormal Distribution**											
2762	95% H-UCL					7.4	90% Chebyshev (MVUE) UCL					6.887
2763	95% Chebyshev (MVUE) UCL					8.02	97.5% Chebyshev (MVUE) UCL					9.593
2764	99% Chebyshev (MVUE) UCL					12.68						
2765												
2766	**Nonparametric Distribution Free UCL Statistics**											
2767	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2768												
2769	**Nonparametric Distribution Free UCLs**											
2770	95% CLT UCL					6.053	95% Jackknife UCL					6.345
2771	95% Standard Bootstrap UCL					5.982	95% Bootstrap-t UCL					9.692
2772	95% Hall's Bootstrap UCL					12.01	95% Percentile Bootstrap UCL					6.071
2773	95% BCA Bootstrap UCL					6.386						
2774	90% Chebyshev(Mean, Sd) UCL					7.379	95% Chebyshev(Mean, Sd) UCL					8.709
2775	97.5% Chebyshev(Mean, Sd) UCL					10.56	99% Chebyshev(Mean, Sd) UCL					14.18
2776												
2777	**Suggested UCL to Use**											
2778	95% H-UCL					7.4						
2779												
2780	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2781	Recommendations are based upon data size, data distribution, and skewness.											
2782	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2783	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2784												
2785	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
2786	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
2787	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
2788	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
2789												
2790												
2791	**Result (eu4_cobalt_roadway)**											
2792												
2793	**General Statistics**											
2794	Total Number of Observations					7	Number of Distinct Observations					7
2795							Number of Missing Observations					0
2796	Minimum					1.5	Mean					6.329
2797	Maximum					24.7	Median					3.5
2798	SD					8.234	Std. Error of Mean					3.112
2799	Coefficient of Variation					1.301	Skewness					2.475
2800												
2801	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2802	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2803	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2804	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2805												
2806	**Normal GOF Test**											
2807	Shapiro Wilk Test Statistic					0.615	**Shapiro Wilk GOF Test**					
2808	5% Shapiro Wilk Critical Value					0.803	Data Not Normal at 5% Significance Level					
2809	Lilliefors Test Statistic					0.373	**Lilliefors GOF Test**					
2810	5% Lilliefors Critical Value					0.304	Data Not Normal at 5% Significance Level					
2811	**Data Not Normal at 5% Significance Level**											
2812												
2813	**Assuming Normal Distribution**											
2814	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					

2815				95% Student's-t UCL	12.38			95% Adjusted-CLT UCL (Chen-1995)	14.56
2816								95% Modified-t UCL (Johnson-1978)	12.86
2817									
2818				**Gamma GOF Test**					
2819				A-D Test Statistic	0.739	**Anderson-Darling Gamma GOF Test**			
2820				5% A-D Critical Value	0.725	Data Not Gamma Distributed at 5% Significance Level			
2821				K-S Test Statistic	0.305	**Kolmogorov-Smirnov Gamma GOF Test**			
2822				5% K-S Critical Value	0.318	Detected data appear Gamma Distributed at 5% Significance Lev			
2823				**Detected data follow Appr. Gamma Distribution at 5% Significance Level**					
2824									
2825				**Gamma Statistics**					
2826				k hat (MLE)	1.223	k star (bias corrected MLE)	0.794		
2827				Theta hat (MLE)	5.175	Theta star (bias corrected MLE)	7.97		
2828				nu hat (MLE)	17.12	nu star (bias corrected)	11.12		
2829				MLE Mean (bias corrected)	6.329	MLE Sd (bias corrected)	7.102		
2830						Approximate Chi Square Value (0.05)	4.651		
2831				Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	3.474		
2832									
2833				**Assuming Gamma Distribution**					
2834				95% Approximate Gamma UCL (use when n>=50)	15.13	95% Adjusted Gamma UCL (use when n<50)	20.25		
2835									
2836				**Lognormal GOF Test**					
2837				Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk Lognormal GOF Test**			
2838				5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level			
2839				Lilliefors Test Statistic	0.247	**Lilliefors Lognormal GOF Test**			
2840				5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level			
2841				**Data appear Lognormal at 5% Significance Level**					
2842									
2843				**Lognormal Statistics**					
2844				Minimum of Logged Data	0.405	Mean of logged Data	1.383		
2845				Maximum of Logged Data	3.207	SD of logged Data	0.928		
2846									
2847				**Assuming Lognormal Distribution**					
2848				95% H-UCL	23.07	90% Chebyshev (MVUE) UCL	11.69		
2849				95% Chebyshev (MVUE) UCL	14.41	97.5% Chebyshev (MVUE) UCL	18.19		
2850				99% Chebyshev (MVUE) UCL	25.61				
2851									
2852				**Nonparametric Distribution Free UCL Statistics**					
2853				**Data appear to follow a Discernible Distribution at 5% Significance Level**					
2854									
2855				**Nonparametric Distribution Free UCLs**					
2856				95% CLT UCL	11.45	95% Jackknife UCL	12.38		
2857				95% Standard Bootstrap UCL	11.08	95% Bootstrap-t UCL	38.67		
2858				95% Hall's Bootstrap UCL	38.75	95% Percentile Bootstrap UCL	12.33		
2859				95% BCA Bootstrap UCL	13.33				
2860				90% Chebyshev(Mean, Sd) UCL	15.66	95% Chebyshev(Mean, Sd) UCL	19.89		
2861				97.5% Chebyshev(Mean, Sd) UCL	25.76	99% Chebyshev(Mean, Sd) UCL	37.29		
2862									
2863				**Suggested UCL to Use**					
2864				95% Adjusted Gamma UCL	20.25				
2865									
2866				When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test					
2867				When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL					
2868									
2869				Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.					
2870				Recommendations are based upon data size, data distribution, and skewness.					
2871				These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).					
2872				However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia					
2873									
2874									
2875	**Result (eu4_iron_roadway)**								
2876									
2877				**General Statistics**					
2878				Total Number of Observations	7	Number of Distinct Observations	7		
2879						Number of Missing Observations	0		
2880				Minimum	13400	Mean	25900		
2881				Maximum	36100	Median	28700		

2882					SD	7398				Std. Error of Mean		2796
2883					Coefficient of Variation	0.286				Skewness		-0.519
2884												
2885	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2886	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2887	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2888	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2889												
2890	**Normal GOF Test**											
2891					Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**					
2892					5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level					
2893					Lilliefors Test Statistic	0.219	**Lilliefors GOF Test**					
2894					5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level					
2895	**Data appear Normal at 5% Significance Level**											
2896												
2897	**Assuming Normal Distribution**											
2898	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
2899					95% Student's-t UCL	31333	95% Adjusted-CLT UCL (Chen-1995)					29913
2900							95% Modified-t UCL (Johnson-1978)					31242
2901												
2902	**Gamma GOF Test**											
2903					A-D Test Statistic	0.353	**Anderson-Darling Gamma GOF Test**					
2904					5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Lev					
2905					K-S Test Statistic	0.249	**Kolmogorov-Smirnov Gamma GOF Test**					
2906					5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Lev					
2907	**Detected data appear Gamma Distributed at 5% Significance Level**											
2908												
2909	**Gamma Statistics**											
2910					k hat (MLE)	12.25	k star (bias corrected MLE)					7.095
2911					Theta hat (MLE)	2114	Theta star (bias corrected MLE)					3651
2912					nu hat (MLE)	171.5	nu star (bias corrected)					99.32
2913					MLE Mean (bias corrected)	25900	MLE Sd (bias corrected)					9724
2914							Approximate Chi Square Value (0.05)					77.33
2915					Adjusted Level of Significance	0.0158	Adjusted Chi Square Value					71.49
2916												
2917	**Assuming Gamma Distribution**											
2918	95% Approximate Gamma UCL (use when n>=50))					33265	95% Adjusted Gamma UCL (use when n<50)					35984
2919												
2920	**Lognormal GOF Test**											
2921					Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk Lognormal GOF Test**					
2922					5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level					
2923					Lilliefors Test Statistic	0.242	**Lilliefors Lognormal GOF Test**					
2924					5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level					
2925	**Data appear Lognormal at 5% Significance Level**											
2926												
2927	**Lognormal Statistics**											
2928					Minimum of Logged Data	9.503	Mean of logged Data					10.12
2929					Maximum of Logged Data	10.49	SD of logged Data					0.326
2930												
2931	**Assuming Lognormal Distribution**											
2932					95% H-UCL	35332	90% Chebyshev (MVUE) UCL					35628
2933					95% Chebyshev (MVUE) UCL	39989	97.5% Chebyshev (MVUE) UCL					46042
2934					99% Chebyshev (MVUE) UCL	57932						
2935												
2936	**Nonparametric Distribution Free UCL Statistics**											
2937	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2938												
2939	**Nonparametric Distribution Free UCLs**											
2940					95% CLT UCL	30499	95% Jackknife UCL					31333
2941					95% Standard Bootstrap UCL	30175	95% Bootstrap-t UCL					30503
2942					95% Hall's Bootstrap UCL	30283	95% Percentile Bootstrap UCL					30214
2943					95% BCA Bootstrap UCL	29743						
2944					90% Chebyshev(Mean, Sd) UCL	34288	95% Chebyshev(Mean, Sd) UCL					38087
2945					97.5% Chebyshev(Mean, Sd) UCL	43361	99% Chebyshev(Mean, Sd) UCL					53720
2946												
2947	**Suggested UCL to Use**											
2948					95% Student's-t UCL	31333						

2949												
2950	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2951	Recommendations are based upon data size, data distribution, and skewness.											
2952	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2953	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2954												
2955	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
2956	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
2957												
2958												
2959	**Result (eu4_lead_roadway)**											
2960												
2961	**General Statistics**											
2962						Total Number of Observations	7			Number of Distinct Observations	7	
2963										Number of Missing Observations	0	
2964						Minimum	13.7			Mean	440.4	
2965						Maximum	2770			Median	76.5	
2966						SD	1028			Std. Error of Mean	388.4	
2967						Coefficient of Variation	2.333			Skewness	2.641	
2968												
2969	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
2970	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
2971	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
2972	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
2973												
2974	**Normal GOF Test**											
2975						Shapiro Wilk Test Statistic	0.48			**Shapiro Wilk GOF Test**		
2976						5% Shapiro Wilk Critical Value	0.803			Data Not Normal at 5% Significance Level		
2977						Lilliefors Test Statistic	0.493			**Lilliefors GOF Test**		
2978						5% Lilliefors Critical Value	0.304			Data Not Normal at 5% Significance Level		
2979	**Data Not Normal at 5% Significance Level**											
2980												
2981	**Assuming Normal Distribution**											
2982					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
2983						95% Student's-t UCL	1195			95% Adjusted-CLT UCL (Chen-1995)	1494	
2984										95% Modified-t UCL (Johnson-1978)	1260	
2985												
2986	**Gamma GOF Test**											
2987						A-D Test Statistic	1.206			**Anderson-Darling Gamma GOF Test**		
2988						5% A-D Critical Value	0.772			Data Not Gamma Distributed at 5% Significance Level		
2989						K-S Test Statistic	0.448			**Kolmogorov-Smirnov Gamma GOF Test**		
2990						5% K-S Critical Value	0.332			Data Not Gamma Distributed at 5% Significance Level		
2991	**Data Not Gamma Distributed at 5% Significance Level**											
2992												
2993	**Gamma Statistics**											
2994						k hat (MLE)	0.375			k star (bias corrected MLE)	0.309	
2995						Theta hat (MLE)	1175			Theta star (bias corrected MLE)	1423	
2996						nu hat (MLE)	5.249			nu star (bias corrected)	4.332	
2997						MLE Mean (bias corrected)	440.4			MLE Sd (bias corrected)	791.7	
2998										Approximate Chi Square Value (0.05)	0.857	
2999						Adjusted Level of Significance	0.0158			Adjusted Chi Square Value	0.488	
3000												
3001	**Assuming Gamma Distribution**											
3002					95% Approximate Gamma UCL (use when n>=50))		2226			95% Adjusted Gamma UCL (use when n<50)	3909	
3003												
3004	**Lognormal GOF Test**											
3005						Shapiro Wilk Test Statistic	0.814			**Shapiro Wilk Lognormal GOF Test**		
3006						5% Shapiro Wilk Critical Value	0.803			Data appear Lognormal at 5% Significance Level		
3007						Lilliefors Test Statistic	0.333			**Lilliefors Lognormal GOF Test**		
3008						5% Lilliefors Critical Value	0.304			Data Not Lognormal at 5% Significance Level		
3009	**Data appear Approximate Lognormal at 5% Significance Level**											
3010												
3011	**Lognormal Statistics**											
3012						Minimum of Logged Data	2.617			Mean of logged Data	4.314	
3013						Maximum of Logged Data	7.927			SD of logged Data	1.768	
3014												
3015	**Assuming Lognormal Distribution**											

3016					95% H-UCL	27420				90% Chebyshev (MVUE) UCL		700.1
3017				95% Chebyshev (MVUE) UCL		908.1				97.5% Chebyshev (MVUE) UCL		1197
3018				99% Chebyshev (MVUE) UCL		1763						
3019												
3020						**Nonparametric Distribution Free UCL Statistics**							
3021						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
3022												
3023						**Nonparametric Distribution Free UCLs**						
3024					95% CLT UCL	1079				95% Jackknife UCL		1195
3025				95% Standard Bootstrap UCL		1013				95% Bootstrap-t UCL		16231
3026				95% Hall's Bootstrap UCL		13510				95% Percentile Bootstrap UCL		1213
3027				95% BCA Bootstrap UCL		1598						
3028				90% Chebyshev(Mean, Sd) UCL		1606				95% Chebyshev(Mean, Sd) UCL		2134
3029				97.5% Chebyshev(Mean, Sd) UCL		2866				99% Chebyshev(Mean, Sd) UCL		4305
3030												
3031						**Suggested UCL to Use**						
3032				99% Chebyshev (Mean, Sd) UCL		4305						
3033												
3034						**Recommended UCL exceeds the maximum observation**						
3035												
3036	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3037	Recommendations are based upon data size, data distribution, and skewness.											
3038	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3039	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3040												
3041												
3042	**Result (eu4_manganese_roadway)**											
3043												
3044						**General Statistics**						
3045					Total Number of Observations	7				Number of Distinct Observations		7
3046										Number of Missing Observations		0
3047					Minimum	182				Mean		2165
3048					Maximum	12800				Median		454
3049					SD	4692				Std. Error of Mean		1773
3050					Coefficient of Variation	2.167				Skewness		2.641
3051												
3052						**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
3053						**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
3054						**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
3055						**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
3056												
3057						**Normal GOF Test**						
3058					Shapiro Wilk Test Statistic	0.482				**Shapiro Wilk GOF Test**		
3059					5% Shapiro Wilk Critical Value	0.803				Data Not Normal at 5% Significance Level		
3060					Lilliefors Test Statistic	0.487				**Lilliefors GOF Test**		
3061					5% Lilliefors Critical Value	0.304				Data Not Normal at 5% Significance Level		
3062						**Data Not Normal at 5% Significance Level**							
3063												
3064						**Assuming Normal Distribution**							
3065						**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**	
3066					95% Student's-t UCL	5611				95% Adjusted-CLT UCL (Chen-1995)		6973
3067										95% Modified-t UCL (Johnson-1978)		5906
3068												
3069						**Gamma GOF Test**						
3070					A-D Test Statistic	1.458				**Anderson-Darling Gamma GOF Test**		
3071					5% A-D Critical Value	0.752				Data Not Gamma Distributed at 5% Significance Level		
3072					K-S Test Statistic	0.452				**Kolmogorov-Smirnov Gamma GOF Test**		
3073					5% K-S Critical Value	0.327				Data Not Gamma Distributed at 5% Significance Level		
3074						**Data Not Gamma Distributed at 5% Significance Level**							
3075												
3076						**Gamma Statistics**						
3077					k hat (MLE)	0.5				k star (bias corrected MLE)		0.381
3078					Theta hat (MLE)	4328				Theta star (bias corrected MLE)		5681
3079					nu hat (MLE)	7.005				nu star (bias corrected)		5.336
3080					MLE Mean (bias corrected)	2165				MLE Sd (bias corrected)		3507
3081										Approximate Chi Square Value (0.05)		1.31
3082					Adjusted Level of Significance	0.0158				Adjusted Chi Square Value		0.804

3083												
3084						**Assuming Gamma Distribution**							
3085				95% Approximate Gamma UCL (use when n>=50))		8816			95% Adjusted Gamma UCL (use when n<50)			14368
3086												
3087						**Lognormal GOF Test**							
3088					Shapiro Wilk Test Statistic	0.724			**Shapiro Wilk Lognormal GOF Test**			
3089					5% Shapiro Wilk Critical Value	0.803			Data Not Lognormal at 5% Significance Level			
3090					Lilliefors Test Statistic	0.355			**Lilliefors Lognormal GOF Test**			
3091					5% Lilliefors Critical Value	0.304			Data Not Lognormal at 5% Significance Level			
3092						**Data Not Lognormal at 5% Significance Level**							
3093												
3094						**Lognormal Statistics**							
3095					Minimum of Logged Data	5.204			Mean of logged Data			6.411
3096					Maximum of Logged Data	9.457			SD of logged Data			1.399
3097												
3098						**Assuming Lognormal Distribution**							
3099					95% H-UCL	26145			90% Chebyshev (MVUE) UCL			3352
3100					95% Chebyshev (MVUE) UCL	4277			97.5% Chebyshev (MVUE) UCL			5562
3101					99% Chebyshev (MVUE) UCL	8085						
3102												
3103						**Nonparametric Distribution Free UCL Statistics**							
3104						**Data do not follow a Discernible Distribution (0.05)**							
3105												
3106						**Nonparametric Distribution Free UCLs**							
3107					95% CLT UCL	5082			95% Jackknife UCL			5611
3108					95% Standard Bootstrap UCL	4855			95% Bootstrap-t UCL			82506
3109					95% Hall's Bootstrap UCL	45630			95% Percentile Bootstrap UCL			5690
3110					95% BCA Bootstrap UCL	7454						
3111					90% Chebyshev(Mean, Sd) UCL	7485			95% Chebyshev(Mean, Sd) UCL			9895
3112					97.5% Chebyshev(Mean, Sd) UCL	13239			99% Chebyshev(Mean, Sd) UCL			19809
3113												
3114						**Suggested UCL to Use**							
3115					95% Hall's Bootstrap UCL	45630						
3116												
3117						**Recommended UCL exceeds the maximum observation**							
3118												
3119	**Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL**											
3120												
3121	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3122	Recommendations are based upon data size, data distribution, and skewness.											
3123	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3124	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3125												
3126	**Result (eu4_thallium_roadway)**											
3127												
3128						**General Statistics**							
3129					Total Number of Observations	6			Number of Distinct Observations			6
3130					Number of Detects	5			Number of Non-Detects			1
3131					Number of Distinct Detects	5			Number of Distinct Non-Detects			1
3132					Minimum Detect	0.044			Minimum Non-Detect			0.038
3133					Maximum Detect	0.13			Maximum Non-Detect			0.038
3134					Variance Detects	0.00154			Percent Non-Detects			16.67%
3135					Mean Detects	0.0844			SD Detects			0.0392
3136					Median Detects	0.077			CV Detects			0.465
3137					Skewness Detects	0.251			Kurtosis Detects			-2.795
3138					Mean of Logged Detects	-2.565			SD of Logged Detects			0.488
3139												
3140	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
3141	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
3142	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
3143	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
3144												
3145						**Normal GOF Test on Detects Only**							
3146					Shapiro Wilk Test Statistic	0.886			**Shapiro Wilk GOF Test**			
3147					5% Shapiro Wilk Critical Value	0.762			Detected Data appear Normal at 5% Significance Level			
3148					Lilliefors Test Statistic	0.218			**Lilliefors GOF Test**			
3149					5% Lilliefors Critical Value	0.343			Detected Data appear Normal at 5% Significance Level			

3150	**Detected Data appear Normal at 5% Significance Level**											
3151												
3152	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
3153						KM Mean	0.0767	KM Standard Error of Mean	0.0166			
3154						KM SD	0.0364	95% KM (BCA) UCL	0.0987			
3155						95% KM (t) UCL	0.11	95% KM (Percentile Bootstrap) UCL	0.101			
3156						95% KM (z) UCL	0.104	95% KM Bootstrap t UCL	0.125			
3157						90% KM Chebyshev UCL	0.126	95% KM Chebyshev UCL	0.149			
3158						97.5% KM Chebyshev UCL	0.18	99% KM Chebyshev UCL	0.242			
3159												
3160	**Gamma GOF Tests on Detected Observations Only**											
3161						A-D Test Statistic	0.369	**Anderson-Darling GOF Test**				
3162						5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Lev				
3163						K-S Test Statistic	0.246	**Kolmogorov-Smirnov GOF**				
3164						5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Lev				
3165	**Detected data appear Gamma Distributed at 5% Significance Level**											
3166												
3167	**Gamma Statistics on Detected Data Only**											
3168						k hat (MLE)	5.561	k star (bias corrected MLE)	2.358			
3169						Theta hat (MLE)	0.0152	Theta star (bias corrected MLE)	0.0358			
3170						nu hat (MLE)	55.61	nu star (bias corrected)	23.58			
3171						Mean (detects)	0.0844					
3172												
3173	**Gamma ROS Statistics using Imputed Non-Detects**											
3174	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
3175	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)											
3176	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
3177	This is especially true when the sample size is small.											
3178	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
3179						Minimum	0.01	Mean	0.072			
3180						Maximum	0.13	Median	0.064			
3181						SD	0.0464	CV	0.644			
3182						k hat (MLE)	1.977	k star (bias corrected MLE)	1.1			
3183						Theta hat (MLE)	0.0364	Theta star (bias corrected MLE)	0.0655			
3184						nu hat (MLE)	23.72	nu star (bias corrected)	13.19			
3185						Adjusted Level of Significance (β)	0.0122					
3186						Approximate Chi Square Value (13.19, α)	6.024	Adjusted Chi Square Value (13.19, β)	4.395			
3187						95% Gamma Approximate UCL (use when n>=50)	0.158	95% Gamma Adjusted UCL (use when n<50)	0.216			
3188												
3189	**Estimates of Gamma Parameters using KM Estimates**											
3190						Mean (KM)	0.0767	SD (KM)	0.0364			
3191						Variance (KM)	0.00132	SE of Mean (KM)	0.0166			
3192						k hat (KM)	4.44	k star (KM)	2.331			
3193						nu hat (KM)	53.28	nu star (KM)	27.97			
3194						theta hat (KM)	0.0173	theta star (KM)	0.0329			
3195						80% gamma percentile (KM)	0.113	90% gamma percentile (KM)	0.144			
3196						95% gamma percentile (KM)	0.173	99% gamma percentile (KM)	0.238			
3197												
3198	**Gamma Kaplan-Meier (KM) Statistics**											
3199						Approximate Chi Square Value (27.97, α)	16.91	Adjusted Chi Square Value (27.97, β)	13.9			
3200	5% Gamma Approximate KM-UCL (use when n>=50)						0.127	95% Gamma Adjusted KM-UCL (use when n<50)	0.154			
3201												
3202	**Lognormal GOF Test on Detected Observations Only**											
3203						Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk GOF Test**				
3204						5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level				
3205						Lilliefors Test Statistic	0.219	**Lilliefors GOF Test**				
3206						5% Lilliefors Critical Value	0.343	Detected Data appear Lognormal at 5% Significance Level				
3207	**Detected Data appear Lognormal at 5% Significance Level**											
3208												
3209	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3210						Mean in Original Scale	0.074	Mean in Log Scale	-2.772			
3211						SD in Original Scale	0.0433	SD in Log Scale	0.669			
3212						95% t UCL (assumes normality of ROS data)	0.11	95% Percentile Bootstrap UCL	0.101			
3213						95% BCA Bootstrap UCL	0.104	95% Bootstrap t UCL	0.133			
3214						95% H-UCL (Log ROS)	0.197					
3215												
3216	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											

3217				KM Mean (logged)	-2.682			KM Geo Mean	0.0684			
3218				KM SD (logged)	0.478			95% Critical H Value (KM-Log)	2.585			
3219				KM Standard Error of Mean (logged)	0.218			95% H-UCL (KM -Log)	0.133			
3220				KM SD (logged)	0.478			95% Critical H Value (KM-Log)	2.585			
3221				KM Standard Error of Mean (logged)	0.218							
3222												
3223					**DL/2 Statistics**							
3224				**DL/2 Normal**				**DL/2 Log-Transformed**				
3225				Mean in Original Scale	0.0735			Mean in Log Scale	-2.798			
3226				SD in Original Scale	0.0441			SD in Log Scale	0.719			
3227				95% t UCL (Assumes normality)	0.11			95% H-Stat UCL	0.223			
3228				**DL/2 is not a recommended method, provided for comparisons and historical reasons**								
3229												
3230					**Nonparametric Distribution Free UCL Statistics**							
3231					**Detected Data appear Normal Distributed at 5% Significance Level**							
3232												
3233					**Suggested UCL to Use**							
3234				95% KM (t) UCL	0.11							
3235												
3236	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3237	Recommendations are based upon data size, data distribution, and skewness.											
3238	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3239	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3240												
3241												
3242	**Result (eu4_zinc_roadway)**											
3243												
3244					**General Statistics**							
3245				Total Number of Observations	7			Number of Distinct Observations	7			
3246								Number of Missing Observations	0			
3247				Minimum	26.8			Mean	602.5			
3248				Maximum	3840			Median	58.8			
3249				SD	1428			Std. Error of Mean	539.7			
3250				Coefficient of Variation	2.37			Skewness	2.644			
3251												
3252	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
3253	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
3254	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
3255	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
3256												
3257					**Normal GOF Test**							
3258				Shapiro Wilk Test Statistic	0.471			**Shapiro Wilk GOF Test**				
3259				5% Shapiro Wilk Critical Value	0.803			Data Not Normal at 5% Significance Level				
3260				Lilliefors Test Statistic	0.49			**Lilliefors GOF Test**				
3261				5% Lilliefors Critical Value	0.304			Data Not Normal at 5% Significance Level				
3262					**Data Not Normal at 5% Significance Level**							
3263												
3264					**Assuming Normal Distribution**							
3265				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
3266				95% Student's-t UCL	1651			95% Adjusted-CLT UCL (Chen-1995)	2066			
3267								95% Modified-t UCL (Johnson-1978)	1741			
3268												
3269					**Gamma GOF Test**							
3270				A-D Test Statistic	1.538			**Anderson-Darling Gamma GOF Test**				
3271				5% A-D Critical Value	0.771			Data Not Gamma Distributed at 5% Significance Level				
3272				K-S Test Statistic	0.445			**Kolmogorov-Smirnov Gamma GOF Test**				
3273				5% K-S Critical Value	0.332			Data Not Gamma Distributed at 5% Significance Level				
3274					**Data Not Gamma Distributed at 5% Significance Level**							
3275												
3276					**Gamma Statistics**							
3277				k hat (MLE)	0.379			k star (bias corrected MLE)	0.312			
3278				Theta hat (MLE)	1591			Theta star (bias corrected MLE)	1933			
3279				nu hat (MLE)	5.302			nu star (bias corrected)	4.363			
3280				MLE Mean (bias corrected)	602.5			MLE Sd (bias corrected)	1079			
3281								Approximate Chi Square Value (0.05)	0.87			
3282				Adjusted Level of Significance	0.0158			Adjusted Chi Square Value	0.497			
3283												

3284	**Assuming Gamma Distribution**											
3285	95% Approximate Gamma UCL (use when n>=50))					3021	95% Adjusted Gamma UCL (use when n<50)					5292
3286												
3287	**Lognormal GOF Test**											
3288	Shapiro Wilk Test Statistic					0.704	**Shapiro Wilk Lognormal GOF Test**					
3289	5% Shapiro Wilk Critical Value					0.803	Data Not Lognormal at 5% Significance Level					
3290	Lilliefors Test Statistic					0.328	**Lilliefors Lognormal GOF Test**					
3291	5% Lilliefors Critical Value					0.304	Data Not Lognormal at 5% Significance Level					
3292	**Data Not Lognormal at 5% Significance Level**											
3293												
3294	**Lognormal Statistics**											
3295	Minimum of Logged Data					3.288	Mean of logged Data					4.648
3296	Maximum of Logged Data					8.253	SD of logged Data					1.649
3297												
3298	**Assuming Lognormal Distribution**											
3299	95% H-UCL					18206	90% Chebyshev (MVUE) UCL					822.3
3300	95% Chebyshev (MVUE) UCL					1062	97.5% Chebyshev (MVUE) UCL					1394
3301	99% Chebyshev (MVUE) UCL					2047						
3302												
3303	**Nonparametric Distribution Free UCL Statistics**											
3304	**Data do not follow a Discernible Distribution (0.05)**											
3305												
3306	**Nonparametric Distribution Free UCLs**											
3307	95% CLT UCL					1490	95% Jackknife UCL					1651
3308	95% Standard Bootstrap UCL					1423	95% Bootstrap-t UCL					54420
3309	95% Hall's Bootstrap UCL					32608	95% Percentile Bootstrap UCL					1676
3310	95% BCA Bootstrap UCL					1697						
3311	90% Chebyshev(Mean, Sd) UCL					2222	95% Chebyshev(Mean, Sd) UCL					2955
3312	97.5% Chebyshev(Mean, Sd) UCL					3973	99% Chebyshev(Mean, Sd) UCL					5972
3313												
3314	**Suggested UCL to Use**											
3315	95% Hall's Bootstrap UCL					32608						
3316												
3317	**Recommended UCL exceeds the maximum observation**											
3318												
3319	**Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL**											
3320												
3321	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3322	Recommendations are based upon data size, data distribution, and skewness.											
3323	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3324	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3325												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.12/1/2019 1:28:07 PM										
5	From File	BPMD_HHRA_SedInput_v3.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10												
11	**Result (eu6_arsenic)**											
12												
13	**General Statistics**											
14	Total Number of Observations			4			Number of Distinct Observations				4	
15							Number of Missing Observations				0	
16	Minimum			14.9			Mean				21.1	
17	Maximum			29.2			Median				20.15	
18	SD			5.951			Std. Error of Mean				2.976	
19	Coefficient of Variation			0.282			Skewness				0.918	
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic			0.937			**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value			0.748			Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic			0.283			**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value			0.375			Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL			28.1			95% Adjusted-CLT UCL (Chen-1995)				27.45	
36							95% Modified-t UCL (Johnson-1978)				28.33	
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic			0.287			**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value			0.657			Detected data appear Gamma Distributed at 5% Significance Lev					
41	K-S Test Statistic			0.258			**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value			0.394			Detected data appear Gamma Distributed at 5% Significance Lev					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)			17.46			k star (bias corrected MLE)				4.531	
47	Theta hat (MLE)			1.209			Theta star (bias corrected MLE)				4.657	
48	nu hat (MLE)			139.7			nu star (bias corrected)				36.25	
49	MLE Mean (bias corrected)			21.1			MLE Sd (bias corrected)				9.912	
50							Approximate Chi Square Value (0.05)				23.47	
51	Adjusted Level of Significance			N/A			Adjusted Chi Square Value				N/A	
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))			32.59			95% Adjusted Gamma UCL (use when n<50)				N/A	
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic			0.966			**Shapiro Wilk Lognormal GOF Test**					
58	5% Shapiro Wilk Critical Value			0.748			Data appear Lognormal at 5% Significance Level					
59	Lilliefors Test Statistic			0.243			**Lilliefors Lognormal GOF Test**					
60	5% Lilliefors Critical Value			0.375			Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data			2.701			Mean of logged Data				3.02	
65	Maximum of Logged Data			3.374			SD of logged Data				0.276	
66												
67	**Assuming Lognormal Distribution**											

68					95% H-UCL	32.72				90% Chebyshev (MVUE) UCL		29.77
69					95% Chebyshev (MVUE) UCL	33.7				97.5% Chebyshev (MVUE) UCL		39.16
70					99% Chebyshev (MVUE) UCL	49.88						
71												
72					**Nonparametric Distribution Free UCL Statistics**							
73					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
74												
75					**Nonparametric Distribution Free UCLs**							
76					95% CLT UCL	25.99				95% Jackknife UCL		28.1
77					95% Standard Bootstrap UCL	N/A				95% Bootstrap-t UCL		N/A
78					95% Hall's Bootstrap UCL	N/A				95% Percentile Bootstrap UCL		N/A
79					95% BCA Bootstrap UCL	N/A						
80					90% Chebyshev(Mean, Sd) UCL	30.03				95% Chebyshev(Mean, Sd) UCL		34.07
81					97.5% Chebyshev(Mean, Sd) UCL	39.68				99% Chebyshev(Mean, Sd) UCL		50.71
82												
83					**Suggested UCL to Use**							
84					95% Student's-t UCL	28.1						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
90												
91												
92	**Result (eu6_cadmium)**											
93												
94					**General Statistics**							
95					Total Number of Observations	4				Number of Distinct Observations		4
96										Number of Missing Observations		0
97					Minimum	2				Mean		2.813
98					Maximum	3.45				Median		2.9
99					SD	0.684				Std. Error of Mean		0.342
100					Coefficient of Variation	0.243				Skewness		-0.401
101												
102	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
103	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
104	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
105	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
106												
107					**Normal GOF Test**							
108					Shapiro Wilk Test Statistic	0.912				**Shapiro Wilk GOF Test**		
109					5% Shapiro Wilk Critical Value	0.748				Data appear Normal at 5% Significance Level		
110					Lilliefors Test Statistic	0.262				**Lilliefors GOF Test**		
111					5% Lilliefors Critical Value	0.375				Data appear Normal at 5% Significance Level		
112					**Data appear Normal at 5% Significance Level**							
113												
114					**Assuming Normal Distribution**							
115					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
116					95% Student's-t UCL	3.617				95% Adjusted-CLT UCL (Chen-1995)		3.302
117										95% Modified-t UCL (Johnson-1978)		3.605
118												
119					**Gamma GOF Test**							
120					A-D Test Statistic	0.351				**Anderson-Darling Gamma GOF Test**		
121					5% A-D Critical Value	0.657				Detected data appear Gamma Distributed at 5% Significance Lev		
122					K-S Test Statistic	0.297				**Kolmogorov-Smirnov Gamma GOF Test**		
123					5% K-S Critical Value	0.394				Detected data appear Gamma Distributed at 5% Significance Lev		
124					**Detected data appear Gamma Distributed at 5% Significance Level**							
125												
126					**Gamma Statistics**							
127					k hat (MLE)	21.32				k star (bias corrected MLE)		5.496
128					Theta hat (MLE)	0.132				Theta star (bias corrected MLE)		0.512
129					nu hat (MLE)	170.5				nu star (bias corrected)		43.96
130					MLE Mean (bias corrected)	2.813				MLE Sd (bias corrected)		1.2
131										Approximate Chi Square Value (0.05)		29.76
132					Adjusted Level of Significance	N/A				Adjusted Chi Square Value		N/A
133												
134					**Assuming Gamma Distribution**							

135	95% Approximate Gamma UCL (use when n>=50))					4.155	95% Adjusted Gamma UCL (use when n<50)					N/A
136												
137	**Lognormal GOF Test**											
138	Shapiro Wilk Test Statistic					0.909	**Shapiro Wilk Lognormal GOF Test**					
139	5% Shapiro Wilk Critical Value					0.748	Data appear Lognormal at 5% Significance Level					
140	Lilliefors Test Statistic					0.264	**Lilliefors Lognormal GOF Test**					
141	5% Lilliefors Critical Value					0.375	Data appear Lognormal at 5% Significance Level					
142	**Data appear Lognormal at 5% Significance Level**											
143												
144	**Lognormal Statistics**											
145	Minimum of Logged Data					0.693	Mean of logged Data					1.01
146	Maximum of Logged Data					1.238	SD of logged Data					0.255
147												
148	**Assuming Lognormal Distribution**											
149	95% H-UCL					4.178	90% Chebyshev (MVUE) UCL					3.886
150	95% Chebyshev (MVUE) UCL					4.371	97.5% Chebyshev (MVUE) UCL					5.045
151	99% Chebyshev (MVUE) UCL					6.368						
152												
153	**Nonparametric Distribution Free UCL Statistics**											
154	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
155												
156	**Nonparametric Distribution Free UCLs**											
157	95% CLT UCL					3.375	95% Jackknife UCL					3.617
158	95% Standard Bootstrap UCL					N/A	95% Bootstrap-t UCL					N/A
159	95% Hall's Bootstrap UCL					N/A	95% Percentile Bootstrap UCL					N/A
160	95% BCA Bootstrap UCL					N/A						
161	90% Chebyshev(Mean, Sd) UCL					3.838	95% Chebyshev(Mean, Sd) UCL					4.302
162	97.5% Chebyshev(Mean, Sd) UCL					4.947	99% Chebyshev(Mean, Sd) UCL					6.213
163												
164	**Suggested UCL to Use**											
165	95% Student's-t UCL					3.617						
166												
167	**Recommended UCL exceeds the maximum observation**											
168												
169	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
170	Recommendations are based upon data size, data distribution, and skewness.											
171	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
172	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
173												
174	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
175	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
176												
177												
178	**Result (eu6_chromium)**											
179												
180	**General Statistics**											
181	Total Number of Observations					4	Number of Distinct Observations					4
182							Number of Missing Observations					0
183	Minimum					1.4	Mean					2.463
184	Maximum					3.3	Median					2.575
185	SD					0.86	Std. Error of Mean					0.43
186	Coefficient of Variation					0.349	Skewness					-0.511
187												
188	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
189	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
190	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
191	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
192												
193	**Normal GOF Test**											
194	Shapiro Wilk Test Statistic					0.946	**Shapiro Wilk GOF Test**					
195	5% Shapiro Wilk Critical Value					0.748	Data appear Normal at 5% Significance Level					
196	Lilliefors Test Statistic					0.234	**Lilliefors GOF Test**					
197	5% Lilliefors Critical Value					0.375	Data appear Normal at 5% Significance Level					
198	**Data appear Normal at 5% Significance Level**											
199												
200	**Assuming Normal Distribution**											
201	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					

202					95% Student's-t UCL	3.474			95% Adjusted-CLT UCL (Chen-1995)			3.052
203									95% Modified-t UCL (Johnson-1978)			3.456
204												
205					**Gamma GOF Test**							
206					A-D Test Statistic	0.306	**Anderson-Darling Gamma GOF Test**					
207					5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Lev					
208					K-S Test Statistic	0.271	**Kolmogorov-Smirnov Gamma GOF Test**					
209					5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Lev					
210					**Detected data appear Gamma Distributed at 5% Significance Level**							
211												
212					**Gamma Statistics**							
213					k hat (MLE)	9.677	k star (bias corrected MLE)					2.586
214					Theta hat (MLE)	0.254	Theta star (bias corrected MLE)					0.952
215					nu hat (MLE)	77.42	nu star (bias corrected)					20.69
216					MLE Mean (bias corrected)	2.463	MLE Sd (bias corrected)					1.531
217							Approximate Chi Square Value (0.05)					11.36
218					Adjusted Level of Significance	N/A	Adjusted Chi Square Value					N/A
219												
220					**Assuming Gamma Distribution**							
221					95% Approximate Gamma UCL (use when n>=50))	4.485	95% Adjusted Gamma UCL (use when n<50)					N/A
222												
223					**Lognormal GOF Test**							
224					Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk Lognormal GOF Test**					
225					5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level					
226					Lilliefors Test Statistic	0.24	**Lilliefors Lognormal GOF Test**					
227					5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level					
228					**Data appear Lognormal at 5% Significance Level**							
229												
230					**Lognormal Statistics**							
231					Minimum of Logged Data	0.336	Mean of logged Data					0.849
232					Maximum of Logged Data	1.194	SD of logged Data					0.388
233												
234					**Assuming Lognormal Distribution**							
235					95% H-UCL	5.066	90% Chebyshev (MVUE) UCL					3.891
236					95% Chebyshev (MVUE) UCL	4.534	97.5% Chebyshev (MVUE) UCL					5.427
237					99% Chebyshev (MVUE) UCL	7.182						
238												
239					**Nonparametric Distribution Free UCL Statistics**							
240					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
241												
242					**Nonparametric Distribution Free UCLs**							
243					95% CLT UCL	3.169	95% Jackknife UCL					3.474
244					95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL					N/A
245					95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL					N/A
246					95% BCA Bootstrap UCL	N/A						
247					90% Chebyshev(Mean, Sd) UCL	3.752	95% Chebyshev(Mean, Sd) UCL					4.336
248					97.5% Chebyshev(Mean, Sd) UCL	5.147	99% Chebyshev(Mean, Sd) UCL					6.739
249												
250					**Suggested UCL to Use**							
251					95% Student's-t UCL	3.474						
252												
253					**Recommended UCL exceeds the maximum observation**							
254												
255	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
256	Recommendations are based upon data size, data distribution, and skewness.											
257	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
258	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
259												
260	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
261	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
262												
263												
264	**Result (eu6_cobalt)**											
265												
266					**General Statistics**							
267					Total Number of Observations	3	Number of Distinct Observations					3
268							Number of Missing Observations					0

269					Minimum	11.1				Mean		20.1
270					Maximum	27.5				Median		21.7
271					SD	8.316				Std. Error of Mean		4.801
272					Coefficient of Variation	0.414				Skewness		-0.834
273												
274	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
275	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
276	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
277	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
278												
279	**Normal GOF Test**											
280					Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**					
281					5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level					
282					Lilliefors Test Statistic	0.243	**Lilliefors GOF Test**					
283					5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level					
284	**Data appear Normal at 5% Significance Level**											
285												
286	**Assuming Normal Distribution**											
287	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
288					95% Student's-t UCL	34.12	95% Adjusted-CLT UCL (Chen-1995)					25.53
289							95% Modified-t UCL (Johnson-1978)					33.73
290												
291	**Gamma GOF Test**											
292	**Not Enough Data to Perform GOF Test**											
293												
294	**Gamma Statistics**											
295					k hat (MLE)	7.526	k star (bias corrected MLE)					N/A
296					Theta hat (MLE)	2.671	Theta star (bias corrected MLE)					N/A
297					nu hat (MLE)	45.16	nu star (bias corrected)					N/A
298					MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)					N/A
299							Approximate Chi Square Value (0.05)					N/A
300					Adjusted Level of Significance	N/A	Adjusted Chi Square Value					N/A
301												
302	**Assuming Gamma Distribution**											
303	95% Approximate Gamma UCL (use when n>=50))					N/A	95% Adjusted Gamma UCL (use when n<50)					N/A
304												
305	**Lognormal GOF Test**											
306					Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk Lognormal GOF Test**					
307					5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level					
308					Lilliefors Test Statistic	0.287	**Lilliefors Lognormal GOF Test**					
309					5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level					
310	**Data appear Lognormal at 5% Significance Level**											
311												
312	**Lognormal Statistics**											
313					Minimum of Logged Data	2.407	Mean of logged Data					2.933
314					Maximum of Logged Data	3.314	SD of logged Data					0.471
315												
316	**Assuming Lognormal Distribution**											
317					95% H-UCL	159.8	90% Chebyshev (MVUE) UCL					36.21
318					95% Chebyshev (MVUE) UCL	43.47	97.5% Chebyshev (MVUE) UCL					53.54
319					99% Chebyshev (MVUE) UCL	73.32						
320												
321	**Nonparametric Distribution Free UCL Statistics**											
322	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
323												
324	**Nonparametric Distribution Free UCLs**											
325					95% CLT UCL	28	95% Jackknife UCL					34.12
326					95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL					N/A
327					95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL					N/A
328					95% BCA Bootstrap UCL	N/A						
329					90% Chebyshev(Mean, Sd) UCL	34.5	95% Chebyshev(Mean, Sd) UCL					41.03
330					97.5% Chebyshev(Mean, Sd) UCL	50.08	99% Chebyshev(Mean, Sd) UCL					67.87
331												
332	**Suggested UCL to Use**											
333					95% Student's-t UCL	34.12						
334												
335	**Recommended UCL exceeds the maximum observation**											

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Result (eu6_copper)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	11.6	Mean	18.9
Maximum	22	Median	21
SD	4.906	Std. Error of Mean	2.453
Coefficient of Variation	0.26	Skewness	-1.905

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.741	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.378	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	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	24.67	95% Adjusted-CLT UCL (Chen-1995)	20.44
		95% Modified-t UCL (Johnson-1978)	24.28

Gamma GOF Test

A-D Test Statistic	0.737	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.657	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.41	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.395	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	16.02	k star (bias corrected MLE)	4.172
Theta hat (MLE)	1.18	Theta star (bias corrected MLE)	4.53
nu hat (MLE)	128.2	nu star (bias corrected)	33.38
MLE Mean (bias corrected)	18.9	MLE Sd (bias corrected)	9.253
		Approximate Chi Square Value (0.05)	21.17
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	29.8	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.715	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.394	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.375	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.451	Mean of logged Data	2.908
Maximum of Logged Data	3.091	SD of logged Data	0.306

Assuming Lognormal Distribution

403					95% H-UCL	31.45				90% Chebyshev (MVUE) UCL		27.6	
404					95% Chebyshev (MVUE) UCL	31.51				97.5% Chebyshev (MVUE) UCL		36.94	
405					99% Chebyshev (MVUE) UCL	47.61							
406													
407					**Nonparametric Distribution Free UCL Statistics**								
408					**Data do not follow a Discernible Distribution (0.05)**								
409													
410					**Nonparametric Distribution Free UCLs**								
411					95% CLT UCL	22.94				95% Jackknife UCL		24.67	
412					95% Standard Bootstrap UCL	N/A				95% Bootstrap-t UCL		N/A	
413					95% Hall's Bootstrap UCL	N/A				95% Percentile Bootstrap UCL		N/A	
414					95% BCA Bootstrap UCL	N/A							
415					90% Chebyshev(Mean, Sd) UCL	26.26				95% Chebyshev(Mean, Sd) UCL		29.59	
416					97.5% Chebyshev(Mean, Sd) UCL	34.22				99% Chebyshev(Mean, Sd) UCL		43.31	
417													
418					**Suggested UCL to Use**								
419					95% Student's-t UCL	24.67				or 95% Modified-t UCL		24.28	
420													
421					**Recommended UCL exceeds the maximum observation**								
422													
423	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
424	Recommendations are based upon data size, data distribution, and skewness.												
425	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
426	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia												
427													
428	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**												
429	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**												
430													
431													
432	**Result (eu6_iron)**												
433													
434					**General Statistics**								
435					Total Number of Observations	4				Number of Distinct Observations		4	
436										Number of Missing Observations		0	
437					Minimum	13700				Mean		23200	
438					Maximum	33100				Median		23000	
439					SD	8343				Std. Error of Mean		4172	
440					Coefficient of Variation	0.36				Skewness		0.116	
441													
442	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**												
443	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**												
444	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**												
445	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**												
446													
447					**Normal GOF Test**								
448					Shapiro Wilk Test Statistic	0.994				**Shapiro Wilk GOF Test**			
449					5% Shapiro Wilk Critical Value	0.748				Data appear Normal at 5% Significance Level			
450					Lilliefors Test Statistic	0.158				**Lilliefors GOF Test**			
451					5% Lilliefors Critical Value	0.375				Data appear Normal at 5% Significance Level			
452					**Data appear Normal at 5% Significance Level**								
453													
454					**Assuming Normal Distribution**								
455					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
456					95% Student's-t UCL	33017				95% Adjusted-CLT UCL (Chen-1995)		30319	
457										95% Modified-t UCL (Johnson-1978)		33057	
458													
459					**Gamma GOF Test**								
460					A-D Test Statistic	0.204				**Anderson-Darling Gamma GOF Test**			
461					5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Lev						
462					K-S Test Statistic	0.189				**Kolmogorov-Smirnov Gamma GOF Test**			
463					5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Lev						
464					**Detected data appear Gamma Distributed at 5% Significance Level**								
465													
466					**Gamma Statistics**								
467					k hat (MLE)	9.768				k star (bias corrected MLE)		2.609	
468					Theta hat (MLE)	2375				Theta star (bias corrected MLE)		8893	
469					nu hat (MLE)	78.14				nu star (bias corrected)		20.87	

470	MLE Mean (bias corrected)				23200	MLE Sd (bias corrected)					14364	
471						Approximate Chi Square Value (0.05)					11.49	
472	Adjusted Level of Significance				N/A	Adjusted Chi Square Value					N/A	
473												
474	**Assuming Gamma Distribution**											
475	95% Approximate Gamma UCL (use when n>=50))				42122	95% Adjusted Gamma UCL (use when n<50)					N/A	
476												
477	**Lognormal GOF Test**											
478	Shapiro Wilk Test Statistic				0.986	**Shapiro Wilk Lognormal GOF Test**						
479	5% Shapiro Wilk Critical Value				0.748	Data appear Lognormal at 5% Significance Level						
480	Lilliefors Test Statistic				0.176	**Lilliefors Lognormal GOF Test**						
481	5% Lilliefors Critical Value				0.375	Data appear Lognormal at 5% Significance Level						
482	**Data appear Lognormal at 5% Significance Level**											
483												
484	**Lognormal Statistics**											
485	Minimum of Logged Data				9.525	Mean of logged Data					10	
486	Maximum of Logged Data				10.41	SD of logged Data					0.38	
487												
488	**Assuming Lognormal Distribution**											
489	95% H-UCL				46592	90% Chebyshev (MVUE) UCL					36329	
490	95% Chebyshev (MVUE) UCL				42261	97.5% Chebyshev (MVUE) UCL					50494	
491	99% Chebyshev (MVUE) UCL				66666							
492												
493	**Nonparametric Distribution Free UCL Statistics**											
494	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
495												
496	**Nonparametric Distribution Free UCLs**											
497	95% CLT UCL				30062	95% Jackknife UCL					33017	
498	95% Standard Bootstrap UCL				N/A	95% Bootstrap-t UCL					N/A	
499	95% Hall's Bootstrap UCL				N/A	95% Percentile Bootstrap UCL					N/A	
500	95% BCA Bootstrap UCL				N/A							
501	90% Chebyshev(Mean, Sd) UCL				35715	95% Chebyshev(Mean, Sd) UCL					41383	
502	97.5% Chebyshev(Mean, Sd) UCL				49251	99% Chebyshev(Mean, Sd) UCL					64706	
503												
504	**Suggested UCL to Use**											
505	95% Student's-t UCL				33017							
506												
507	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
508	Recommendations are based upon data size, data distribution, and skewness.											
509	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
510	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
511												
512												
513	**Result (eu6_lead)**											
514												
515	**General Statistics**											
516	Total Number of Observations				4	Number of Distinct Observations					4	
517						Number of Missing Observations					0	
518	Minimum				222	Mean					287	
519	Maximum				420	Median					253	
520	SD				90.81	Std. Error of Mean					45.4	
521	Coefficient of Variation				0.316	Skewness					1.734	
522												
523	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
524	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
525	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
526	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
527												
528	**Normal GOF Test**											
529	Shapiro Wilk Test Statistic				0.809	**Shapiro Wilk GOF Test**						
530	5% Shapiro Wilk Critical Value				0.748	Data appear Normal at 5% Significance Level						
531	Lilliefors Test Statistic				0.329	**Lilliefors GOF Test**						
532	5% Lilliefors Critical Value				0.375	Data appear Normal at 5% Significance Level						
533	**Data appear Normal at 5% Significance Level**											
534												
535	**Assuming Normal Distribution**											
536	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						

537					95% Student's-t UCL	393.9			95% Adjusted-CLT UCL (Chen-1995)			403.7
538									95% Modified-t UCL (Johnson-1978)			400.4
539												
540					**Gamma GOF Test**							
541					A-D Test Statistic	0.486			**Anderson-Darling Gamma GOF Test**			
542					5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Lev					
543					K-S Test Statistic	0.315			**Kolmogorov-Smirnov Gamma GOF Test**			
544					5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Lev					
545					**Detected data appear Gamma Distributed at 5% Significance Level**							
546												
547					**Gamma Statistics**							
548					k hat (MLE)	15.29			k star (bias corrected MLE)			3.989
549					Theta hat (MLE)	18.77			Theta star (bias corrected MLE)			71.94
550					nu hat (MLE)	122.3			nu star (bias corrected)			31.91
551					MLE Mean (bias corrected)	287			MLE Sd (bias corrected)			143.7
552									Approximate Chi Square Value (0.05)			20
553					Adjusted Level of Significance	N/A			Adjusted Chi Square Value			N/A
554												
555					**Assuming Gamma Distribution**							
556					95% Approximate Gamma UCL (use when n>=50))	457.9			95% Adjusted Gamma UCL (use when n<50)			N/A
557												
558					**Lognormal GOF Test**							
559					Shapiro Wilk Test Statistic	0.853			**Shapiro Wilk Lognormal GOF Test**			
560					5% Shapiro Wilk Critical Value	0.748			Data appear Lognormal at 5% Significance Level			
561					Lilliefors Test Statistic	0.294			**Lilliefors Lognormal GOF Test**			
562					5% Lilliefors Critical Value	0.375			Data appear Lognormal at 5% Significance Level			
563					**Data appear Lognormal at 5% Significance Level**							
564												
565					**Lognormal Statistics**							
566					Minimum of Logged Data	5.403			Mean of logged Data			5.626
567					Maximum of Logged Data	6.04			SD of logged Data			0.287
568												
569					**Assuming Lognormal Distribution**							
570					95% H-UCL	455.2			90% Chebyshev (MVUE) UCL			408.9
571					95% Chebyshev (MVUE) UCL	464.4			97.5% Chebyshev (MVUE) UCL			541.5
572					99% Chebyshev (MVUE) UCL	692.9						
573												
574					**Nonparametric Distribution Free UCL Statistics**							
575					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
576												
577					**Nonparametric Distribution Free UCLs**							
578					95% CLT UCL	361.7			95% Jackknife UCL			393.9
579					95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL			N/A
580					95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL			N/A
581					95% BCA Bootstrap UCL	N/A						
582					90% Chebyshev(Mean, Sd) UCL	423.2			95% Chebyshev(Mean, Sd) UCL			484.9
583					97.5% Chebyshev(Mean, Sd) UCL	570.5			99% Chebyshev(Mean, Sd) UCL			738.8
584												
585					**Suggested UCL to Use**							
586					95% Student's-t UCL	393.9						
587												
588	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
589	Recommendations are based upon data size, data distribution, and skewness.											
590	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
591	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
592												
593												
594	**Result (eu6_manganese)**											
595												
596					**General Statistics**							
597					Total Number of Observations	4			Number of Distinct Observations			4
598									Number of Missing Observations			0
599					Minimum	1910			Mean			2438
600					Maximum	2780			Median			2530
601					SD	375.3			Std. Error of Mean			187.6
602					Coefficient of Variation	0.154			Skewness			-1.291
603												

604	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
605	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
606	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
607	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
608												
609	**Normal GOF Test**											
610						Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk GOF Test**				
611						5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level				
612						Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**				
613						5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level				
614	**Data appear Normal at 5% Significance Level**											
615												
616	**Assuming Normal Distribution**											
617	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
618						95% Student's-t UCL	2879	95% Adjusted-CLT UCL (Chen-1995)	2617			
619								95% Modified-t UCL (Johnson-1978)	2859			
620												
621	**Gamma GOF Test**											
622						A-D Test Statistic	0.384	**Anderson-Darling Gamma GOF Test**				
623						5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Lev				
624						K-S Test Statistic	0.295	**Kolmogorov-Smirnov Gamma GOF Test**				
625						5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Lev				
626	**Detected data appear Gamma Distributed at 5% Significance Level**											
627												
628	**Gamma Statistics**											
629						k hat (MLE)	51.89	k star (bias corrected MLE)	13.14			
630						Theta hat (MLE)	46.97	Theta star (bias corrected MLE)	185.5			
631						nu hat (MLE)	415.1	nu star (bias corrected)	105.1			
632						MLE Mean (bias corrected)	2438	MLE Sd (bias corrected)	672.4			
633								Approximate Chi Square Value (0.05)	82.46			
634						Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A			
635												
636	**Assuming Gamma Distribution**											
637	95% Approximate Gamma UCL (use when n>=50))						3107	95% Adjusted Gamma UCL (use when n<50)	N/A			
638												
639	**Lognormal GOF Test**											
640						Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk Lognormal GOF Test**				
641						5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level				
642						Lilliefors Test Statistic	0.296	**Lilliefors Lognormal GOF Test**				
643						5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level				
644	**Data appear Lognormal at 5% Significance Level**											
645												
646	**Lognormal Statistics**											
647						Minimum of Logged Data	7.555	Mean of logged Data	7.789			
648						Maximum of Logged Data	7.93	SD of logged Data	0.164			
649												
650	**Assuming Lognormal Distribution**											
651						95% H-UCL	3061	90% Chebyshev (MVUE) UCL	3037			
652						95% Chebyshev (MVUE) UCL	3308	97.5% Chebyshev (MVUE) UCL	3684			
653						99% Chebyshev (MVUE) UCL	4423					
654												
655	**Nonparametric Distribution Free UCL Statistics**											
656	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
657												
658	**Nonparametric Distribution Free UCLs**											
659						95% CLT UCL	2746	95% Jackknife UCL	2879			
660						95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A			
661						95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A			
662						95% BCA Bootstrap UCL	N/A					
663						90% Chebyshev(Mean, Sd) UCL	3000	95% Chebyshev(Mean, Sd) UCL	3255			
664						97.5% Chebyshev(Mean, Sd) UCL	3609	99% Chebyshev(Mean, Sd) UCL	4304			
665												
666	**Suggested UCL to Use**											
667						95% Student's-t UCL	2879					
668												
669	**Recommended UCL exceeds the maximum observation**											
670												

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 statisticia

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Result (eu6_thallium)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	0	Number of Non-Detects	4
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 Result (eu6_thallium) was not processed!

Result (eu6_zinc)

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	422	Mean	713
Maximum	1030	Median	700
SD	258.4	Std. Error of Mean	129.2
Coefficient of Variation	0.362	Skewness	0.256

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.996	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.149	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1017	95% Adjusted-CLT UCL (Chen-1995)	943.2
		95% Modified-t UCL (Johnson-1978)	1020

Gamma GOF Test

A-D Test Statistic	0.193	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Lev
K-S Test Statistic	0.168	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Lev

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.749	k star (bias corrected MLE)	2.604
Theta hat (MLE)	73.14	Theta star (bias corrected MLE)	273.8
nu hat (MLE)	77.99	nu star (bias corrected)	20.83
MLE Mean (bias corrected)	713	MLE Sd (bias corrected)	441.9
		Approximate Chi Square Value (0.05)	11.47
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1295	95% Adjusted Gamma UCL (use when n<50)	N/A

738												
739						**Lognormal GOF Test**						
740					Shapiro Wilk Test Statistic	0.993	**Shapiro Wilk Lognormal GOF Test**					
741					5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level					
742					Lilliefors Test Statistic	0.153	**Lilliefors Lognormal GOF Test**					
743					5% Lilliefors Critical Value	0.375	Data appear Lognormal at 5% Significance Level					
744					**Data appear Lognormal at 5% Significance Level**							
745												
746						**Lognormal Statistics**						
747					Minimum of Logged Data	6.045	Mean of logged Data	6.517				
748					Maximum of Logged Data	6.937	SD of logged Data	0.379				
749												
750						**Assuming Lognormal Distribution**						
751					95% H-UCL	1429	90% Chebyshev (MVUE) UCL	1116				
752					95% Chebyshev (MVUE) UCL	1297	97.5% Chebyshev (MVUE) UCL	1550				
753					99% Chebyshev (MVUE) UCL	2046						
754												
755						**Nonparametric Distribution Free UCL Statistics**						
756						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
757												
758						**Nonparametric Distribution Free UCLs**						
759					95% CLT UCL	925.5	95% Jackknife UCL	1017				
760					95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A				
761					95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A				
762					95% BCA Bootstrap UCL	N/A						
763					90% Chebyshev(Mean, Sd) UCL	1101	95% Chebyshev(Mean, Sd) UCL	1276				
764					97.5% Chebyshev(Mean, Sd) UCL	1520	99% Chebyshev(Mean, Sd) UCL	1998				
765												
766						**Suggested UCL to Use**						
767					95% Student's-t UCL	1017						
768												
769	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
770	Recommendations are based upon data size, data distribution, and skewness.											
771	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
772	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
773												
774												
775	**Result (eu7_arsenic)**											
776												
777						**General Statistics**						
778					Total Number of Observations	39	Number of Distinct Observations	37				
779							Number of Missing Observations	0				
780					Minimum	5.1	Mean	26.07				
781					Maximum	83	Median	19.8				
782					SD	19.5	Std. Error of Mean	3.123				
783					Coefficient of Variation	0.748	Skewness	1.18				
784												
785						**Normal GOF Test**						
786					Shapiro Wilk Test Statistic	0.869	**Shapiro Wilk GOF Test**					
787					5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level					
788					Lilliefors Test Statistic	0.186	**Lilliefors GOF Test**					
789					5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level					
790					**Data Not Normal at 5% Significance Level**							
791												
792						**Assuming Normal Distribution**						
793					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
794					95% Student's-t UCL	31.34	95% Adjusted-CLT UCL (Chen-1995)	31.84				
795							95% Modified-t UCL (Johnson-1978)	31.44				
796												
797						**Gamma GOF Test**						
798					A-D Test Statistic	0.504	**Anderson-Darling Gamma GOF Test**					
799					5% A-D Critical Value	0.76	Detected data appear Gamma Distributed at 5% Significance Lev					
800					K-S Test Statistic	0.101	**Kolmogorov-Smirnov Gamma GOF Test**					
801					5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Lev					
802					**Detected data appear Gamma Distributed at 5% Significance Level**							
803												
804						**Gamma Statistics**						

805					k hat (MLE)	1.95			k star (bias corrected MLE)			1.817
806					Theta hat (MLE)	13.37			Theta star (bias corrected MLE)			14.35
807					nu hat (MLE)	152.1			nu star (bias corrected)			141.7
808					MLE Mean (bias corrected)	26.07			MLE Sd (bias corrected)			19.34
809									Approximate Chi Square Value (0.05)			115.2
810					Adjusted Level of Significance	0.0437			Adjusted Chi Square Value			114.3
811												
812					**Assuming Gamma Distribution**							
813					95% Approximate Gamma UCL (use when n>=50)	32.07			95% Adjusted Gamma UCL (use when n<50)			32.33
814												
815					**Lognormal GOF Test**							
816					Shapiro Wilk Test Statistic	0.95			**Shapiro Wilk Lognormal GOF Test**			
817					5% Shapiro Wilk Critical Value	0.939			Data appear Lognormal at 5% Significance Level			
818					Lilliefors Test Statistic	0.111			**Lilliefors Lognormal GOF Test**			
819					5% Lilliefors Critical Value	0.14			Data appear Lognormal at 5% Significance Level			
820					**Data appear Lognormal at 5% Significance Level**							
821												
822					**Lognormal Statistics**							
823					Minimum of Logged Data	1.629			Mean of logged Data			2.983
824					Maximum of Logged Data	4.419			SD of logged Data			0.783
825												
826					**Assuming Lognormal Distribution**							
827					95% H-UCL	35.33			90% Chebyshev (MVUE) UCL			37.63
828					95% Chebyshev (MVUE) UCL	42.64			97.5% Chebyshev (MVUE) UCL			49.6
829					99% Chebyshev (MVUE) UCL	63.27						
830												
831					**Nonparametric Distribution Free UCL Statistics**							
832					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
833												
834					**Nonparametric Distribution Free UCLs**							
835					95% CLT UCL	31.21			95% Jackknife UCL			31.34
836					95% Standard Bootstrap UCL	31.2			95% Bootstrap-t UCL			32.03
837					95% Hall's Bootstrap UCL	32.1			95% Percentile Bootstrap UCL			31.35
838					95% BCA Bootstrap UCL	31.75						
839					90% Chebyshev(Mean, Sd) UCL	35.44			95% Chebyshev(Mean, Sd) UCL			39.69
840					97.5% Chebyshev(Mean, Sd) UCL	45.58			99% Chebyshev(Mean, Sd) UCL			57.15
841												
842					**Suggested UCL to Use**							
843					95% Adjusted Gamma UCL	32.33						
844												
845	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
846	Recommendations are based upon data size, data distribution, and skewness.											
847	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
848	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
849												
850	**Result (eu7_cadmium)**											
851												
852					**General Statistics**							
853					Total Number of Observations	39			Number of Distinct Observations			37
854					Number of Detects	38			Number of Non-Detects			1
855					Number of Distinct Detects	36			Number of Distinct Non-Detects			1
856					Minimum Detect	0.199			Minimum Non-Detect			0.064
857					Maximum Detect	268			Maximum Non-Detect			0.064
858					Variance Detects	1841			Percent Non-Detects			2.564%
859					Mean Detects	11.87			SD Detects			42.91
860					Median Detects	3.2			CV Detects			3.615
861					Skewness Detects	6.059			Kurtosis Detects			37.1
862					Mean of Logged Detects	1.063			SD of Logged Detects			1.529
863												
864					**Normal GOF Test on Detects Only**							
865					Shapiro Wilk Test Statistic	0.242			**Shapiro Wilk GOF Test**			
866					5% Shapiro Wilk Critical Value	0.938			Detected Data Not Normal at 5% Significance Level			
867					Lilliefors Test Statistic	0.45			**Lilliefors GOF Test**			
868					5% Lilliefors Critical Value	0.142			Detected Data Not Normal at 5% Significance Level			
869					**Detected Data Not Normal at 5% Significance Level**							
870												
871					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							

872					KM Mean	11.57				KM Standard Error of Mean		6.789
873					KM SD	41.84				95% KM (BCA) UCL		25.85
874					95% KM (t) UCL	23.01				95% KM (Percentile Bootstrap) UCL		24.95
875					95% KM (z) UCL	22.73				95% KM Bootstrap t UCL		88.67
876					90% KM Chebyshev UCL	31.93				95% KM Chebyshev UCL		41.16
877					97.5% KM Chebyshev UCL	53.96				99% KM Chebyshev UCL		79.11
878												
879					**Gamma GOF Tests on Detected Observations Only**							
880					A-D Test Statistic	2.649	**Anderson-Darling GOF Test**					
881					5% A-D Critical Value	0.822	Detected Data Not Gamma Distributed at 5% Significance Level					
882					K-S Test Statistic	0.239	**Kolmogorov-Smirnov GOF**					
883					5% K-S Critical Value	0.152	Detected Data Not Gamma Distributed at 5% Significance Level					
884					**Detected Data Not Gamma Distributed at 5% Significance Level**							
885												
886					**Gamma Statistics on Detected Data Only**							
887					k hat (MLE)	0.457	k star (bias corrected MLE)					0.438
888					Theta hat (MLE)	25.99	Theta star (bias corrected MLE)					27.09
889					nu hat (MLE)	34.71	nu star (bias corrected)					33.3
890					Mean (detects)	11.87						
891												
892					**Gamma ROS Statistics using Imputed Non-Detects**							
893					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
894					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)							
895					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
896					This is especially true when the sample size is small.							
897					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
898					Minimum	0.01	Mean					11.56
899					Maximum	268	Median					2.8
900					SD	42.38	CV					3.665
901					k hat (MLE)	0.426	k star (bias corrected MLE)					0.41
902					Theta hat (MLE)	27.16	Theta star (bias corrected MLE)					28.2
903					nu hat (MLE)	33.21	nu star (bias corrected)					31.99
904					Adjusted Level of Significance (β)	0.0437						
905					Approximate Chi Square Value (31.99, α)	20.06	Adjusted Chi Square Value (31.99, β)					19.69
906					95% Gamma Approximate UCL (use when n>=50)	18.44	95% Gamma Adjusted UCL (use when n<50)					18.79
907												
908					**Estimates of Gamma Parameters using KM Estimates**							
909					Mean (KM)	11.57	SD (KM)					41.84
910					Variance (KM)	1750	SE of Mean (KM)					6.789
911					k hat (KM)	0.0764	k star (KM)					0.0876
912					nu hat (KM)	5.962	nu star (KM)					6.836
913					theta hat (KM)	151.3	theta star (KM)					132
914					80% gamma percentile (KM)	6.51	90% gamma percentile (KM)					28.92
915					95% gamma percentile (KM)	67.39	99% gamma percentile (KM)					196.1
916												
917					**Gamma Kaplan-Meier (KM) Statistics**							
918					Approximate Chi Square Value (6.84, α)	2.081	Adjusted Chi Square Value (6.84, β)					1.979
919					5% Gamma Approximate KM-UCL (use when n>=50)	37.99	95% Gamma Adjusted KM-UCL (use when n<50)					39.94
920					95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)							
921												
922					**Lognormal GOF Test on Detected Observations Only**							
923					Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk GOF Test**					
924					5% Shapiro Wilk Critical Value	0.938	Detected Data appear Lognormal at 5% Significance Level					
925					Lilliefors Test Statistic	0.131	**Lilliefors GOF Test**					
926					5% Lilliefors Critical Value	0.142	Detected Data appear Lognormal at 5% Significance Level					
927					**Detected Data appear Lognormal at 5% Significance Level**							
928												
929					**Lognormal ROS Statistics Using Imputed Non-Detects**							
930					Mean in Original Scale	11.57	Mean in Log Scale					0.965
931					SD in Original Scale	42.38	SD in Log Scale					1.627
932					95% t UCL (assumes normality of ROS data)	23.01	95% Percentile Bootstrap UCL					25.04
933					95% BCA Bootstrap UCL	32.44	95% Bootstrap t UCL					87.97
934					95% H-UCL (Log ROS)	23.08						
935												
936					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
937					KM Mean (logged)	0.965	KM Geo Mean					2.626
938					KM SD (logged)	1.606	95% Critical H Value (KM-Log)					3.187

939	KM Standard Error of Mean (logged)				0.261		95% H-UCL (KM -Log)					21.88
940	KM SD (logged)				1.606		95% Critical H Value (KM-Log)					3.187
941	KM Standard Error of Mean (logged)				0.261							
942												
943	**DL/2 Statistics**											
944	**DL/2 Normal**						**DL/2 Log-Transformed**					
945	Mean in Original Scale				11.57		Mean in Log Scale					0.948
946	SD in Original Scale				42.38		SD in Log Scale					1.672
947	95% t UCL (Assumes normality)				23.01		95% H-Stat UCL					25.41
948	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
949												
950	**Nonparametric Distribution Free UCL Statistics**											
951	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
952												
953	**Suggested UCL to Use**											
954	95% KM (Chebyshev) UCL				41.16							
955												
956	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
957	Recommendations are based upon data size, data distribution, and skewness.											
958	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
959	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
960												
961	**Result (eu7_chromium)**											
962												
963	**General Statistics**											
964	Total Number of Observations				39		Number of Distinct Observations					31
965	Number of Detects				37		Number of Non-Detects					2
966	Number of Distinct Detects				29		Number of Distinct Non-Detects					2
967	Minimum Detect				1.9		Minimum Non-Detect					2.49
968	Maximum Detect				6.6		Maximum Non-Detect					5.03
969	Variance Detects				1.069		Percent Non-Detects					5.128%
970	Mean Detects				3.832		SD Detects					1.034
971	Median Detects				3.71		CV Detects					0.27
972	Skewness Detects				0.348		Kurtosis Detects					0.359
973	Mean of Logged Detects				1.306		SD of Logged Detects					0.283
974												
975	**Normal GOF Test on Detects Only**											
976	Shapiro Wilk Test Statistic				0.976		**Shapiro Wilk GOF Test**					
977	5% Shapiro Wilk Critical Value				0.936		Detected Data appear Normal at 5% Significance Level					
978	Lilliefors Test Statistic				0.0811		**Lilliefors GOF Test**					
979	5% Lilliefors Critical Value				0.144		Detected Data appear Normal at 5% Significance Level					
980	**Detected Data appear Normal at 5% Significance Level**											
981												
982	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
983	KM Mean				3.774		KM Standard Error of Mean					0.171
984	KM SD				1.045		95% KM (BCA) UCL					4.055
985	95% KM (t) UCL				4.063		95% KM (Percentile Bootstrap) UCL					4.055
986	95% KM (z) UCL				4.055		95% KM Bootstrap t UCL					4.061
987	90% KM Chebyshev UCL				4.287		95% KM Chebyshev UCL					4.519
988	97.5% KM Chebyshev UCL				4.842		99% KM Chebyshev UCL					5.475
989												
990	**Gamma GOF Tests on Detected Observations Only**											
991	A-D Test Statistic				0.301		**Anderson-Darling GOF Test**					
992	5% A-D Critical Value				0.748		Detected data appear Gamma Distributed at 5% Significance Lev					
993	K-S Test Statistic				0.0917		**Kolmogorov-Smirnov GOF**					
994	5% K-S Critical Value				0.145		Detected data appear Gamma Distributed at 5% Significance Lev					
995	**Detected data appear Gamma Distributed at 5% Significance Level**											
996												
997	**Gamma Statistics on Detected Data Only**											
998	k hat (MLE)				13.59		k star (bias corrected MLE)					12.5
999	Theta hat (MLE)				0.282		Theta star (bias corrected MLE)					0.306
1000	nu hat (MLE)				1005		nu star (bias corrected)					925.3
1001	Mean (detects)				3.832							
1002												
1003	**Gamma ROS Statistics using Imputed Non-Detects**											
1004	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1005	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)											

1006	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1007	This is especially true when the sample size is small.											
1008	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1009					Minimum	1.9			Mean	3.781		
1010					Maximum	6.6			Median	3.6		
1011					SD	1.041			CV	0.275		
1012					k hat (MLE)	13.1			k star (bias corrected MLE)	12.11		
1013					Theta hat (MLE)	0.289			Theta star (bias corrected MLE)	0.312		
1014					nu hat (MLE)	1022			nu star (bias corrected)	944.3		
1015					Adjusted Level of Significance (β)	0.0437						
1016					Approximate Chi Square Value (944.26, α)	873.9			Adjusted Chi Square Value (944.26, β)	871.3		
1017					95% Gamma Approximate UCL (use when n>=50)	4.085			95% Gamma Adjusted UCL (use when n<50)	4.098		
1018												
1019	**Estimates of Gamma Parameters using KM Estimates**											
1020					Mean (KM)	3.774			SD (KM)	1.045		
1021					Variance (KM)	1.092			SE of Mean (KM)	0.171		
1022					k hat (KM)	13.05			k star (KM)	12.06		
1023					nu hat (KM)	1018			nu star (KM)	940.8		
1024					theta hat (KM)	0.289			theta star (KM)	0.313		
1025					80% gamma percentile (KM)	4.646			90% gamma percentile (KM)	5.217		
1026					95% gamma percentile (KM)	5.722			99% gamma percentile (KM)	6.751		
1027												
1028	**Gamma Kaplan-Meier (KM) Statistics**											
1029					Approximate Chi Square Value (940.78, α)	870.6			Adjusted Chi Square Value (940.78, β)	867.9		
1030	5% Gamma Approximate KM-UCL (use when n>=50)					4.079			95% Gamma Adjusted KM-UCL (use when n<50)	4.091		
1031												
1032	**Lognormal GOF Test on Detected Observations Only**											
1033					Shapiro Wilk Test Statistic	0.962			**Shapiro Wilk GOF Test**			
1034					5% Shapiro Wilk Critical Value	0.936			Detected Data appear Lognormal at 5% Significance Level			
1035					Lilliefors Test Statistic	0.106			**Lilliefors GOF Test**			
1036					5% Lilliefors Critical Value	0.144			Detected Data appear Lognormal at 5% Significance Level			
1037	**Detected Data appear Lognormal at 5% Significance Level**											
1038												
1039	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1040					Mean in Original Scale	3.781			Mean in Log Scale	1.291		
1041					SD in Original Scale	1.039			SD in Log Scale	0.287		
1042					95% t UCL (assumes normality of ROS data)	4.061			95% Percentile Bootstrap UCL	4.063		
1043					95% BCA Bootstrap UCL	4.076			95% Bootstrap t UCL	4.092		
1044					95% H-UCL (Log ROS)	4.118						
1045												
1046	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1047					KM Mean (logged)	1.288			KM Geo Mean	3.624		
1048					KM SD (logged)	0.293			95% Critical H Value (KM-Log)	1.785		
1049					KM Standard Error of Mean (logged)	0.048			95% H-UCL (KM -Log)	4.117		
1050					KM SD (logged)	0.293			95% Critical H Value (KM-Log)	1.785		
1051					KM Standard Error of Mean (logged)	0.048						
1052												
1053	**DL/2 Statistics**											
1054	**DL/2 Normal**								**DL/2 Log-Transformed**			
1055					Mean in Original Scale	3.732			Mean in Log Scale	1.268		
1056					SD in Original Scale	1.106			SD in Log Scale	0.331		
1057					95% t UCL (Assumes normality)	4.03			95% H-Stat UCL	4.137		
1058	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1059												
1060	**Nonparametric Distribution Free UCL Statistics**											
1061	**Detected Data appear Normal Distributed at 5% Significance Level**											
1062												
1063	**Suggested UCL to Use**											
1064					95% KM (t) UCL	4.063						
1065												
1066	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1067	Recommendations are based upon data size, data distribution, and skewness.											
1068	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1069	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1070												
1071												
1072	**Result (eu7_cobalt)**											

1073												
1074						**General Statistics**						
1075						Total Number of Observations	29			Number of Distinct Observations	24	
1076										Number of Missing Observations	0	
1077						Minimum	3			Mean	10.9	
1078						Maximum	21.5			Median	12	
1079						SD	4.588			Std. Error of Mean	0.852	
1080						Coefficient of Variation	0.421			Skewness	0.0834	
1081												
1082						**Normal GOF Test**						
1083						Shapiro Wilk Test Statistic	0.961			**Shapiro Wilk GOF Test**		
1084						5% Shapiro Wilk Critical Value	0.926			Data appear Normal at 5% Significance Level		
1085						Lilliefors Test Statistic	0.112			**Lilliefors GOF Test**		
1086						5% Lilliefors Critical Value	0.161			Data appear Normal at 5% Significance Level		
1087						**Data appear Normal at 5% Significance Level**						
1088												
1089						**Assuming Normal Distribution**						
1090						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
1091						95% Student's-t UCL	12.35			95% Adjusted-CLT UCL (Chen-1995)	12.32	
1092										95% Modified-t UCL (Johnson-1978)	12.36	
1093												
1094						**Gamma GOF Test**						
1095						A-D Test Statistic	0.741			**Anderson-Darling Gamma GOF Test**		
1096						5% A-D Critical Value	0.748			Detected data appear Gamma Distributed at 5% Significance Lev		
1097						K-S Test Statistic	0.165			**Kolmogorov-Smirnov Gamma GOF Test**		
1098						5% K-S Critical Value	0.163			Data Not Gamma Distributed at 5% Significance Level		
1099						**Detected data follow Appr. Gamma Distribution at 5% Significance Level**						
1100												
1101						**Gamma Statistics**						
1102						k hat (MLE)	4.882			k star (bias corrected MLE)	4.4	
1103						Theta hat (MLE)	2.234			Theta star (bias corrected MLE)	2.478	
1104						nu hat (MLE)	283.2			nu star (bias corrected)	255.2	
1105						MLE Mean (bias corrected)	10.9			MLE Sd (bias corrected)	5.198	
1106										Approximate Chi Square Value (0.05)	219.2	
1107						Adjusted Level of Significance	0.0407			Adjusted Chi Square Value	217.2	
1108												
1109						**Assuming Gamma Distribution**						
1110						95% Approximate Gamma UCL (use when n>=50))	12.69			95% Adjusted Gamma UCL (use when n<50)	12.81	
1111												
1112						**Lognormal GOF Test**						
1113						Shapiro Wilk Test Statistic	0.917			**Shapiro Wilk Lognormal GOF Test**		
1114						5% Shapiro Wilk Critical Value	0.926			Data Not Lognormal at 5% Significance Level		
1115						Lilliefors Test Statistic	0.183			**Lilliefors Lognormal GOF Test**		
1116						5% Lilliefors Critical Value	0.161			Data Not Lognormal at 5% Significance Level		
1117						**Data Not Lognormal at 5% Significance Level**						
1118												
1119						**Lognormal Statistics**						
1120						Minimum of Logged Data	1.099			Mean of logged Data	2.283	
1121						Maximum of Logged Data	3.068			SD of logged Data	0.501	
1122												
1123						**Assuming Lognormal Distribution**						
1124						95% H-UCL	13.38			90% Chebyshev (MVUE) UCL	14.3	
1125						95% Chebyshev (MVUE) UCL	15.76			97.5% Chebyshev (MVUE) UCL	17.78	
1126						99% Chebyshev (MVUE) UCL	21.77					
1127												
1128						**Nonparametric Distribution Free UCL Statistics**						
1129						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
1130												
1131						**Nonparametric Distribution Free UCLs**						
1132						95% CLT UCL	12.31			95% Jackknife UCL	12.35	
1133						95% Standard Bootstrap UCL	12.29			95% Bootstrap-t UCL	12.36	
1134						95% Hall's Bootstrap UCL	12.33			95% Percentile Bootstrap UCL	12.27	
1135						95% BCA Bootstrap UCL	12.3					
1136						90% Chebyshev(Mean, Sd) UCL	13.46			95% Chebyshev(Mean, Sd) UCL	14.62	
1137						97.5% Chebyshev(Mean, Sd) UCL	16.22			99% Chebyshev(Mean, Sd) UCL	19.38	
1138												
1139						**Suggested UCL to Use**						

1140				95% Student's-t UCL	12.35							
1141												
1142	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1143	Recommendations are based upon data size, data distribution, and skewness.											
1144	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1145	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1146												
1147												
1148	**Result (eu7_copper)**											
1149												
1150	**General Statistics**											
1151				Total Number of Observations	39			Number of Distinct Observations	38			
1152								Number of Missing Observations	0			
1153				Minimum	13.9			Mean	312.7			
1154				Maximum	5630			Median	84.9			
1155				SD	888.8			Std. Error of Mean	142.3			
1156				Coefficient of Variation	2.842			Skewness	5.926			
1157												
1158	**Normal GOF Test**											
1159				Shapiro Wilk Test Statistic	0.297			**Shapiro Wilk GOF Test**				
1160				5% Shapiro Wilk Critical Value	0.939			Data Not Normal at 5% Significance Level				
1161				Lilliefors Test Statistic	0.391			**Lilliefors GOF Test**				
1162				5% Lilliefors Critical Value	0.14			Data Not Normal at 5% Significance Level				
1163	**Data Not Normal at 5% Significance Level**											
1164												
1165	**Assuming Normal Distribution**											
1166				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
1167				95% Student's-t UCL	552.7			95% Adjusted-CLT UCL (Chen-1995)	691.2			
1168								95% Modified-t UCL (Johnson-1978)	575.2			
1169												
1170	**Gamma GOF Test**											
1171				A-D Test Statistic	2.337			**Anderson-Darling Gamma GOF Test**				
1172				5% A-D Critical Value	0.803			Data Not Gamma Distributed at 5% Significance Level				
1173				K-S Test Statistic	0.199			**Kolmogorov-Smirnov Gamma GOF Test**				
1174				5% K-S Critical Value	0.148			Data Not Gamma Distributed at 5% Significance Level				
1175	**Data Not Gamma Distributed at 5% Significance Level**											
1176												
1177	**Gamma Statistics**											
1178				k hat (MLE)	0.604			k star (bias corrected MLE)	0.575			
1179				Theta hat (MLE)	517.7			Theta star (bias corrected MLE)	544.1			
1180				nu hat (MLE)	47.12			nu star (bias corrected)	44.83			
1181				MLE Mean (bias corrected)	312.7			MLE Sd (bias corrected)	412.5			
1182								Approximate Chi Square Value (0.05)	30.47			
1183				Adjusted Level of Significance	0.0437			Adjusted Chi Square Value	30			
1184												
1185	**Assuming Gamma Distribution**											
1186	95% Approximate Gamma UCL (use when n>=50))				460.1			95% Adjusted Gamma UCL (use when n<50)	467.3			
1187												
1188	**Lognormal GOF Test**											
1189				Shapiro Wilk Test Statistic	0.932			**Shapiro Wilk Lognormal GOF Test**				
1190				5% Shapiro Wilk Critical Value	0.939			Data Not Lognormal at 5% Significance Level				
1191				Lilliefors Test Statistic	0.145			**Lilliefors Lognormal GOF Test**				
1192				5% Lilliefors Critical Value	0.14			Data Not Lognormal at 5% Significance Level				
1193	**Data Not Lognormal at 5% Significance Level**											
1194												
1195	**Lognormal Statistics**											
1196				Minimum of Logged Data	2.632			Mean of logged Data	4.724			
1197				Maximum of Logged Data	8.636			SD of logged Data	1.283			
1198												
1199	**Assuming Lognormal Distribution**											
1200				95% H-UCL	454			90% Chebyshev (MVUE) UCL	436.1			
1201				95% Chebyshev (MVUE) UCL	521.6			97.5% Chebyshev (MVUE) UCL	640.4			
1202				99% Chebyshev (MVUE) UCL	873.8							
1203												
1204	**Nonparametric Distribution Free UCL Statistics**											
1205	**Data do not follow a Discernible Distribution (0.05)**											
1206												

1207	**Nonparametric Distribution Free UCLs**											
1208					95% CLT UCL	546.8			95% Jackknife UCL	552.7		
1209					95% Standard Bootstrap UCL	551.9			95% Bootstrap-t UCL	1383		
1210					95% Hall's Bootstrap UCL	1438			95% Percentile Bootstrap UCL	590.9		
1211					95% BCA Bootstrap UCL	751.9						
1212					90% Chebyshev(Mean, Sd) UCL	739.7			95% Chebyshev(Mean, Sd) UCL	933.1		
1213					97.5% Chebyshev(Mean, Sd) UCL	1202			99% Chebyshev(Mean, Sd) UCL	1729		
1214												
1215	**Suggested UCL to Use**											
1216					95% Chebyshev (Mean, Sd) UCL	933.1						
1217												
1218	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1219	Recommendations are based upon data size, data distribution, and skewness.											
1220	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1221	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1222												
1223												
1224	**Result (eu7_iron)**											
1225												
1226	**General Statistics**											
1227					Total Number of Observations	39			Number of Distinct Observations	35		
1228									Number of Missing Observations	0		
1229					Minimum	14400			Mean	40900		
1230					Maximum	250000			Median	27100		
1231					SD	41900			Std. Error of Mean	6709		
1232					Coefficient of Variation	1.024			Skewness	3.666		
1233												
1234	**Normal GOF Test**											
1235					Shapiro Wilk Test Statistic	0.564			**Shapiro Wilk GOF Test**			
1236					5% Shapiro Wilk Critical Value	0.939			Data Not Normal at 5% Significance Level			
1237					Lilliefors Test Statistic	0.34			**Lilliefors GOF Test**			
1238					5% Lilliefors Critical Value	0.14			Data Not Normal at 5% Significance Level			
1239	**Data Not Normal at 5% Significance Level**											
1240												
1241	**Assuming Normal Distribution**											
1242					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
1243					95% Student's-t UCL	52212			95% Adjusted-CLT UCL (Chen-1995)	56144		
1244									95% Modified-t UCL (Johnson-1978)	52868		
1245												
1246	**Gamma GOF Test**											
1247					A-D Test Statistic	3.519			**Anderson-Darling Gamma GOF Test**			
1248					5% A-D Critical Value	0.758			Data Not Gamma Distributed at 5% Significance Level			
1249					K-S Test Statistic	0.291			**Kolmogorov-Smirnov Gamma GOF Test**			
1250					5% K-S Critical Value	0.143			Data Not Gamma Distributed at 5% Significance Level			
1251	**Data Not Gamma Distributed at 5% Significance Level**											
1252												
1253	**Gamma Statistics**											
1254					k hat (MLE)	2.147			k star (bias corrected MLE)	1.998		
1255					Theta hat (MLE)	19054			Theta star (bias corrected MLE)	20465		
1256					nu hat (MLE)	167.4			nu star (bias corrected)	155.9		
1257					MLE Mean (bias corrected)	40900			MLE Sd (bias corrected)	28932		
1258									Approximate Chi Square Value (0.05)	128		
1259					Adjusted Level of Significance	0.0437			Adjusted Chi Square Value	127		
1260												
1261	**Assuming Gamma Distribution**											
1262					95% Approximate Gamma UCL (use when n>=50))	49801			95% Adjusted Gamma UCL (use when n<50)	50191		
1263												
1264	**Lognormal GOF Test**											
1265					Shapiro Wilk Test Statistic	0.841			**Shapiro Wilk Lognormal GOF Test**			
1266					5% Shapiro Wilk Critical Value	0.939			Data Not Lognormal at 5% Significance Level			
1267					Lilliefors Test Statistic	0.245			**Lilliefors Lognormal GOF Test**			
1268					5% Lilliefors Critical Value	0.14			Data Not Lognormal at 5% Significance Level			
1269	**Data Not Lognormal at 5% Significance Level**											
1270												
1271	**Lognormal Statistics**											
1272					Minimum of Logged Data	9.575			Mean of logged Data	10.37		
1273					Maximum of Logged Data	12.43			SD of logged Data	0.621		

1274												
1275						**Assuming Lognormal Distribution**							
1276						95% H-UCL	47302			90% Chebyshev (MVUE) UCL	50652	
1277						95% Chebyshev (MVUE) UCL	56210			97.5% Chebyshev (MVUE) UCL	63924	
1278						99% Chebyshev (MVUE) UCL	79078					
1279												
1280						**Nonparametric Distribution Free UCL Statistics**							
1281						**Data do not follow a Discernible Distribution (0.05)**							
1282												
1283						**Nonparametric Distribution Free UCLs**							
1284						95% CLT UCL	51936			95% Jackknife UCL	52212	
1285						95% Standard Bootstrap UCL	51451			95% Bootstrap-t UCL	62006	
1286						95% Hall's Bootstrap UCL	93774			95% Percentile Bootstrap UCL	52733	
1287						95% BCA Bootstrap UCL	57597					
1288						90% Chebyshev(Mean, Sd) UCL	61028			95% Chebyshev(Mean, Sd) UCL	70145	
1289						97.5% Chebyshev(Mean, Sd) UCL	82800			99% Chebyshev(Mean, Sd) UCL	107657	
1290												
1291						**Suggested UCL to Use**							
1292						95% Chebyshev (Mean, Sd) UCL	70145					
1293												
1294	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1295	Recommendations are based upon data size, data distribution, and skewness.											
1296	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1297	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1298												
1299												
1300	**Result (eu7_lead)**											
1301												
1302						**General Statistics**							
1303						Total Number of Observations	39			Number of Distinct Observations	39	
1304										Number of Missing Observations	0	
1305						Minimum	9.4			Mean	956.4	
1306						Maximum	4130			Median	512	
1307						SD	1007			Std. Error of Mean	161.3	
1308						Coefficient of Variation	1.053			Skewness	1.186	
1309												
1310						**Normal GOF Test**							
1311						Shapiro Wilk Test Statistic	0.842			**Shapiro Wilk GOF Test**		
1312						5% Shapiro Wilk Critical Value	0.939			Data Not Normal at 5% Significance Level		
1313						Lilliefors Test Statistic	0.183			**Lilliefors GOF Test**		
1314						5% Lilliefors Critical Value	0.14			Data Not Normal at 5% Significance Level		
1315						**Data Not Normal at 5% Significance Level**							
1316												
1317						**Assuming Normal Distribution**							
1318						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
1319						95% Student's-t UCL	1228			95% Adjusted-CLT UCL (Chen-1995)	1254	
1320										95% Modified-t UCL (Johnson-1978)	1233	
1321												
1322						**Gamma GOF Test**							
1323						A-D Test Statistic	1.033			**Anderson-Darling Gamma GOF Test**		
1324						5% A-D Critical Value	0.799			Data Not Gamma Distributed at 5% Significance Level		
1325						K-S Test Statistic	0.183			**Kolmogorov-Smirnov Gamma GOF Test**		
1326						5% K-S Critical Value	0.148			Data Not Gamma Distributed at 5% Significance Level		
1327						**Data Not Gamma Distributed at 5% Significance Level**							
1328												
1329						**Gamma Statistics**							
1330						k hat (MLE)	0.64			k star (bias corrected MLE)	0.608	
1331						Theta hat (MLE)	1495			Theta star (bias corrected MLE)	1574	
1332						nu hat (MLE)	49.9			nu star (bias corrected)	47.4	
1333						MLE Mean (bias corrected)	956.4			MLE Sd (bias corrected)	1227	
1334										Approximate Chi Square Value (0.05)	32.6	
1335						Adjusted Level of Significance	0.0437			Adjusted Chi Square Value	32.11	
1336												
1337						**Assuming Gamma Distribution**							
1338						95% Approximate Gamma UCL (use when n>=50))	1391			95% Adjusted Gamma UCL (use when n<50)	1412	
1339												
1340						**Lognormal GOF Test**							

1341					Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**					
1342					5% Shapiro Wilk Critical Value	0.939	Data Not Lognormal at 5% Significance Level					
1343					Lilliefors Test Statistic	0.192	**Lilliefors Lognormal GOF Test**					
1344					5% Lilliefors Critical Value	0.14	Data Not Lognormal at 5% Significance Level					
1345					**Data Not Lognormal at 5% Significance Level**							
1346												
1347					**Lognormal Statistics**							
1348					Minimum of Logged Data	2.241	Mean of logged Data	5.906				
1349					Maximum of Logged Data	8.326	SD of logged Data	1.734				
1350												
1351					**Assuming Lognormal Distribution**							
1352					95% H-UCL	4265	90% Chebyshev (MVUE) UCL	3221				
1353					95% Chebyshev (MVUE) UCL	3995	97.5% Chebyshev (MVUE) UCL	5068				
1354					99% Chebyshev (MVUE) UCL	7177						
1355												
1356					**Nonparametric Distribution Free UCL Statistics**							
1357					**Data do not follow a Discernible Distribution (0.05)**							
1358												
1359					**Nonparametric Distribution Free UCLs**							
1360					95% CLT UCL	1222	95% Jackknife UCL	1228				
1361					95% Standard Bootstrap UCL	1217	95% Bootstrap-t UCL	1268				
1362					95% Hall's Bootstrap UCL	1262	95% Percentile Bootstrap UCL	1217				
1363					95% BCA Bootstrap UCL	1242						
1364					90% Chebyshev(Mean, Sd) UCL	1440	95% Chebyshev(Mean, Sd) UCL	1659				
1365					97.5% Chebyshev(Mean, Sd) UCL	1964	99% Chebyshev(Mean, Sd) UCL	2561				
1366												
1367					**Suggested UCL to Use**							
1368					95% Chebyshev (Mean, Sd) UCL	1659						
1369												
1370	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1371	Recommendations are based upon data size, data distribution, and skewness.											
1372	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1373	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1374												
1375												
1376	**Result (eu7_manganese)**											
1377												
1378					**General Statistics**							
1379					Total Number of Observations	39	Number of Distinct Observations	38				
1380							Number of Missing Observations	0				
1381					Minimum	349	Mean	5676				
1382					Maximum	42300	Median	4300				
1383					SD	7291	Std. Error of Mean	1168				
1384					Coefficient of Variation	1.285	Skewness	3.479				
1385												
1386					**Normal GOF Test**							
1387					Shapiro Wilk Test Statistic	0.655	**Shapiro Wilk GOF Test**					
1388					5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level					
1389					Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**					
1390					5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level					
1391					**Data Not Normal at 5% Significance Level**							
1392												
1393					**Assuming Normal Distribution**							
1394					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
1395					95% Student's-t UCL	7644	95% Adjusted-CLT UCL (Chen-1995)	8291				
1396							95% Modified-t UCL (Johnson-1978)	7753				
1397												
1398					**Gamma GOF Test**							
1399					A-D Test Statistic	0.911	**Anderson-Darling Gamma GOF Test**					
1400					5% A-D Critical Value	0.785	Data Not Gamma Distributed at 5% Significance Level					
1401					K-S Test Statistic	0.13	**Kolmogorov-Smirnov Gamma GOF Test**					
1402					5% K-S Critical Value	0.146	Detected data appear Gamma Distributed at 5% Significance Lev					
1403					**Detected data follow Appr. Gamma Distribution at 5% Significance Level**							
1404												
1405					**Gamma Statistics**							
1406					k hat (MLE)	0.837	k star (bias corrected MLE)	0.79				
1407					Theta hat (MLE)	6781	Theta star (bias corrected MLE)	7187				

1408					nu hat (MLE)	65.29				nu star (bias corrected)		61.6
1409					MLE Mean (bias corrected)	5676				MLE Sd (bias corrected)		6387
1410										Approximate Chi Square Value (0.05)		44.55
1411					Adjusted Level of Significance	0.0437				Adjusted Chi Square Value		43.97
1412												
1413					**Assuming Gamma Distribution**							
1414				95% Approximate Gamma UCL (use when n>=50)		7848				95% Adjusted Gamma UCL (use when n<50)		7951
1415												
1416					**Lognormal GOF Test**							
1417					Shapiro Wilk Test Statistic	0.917				**Shapiro Wilk Lognormal GOF Test**		
1418					5% Shapiro Wilk Critical Value	0.939				Data Not Lognormal at 5% Significance Level		
1419					Lilliefors Test Statistic	0.141				**Lilliefors Lognormal GOF Test**		
1420					5% Lilliefors Critical Value	0.14				Data Not Lognormal at 5% Significance Level		
1421					**Data Not Lognormal at 5% Significance Level**							
1422												
1423					**Lognormal Statistics**							
1424					Minimum of Logged Data	5.855				Mean of logged Data		7.939
1425					Maximum of Logged Data	10.65				SD of logged Data		1.307
1426												
1427					**Assuming Lognormal Distribution**							
1428					95% H-UCL	11875				90% Chebyshev (MVUE) UCL		11304
1429					95% Chebyshev (MVUE) UCL	13553				97.5% Chebyshev (MVUE) UCL		16674
1430					99% Chebyshev (MVUE) UCL	22805						
1431												
1432					**Nonparametric Distribution Free UCL Statistics**							
1433					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1434												
1435					**Nonparametric Distribution Free UCLs**							
1436					95% CLT UCL	7596				95% Jackknife UCL		7644
1437					95% Standard Bootstrap UCL	7560				95% Bootstrap-t UCL		8919
1438					95% Hall's Bootstrap UCL	16661				95% Percentile Bootstrap UCL		7760
1439					95% BCA Bootstrap UCL	8419						
1440					90% Chebyshev(Mean, Sd) UCL	9178				95% Chebyshev(Mean, Sd) UCL		10765
1441					97.5% Chebyshev(Mean, Sd) UCL	12967				99% Chebyshev(Mean, Sd) UCL		17293
1442												
1443					**Suggested UCL to Use**							
1444					95% Adjusted Gamma UCL	7951						
1445												
1446					When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test							
1447					When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL							
1448												
1449					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
1450					Recommendations are based upon data size, data distribution, and skewness.							
1451					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
1452					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia							
1453												
1454	**Result (eu7_thallium)**											
1455												
1456					**General Statistics**							
1457					Total Number of Observations	39				Number of Distinct Observations		30
1458					Number of Detects	8				Number of Non-Detects		31
1459					Number of Distinct Detects	8				Number of Distinct Non-Detects		22
1460					Minimum Detect	0.18				Minimum Non-Detect		0.004
1461					Maximum Detect	0.644				Maximum Non-Detect		5.03
1462					Variance Detects	0.0347				Percent Non-Detects		79.49%
1463					Mean Detects	0.336				SD Detects		0.186
1464					Median Detects	0.245				CV Detects		0.555
1465					Skewness Detects	1.201				Kurtosis Detects		-0.35
1466					Mean of Logged Detects	-1.208				SD of Logged Detects		0.494
1467												
1468					**Normal GOF Test on Detects Only**							
1469					Shapiro Wilk Test Statistic	0.769				**Shapiro Wilk GOF Test**		
1470					5% Shapiro Wilk Critical Value	0.818				Detected Data Not Normal at 5% Significance Level		
1471					Lilliefors Test Statistic	0.302				**Lilliefors GOF Test**		
1472					5% Lilliefors Critical Value	0.283				Detected Data Not Normal at 5% Significance Level		
1473					**Detected Data Not Normal at 5% Significance Level**							
1474												

1475	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1476					KM Mean	0.101			KM Standard Error of Mean	0.0334		
1477					KM SD	0.168			95% KM (BCA) UCL	0.168		
1478					95% KM (t) UCL	0.157			95% KM (Percentile Bootstrap) UCL	0.161		
1479					95% KM (z) UCL	0.156			95% KM Bootstrap t UCL	0.158		
1480					90% KM Chebyshev UCL	0.201			95% KM Chebyshev UCL	0.246		
1481					97.5% KM Chebyshev UCL	0.309			99% KM Chebyshev UCL	0.433		
1482												
1483	**Gamma GOF Tests on Detected Observations Only**											
1484					A-D Test Statistic	0.736	**Anderson-Darling GOF Test**					
1485					5% A-D Critical Value	0.719	Detected Data Not Gamma Distributed at 5% Significance Level					
1486					K-S Test Statistic	0.292	**Kolmogorov-Smirnov GOF**					
1487					5% K-S Critical Value	0.295	Detected data appear Gamma Distributed at 5% Significance Lev					
1488	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
1489												
1490	**Gamma Statistics on Detected Data Only**											
1491					k hat (MLE)	4.471			k star (bias corrected MLE)	2.878		
1492					Theta hat (MLE)	0.075			Theta star (bias corrected MLE)	0.117		
1493					nu hat (MLE)	71.53			nu star (bias corrected)	46.04		
1494					Mean (detects)	0.336						
1495												
1496	**Gamma ROS Statistics using Imputed Non-Detects**											
1497	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1498	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)											
1499	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1500	This is especially true when the sample size is small.											
1501	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1502					Minimum	0.01			Mean	0.0828		
1503					Maximum	0.644			Median	0.01		
1504					SD	0.154			CV	1.86		
1505					k hat (MLE)	0.513			k star (bias corrected MLE)	0.491		
1506					Theta hat (MLE)	0.161			Theta star (bias corrected MLE)	0.169		
1507					nu hat (MLE)	40			nu star (bias corrected)	38.26		
1508					Adjusted Level of Significance (β)	0.0437						
1509					Approximate Chi Square Value (38.26, α)	25.1			Adjusted Chi Square Value (38.26, β)	24.67		
1510					95% Gamma Approximate UCL (use when n>=50)	0.126			95% Gamma Adjusted UCL (use when n<50)	0.128		
1511												
1512	**Estimates of Gamma Parameters using KM Estimates**											
1513					Mean (KM)	0.101			SD (KM)	0.168		
1514					Variance (KM)	0.0282			SE of Mean (KM)	0.0334		
1515					k hat (KM)	0.36			k star (KM)	0.349		
1516					nu hat (KM)	28.06			nu star (KM)	27.23		
1517					theta hat (KM)	0.28			theta star (KM)	0.289		
1518					80% gamma percentile (KM)	0.16			90% gamma percentile (KM)	0.291		
1519					95% gamma percentile (KM)	0.439			99% gamma percentile (KM)	0.815		
1520												
1521	**Gamma Kaplan-Meier (KM) Statistics**											
1522					Approximate Chi Square Value (27.23, α)	16.33			Adjusted Chi Square Value (27.23, β)	16		
1523	5% Gamma Approximate KM-UCL (use when n>=50)					0.168			95% Gamma Adjusted KM-UCL (use when n<50)	0.172		
1524												
1525	**Lognormal GOF Test on Detected Observations Only**											
1526					Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**					
1527					5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level					
1528					Lilliefors Test Statistic	0.266	**Lilliefors GOF Test**					
1529					5% Lilliefors Critical Value	0.283	Detected Data appear Lognormal at 5% Significance Level					
1530	**Detected Data appear Lognormal at 5% Significance Level**											
1531												
1532	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1533					Mean in Original Scale	0.136			Mean in Log Scale	-2.255		
1534					SD in Original Scale	0.132			SD in Log Scale	0.646		
1535					95% t UCL (assumes normality of ROS data)	0.171			95% Percentile Bootstrap UCL	0.173		
1536					95% BCA Bootstrap UCL	0.183			95% Bootstrap t UCL	0.199		
1537					95% H-UCL (Log ROS)	0.16						
1538												
1539	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1540					KM Mean (logged)	-4.18			KM Geo Mean	0.0153		
1541					KM SD (logged)	1.99			95% Critical H Value (KM-Log)	3.745		

1542	KM Standard Error of Mean (logged)				0.425	95% H-UCL (KM -Log)						0.371
1543	KM SD (logged)				1.99	95% Critical H Value (KM-Log)						3.745
1544	KM Standard Error of Mean (logged)				0.425							
1545												
1546	**DL/2 Statistics**											
1547	**DL/2 Normal**					**DL/2 Log-Transformed**						
1548	Mean in Original Scale				0.277	Mean in Log Scale						-2.274
1549	SD in Original Scale				0.442	SD in Log Scale						1.639
1550	95% t UCL (Assumes normality)				0.396	95% H-Stat UCL						0.932
1551	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1552												
1553	**Nonparametric Distribution Free UCL Statistics**											
1554	**Detected Data appear Approximate Gamma Distributed at 5% Significance Level**											
1555												
1556	**Suggested UCL to Use**											
1557	95% KM Adjusted Gamma UCL				0.172	95% GROS Adjusted Gamma UCL						0.128
1558												
1559	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
1560	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
1561												
1562	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1563	Recommendations are based upon data size, data distribution, and skewness.											
1564	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1565	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1566												
1567												
1568	**Result (eu7_zinc)**											
1569												
1570	**General Statistics**											
1571	Total Number of Observations				39	Number of Distinct Observations						39
1572						Number of Missing Observations						0
1573	Minimum				109	Mean						2168
1574	Maximum				37300	Median						977
1575	SD				5883	Std. Error of Mean						942
1576	Coefficient of Variation				2.713	Skewness						5.892
1577												
1578	**Normal GOF Test**											
1579	Shapiro Wilk Test Statistic				0.309	**Shapiro Wilk GOF Test**						
1580	5% Shapiro Wilk Critical Value				0.939	Data Not Normal at 5% Significance Level						
1581	Lilliefors Test Statistic				0.363	**Lilliefors GOF Test**						
1582	5% Lilliefors Critical Value				0.14	Data Not Normal at 5% Significance Level						
1583	**Data Not Normal at 5% Significance Level**											
1584												
1585	**Assuming Normal Distribution**											
1586	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
1587	95% Student's-t UCL				3757	95% Adjusted-CLT UCL (Chen-1995)						4668
1588						95% Modified-t UCL (Johnson-1978)						3905
1589												
1590	**Gamma GOF Test**											
1591	A-D Test Statistic				1.951	**Anderson-Darling Gamma GOF Test**						
1592	5% A-D Critical Value				0.8	Data Not Gamma Distributed at 5% Significance Level						
1593	K-S Test Statistic				0.161	**Kolmogorov-Smirnov Gamma GOF Test**						
1594	5% K-S Critical Value				0.148	Data Not Gamma Distributed at 5% Significance Level						
1595	**Data Not Gamma Distributed at 5% Significance Level**											
1596												
1597	**Gamma Statistics**											
1598	k hat (MLE)				0.633	k star (bias corrected MLE)						0.601
1599	Theta hat (MLE)				3426	Theta star (bias corrected MLE)						3606
1600	nu hat (MLE)				49.37	nu star (bias corrected)						46.9
1601	MLE Mean (bias corrected)				2168	MLE Sd (bias corrected)						2796
1602						Approximate Chi Square Value (0.05)						32.19
1603	Adjusted Level of Significance				0.0437	Adjusted Chi Square Value						31.71
1604												
1605	**Assuming Gamma Distribution**											
1606	95% Approximate Gamma UCL (use when n>=50))				3160	95% Adjusted Gamma UCL (use when n<50)						3208
1607												
1608	**Lognormal GOF Test**											

1609					Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk Lognormal GOF Test**					
1610					5% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 5% Significance Level					
1611					Lilliefors Test Statistic	0.138	**Lilliefors Lognormal GOF Test**					
1612					5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level					
1613					**Data appear Lognormal at 5% Significance Level**							
1614												
1615					**Lognormal Statistics**							
1616					Minimum of Logged Data	4.691	Mean of logged Data	6.713				
1617					Maximum of Logged Data	10.53	SD of logged Data	1.265				
1618												
1619					**Assuming Lognormal Distribution**							
1620					95% H-UCL	3207	90% Chebyshev (MVUE) UCL	3099				
1621					95% Chebyshev (MVUE) UCL	3702	97.5% Chebyshev (MVUE) UCL	4537				
1622					99% Chebyshev (MVUE) UCL	6180						
1623												
1624					**Nonparametric Distribution Free UCL Statistics**							
1625					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1626												
1627					**Nonparametric Distribution Free UCLs**							
1628					95% CLT UCL	3718	95% Jackknife UCL	3757				
1629					95% Standard Bootstrap UCL	3725	95% Bootstrap-t UCL	8730				
1630					95% Hall's Bootstrap UCL	9742	95% Percentile Bootstrap UCL	4031				
1631					95% BCA Bootstrap UCL	4997						
1632					90% Chebyshev(Mean, Sd) UCL	4994	95% Chebyshev(Mean, Sd) UCL	6275				
1633					97.5% Chebyshev(Mean, Sd) UCL	8051	99% Chebyshev(Mean, Sd) UCL	11541				
1634												
1635					**Suggested UCL to Use**							
1636					95% H-UCL	3207						
1637												
1638	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1639	Recommendations are based upon data size, data distribution, and skewness.											
1640	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1641	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1642												
1643	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
1644	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
1645	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
1646	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
1647												
1648												
1649	**Result (eu8_arsenic)**											
1650												
1651					**General Statistics**							
1652					Total Number of Observations	65	Number of Distinct Observations	63				
1653							Number of Missing Observations	0				
1654					Minimum	8.3	Mean	97.96				
1655					Maximum	448	Median	54.5				
1656					SD	104.4	Std. Error of Mean	12.94				
1657					Coefficient of Variation	1.065	Skewness	1.916				
1658												
1659					**Normal GOF Test**							
1660					Shapiro Wilk Test Statistic	0.718	**Shapiro Wilk GOF Test**					
1661					5% Shapiro Wilk P Value	1.110E-16	Data Not Normal at 5% Significance Level					
1662					Lilliefors Test Statistic	0.254	**Lilliefors GOF Test**					
1663					5% Lilliefors Critical Value	0.11	Data Not Normal at 5% Significance Level					
1664					**Data Not Normal at 5% Significance Level**							
1665												
1666					**Assuming Normal Distribution**							
1667					**95% Normal UCL**		**95% UCLs (Adjusted for Skewness)**					
1668					95% Student's-t UCL	119.6	95% Adjusted-CLT UCL (Chen-1995)	122.5				
1669							95% Modified-t UCL (Johnson-1978)	120.1				
1670												
1671					**Gamma GOF Test**							
1672					A-D Test Statistic	2.846	**Anderson-Darling Gamma GOF Test**					
1673					5% A-D Critical Value	0.773	Data Not Gamma Distributed at 5% Significance Level					
1674					K-S Test Statistic	0.176	**Kolmogorov-Smirnov Gamma GOF Test**					
1675					5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level					

1676	**Data Not Gamma Distributed at 5% Significance Level**											
1677												
1678	**Gamma Statistics**											
1679						k hat (MLE)	1.315			k star (bias corrected MLE)	1.264	
1680						Theta hat (MLE)	74.51			Theta star (bias corrected MLE)	77.48	
1681						nu hat (MLE)	170.9			nu star (bias corrected)	164.4	
1682						MLE Mean (bias corrected)	97.96			MLE Sd (bias corrected)	87.12	
1683										Approximate Chi Square Value (0.05)	135.7	
1684						Adjusted Level of Significance	0.0463			Adjusted Chi Square Value	135.1	
1685												
1686	**Assuming Gamma Distribution**											
1687					95% Approximate Gamma UCL (use when n>=50))		118.6			95% Adjusted Gamma UCL (use when n<50)	119.1	
1688												
1689	**Lognormal GOF Test**											
1690						Shapiro Wilk Test Statistic	0.938			**Shapiro Wilk Lognormal GOF Test**		
1691						5% Shapiro Wilk P Value	0.00423			Data Not Lognormal at 5% Significance Level		
1692						Lilliefors Test Statistic	0.121			**Lilliefors Lognormal GOF Test**		
1693						5% Lilliefors Critical Value	0.11			Data Not Lognormal at 5% Significance Level		
1694	**Data Not Lognormal at 5% Significance Level**											
1695												
1696	**Lognormal Statistics**											
1697						Minimum of Logged Data	2.116			Mean of logged Data	4.158	
1698						Maximum of Logged Data	6.105			SD of logged Data	0.893	
1699												
1700	**Assuming Lognormal Distribution**											
1701						95% H-UCL	121.5			90% Chebyshev (MVUE) UCL	130.6	
1702						95% Chebyshev (MVUE) UCL	147			97.5% Chebyshev (MVUE) UCL	169.8	
1703						99% Chebyshev (MVUE) UCL	214.5					
1704												
1705	**Nonparametric Distribution Free UCL Statistics**											
1706	**Data do not follow a Discernible Distribution (0.05)**											
1707												
1708	**Nonparametric Distribution Free UCLs**											
1709						95% CLT UCL	119.2			95% Jackknife UCL	119.6	
1710						95% Standard Bootstrap UCL	119.2			95% Bootstrap-t UCL	124.8	
1711						95% Hall's Bootstrap UCL	122.1			95% Percentile Bootstrap UCL	118.8	
1712						95% BCA Bootstrap UCL	120					
1713						90% Chebyshev(Mean, Sd) UCL	136.8			95% Chebyshev(Mean, Sd) UCL	154.4	
1714						97.5% Chebyshev(Mean, Sd) UCL	178.8			99% Chebyshev(Mean, Sd) UCL	226.7	
1715												
1716	**Suggested UCL to Use**											
1717						95% Chebyshev (Mean, Sd) UCL	154.4					
1718												
1719	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1720	Recommendations are based upon data size, data distribution, and skewness.											
1721	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1722	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1723												
1724												
1725	**Result (eu8_cadmium)**											
1726												
1727	**General Statistics**											
1728						Total Number of Observations	65			Number of Distinct Observations	59	
1729										Number of Missing Observations	0	
1730						Minimum	0.32			Mean	3.098	
1731						Maximum	13.9			Median	2.27	
1732						SD	2.877			Std. Error of Mean	0.357	
1733						Coefficient of Variation	0.929			Skewness	1.76	
1734												
1735	**Normal GOF Test**											
1736						Shapiro Wilk Test Statistic	0.811			**Shapiro Wilk GOF Test**		
1737						5% Shapiro Wilk P Value	3.774E-11			Data Not Normal at 5% Significance Level		
1738						Lilliefors Test Statistic	0.187			**Lilliefors GOF Test**		
1739						5% Lilliefors Critical Value	0.11			Data Not Normal at 5% Significance Level		
1740	**Data Not Normal at 5% Significance Level**											
1741												
1742	**Assuming Normal Distribution**											

	A	B	C	D	E	F	G	H	I	J	K	L
1743	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
1744					95% Student's-t UCL	3.694			95% Adjusted-CLT UCL (Chen-1995)			3.769
1745									95% Modified-t UCL (Johnson-1978)			3.707
1746												
1747	**Gamma GOF Test**											
1748					A-D Test Statistic	0.647	**Anderson-Darling Gamma GOF Test**					
1749					5% A-D Critical Value	0.77	Detected data appear Gamma Distributed at 5% Significance Lev					
1750					K-S Test Statistic	0.0842	**Kolmogorov-Smirnov Gamma GOF Test**					
1751					5% K-S Critical Value	0.113	Detected data appear Gamma Distributed at 5% Significance Lev					
1752	**Detected data appear Gamma Distributed at 5% Significance Level**											
1753												
1754	**Gamma Statistics**											
1755					k hat (MLE)	1.43	k star (bias corrected MLE)					1.374
1756					Theta hat (MLE)	2.167	Theta star (bias corrected MLE)					2.255
1757					nu hat (MLE)	185.8	nu star (bias corrected)					178.6
1758					MLE Mean (bias corrected)	3.098	MLE Sd (bias corrected)					2.643
1759							Approximate Chi Square Value (0.05)					148.7
1760					Adjusted Level of Significance	0.0463	Adjusted Chi Square Value					148.1
1761												
1762	**Assuming Gamma Distribution**											
1763	95% Approximate Gamma UCL (use when n>=50)					3.722	95% Adjusted Gamma UCL (use when n<50)					3.737
1764												
1765	**Lognormal GOF Test**											
1766					Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk Lognormal GOF Test**					
1767					5% Shapiro Wilk P Value	0.325	Data appear Lognormal at 5% Significance Level					
1768					Lilliefors Test Statistic	0.0741	**Lilliefors Lognormal GOF Test**					
1769					5% Lilliefors Critical Value	0.11	Data appear Lognormal at 5% Significance Level					
1770	**Data appear Lognormal at 5% Significance Level**											
1771												
1772	**Lognormal Statistics**											
1773					Minimum of Logged Data	-1.139	Mean of logged Data					0.742
1774					Maximum of Logged Data	2.632	SD of logged Data					0.909
1775												
1776	**Assuming Lognormal Distribution**											
1777					95% H-UCL	4.073	90% Chebyshev (MVUE) UCL					4.379
1778					95% Chebyshev (MVUE) UCL	4.938	97.5% Chebyshev (MVUE) UCL					5.713
1779					99% Chebyshev (MVUE) UCL	7.235						
1780												
1781	**Nonparametric Distribution Free UCL Statistics**											
1782	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
1783												
1784	**Nonparametric Distribution Free UCLs**											
1785					95% CLT UCL	3.685	95% Jackknife UCL					3.694
1786					95% Standard Bootstrap UCL	3.678	95% Bootstrap-t UCL					3.812
1787					95% Hall's Bootstrap UCL	3.78	95% Percentile Bootstrap UCL					3.667
1788					95% BCA Bootstrap UCL	3.75						
1789					90% Chebyshev(Mean, Sd) UCL	4.169	95% Chebyshev(Mean, Sd) UCL					4.654
1790					97.5% Chebyshev(Mean, Sd) UCL	5.327	99% Chebyshev(Mean, Sd) UCL					6.649
1791												
1792	**Suggested UCL to Use**											
1793					95% Approximate Gamma UCL	3.722						
1794												
1795	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1796	Recommendations are based upon data size, data distribution, and skewness.											
1797	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1798	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1799												
1800	**Result (eu8_chromium)**											
1801												
1802	**General Statistics**											
1803					Total Number of Observations	65	Number of Distinct Observations					43
1804					Number of Detects	59	Number of Non-Detects					6
1805					Number of Distinct Detects	41	Number of Distinct Non-Detects					3
1806					Minimum Detect	1.05	Minimum Non-Detect					2.48
1807					Maximum Detect	7.8	Maximum Non-Detect					2.5
1808					Variance Detects	1.212	Percent Non-Detects					9.231%
1809					Mean Detects	3.159	SD Detects					1.101

1810					Median Detects	3				CV Detects	0.348	
1811					Skewness Detects	1.345				Kurtosis Detects	4.127	
1812					Mean of Logged Detects	1.094				SD of Logged Detects	0.34	
1813												
1814					**Normal GOF Test on Detects Only**							
1815					Shapiro Wilk Test Statistic	0.927	**Normal GOF Test on Detected Observations Only**					
1816					5% Shapiro Wilk P Value	0.00163	Detected Data Not Normal at 5% Significance Level					
1817					Lilliefors Test Statistic	0.11	**Lilliefors GOF Test**					
1818					5% Lilliefors Critical Value	0.115	Detected Data appear Normal at 5% Significance Level					
1819					**Detected Data appear Approximate Normal at 5% Significance Level**							
1820												
1821					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
1822					KM Mean	3.054	KM Standard Error of Mean	0.138				
1823					KM SD	1.097	95% KM (BCA) UCL	3.296				
1824					95% KM (t) UCL	3.284	95% KM (Percentile Bootstrap) UCL	3.291				
1825					95% KM (z) UCL	3.281	95% KM Bootstrap t UCL	3.309				
1826					90% KM Chebyshev UCL	3.469	95% KM Chebyshev UCL	3.656				
1827					97.5% KM Chebyshev UCL	3.917	99% KM Chebyshev UCL	4.429				
1828												
1829					**Gamma GOF Tests on Detected Observations Only**							
1830					A-D Test Statistic	0.384	**Anderson-Darling GOF Test**					
1831					5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Lev					
1832					K-S Test Statistic	0.077	**Kolmogorov-Smirnov GOF**					
1833					5% K-S Critical Value	0.116	Detected data appear Gamma Distributed at 5% Significance Lev					
1834					**Detected data appear Gamma Distributed at 5% Significance Level**							
1835												
1836					**Gamma Statistics on Detected Data Only**							
1837					k hat (MLE)	9.08	k star (bias corrected MLE)	8.63				
1838					Theta hat (MLE)	0.348	Theta star (bias corrected MLE)	0.366				
1839					nu hat (MLE)	1071	nu star (bias corrected)	1018				
1840					Mean (detects)	3.159						
1841												
1842					**Gamma ROS Statistics using Imputed Non-Detects**							
1843					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
1844					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)							
1845					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
1846					This is especially true when the sample size is small.							
1847					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
1848					Minimum	1.05	Mean	3.045				
1849					Maximum	7.8	Median	2.8				
1850					SD	1.11	CV	0.364				
1851					k hat (MLE)	8.437	k star (bias corrected MLE)	8.058				
1852					Theta hat (MLE)	0.361	Theta star (bias corrected MLE)	0.378				
1853					nu hat (MLE)	1097	nu star (bias corrected)	1048				
1854					Adjusted Level of Significance (β)	0.0463						
1855					Approximate Chi Square Value (N/A, α)	973.4	Adjusted Chi Square Value (N/A, β)	971.8				
1856					95% Gamma Approximate UCL (use when n>=50)	3.277	95% Gamma Adjusted UCL (use when n<50)	3.282				
1857												
1858					**Estimates of Gamma Parameters using KM Estimates**							
1859					Mean (KM)	3.054	SD (KM)	1.097				
1860					Variance (KM)	1.203	SE of Mean (KM)	0.138				
1861					k hat (KM)	7.75	k star (KM)	7.403				
1862					nu hat (KM)	1008	nu star (KM)	962.4				
1863					theta hat (KM)	0.394	theta star (KM)	0.413				
1864					80% gamma percentile (KM)	3.936	90% gamma percentile (KM)	4.551				
1865					95% gamma percentile (KM)	5.103	99% gamma percentile (KM)	6.249				
1866												
1867					**Gamma Kaplan-Meier (KM) Statistics**							
1868					Approximate Chi Square Value (962.36, α)	891.3	Adjusted Chi Square Value (962.36, β)	889.8				
1869					95% Gamma Approximate KM-UCL (use when n>=50)	3.297	95% Gamma Adjusted KM-UCL (use when n<50)	3.303				
1870												
1871					**Lognormal GOF Test on Detected Observations Only**							
1872					Shapiro Wilk Approximate Test Statistic	0.988	**Shapiro Wilk GOF Test**					
1873					5% Shapiro Wilk P Value	0.941	Detected Data appear Lognormal at 5% Significance Level					
1874					Lilliefors Test Statistic	0.0735	**Lilliefors GOF Test**					
1875					5% Lilliefors Critical Value	0.115	Detected Data appear Lognormal at 5% Significance Level					
1876					**Detected Data appear Lognormal at 5% Significance Level**							

Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	3.051	Mean in Log Scale	1.056
SD in Original Scale	1.103	SD in Log Scale	0.346
95% t UCL (assumes normality of ROS data)	3.28	95% Percentile Bootstrap UCL	3.289
95% BCA Bootstrap UCL	3.291	95% Bootstrap t UCL	3.305
95% H-UCL (Log ROS)	3.297		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	1.056	KM Geo Mean	2.875
KM SD (logged)	0.349	95% Critical H Value (KM-Log)	1.778
KM Standard Error of Mean (logged)	0.0447	95% H-UCL (KM -Log)	3.302
KM SD (logged)	0.349	95% Critical H Value (KM-Log)	1.778
KM Standard Error of Mean (logged)	0.0447		

DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.982	Mean in Log Scale	1.013
SD in Original Scale	1.187	SD in Log Scale	0.412
95% t UCL (Assumes normality)	3.228	95% H-Stat UCL	3.292

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	3.284		

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 statisticia

Result (eu8_cobalt)

General Statistics			
Total Number of Observations	42	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	4.2	Mean	15.6
Maximum	52.3	Median	13.25
SD	8.889	Std. Error of Mean	1.372
Coefficient of Variation	0.57	Skewness	1.989

Normal GOF Test			
Shapiro Wilk Test Statistic	0.817	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.141	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.135	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	17.91	95% Adjusted-CLT UCL (Chen-1995)	18.3
		95% Modified-t UCL (Johnson-1978)	17.98

Gamma GOF Test			
A-D Test Statistic	0.369	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Lev	
K-S Test Statistic	0.091	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.137	Detected data appear Gamma Distributed at 5% Significance Lev	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

1944					k hat (MLE)	3.936			k star (bias corrected MLE)			3.67
1945					Theta hat (MLE)	3.963			Theta star (bias corrected MLE)			4.25
1946					nu hat (MLE)	330.6			nu star (bias corrected)			308.3
1947					MLE Mean (bias corrected)	15.6			MLE Sd (bias corrected)			8.141
1948									Approximate Chi Square Value (0.05)			268.6
1949					Adjusted Level of Significance	0.0443			Adjusted Chi Square Value			267.3
1950												
1951					**Assuming Gamma Distribution**							
1952					95% Approximate Gamma UCL (use when n>=50)	17.9			95% Adjusted Gamma UCL (use when n<50)			17.99
1953												
1954					**Lognormal GOF Test**							
1955					Shapiro Wilk Test Statistic	0.945			**Shapiro Wilk Lognormal GOF Test**			
1956					5% Shapiro Wilk Critical Value	0.942			Data appear Lognormal at 5% Significance Level			
1957					Lilliefors Test Statistic	0.0658			**Lilliefors Lognormal GOF Test**			
1958					5% Lilliefors Critical Value	0.135			Data appear Lognormal at 5% Significance Level			
1959					**Data appear Lognormal at 5% Significance Level**							
1960												
1961					**Lognormal Statistics**							
1962					Minimum of Logged Data	1.435			Mean of logged Data			2.615
1963					Maximum of Logged Data	3.957			SD of logged Data			0.515
1964												
1965					**Assuming Lognormal Distribution**							
1966					95% H-UCL	18.2			90% Chebyshev (MVUE) UCL			19.45
1967					95% Chebyshev (MVUE) UCL	21.21			97.5% Chebyshev (MVUE) UCL			23.67
1968					99% Chebyshev (MVUE) UCL	28.48						
1969												
1970					**Nonparametric Distribution Free UCL Statistics**							
1971					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
1972												
1973					**Nonparametric Distribution Free UCLs**							
1974					95% CLT UCL	17.85			95% Jackknife UCL			17.91
1975					95% Standard Bootstrap UCL	17.83			95% Bootstrap-t UCL			18.74
1976					95% Hall's Bootstrap UCL	19.16			95% Percentile Bootstrap UCL			18.04
1977					95% BCA Bootstrap UCL	18.48						
1978					90% Chebyshev(Mean, Sd) UCL	19.71			95% Chebyshev(Mean, Sd) UCL			21.58
1979					97.5% Chebyshev(Mean, Sd) UCL	24.16			99% Chebyshev(Mean, Sd) UCL			29.25
1980												
1981					**Suggested UCL to Use**							
1982					95% Adjusted Gamma UCL	17.99						
1983												
1984	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1985	Recommendations are based upon data size, data distribution, and skewness.											
1986	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1987	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1988												
1989												
1990	**Result (eu8_copper)**											
1991												
1992					**General Statistics**							
1993					Total Number of Observations	65			Number of Distinct Observations			62
1994									Number of Missing Observations			0
1995					Minimum	19			Mean			211.6
1996					Maximum	1010			Median			142
1997					SD	205.6			Std. Error of Mean			25.51
1998					Coefficient of Variation	0.972			Skewness			2.095
1999												
2000					**Normal GOF Test**							
2001					Shapiro Wilk Test Statistic	0.741			**Shapiro Wilk GOF Test**			
2002					5% Shapiro Wilk P Value	3.109E-15			Data Not Normal at 5% Significance Level			
2003					Lilliefors Test Statistic	0.22			**Lilliefors GOF Test**			
2004					5% Lilliefors Critical Value	0.11			Data Not Normal at 5% Significance Level			
2005					**Data Not Normal at 5% Significance Level**							
2006												
2007					**Assuming Normal Distribution**							
2008					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
2009					95% Student's-t UCL	254.2			95% Adjusted-CLT UCL (Chen-1995)			260.7
2010									95% Modified-t UCL (Johnson-1978)			255.3

2011												
2012						**Gamma GOF Test**						
2013					A-D Test Statistic	1.644	**Anderson-Darling Gamma GOF Test**					
2014					5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level					
2015					K-S Test Statistic	0.115	**Kolmogorov-Smirnov Gamma GOF Test**					
2016					5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level					
2017					**Data Not Gamma Distributed at 5% Significance Level**							
2018												
2019						**Gamma Statistics**						
2020					k hat (MLE)	1.582	k star (bias corrected MLE)	1.52				
2021					Theta hat (MLE)	133.7	Theta star (bias corrected MLE)	139.3				
2022					nu hat (MLE)	205.7	nu star (bias corrected)	197.6				
2023					MLE Mean (bias corrected)	211.6	MLE Sd (bias corrected)	171.7				
2024							Approximate Chi Square Value (0.05)	166				
2025					Adjusted Level of Significance	0.0463	Adjusted Chi Square Value	165.4				
2026												
2027						**Assuming Gamma Distribution**						
2028				95% Approximate Gamma UCL (use when n>=50))		251.8	95% Adjusted Gamma UCL (use when n<50)	252.8				
2029												
2030						**Lognormal GOF Test**						
2031					Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**					
2032					5% Shapiro Wilk P Value	0.306	Data appear Lognormal at 5% Significance Level					
2033					Lilliefors Test Statistic	0.077	**Lilliefors Lognormal GOF Test**					
2034					5% Lilliefors Critical Value	0.11	Data appear Lognormal at 5% Significance Level					
2035					**Data appear Lognormal at 5% Significance Level**							
2036												
2037						**Lognormal Statistics**						
2038					Minimum of Logged Data	2.944	Mean of logged Data	5.007				
2039					Maximum of Logged Data	6.918	SD of logged Data	0.816				
2040												
2041						**Assuming Lognormal Distribution**						
2042					95% H-UCL	258.5	90% Chebyshev (MVUE) UCL	278.2				
2043					95% Chebyshev (MVUE) UCL	310.4	97.5% Chebyshev (MVUE) UCL	355.1				
2044					99% Chebyshev (MVUE) UCL	443						
2045												
2046						**Nonparametric Distribution Free UCL Statistics**						
2047						**Data appear to follow a Discernible Distribution at 5% Significance Level**						
2048												
2049						**Nonparametric Distribution Free UCLs**						
2050					95% CLT UCL	253.6	95% Jackknife UCL	254.2				
2051					95% Standard Bootstrap UCL	252.3	95% Bootstrap-t UCL	263.4				
2052					95% Hall's Bootstrap UCL	263.4	95% Percentile Bootstrap UCL	255.7				
2053					95% BCA Bootstrap UCL	258.7						
2054					90% Chebyshev(Mean, Sd) UCL	288.1	95% Chebyshev(Mean, Sd) UCL	322.8				
2055					97.5% Chebyshev(Mean, Sd) UCL	370.9	99% Chebyshev(Mean, Sd) UCL	465.4				
2056												
2057						**Suggested UCL to Use**						
2058					95% H-UCL	258.5						
2059												
2060	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2061	Recommendations are based upon data size, data distribution, and skewness.											
2062	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2063	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2064												
2065	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
2066	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
2067	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
2068	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
2069												
2070												
2071	**Result (eu8_iron)**											
2072												
2073						**General Statistics**						
2074					Total Number of Observations	65	Number of Distinct Observations	61				
2075							Number of Missing Observations	0				
2076					Minimum	17700	Mean	55255				
2077					Maximum	180000	Median	47300				

2078					SD	27840				Std. Error of Mean		3453
2079					Coefficient of Variation	0.504				Skewness		2.187
2080												
2081					**Normal GOF Test**							
2082					Shapiro Wilk Test Statistic	0.808			**Shapiro Wilk GOF Test**			
2083					5% Shapiro Wilk P Value	2.373E-11			Data Not Normal at 5% Significance Level			
2084					Lilliefors Test Statistic	0.187			**Lilliefors GOF Test**			
2085					5% Lilliefors Critical Value	0.11			Data Not Normal at 5% Significance Level			
2086					**Data Not Normal at 5% Significance Level**							
2087												
2088					**Assuming Normal Distribution**							
2089					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
2090					95% Student's-t UCL	61019			95% Adjusted-CLT UCL (Chen-1995)			61936
2091									95% Modified-t UCL (Johnson-1978)			61175
2092												
2093					**Gamma GOF Test**							
2094					A-D Test Statistic	1.513			**Anderson-Darling Gamma GOF Test**			
2095					5% A-D Critical Value	0.754			Data Not Gamma Distributed at 5% Significance Level			
2096					K-S Test Statistic	0.13			**Kolmogorov-Smirnov Gamma GOF Test**			
2097					5% K-S Critical Value	0.111			Data Not Gamma Distributed at 5% Significance Level			
2098					**Data Not Gamma Distributed at 5% Significance Level**							
2099												
2100					**Gamma Statistics**							
2101					k hat (MLE)	5.446			k star (bias corrected MLE)			5.205
2102					Theta hat (MLE)	10146			Theta star (bias corrected MLE)			10616
2103					nu hat (MLE)	708			nu star (bias corrected)			676.6
2104					MLE Mean (bias corrected)	55255			MLE Sd (bias corrected)			24220
2105									Approximate Chi Square Value (0.05)			617.3
2106					Adjusted Level of Significance	0.0463			Adjusted Chi Square Value			616
2107												
2108					**Assuming Gamma Distribution**							
2109					95% Approximate Gamma UCL (use when n>=50))	60568			95% Adjusted Gamma UCL (use when n<50)			60694
2110												
2111					**Lognormal GOF Test**							
2112					Shapiro Wilk Test Statistic	0.964			**Shapiro Wilk Lognormal GOF Test**			
2113					5% Shapiro Wilk P Value	0.142			Data appear Lognormal at 5% Significance Level			
2114					Lilliefors Test Statistic	0.0994			**Lilliefors Lognormal GOF Test**			
2115					5% Lilliefors Critical Value	0.11			Data appear Lognormal at 5% Significance Level			
2116					**Data appear Lognormal at 5% Significance Level**							
2117												
2118					**Lognormal Statistics**							
2119					Minimum of Logged Data	9.781			Mean of logged Data			10.83
2120					Maximum of Logged Data	12.1			SD of logged Data			0.419
2121												
2122					**Assuming Lognormal Distribution**							
2123					95% H-UCL	60342			90% Chebyshev (MVUE) UCL			63647
2124					95% Chebyshev (MVUE) UCL	67658			97.5% Chebyshev (MVUE) UCL			73226
2125					99% Chebyshev (MVUE) UCL	84161						
2126												
2127					**Nonparametric Distribution Free UCL Statistics**							
2128					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
2129												
2130					**Nonparametric Distribution Free UCLs**							
2131					95% CLT UCL	60935			95% Jackknife UCL			61019
2132					95% Standard Bootstrap UCL	60809			95% Bootstrap-t UCL			62752
2133					95% Hall's Bootstrap UCL	62771			95% Percentile Bootstrap UCL			61000
2134					95% BCA Bootstrap UCL	61352						
2135					90% Chebyshev(Mean, Sd) UCL	65615			95% Chebyshev(Mean, Sd) UCL			70307
2136					97.5% Chebyshev(Mean, Sd) UCL	76820			99% Chebyshev(Mean, Sd) UCL			89614
2137												
2138					**Suggested UCL to Use**							
2139					95% Student's-t UCL	61019			or 95% Modified-t UCL			61175
2140					or 95% H-UCL	60342						
2141												
2142	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2143	Recommendations are based upon data size, data distribution, and skewness.											
2144	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

2145	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2146												
2147	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
2148	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
2149	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
2150	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
2151												
2152												
2153	**Result (eu8_lead)**											
2154												
2155	**General Statistics**											
2156						Total Number of Observations	65			Number of Distinct Observations	63	
2157										Number of Missing Observations	0	
2158						Minimum	47.5			Mean	670.9	
2159						Maximum	4670			Median	343	
2160						SD	932.6			Std. Error of Mean	115.7	
2161						Coefficient of Variation	1.39			Skewness	3.103	
2162												
2163	**Normal GOF Test**											
2164						Shapiro Wilk Test Statistic	0.577			**Shapiro Wilk GOF Test**		
2165						5% Shapiro Wilk P Value	0			Data Not Normal at 5% Significance Level		
2166						Lilliefors Test Statistic	0.282			**Lilliefors GOF Test**		
2167						5% Lilliefors Critical Value	0.11			Data Not Normal at 5% Significance Level		
2168	**Data Not Normal at 5% Significance Level**											
2169												
2170	**Assuming Normal Distribution**											
2171	**95% Normal UCL**									**95% UCLs (Adjusted for Skewness)**		
2172						95% Student's-t UCL	864			95% Adjusted-CLT UCL (Chen-1995)	908.8	
2173										95% Modified-t UCL (Johnson-1978)	871.4	
2174												
2175	**Gamma GOF Test**											
2176						A-D Test Statistic	2.97			**Anderson-Darling Gamma GOF Test**		
2177						5% A-D Critical Value	0.778			Data Not Gamma Distributed at 5% Significance Level		
2178						K-S Test Statistic	0.164			**Kolmogorov-Smirnov Gamma GOF Test**		
2179						5% K-S Critical Value	0.114			Data Not Gamma Distributed at 5% Significance Level		
2180	**Data Not Gamma Distributed at 5% Significance Level**											
2181												
2182	**Gamma Statistics**											
2183						k hat (MLE)	1.105			k star (bias corrected MLE)	1.064	
2184						Theta hat (MLE)	607.2			Theta star (bias corrected MLE)	630.4	
2185						nu hat (MLE)	143.7			nu star (bias corrected)	138.4	
2186						MLE Mean (bias corrected)	670.9			MLE Sd (bias corrected)	650.3	
2187										Approximate Chi Square Value (0.05)	112.2	
2188						Adjusted Level of Significance	0.0463			Adjusted Chi Square Value	111.6	
2189												
2190	**Assuming Gamma Distribution**											
2191	95% Approximate Gamma UCL (use when n>=50))						827.5			95% Adjusted Gamma UCL (use when n<50)	831.4	
2192												
2193	**Lognormal GOF Test**											
2194						Shapiro Wilk Test Statistic	0.961			**Shapiro Wilk Lognormal GOF Test**		
2195						5% Shapiro Wilk P Value	0.0938			Data appear Lognormal at 5% Significance Level		
2196						Lilliefors Test Statistic	0.1			**Lilliefors Lognormal GOF Test**		
2197						5% Lilliefors Critical Value	0.11			Data appear Lognormal at 5% Significance Level		
2198	**Data appear Lognormal at 5% Significance Level**											
2199												
2200	**Lognormal Statistics**											
2201						Minimum of Logged Data	3.861			Mean of logged Data	5.992	
2202						Maximum of Logged Data	8.449			SD of logged Data	0.941	
2203												
2204	**Assuming Lognormal Distribution**											
2205						95% H-UCL	808.9			90% Chebyshev (MVUE) UCL	869.7	
2206						95% Chebyshev (MVUE) UCL	984.1			97.5% Chebyshev (MVUE) UCL	1143	
2207						99% Chebyshev (MVUE) UCL	1455					
2208												
2209	**Nonparametric Distribution Free UCL Statistics**											
2210	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2211												

2212	**Nonparametric Distribution Free UCLs**											
2213					95% CLT UCL	861.2			95% Jackknife UCL	864		
2214					95% Standard Bootstrap UCL	856.6			95% Bootstrap-t UCL	935.8		
2215					95% Hall's Bootstrap UCL	915.8			95% Percentile Bootstrap UCL	854.7		
2216					95% BCA Bootstrap UCL	919.1						
2217					90% Chebyshev(Mean, Sd) UCL	1018			95% Chebyshev(Mean, Sd) UCL	1175		
2218					97.5% Chebyshev(Mean, Sd) UCL	1393			99% Chebyshev(Mean, Sd) UCL	1822		
2219												
2220	**Suggested UCL to Use**											
2221					95% H-UCL	808.9						
2222												
2223	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2224	Recommendations are based upon data size, data distribution, and skewness.											
2225	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2226	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2227												
2228	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
2229	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
2230	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
2231	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
2232												
2233												
2234	**Result (eu8_manganese)**											
2235												
2236	**General Statistics**											
2237					Total Number of Observations	65			Number of Distinct Observations	62		
2238									Number of Missing Observations	0		
2239					Minimum	433			Mean	1711		
2240					Maximum	6610			Median	1560		
2241					SD	1036			Std. Error of Mean	128.5		
2242					Coefficient of Variation	0.606			Skewness	1.943		
2243												
2244	**Normal GOF Test**											
2245					Shapiro Wilk Test Statistic	0.859			**Shapiro Wilk GOF Test**			
2246					5% Shapiro Wilk P Value	3.5864E-8			Data Not Normal at 5% Significance Level			
2247					Lilliefors Test Statistic	0.117			**Lilliefors GOF Test**			
2248					5% Lilliefors Critical Value	0.11			Data Not Normal at 5% Significance Level			
2249	**Data Not Normal at 5% Significance Level**											
2250												
2251	**Assuming Normal Distribution**											
2252	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
2253					95% Student's-t UCL	1926			95% Adjusted-CLT UCL (Chen-1995)	1956		
2254									95% Modified-t UCL (Johnson-1978)	1931		
2255												
2256	**Gamma GOF Test**											
2257					A-D Test Statistic	0.442			**Anderson-Darling Gamma GOF Test**			
2258					5% A-D Critical Value	0.757			Detected data appear Gamma Distributed at 5% Significance Lev			
2259					K-S Test Statistic	0.0791			**Kolmogorov-Smirnov Gamma GOF Test**			
2260					5% K-S Critical Value	0.111			Detected data appear Gamma Distributed at 5% Significance Lev			
2261	**Detected data appear Gamma Distributed at 5% Significance Level**											
2262												
2263	**Gamma Statistics**											
2264					k hat (MLE)	3.36			k star (bias corrected MLE)	3.215		
2265					Theta hat (MLE)	509.3			Theta star (bias corrected MLE)	532.3		
2266					nu hat (MLE)	436.8			nu star (bias corrected)	418		
2267					MLE Mean (bias corrected)	1711			MLE Sd (bias corrected)	954.4		
2268									Approximate Chi Square Value (0.05)	371.6		
2269					Adjusted Level of Significance	0.0463			Adjusted Chi Square Value	370.6		
2270												
2271	**Assuming Gamma Distribution**											
2272					95% Approximate Gamma UCL (use when n>=50)	1925			95% Adjusted Gamma UCL (use when n<50)	1930		
2273												
2274	**Lognormal GOF Test**											
2275					Shapiro Wilk Test Statistic	0.98			**Shapiro Wilk Lognormal GOF Test**			
2276					5% Shapiro Wilk P Value	0.64			Data appear Lognormal at 5% Significance Level			
2277					Lilliefors Test Statistic	0.0774			**Lilliefors Lognormal GOF Test**			
2278					5% Lilliefors Critical Value	0.11			Data appear Lognormal at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
2279	**Data appear Lognormal at 5% Significance Level**											
2280												
2281	**Lognormal Statistics**											
2282					Minimum of Logged Data	6.071			Mean of logged Data			7.289
2283					Maximum of Logged Data	8.796			SD of logged Data			0.562
2284												
2285	**Assuming Lognormal Distribution**											
2286					95% H-UCL	1960			90% Chebyshev (MVUE) UCL			2090
2287					95% Chebyshev (MVUE) UCL	2263			97.5% Chebyshev (MVUE) UCL			2502
2288					99% Chebyshev (MVUE) UCL	2973						
2289												
2290	**Nonparametric Distribution Free UCL Statistics**											
2291	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2292												
2293	**Nonparametric Distribution Free UCLs**											
2294					95% CLT UCL	1923			95% Jackknife UCL			1926
2295					95% Standard Bootstrap UCL	1920			95% Bootstrap-t UCL			1968
2296					95% Hall's Bootstrap UCL	1992			95% Percentile Bootstrap UCL			1924
2297					95% BCA Bootstrap UCL	1949						
2298					90% Chebyshev(Mean, Sd) UCL	2097			95% Chebyshev(Mean, Sd) UCL			2272
2299					97.5% Chebyshev(Mean, Sd) UCL	2514			99% Chebyshev(Mean, Sd) UCL			2990
2300												
2301	**Suggested UCL to Use**											
2302					95% Approximate Gamma UCL	1925						
2303												
2304	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2305	Recommendations are based upon data size, data distribution, and skewness.											
2306	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2307	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2308												
2309	**Result (eu8_thallium)**											
2310												
2311	**General Statistics**											
2312					Total Number of Observations	65			Number of Distinct Observations			39
2313					Number of Detects	14			Number of Non-Detects			51
2314					Number of Distinct Detects	12			Number of Distinct Non-Detects			27
2315					Minimum Detect	0.045			Minimum Non-Detect			0.036
2316					Maximum Detect	1.26			Maximum Non-Detect			2.51
2317					Variance Detects	0.137			Percent Non-Detects			78.46%
2318					Mean Detects	0.338			SD Detects			0.37
2319					Median Detects	0.18			CV Detects			1.095
2320					Skewness Detects	1.606			Kurtosis Detects			1.811
2321					Mean of Logged Detects	-1.6			SD of Logged Detects			1.058
2322												
2323	**Normal GOF Test on Detects Only**											
2324					Shapiro Wilk Test Statistic	0.765			**Shapiro Wilk GOF Test**			
2325					5% Shapiro Wilk Critical Value	0.874			Detected Data Not Normal at 5% Significance Level			
2326					Lilliefors Test Statistic	0.288			**Lilliefors GOF Test**			
2327					5% Lilliefors Critical Value	0.226			Detected Data Not Normal at 5% Significance Level			
2328	**Detected Data Not Normal at 5% Significance Level**											
2329												
2330	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2331					KM Mean	0.121			KM Standard Error of Mean			0.0315
2332					KM SD	0.222			95% KM (BCA) UCL			0.185
2333					95% KM (t) UCL	0.173			95% KM (Percentile Bootstrap) UCL			0.177
2334					95% KM (z) UCL	0.173			95% KM Bootstrap t UCL			0.193
2335					90% KM Chebyshev UCL	0.215			95% KM Chebyshev UCL			0.258
2336					97.5% KM Chebyshev UCL	0.317			99% KM Chebyshev UCL			0.434
2337												
2338	**Gamma GOF Tests on Detected Observations Only**											
2339					A-D Test Statistic	0.578			**Anderson-Darling GOF Test**			
2340					5% A-D Critical Value	0.758			Detected data appear Gamma Distributed at 5% Significance Lev			
2341					K-S Test Statistic	0.213			**Kolmogorov-Smirnov GOF**			
2342					5% K-S Critical Value	0.235			Detected data appear Gamma Distributed at 5% Significance Lev			
2343	**Detected data appear Gamma Distributed at 5% Significance Level**											
2344												
2345	**Gamma Statistics on Detected Data Only**											

2346					k hat (MLE)	1.107			k star (bias corrected MLE)			0.918
2347					Theta hat (MLE)	0.305			Theta star (bias corrected MLE)			0.368
2348					nu hat (MLE)	31			nu star (bias corrected)			25.69
2349					Mean (detects)	0.338						
2350												
2351					**Gamma ROS Statistics using Imputed Non-Detects**							
2352					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
2353					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)							
2354					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
2355					This is especially true when the sample size is small.							
2356					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
2357					Minimum	0.01			Mean			0.0815
2358					Maximum	1.26			Median			0.01
2359					SD	0.215			CV			2.639
2360					k hat (MLE)	0.456			k star (bias corrected MLE)			0.446
2361					Theta hat (MLE)	0.179			Theta star (bias corrected MLE)			0.183
2362					nu hat (MLE)	59.33			nu star (bias corrected)			57.93
2363					Adjusted Level of Significance (β)	0.0463						
2364					Approximate Chi Square Value (57.93, α)	41.43			Adjusted Chi Square Value (57.93, β)			41.12
2365					95% Gamma Approximate UCL (use when n>=50)	0.114			95% Gamma Adjusted UCL (use when n<50)			0.115
2366												
2367					**Estimates of Gamma Parameters using KM Estimates**							
2368					Mean (KM)	0.121			SD (KM)			0.222
2369					Variance (KM)	0.0493			SE of Mean (KM)			0.0315
2370					k hat (KM)	0.296			k star (KM)			0.293
2371					nu hat (KM)	38.51			nu star (KM)			38.07
2372					theta hat (KM)	0.408			theta star (KM)			0.413
2373					80% gamma percentile (KM)	0.184			90% gamma percentile (KM)			0.357
2374					95% gamma percentile (KM)	0.557			99% gamma percentile (KM)			1.078
2375												
2376					**Gamma Kaplan-Meier (KM) Statistics**							
2377					Approximate Chi Square Value (38.07, α)	24.94			Adjusted Chi Square Value (38.07, β)			24.7
2378	5% Gamma Approximate KM-UCL (use when n>=50)					0.184			95% Gamma Adjusted KM-UCL (use when n<50)			0.186
2379												
2380					**Lognormal GOF Test on Detected Observations Only**							
2381					Shapiro Wilk Test Statistic	0.942			**Shapiro Wilk GOF Test**			
2382					5% Shapiro Wilk Critical Value	0.874			Detected Data appear Lognormal at 5% Significance Level			
2383					Lilliefors Test Statistic	0.146			**Lilliefors GOF Test**			
2384					5% Lilliefors Critical Value	0.226			Detected Data appear Lognormal at 5% Significance Level			
2385					**Detected Data appear Lognormal at 5% Significance Level**							
2386												
2387					**Lognormal ROS Statistics Using Imputed Non-Detects**							
2388					Mean in Original Scale	0.088			Mean in Log Scale			-3.678
2389					SD in Original Scale	0.213			SD in Log Scale			1.397
2390					95% t UCL (assumes normality of ROS data)	0.132			95% Percentile Bootstrap UCL			0.135
2391					95% BCA Bootstrap UCL	0.147			95% Bootstrap t UCL			0.167
2392					95% H-UCL (Log ROS)	0.1						
2393												
2394					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
2395					KM Mean (logged)	-2.797			KM Geo Mean			0.061
2396					KM SD (logged)	0.938			95% Critical H Value (KM-Log)			2.215
2397					KM Standard Error of Mean (logged)	0.142			95% H-UCL (KM -Log)			0.123
2398					KM SD (logged)	0.938			95% Critical H Value (KM-Log)			2.215
2399					KM Standard Error of Mean (logged)	0.142						
2400												
2401					**DL/2 Statistics**							
2402					**DL/2 Normal**				**DL/2 Log-Transformed**			
2403					Mean in Original Scale	0.292			Mean in Log Scale			-2.248
2404					SD in Original Scale	0.404			SD in Log Scale			1.51
2405					95% t UCL (Assumes normality)	0.376			95% H-Stat UCL			0.524
2406					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
2407												
2408					**Nonparametric Distribution Free UCL Statistics**							
2409					**Detected Data appear Gamma Distributed at 5% Significance Level**							
2410												
2411					**Suggested UCL to Use**							
2412					95% KM Approximate Gamma UCL	0.184						

	A	B	C	D	E	F	G	H	I	J	K	L
2413												
2414	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2415	Recommendations are based upon data size, data distribution, and skewness.											
2416	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2417	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2418												
2419												
2420	**Result (eu8_zinc)**											
2421												
2422	**General Statistics**											
2423					Total Number of Observations	65			Number of Distinct Observations	64		
2424									Number of Missing Observations	0		
2425					Minimum	183			Mean	1099		
2426					Maximum	5330			Median	776		
2427					SD	962.6			Std. Error of Mean	119.4		
2428					Coefficient of Variation	0.876			Skewness	1.901		
2429												
2430	**Normal GOF Test**											
2431					Shapiro Wilk Test Statistic	0.802			**Shapiro Wilk GOF Test**			
2432					5% Shapiro Wilk P Value	1.143E-11			Data Not Normal at 5% Significance Level			
2433					Lilliefors Test Statistic	0.201			**Lilliefors GOF Test**			
2434					5% Lilliefors Critical Value	0.11			Data Not Normal at 5% Significance Level			
2435	**Data Not Normal at 5% Significance Level**											
2436												
2437	**Assuming Normal Distribution**											
2438					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
2439					95% Student's-t UCL	1298			95% Adjusted-CLT UCL (Chen-1995)	1326		
2440									95% Modified-t UCL (Johnson-1978)	1303		
2441												
2442	**Gamma GOF Test**											
2443					A-D Test Statistic	1.298			**Anderson-Darling Gamma GOF Test**			
2444					5% A-D Critical Value	0.766			Data Not Gamma Distributed at 5% Significance Level			
2445					K-S Test Statistic	0.13			**Kolmogorov-Smirnov Gamma GOF Test**			
2446					5% K-S Critical Value	0.112			Data Not Gamma Distributed at 5% Significance Level			
2447	**Data Not Gamma Distributed at 5% Significance Level**											
2448												
2449	**Gamma Statistics**											
2450					k hat (MLE)	1.72			k star (bias corrected MLE)	1.651		
2451					Theta hat (MLE)	638.9			Theta star (bias corrected MLE)	665.7		
2452					nu hat (MLE)	223.6			nu star (bias corrected)	214.6		
2453					MLE Mean (bias corrected)	1099			MLE Sd (bias corrected)	855.3		
2454									Approximate Chi Square Value (0.05)	181.7		
2455					Adjusted Level of Significance	0.0463			Adjusted Chi Square Value	181.1		
2456												
2457	**Assuming Gamma Distribution**											
2458	95% Approximate Gamma UCL (use when n>=50))					1298			95% Adjusted Gamma UCL (use when n<50)	1303		
2459												
2460	**Lognormal GOF Test**											
2461					Shapiro Wilk Test Statistic	0.959			**Shapiro Wilk Lognormal GOF Test**			
2462					5% Shapiro Wilk P Value	0.0742			Data appear Lognormal at 5% Significance Level			
2463					Lilliefors Test Statistic	0.0878			**Lilliefors Lognormal GOF Test**			
2464					5% Lilliefors Critical Value	0.11			Data appear Lognormal at 5% Significance Level			
2465	**Data appear Lognormal at 5% Significance Level**											
2466												
2467	**Lognormal Statistics**											
2468					Minimum of Logged Data	5.209			Mean of logged Data	6.684		
2469					Maximum of Logged Data	8.581			SD of logged Data	0.794		
2470												
2471	**Assuming Lognormal Distribution**											
2472					95% H-UCL	1349			90% Chebyshev (MVUE) UCL	1452		
2473					95% Chebyshev (MVUE) UCL	1616			97.5% Chebyshev (MVUE) UCL	1843		
2474					99% Chebyshev (MVUE) UCL	2291						
2475												
2476	**Nonparametric Distribution Free UCL Statistics**											
2477	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2478												
2479	**Nonparametric Distribution Free UCLs**											

2480				95% CLT UCL	1295			95% Jackknife UCL	1298			
2481				95% Standard Bootstrap UCL	1291			95% Bootstrap-t UCL	1338			
2482				95% Hall's Bootstrap UCL	1341			95% Percentile Bootstrap UCL	1300			
2483				95% BCA Bootstrap UCL	1321							
2484				90% Chebyshev(Mean, Sd) UCL	1457			95% Chebyshev(Mean, Sd) UCL	1620			
2485				97.5% Chebyshev(Mean, Sd) UCL	1845			99% Chebyshev(Mean, Sd) UCL	2287			
2486												
2487				**Suggested UCL to Use**								
2488				95% H-UCL	1349							
2489												
2490	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2491	Recommendations are based upon data size, data distribution, and skewness.											
2492	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2493	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2494												
2495	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
2496	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
2497	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
2498	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
2499												
2500												
2501	**Result (eu9_arsenic)**											
2502												
2503	**General Statistics**											
2504	Total Number of Observations				54			Number of Distinct Observations	49			
2505								Number of Missing Observations	0			
2506	Minimum				3.6			Mean	27.86			
2507	Maximum				87.8			Median	23			
2508	SD				16.36			Std. Error of Mean	2.226			
2509	Coefficient of Variation				0.587			Skewness	1.672			
2510												
2511	**Normal GOF Test**											
2512	Shapiro Wilk Test Statistic				0.856			**Shapiro Wilk GOF Test**				
2513	5% Shapiro Wilk P Value				7.6608E-7			Data Not Normal at 5% Significance Level				
2514	Lilliefors Test Statistic				0.181			**Lilliefors GOF Test**				
2515	5% Lilliefors Critical Value				0.12			Data Not Normal at 5% Significance Level				
2516	**Data Not Normal at 5% Significance Level**											
2517												
2518	**Assuming Normal Distribution**											
2519	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
2520	95% Student's-t UCL				31.59			95% Adjusted-CLT UCL (Chen-1995)	32.07			
2521								95% Modified-t UCL (Johnson-1978)	31.68			
2522												
2523	**Gamma GOF Test**											
2524	A-D Test Statistic				1.11			**Anderson-Darling Gamma GOF Test**				
2525	5% A-D Critical Value				0.757			Data Not Gamma Distributed at 5% Significance Level				
2526	K-S Test Statistic				0.139			**Kolmogorov-Smirnov Gamma GOF Test**				
2527	5% K-S Critical Value				0.122			Data Not Gamma Distributed at 5% Significance Level				
2528	**Data Not Gamma Distributed at 5% Significance Level**											
2529												
2530	**Gamma Statistics**											
2531	k hat (MLE)				3.214			k star (bias corrected MLE)	3.048			
2532	Theta hat (MLE)				8.67			Theta star (bias corrected MLE)	9.143			
2533	nu hat (MLE)				347.1			nu star (bias corrected)	329.2			
2534	MLE Mean (bias corrected)				27.86			MLE Sd (bias corrected)	15.96			
2535								Approximate Chi Square Value (0.05)	288.1			
2536	Adjusted Level of Significance				0.0456			Adjusted Chi Square Value	287.1			
2537												
2538	**Assuming Gamma Distribution**											
2539	95% Approximate Gamma UCL (use when n>=50))				31.83			95% Adjusted Gamma UCL (use when n<50)	31.95			
2540												
2541	**Lognormal GOF Test**											
2542	Shapiro Wilk Test Statistic				0.922			**Shapiro Wilk Lognormal GOF Test**				
2543	5% Shapiro Wilk P Value				0.00165			Data Not Lognormal at 5% Significance Level				
2544	Lilliefors Test Statistic				0.171			**Lilliefors Lognormal GOF Test**				
2545	5% Lilliefors Critical Value				0.12			Data Not Lognormal at 5% Significance Level				
2546	**Data Not Lognormal at 5% Significance Level**											

2547												
2548						**Lognormal Statistics**						
2549						Minimum of Logged Data	1.281			Mean of logged Data	3.164	
2550						Maximum of Logged Data	4.475			SD of logged Data	0.613	
2551												
2552						**Assuming Lognormal Distribution**						
2553						95% H-UCL	33.67			90% Chebyshev (MVUE) UCL	36.07	
2554						95% Chebyshev (MVUE) UCL	39.54			97.5% Chebyshev (MVUE) UCL	44.34	
2555						99% Chebyshev (MVUE) UCL	53.78					
2556												
2557						**Nonparametric Distribution Free UCL Statistics**						
2558						**Data do not follow a Discernible Distribution (0.05)**						
2559												
2560						**Nonparametric Distribution Free UCLs**						
2561						95% CLT UCL	31.53			95% Jackknife UCL	31.59	
2562						95% Standard Bootstrap UCL	31.41			95% Bootstrap-t UCL	32.63	
2563						95% Hall's Bootstrap UCL	32.51			95% Percentile Bootstrap UCL	31.46	
2564						95% BCA Bootstrap UCL	31.99					
2565						90% Chebyshev(Mean, Sd) UCL	34.54			95% Chebyshev(Mean, Sd) UCL	37.57	
2566						97.5% Chebyshev(Mean, Sd) UCL	41.77			99% Chebyshev(Mean, Sd) UCL	50.01	
2567												
2568						**Suggested UCL to Use**						
2569						95% Chebyshev (Mean, Sd) UCL	37.57					
2570												
2571	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2572	Recommendations are based upon data size, data distribution, and skewness.											
2573	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2574	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2575												
2576												
2577	**Result (eu9_cadmium)**											
2578												
2579						**General Statistics**						
2580						Total Number of Observations	54			Number of Distinct Observations	49	
2581										Number of Missing Observations	0	
2582						Minimum	2			Mean	10.79	
2583						Maximum	51.2			Median	9.685	
2584						SD	7.622			Std. Error of Mean	1.037	
2585						Coefficient of Variation	0.706			Skewness	3.146	
2586												
2587						**Normal GOF Test**						
2588						Shapiro Wilk Test Statistic	0.741			**Shapiro Wilk GOF Test**		
2589						5% Shapiro Wilk P Value	4.681E-12			Data Not Normal at 5% Significance Level		
2590						Lilliefors Test Statistic	0.198			**Lilliefors GOF Test**		
2591						5% Lilliefors Critical Value	0.12			Data Not Normal at 5% Significance Level		
2592						**Data Not Normal at 5% Significance Level**						
2593												
2594						**Assuming Normal Distribution**						
2595						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
2596						95% Student's-t UCL	12.53			95% Adjusted-CLT UCL (Chen-1995)	12.97	
2597										95% Modified-t UCL (Johnson-1978)	12.6	
2598												
2599						**Gamma GOF Test**						
2600						A-D Test Statistic	0.839			**Anderson-Darling Gamma GOF Test**		
2601						5% A-D Critical Value	0.758			Data Not Gamma Distributed at 5% Significance Level		
2602						K-S Test Statistic	0.119			**Kolmogorov-Smirnov Gamma GOF Test**		
2603						5% K-S Critical Value	0.122			Detected data appear Gamma Distributed at 5% Significance Lev		
2604						**Detected data follow Appr. Gamma Distribution at 5% Significance Level**						
2605												
2606						**Gamma Statistics**						
2607						k hat (MLE)	2.965			k star (bias corrected MLE)	2.813	
2608						Theta hat (MLE)	3.64			Theta star (bias corrected MLE)	3.837	
2609						nu hat (MLE)	320.2			nu star (bias corrected)	303.8	
2610						MLE Mean (bias corrected)	10.79			MLE Sd (bias corrected)	6.435	
2611										Approximate Chi Square Value (0.05)	264.4	
2612						Adjusted Level of Significance	0.0456			Adjusted Chi Square Value	263.4	
2613												

2614	**Assuming Gamma Distribution**											
2615	95% Approximate Gamma UCL (use when n>=50)				12.4		95% Adjusted Gamma UCL (use when n<50)					12.45
2616												
2617	**Lognormal GOF Test**											
2618	Shapiro Wilk Test Statistic				0.97		**Shapiro Wilk Lognormal GOF Test**					
2619	5% Shapiro Wilk P Value				0.346		Data appear Lognormal at 5% Significance Level					
2620	Lilliefors Test Statistic				0.109		**Lilliefors Lognormal GOF Test**					
2621	5% Lilliefors Critical Value				0.12		Data appear Lognormal at 5% Significance Level					
2622	**Data appear Lognormal at 5% Significance Level**											
2623												
2624	**Lognormal Statistics**											
2625	Minimum of Logged Data				0.693		Mean of logged Data					2.201
2626	Maximum of Logged Data				3.936		SD of logged Data					0.601
2627												
2628	**Assuming Lognormal Distribution**											
2629	95% H-UCL				12.71		90% Chebyshev (MVUE) UCL					13.61
2630	95% Chebyshev (MVUE) UCL				14.9		97.5% Chebyshev (MVUE) UCL					16.68
2631	99% Chebyshev (MVUE) UCL				20.18							
2632												
2633	**Nonparametric Distribution Free UCL Statistics**											
2634	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2635												
2636	**Nonparametric Distribution Free UCLs**											
2637	95% CLT UCL				12.5		95% Jackknife UCL					12.53
2638	95% Standard Bootstrap UCL				12.46		95% Bootstrap-t UCL					13.43
2639	95% Hall's Bootstrap UCL				15.22		95% Percentile Bootstrap UCL					12.57
2640	95% BCA Bootstrap UCL				13.12							
2641	90% Chebyshev(Mean, Sd) UCL				13.9		95% Chebyshev(Mean, Sd) UCL					15.31
2642	97.5% Chebyshev(Mean, Sd) UCL				17.27		99% Chebyshev(Mean, Sd) UCL					21.11
2643												
2644	**Suggested UCL to Use**											
2645	95% Approximate Gamma UCL				12.4							
2646												
2647	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
2648	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
2649												
2650	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2651	Recommendations are based upon data size, data distribution, and skewness.											
2652	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2653	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2654												
2655												
2656	**Result (eu9_chromium)**											
2657												
2658	**General Statistics**											
2659	Total Number of Observations				54		Number of Distinct Observations					43
2660							Number of Missing Observations					0
2661	Minimum				1.9		Mean					4.413
2662	Maximum				37.3		Median					3.8
2663	SD				4.64		Std. Error of Mean					0.631
2664	Coefficient of Variation				1.052		Skewness					6.959
2665												
2666	**Normal GOF Test**											
2667	Shapiro Wilk Test Statistic				0.286		**Shapiro Wilk GOF Test**					
2668	5% Shapiro Wilk P Value				0		Data Not Normal at 5% Significance Level					
2669	Lilliefors Test Statistic				0.38		**Lilliefors GOF Test**					
2670	5% Lilliefors Critical Value				0.12		Data Not Normal at 5% Significance Level					
2671	**Data Not Normal at 5% Significance Level**											
2672												
2673	**Assuming Normal Distribution**											
2674	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
2675	95% Student's-t UCL				5.47		95% Adjusted-CLT UCL (Chen-1995)					6.09
2676							95% Modified-t UCL (Johnson-1978)					5.569
2677												
2678	**Gamma GOF Test**											
2679	A-D Test Statistic				6.106		**Anderson-Darling Gamma GOF Test**					
2680	5% A-D Critical Value				0.754		Data Not Gamma Distributed at 5% Significance Level					

2681					K-S Test Statistic	0.248	**Kolmogorov-Smirnov Gamma GOF Test**					
2682					5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level					
2683	**Data Not Gamma Distributed at 5% Significance Level**											
2684												
2685	**Gamma Statistics**											
2686					k hat (MLE)	3.811	k star (bias corrected MLE)	3.611				
2687					Theta hat (MLE)	1.158	Theta star (bias corrected MLE)	1.222				
2688					nu hat (MLE)	411.5	nu star (bias corrected)	390				
2689					MLE Mean (bias corrected)	4.413	MLE Sd (bias corrected)	2.322				
2690							Approximate Chi Square Value (0.05)	345.2				
2691					Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	344.1				
2692												
2693	**Assuming Gamma Distribution**											
2694	95% Approximate Gamma UCL (use when n>=50))					4.985	95% Adjusted Gamma UCL (use when n<50)	5.002				
2695												
2696	**Lognormal GOF Test**											
2697					Shapiro Wilk Test Statistic	0.727	**Shapiro Wilk Lognormal GOF Test**					
2698					5% Shapiro Wilk P Value	1.143E-12	Data Not Lognormal at 5% Significance Level					
2699					Lilliefors Test Statistic	0.164	**Lilliefors Lognormal GOF Test**					
2700					5% Lilliefors Critical Value	0.12	Data Not Lognormal at 5% Significance Level					
2701	**Data Not Lognormal at 5% Significance Level**											
2702												
2703	**Lognormal Statistics**											
2704					Minimum of Logged Data	0.642	Mean of logged Data	1.348				
2705					Maximum of Logged Data	3.619	SD of logged Data	0.399				
2706												
2707	**Assuming Lognormal Distribution**											
2708					95% H-UCL	4.602	90% Chebyshev (MVUE) UCL	4.86				
2709					95% Chebyshev (MVUE) UCL	5.177	97.5% Chebyshev (MVUE) UCL	5.617				
2710					99% Chebyshev (MVUE) UCL	6.482						
2711												
2712	**Nonparametric Distribution Free UCL Statistics**											
2713	**Data do not follow a Discernible Distribution (0.05)**											
2714												
2715	**Nonparametric Distribution Free UCLs**											
2716					95% CLT UCL	5.451	95% Jackknife UCL	5.47				
2717					95% Standard Bootstrap UCL	5.45	95% Bootstrap-t UCL	8.662				
2718					95% Hall's Bootstrap UCL	9.953	95% Percentile Bootstrap UCL	5.671				
2719					95% BCA Bootstrap UCL	6.406						
2720					90% Chebyshev(Mean, Sd) UCL	6.307	95% Chebyshev(Mean, Sd) UCL	7.165				
2721					97.5% Chebyshev(Mean, Sd) UCL	8.356	99% Chebyshev(Mean, Sd) UCL	10.7				
2722												
2723	**Suggested UCL to Use**											
2724					95% Student's-t UCL	5.47	or 95% Modified-t UCL	5.569				
2725												
2726	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2727	Recommendations are based upon data size, data distribution, and skewness.											
2728	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2729	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2730												
2731												
2732	**Result (eu9_cobalt)**											
2733												
2734	**General Statistics**											
2735					Total Number of Observations	39	Number of Distinct Observations	32				
2736							Number of Missing Observations	0				
2737					Minimum	3.9	Mean	11.53				
2738					Maximum	20	Median	12				
2739					SD	3.595	Std. Error of Mean	0.576				
2740					Coefficient of Variation	0.312	Skewness	-0.0971				
2741												
2742	**Normal GOF Test**											
2743					Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk GOF Test**					
2744					5% Shapiro Wilk Critical Value	0.939	Data appear Normal at 5% Significance Level					
2745					Lilliefors Test Statistic	0.101	**Lilliefors GOF Test**					
2746					5% Lilliefors Critical Value	0.14	Data appear Normal at 5% Significance Level					
2747	**Data appear Normal at 5% Significance Level**											

2748												
2749						**Assuming Normal Distribution**							
2750					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
2751					95% Student's-t UCL	12.5			95% Adjusted-CLT UCL (Chen-1995)	12.47		
2752									95% Modified-t UCL (Johnson-1978)	12.5		
2753												
2754						**Gamma GOF Test**							
2755					A-D Test Statistic	0.767			**Anderson-Darling Gamma GOF Test**			
2756					5% A-D Critical Value	0.749			Data Not Gamma Distributed at 5% Significance Level			
2757					K-S Test Statistic	0.146			**Kolmogorov-Smirnov Gamma GOF Test**			
2758					5% K-S Critical Value	0.141			Data Not Gamma Distributed at 5% Significance Level			
2759					**Data Not Gamma Distributed at 5% Significance Level**							
2760												
2761						**Gamma Statistics**						
2762					k hat (MLE)	9.106			k star (bias corrected MLE)	8.423		
2763					Theta hat (MLE)	1.266			Theta star (bias corrected MLE)	1.369		
2764					nu hat (MLE)	710.3			nu star (bias corrected)	657		
2765					MLE Mean (bias corrected)	11.53			MLE Sd (bias corrected)	3.973		
2766									Approximate Chi Square Value (0.05)	598.5		
2767					Adjusted Level of Significance	0.0437			Adjusted Chi Square Value	596.3		
2768												
2769						**Assuming Gamma Distribution**							
2770					95% Approximate Gamma UCL (use when n>=50))	12.66			95% Adjusted Gamma UCL (use when n<50)	12.7		
2771												
2772						**Lognormal GOF Test**							
2773					Shapiro Wilk Test Statistic	0.929			**Shapiro Wilk Lognormal GOF Test**			
2774					5% Shapiro Wilk Critical Value	0.939			Data Not Lognormal at 5% Significance Level			
2775					Lilliefors Test Statistic	0.165			**Lilliefors Lognormal GOF Test**			
2776					5% Lilliefors Critical Value	0.14			Data Not Lognormal at 5% Significance Level			
2777					**Data Not Lognormal at 5% Significance Level**							
2778												
2779						**Lognormal Statistics**						
2780					Minimum of Logged Data	1.361			Mean of logged Data	2.389		
2781					Maximum of Logged Data	2.996			SD of logged Data	0.357		
2782												
2783						**Assuming Lognormal Distribution**							
2784					95% H-UCL	12.92			90% Chebyshev (MVUE) UCL	13.64		
2785					95% Chebyshev (MVUE) UCL	14.57			97.5% Chebyshev (MVUE) UCL	15.85		
2786					99% Chebyshev (MVUE) UCL	18.37						
2787												
2788						**Nonparametric Distribution Free UCL Statistics**							
2789					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
2790												
2791						**Nonparametric Distribution Free UCLs**							
2792					95% CLT UCL	12.48			95% Jackknife UCL	12.5		
2793					95% Standard Bootstrap UCL	12.48			95% Bootstrap-t UCL	12.49		
2794					95% Hall's Bootstrap UCL	12.41			95% Percentile Bootstrap UCL	12.44		
2795					95% BCA Bootstrap UCL	12.46						
2796					90% Chebyshev(Mean, Sd) UCL	13.26			95% Chebyshev(Mean, Sd) UCL	14.04		
2797					97.5% Chebyshev(Mean, Sd) UCL	15.13			99% Chebyshev(Mean, Sd) UCL	17.26		
2798												
2799						**Suggested UCL to Use**							
2800					95% Student's-t UCL	12.5						
2801												
2802	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2803	Recommendations are based upon data size, data distribution, and skewness.											
2804	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2805	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2806												
2807	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
2808	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
2809												
2810												
2811	**Result (eu9_copper)**											
2812												
2813						**General Statistics**							
2814					Total Number of Observations	54			Number of Distinct Observations	52		

2815								Number of Missing Observations				0
2816					Minimum	61.5				Mean		376.4
2817					Maximum	2680				Median		303
2818					SD	378.3				Std. Error of Mean		51.48
2819					Coefficient of Variation	1.005				Skewness		4.819
2820												
2821	**Normal GOF Test**											
2822					Shapiro Wilk Test Statistic	0.507	**Shapiro Wilk GOF Test**					
2823					5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level					
2824					Lilliefors Test Statistic	0.312	**Lilliefors GOF Test**					
2825					5% Lilliefors Critical Value	0.12	Data Not Normal at 5% Significance Level					
2826	**Data Not Normal at 5% Significance Level**											
2827												
2828	**Assuming Normal Distribution**											
2829	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
2830					95% Student's-t UCL	462.6				95% Adjusted-CLT UCL (Chen-1995)		497.2
2831										95% Modified-t UCL (Johnson-1978)		468.2
2832												
2833	**Gamma GOF Test**											
2834					A-D Test Statistic	3.109	**Anderson-Darling Gamma GOF Test**					
2835					5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level					
2836					K-S Test Statistic	0.203	**Kolmogorov-Smirnov Gamma GOF Test**					
2837					5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level					
2838	**Data Not Gamma Distributed at 5% Significance Level**											
2839												
2840	**Gamma Statistics**											
2841					k hat (MLE)	2.443				k star (bias corrected MLE)		2.32
2842					Theta hat (MLE)	154.1				Theta star (bias corrected MLE)		162.3
2843					nu hat (MLE)	263.8				nu star (bias corrected)		250.5
2844					MLE Mean (bias corrected)	376.4				MLE Sd (bias corrected)		247.1
2845										Approximate Chi Square Value (0.05)		214.9
2846					Adjusted Level of Significance	0.0456				Adjusted Chi Square Value		214
2847												
2848	**Assuming Gamma Distribution**											
2849	95% Approximate Gamma UCL (use when n>=50))					438.9	95% Adjusted Gamma UCL (use when n<50)					440.7
2850												
2851	**Lognormal GOF Test**											
2852					Shapiro Wilk Test Statistic	0.911	**Shapiro Wilk Lognormal GOF Test**					
2853					5% Shapiro Wilk P Value	4.5260E-4	Data Not Lognormal at 5% Significance Level					
2854					Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**					
2855					5% Lilliefors Critical Value	0.12	Data Not Lognormal at 5% Significance Level					
2856	**Data Not Lognormal at 5% Significance Level**											
2857												
2858	**Lognormal Statistics**											
2859					Minimum of Logged Data	4.119				Mean of logged Data		5.712
2860					Maximum of Logged Data	7.894				SD of logged Data		0.607
2861												
2862	**Assuming Lognormal Distribution**											
2863					95% H-UCL	428.1				90% Chebyshev (MVUE) UCL		458.6
2864					95% Chebyshev (MVUE) UCL	502.2				97.5% Chebyshev (MVUE) UCL		562.8
2865					99% Chebyshev (MVUE) UCL	681.7						
2866												
2867	**Nonparametric Distribution Free UCL Statistics**											
2868	**Data do not follow a Discernible Distribution (0.05)**											
2869												
2870	**Nonparametric Distribution Free UCLs**											
2871					95% CLT UCL	461.1				95% Jackknife UCL		462.6
2872					95% Standard Bootstrap UCL	461.4				95% Bootstrap-t UCL		587.1
2873					95% Hall's Bootstrap UCL	861.6				95% Percentile Bootstrap UCL		465.7
2874					95% BCA Bootstrap UCL	502.8						
2875					90% Chebyshev(Mean, Sd) UCL	530.9				95% Chebyshev(Mean, Sd) UCL		600.8
2876					97.5% Chebyshev(Mean, Sd) UCL	697.9				99% Chebyshev(Mean, Sd) UCL		888.6
2877												
2878	**Suggested UCL to Use**											
2879					95% Chebyshev (Mean, Sd) UCL	600.8						
2880												
2881	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

2882	Recommendations are based upon data size, data distribution, and skewness.											
2883	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2884	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2885												
2886												
2887	**Result (eu9_iron)**											
2888												
2889	**General Statistics**											
2890						Total Number of Observations	54			Number of Distinct Observations	49	
2891										Number of Missing Observations	0	
2892						Minimum	19300			Mean	26626	
2893						Maximum	41300			Median	25300	
2894						SD	5077			Std. Error of Mean	690.8	
2895						Coefficient of Variation	0.191			Skewness	0.979	
2896												
2897	**Normal GOF Test**											
2898						Shapiro Wilk Test Statistic	0.926			**Shapiro Wilk GOF Test**		
2899						5% Shapiro Wilk P Value	0.00261			Data Not Normal at 5% Significance Level		
2900						Lilliefors Test Statistic	0.114			**Lilliefors GOF Test**		
2901						5% Lilliefors Critical Value	0.12			Data appear Normal at 5% Significance Level		
2902	**Data appear Approximate Normal at 5% Significance Level**											
2903												
2904	**Assuming Normal Distribution**											
2905						**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**		
2906						95% Student's-t UCL	27782			95% Adjusted-CLT UCL (Chen-1995)	27861	
2907										95% Modified-t UCL (Johnson-1978)	27798	
2908												
2909	**Gamma GOF Test**											
2910						A-D Test Statistic	0.551			**Anderson-Darling Gamma GOF Test**		
2911						5% A-D Critical Value	0.748			Detected data appear Gamma Distributed at 5% Significance Lev		
2912						K-S Test Statistic	0.0963			**Kolmogorov-Smirnov Gamma GOF Test**		
2913						5% K-S Critical Value	0.121			Detected data appear Gamma Distributed at 5% Significance Lev		
2914	**Detected data appear Gamma Distributed at 5% Significance Level**											
2915												
2916	**Gamma Statistics**											
2917						k hat (MLE)	30.24			k star (bias corrected MLE)	28.58	
2918						Theta hat (MLE)	880.4			Theta star (bias corrected MLE)	931.7	
2919						nu hat (MLE)	3266			nu star (bias corrected)	3086	
2920						MLE Mean (bias corrected)	26626			MLE Sd (bias corrected)	4981	
2921										Approximate Chi Square Value (0.05)	2958	
2922						Adjusted Level of Significance	0.0456			Adjusted Chi Square Value	2955	
2923												
2924	**Assuming Gamma Distribution**											
2925						95% Approximate Gamma UCL (use when n>=50))	27779			95% Adjusted Gamma UCL (use when n<50)	27811	
2926												
2927	**Lognormal GOF Test**											
2928						Shapiro Wilk Test Statistic	0.962			**Shapiro Wilk Lognormal GOF Test**		
2929						5% Shapiro Wilk P Value	0.16			Data appear Lognormal at 5% Significance Level		
2930						Lilliefors Test Statistic	0.0853			**Lilliefors Lognormal GOF Test**		
2931						5% Lilliefors Critical Value	0.12			Data appear Lognormal at 5% Significance Level		
2932	**Data appear Lognormal at 5% Significance Level**											
2933												
2934	**Lognormal Statistics**											
2935						Minimum of Logged Data	9.868			Mean of logged Data	10.17	
2936						Maximum of Logged Data	10.63			SD of logged Data	0.181	
2937												
2938	**Assuming Lognormal Distribution**											
2939						95% H-UCL	27785			90% Chebyshev (MVUE) UCL	28597	
2940						95% Chebyshev (MVUE) UCL	29496			97.5% Chebyshev (MVUE) UCL	30744	
2941						99% Chebyshev (MVUE) UCL	33194					
2942												
2943	**Nonparametric Distribution Free UCL Statistics**											
2944	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2945												
2946	**Nonparametric Distribution Free UCLs**											
2947						95% CLT UCL	27762			95% Jackknife UCL	27782	
2948						95% Standard Bootstrap UCL	27774			95% Bootstrap-t UCL	27931	

2949				95% Hall's Bootstrap UCL	27893			95% Percentile Bootstrap UCL	27839			
2950				95% BCA Bootstrap UCL	27839							
2951				90% Chebyshev(Mean, Sd) UCL	28698			95% Chebyshev(Mean, Sd) UCL	29637			
2952				97.5% Chebyshev(Mean, Sd) UCL	30940			99% Chebyshev(Mean, Sd) UCL	33500			
2953												
2954					**Suggested UCL to Use**							
2955				95% Student's-t UCL	27782							
2956												
2957	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
2958	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
2959												
2960	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2961	Recommendations are based upon data size, data distribution, and skewness.											
2962	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2963	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2964												
2965												
2966	**Result (eu9_lead)**											
2967												
2968					**General Statistics**							
2969				Total Number of Observations	54			Number of Distinct Observations	51			
2970								Number of Missing Observations	0			
2971				Minimum	83.1			Mean	1843			
2972				Maximum	22400			Median	1460			
2973				SD	2924			Std. Error of Mean	397.8			
2974				Coefficient of Variation	1.587			Skewness	6.798			
2975												
2976					**Normal GOF Test**							
2977				Shapiro Wilk Test Statistic	0.313			**Shapiro Wilk GOF Test**				
2978				5% Shapiro Wilk P Value	0			Data Not Normal at 5% Significance Level				
2979				Lilliefors Test Statistic	0.377			**Lilliefors GOF Test**				
2980				5% Lilliefors Critical Value	0.12			Data Not Normal at 5% Significance Level				
2981					**Data Not Normal at 5% Significance Level**							
2982												
2983					**Assuming Normal Distribution**							
2984				**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**				
2985				95% Student's-t UCL	2509			95% Adjusted-CLT UCL (Chen-1995)	2890			
2986								95% Modified-t UCL (Johnson-1978)	2570			
2987												
2988					**Gamma GOF Test**							
2989				A-D Test Statistic	4.102			**Anderson-Darling Gamma GOF Test**				
2990				5% A-D Critical Value	0.766			Data Not Gamma Distributed at 5% Significance Level				
2991				K-S Test Statistic	0.237			**Kolmogorov-Smirnov Gamma GOF Test**				
2992				5% K-S Critical Value	0.123			Data Not Gamma Distributed at 5% Significance Level				
2993					**Data Not Gamma Distributed at 5% Significance Level**							
2994												
2995					**Gamma Statistics**							
2996				k hat (MLE)	1.714			k star (bias corrected MLE)	1.631			
2997				Theta hat (MLE)	1075			Theta star (bias corrected MLE)	1130			
2998				nu hat (MLE)	185.1			nu star (bias corrected)	176.1			
2999				MLE Mean (bias corrected)	1843			MLE Sd (bias corrected)	1443			
3000								Approximate Chi Square Value (0.05)	146.4			
3001				Adjusted Level of Significance	0.0456			Adjusted Chi Square Value	145.7			
3002												
3003					**Assuming Gamma Distribution**							
3004				95% Approximate Gamma UCL (use when n>=50))	2216			95% Adjusted Gamma UCL (use when n<50)	2228			
3005												
3006					**Lognormal GOF Test**							
3007				Shapiro Wilk Test Statistic	0.855			**Shapiro Wilk Lognormal GOF Test**				
3008				5% Shapiro Wilk P Value	7.1248E-7			Data Not Lognormal at 5% Significance Level				
3009				Lilliefors Test Statistic	0.173			**Lilliefors Lognormal GOF Test**				
3010				5% Lilliefors Critical Value	0.12			Data Not Lognormal at 5% Significance Level				
3011					**Data Not Lognormal at 5% Significance Level**							
3012												
3013					**Lognormal Statistics**							
3014				Minimum of Logged Data	4.42			Mean of logged Data	7.2			
3015				Maximum of Logged Data	10.02			SD of logged Data	0.726			

3016												
3017						**Assuming Lognormal Distribution**						
3018					95% H-UCL	2139			90% Chebyshev (MVUE) UCL	2299		
3019					95% Chebyshev (MVUE) UCL	2556			97.5% Chebyshev (MVUE) UCL	2912		
3020					99% Chebyshev (MVUE) UCL	3611						
3021												
3022						**Nonparametric Distribution Free UCL Statistics**						
3023						**Data do not follow a Discernible Distribution (0.05)**						
3024												
3025						**Nonparametric Distribution Free UCLs**						
3026					95% CLT UCL	2497			95% Jackknife UCL	2509		
3027					95% Standard Bootstrap UCL	2504			95% Bootstrap-t UCL	4378		
3028					95% Hall's Bootstrap UCL	5205			95% Percentile Bootstrap UCL	2643		
3029					95% BCA Bootstrap UCL	3053						
3030					90% Chebyshev(Mean, Sd) UCL	3036			95% Chebyshev(Mean, Sd) UCL	3577		
3031					97.5% Chebyshev(Mean, Sd) UCL	4327			99% Chebyshev(Mean, Sd) UCL	5801		
3032												
3033						**Suggested UCL to Use**						
3034					95% Chebyshev (Mean, Sd) UCL	3577						
3035												
3036	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3037	Recommendations are based upon data size, data distribution, and skewness.											
3038	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3039	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3040												
3041												
3042	**Result (eu9_manganese)**											
3043												
3044						**General Statistics**						
3045					Total Number of Observations	54			Number of Distinct Observations	51		
3046									Number of Missing Observations	0		
3047					Minimum	729			Mean	10190		
3048					Maximum	31100			Median	8895		
3049					SD	5631			Std. Error of Mean	766.3		
3050					Coefficient of Variation	0.553			Skewness	1.471		
3051												
3052						**Normal GOF Test**						
3053					Shapiro Wilk Test Statistic	0.889			**Shapiro Wilk GOF Test**			
3054					5% Shapiro Wilk P Value	3.2751E-5			Data Not Normal at 5% Significance Level			
3055					Lilliefors Test Statistic	0.165			**Lilliefors GOF Test**			
3056					5% Lilliefors Critical Value	0.12			Data Not Normal at 5% Significance Level			
3057						**Data Not Normal at 5% Significance Level**						
3058												
3059						**Assuming Normal Distribution**						
3060					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
3061					95% Student's-t UCL	11473			95% Adjusted-CLT UCL (Chen-1995)	11614		
3062									95% Modified-t UCL (Johnson-1978)	11499		
3063												
3064						**Gamma GOF Test**						
3065					A-D Test Statistic	1.308			**Anderson-Darling Gamma GOF Test**			
3066					5% A-D Critical Value	0.757			Data Not Gamma Distributed at 5% Significance Level			
3067					K-S Test Statistic	0.162			**Kolmogorov-Smirnov Gamma GOF Test**			
3068					5% K-S Critical Value	0.122			Data Not Gamma Distributed at 5% Significance Level			
3069						**Data Not Gamma Distributed at 5% Significance Level**						
3070												
3071						**Gamma Statistics**						
3072					k hat (MLE)	3.133			k star (bias corrected MLE)	2.971		
3073					Theta hat (MLE)	3253			Theta star (bias corrected MLE)	3430		
3074					nu hat (MLE)	338.3			nu star (bias corrected)	320.9		
3075					MLE Mean (bias corrected)	10190			MLE Sd (bias corrected)	5912		
3076									Approximate Chi Square Value (0.05)	280.4		
3077					Adjusted Level of Significance	0.0456			Adjusted Chi Square Value	279.3		
3078												
3079						**Assuming Gamma Distribution**						
3080	95% Approximate Gamma UCL (use when n>=50))					11662			95% Adjusted Gamma UCL (use when n<50)	11705		
3081												
3082						**Lognormal GOF Test**						

3083					Shapiro Wilk Test Statistic	0.877	**Shapiro Wilk Lognormal GOF Test**					
3084					5% Shapiro Wilk P Value	8.8210E-6	Data Not Lognormal at 5% Significance Level					
3085					Lilliefors Test Statistic	0.205	**Lilliefors Lognormal GOF Test**					
3086					5% Lilliefors Critical Value	0.12	Data Not Lognormal at 5% Significance Level					
3087					**Data Not Lognormal at 5% Significance Level**							
3088												
3089					**Lognormal Statistics**							
3090					Minimum of Logged Data	6.592	Mean of logged Data	9.061				
3091					Maximum of Logged Data	10.34	SD of logged Data	0.659				
3092												
3093					**Assuming Lognormal Distribution**							
3094					95% H-UCL	12825	90% Chebyshev (MVUE) UCL	13764				
3095					95% Chebyshev (MVUE) UCL	15174	97.5% Chebyshev (MVUE) UCL	17131				
3096					99% Chebyshev (MVUE) UCL	20974						
3097												
3098					**Nonparametric Distribution Free UCL Statistics**							
3099					**Data do not follow a Discernible Distribution (0.05)**							
3100												
3101					**Nonparametric Distribution Free UCLs**							
3102					95% CLT UCL	11451	95% Jackknife UCL	11473				
3103					95% Standard Bootstrap UCL	11442	95% Bootstrap-t UCL	11764				
3104					95% Hall's Bootstrap UCL	11736	95% Percentile Bootstrap UCL	11510				
3105					95% BCA Bootstrap UCL	11571						
3106					90% Chebyshev(Mean, Sd) UCL	12489	95% Chebyshev(Mean, Sd) UCL	13530				
3107					97.5% Chebyshev(Mean, Sd) UCL	14975	99% Chebyshev(Mean, Sd) UCL	17814				
3108												
3109					**Suggested UCL to Use**							
3110					95% Chebyshev (Mean, Sd) UCL	13530						
3111												
3112	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3113	Recommendations are based upon data size, data distribution, and skewness.											
3114	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3115	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3116												
3117	**Result (eu9_thallium)**											
3118												
3119					**General Statistics**							
3120					Total Number of Observations	52	Number of Distinct Observations	35				
3121					Number of Detects	16	Number of Non-Detects	36				
3122					Number of Distinct Detects	14	Number of Distinct Non-Detects	21				
3123					Minimum Detect	0.18	Minimum Non-Detect	0.004				
3124					Maximum Detect	171	Maximum Non-Detect	1				
3125					Variance Detects	1806	Percent Non-Detects	69.23%				
3126					Mean Detects	11.75	SD Detects	42.5				
3127					Median Detects	0.295	CV Detects	3.618				
3128					Skewness Detects	3.99	Kurtosis Detects	15.94				
3129					Mean of Logged Detects	-0.319	SD of Logged Detects	1.853				
3130												
3131					**Normal GOF Test on Detects Only**							
3132					Shapiro Wilk Test Statistic	0.298	**Shapiro Wilk GOF Test**					
3133					5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level					
3134					Lilliefors Test Statistic	0.497	**Lilliefors GOF Test**					
3135					5% Lilliefors Critical Value	0.213	Detected Data Not Normal at 5% Significance Level					
3136					**Detected Data Not Normal at 5% Significance Level**							
3137												
3138					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
3139					KM Mean	3.663	KM Standard Error of Mean	3.359				
3140					KM SD	23.45	95% KM (BCA) UCL	10.25				
3141					95% KM (t) UCL	9.291	95% KM (Percentile Bootstrap) UCL	10.18				
3142					95% KM (z) UCL	9.188	95% KM Bootstrap t UCL	126.8				
3143					90% KM Chebyshev UCL	13.74	95% KM Chebyshev UCL	18.31				
3144					97.5% KM Chebyshev UCL	24.64	99% KM Chebyshev UCL	37.09				
3145												
3146					**Gamma GOF Tests on Detected Observations Only**							
3147					A-D Test Statistic	3.289	**Anderson-Darling GOF Test**					
3148					5% A-D Critical Value	0.859	Detected Data Not Gamma Distributed at 5% Significance Level					
3149					K-S Test Statistic	0.352	**Kolmogorov-Smirnov GOF**					

3150					5% K-S Critical Value	0.235	Detected Data Not Gamma Distributed at 5% Significance Level					
3151	**Detected Data Not Gamma Distributed at 5% Significance Level**											
3152												
3153	**Gamma Statistics on Detected Data Only**											
3154					k hat (MLE)	0.255	k star (bias corrected MLE)	0.248				
3155					Theta hat (MLE)	46.15	Theta star (bias corrected MLE)	47.28				
3156					nu hat (MLE)	8.146	nu star (bias corrected)	7.952				
3157					Mean (detects)	11.75						
3158												
3159	**Gamma ROS Statistics using Imputed Non-Detects**											
3160	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
3161	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)											
3162	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
3163	This is especially true when the sample size is small.											
3164	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
3165					Minimum	0.01	Mean	3.622				
3166					Maximum	171	Median	0.01				
3167					SD	23.69	CV	6.541				
3168					k hat (MLE)	0.166	k star (bias corrected MLE)	0.169				
3169					Theta hat (MLE)	21.87	Theta star (bias corrected MLE)	21.44				
3170					nu hat (MLE)	17.23	nu star (bias corrected)	17.56				
3171					Adjusted Level of Significance (β)	0.0454						
3172					Approximate Chi Square Value (17.56, α)	9.077	Adjusted Chi Square Value (17.56, β)	8.903				
3173					95% Gamma Approximate UCL (use when n>=50)	7.008	95% Gamma Adjusted UCL (use when n<50)	7.145				
3174												
3175	**Estimates of Gamma Parameters using KM Estimates**											
3176					Mean (KM)	3.663	SD (KM)	23.45				
3177					Variance (KM)	550.1	SE of Mean (KM)	3.359				
3178					k hat (KM)	0.0244	k star (KM)	0.0358				
3179					nu hat (KM)	2.537	nu star (KM)	3.724				
3180					theta hat (KM)	150.2	theta star (KM)	102.3				
3181					80% gamma percentile (KM)	0.116	90% gamma percentile (KM)	3.214				
3182					95% gamma percentile (KM)	16.38	99% gamma percentile (KM)	89.81				
3183												
3184	**Gamma Kaplan-Meier (KM) Statistics**											
3185					Approximate Chi Square Value (3.72, α)	0.616	Adjusted Chi Square Value (3.72, β)	0.583				
3186	5% Gamma Approximate KM-UCL (use when n>=50)					22.15	95% Gamma Adjusted KM-UCL (use when n<50)	23.4				
3187												
3188	**Lognormal GOF Test on Detected Observations Only**											
3189					Shapiro Wilk Test Statistic	0.729	**Shapiro Wilk GOF Test**					
3190					5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level					
3191					Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**					
3192					5% Lilliefors Critical Value	0.213	Detected Data Not Lognormal at 5% Significance Level					
3193	**Detected Data Not Lognormal at 5% Significance Level**											
3194												
3195	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3196					Mean in Original Scale	3.644	Mean in Log Scale	-2.733				
3197					SD in Original Scale	23.68	SD in Log Scale	2.141				
3198					95% t UCL (assumes normality of ROS data)	9.147	95% Percentile Bootstrap UCL	10.2				
3199					95% BCA Bootstrap UCL	13.67	95% Bootstrap t UCL	143.1				
3200					95% H-UCL (Log ROS)	1.994						
3201												
3202	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
3203					KM Mean (logged)	-3.206	KM Geo Mean	0.0405				
3204					KM SD (logged)	2.638	95% Critical H Value (KM-Log)	4.506				
3205					KM Standard Error of Mean (logged)	0.455	95% H-UCL (KM -Log)	6.947				
3206					KM SD (logged)	2.638	95% Critical H Value (KM-Log)	4.506				
3207					KM Standard Error of Mean (logged)	0.455						
3208												
3209	**DL/2 Statistics**											
3210	**DL/2 Normal**						**DL/2 Log-Transformed**					
3211					Mean in Original Scale	3.754	Mean in Log Scale	-1.79				
3212					SD in Original Scale	23.67	SD in Log Scale	1.979				
3213					95% t UCL (Assumes normality)	9.253	95% H-Stat UCL	3.157				
3214	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3215												
3216	**Nonparametric Distribution Free UCL Statistics**											

3217	**Data do not follow a Discernible Distribution at 5% Significance Level**											
3218												
3219	**Suggested UCL to Use**											
3220					95% KM (Chebyshev) UCL		18.31					
3221												
3222	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3223	Recommendations are based upon data size, data distribution, and skewness.											
3224	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3225	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3226												
3227												
3228	**Result (eu9_zinc)**											
3229												
3230	**General Statistics**											
3231					Total Number of Observations		54		Number of Distinct Observations		48	
3232									Number of Missing Observations		0	
3233					Minimum		539		Mean		2578	
3234					Maximum		9650		Median		2250	
3235					SD		1588		Std. Error of Mean		216.1	
3236					Coefficient of Variation		0.616		Skewness		2.106	
3237												
3238	**Normal GOF Test**											
3239					Shapiro Wilk Test Statistic		0.841		**Shapiro Wilk GOF Test**			
3240					5% Shapiro Wilk P Value		1.4005E-7		Data Not Normal at 5% Significance Level			
3241					Lilliefors Test Statistic		0.14		**Lilliefors GOF Test**			
3242					5% Lilliefors Critical Value		0.12		Data Not Normal at 5% Significance Level			
3243	**Data Not Normal at 5% Significance Level**											
3244												
3245	**Assuming Normal Distribution**											
3246					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
3247					95% Student's-t UCL		2940		95% Adjusted-CLT UCL (Chen-1995)		2999	
3248									95% Modified-t UCL (Johnson-1978)		2950	
3249												
3250	**Gamma GOF Test**											
3251					A-D Test Statistic		0.413		**Anderson-Darling Gamma GOF Test**			
3252					5% A-D Critical Value		0.756		Detected data appear Gamma Distributed at 5% Significance Lev			
3253					K-S Test Statistic		0.0754		**Kolmogorov-Smirnov Gamma GOF Test**			
3254					5% K-S Critical Value		0.122		Detected data appear Gamma Distributed at 5% Significance Lev			
3255	**Detected data appear Gamma Distributed at 5% Significance Level**											
3256												
3257	**Gamma Statistics**											
3258					k hat (MLE)		3.327		k star (bias corrected MLE)		3.154	
3259					Theta hat (MLE)		774.9		Theta star (bias corrected MLE)		817.3	
3260					nu hat (MLE)		359.3		nu star (bias corrected)		340.6	
3261					MLE Mean (bias corrected)		2578		MLE Sd (bias corrected)		1451	
3262									Approximate Chi Square Value (0.05)		298.9	
3263					Adjusted Level of Significance		0.0456		Adjusted Chi Square Value		297.8	
3264												
3265	**Assuming Gamma Distribution**											
3266					95% Approximate Gamma UCL (use when n>=50)		2938		95% Adjusted Gamma UCL (use when n<50)		2949	
3267												
3268	**Lognormal GOF Test**											
3269					Shapiro Wilk Test Statistic		0.983		**Shapiro Wilk Lognormal GOF Test**			
3270					5% Shapiro Wilk P Value		0.818		Data appear Lognormal at 5% Significance Level			
3271					Lilliefors Test Statistic		0.0884		**Lilliefors Lognormal GOF Test**			
3272					5% Lilliefors Critical Value		0.12		Data appear Lognormal at 5% Significance Level			
3273	**Data appear Lognormal at 5% Significance Level**											
3274												
3275	**Lognormal Statistics**											
3276					Minimum of Logged Data		6.29		Mean of logged Data		7.697	
3277					Maximum of Logged Data		9.175		SD of logged Data		0.572	
3278												
3279	**Assuming Lognormal Distribution**											
3280					95% H-UCL		3017		90% Chebyshev (MVUE) UCL		3226	
3281					95% Chebyshev (MVUE) UCL		3517		97.5% Chebyshev (MVUE) UCL		3921	
3282					99% Chebyshev (MVUE) UCL		4715					
3283												

	A	B	C	D	E	F	G	H	I	J	K	L
3284	**Nonparametric Distribution Free UCL Statistics**											
3285	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
3286												
3287	**Nonparametric Distribution Free UCLs**											
3288					95% CLT UCL	2933			95% Jackknife UCL	2940		
3289					95% Standard Bootstrap UCL	2927			95% Bootstrap-t UCL	3055		
3290					95% Hall's Bootstrap UCL	3067			95% Percentile Bootstrap UCL	2953		
3291					95% BCA Bootstrap UCL	3000						
3292					90% Chebyshev(Mean, Sd) UCL	3226			95% Chebyshev(Mean, Sd) UCL	3520		
3293					97.5% Chebyshev(Mean, Sd) UCL	3928			99% Chebyshev(Mean, Sd) UCL	4728		
3294												
3295	**Suggested UCL to Use**											
3296					95% Approximate Gamma UCL	2938						
3297												
3298	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3299	Recommendations are based upon data size, data distribution, and skewness.											
3300	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3301	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3302												

1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.12/1/2019 4:39:34 PM										
5	From File	BPMD_HHRA_SWInput_v2.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	mber of Bootstrap Operations	2000										
9												
10												
11	**Result (eu6_aluminum)**											
12												
13	**General Statistics**											
14	Total Number of Observations			7			Number of Distinct Observations				7	
15							Number of Missing Observations				0	
16	Minimum			75.4			Mean				599.6	
17	Maximum			1260			Median				548	
18	SD			381.5			Std. Error of Mean				144.2	
19	Coefficient of Variation			0.636			Skewness				0.68	
20												
21	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
22	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
23	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
24	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
25												
26	**Normal GOF Test**											
27	Shapiro Wilk Test Statistic			0.942			**Shapiro Wilk GOF Test**					
28	5% Shapiro Wilk Critical Value			0.803			Data appear Normal at 5% Significance Level					
29	Lilliefors Test Statistic			0.265			**Lilliefors GOF Test**					
30	5% Lilliefors Critical Value			0.304			Data appear Normal at 5% Significance Level					
31	**Data appear Normal at 5% Significance Level**											
32												
33	**Assuming Normal Distribution**											
34	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
35	95% Student's-t UCL			879.9			95% Adjusted-CLT UCL (Chen-1995)				876.4	
36							95% Modified-t UCL (Johnson-1978)				886	
37												
38	**Gamma GOF Test**											
39	A-D Test Statistic			0.365			**Anderson-Darling Gamma GOF Test**					
40	5% A-D Critical Value			0.715			Detected data appear Gamma Distributed at 5% Significance Lev					
41	K-S Test Statistic			0.226			**Kolmogorov-Smirnov Gamma GOF Test**					
42	5% K-S Critical Value			0.315			Detected data appear Gamma Distributed at 5% Significance Lev					
43	**Detected data appear Gamma Distributed at 5% Significance Level**											
44												
45	**Gamma Statistics**											
46	k hat (MLE)			2.124			k star (bias corrected MLE)				1.309	
47	Theta hat (MLE)			282.3			Theta star (bias corrected MLE)				458.1	
48	nu hat (MLE)			29.74			nu star (bias corrected)				18.32	
49	MLE Mean (bias corrected)			599.6			MLE Sd (bias corrected)				524.1	
50							Approximate Chi Square Value (0.05)				9.626	
51	Adjusted Level of Significance			0.0158			Adjusted Chi Square Value				7.798	
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))			1141			95% Adjusted Gamma UCL (use when n<50)				1409	
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic			0.855			**Shapiro Wilk Lognormal GOF Test**					
58	5% Shapiro Wilk Critical Value			0.803			Data appear Lognormal at 5% Significance Level					
59	Lilliefors Test Statistic			0.284			**Lilliefors Lognormal GOF Test**					
60	5% Lilliefors Critical Value			0.304			Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data			4.323			Mean of logged Data				6.143	
65	Maximum of Logged Data			7.139			SD of logged Data				0.898	
66												
67	**Assuming Lognormal Distribution**											

68					95% H-UCL	2433			90% Chebyshev (MVUE) UCL	1312		
69					95% Chebyshev (MVUE) UCL	1613			97.5% Chebyshev (MVUE) UCL	2030		
70					99% Chebyshev (MVUE) UCL	2850						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76					95% CLT UCL	836.8			95% Jackknife UCL	879.9		
77					95% Standard Bootstrap UCL	826.3			95% Bootstrap-t UCL	1046		
78					95% Hall's Bootstrap UCL	3305			95% Percentile Bootstrap UCL	830.9		
79					95% BCA Bootstrap UCL	833						
80					90% Chebyshev(Mean, Sd) UCL	1032			95% Chebyshev(Mean, Sd) UCL	1228		
81					97.5% Chebyshev(Mean, Sd) UCL	1500			99% Chebyshev(Mean, Sd) UCL	2034		
82												
83	**Suggested UCL to Use**											
84					95% Student's-t UCL	879.9						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
90												
91	**Result (eu6_antimony)**											
92												
93	**General Statistics**											
94					Total Number of Observations	7			Number of Distinct Observations	2		
95					Number of Detects	0			Number of Non-Detects	7		
96					Number of Distinct Detects	0			Number of Distinct Non-Detects	2		
97												
98	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
99	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
100	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
101												
102	**The data set for variable Result (eu6_antimony) was not processed!**											
103												
104												
105	**Result (eu6_arsenic)**											
106												
107	**General Statistics**											
108					Total Number of Observations	7			Number of Distinct Observations	2		
109					Number of Detects	1			Number of Non-Detects	6		
110					Number of Distinct Detects	1			Number of Distinct Non-Detects	1		
111												
112	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
113	**gested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, B**											
114												
115	**The data set for variable Result (eu6_arsenic) was not processed!**											
116												
117												
118	**Result (eu6_beryllium)**											
119												
120	**General Statistics**											
121					Total Number of Observations	7			Number of Distinct Observations	2		
122					Number of Detects	0			Number of Non-Detects	7		
123					Number of Distinct Detects	0			Number of Distinct Non-Detects	2		
124												
125	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
126	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
127	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
128												
129	**The data set for variable Result (eu6_beryllium) was not processed!**											
130												
131												
132	**Result (eu6_cadmium)**											
133												
134	**General Statistics**											

135				Total Number of Observations	7			Number of Distinct Observations	2			
136				Number of Detects	1			Number of Non-Detects	6			
137				Number of Distinct Detects	1			Number of Distinct Non-Detects	1			
138												
139	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
140	**gested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, B**											
141												
142	**The data set for variable Result (eu6_cadmium) was not processed!**											
143												
144												
145	**Result (eu6_chromium)**											
146												
147	**General Statistics**											
148				Total Number of Observations	7			Number of Distinct Observations	2			
149				Number of Detects	0			Number of Non-Detects	7			
150				Number of Distinct Detects	0			Number of Distinct Non-Detects	2			
151												
152	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
153	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
154	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
155												
156	**The data set for variable Result (eu6_chromium) was not processed!**											
157												
158												
159												
160	**Result (eu6_cobalt)**											
161												
162	**General Statistics**											
163				Total Number of Observations	1			Number of Distinct Observations	1			
164								Number of Missing Observations	0			
165				Minimum	0.97			Mean	0.97			
166				Maximum	0.97			Median	0.97			
167												
168	**Warning: This data set only has 1 observations!**											
169	**Data set is too small to compute reliable and meaningful statistics and estimates!**											
170	**The data set for variable Result (eu6_cobalt) was not processed!**											
171												
172	**It is suggested to collect at least 8 to 10 observations before using these statistical methods!**											
173	**If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.**											
174												
175												
176	**Result (eu6_copper)**											
177												
178	**General Statistics**											
179				Total Number of Observations	7			Number of Distinct Observations	2			
180				Number of Detects	0			Number of Non-Detects	7			
181				Number of Distinct Detects	0			Number of Distinct Non-Detects	2			
182												
183	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
184	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
185	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
186												
187	**The data set for variable Result (eu6_copper) was not processed!**											
188												
189												
190	**Result (eu6_iron)**											
191												
192	**General Statistics**											
193				Total Number of Observations	7			Number of Distinct Observations	6			
194				Number of Detects	4			Number of Non-Detects	3			
195				Number of Distinct Detects	4			Number of Distinct Non-Detects	2			
196				Minimum Detect	112			Minimum Non-Detect	2.1			
197				Maximum Detect	220			Maximum Non-Detect	100			
198				Variance Detects	2032			Percent Non-Detects	42.86%			
199				Mean Detects	173.8			SD Detects	45.08			
200				Median Detects	181.5			CV Detects	0.259			
201				Skewness Detects	-0.983			Kurtosis Detects	1.941			

202					Mean of Logged Detects	5.129				SD of Logged Detects		0.288
203												
204					**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**							
205					**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**							
206					**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**							
207					**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**							
208												
209					**Normal GOF Test on Detects Only**							
210					Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**					
211					5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level					
212					Lilliefors Test Statistic	0.288	**Lilliefors GOF Test**					
213					5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level					
214					**Detected Data appear Normal at 5% Significance Level**							
215												
216					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
217					KM Mean	100.2	KM Standard Error of Mean	39.25				
218					KM SD	89.93	95% KM (BCA) UCL	N/A				
219					95% KM (t) UCL	176.4	95% KM (Percentile Bootstrap) UCL	N/A				
220					95% KM (z) UCL	164.7	95% KM Bootstrap t UCL	N/A				
221					90% KM Chebyshev UCL	217.9	95% KM Chebyshev UCL	271.3				
222					97.5% KM Chebyshev UCL	345.3	99% KM Chebyshev UCL	490.7				
223												
224					**Gamma GOF Tests on Detected Observations Only**							
225					A-D Test Statistic	0.389	**Anderson-Darling GOF Test**					
226					5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Lev					
227					K-S Test Statistic	0.322	**Kolmogorov-Smirnov GOF**					
228					5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Lev					
229					**Detected data appear Gamma Distributed at 5% Significance Level**							
230												
231					**Gamma Statistics on Detected Data Only**							
232					k hat (MLE)	17.38	k star (bias corrected MLE)	4.511				
233					Theta hat (MLE)	9.999	Theta star (bias corrected MLE)	38.52				
234					nu hat (MLE)	139	nu star (bias corrected)	36.09				
235					Mean (detects)	173.8						
236												
237					**Gamma ROS Statistics using Imputed Non-Detects**							
238					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
239					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)							
240					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
241					This is especially true when the sample size is small.							
242					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
243					Minimum	43.6	Mean	125.6				
244					Maximum	220	Median	112				
245					SD	68.72	CV	0.547				
246					k hat (MLE)	3.493	k star (bias corrected MLE)	2.091				
247					Theta hat (MLE)	35.96	Theta star (bias corrected MLE)	60.07				
248					nu hat (MLE)	48.9	nu star (bias corrected)	29.28				
249					Adjusted Level of Significance (β)	0.0158						
250					Approximate Chi Square Value (29.28, α)	17.93	Adjusted Chi Square Value (29.28, β)	15.31				
251					95% Gamma Approximate UCL (use when n>=50)	205.2	95% Gamma Adjusted UCL (use when n<50)	N/A				
252												
253					**Estimates of Gamma Parameters using KM Estimates**							
254					Mean (KM)	100.2	SD (KM)	89.93				
255					Variance (KM)	8087	SE of Mean (KM)	39.25				
256					k hat (KM)	1.241	k star (KM)	0.805				
257					nu hat (KM)	17.38	nu star (KM)	11.26				
258					theta hat (KM)	80.72	theta star (KM)	124.5				
259					80% gamma percentile (KM)	163.7	90% gamma percentile (KM)	243.3				
260					95% gamma percentile (KM)	324.3	99% gamma percentile (KM)	515.7				
261												
262					**Gamma Kaplan-Meier (KM) Statistics**							
263					Approximate Chi Square Value (11.26, α)	4.746	Adjusted Chi Square Value (11.26, β)	3.554				
264					5% Gamma Approximate KM-UCL (use when n>=50)	237.8	95% Gamma Adjusted KM-UCL (use when n<50)	317.5				
265												
266					**Lognormal GOF Test on Detected Observations Only**							
267					Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk GOF Test**					
268					5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level					

269					Lilliefors Test Statistic	0.323	**Lilliefors GOF Test**					
270					5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level					
271	**Detected Data appear Lognormal at 5% Significance Level**											
272												
273	**Lognormal ROS Statistics Using Imputed Non-Detects**											
274					Mean in Original Scale	132.6				Mean in Log Scale	4.794	
275					SD in Original Scale	60.69				SD in Log Scale	0.471	
276				95% t UCL (assumes normality of ROS data)		177.2				95% Percentile Bootstrap UCL	167.4	
277					95% BCA Bootstrap UCL	171.7				95% Bootstrap t UCL	183.6	
278					95% H-UCL (Log ROS)	214.2						
279												
280	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
281					KM Mean (logged)	3.249				KM Geo Mean	25.75	
282					KM SD (logged)	2.179				95% Critical H Value (KM-Log)	7.314	
283					KM Standard Error of Mean (logged)	0.951				95% H-UCL (KM -Log)	185210	
284					KM SD (logged)	2.179				95% Critical H Value (KM-Log)	7.314	
285					KM Standard Error of Mean (logged)	0.951						
286												
287	**DL/2 Statistics**											
288	**DL/2 Normal**						**DL/2 Log-Transformed**					
289					Mean in Original Scale	113.7				Mean in Log Scale	4.055	
290					SD in Original Scale	82.99				SD in Log Scale	1.869	
291					95% t UCL (Assumes normality)	174.7				95% H-Stat UCL	41425	
292	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
293												
294	**Nonparametric Distribution Free UCL Statistics**											
295	**Detected Data appear Normal Distributed at 5% Significance Level**											
296												
297	**Suggested UCL to Use**											
298					95% KM (t) UCL	176.4						
299												
300	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
301	Recommendations are based upon data size, data distribution, and skewness.											
302	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
303	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
304												
305	**Result (eu6_lead)**											
306												
307	**General Statistics**											
308					Total Number of Observations	7				Number of Distinct Observations	6	
309					Number of Detects	4				Number of Non-Detects	3	
310					Number of Distinct Detects	4				Number of Distinct Non-Detects	2	
311					Minimum Detect	1.01				Minimum Non-Detect	0.03	
312					Maximum Detect	10.1				Maximum Non-Detect	0.5	
313					Variance Detects	17.83				Percent Non-Detects	42.86%	
314					Mean Detects	3.87				SD Detects	4.222	
315					Median Detects	2.185				CV Detects	1.091	
316					Skewness Detects	1.814				Kurtosis Detects	3.321	
317					Mean of Logged Detects	0.949				SD of Logged Detects	1.002	
318												
319	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
320	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
321	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
322	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
323												
324	**Normal GOF Test on Detects Only**											
325					Shapiro Wilk Test Statistic	0.78	**Shapiro Wilk GOF Test**					
326					5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level					
327					Lilliefors Test Statistic	0.348	**Lilliefors GOF Test**					
328					5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level					
329	**Detected Data appear Normal at 5% Significance Level**											
330												
331	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
332					KM Mean	2.224				KM Standard Error of Mean	1.464	
333					KM SD	3.354				95% KM (BCA) UCL	N/A	
334					95% KM (t) UCL	5.069				95% KM (Percentile Bootstrap) UCL	N/A	
335					95% KM (z) UCL	4.632				95% KM Bootstrap t UCL	N/A	

336				90% KM Chebyshev UCL	6.616				95% KM Chebyshev UCL	8.605		
337				97.5% KM Chebyshev UCL	11.37				99% KM Chebyshev UCL	16.79		
338												
339				**Gamma GOF Tests on Detected Observations Only**								
340				A-D Test Statistic	0.385	**Anderson-Darling GOF Test**						
341				5% A-D Critical Value	0.663	Detected data appear Gamma Distributed at 5% Significance Lev						
342				K-S Test Statistic	0.274	**Kolmogorov-Smirnov GOF**						
343				5% K-S Critical Value	0.4	Detected data appear Gamma Distributed at 5% Significance Lev						
344				**Detected data appear Gamma Distributed at 5% Significance Level**								
345												
346				**Gamma Statistics on Detected Data Only**								
347				k hat (MLE)	1.381	k star (bias corrected MLE)	0.512					
348				Theta hat (MLE)	2.803	Theta star (bias corrected MLE)	7.56					
349				nu hat (MLE)	11.05	nu star (bias corrected)	4.095					
350				Mean (detects)	3.87							
351												
352				**Gamma ROS Statistics using Imputed Non-Detects**								
353				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
354				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)								
355				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
356				This is especially true when the sample size is small.								
357				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
358				Minimum	0.01	Mean	2.216					
359				Maximum	10.1	Median	1.01					
360				SD	3.629	CV	1.638					
361				k hat (MLE)	0.308	k star (bias corrected MLE)	0.271					
362				Theta hat (MLE)	7.187	Theta star (bias corrected MLE)	8.164					
363				nu hat (MLE)	4.316	nu star (bias corrected)	3.8					
364				Adjusted Level of Significance (β)	0.0158							
365				Approximate Chi Square Value (3.80, α)	0.644	Adjusted Chi Square Value (3.80, β)	0.35					
366				95% Gamma Approximate UCL (use when n>=50)	13.07	95% Gamma Adjusted UCL (use when n<50)	N/A					
367												
368				**Estimates of Gamma Parameters using KM Estimates**								
369				Mean (KM)	2.224	SD (KM)	3.354					
370				Variance (KM)	11.25	SE of Mean (KM)	1.464					
371				k hat (KM)	0.44	k star (KM)	0.347					
372				nu hat (KM)	6.156	nu star (KM)	4.851					
373				theta hat (KM)	5.058	theta star (KM)	6.419					
374				80% gamma percentile (KM)	3.516	90% gamma percentile (KM)	6.433					
375				95% gamma percentile (KM)	9.705	99% gamma percentile (KM)	18.06					
376												
377				**Gamma Kaplan-Meier (KM) Statistics**								
378				Approximate Chi Square Value (4.85, α)	1.084	Adjusted Chi Square Value (4.85, β)	0.643					
379				5% Gamma Approximate KM-UCL (use when n>=50)	9.954	95% Gamma Adjusted KM-UCL (use when n<50)	16.78					
380												
381				**Lognormal GOF Test on Detected Observations Only**								
382				Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**						
383				5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level						
384				Lilliefors Test Statistic	0.215	**Lilliefors GOF Test**						
385				5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level						
386				**Detected Data appear Lognormal at 5% Significance Level**								
387												
388				**Lognormal ROS Statistics Using Imputed Non-Detects**								
389				Mean in Original Scale	2.272	Mean in Log Scale	-0.333					
390				SD in Original Scale	3.59	SD in Log Scale	1.776					
391				95% t UCL (assumes normality of ROS data)	4.909	95% Percentile Bootstrap UCL	4.812					
392				95% BCA Bootstrap UCL	5.821	95% Bootstrap t UCL	12.33					
393				95% H-UCL (Log ROS)	276.4							
394												
395				**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**								
396				KM Mean (logged)	-0.96	KM Geo Mean	0.383					
397				KM SD (logged)	2.301	95% Critical H Value (KM-Log)	7.701					
398				KM Standard Error of Mean (logged)	1.004	95% H-UCL (KM -Log)	7470					
399				KM SD (logged)	2.301	95% Critical H Value (KM-Log)	7.701					
400				KM Standard Error of Mean (logged)	1.004							
401												
402				**DL/2 Statistics**								

	A	B	C	D	E	F	G	H	I	J	K	L
403	**DL/2 Normal**						**DL/2 Log-Transformed**					
404					Mean in Original Scale	2.285					Mean in Log Scale	-0.454
405					SD in Original Scale	3.581					SD in Log Scale	2.108
406					95% t UCL (Assumes normality)	4.915					95% H-Stat UCL	2610
407	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
408												
409	**Nonparametric Distribution Free UCL Statistics**											
410	**Detected Data appear Normal Distributed at 5% Significance Level**											
411												
412	**Suggested UCL to Use**											
413					95% KM (t) UCL	5.069						
414												
415	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
416	Recommendations are based upon data size, data distribution, and skewness.											
417	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
418	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
419												
420												
421	**Result (eu6_manganese)**											
422												
423	**General Statistics**											
424					Total Number of Observations	7					Number of Distinct Observations	7
425											Number of Missing Observations	0
426					Minimum	55.3					Mean	104.7
427					Maximum	172					Median	100
428					SD	44.64					Std. Error of Mean	16.87
429					Coefficient of Variation	0.426					Skewness	0.381
430												
431	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
432	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
433	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
434	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
435												
436	**Normal GOF Test**											
437					Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk GOF Test**					
438					5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level					
439					Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**					
440					5% Lilliefors Critical Value	0.304	Data appear Normal at 5% Significance Level					
441	**Data appear Normal at 5% Significance Level**											
442												
443	**Assuming Normal Distribution**											
444	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
445					95% Student's-t UCL	137.5					95% Adjusted-CLT UCL (Chen-1995)	135.1
446											95% Modified-t UCL (Johnson-1978)	137.9
447												
448	**Gamma GOF Test**											
449					A-D Test Statistic	0.308	**Anderson-Darling Gamma GOF Test**					
450					5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Lev					
451					K-S Test Statistic	0.214	**Kolmogorov-Smirnov Gamma GOF Test**					
452					5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Lev					
453	**Detected data appear Gamma Distributed at 5% Significance Level**											
454												
455	**Gamma Statistics**											
456					k hat (MLE)	6.318					k star (bias corrected MLE)	3.706
457					Theta hat (MLE)	16.58					Theta star (bias corrected MLE)	28.27
458					nu hat (MLE)	88.46					nu star (bias corrected)	51.88
459					MLE Mean (bias corrected)	104.7					MLE Sd (bias corrected)	54.41
460											Approximate Chi Square Value (0.05)	36.34
461					Adjusted Level of Significance	0.0158					Adjusted Chi Square Value	32.45
462												
463	**Assuming Gamma Distribution**											
464	95% Approximate Gamma UCL (use when n>=50))					149.5	95% Adjusted Gamma UCL (use when n<50)					167.4
465												
466	**Lognormal GOF Test**											
467					Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk Lognormal GOF Test**					
468					5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level					
469					Lilliefors Test Statistic	0.189	**Lilliefors Lognormal GOF Test**					

470				5% Lilliefors Critical Value	0.304	Data appear Lognormal at 5% Significance Level						
471	**Data appear Lognormal at 5% Significance Level**											
472												
473	**Lognormal Statistics**											
474				Minimum of Logged Data	4.013	Mean of logged Data	4.57					
475				Maximum of Logged Data	5.147	SD of logged Data	0.44					
476												
477	**Assuming Lognormal Distribution**											
478				95% H-UCL	162	90% Chebyshev (MVUE) UCL	157.3					
479				95% Chebyshev (MVUE) UCL	181.1	97.5% Chebyshev (MVUE) UCL	214.1					
480				99% Chebyshev (MVUE) UCL	279							
481												
482	**Nonparametric Distribution Free UCL Statistics**											
483	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
484												
485	**Nonparametric Distribution Free UCLs**											
486				95% CLT UCL	132.5	95% Jackknife UCL	137.5					
487				95% Standard Bootstrap UCL	130.6	95% Bootstrap-t UCL	146.7					
488				95% Hall's Bootstrap UCL	130.7	95% Percentile Bootstrap UCL	131.7					
489				95% BCA Bootstrap UCL	133							
490				90% Chebyshev(Mean, Sd) UCL	155.4	95% Chebyshev(Mean, Sd) UCL	178.3					
491				97.5% Chebyshev(Mean, Sd) UCL	210.1	99% Chebyshev(Mean, Sd) UCL	272.6					
492												
493	**Suggested UCL to Use**											
494				95% Student's-t UCL	137.5							
495												
496	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
497	Recommendations are based upon data size, data distribution, and skewness.											
498	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
499	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
500												
501												
502	**Result (eu6_strontium)**											
503												
504	**General Statistics**											
505				Total Number of Observations	6	Number of Distinct Observations	6					
506						Number of Missing Observations	0					
507				Minimum	86	Mean	141.4					
508				Maximum	245	Median	128.5					
509				SD	64.39	Std. Error of Mean	26.29					
510				Coefficient of Variation	0.455	Skewness	0.796					
511												
512	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
513	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
514	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
515	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
516												
517	**Normal GOF Test**											
518				Shapiro Wilk Test Statistic	0.853	**Shapiro Wilk GOF Test**						
519				5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level						
520				Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**						
521				5% Lilliefors Critical Value	0.325	Data appear Normal at 5% Significance Level						
522	**Data appear Normal at 5% Significance Level**											
523												
524	**Assuming Normal Distribution**											
525	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
526				95% Student's-t UCL	194.4	95% Adjusted-CLT UCL (Chen-1995)	193.8					
527						95% Modified-t UCL (Johnson-1978)	195.8					
528												
529	**Gamma GOF Test**											
530				A-D Test Statistic	0.521	**Anderson-Darling Gamma GOF Test**						
531				5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Lev						
532				K-S Test Statistic	0.297	**Kolmogorov-Smirnov Gamma GOF Test**						
533				5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Lev						
534	**Detected data appear Gamma Distributed at 5% Significance Level**											
535												
536	**Gamma Statistics**											

537					k hat (MLE)	6.126			k star (bias corrected MLE)			3.174
538					Theta hat (MLE)	23.08			Theta star (bias corrected MLE)			44.55
539					nu hat (MLE)	73.51			nu star (bias corrected)			38.09
540					MLE Mean (bias corrected)	141.4			MLE Sd (bias corrected)			79.38
541									Approximate Chi Square Value (0.05)			24.96
542					Adjusted Level of Significance	0.0122			Adjusted Chi Square Value			21.2
543												
544					**Assuming Gamma Distribution**							
545				95% Approximate Gamma UCL (use when n>=50))		215.8			95% Adjusted Gamma UCL (use when n<50)			254.1
546												
547					**Lognormal GOF Test**							
548					Shapiro Wilk Test Statistic	0.854			**Shapiro Wilk Lognormal GOF Test**			
549					5% Shapiro Wilk Critical Value	0.788			Data appear Lognormal at 5% Significance Level			
550					Lilliefors Test Statistic	0.274			**Lilliefors Lognormal GOF Test**			
551					5% Lilliefors Critical Value	0.325			Data appear Lognormal at 5% Significance Level			
552					**Data appear Lognormal at 5% Significance Level**							
553												
554					**Lognormal Statistics**							
555					Minimum of Logged Data	4.454			Mean of logged Data			4.868
556					Maximum of Logged Data	5.501			SD of logged Data			0.445
557												
558					**Assuming Lognormal Distribution**							
559					95% H-UCL	236.6			90% Chebyshev (MVUE) UCL			217.9
560					95% Chebyshev (MVUE) UCL	252.7			97.5% Chebyshev (MVUE) UCL			301
561					99% Chebyshev (MVUE) UCL	395.8						
562												
563					**Nonparametric Distribution Free UCL Statistics**							
564					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
565												
566					**Nonparametric Distribution Free UCLs**							
567					95% CLT UCL	184.7			95% Jackknife UCL			194.4
568					95% Standard Bootstrap UCL	181			95% Bootstrap-t UCL			214.2
569					95% Hall's Bootstrap UCL	179.6			95% Percentile Bootstrap UCL			181.3
570					95% BCA Bootstrap UCL	182.5						
571					90% Chebyshev(Mean, Sd) UCL	220.3			95% Chebyshev(Mean, Sd) UCL			256
572					97.5% Chebyshev(Mean, Sd) UCL	305.6			99% Chebyshev(Mean, Sd) UCL			403
573												
574					**Suggested UCL to Use**							
575					95% Student's-t UCL	194.4						
576												
577	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
578	Recommendations are based upon data size, data distribution, and skewness.											
579	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
580	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
581												
582	**Result (eu6_thallium)**											
583												
584					**General Statistics**							
585					Total Number of Observations	7			Number of Distinct Observations			4
586					Number of Detects	2			Number of Non-Detects			5
587					Number of Distinct Detects	2			Number of Distinct Non-Detects			2
588					Minimum Detect	7.87			Minimum Non-Detect			0.031
589					Maximum Detect	8.53			Maximum Non-Detect			5
590					Variance Detects	0.218			Percent Non-Detects			71.43%
591					Mean Detects	8.2			SD Detects			0.467
592					Median Detects	8.2			CV Detects			0.0569
593					Skewness Detects	N/A			Kurtosis Detects			N/A
594					Mean of Logged Detects	2.103			SD of Logged Detects			0.0569
595												
596					**Warning: Data set has only 2 Detected Values.**							
597					**This is not enough to compute meaningful or reliable statistics and estimates.**							
598												
599												
600	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
601	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
602	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
603	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											

604												
605	**Normal GOF Test on Detects Only**											
606	**Not Enough Data to Perform GOF Test**											
607												
608	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
609						KM Mean	2.365			KM Standard Error of Mean	1.975	
610						KM SD	3.695			95% KM (BCA) UCL	N/A	
611						95% KM (t) UCL	6.202			95% KM (Percentile Bootstrap) UCL	N/A	
612						95% KM (z) UCL	5.613			95% KM Bootstrap t UCL	N/A	
613						90% KM Chebyshev UCL	8.29			95% KM Chebyshev UCL	10.97	
614						97.5% KM Chebyshev UCL	14.7			99% KM Chebyshev UCL	22.01	
615												
616	**Gamma GOF Tests on Detected Observations Only**											
617	**Not Enough Data to Perform GOF Test**											
618												
619	**Gamma Statistics on Detected Data Only**											
620						k hat (MLE)	617.1			k star (bias corrected MLE)	N/A	
621						Theta hat (MLE)	0.0133			Theta star (bias corrected MLE)	N/A	
622						nu hat (MLE)	2468			nu star (bias corrected)	N/A	
623						Mean (detects)	8.2					
624												
625	**Estimates of Gamma Parameters using KM Estimates**											
626						Mean (KM)	2.365			SD (KM)	3.695	
627						Variance (KM)	13.65			SE of Mean (KM)	1.975	
628						k hat (KM)	0.41			k star (KM)	0.329	
629						nu hat (KM)	5.737			nu star (KM)	4.611	
630						theta hat (KM)	5.772			theta star (KM)	7.18	
631						80% gamma percentile (KM)	3.703			90% gamma percentile (KM)	6.891	
632						95% gamma percentile (KM)	10.49			99% gamma percentile (KM)	19.75	
633												
634	**Gamma Kaplan-Meier (KM) Statistics**											
635										Adjusted Level of Significance (β)	0.0158	
636						Approximate Chi Square Value (4.61, α)	0.977			Adjusted Chi Square Value (4.61, β)	0.569	
637						5% Gamma Approximate KM-UCL (use when n>=50)	11.16			95% Gamma Adjusted KM-UCL (use when n<50)	19.16	
638												
639	**Lognormal GOF Test on Detected Observations Only**											
640	**Not Enough Data to Perform GOF Test**											
641												
642	**Lognormal ROS Statistics Using Imputed Non-Detects**											
643						Mean in Original Scale	6.79			Mean in Log Scale	1.905	
644						SD in Original Scale	1.073			SD in Log Scale	0.154	
645						95% t UCL (assumes normality of ROS data)	7.578			95% Percentile Bootstrap UCL	7.443	
646						95% BCA Bootstrap UCL	7.551			95% Bootstrap t UCL	8.071	
647						95% H-UCL (Log ROS)	7.68					
648												
649	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
650						KM Mean (logged)	-1.88			KM Geo Mean	0.153	
651						KM SD (logged)	2.52			95% Critical H Value (KM-Log)	8.402	
652						KM Standard Error of Mean (logged)	1.347			95% H-UCL (KM -Log)	20655	
653						KM SD (logged)	2.52			95% Critical H Value (KM-Log)	8.402	
654						KM Standard Error of Mean (logged)	1.347					
655												
656	**DL/2 Statistics**											
657	**DL/2 Normal**									**DL/2 Log-Transformed**		
658						Mean in Original Scale	3.774			Mean in Log Scale	0.529	
659						SD in Original Scale	3.163			SD in Log Scale	2.145	
660						95% t UCL (Assumes normality)	6.096			95% H-Stat UCL	9339	
661	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
662												
663	**Nonparametric Distribution Free UCL Statistics**											
664	**Data do not follow a Discernible Distribution at 5% Significance Level**											
665												
666	**Suggested UCL to Use**											
667						95% KM (t) UCL	6.202			KM H-UCL	20655	
668						95% KM (BCA) UCL	N/A					
669	**Warning: One or more Recommended UCL(s) not available!**											
670												

	A	B	C	D	E	F	G	H	I	J	K	L
671	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
672	Recommendations are based upon data size, data distribution, and skewness.											
673	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
674	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
675												
676												
677	**Result (eu6_zinc)**											
678												
679	**General Statistics**											
680	Total Number of Observations					7		Number of Distinct Observations				7
681								Number of Missing Observations				0
682	Minimum					17.3		Mean				41.24
683	Maximum					85.2		Median				31.3
684	SD					26.25		Std. Error of Mean				9.922
685	Coefficient of Variation					0.637		Skewness				0.929
686												
687	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
688	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
689	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
690	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
691												
692	**Normal GOF Test**											
693	Shapiro Wilk Test Statistic					0.867		**Shapiro Wilk GOF Test**				
694	5% Shapiro Wilk Critical Value					0.803		Data appear Normal at 5% Significance Level				
695	Lilliefors Test Statistic					0.219		**Lilliefors GOF Test**				
696	5% Lilliefors Critical Value					0.304		Data appear Normal at 5% Significance Level				
697	**Data appear Normal at 5% Significance Level**											
698												
699	**Assuming Normal Distribution**											
700	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
701	95% Student's-t UCL					60.52		95% Adjusted-CLT UCL (Chen-1995)				61.29
702								95% Modified-t UCL (Johnson-1978)				61.1
703												
704	**Gamma GOF Test**											
705	A-D Test Statistic					0.392		**Anderson-Darling Gamma GOF Test**				
706	5% A-D Critical Value					0.712		Detected data appear Gamma Distributed at 5% Significance Lev				
707	K-S Test Statistic					0.234		**Kolmogorov-Smirnov Gamma GOF Test**				
708	5% K-S Critical Value					0.314		Detected data appear Gamma Distributed at 5% Significance Lev				
709	**Detected data appear Gamma Distributed at 5% Significance Level**											
710												
711	**Gamma Statistics**											
712	k hat (MLE)					3.12		k star (bias corrected MLE)				1.878
713	Theta hat (MLE)					13.22		Theta star (bias corrected MLE)				21.96
714	nu hat (MLE)					43.68		nu star (bias corrected)				26.29
715	MLE Mean (bias corrected)					41.24		MLE Sd (bias corrected)				30.09
716								Approximate Chi Square Value (0.05)				15.61
717	Adjusted Level of Significance					0.0158		Adjusted Chi Square Value				13.19
718												
719	**Assuming Gamma Distribution**											
720	95% Approximate Gamma UCL (use when n>=50))					69.49		95% Adjusted Gamma UCL (use when n<50)				82.24
721												
722	**Lognormal GOF Test**											
723	Shapiro Wilk Test Statistic					0.915		**Shapiro Wilk Lognormal GOF Test**				
724	5% Shapiro Wilk Critical Value					0.803		Data appear Lognormal at 5% Significance Level				
725	Lilliefors Test Statistic					0.216		**Lilliefors Lognormal GOF Test**				
726	5% Lilliefors Critical Value					0.304		Data appear Lognormal at 5% Significance Level				
727	**Data appear Lognormal at 5% Significance Level**											
728												
729	**Lognormal Statistics**											
730	Minimum of Logged Data					2.851		Mean of logged Data				3.551
731	Maximum of Logged Data					4.445		SD of logged Data				0.622
732												
733	**Assuming Lognormal Distribution**											
734	95% H-UCL					84.41		90% Chebyshev (MVUE) UCL				70.09
735	95% Chebyshev (MVUE) UCL					83.27		97.5% Chebyshev (MVUE) UCL				101.6
736	99% Chebyshev (MVUE) UCL					137.5						
737												

738	**Nonparametric Distribution Free UCL Statistics**											
739	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
740												
741	**Nonparametric Distribution Free UCLs**											
742						95% CLT UCL	57.56			95% Jackknife UCL	60.52	
743						95% Standard Bootstrap UCL	56.3			95% Bootstrap-t UCL	79.22	
744						95% Hall's Bootstrap UCL	69.4			95% Percentile Bootstrap UCL	57.07	
745						95% BCA Bootstrap UCL	58.76					
746						90% Chebyshev(Mean, Sd) UCL	71.01			95% Chebyshev(Mean, Sd) UCL	84.49	
747						97.5% Chebyshev(Mean, Sd) UCL	103.2			99% Chebyshev(Mean, Sd) UCL	140	
748												
749	**Suggested UCL to Use**											
750						95% Student's-t UCL	60.52					
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 statisticia											
756												
757	**Result (eu7_aluminum)**											
758												
759	**General Statistics**											
760						Total Number of Observations	152			Number of Distinct Observations	142	
761						Number of Detects	149			Number of Non-Detects	3	
762						Number of Distinct Detects	141			Number of Distinct Non-Detects	1	
763						Minimum Detect	20.1			Minimum Non-Detect	20	
764						Maximum Detect	8290			Maximum Non-Detect	20	
765						Variance Detects	2083135			Percent Non-Detects	1.974%	
766						Mean Detects	662.5			SD Detects	1443	
767						Median Detects	143			CV Detects	2.178	
768						Skewness Detects	3.506			Kurtosis Detects	12.42	
769						Mean of Logged Detects	5.254			SD of Logged Detects	1.445	
770												
771	**Normal GOF Test on Detects Only**											
772						Shapiro Wilk Test Statistic	0.476			**Normal GOF Test on Detected Observations Only**		
773						5% Shapiro Wilk P Value	0			Detected Data Not Normal at 5% Significance Level		
774						Lilliefors Test Statistic	0.328			**Lilliefors GOF Test**		
775						5% Lilliefors Critical Value	0.073			Detected Data Not Normal at 5% Significance Level		
776	**Detected Data Not Normal at 5% Significance Level**											
777												
778	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
779						KM Mean	649.9			KM Standard Error of Mean	116.1	
780						KM SD	1427			95% KM (BCA) UCL	853.4	
781						95% KM (t) UCL	842.1			95% KM (Percentile Bootstrap) UCL	841.9	
782						95% KM (z) UCL	840.9			95% KM Bootstrap t UCL	913.7	
783						90% KM Chebyshev UCL	998.3			95% KM Chebyshev UCL	1156	
784						97.5% KM Chebyshev UCL	1375			99% KM Chebyshev UCL	1805	
785												
786	**Gamma GOF Tests on Detected Observations Only**											
787						A-D Test Statistic	10.39			**Anderson-Darling GOF Test**		
788						5% A-D Critical Value	0.819			Detected Data Not Gamma Distributed at 5% Significance Level		
789						K-S Test Statistic	0.209			**Kolmogorov-Smirnov GOF**		
790						5% K-S Critical Value	0.0812			Detected Data Not Gamma Distributed at 5% Significance Level		
791	**Detected Data Not Gamma Distributed at 5% Significance Level**											
792												
793	**Gamma Statistics on Detected Data Only**											
794						k hat (MLE)	0.51			k star (bias corrected MLE)	0.504	
795						Theta hat (MLE)	1300			Theta star (bias corrected MLE)	1315	
796						nu hat (MLE)	151.9			nu star (bias corrected)	150.2	
797						Mean (detects)	662.5					
798												
799	**Gamma ROS Statistics using Imputed Non-Detects**											
800	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
801	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)											
802	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
803	This is especially true when the sample size is small.											
804	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											

805					Minimum	0.01				Mean		649.5
806					Maximum	8290				Median		135
807					SD	1432				CV		2.205
808					k hat (MLE)	0.455				k star (bias corrected MLE)		0.45
809					Theta hat (MLE)	1427				Theta star (bias corrected MLE)		1442
810					nu hat (MLE)	138.3				nu star (bias corrected)		136.9
811					Adjusted Level of Significance (β)	0.0484						
812					Approximate Chi Square Value (136.92, α)	110.9				Adjusted Chi Square Value (136.92, β)		110.7
813					95% Gamma Approximate UCL (use when n>=50)	802				95% Gamma Adjusted UCL (use when n<50)		803.6
814												
815					**Estimates of Gamma Parameters using KM Estimates**							
816					Mean (KM)	649.9				SD (KM)		1427
817					Variance (KM)	2036304				SE of Mean (KM)		116.1
818					k hat (KM)	0.207				k star (KM)		0.208
819					nu hat (KM)	63.05				nu star (KM)		63.14
820					theta hat (KM)	3133				theta star (KM)		3129
821					80% gamma percentile (KM)	872.9				90% gamma percentile (KM)		1965
822					95% gamma percentile (KM)	3315				99% gamma percentile (KM)		7009
823												
824					**Gamma Kaplan-Meier (KM) Statistics**							
825					Approximate Chi Square Value (63.14, α)	45.86				Adjusted Chi Square Value (63.14, β)		45.72
826					5% Gamma Approximate KM-UCL (use when n>=50)	894.7				95% Gamma Adjusted KM-UCL (use when n<50)		897.5
827												
828					**Lognormal GOF Test on Detected Observations Only**							
829					Shapiro Wilk Approximate Test Statistic	0.923				**Shapiro Wilk GOF Test**		
830					5% Shapiro Wilk P Value	7.843E-10				Detected Data Not Lognormal at 5% Significance Level		
831					Lilliefors Test Statistic	0.0985				**Lilliefors GOF Test**		
832					5% Lilliefors Critical Value	0.073				Detected Data Not Lognormal at 5% Significance Level		
833					**Detected Data Not Lognormal at 5% Significance Level**							
834												
835					**Lognormal ROS Statistics Using Imputed Non-Detects**							
836					Mean in Original Scale	649.6				Mean in Log Scale		5.181
837					SD in Original Scale	1432				SD in Log Scale		1.52
838					95% t UCL (assumes normality of ROS data)	841.8				95% Percentile Bootstrap UCL		843.1
839					95% BCA Bootstrap UCL	889.5				95% Bootstrap t UCL		892.5
840					95% H-UCL (Log ROS)	792.1						
841												
842					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
843					KM Mean (logged)	5.209				KM Geo Mean		183
844					KM SD (logged)	1.46				95% Critical H Value (KM-Log)		2.67
845					KM Standard Error of Mean (logged)	0.119				95% H-UCL (KM -Log)		729.1
846					KM SD (logged)	1.46				95% Critical H Value (KM-Log)		2.67
847					KM Standard Error of Mean (logged)	0.119						
848												
849					**DL/2 Statistics**							
850					**DL/2 Normal**					**DL/2 Log-Transformed**		
851					Mean in Original Scale	649.7				Mean in Log Scale		5.196
852					SD in Original Scale	1432				SD in Log Scale		1.488
853					95% t UCL (Assumes normality)	841.9				95% H-Stat UCL		757.9
854					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
855												
856					**Nonparametric Distribution Free UCL Statistics**							
857					**Data do not follow a Discernible Distribution at 5% Significance Level**							
858												
859					**Suggested UCL to Use**							
860					95% KM (Chebyshev) UCL	1156						
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 statisticia											
866												
867	**Result (eu7_antimony)**											
868												
869					**General Statistics**							
870					Total Number of Observations	129				Number of Distinct Observations		5
871					Number of Detects	3				Number of Non-Detects		126

872				Number of Distinct Detects	3				Number of Distinct Non-Detects	2		
873				Minimum Detect	4.42				Minimum Non-Detect	0.047		
874				Maximum Detect	5.04				Maximum Non-Detect	2.5		
875				Variance Detects	0.0966				Percent Non-Detects	97.67%		
876				Mean Detects	4.717				SD Detects	0.311		
877				Median Detects	4.69				CV Detects	0.0659		
878				Skewness Detects	0.383				Kurtosis Detects	N/A		
879				Mean of Logged Detects	1.55				SD of Logged Detects	0.0657		
880												
881					**Warning: Data set has only 3 Detected Values.**							
882					**This is not enough to compute meaningful or reliable statistics and estimates.**							
883												
884												
885					**Normal GOF Test on Detects Only**							
886				Shapiro Wilk Test Statistic	0.994				**Shapiro Wilk GOF Test**			
887				5% Shapiro Wilk Critical Value	0.767				Detected Data appear Normal at 5% Significance Level			
888				Lilliefors Test Statistic	0.201				**Lilliefors GOF Test**			
889				5% Lilliefors Critical Value	0.425				Detected Data appear Normal at 5% Significance Level			
890					**Detected Data appear Normal at 5% Significance Level**							
891												
892					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
893				KM Mean	0.156				KM Standard Error of Mean	0.076		
894				KM SD	0.705				95% KM (BCA) UCL	N/A		
895				95% KM (t) UCL	0.282				95% KM (Percentile Bootstrap) UCL	N/A		
896				95% KM (z) UCL	0.281				95% KM Bootstrap t UCL	N/A		
897				90% KM Chebyshev UCL	0.384				95% KM Chebyshev UCL	0.487		
898				97.5% KM Chebyshev UCL	0.63				99% KM Chebyshev UCL	0.912		
899												
900					**Gamma GOF Tests on Detected Observations Only**							
901					**Not Enough Data to Perform GOF Test**							
902												
903					**Gamma Statistics on Detected Data Only**							
904				k hat (MLE)	346.7				k star (bias corrected MLE)	N/A		
905				Theta hat (MLE)	0.0136				Theta star (bias corrected MLE)	N/A		
906				nu hat (MLE)	2080				nu star (bias corrected)	N/A		
907				Mean (detects)	4.717							
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	1.539		
916				Maximum	5.04				Median	1.417		
917				SD	1.194				CV	0.775		
918				k hat (MLE)	0.738				k star (bias corrected MLE)	0.726		
919				Theta hat (MLE)	2.086				Theta star (bias corrected MLE)	2.12		
920				nu hat (MLE)	190.4				nu star (bias corrected)	187.3		
921				Adjusted Level of Significance (β)	0.0481							
922				Approximate Chi Square Value (187.35, α)	156.7				Adjusted Chi Square Value (187.35, β)	156.4		
923				95% Gamma Approximate UCL (use when n>=50)	1.841				95% Gamma Adjusted UCL (use when n<50)	N/A		
924												
925					**Estimates of Gamma Parameters using KM Estimates**							
926				Mean (KM)	0.156				SD (KM)	0.705		
927				Variance (KM)	0.497				SE of Mean (KM)	0.076		
928				k hat (KM)	0.0487				k star (KM)	0.0528		
929				nu hat (KM)	12.57				nu star (KM)	13.61		
930				theta hat (KM)	3.193				theta star (KM)	2.949		
931				80% gamma percentile (KM)	0.0254				90% gamma percentile (KM)	0.254		
932				95% gamma percentile (KM)	0.843				99% gamma percentile (KM)	3.312		
933												
934					**Gamma Kaplan-Meier (KM) Statistics**							
935				Approximate Chi Square Value (13.61, α)	6.308				Adjusted Chi Square Value (13.61, β)	6.251		
936				5% Gamma Approximate KM-UCL (use when n>=50)	0.336				95% Gamma Adjusted KM-UCL (use when n<50)	0.339		
937												
938					**Lognormal GOF Test on Detected Observations Only**							

939					Shapiro Wilk Test Statistic	0.997	**Shapiro Wilk GOF Test**					
940					5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level					
941					Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**					
942					5% Lilliefors Critical Value	0.425	Detected Data appear Lognormal at 5% Significance Level					
943	**Detected Data appear Lognormal at 5% Significance Level**											
944												
945	**Lognormal ROS Statistics Using Imputed Non-Detects**											
946					Mean in Original Scale	2.395	Mean in Log Scale	0.828				
947					SD in Original Scale	0.744	SD in Log Scale	0.303				
948					95% t UCL (assumes normality of ROS data)	2.504	95% Percentile Bootstrap UCL	2.505				
949					95% BCA Bootstrap UCL	2.51	95% Bootstrap t UCL	2.507				
950					95% H-UCL (Log ROS)	2.509						
951												
952	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
953					KM Mean (logged)	-2.95	KM Geo Mean	0.0523				
954					KM SD (logged)	0.694	95% Critical H Value (KM-Log)	1.947				
955					KM Standard Error of Mean (logged)	0.0749	95% H-UCL (KM -Log)	0.075				
956					KM SD (logged)	0.694	95% Critical H Value (KM-Log)	1.947				
957					KM Standard Error of Mean (logged)	0.0749						
958												
959	**DL/2 Statistics**											
960	**DL/2 Normal**						**DL/2 Log-Transformed**					
961					Mean in Original Scale	1.245	Mean in Log Scale	-0.0233				
962					SD in Original Scale	0.624	SD in Log Scale	1.044				
963					95% t UCL (Assumes normality)	1.336	95% H-Stat UCL	2.071				
964	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
965												
966	**Nonparametric Distribution Free UCL Statistics**											
967	**Detected Data appear Normal Distributed at 5% Significance Level**											
968												
969	**Suggested UCL to Use**											
970					95% KM (t) UCL	0.282						
971												
972	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
973	Recommendations are based upon data size, data distribution, and skewness.											
974	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
975	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
976												
977	**Result (eu7_arsenic)**											
978												
979	**General Statistics**											
980					Total Number of Observations	150	Number of Distinct Observations	13				
981					Number of Detects	11	Number of Non-Detects	139				
982					Number of Distinct Detects	11	Number of Distinct Non-Detects	2				
983					Minimum Detect	0.1	Minimum Non-Detect	0.026				
984					Maximum Detect	6.9	Maximum Non-Detect	2.5				
985					Variance Detects	5.632	Percent Non-Detects	92.67%				
986					Mean Detects	2.947	SD Detects	2.373				
987					Median Detects	2.8	CV Detects	0.805				
988					Skewness Detects	0.486	Kurtosis Detects	-0.676				
989					Mean of Logged Detects	0.495	SD of Logged Detects	1.434				
990												
991	**Normal GOF Test on Detects Only**											
992					Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk GOF Test**					
993					5% Shapiro Wilk Critical Value	0.85	Detected Data appear Normal at 5% Significance Level					
994					Lilliefors Test Statistic	0.145	**Lilliefors GOF Test**					
995					5% Lilliefors Critical Value	0.251	Detected Data appear Normal at 5% Significance Level					
996	**Detected Data appear Normal at 5% Significance Level**											
997												
998	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
999					KM Mean	0.491	KM Standard Error of Mean	0.167				
1000					KM SD	0.996	95% KM (BCA) UCL	0.804				
1001					95% KM (t) UCL	0.767	95% KM (Percentile Bootstrap) UCL	0.786				
1002					95% KM (z) UCL	0.765	95% KM Bootstrap t UCL	0.989				
1003					90% KM Chebyshev UCL	0.991	95% KM Chebyshev UCL	1.218				
1004					97.5% KM Chebyshev UCL	1.533	99% KM Chebyshev UCL	2.151				
1005												

1006	**Gamma GOF Tests on Detected Observations Only**											
1007					A-D Test Statistic	0.465	**Anderson-Darling GOF Test**					
1008					5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Lev					
1009					K-S Test Statistic	0.229	**Kolmogorov-Smirnov GOF**					
1010					5% K-S Critical Value	0.263	Detected data appear Gamma Distributed at 5% Significance Lev					
1011	**Detected data appear Gamma Distributed at 5% Significance Level**											
1012												
1013	**Gamma Statistics on Detected Data Only**											
1014					k hat (MLE)	0.986	k star (bias corrected MLE)	0.778				
1015					Theta hat (MLE)	2.988	Theta star (bias corrected MLE)	3.789				
1016					nu hat (MLE)	21.7	nu star (bias corrected)	17.11				
1017					Mean (detects)	2.947						
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	0.532				
1026					Maximum	6.9	Median	0.01				
1027					SD	1.117	CV	2.098				
1028					k hat (MLE)	0.294	k star (bias corrected MLE)	0.293				
1029					Theta hat (MLE)	1.81	Theta star (bias corrected MLE)	1.819				
1030					nu hat (MLE)	88.24	nu star (bias corrected)	87.81				
1031					Adjusted Level of Significance (β)	0.0484						
1032					Approximate Chi Square Value (87.81, α)	67.2	Adjusted Chi Square Value (87.81, β)	67.03				
1033					95% Gamma Approximate UCL (use when n>=50)	0.696	95% Gamma Adjusted UCL (use when n<50)	0.697				
1034												
1035	**Estimates of Gamma Parameters using KM Estimates**											
1036					Mean (KM)	0.491	SD (KM)	0.996				
1037					Variance (KM)	0.992	SE of Mean (KM)	0.167				
1038					k hat (KM)	0.243	k star (KM)	0.243				
1039					nu hat (KM)	72.93	nu star (KM)	72.81				
1040					theta hat (KM)	2.02	theta star (KM)	2.023				
1041					80% gamma percentile (KM)	0.705	90% gamma percentile (KM)	1.477				
1042					95% gamma percentile (KM)	2.398	99% gamma percentile (KM)	4.859				
1043												
1044	**Gamma Kaplan-Meier (KM) Statistics**											
1045					Approximate Chi Square Value (72.81, α)	54.16	Adjusted Chi Square Value (72.81, β)	54				
1046	5% Gamma Approximate KM-UCL (use when n>=50)					0.66	95% Gamma Adjusted KM-UCL (use when n<50)	0.662				
1047												
1048	**Lognormal GOF Test on Detected Observations Only**											
1049					Shapiro Wilk Test Statistic	0.854	**Shapiro Wilk GOF Test**					
1050					5% Shapiro Wilk Critical Value	0.85	Detected Data appear Lognormal at 5% Significance Level					
1051					Lilliefors Test Statistic	0.266	**Lilliefors GOF Test**					
1052					5% Lilliefors Critical Value	0.251	Detected Data Not Lognormal at 5% Significance Level					
1053	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
1054												
1055	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1056					Mean in Original Scale	0.476	Mean in Log Scale	-1.987				
1057					SD in Original Scale	1.003	SD in Log Scale	1.631				
1058					95% t UCL (assumes normality of ROS data)	0.611	95% Percentile Bootstrap UCL	0.623				
1059					95% BCA Bootstrap UCL	0.648	95% Bootstrap t UCL	0.672				
1060					95% H-UCL (Log ROS)	0.76						
1061												
1062	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1063					KM Mean (logged)	-2.022	KM Geo Mean	0.132				
1064					KM SD (logged)	1.62	95% Critical H Value (KM-Log)	2.846				
1065					KM Standard Error of Mean (logged)	0.557	95% H-UCL (KM -Log)	0.717				
1066					KM SD (logged)	1.62	95% Critical H Value (KM-Log)	2.846				
1067					KM Standard Error of Mean (logged)	0.557						
1068												
1069	**DL/2 Statistics**											
1070	**DL/2 Normal**						**DL/2 Log-Transformed**					
1071					Mean in Original Scale	1.35	Mean in Log Scale	0.152				
1072					SD in Original Scale	0.782	SD in Log Scale	0.747				

1073				95% t UCL (Assumes normality)		1.455				95% H-Stat UCL		1.738
1074	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1075												
1076	**Nonparametric Distribution Free UCL Statistics**											
1077	**Detected Data appear Normal Distributed at 5% Significance Level**											
1078												
1079	**Suggested UCL to Use**											
1080				95% KM (t) UCL		0.767						
1081												
1082	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1083	Recommendations are based upon data size, data distribution, and skewness.											
1084	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1085	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1086												
1087	**Result (eu7_beryllium)**											
1088												
1089	**General Statistics**											
1090				Total Number of Observations		150				Number of Distinct Observations		5
1091				Number of Detects		3				Number of Non-Detects		147
1092				Number of Distinct Detects		3				Number of Distinct Non-Detects		2
1093				Minimum Detect		1.1				Minimum Non-Detect		0.043
1094				Maximum Detect		4.63				Maximum Non-Detect		2
1095				Variance Detects		4.039				Percent Non-Detects		98%
1096				Mean Detects		2.31				SD Detects		2.01
1097				Median Detects		1.2				CV Detects		0.87
1098				Skewness Detects		1.727				Kurtosis Detects		N/A
1099				Mean of Logged Detects		0.603				SD of Logged Detects		0.806
1100												
1101	**Warning: Data set has only 3 Detected Values.**											
1102	**This is not enough to compute meaningful or reliable statistics and estimates.**											
1103												
1104												
1105	**Normal GOF Test on Detects Only**											
1106				Shapiro Wilk Test Statistic		0.771				**Shapiro Wilk GOF Test**		
1107				5% Shapiro Wilk Critical Value		0.767				Detected Data appear Normal at 5% Significance Level		
1108				Lilliefors Test Statistic		0.376				**Lilliefors GOF Test**		
1109				5% Lilliefors Critical Value		0.425				Detected Data appear Normal at 5% Significance Level		
1110	**Detected Data appear Normal at 5% Significance Level**											
1111												
1112	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1113				KM Mean		0.318				KM Standard Error of Mean		0.19
1114				KM SD		0.579				95% KM (BCA) UCL		N/A
1115				95% KM (t) UCL		0.633				95% KM (Percentile Bootstrap) UCL		N/A
1116				95% KM (z) UCL		0.631				95% KM Bootstrap t UCL		N/A
1117				90% KM Chebyshev UCL		0.889				95% KM Chebyshev UCL		1.147
1118				97.5% KM Chebyshev UCL		1.506				99% KM Chebyshev UCL		2.21
1119												
1120	**Gamma GOF Tests on Detected Observations Only**											
1121	**Not Enough Data to Perform GOF Test**											
1122												
1123	**Gamma Statistics on Detected Data Only**											
1124				k hat (MLE)		2.291				k star (bias corrected MLE)		N/A
1125				Theta hat (MLE)		1.008				Theta star (bias corrected MLE)		N/A
1126				nu hat (MLE)		13.75				nu star (bias corrected)		N/A
1127				Mean (detects)		2.31						
1128												
1129	**Gamma ROS Statistics using Imputed Non-Detects**											
1130	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1131	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)											
1132	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1133	This is especially true when the sample size is small.											
1134	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1135				Minimum		0.01				Mean		0.339
1136				Maximum		4.63				Median		0.01
1137				SD		0.72				CV		2.122
1138				k hat (MLE)		0.31				k star (bias corrected MLE)		0.308
1139				Theta hat (MLE)		1.095				Theta star (bias corrected MLE)		1.101

1140					nu hat (MLE)	92.97				nu star (bias corrected)		92.45
1141				Adjusted Level of Significance (β)		0.0484						
1142				Approximate Chi Square Value (92.45, α)		71.27				Adjusted Chi Square Value (92.45, β)		71.09
1143			95% Gamma Approximate UCL (use when n>=50)			0.44				95% Gamma Adjusted UCL (use when n<50)		N/A
1144												
1145					**Estimates of Gamma Parameters using KM Estimates**							
1146					Mean (KM)	0.318				SD (KM)		0.579
1147					Variance (KM)	0.336				SE of Mean (KM)		0.19
1148					k hat (KM)	0.301				k star (KM)		0.3
1149					nu hat (KM)	90.33				nu star (KM)		89.85
1150					theta hat (KM)	1.056				theta star (KM)		1.062
1151					80% gamma percentile (KM)	0.487				90% gamma percentile (KM)		0.938
1152					95% gamma percentile (KM)	1.455				99% gamma percentile (KM)		2.8
1153												
1154					**Gamma Kaplan-Meier (KM) Statistics**							
1155				Approximate Chi Square Value (89.85, α)		69				Adjusted Chi Square Value (89.85, β)		68.82
1156	5% Gamma Approximate KM-UCL (use when n>=50)					0.414				95% Gamma Adjusted KM-UCL (use when n<50)		0.415
1157												
1158					**Lognormal GOF Test on Detected Observations Only**							
1159					Shapiro Wilk Test Statistic	0.795				**Shapiro Wilk GOF Test**		
1160					5% Shapiro Wilk Critical Value	0.767				Detected Data appear Lognormal at 5% Significance Level		
1161					Lilliefors Test Statistic	0.366				**Lilliefors GOF Test**		
1162					5% Lilliefors Critical Value	0.425				Detected Data appear Lognormal at 5% Significance Level		
1163					**Detected Data appear Lognormal at 5% Significance Level**							
1164												
1165					**Lognormal ROS Statistics Using Imputed Non-Detects**							
1166					Mean in Original Scale	0.576				Mean in Log Scale		-0.928
1167					SD in Original Scale	0.592				SD in Log Scale		0.869
1168				95% t UCL (assumes normality of ROS data)		0.656				95% Percentile Bootstrap UCL		0.659
1169					95% BCA Bootstrap UCL	0.672				95% Bootstrap t UCL		0.684
1170					95% H-UCL (Log ROS)	0.67						
1171												
1172					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1173					KM Mean (logged)	-2.39				KM Geo Mean		0.0916
1174					KM SD (logged)	1.399				95% Critical H Value (KM-Log)		2.602
1175				KM Standard Error of Mean (logged)		0.555				95% H-UCL (KM -Log)		0.328
1176					KM SD (logged)	1.399				95% Critical H Value (KM-Log)		2.602
1177				KM Standard Error of Mean (logged)		0.555						
1178												
1179					**DL/2 Statistics**							
1180					**DL/2 Normal**					**DL/2 Log-Transformed**		
1181					Mean in Original Scale	0.981				Mean in Log Scale		-0.167
1182					SD in Original Scale	0.365				SD in Log Scale		0.825
1183					95% t UCL (Assumes normality)	1.03				95% H-Stat UCL		1.366
1184					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1185												
1186					**Nonparametric Distribution Free UCL Statistics**							
1187					**Detected Data appear Normal Distributed at 5% Significance Level**							
1188												
1189					**Suggested UCL to Use**							
1190					95% KM (t) UCL	0.633						
1191												
1192	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1193	Recommendations are based upon data size, data distribution, and skewness.											
1194	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1195	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1196												
1197	**Result (eu7_cadmium)**											
1198												
1199					**General Statistics**							
1200					Total Number of Observations	152				Number of Distinct Observations		102
1201					Number of Detects	119				Number of Non-Detects		33
1202					Number of Distinct Detects	100				Number of Distinct Non-Detects		2
1203					Minimum Detect	0.33				Minimum Non-Detect		0.05
1204					Maximum Detect	62.4				Maximum Non-Detect		0.5
1205					Variance Detects	73.42				Percent Non-Detects		21.71%
1206					Mean Detects	2.683				SD Detects		8.569

1207					Median Detects	0.926				CV Detects		3.193
1208					Skewness Detects	5.539				Kurtosis Detects		30.98
1209					Mean of Logged Detects	0.106				SD of Logged Detects		0.847
1210												
1211					**Normal GOF Test on Detects Only**							
1212					Shapiro Wilk Test Statistic	0.253		**Normal GOF Test on Detected Observations Only**				
1213					5% Shapiro Wilk P Value	0		Detected Data Not Normal at 5% Significance Level				
1214					Lilliefors Test Statistic	0.431		**Lilliefors GOF Test**				
1215					5% Lilliefors Critical Value	0.0816		Detected Data Not Normal at 5% Significance Level				
1216					**Detected Data Not Normal at 5% Significance Level**							
1217												
1218					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
1219					KM Mean	2.122				KM Standard Error of Mean		0.621
1220					KM SD	7.625				95% KM (BCA) UCL		3.372
1221					95% KM (t) UCL	3.15				95% KM (Percentile Bootstrap) UCL		3.151
1222					95% KM (z) UCL	3.144				95% KM Bootstrap t UCL		4.073
1223					90% KM Chebyshev UCL	3.986				95% KM Chebyshev UCL		4.83
1224					97.5% KM Chebyshev UCL	6.002				99% KM Chebyshev UCL		8.303
1225												
1226					**Gamma GOF Tests on Detected Observations Only**							
1227					A-D Test Statistic	24.39		**Anderson-Darling GOF Test**				
1228					5% A-D Critical Value	0.801		Detected Data Not Gamma Distributed at 5% Significance Level				
1229					K-S Test Statistic	0.373		**Kolmogorov-Smirnov GOF**				
1230					5% K-S Critical Value	0.0883		Detected Data Not Gamma Distributed at 5% Significance Level				
1231					**Detected Data Not Gamma Distributed at 5% Significance Level**							
1232												
1233					**Gamma Statistics on Detected Data Only**							
1234					k hat (MLE)	0.687				k star (bias corrected MLE)		0.676
1235					Theta hat (MLE)	3.904				Theta star (bias corrected MLE)		3.971
1236					nu hat (MLE)	163.6				nu star (bias corrected)		160.8
1237					Mean (detects)	2.683						
1238												
1239					**Gamma ROS Statistics using Imputed Non-Detects**							
1240					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
1241					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)							
1242					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
1243					This is especially true when the sample size is small.							
1244					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
1245					Minimum	0.01				Mean		2.103
1246					Maximum	62.4				Median		0.815
1247					SD	7.655				CV		3.64
1248					k hat (MLE)	0.397				k star (bias corrected MLE)		0.393
1249					Theta hat (MLE)	5.3				Theta star (bias corrected MLE)		5.346
1250					nu hat (MLE)	120.6				nu star (bias corrected)		119.6
1251					Adjusted Level of Significance (β)	0.0484						
1252					Approximate Chi Square Value (119.59, α)	95.33				Adjusted Chi Square Value (119.59, β)		95.13
1253					95% Gamma Approximate UCL (use when n>=50)	2.638				95% Gamma Adjusted UCL (use when n<50)		2.644
1254												
1255					**Estimates of Gamma Parameters using KM Estimates**							
1256					Mean (KM)	2.122				SD (KM)		7.625
1257					Variance (KM)	58.14				SE of Mean (KM)		0.621
1258					k hat (KM)	0.0775				k star (KM)		0.0803
1259					nu hat (KM)	23.56				nu star (KM)		24.42
1260					theta hat (KM)	27.39				theta star (KM)		26.42
1261					80% gamma percentile (KM)	1.019				90% gamma percentile (KM)		5.046
1262					95% gamma percentile (KM)	12.34				99% gamma percentile (KM)		37.51
1263												
1264					**Gamma Kaplan-Meier (KM) Statistics**							
1265					Approximate Chi Square Value (24.42, α)	14.17				Adjusted Chi Square Value (24.42, β)		14.1
1266					5% Gamma Approximate KM-UCL (use when n>=50)	3.658				95% Gamma Adjusted KM-UCL (use when n<50)		3.677
1267												
1268					**Lognormal GOF Test on Detected Observations Only**							
1269					Shapiro Wilk Approximate Test Statistic	0.677		**Shapiro Wilk GOF Test**				
1270					5% Shapiro Wilk P Value	0		Detected Data Not Lognormal at 5% Significance Level				
1271					Lilliefors Test Statistic	0.243		**Lilliefors GOF Test**				
1272					5% Lilliefors Critical Value	0.0816		Detected Data Not Lognormal at 5% Significance Level				
1273					**Detected Data Not Lognormal at 5% Significance Level**							

1274												
1275	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1276						Mean in Original Scale	2.15			Mean in Log Scale	-0.258	
1277						SD in Original Scale	7.643			SD in Log Scale	1.038	
1278						95% t UCL (assumes normality of ROS data)	3.176			95% Percentile Bootstrap UCL	3.227	
1279						95% BCA Bootstrap UCL	3.673			95% Bootstrap t UCL	4.293	
1280						95% H-UCL (Log ROS)	1.6					
1281												
1282	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1283						KM Mean (logged)	-0.496			KM Geo Mean	0.609	
1284						KM SD (logged)	1.405			95% Critical H Value (KM-Log)	2.61	
1285						KM Standard Error of Mean (logged)	0.134			95% H-UCL (KM -Log)	2.202	
1286						KM SD (logged)	1.405			95% Critical H Value (KM-Log)	2.61	
1287						KM Standard Error of Mean (logged)	0.134					
1288												
1289	**DL/2 Statistics**											
1290						**DL/2 Normal**				**DL/2 Log-Transformed**		
1291						Mean in Original Scale	2.149			Mean in Log Scale	-0.279	
1292						SD in Original Scale	7.643			SD in Log Scale	1.105	
1293						95% t UCL (Assumes normality)	3.175			95% H-Stat UCL	1.714	
1294	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1295												
1296	**Nonparametric Distribution Free UCL Statistics**											
1297	**Data do not follow a Discernible Distribution at 5% Significance Level**											
1298												
1299	**Suggested UCL to Use**											
1300						95% KM (Chebyshev) UCL	4.83					
1301												
1302	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1303	Recommendations are based upon data size, data distribution, and skewness.											
1304	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1305	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1306												
1307	**Result (eu7_chromium)**											
1308												
1309	**General Statistics**											
1310						Total Number of Observations	152			Number of Distinct Observations	5	
1311						Number of Detects	3			Number of Non-Detects	149	
1312						Number of Distinct Detects	3			Number of Distinct Non-Detects	2	
1313						Minimum Detect	0.13			Minimum Non-Detect	0.035	
1314						Maximum Detect	8.76			Maximum Non-Detect	5	
1315						Variance Detects	24.71			Percent Non-Detects	98.03%	
1316						Mean Detects	3.02			SD Detects	4.971	
1317						Median Detects	0.17			CV Detects	1.646	
1318						Skewness Detects	1.732			Kurtosis Detects	N/A	
1319						Mean of Logged Detects	-0.547			SD of Logged Detects	2.357	
1320												
1321	**Warning: Data set has only 3 Detected Values.**											
1322	**This is not enough to compute meaningful or reliable statistics and estimates.**											
1323												
1324												
1325	**Normal GOF Test on Detects Only**											
1326						Shapiro Wilk Test Statistic	0.753			**Shapiro Wilk GOF Test**		
1327						5% Shapiro Wilk Critical Value	0.767			Detected Data Not Normal at 5% Significance Level		
1328						Lilliefors Test Statistic	0.383			**Lilliefors GOF Test**		
1329						5% Lilliefors Critical Value	0.425			Detected Data appear Normal at 5% Significance Level		
1330	**Detected Data appear Approximate Normal at 5% Significance Level**											
1331												
1332	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1333						KM Mean	0.118			KM Standard Error of Mean	0.0726	
1334						KM SD	0.705			95% KM (BCA) UCL	N/A	
1335						95% KM (t) UCL	0.238			95% KM (Percentile Bootstrap) UCL	N/A	
1336						95% KM (z) UCL	0.237			95% KM Bootstrap t UCL	N/A	
1337						90% KM Chebyshev UCL	0.336			95% KM Chebyshev UCL	0.434	
1338						97.5% KM Chebyshev UCL	0.571			99% KM Chebyshev UCL	0.84	
1339												
1340	**Gamma GOF Tests on Detected Observations Only**											

1341	**Not Enough Data to Perform GOF Test**											
1342												
1343	**Gamma Statistics on Detected Data Only**											
1344						k hat (MLE)	0.398			k star (bias corrected MLE)		N/A
1345						Theta hat (MLE)	7.58			Theta star (bias corrected MLE)		N/A
1346						nu hat (MLE)	2.391			nu star (bias corrected)		N/A
1347						Mean (detects)	3.02					
1348												
1349	**Gamma ROS Statistics using Imputed Non-Detects**											
1350	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1351	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)											
1352	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1353	This is especially true when the sample size is small.											
1354	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1355						Minimum	0.01			Mean		0.25
1356						Maximum	8.76			Median		0.01
1357						SD	0.989			CV		3.95
1358						k hat (MLE)	0.266			k star (bias corrected MLE)		0.265
1359						Theta hat (MLE)	0.943			Theta star (bias corrected MLE)		0.946
1360						nu hat (MLE)	80.73			nu star (bias corrected)		80.47
1361						Adjusted Level of Significance (β)	0.0484					
1362						Approximate Chi Square Value (80.47, α)	60.8			Adjusted Chi Square Value (80.47, β)		60.64
1363						95% Gamma Approximate UCL (use when n>=50)	0.331			95% Gamma Adjusted UCL (use when n<50)		N/A
1364												
1365	**Estimates of Gamma Parameters using KM Estimates**											
1366						Mean (KM)	0.118			SD (KM)		0.705
1367						Variance (KM)	0.497			SE of Mean (KM)		0.0726
1368						k hat (KM)	0.0279			k star (KM)		0.0318
1369						nu hat (KM)	8.487			nu star (KM)		9.653
1370						theta hat (KM)	4.219			theta star (KM)		3.71
1371						80% gamma percentile (KM)	0.0019			90% gamma percentile (KM)		0.079
1372						95% gamma percentile (KM)	0.48			99% gamma percentile (KM)		2.994
1373												
1374	**Gamma Kaplan-Meier (KM) Statistics**											
1375						Approximate Chi Square Value (9.65, α)	3.726			Adjusted Chi Square Value (9.65, β)		3.691
1376	5% Gamma Approximate KM-UCL (use when n>=50)						0.305			95% Gamma Adjusted KM-UCL (use when n<50)		0.308
1377												
1378	**Lognormal GOF Test on Detected Observations Only**											
1379						Shapiro Wilk Test Statistic	0.798			**Shapiro Wilk GOF Test**		
1380						5% Shapiro Wilk Critical Value	0.767			Detected Data appear Lognormal at 5% Significance Level		
1381						Lilliefors Test Statistic	0.365			**Lilliefors GOF Test**		
1382						5% Lilliefors Critical Value	0.425			Detected Data appear Lognormal at 5% Significance Level		
1383	**Detected Data appear Lognormal at 5% Significance Level**											
1384												
1385	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1386						Mean in Original Scale	0.132			Mean in Log Scale		-5.022
1387						SD in Original Scale	0.744			SD in Log Scale		2.539
1388						95% t UCL (assumes normality of ROS data)	0.232			95% Percentile Bootstrap UCL		0.247
1389						95% BCA Bootstrap UCL	0.325			95% Bootstrap t UCL		0.5
1390						95% H-UCL (Log ROS)	0.376					
1391												
1392	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1393						KM Mean (logged)	-2.997			KM Geo Mean		0.0499
1394						KM SD (logged)	0.735			95% Critical H Value (KM-Log)		1.985
1395						KM Standard Error of Mean (logged)	0.249			95% H-UCL (KM -Log)		0.0737
1396						KM SD (logged)	0.735			95% Critical H Value (KM-Log)		1.985
1397						KM Standard Error of Mean (logged)	0.249					
1398												
1399	**DL/2 Statistics**											
1400	**DL/2 Normal**									**DL/2 Log-Transformed**		
1401						Mean in Original Scale	2.396			Mean in Log Scale		0.659
1402						SD in Original Scale	0.779			SD in Log Scale		1.091
1403						95% t UCL (Assumes normality)	2.501			95% H-Stat UCL		4.296
1404	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1405												
1406	**Nonparametric Distribution Free UCL Statistics**											
1407	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**											

1408												
1409						**Suggested UCL to Use**						
1410					95% KM (t) UCL	0.238						
1411												
1412					When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test							
1413					When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL							
1414												
1415					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
1416					Recommendations are based upon data size, data distribution, and skewness.							
1417					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
1418					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia							
1419												
1420	**Result (eu7_cobalt)**											
1421												
1422						**General Statistics**						
1423					Total Number of Observations	83			Number of Distinct Observations	18		
1424					Number of Detects	17			Number of Non-Detects	66		
1425					Number of Distinct Detects	17			Number of Distinct Non-Detects	1		
1426					Minimum Detect	0.16			Minimum Non-Detect	0.5		
1427					Maximum Detect	29.1			Maximum Non-Detect	0.5		
1428					Variance Detects	75.93			Percent Non-Detects	79.52%		
1429					Mean Detects	7.481			SD Detects	8.714		
1430					Median Detects	3.38			CV Detects	1.165		
1431					Skewness Detects	1.419			Kurtosis Detects	1.37		
1432					Mean of Logged Detects	1.048			SD of Logged Detects	1.713		
1433												
1434						**Normal GOF Test on Detects Only**						
1435					Shapiro Wilk Test Statistic	0.814			**Shapiro Wilk GOF Test**			
1436					5% Shapiro Wilk Critical Value	0.892			Detected Data Not Normal at 5% Significance Level			
1437					Lilliefors Test Statistic	0.21			**Lilliefors GOF Test**			
1438					5% Lilliefors Critical Value	0.207			Detected Data Not Normal at 5% Significance Level			
1439						**Detected Data Not Normal at 5% Significance Level**						
1440												
1441						**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**						
1442					KM Mean	1.689			KM Standard Error of Mean	0.546		
1443					KM SD	4.825			95% KM (BCA) UCL	2.63		
1444					95% KM (t) UCL	2.597			95% KM (Percentile Bootstrap) UCL	2.628		
1445					95% KM (z) UCL	2.587			95% KM Bootstrap t UCL	3.166		
1446					90% KM Chebyshev UCL	3.327			95% KM Chebyshev UCL	4.069		
1447					97.5% KM Chebyshev UCL	5.099			99% KM Chebyshev UCL	7.122		
1448												
1449						**Gamma GOF Tests on Detected Observations Only**						
1450					A-D Test Statistic	0.28			**Anderson-Darling GOF Test**			
1451					5% A-D Critical Value	0.786			Detected data appear Gamma Distributed at 5% Significance Lev			
1452					K-S Test Statistic	0.12			**Kolmogorov-Smirnov GOF**			
1453					5% K-S Critical Value	0.219			Detected data appear Gamma Distributed at 5% Significance Lev			
1454						**Detected data appear Gamma Distributed at 5% Significance Level**						
1455												
1456						**Gamma Statistics on Detected Data Only**						
1457					k hat (MLE)	0.636			k star (bias corrected MLE)	0.563		
1458					Theta hat (MLE)	11.77			Theta star (bias corrected MLE)	13.3		
1459					nu hat (MLE)	21.61			nu star (bias corrected)	19.13		
1460					Mean (detects)	7.481						
1461												
1462						**Gamma ROS Statistics using Imputed Non-Detects**						
1463					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
1464					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)							
1465					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
1466					This is especially true when the sample size is small.							
1467					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
1468					Minimum	0.01			Mean	1.659		
1469					Maximum	29.1			Median	0.01		
1470					SD	4.885			CV	2.944		
1471					k hat (MLE)	0.206			k star (bias corrected MLE)	0.207		
1472					Theta hat (MLE)	8.051			Theta star (bias corrected MLE)	8.029		
1473					nu hat (MLE)	34.21			nu star (bias corrected)	34.3		
1474					Adjusted Level of Significance (β)	0.0471						

1475	Approximate Chi Square Value (34.30, α)					21.91	Adjusted Chi Square Value (34.30, β)					21.73
1476	95% Gamma Approximate UCL (use when n>=50)					2.598	95% Gamma Adjusted UCL (use when n<50)					2.619
1477												
1478	**Estimates of Gamma Parameters using KM Estimates**											
1479	Mean (KM)					1.689	SD (KM)					4.825
1480	Variance (KM)					23.28	SE of Mean (KM)					0.546
1481	k hat (KM)					0.122	k star (KM)					0.126
1482	nu hat (KM)					20.33	nu star (KM)					20.93
1483	theta hat (KM)					13.79	theta star (KM)					13.39
1484	80% gamma percentile (KM)					1.563	90% gamma percentile (KM)					4.846
1485	95% gamma percentile (KM)					9.572	99% gamma percentile (KM)					23.82
1486												
1487	**Gamma Kaplan-Meier (KM) Statistics**											
1488	Approximate Chi Square Value (20.93, α)					11.54	Adjusted Chi Square Value (20.93, β)					11.42
1489	5% Gamma Approximate KM-UCL (use when n>=50)					3.063	95% Gamma Adjusted KM-UCL (use when n<50)					3.096
1490												
1491	**Lognormal GOF Test on Detected Observations Only**											
1492	Shapiro Wilk Test Statistic					0.926	**Shapiro Wilk GOF Test**					
1493	5% Shapiro Wilk Critical Value					0.892	Detected Data appear Lognormal at 5% Significance Level					
1494	Lilliefors Test Statistic					0.155	**Lilliefors GOF Test**					
1495	5% Lilliefors Critical Value					0.207	Detected Data appear Lognormal at 5% Significance Level					
1496	**Detected Data appear Lognormal at 5% Significance Level**											
1497												
1498	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1499	Mean in Original Scale					1.813	Mean in Log Scale					-1.303
1500	SD in Original Scale					4.83	SD in Log Scale					1.973
1501	95% t UCL (assumes normality of ROS data)					2.695	95% Percentile Bootstrap UCL					2.691
1502	95% BCA Bootstrap UCL					3.033	95% Bootstrap t UCL					3.309
1503	95% H-UCL (Log ROS)					3.935						
1504												
1505	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1506	KM Mean (logged)					-1.087	KM Geo Mean					0.337
1507	KM SD (logged)					1.326	95% Critical H Value (KM-Log)					2.568
1508	KM Standard Error of Mean (logged)					0.167	95% H-UCL (KM -Log)					1.183
1509	KM SD (logged)					1.326	95% Critical H Value (KM-Log)					2.568
1510	KM Standard Error of Mean (logged)					0.167						
1511												
1512	**DL/2 Statistics**											
1513	**DL/2 Normal**						**DL/2 Log-Transformed**					
1514	Mean in Original Scale					1.731	Mean in Log Scale					-0.888
1515	SD in Original Scale					4.841	SD in Log Scale					1.245
1516	95% t UCL (Assumes normality)					2.615	95% H-Stat UCL					1.257
1517	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1518												
1519	**Nonparametric Distribution Free UCL Statistics**											
1520	**Detected Data appear Gamma Distributed at 5% Significance Level**											
1521												
1522	**Suggested UCL to Use**											
1523	95% KM Approximate Gamma UCL					3.063						
1524												
1525	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1526	Recommendations are based upon data size, data distribution, and skewness.											
1527	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1528	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1529												
1530	**Result (eu7_copper)**											
1531												
1532	**General Statistics**											
1533	Total Number of Observations					152	Number of Distinct Observations					105
1534	Number of Detects					114	Number of Non-Detects					38
1535	Number of Distinct Detects					104	Number of Distinct Non-Detects					2
1536	Minimum Detect					2.4	Minimum Non-Detect					0.073
1537	Maximum Detect					327	Maximum Non-Detect					2.5
1538	Variance Detects					2204	Percent Non-Detects					25%
1539	Mean Detects					20.31	SD Detects					46.95
1540	Median Detects					8.795	CV Detects					2.312
1541	Skewness Detects					4.843	Kurtosis Detects					24.69

1542	Mean of Logged Detects					2.29	SD of Logged Detects					0.932
1543												
1544	**Normal GOF Test on Detects Only**											
1545	Shapiro Wilk Test Statistic					0.358	**Normal GOF Test on Detected Observations Only**					
1546	5% Shapiro Wilk P Value					0	Detected Data Not Normal at 5% Significance Level					
1547	Lilliefors Test Statistic					0.401	**Lilliefors GOF Test**					
1548	5% Lilliefors Critical Value					0.0833	Detected Data Not Normal at 5% Significance Level					
1549	**Detected Data Not Normal at 5% Significance Level**											
1550												
1551	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1552	KM Mean					15.38	KM Standard Error of Mean					3.373
1553	KM SD					41.37	95% KM (BCA) UCL					21.87
1554	95% KM (t) UCL					20.96	95% KM (Percentile Bootstrap) UCL					21.49
1555	95% KM (z) UCL					20.93	95% KM Bootstrap t UCL					24.42
1556	90% KM Chebyshev UCL					25.5	95% KM Chebyshev UCL					30.08
1557	97.5% KM Chebyshev UCL					36.44	99% KM Chebyshev UCL					48.94
1558												
1559	**Gamma GOF Tests on Detected Observations Only**											
1560	A-D Test Statistic					12.29	**Anderson-Darling GOF Test**					
1561	5% A-D Critical Value					0.792	Detected Data Not Gamma Distributed at 5% Significance Level					
1562	K-S Test Statistic					0.271	**Kolmogorov-Smirnov GOF**					
1563	5% K-S Critical Value					0.089	Detected Data Not Gamma Distributed at 5% Significance Level					
1564	**Detected Data Not Gamma Distributed at 5% Significance Level**											
1565												
1566	**Gamma Statistics on Detected Data Only**											
1567	k hat (MLE)					0.821	k star (bias corrected MLE)					0.805
1568	Theta hat (MLE)					24.74	Theta star (bias corrected MLE)					25.23
1569	nu hat (MLE)					187.1	nu star (bias corrected)					183.5
1570	Mean (detects)					20.31						
1571												
1572	**Gamma ROS Statistics using Imputed Non-Detects**											
1573	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1574	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)											
1575	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1576	This is especially true when the sample size is small.											
1577	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1578	Minimum					0.01	Mean					15.23
1579	Maximum					327	Median					6.69
1580	SD					41.56	CV					2.728
1581	k hat (MLE)					0.317	k star (bias corrected MLE)					0.315
1582	Theta hat (MLE)					48.08	Theta star (bias corrected MLE)					48.36
1583	nu hat (MLE)					96.32	nu star (bias corrected)					95.75
1584	Adjusted Level of Significance (β)					0.0484						
1585	Approximate Chi Square Value (95.75, α)					74.18	Adjusted Chi Square Value (95.75, β)					74
1586	95% Gamma Approximate UCL (use when n>=50)					19.66	95% Gamma Adjusted UCL (use when n<50)					19.71
1587												
1588	**Estimates of Gamma Parameters using KM Estimates**											
1589	Mean (KM)					15.38	SD (KM)					41.37
1590	Variance (KM)					1711	SE of Mean (KM)					3.373
1591	k hat (KM)					0.138	k star (KM)					0.14
1592	nu hat (KM)					42.03	nu star (KM)					42.53
1593	theta hat (KM)					111.3	theta star (KM)					109.9
1594	80% gamma percentile (KM)					15.77	90% gamma percentile (KM)					45.12
1595	95% gamma percentile (KM)					85.76	99% gamma percentile (KM)					205.5
1596												
1597	**Gamma Kaplan-Meier (KM) Statistics**											
1598	Approximate Chi Square Value (42.53, α)					28.58	Adjusted Chi Square Value (42.53, β)					28.47
1599	5% Gamma Approximate KM-UCL (use when n>=50)					22.89	95% Gamma Adjusted KM-UCL (use when n<50)					22.98
1600												
1601	**Lognormal GOF Test on Detected Observations Only**											
1602	Shapiro Wilk Approximate Test Statistic					0.869	**Shapiro Wilk GOF Test**					
1603	5% Shapiro Wilk P Value					3.886E-15	Detected Data Not Lognormal at 5% Significance Level					
1604	Lilliefors Test Statistic					0.136	**Lilliefors GOF Test**					
1605	5% Lilliefors Critical Value					0.0833	Detected Data Not Lognormal at 5% Significance Level					
1606	**Detected Data Not Lognormal at 5% Significance Level**											
1607												
1608	**Lognormal ROS Statistics Using Imputed Non-Detects**											

1609					Mean in Original Scale	15.58				Mean in Log Scale		1.771
1610					SD in Original Scale	41.43				SD in Log Scale		1.24
1611				95% t UCL (assumes normality of ROS data)		21.14				95% Percentile Bootstrap UCL		21.59
1612					95% BCA Bootstrap UCL	22.51				95% Bootstrap t UCL		24.14
1613					95% H-UCL (Log ROS)	16.22						
1614												
1615					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1616					KM Mean (logged)	1.264				KM Geo Mean		3.541
1617					KM SD (logged)	2.084				95% Critical H Value (KM-Log)		3.401
1618					KM Standard Error of Mean (logged)	0.251				95% H-UCL (KM -Log)		55.29
1619					KM SD (logged)	2.084				95% Critical H Value (KM-Log)		3.401
1620					KM Standard Error of Mean (logged)	0.251						
1621												
1622					**DL/2 Statistics**							
1623					**DL/2 Normal**					**DL/2 Log-Transformed**		
1624					Mean in Original Scale	15.52				Mean in Log Scale		1.704
1625					SD in Original Scale	41.46				SD in Log Scale		1.385
1626					95% t UCL (Assumes normality)	21.08				95% H-Stat UCL		19.18
1627					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1628												
1629					**Nonparametric Distribution Free UCL Statistics**							
1630					**Data do not follow a Discernible Distribution at 5% Significance Level**							
1631												
1632					**Suggested UCL to Use**							
1633					95% KM (Chebyshev) UCL	30.08						
1634												
1635	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1636	Recommendations are based upon data size, data distribution, and skewness.											
1637	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1638	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1639												
1640	**Result (eu7_iron)**											
1641												
1642					**General Statistics**							
1643					Total Number of Observations	150				Number of Distinct Observations		83
1644					Number of Detects	96				Number of Non-Detects		54
1645					Number of Distinct Detects	81				Number of Distinct Non-Detects		2
1646					Minimum Detect	101				Minimum Non-Detect		2.1
1647					Maximum Detect	31100				Maximum Non-Detect		100
1648					Variance Detects	27478792				Percent Non-Detects		36%
1649					Mean Detects	2412				SD Detects		5242
1650					Median Detects	240.5				CV Detects		2.174
1651					Skewness Detects	3.264				Kurtosis Detects		12.05
1652					Mean of Logged Detects	6.223				SD of Logged Detects		1.606
1653												
1654					**Normal GOF Test on Detects Only**							
1655					Shapiro Wilk Test Statistic	0.515				**Normal GOF Test on Detected Observations Only**		
1656					5% Shapiro Wilk P Value	0				Detected Data Not Normal at 5% Significance Level		
1657					Lilliefors Test Statistic	0.368				**Lilliefors GOF Test**		
1658					5% Lilliefors Critical Value	0.0907				Detected Data Not Normal at 5% Significance Level		
1659					**Detected Data Not Normal at 5% Significance Level**							
1660												
1661					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
1662					KM Mean	1544				KM Standard Error of Mean		355.3
1663					KM SD	4329				95% KM (BCA) UCL		2093
1664					95% KM (t) UCL	2132				95% KM (Percentile Bootstrap) UCL		2175
1665					95% KM (z) UCL	2129				95% KM Bootstrap t UCL		2339
1666					90% KM Chebyshev UCL	2610				95% KM Chebyshev UCL		3093
1667					97.5% KM Chebyshev UCL	3763				99% KM Chebyshev UCL		5080
1668												
1669					**Gamma GOF Tests on Detected Observations Only**							
1670					A-D Test Statistic	11.52				**Anderson-Darling GOF Test**		
1671					5% A-D Critical Value	0.839				Detected Data Not Gamma Distributed at 5% Significance Level		
1672					K-S Test Statistic	0.296				**Kolmogorov-Smirnov GOF**		
1673					5% K-S Critical Value	0.0977				Detected Data Not Gamma Distributed at 5% Significance Level		
1674					**Detected Data Not Gamma Distributed at 5% Significance Level**							
1675												

1676	**Gamma Statistics on Detected Data Only**											
1677					k hat (MLE)	0.417		k star (bias corrected MLE)				0.411
1678					Theta hat (MLE)	5776		Theta star (bias corrected MLE)				5862
1679					nu hat (MLE)	80.16		nu star (bias corrected)				78.99
1680					Mean (detects)	2412						
1681												
1682	**Gamma ROS Statistics using Imputed Non-Detects**											
1683	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1684	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)											
1685	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1686	This is especially true when the sample size is small.											
1687	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1688					Minimum	0.01		Mean				1543
1689					Maximum	31100		Median				157
1690					SD	4344		CV				2.814
1691					k hat (MLE)	0.153		k star (bias corrected MLE)				0.154
1692					Theta hat (MLE)	10102		Theta star (bias corrected MLE)				10011
1693					nu hat (MLE)	45.83		nu star (bias corrected)				46.25
1694					Adjusted Level of Significance (β)	0.0484						
1695					Approximate Chi Square Value (46.25, α)	31.65		Adjusted Chi Square Value (46.25, β)				31.53
1696	95% Gamma Approximate UCL (use when n>=50)					2256		95% Gamma Adjusted UCL (use when n<50)				2264
1697												
1698	**Estimates of Gamma Parameters using KM Estimates**											
1699					Mean (KM)	1544		SD (KM)				4329
1700					Variance (KM)	18740790		SE of Mean (KM)				355.3
1701					k hat (KM)	0.127		k star (KM)				0.129
1702					nu hat (KM)	38.17		nu star (KM)				38.74
1703					theta hat (KM)	12137		theta star (KM)				11958
1704					80% gamma percentile (KM)	1465		90% gamma percentile (KM)				4456
1705					95% gamma percentile (KM)	8722		99% gamma percentile (KM)				21515
1706												
1707	**Gamma Kaplan-Meier (KM) Statistics**											
1708					Approximate Chi Square Value (38.74, α)	25.48		Adjusted Chi Square Value (38.74, β)				25.38
1709	5% Gamma Approximate KM-UCL (use when n>=50)					2347		95% Gamma Adjusted KM-UCL (use when n<50)				2357
1710												
1711	**Lognormal GOF Test on Detected Observations Only**											
1712					Shapiro Wilk Approximate Test Statistic	0.801		**Shapiro Wilk GOF Test**				
1713					5% Shapiro Wilk P Value	0		Detected Data Not Lognormal at 5% Significance Level				
1714					Lilliefors Test Statistic	0.231		**Lilliefors GOF Test**				
1715					5% Lilliefors Critical Value	0.0907		Detected Data Not Lognormal at 5% Significance Level				
1716	**Detected Data Not Lognormal at 5% Significance Level**											
1717												
1718	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1719					Mean in Original Scale	1550		Mean in Log Scale				4.85
1720					SD in Original Scale	4342		SD in Log Scale				2.349
1721					95% t UCL (assumes normality of ROS data)	2137		95% Percentile Bootstrap UCL				2170
1722					95% BCA Bootstrap UCL	2237		95% Bootstrap t UCL				2313
1723					95% H-UCL (Log ROS)	4131						
1724												
1725	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1726					KM Mean (logged)	4.25		KM Geo Mean				70.08
1727					KM SD (logged)	2.925		95% Critical H Value (KM-Log)				4.468
1728					KM Standard Error of Mean (logged)	0.24		95% H-UCL (KM -Log)				14727
1729					KM SD (logged)	2.925		95% Critical H Value (KM-Log)				4.468
1730					KM Standard Error of Mean (logged)	0.24						
1731												
1732	**DL/2 Statistics**											
1733	**DL/2 Normal**							**DL/2 Log-Transformed**				
1734					Mean in Original Scale	1560		Mean in Log Scale				5.288
1735					SD in Original Scale	4338		SD in Log Scale				1.892
1736					95% t UCL (Assumes normality)	2146		95% H-Stat UCL				1936
1737	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1738												
1739	**Nonparametric Distribution Free UCL Statistics**											
1740	**Data do not follow a Discernible Distribution at 5% Significance Level**											
1741												
1742	**Suggested UCL to Use**											

1743				95% KM (Chebyshev) UCL	3093							
1744												
1745	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1746	Recommendations are based upon data size, data distribution, and skewness.											
1747	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1748	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1749												
1750	**Result (eu7_lead)**											
1751												
1752	**General Statistics**											
1753	Total Number of Observations				152			Number of Distinct Observations				128
1754	Number of Detects				132			Number of Non-Detects				20
1755	Number of Distinct Detects				126			Number of Distinct Non-Detects				2
1756	Minimum Detect				0.601			Minimum Non-Detect				0.03
1757	Maximum Detect				286			Maximum Non-Detect				0.5
1758	Variance Detects				1245			Percent Non-Detects				13.16%
1759	Mean Detects				11.07			SD Detects				35.28
1760	Median Detects				2.89			CV Detects				3.188
1761	Skewness Detects				6.43			Kurtosis Detects				43.06
1762	Mean of Logged Detects				1.331			SD of Logged Detects				1.179
1763												
1764	**Normal GOF Test on Detects Only**											
1765	Shapiro Wilk Test Statistic				0.283			**Normal GOF Test on Detected Observations Only**				
1766	5% Shapiro Wilk P Value				0			Detected Data Not Normal at 5% Significance Level				
1767	Lilliefors Test Statistic				0.383			**Lilliefors GOF Test**				
1768	5% Lilliefors Critical Value				0.0775			Detected Data Not Normal at 5% Significance Level				
1769	**Detected Data Not Normal at 5% Significance Level**											
1770												
1771	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1772	KM Mean				9.614			KM Standard Error of Mean				2.684
1773	KM SD				32.97			95% KM (BCA) UCL				14.37
1774	95% KM (t) UCL				14.06			95% KM (Percentile Bootstrap) UCL				14.4
1775	95% KM (z) UCL				14.03			95% KM Bootstrap t UCL				18.81
1776	90% KM Chebyshev UCL				17.67			95% KM Chebyshev UCL				21.31
1777	97.5% KM Chebyshev UCL				26.38			99% KM Chebyshev UCL				36.32
1778												
1779	**Gamma GOF Tests on Detected Observations Only**											
1780	A-D Test Statistic				10.89			**Anderson-Darling GOF Test**				
1781	5% A-D Critical Value				0.812			Detected Data Not Gamma Distributed at 5% Significance Level				
1782	K-S Test Statistic				0.203			**Kolmogorov-Smirnov GOF**				
1783	5% K-S Critical Value				0.0854			Detected Data Not Gamma Distributed at 5% Significance Level				
1784	**Detected Data Not Gamma Distributed at 5% Significance Level**											
1785												
1786	**Gamma Statistics on Detected Data Only**											
1787	k hat (MLE)				0.579			k star (bias corrected MLE)				0.571
1788	Theta hat (MLE)				19.11			Theta star (bias corrected MLE)				19.38
1789	nu hat (MLE)				152.9			nu star (bias corrected)				150.7
1790	Mean (detects)				11.07							
1791												
1792	**Gamma ROS Statistics using Imputed Non-Detects**											
1793	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1794	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)											
1795	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1796	This is especially true when the sample size is small.											
1797	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1798	Minimum				0.01			Mean				9.612
1799	Maximum				286			Median				2.695
1800	SD				33.07			CV				3.441
1801	k hat (MLE)				0.386			k star (bias corrected MLE)				0.383
1802	Theta hat (MLE)				24.88			Theta star (bias corrected MLE)				25.09
1803	nu hat (MLE)				117.4			nu star (bias corrected)				116.5
1804	Adjusted Level of Significance (β)				0.0484							
1805	Approximate Chi Square Value (116.46, α)				92.55			Adjusted Chi Square Value (116.46, β)				92.34
1806	95% Gamma Approximate UCL (use when n>=50)				12.1			95% Gamma Adjusted UCL (use when n<50)				12.12
1807												
1808	**Estimates of Gamma Parameters using KM Estimates**											
1809	Mean (KM)				9.614			SD (KM)				32.97

1810					Variance (KM)	1087					SE of Mean (KM)	2.684
1811					k hat (KM)	0.0851					k star (KM)	0.0878
1812					nu hat (KM)	25.86					nu star (KM)	26.68
1813					theta hat (KM)	113					theta star (KM)	109.5
1814					80% gamma percentile (KM)	5.425					90% gamma percentile (KM)	24.06
1815					95% gamma percentile (KM)	56.02					99% gamma percentile (KM)	162.9
1816												
1817					**Gamma Kaplan-Meier (KM) Statistics**							
1818					Approximate Chi Square Value (26.68, α)	15.91					Adjusted Chi Square Value (26.68, β)	15.83
1819				5% Gamma Approximate KM-UCL (use when n>=50)		16.13					95% Gamma Adjusted KM-UCL (use when n<50)	16.21
1820												
1821					**Lognormal GOF Test on Detected Observations Only**							
1822					Shapiro Wilk Approximate Test Statistic	0.922					**Shapiro Wilk GOF Test**	
1823					5% Shapiro Wilk P Value	1.2169E-8					Detected Data Not Lognormal at 5% Significance Level	
1824					Lilliefors Test Statistic	0.103					**Lilliefors GOF Test**	
1825					5% Lilliefors Critical Value	0.0775					Detected Data Not Lognormal at 5% Significance Level	
1826					**Detected Data Not Lognormal at 5% Significance Level**							
1827												
1828					**Lognormal ROS Statistics Using Imputed Non-Detects**							
1829					Mean in Original Scale	9.649					Mean in Log Scale	0.982
1830					SD in Original Scale	33.06					SD in Log Scale	1.431
1831					95% t UCL (assumes normality of ROS data)	14.09					95% Percentile Bootstrap UCL	14.53
1832					95% BCA Bootstrap UCL	15.64					95% Bootstrap t UCL	24.49
1833					95% H-UCL (Log ROS)	10.1						
1834												
1835					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
1836					KM Mean (logged)	0.695					KM Geo Mean	2.003
1837					KM SD (logged)	1.968					95% Critical H Value (KM-Log)	3.258
1838					KM Standard Error of Mean (logged)	0.16					95% H-UCL (KM -Log)	23.39
1839					KM SD (logged)	1.968					95% Critical H Value (KM-Log)	3.258
1840					KM Standard Error of Mean (logged)	0.16						
1841												
1842					**DL/2 Statistics**							
1843					**DL/2 Normal**						**DL/2 Log-Transformed**	
1844					Mean in Original Scale	9.637					Mean in Log Scale	0.9
1845					SD in Original Scale	33.07					SD in Log Scale	1.616
1846					95% t UCL (Assumes normality)	14.08					95% H-Stat UCL	13.18
1847					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
1848												
1849					**Nonparametric Distribution Free UCL Statistics**							
1850					**Data do not follow a Discernible Distribution at 5% Significance Level**							
1851												
1852					**Suggested UCL to Use**							
1853					95% KM (Chebyshev) UCL	21.31						
1854												
1855	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1856	Recommendations are based upon data size, data distribution, and skewness.											
1857	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1858	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1859												
1860	**Result (eu7_manganese)**											
1861												
1862					**General Statistics**							
1863					Total Number of Observations	152					Number of Distinct Observations	130
1864					Number of Detects	141					Number of Non-Detects	11
1865					Number of Distinct Detects	129					Number of Distinct Non-Detects	1
1866					Minimum Detect	2.05					Minimum Non-Detect	2
1867					Maximum Detect	5840					Maximum Non-Detect	2
1868					Variance Detects	1015815					Percent Non-Detects	7.237%
1869					Mean Detects	535.1					SD Detects	1008
1870					Median Detects	296					CV Detects	1.883
1871					Skewness Detects	3.992					Kurtosis Detects	15.91
1872					Mean of Logged Detects	5.321					SD of Logged Detects	1.659
1873												
1874					**Normal GOF Test on Detects Only**							
1875					Shapiro Wilk Test Statistic	0.442					**Normal GOF Test on Detected Observations Only**	
1876					5% Shapiro Wilk P Value	0					Detected Data Not Normal at 5% Significance Level	

1877					Lilliefors Test Statistic	0.363	**Lilliefors GOF Test**					
1878					5% Lilliefors Critical Value	0.075	Detected Data Not Normal at 5% Significance Level					
1879	**Detected Data Not Normal at 5% Significance Level**											
1880												
1881	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
1882					KM Mean	496.5	KM Standard Error of Mean	79.53				
1883					KM SD	977.1	95% KM (BCA) UCL	650.4				
1884					95% KM (t) UCL	628.2	95% KM (Percentile Bootstrap) UCL	635.9				
1885					95% KM (z) UCL	627.4	95% KM Bootstrap t UCL	675.2				
1886					90% KM Chebyshev UCL	735.1	95% KM Chebyshev UCL	843.2				
1887					97.5% KM Chebyshev UCL	993.2	99% KM Chebyshev UCL	1288				
1888												
1889	**Gamma GOF Tests on Detected Observations Only**											
1890					A-D Test Statistic	8.116	**Anderson-Darling GOF Test**					
1891					5% A-D Critical Value	0.806	Detected Data Not Gamma Distributed at 5% Significance Level					
1892					K-S Test Statistic	0.206	**Kolmogorov-Smirnov GOF**					
1893					5% K-S Critical Value	0.0826	Detected Data Not Gamma Distributed at 5% Significance Level					
1894	**Detected Data Not Gamma Distributed at 5% Significance Level**											
1895												
1896	**Gamma Statistics on Detected Data Only**											
1897					k hat (MLE)	0.637	k star (bias corrected MLE)	0.628				
1898					Theta hat (MLE)	840	Theta star (bias corrected MLE)	851.8				
1899					nu hat (MLE)	179.6	nu star (bias corrected)	177.1				
1900					Mean (detects)	535.1						
1901												
1902	**Gamma ROS Statistics using Imputed Non-Detects**											
1903	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
1904	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)											
1905	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
1906	This is especially true when the sample size is small.											
1907	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
1908					Minimum	0.01	Mean	496.4				
1909					Maximum	5840	Median	280.5				
1910					SD	980.4	CV	1.975				
1911					k hat (MLE)	0.409	k star (bias corrected MLE)	0.405				
1912					Theta hat (MLE)	1215	Theta star (bias corrected MLE)	1226				
1913					nu hat (MLE)	124.2	nu star (bias corrected)	123.1				
1914					Adjusted Level of Significance (β)	0.0484						
1915					Approximate Chi Square Value (123.11, α)	98.49	Adjusted Chi Square Value (123.11, β)	98.28				
1916					95% Gamma Approximate UCL (use when n>=50)	620.5	95% Gamma Adjusted UCL (use when n<50)	621.8				
1917												
1918	**Estimates of Gamma Parameters using KM Estimates**											
1919					Mean (KM)	496.5	SD (KM)	977.1				
1920					Variance (KM)	954698	SE of Mean (KM)	79.53				
1921					k hat (KM)	0.258	k star (KM)	0.258				
1922					nu hat (KM)	78.51	nu star (KM)	78.29				
1923					theta hat (KM)	1923	theta star (KM)	1928				
1924					80% gamma percentile (KM)	728.6	90% gamma percentile (KM)	1487				
1925					95% gamma percentile (KM)	2382	99% gamma percentile (KM)	4755				
1926												
1927	**Gamma Kaplan-Meier (KM) Statistics**											
1928					Approximate Chi Square Value (78.29, α)	58.9	Adjusted Chi Square Value (78.29, β)	58.74				
1929	5% Gamma Approximate KM-UCL (use when n>=50)					659.9	95% Gamma Adjusted KM-UCL (use when n<50)	661.7				
1930												
1931	**Lognormal GOF Test on Detected Observations Only**											
1932					Shapiro Wilk Approximate Test Statistic	0.823	**Shapiro Wilk GOF Test**					
1933					5% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 5% Significance Level					
1934					Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**					
1935					5% Lilliefors Critical Value	0.075	Detected Data Not Lognormal at 5% Significance Level					
1936	**Detected Data Not Lognormal at 5% Significance Level**											
1937												
1938	**Lognormal ROS Statistics Using Imputed Non-Detects**											
1939					Mean in Original Scale	496.9	Mean in Log Scale	5.073				
1940					SD in Original Scale	980.1	SD in Log Scale	1.833				
1941					95% t UCL (assumes normality of ROS data)	628.5	95% Percentile Bootstrap UCL	629.7				
1942					95% BCA Bootstrap UCL	662.8	95% Bootstrap t UCL	667				
1943					95% H-UCL (Log ROS)	1361						

1944												
1945	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
1946					KM Mean (logged)	4.986			KM Geo Mean	146.4		
1947					KM SD (logged)	1.993			95% Critical H Value (KM-Log)	3.289		
1948					KM Standard Error of Mean (logged)	0.162			95% H-UCL (KM -Log)	1818		
1949					KM SD (logged)	1.993			95% Critical H Value (KM-Log)	3.289		
1950					KM Standard Error of Mean (logged)	0.162						
1951												
1952	**DL/2 Statistics**											
1953	**DL/2 Normal**								**DL/2 Log-Transformed**			
1954					Mean in Original Scale	496.5			Mean in Log Scale	4.936		
1955					SD in Original Scale	980.4			SD in Log Scale	2.113		
1956					95% t UCL (Assumes normality)	628.1			95% H-Stat UCL	2342		
1957	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
1958												
1959	**Nonparametric Distribution Free UCL Statistics**											
1960	**Data do not follow a Discernible Distribution at 5% Significance Level**											
1961												
1962	**Suggested UCL to Use**											
1963					95% KM (Chebyshev) UCL	843.2						
1964												
1965	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1966	Recommendations are based upon data size, data distribution, and skewness.											
1967	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1968	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
1969												
1970												
1971	**Result (eu7_strontium)**											
1972												
1973	**General Statistics**											
1974					Total Number of Observations	67			Number of Distinct Observations	65		
1975									Number of Missing Observations	0		
1976					Minimum	95.4			Mean	426.4		
1977					Maximum	2100			Median	366		
1978					SD	364.1			Std. Error of Mean	44.48		
1979					Coefficient of Variation	0.854			Skewness	2.936		
1980												
1981	**Normal GOF Test**											
1982					Shapiro Wilk Test Statistic	0.705			**Shapiro Wilk GOF Test**			
1983					5% Shapiro Wilk P Value	0			Data Not Normal at 5% Significance Level			
1984					Lilliefors Test Statistic	0.207			**Lilliefors GOF Test**			
1985					5% Lilliefors Critical Value	0.108			Data Not Normal at 5% Significance Level			
1986	**Data Not Normal at 5% Significance Level**											
1987												
1988	**Assuming Normal Distribution**											
1989	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
1990					95% Student's-t UCL	500.6			95% Adjusted-CLT UCL (Chen-1995)	516.7		
1991									95% Modified-t UCL (Johnson-1978)	503.3		
1992												
1993	**Gamma GOF Test**											
1994					A-D Test Statistic	1.142			**Anderson-Darling Gamma GOF Test**			
1995					5% A-D Critical Value	0.762			Data Not Gamma Distributed at 5% Significance Level			
1996					K-S Test Statistic	0.107			**Kolmogorov-Smirnov Gamma GOF Test**			
1997					5% K-S Critical Value	0.11			Detected data appear Gamma Distributed at 5% Significance Lev			
1998	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
1999												
2000	**Gamma Statistics**											
2001					k hat (MLE)	2.212			k star (bias corrected MLE)	2.123		
2002					Theta hat (MLE)	192.8			Theta star (bias corrected MLE)	200.9		
2003					nu hat (MLE)	296.4			nu star (bias corrected)	284.4		
2004					MLE Mean (bias corrected)	426.4			MLE Sd (bias corrected)	292.7		
2005									Approximate Chi Square Value (0.05)	246.4		
2006					Adjusted Level of Significance	0.0464			Adjusted Chi Square Value	245.6		
2007												
2008	**Assuming Gamma Distribution**											
2009	95% Approximate Gamma UCL (use when n>=50)					492.3			95% Adjusted Gamma UCL (use when n<50)	493.9		
2010												

2011	**Lognormal GOF Test**											
2012					Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**					
2013					5% Shapiro Wilk P Value	0.107	Data appear Lognormal at 5% Significance Level					
2014					Lilliefors Test Statistic	0.0824	**Lilliefors Lognormal GOF Test**					
2015					5% Lilliefors Critical Value	0.108	Data appear Lognormal at 5% Significance Level					
2016	**Data appear Lognormal at 5% Significance Level**											
2017												
2018	**Lognormal Statistics**											
2019					Minimum of Logged Data	4.558	Mean of logged Data	5.813				
2020					Maximum of Logged Data	7.65	SD of logged Data	0.676				
2021												
2022	**Assuming Lognormal Distribution**											
2023					95% H-UCL	496.1	90% Chebyshev (MVUE) UCL	531.8				
2024					95% Chebyshev (MVUE) UCL	583.2	97.5% Chebyshev (MVUE) UCL	654.4				
2025					99% Chebyshev (MVUE) UCL	794.3						
2026												
2027	**Nonparametric Distribution Free UCL Statistics**											
2028	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
2029												
2030	**Nonparametric Distribution Free UCLs**											
2031					95% CLT UCL	499.6	95% Jackknife UCL	500.6				
2032					95% Standard Bootstrap UCL	499.4	95% Bootstrap-t UCL	524.2				
2033					95% Hall's Bootstrap UCL	573.3	95% Percentile Bootstrap UCL	504.1				
2034					95% BCA Bootstrap UCL	516.7						
2035					90% Chebyshev(Mean, Sd) UCL	559.9	95% Chebyshev(Mean, Sd) UCL	620.3				
2036					97.5% Chebyshev(Mean, Sd) UCL	704.2	99% Chebyshev(Mean, Sd) UCL	869				
2037												
2038	**Suggested UCL to Use**											
2039					95% Approximate Gamma UCL	492.3						
2040												
2041	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
2042	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
2043												
2044	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2045	Recommendations are based upon data size, data distribution, and skewness.											
2046	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2047	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2048												
2049	**Result (eu7_thallium)**											
2050												
2051	**General Statistics**											
2052					Total Number of Observations	150	Number of Distinct Observations	28				
2053					Number of Detects	25	Number of Non-Detects	125				
2054					Number of Distinct Detects	25	Number of Distinct Non-Detects	3				
2055					Minimum Detect	5.81	Minimum Non-Detect	0.031				
2056					Maximum Detect	28.3	Maximum Non-Detect	5				
2057					Variance Detects	20.15	Percent Non-Detects	83.33%				
2058					Mean Detects	9.604	SD Detects	4.489				
2059					Median Detects	8.43	CV Detects	0.467				
2060					Skewness Detects	3.208	Kurtosis Detects	12.86				
2061					Mean of Logged Detects	2.195	SD of Logged Detects	0.343				
2062												
2063	**Normal GOF Test on Detects Only**											
2064					Shapiro Wilk Test Statistic	0.665	**Shapiro Wilk GOF Test**					
2065					5% Shapiro Wilk Critical Value	0.918	Detected Data Not Normal at 5% Significance Level					
2066					Lilliefors Test Statistic	0.221	**Lilliefors GOF Test**					
2067					5% Lilliefors Critical Value	0.173	Detected Data Not Normal at 5% Significance Level					
2068	**Detected Data Not Normal at 5% Significance Level**											
2069												
2070	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2071					KM Mean	1.627	KM Standard Error of Mean	0.333				
2072					KM SD	3.994	95% KM (BCA) UCL	2.19				
2073					95% KM (t) UCL	2.177	95% KM (Percentile Bootstrap) UCL	2.195				
2074					95% KM (z) UCL	2.174	95% KM Bootstrap t UCL	2.245				
2075					90% KM Chebyshev UCL	2.625	95% KM Chebyshev UCL	3.077				
2076					97.5% KM Chebyshev UCL	3.705	99% KM Chebyshev UCL	4.938				
2077												

	A	B	C	D	E	F	G	H	I	J	K	L
2078	**Gamma GOF Tests on Detected Observations Only**											
2079					A-D Test Statistic	1.038	**Anderson-Darling GOF Test**					
2080					5% A-D Critical Value	0.746	Detected Data Not Gamma Distributed at 5% Significance Level					
2081					K-S Test Statistic	0.185	**Kolmogorov-Smirnov GOF**					
2082					5% K-S Critical Value	0.175	Detected Data Not Gamma Distributed at 5% Significance Level					
2083	**Detected Data Not Gamma Distributed at 5% Significance Level**											
2084												
2085	**Gamma Statistics on Detected Data Only**											
2086					k hat (MLE)	7.578	k star (bias corrected MLE)					6.695
2087					Theta hat (MLE)	1.267	Theta star (bias corrected MLE)					1.435
2088					nu hat (MLE)	378.9	nu star (bias corrected)					334.8
2089					Mean (detects)	9.604						
2090												
2091	**Gamma ROS Statistics using Imputed Non-Detects**											
2092	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2093	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)											
2094	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2095	This is especially true when the sample size is small.											
2096	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2097					Minimum	0.01	Mean					1.98
2098					Maximum	28.3	Median					0.01
2099					SD	3.981	CV					2.011
2100					k hat (MLE)	0.223	k star (bias corrected MLE)					0.223
2101					Theta hat (MLE)	8.887	Theta star (bias corrected MLE)					8.888
2102					nu hat (MLE)	66.82	nu star (bias corrected)					66.82
2103					Adjusted Level of Significance (β)	0.0484						
2104					Approximate Chi Square Value (66.82, α)	49.01	Adjusted Chi Square Value (66.82, β)					48.86
2105					95% Gamma Approximate UCL (use when n>=50)	2.699	95% Gamma Adjusted UCL (use when n<50)					2.707
2106												
2107	**Estimates of Gamma Parameters using KM Estimates**											
2108					Mean (KM)	1.627	SD (KM)					3.994
2109					Variance (KM)	15.95	SE of Mean (KM)					0.333
2110					k hat (KM)	0.166	k star (KM)					0.167
2111					nu hat (KM)	49.75	nu star (KM)					50.09
2112					theta hat (KM)	9.808	theta star (KM)					9.742
2113					80% gamma percentile (KM)	1.92	90% gamma percentile (KM)					4.881
2114					95% gamma percentile (KM)	8.755	99% gamma percentile (KM)					19.76
2115												
2116	**Gamma Kaplan-Meier (KM) Statistics**											
2117					Approximate Chi Square Value (50.09, α)	34.84	Adjusted Chi Square Value (50.09, β)					34.72
2118	5% Gamma Approximate KM-UCL (use when n>=50)					2.339	95% Gamma Adjusted KM-UCL (use when n<50)					2.347
2119												
2120	**Lognormal GOF Test on Detected Observations Only**											
2121					Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk GOF Test**					
2122					5% Shapiro Wilk Critical Value	0.918	Detected Data Not Lognormal at 5% Significance Level					
2123					Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**					
2124					5% Lilliefors Critical Value	0.173	Detected Data appear Lognormal at 5% Significance Level					
2125	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
2126												
2127	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2128					Mean in Original Scale	3.66	Mean in Log Scale					0.979
2129					SD in Original Scale	3.447	SD in Log Scale					0.795
2130					95% t UCL (assumes normality of ROS data)	4.126	95% Percentile Bootstrap UCL					4.127
2131					95% BCA Bootstrap UCL	4.199	95% Bootstrap t UCL					4.256
2132					95% H-UCL (Log ROS)	4.168						
2133												
2134	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2135					KM Mean (logged)	-2.529	KM Geo Mean					0.0797
2136					KM SD (logged)	2.117	95% Critical H Value (KM-Log)					3.438
2137					KM Standard Error of Mean (logged)	0.176	95% H-UCL (KM -Log)					1.361
2138					KM SD (logged)	2.117	95% Critical H Value (KM-Log)					3.438
2139					KM Standard Error of Mean (logged)	0.176						
2140												
2141	**DL/2 Statistics**											
2142	**DL/2 Normal**						**DL/2 Log-Transformed**					
2143					Mean in Original Scale	3.252	Mean in Log Scale					0.667
2144					SD in Original Scale	3.446	SD in Log Scale					1.379

2145				95% t UCL (Assumes normality)		3.717				95% H-Stat UCL		6.748
2146	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
2147												
2148	**Nonparametric Distribution Free UCL Statistics**											
2149	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**											
2150												
2151	**Suggested UCL to Use**											
2152				KM Student's t		0.0971				KM H-UCL		1.361
2153												
2154	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2155	Recommendations are based upon data size, data distribution, and skewness.											
2156	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2157	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2158												
2159	**Result (eu7_zinc)**											
2160												
2161	**General Statistics**											
2162				Total Number of Observations		152				Number of Distinct Observations		124
2163				Number of Detects		151				Number of Non-Detects		1
2164				Number of Distinct Detects		123				Number of Distinct Non-Detects		1
2165				Minimum Detect		11.9				Minimum Non-Detect		10
2166				Maximum Detect		12400				Maximum Non-Detect		10
2167				Variance Detects		3018501				Percent Non-Detects		0.658%
2168				Mean Detects		575.2				SD Detects		1737
2169				Median Detects		279				CV Detects		3.021
2170				Skewness Detects		5.827				Kurtosis Detects		34.11
2171				Mean of Logged Detects		5.413				SD of Logged Detects		1.15
2172												
2173	**Normal GOF Test on Detects Only**											
2174				Shapiro Wilk Test Statistic		0.265				**Normal GOF Test on Detected Observations Only**		
2175				5% Shapiro Wilk P Value		0				Detected Data Not Normal at 5% Significance Level		
2176				Lilliefors Test Statistic		0.434				**Lilliefors GOF Test**		
2177				5% Lilliefors Critical Value		0.0725				Detected Data Not Normal at 5% Significance Level		
2178	**Detected Data Not Normal at 5% Significance Level**											
2179												
2180	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2181				KM Mean		571.5				KM Standard Error of Mean		140.5
2182				KM SD		1727				95% KM (BCA) UCL		815
2183				95% KM (t) UCL		804				95% KM (Percentile Bootstrap) UCL		818.8
2184				95% KM (z) UCL		802.6				95% KM Bootstrap t UCL		967.5
2185				90% KM Chebyshev UCL		993				95% KM Chebyshev UCL		1184
2186				97.5% KM Chebyshev UCL		1449				99% KM Chebyshev UCL		1969
2187												
2188	**Gamma GOF Tests on Detected Observations Only**											
2189				A-D Test Statistic		17.37				**Anderson-Darling GOF Test**		
2190				5% A-D Critical Value		0.805				Detected Data Not Gamma Distributed at 5% Significance Level		
2191				K-S Test Statistic		0.332				**Kolmogorov-Smirnov GOF**		
2192				5% K-S Critical Value		0.0799				Detected Data Not Gamma Distributed at 5% Significance Level		
2193	**Detected Data Not Gamma Distributed at 5% Significance Level**											
2194												
2195	**Gamma Statistics on Detected Data Only**											
2196				k hat (MLE)		0.649				k star (bias corrected MLE)		0.64
2197				Theta hat (MLE)		886.4				Theta star (bias corrected MLE)		898.2
2198				nu hat (MLE)		196				nu star (bias corrected)		193.4
2199				Mean (detects)		575.2						
2200												
2201	**Gamma ROS Statistics using Imputed Non-Detects**											
2202	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2203	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)											
2204	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2205	This is especially true when the sample size is small.											
2206	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2207				Minimum		0.01				Mean		571.4
2208				Maximum		12400				Median		275.5
2209				SD		1732				CV		3.032
2210				k hat (MLE)		0.615				k star (bias corrected MLE)		0.607
2211				Theta hat (MLE)		928.9				Theta star (bias corrected MLE)		940.7

2212					nu hat (MLE)	187				nu star (bias corrected)		184.6
2213					Adjusted Level of Significance (β)	0.0484						
2214					Approximate Chi Square Value (184.65, α)	154.2				Adjusted Chi Square Value (184.65, β)		154
2215					95% Gamma Approximate UCL (use when n>=50)	684.2				95% Gamma Adjusted UCL (use when n<50)		685.3
2216												
2217					**Estimates of Gamma Parameters using KM Estimates**							
2218					Mean (KM)	571.5				SD (KM)		1727
2219					Variance (KM)	2980872				SE of Mean (KM)		140.5
2220					k hat (KM)	0.11				k star (KM)		0.112
2221					nu hat (KM)	33.31				nu star (KM)		33.98
2222					theta hat (KM)	5216				theta star (KM)		5112
2223					80% gamma percentile (KM)	460.7				90% gamma percentile (KM)		1585
2224					95% gamma percentile (KM)	3288				99% gamma percentile (KM)		8580
2225												
2226					**Gamma Kaplan-Meier (KM) Statistics**							
2227					Approximate Chi Square Value (33.98, α)	21.65				Adjusted Chi Square Value (33.98, β)		21.56
2228	5% Gamma Approximate KM-UCL (use when n>=50)					897				95% Gamma Adjusted KM-UCL (use when n<50)		900.9
2229												
2230					**Lognormal GOF Test on Detected Observations Only**							
2231					Shapiro Wilk Approximate Test Statistic	0.862				**Shapiro Wilk GOF Test**		
2232					5% Shapiro Wilk P Value	0				Detected Data Not Lognormal at 5% Significance Level		
2233					Lilliefors Test Statistic	0.202				**Lilliefors GOF Test**		
2234					5% Lilliefors Critical Value	0.0725				Detected Data Not Lognormal at 5% Significance Level		
2235					**Detected Data Not Lognormal at 5% Significance Level**							
2236												
2237					**Lognormal ROS Statistics Using Imputed Non-Detects**							
2238					Mean in Original Scale	571.5				Mean in Log Scale		5.393
2239					SD in Original Scale	1732				SD in Log Scale		1.172
2240					95% t UCL (assumes normality of ROS data)	804				95% Percentile Bootstrap UCL		817.5
2241					95% BCA Bootstrap UCL	881.1				95% Bootstrap t UCL		996.2
2242					95% H-UCL (Log ROS)	547.8						
2243												
2244					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
2245					KM Mean (logged)	5.393				KM Geo Mean		219.8
2246					KM SD (logged)	1.169				95% Critical H Value (KM-Log)		2.366
2247					KM Standard Error of Mean (logged)	0.0952				95% H-UCL (KM -Log)		545.5
2248					KM SD (logged)	1.169				95% Critical H Value (KM-Log)		2.366
2249					KM Standard Error of Mean (logged)	0.0952						
2250												
2251					**DL/2 Statistics**							
2252					**DL/2 Normal**					**DL/2 Log-Transformed**		
2253					Mean in Original Scale	571.4				Mean in Log Scale		5.388
2254					SD in Original Scale	1732				SD in Log Scale		1.187
2255					95% t UCL (Assumes normality)	804				95% H-Stat UCL		557
2256					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
2257												
2258					**Nonparametric Distribution Free UCL Statistics**							
2259					**Data do not follow a Discernible Distribution at 5% Significance Level**							
2260												
2261					**Suggested UCL to Use**							
2262					95% KM (Chebyshev) UCL	1184						
2263												
2264	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2265	Recommendations are based upon data size, data distribution, and skewness.											
2266	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2267	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2268												
2269	**Result (eu8_aluminum)**											
2270												
2271					**General Statistics**							
2272					Total Number of Observations	149				Number of Distinct Observations		141
2273					Number of Detects	146				Number of Non-Detects		3
2274					Number of Distinct Detects	139				Number of Distinct Non-Detects		2
2275					Minimum Detect	29				Minimum Non-Detect		0.7
2276					Maximum Detect	9350				Maximum Non-Detect		20
2277					Variance Detects	3499949				Percent Non-Detects		2.013%
2278					Mean Detects	1452				SD Detects		1871

2279					Median Detects	775.5					CV Detects	1.289
2280					Skewness Detects	2.228					Kurtosis Detects	5.303
2281					Mean of Logged Detects	6.486					SD of Logged Detects	1.37
2282												
2283					**Normal GOF Test on Detects Only**							
2284					Shapiro Wilk Test Statistic	0.717					**Normal GOF Test on Detected Observations Only**	
2285					5% Shapiro Wilk P Value	0					Detected Data Not Normal at 5% Significance Level	
2286					Lilliefors Test Statistic	0.223					**Lilliefors GOF Test**	
2287					5% Lilliefors Critical Value	0.0737					Detected Data Not Normal at 5% Significance Level	
2288					**Detected Data Not Normal at 5% Significance Level**							
2289												
2290					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
2291					KM Mean	1423					KM Standard Error of Mean	152.6
2292					KM SD	1857					95% KM (BCA) UCL	1682
2293					95% KM (t) UCL	1675					95% KM (Percentile Bootstrap) UCL	1691
2294					95% KM (z) UCL	1674					95% KM Bootstrap t UCL	1702
2295					90% KM Chebyshev UCL	1880					95% KM Chebyshev UCL	2088
2296					97.5% KM Chebyshev UCL	2376					99% KM Chebyshev UCL	2941
2297												
2298					**Gamma GOF Tests on Detected Observations Only**							
2299					A-D Test Statistic	1.587					**Anderson-Darling GOF Test**	
2300					5% A-D Critical Value	0.795					Detected Data Not Gamma Distributed at 5% Significance Level	
2301					K-S Test Statistic	0.0882					**Kolmogorov-Smirnov GOF**	
2302					5% K-S Critical Value	0.0806					Detected Data Not Gamma Distributed at 5% Significance Level	
2303					**Detected Data Not Gamma Distributed at 5% Significance Level**							
2304												
2305					**Gamma Statistics on Detected Data Only**							
2306					k hat (MLE)	0.753					k star (bias corrected MLE)	0.742
2307					Theta hat (MLE)	1927					Theta star (bias corrected MLE)	1955
2308					nu hat (MLE)	220					nu star (bias corrected)	216.8
2309					Mean (detects)	1452						
2310												
2311					**Gamma ROS Statistics using Imputed Non-Detects**							
2312					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
2313					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)							
2314					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
2315					This is especially true when the sample size is small.							
2316					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
2317					Minimum	0.01					Mean	1423
2318					Maximum	9350					Median	741
2319					SD	1863					CV	1.31
2320					k hat (MLE)	0.617					k star (bias corrected MLE)	0.609
2321					Theta hat (MLE)	2305					Theta star (bias corrected MLE)	2335
2322					nu hat (MLE)	183.9					nu star (bias corrected)	181.5
2323					Adjusted Level of Significance (β)	0.0484						
2324					Approximate Chi Square Value (181.53, α)	151.4					Adjusted Chi Square Value (181.53, β)	151.1
2325					95% Gamma Approximate UCL (use when n>=50)	1706					95% Gamma Adjusted UCL (use when n<50)	1709
2326												
2327					**Estimates of Gamma Parameters using KM Estimates**							
2328					Mean (KM)	1423					SD (KM)	1857
2329					Variance (KM)	3447533					SE of Mean (KM)	152.6
2330					k hat (KM)	0.587					k star (KM)	0.58
2331					nu hat (KM)	174.9					nu star (KM)	172.7
2332					theta hat (KM)	2423					theta star (KM)	2454
2333					80% gamma percentile (KM)	2345					90% gamma percentile (KM)	3728
2334					95% gamma percentile (KM)	5183					99% gamma percentile (KM)	8711
2335												
2336					**Gamma Kaplan-Meier (KM) Statistics**							
2337					Approximate Chi Square Value (172.74, α)	143.3					Adjusted Chi Square Value (172.74, β)	143.1
2338					5% Gamma Approximate KM-UCL (use when n>=50)	1714					95% Gamma Adjusted KM-UCL (use when n<50)	1717
2339												
2340					**Lognormal GOF Test on Detected Observations Only**							
2341					Shapiro Wilk Approximate Test Statistic	0.962					**Shapiro Wilk GOF Test**	
2342					5% Shapiro Wilk P Value	0.00532					Detected Data Not Lognormal at 5% Significance Level	
2343					Lilliefors Test Statistic	0.0654					**Lilliefors GOF Test**	
2344					5% Lilliefors Critical Value	0.0737					Detected Data appear Lognormal at 5% Significance Level	
2345					**Detected Data appear Approximate Lognormal at 5% Significance Level**							

2346												
2347	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2348					Mean in Original Scale	1423			Mean in Log Scale	6.416		
2349					SD in Original Scale	1863			SD in Log Scale	1.442		
2350				95% t UCL (assumes normality of ROS data)		1676			95% Percentile Bootstrap UCL	1692		
2351					95% BCA Bootstrap UCL	1731			95% Bootstrap t UCL	1717		
2352					95% H-UCL (Log ROS)	2368						
2353												
2354	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2355					KM Mean (logged)	6.349			KM Geo Mean	571.7		
2356					KM SD (logged)	1.658			95% Critical H Value (KM-Log)	2.889		
2357					KM Standard Error of Mean (logged)	0.136			95% H-UCL (KM -Log)	3351		
2358					KM SD (logged)	1.658			95% Critical H Value (KM-Log)	2.889		
2359					KM Standard Error of Mean (logged)	0.136						
2360												
2361	**DL/2 Statistics**											
2362	**DL/2 Normal**								**DL/2 Log-Transformed**			
2363					Mean in Original Scale	1423			Mean in Log Scale	6.38		
2364					SD in Original Scale	1863			SD in Log Scale	1.564		
2365					95% t UCL (Assumes normality)	1675			95% H-Stat UCL	2866		
2366	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
2367												
2368	**Nonparametric Distribution Free UCL Statistics**											
2369	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**											
2370												
2371	**Suggested UCL to Use**											
2372					KM H-UCL	3351						
2373												
2374	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2375	Recommendations are based upon data size, data distribution, and skewness.											
2376	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2377	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2378												
2379	**Result (eu8_antimony)**											
2380												
2381	**General Statistics**											
2382					Total Number of Observations	132			Number of Distinct Observations	3		
2383					Number of Detects	0			Number of Non-Detects	132		
2384					Number of Distinct Detects	0			Number of Distinct Non-Detects	3		
2385												
2386	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
2387	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
2388	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
2389												
2390	**The data set for variable Result (eu8_antimony) was not processed!**											
2391												
2392												
2393	**Result (eu8_arsenic)**											
2394												
2395	**General Statistics**											
2396					Total Number of Observations	149			Number of Distinct Observations	43		
2397					Number of Detects	44			Number of Non-Detects	105		
2398					Number of Distinct Detects	41			Number of Distinct Non-Detects	2		
2399					Minimum Detect	0.15			Minimum Non-Detect	0.026		
2400					Maximum Detect	24.6			Maximum Non-Detect	2.5		
2401					Variance Detects	32.72			Percent Non-Detects	70.47%		
2402					Mean Detects	4.643			SD Detects	5.72		
2403					Median Detects	3.19			CV Detects	1.232		
2404					Skewness Detects	2.148			Kurtosis Detects	4.65		
2405					Mean of Logged Detects	0.793			SD of Logged Detects	1.36		
2406												
2407	**Normal GOF Test on Detects Only**											
2408					Shapiro Wilk Test Statistic	0.727			**Shapiro Wilk GOF Test**			
2409					5% Shapiro Wilk Critical Value	0.944			Detected Data Not Normal at 5% Significance Level			
2410					Lilliefors Test Statistic	0.233			**Lilliefors GOF Test**			
2411					5% Lilliefors Critical Value	0.132			Detected Data Not Normal at 5% Significance Level			
2412	**Detected Data Not Normal at 5% Significance Level**											

2413												
2414	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2415					KM Mean	1.771			KM Standard Error of Mean	0.308		
2416					KM SD	3.61			95% KM (BCA) UCL	2.285		
2417					95% KM (t) UCL	2.281			95% KM (Percentile Bootstrap) UCL	2.325		
2418					95% KM (z) UCL	2.277			95% KM Bootstrap t UCL	2.427		
2419					90% KM Chebyshev UCL	2.694			95% KM Chebyshev UCL	3.112		
2420					97.5% KM Chebyshev UCL	3.692			99% KM Chebyshev UCL	4.832		
2421												
2422	**Gamma GOF Tests on Detected Observations Only**											
2423					A-D Test Statistic	0.586			**Anderson-Darling GOF Test**			
2424					5% A-D Critical Value	0.787			Detected data appear Gamma Distributed at 5% Significance Lev			
2425					K-S Test Statistic	0.108			**Kolmogorov-Smirnov GOF**			
2426					5% K-S Critical Value	0.138			Detected data appear Gamma Distributed at 5% Significance Lev			
2427	**Detected data appear Gamma Distributed at 5% Significance Level**											
2428												
2429	**Gamma Statistics on Detected Data Only**											
2430					k hat (MLE)	0.8			k star (bias corrected MLE)	0.76		
2431					Theta hat (MLE)	5.806			Theta star (bias corrected MLE)	6.107		
2432					nu hat (MLE)	70.37			nu star (bias corrected)	66.91		
2433					Mean (detects)	4.643						
2434												
2435	**Gamma ROS Statistics using Imputed Non-Detects**											
2436	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2437	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)											
2438	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2439	This is especially true when the sample size is small.											
2440	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2441					Minimum	0.01			Mean	1.726		
2442					Maximum	24.6			Median	0.148		
2443					SD	3.707			CV	2.147		
2444					k hat (MLE)	0.276			k star (bias corrected MLE)	0.275		
2445					Theta hat (MLE)	6.261			Theta star (bias corrected MLE)	6.285		
2446					nu hat (MLE)	82.18			nu star (bias corrected)	81.85		
2447					Adjusted Level of Significance (β)	0.0484						
2448					Approximate Chi Square Value (81.85, α)	62.01			Adjusted Chi Square Value (81.85, β)	61.84		
2449					95% Gamma Approximate UCL (use when n>=50)	2.279			95% Gamma Adjusted UCL (use when n<50)	2.285		
2450												
2451	**Estimates of Gamma Parameters using KM Estimates**											
2452					Mean (KM)	1.771			SD (KM)	3.61		
2453					Variance (KM)	13.03			SE of Mean (KM)	0.308		
2454					k hat (KM)	0.241			k star (KM)	0.24		
2455					nu hat (KM)	71.74			nu star (KM)	71.63		
2456					theta hat (KM)	7.358			theta star (KM)	7.37		
2457					80% gamma percentile (KM)	2.536			90% gamma percentile (KM)	5.33		
2458					95% gamma percentile (KM)	8.674			99% gamma percentile (KM)	17.62		
2459												
2460	**Gamma Kaplan-Meier (KM) Statistics**											
2461					Approximate Chi Square Value (71.63, α)	53.14			Adjusted Chi Square Value (71.63, β)	52.98		
2462	5% Gamma Approximate KM-UCL (use when n>=50)					2.388			95% Gamma Adjusted KM-UCL (use when n<50)	2.395		
2463												
2464	**Lognormal GOF Test on Detected Observations Only**											
2465					Shapiro Wilk Test Statistic	0.949			**Shapiro Wilk GOF Test**			
2466					5% Shapiro Wilk Critical Value	0.944			Detected Data appear Lognormal at 5% Significance Level			
2467					Lilliefors Test Statistic	0.157			**Lilliefors GOF Test**			
2468					5% Lilliefors Critical Value	0.132			Detected Data Not Lognormal at 5% Significance Level			
2469	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
2470												
2471	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2472					Mean in Original Scale	1.834			Mean in Log Scale	-0.452		
2473					SD in Original Scale	3.621			SD in Log Scale	1.475		
2474					95% t UCL (assumes normality of ROS data)	2.325			95% Percentile Bootstrap UCL	2.372		
2475					95% BCA Bootstrap UCL	2.443			95% Bootstrap t UCL	2.516		
2476					95% H-UCL (Log ROS)	2.614						
2477												
2478	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2479					KM Mean (logged)	-0.554			KM Geo Mean	0.575		

2480				KM SD (logged)	1.58			95% Critical H Value (KM-Log)			2.8
2481			KM Standard Error of Mean (logged)		0.245			95% H-UCL (KM -Log)			2.881
2482				KM SD (logged)	1.58			95% Critical H Value (KM-Log)			2.8
2483			KM Standard Error of Mean (logged)		0.245						
2484											
2485					**DL/2 Statistics**						
2486				**DL/2 Normal**				**DL/2 Log-Transformed**			
2487				Mean in Original Scale	2.227			Mean in Log Scale			0.3
2488				SD in Original Scale	3.464			SD in Log Scale			1.025
2489			95% t UCL (Assumes normality)		2.697			95% H-Stat UCL			2.752
2490					**DL/2 is not a recommended method, provided for comparisons and historical reasons**						
2491											
2492					**Nonparametric Distribution Free UCL Statistics**						
2493					**Detected Data appear Gamma Distributed at 5% Significance Level**						
2494											
2495					**Suggested UCL to Use**						
2496				95% KM Approximate Gamma UCL	2.388						
2497											
2498	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
2499	Recommendations are based upon data size, data distribution, and skewness.										
2500	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).										
2501	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia										
2502											
2503	**Result (eu8_beryllium)**										
2504											
2505					**General Statistics**						
2506				Total Number of Observations	149			Number of Distinct Observations			12
2507				Number of Detects	12			Number of Non-Detects			137
2508				Number of Distinct Detects	10			Number of Distinct Non-Detects			2
2509				Minimum Detect	0.06			Minimum Non-Detect			0.043
2510				Maximum Detect	0.35			Maximum Non-Detect			2
2511				Variance Detects	0.0145			Percent Non-Detects			91.95%
2512				Mean Detects	0.198			SD Detects			0.12
2513				Median Detects	0.22			CV Detects			0.607
2514				Skewness Detects	-0.039			Kurtosis Detects			-2.069
2515				Mean of Logged Detects	-1.84			SD of Logged Detects			0.74
2516											
2517					**Normal GOF Test on Detects Only**						
2518				Shapiro Wilk Test Statistic	0.83			**Shapiro Wilk GOF Test**			
2519				5% Shapiro Wilk Critical Value	0.859			Detected Data Not Normal at 5% Significance Level			
2520				Lilliefors Test Statistic	0.233			**Lilliefors GOF Test**			
2521				5% Lilliefors Critical Value	0.243			Detected Data appear Normal at 5% Significance Level			
2522					**Detected Data appear Approximate Normal at 5% Significance Level**						
2523											
2524					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**						
2525				KM Mean	0.124			KM Standard Error of Mean			0.0248
2526				KM SD	0.114			95% KM (BCA) UCL			0.172
2527				95% KM (t) UCL	0.165			95% KM (Percentile Bootstrap) UCL			0.164
2528				95% KM (z) UCL	0.165			95% KM Bootstrap t UCL			0.175
2529				90% KM Chebyshev UCL	0.198			95% KM Chebyshev UCL			0.232
2530				97.5% KM Chebyshev UCL	0.279			99% KM Chebyshev UCL			0.371
2531											
2532					**Gamma GOF Tests on Detected Observations Only**						
2533				A-D Test Statistic	0.969			**Anderson-Darling GOF Test**			
2534				5% A-D Critical Value	0.741			Detected Data Not Gamma Distributed at 5% Significance Level			
2535				K-S Test Statistic	0.263			**Kolmogorov-Smirnov GOF**			
2536				5% K-S Critical Value	0.248			Detected Data Not Gamma Distributed at 5% Significance Level			
2537					**Detected Data Not Gamma Distributed at 5% Significance Level**						
2538											
2539					**Gamma Statistics on Detected Data Only**						
2540				k hat (MLE)	2.405			k star (bias corrected MLE)			1.859
2541				Theta hat (MLE)	0.0825			Theta star (bias corrected MLE)			0.107
2542				nu hat (MLE)	57.71			nu star (bias corrected)			44.62
2543				Mean (detects)	0.198						
2544											
2545					**Gamma ROS Statistics using Imputed Non-Detects**						
2546	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs										

	A	B	C	D	E	F	G	H	I	J	K	L
2547	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)											
2548	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2549	This is especially true when the sample size is small.											
2550	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2551					Minimum	0.01			Mean			0.115
2552					Maximum	0.631			Median			0.0619
2553					SD	0.131			CV			1.137
2554					k hat (MLE)	0.747			k star (bias corrected MLE)			0.737
2555					Theta hat (MLE)	0.154			Theta star (bias corrected MLE)			0.156
2556					nu hat (MLE)	222.7			nu star (bias corrected)			219.6
2557					Adjusted Level of Significance (β)	0.0484						
2558					Approximate Chi Square Value (219.56, α)	186.3			Adjusted Chi Square Value (219.56, β)			186
2559					95% Gamma Approximate UCL (use when n>=50)	0.136			95% Gamma Adjusted UCL (use when n<50)			0.136
2560												
2561	**Estimates of Gamma Parameters using KM Estimates**											
2562					Mean (KM)	0.124			SD (KM)			0.114
2563					Variance (KM)	0.0129			SE of Mean (KM)			0.0248
2564					k hat (KM)	1.189			k star (KM)			1.17
2565					nu hat (KM)	354.3			nu star (KM)			348.5
2566					theta hat (KM)	0.104			theta star (KM)			0.106
2567					80% gamma percentile (KM)	0.197			90% gamma percentile (KM)			0.275
2568					95% gamma percentile (KM)	0.352			99% gamma percentile (KM)			0.528
2569												
2570	**Gamma Kaplan-Meier (KM) Statistics**											
2571					Approximate Chi Square Value (348.52, α)	306.3			Adjusted Chi Square Value (348.52, β)			305.9
2572	5% Gamma Approximate KM-UCL (use when n>=50)					0.141			95% Gamma Adjusted KM-UCL (use when n<50)			0.141
2573												
2574	**Lognormal GOF Test on Detected Observations Only**											
2575					Shapiro Wilk Test Statistic	0.818			**Shapiro Wilk GOF Test**			
2576					5% Shapiro Wilk Critical Value	0.859			Detected Data Not Lognormal at 5% Significance Level			
2577					Lilliefors Test Statistic	0.263			**Lilliefors GOF Test**			
2578					5% Lilliefors Critical Value	0.243			Detected Data Not Lognormal at 5% Significance Level			
2579	**Detected Data Not Lognormal at 5% Significance Level**											
2580												
2581	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2582					Mean in Original Scale	0.128			Mean in Log Scale			-2.759
2583					SD in Original Scale	0.183			SD in Log Scale			1.22
2584					95% t UCL (assumes normality of ROS data)	0.153			95% Percentile Bootstrap UCL			0.154
2585					95% BCA Bootstrap UCL	0.157			95% Bootstrap t UCL			0.158
2586					95% H-UCL (Log ROS)	0.17						
2587												
2588	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2589					KM Mean (logged)	-2.465			KM Geo Mean			0.085
2590					KM SD (logged)	0.829			95% Critical H Value (KM-Log)			2.057
2591					KM Standard Error of Mean (logged)	0.181			95% H-UCL (KM -Log)			0.138
2592					KM SD (logged)	0.829			95% Critical H Value (KM-Log)			2.057
2593					KM Standard Error of Mean (logged)	0.181						
2594												
2595	**DL/2 Statistics**											
2596	**DL/2 Normal**								**DL/2 Log-Transformed**			
2597					Mean in Original Scale	0.863			Mean in Log Scale			-0.432
2598					SD in Original Scale	0.325			SD in Log Scale			1.106
2599					95% t UCL (Assumes normality)	0.907			95% H-Stat UCL			1.476
2600	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
2601												
2602	**Nonparametric Distribution Free UCL Statistics**											
2603	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**											
2604												
2605	**Suggested UCL to Use**											
2606					95% KM (t) UCL	0.165						
2607												
2608	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
2609	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
2610												
2611	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2612	Recommendations are based upon data size, data distribution, and skewness.											
2613	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

2614	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2615												
2616	**Result (eu8_cadmium)**											
2617												
2618	**General Statistics**											
2619					Total Number of Observations	149			Number of Distinct Observations	89		
2620					Number of Detects	95			Number of Non-Detects	54		
2621					Number of Distinct Detects	89			Number of Distinct Non-Detects	1		
2622					Minimum Detect	0.13			Minimum Non-Detect	0.5		
2623					Maximum Detect	16.4			Maximum Non-Detect	0.5		
2624					Variance Detects	8.077			Percent Non-Detects	36.24%		
2625					Mean Detects	1.869			SD Detects	2.842		
2626					Median Detects	0.899			CV Detects	1.521		
2627					Skewness Detects	3.061			Kurtosis Detects	9.5		
2628					Mean of Logged Detects	0.105			SD of Logged Detects	0.852		
2629												
2630	**Normal GOF Test on Detects Only**											
2631					Shapiro Wilk Test Statistic	0.508			**Normal GOF Test on Detected Observations Only**			
2632					5% Shapiro Wilk P Value	0			Detected Data Not Normal at 5% Significance Level			
2633					Lilliefors Test Statistic	0.383			**Lilliefors GOF Test**			
2634					5% Lilliefors Critical Value	0.0911			Detected Data Not Normal at 5% Significance Level			
2635	**Detected Data Not Normal at 5% Significance Level**											
2636												
2637	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2638					KM Mean	1.238			KM Standard Error of Mean	0.198		
2639					KM SD	2.407			95% KM (BCA) UCL	1.761		
2640					95% KM (t) UCL	1.567			95% KM (Percentile Bootstrap) UCL	1.638		
2641					95% KM (z) UCL	1.565			95% KM Bootstrap t UCL	1.615		
2642					90% KM Chebyshev UCL	1.833			95% KM Chebyshev UCL	2.103		
2643					97.5% KM Chebyshev UCL	2.476			99% KM Chebyshev UCL	3.211		
2644												
2645	**Gamma GOF Tests on Detected Observations Only**											
2646					A-D Test Statistic	12.2			**Anderson-Darling GOF Test**			
2647					5% A-D Critical Value	0.78			Detected Data Not Gamma Distributed at 5% Significance Level			
2648					K-S Test Statistic	0.29			**Kolmogorov-Smirnov GOF**			
2649					5% K-S Critical Value	0.0944			Detected Data Not Gamma Distributed at 5% Significance Level			
2650	**Detected Data Not Gamma Distributed at 5% Significance Level**											
2651												
2652	**Gamma Statistics on Detected Data Only**											
2653					k hat (MLE)	1.098			k star (bias corrected MLE)	1.07		
2654					Theta hat (MLE)	1.702			Theta star (bias corrected MLE)	1.746		
2655					nu hat (MLE)	208.6			nu star (bias corrected)	203.4		
2656					Mean (detects)	1.869						
2657												
2658	**Gamma ROS Statistics using Imputed Non-Detects**											
2659	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2660	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)											
2661	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2662	This is especially true when the sample size is small.											
2663	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2664					Minimum	0.01			Mean	1.195		
2665					Maximum	16.4			Median	0.662		
2666					SD	2.436			CV	2.038		
2667					k hat (MLE)	0.374			k star (bias corrected MLE)	0.371		
2668					Theta hat (MLE)	3.197			Theta star (bias corrected MLE)	3.224		
2669					nu hat (MLE)	111.4			nu star (bias corrected)	110.5		
2670					Adjusted Level of Significance (β)	0.0484						
2671					Approximate Chi Square Value (110.46, α)	87.2			Adjusted Chi Square Value (110.46, β)	87		
2672					95% Gamma Approximate UCL (use when n>=50)	1.514			95% Gamma Adjusted UCL (use when n<50)	1.517		
2673												
2674	**Estimates of Gamma Parameters using KM Estimates**											
2675					Mean (KM)	1.238			SD (KM)	2.407		
2676					Variance (KM)	5.794			SE of Mean (KM)	0.198		
2677					k hat (KM)	0.265			k star (KM)	0.264		
2678					nu hat (KM)	78.89			nu star (KM)	78.63		
2679					theta hat (KM)	4.678			theta star (KM)	4.694		
2680					80% gamma percentile (KM)	1.832			90% gamma percentile (KM)	3.702		

2681					95% gamma percentile (KM)	5.898				99% gamma percentile (KM)		11.7
2682												
2683					**Gamma Kaplan-Meier (KM) Statistics**							
2684					Approximate Chi Square Value (78.63, α)	59.2				Adjusted Chi Square Value (78.63, β)		59.04
2685	5% Gamma Approximate KM-UCL (use when n>=50)					1.645	95% Gamma Adjusted KM-UCL (use when n<50)					1.649
2686												
2687					**Lognormal GOF Test on Detected Observations Only**							
2688					Shapiro Wilk Approximate Test Statistic	0.809	**Shapiro Wilk GOF Test**					
2689					5% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 5% Significance Level					
2690					Lilliefors Test Statistic	0.194	**Lilliefors GOF Test**					
2691					5% Lilliefors Critical Value	0.0911	Detected Data Not Lognormal at 5% Significance Level					
2692					**Detected Data Not Lognormal at 5% Significance Level**							
2693												
2694					**Lognormal ROS Statistics Using Imputed Non-Detects**							
2695					Mean in Original Scale	1.26	Mean in Log Scale					-0.596
2696					SD in Original Scale	2.406	SD in Log Scale					1.214
2697					95% t UCL (assumes normality of ROS data)	1.586	95% Percentile Bootstrap UCL					1.607
2698					95% BCA Bootstrap UCL	1.67	95% Bootstrap t UCL					1.704
2699					95% H-UCL (Log ROS)	1.464						
2700												
2701					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
2702					KM Mean (logged)	-0.672	KM Geo Mean					0.51
2703					KM SD (logged)	1.234	95% Critical H Value (KM-Log)					2.428
2704					KM Standard Error of Mean (logged)	0.102	95% H-UCL (KM -Log)					1.397
2705					KM SD (logged)	1.234	95% Critical H Value (KM-Log)					2.428
2706					KM Standard Error of Mean (logged)	0.102						
2707												
2708					**DL/2 Statistics**							
2709					**DL/2 Normal**		**DL/2 Log-Transformed**					
2710					Mean in Original Scale	1.282	Mean in Log Scale					-0.435
2711					SD in Original Scale	2.396	SD in Log Scale					0.989
2712					95% t UCL (Assumes normality)	1.607	95% H-Stat UCL					1.262
2713					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
2714												
2715					**Nonparametric Distribution Free UCL Statistics**							
2716					**Data do not follow a Discernible Distribution at 5% Significance Level**							
2717												
2718					**Suggested UCL to Use**							
2719					95% KM (Chebyshev) UCL	2.103						
2720												
2721	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2722	Recommendations are based upon data size, data distribution, and skewness.											
2723	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2724	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2725												
2726	**Result (eu8_chromium)**											
2727												
2728					**General Statistics**							
2729					Total Number of Observations	149	Number of Distinct Observations					5
2730					Number of Detects	3	Number of Non-Detects					146
2731					Number of Distinct Detects	3	Number of Distinct Non-Detects					2
2732					Minimum Detect	0.1	Minimum Non-Detect					0.035
2733					Maximum Detect	0.4	Maximum Non-Detect					5
2734					Variance Detects	0.029	Percent Non-Detects					97.99%
2735					Mean Detects	0.203	SD Detects					0.17
2736					Median Detects	0.11	CV Detects					0.838
2737					Skewness Detects	1.725	Kurtosis Detects					N/A
2738					Mean of Logged Detects	-1.809	SD of Logged Detects					0.774
2739												
2740					**Warning: Data set has only 3 Detected Values.**							
2741					**This is not enough to compute meaningful or reliable statistics and estimates.**							
2742												
2743												
2744					**Normal GOF Test on Detects Only**							
2745					Shapiro Wilk Test Statistic	0.775	**Shapiro Wilk GOF Test**					
2746					5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level					
2747					Lilliefors Test Statistic	0.375	**Lilliefors GOF Test**					

2748				5% Lilliefors Critical Value		0.425	Detected Data appear Normal at 5% Significance Level					
2749	**Detected Data appear Normal at 5% Significance Level**											
2750												
2751	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
2752				KM Mean		0.057	KM Standard Error of Mean					0.0193
2753				KM SD		0.0758	95% KM (BCA) UCL					N/A
2754				95% KM (t) UCL		0.089	95% KM (Percentile Bootstrap) UCL					N/A
2755				95% KM (z) UCL		0.0888	95% KM Bootstrap t UCL					N/A
2756				90% KM Chebyshev UCL		0.115	95% KM Chebyshev UCL					0.141
2757				97.5% KM Chebyshev UCL		0.178	99% KM Chebyshev UCL					0.249
2758												
2759	**Gamma GOF Tests on Detected Observations Only**											
2760	**Not Enough Data to Perform GOF Test**											
2761												
2762	**Gamma Statistics on Detected Data Only**											
2763				k hat (MLE)		2.471	k star (bias corrected MLE)					N/A
2764				Theta hat (MLE)		0.0823	Theta star (bias corrected MLE)					N/A
2765				nu hat (MLE)		14.82	nu star (bias corrected)					N/A
2766				Mean (detects)		0.203						
2767												
2768	**Gamma ROS Statistics using Imputed Non-Detects**											
2769	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2770	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)											
2771	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
2772	This is especially true when the sample size is small.											
2773	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2774				Minimum		0.01	Mean					0.0377
2775				Maximum		0.761	Median					0.01
2776				SD		0.103	CV					2.731
2777				k hat (MLE)		0.615	k star (bias corrected MLE)					0.607
2778				Theta hat (MLE)		0.0614	Theta star (bias corrected MLE)					0.0622
2779				nu hat (MLE)		183.3	nu star (bias corrected)					180.9
2780				Adjusted Level of Significance (β)		0.0484						
2781				Approximate Chi Square Value (180.91, α)		150.8	Adjusted Chi Square Value (180.91, β)					150.5
2782				95% Gamma Approximate UCL (use when n>=50)		0.0453	95% Gamma Adjusted UCL (use when n<50)					N/A
2783												
2784	**Estimates of Gamma Parameters using KM Estimates**											
2785				Mean (KM)		0.057	SD (KM)					0.0758
2786				Variance (KM)		0.00574	SE of Mean (KM)					0.0193
2787				k hat (KM)		0.565	k star (KM)					0.558
2788				nu hat (KM)		168.5	nu star (KM)					166.4
2789				theta hat (KM)		0.101	theta star (KM)					0.102
2790				80% gamma percentile (KM)		0.0938	90% gamma percentile (KM)					0.151
2791				95% gamma percentile (KM)		0.21	99% gamma percentile (KM)					0.356
2792												
2793	**Gamma Kaplan-Meier (KM) Statistics**											
2794				Approximate Chi Square Value (166.40, α)		137.6	Adjusted Chi Square Value (166.40, β)					137.3
2795	5% Gamma Approximate KM-UCL (use when n>=50)					0.0689	95% Gamma Adjusted KM-UCL (use when n<50)					0.069
2796												
2797	**Lognormal GOF Test on Detected Observations Only**											
2798				Shapiro Wilk Test Statistic		0.801	**Shapiro Wilk GOF Test**					
2799				5% Shapiro Wilk Critical Value		0.767	Detected Data appear Lognormal at 5% Significance Level					
2800				Lilliefors Test Statistic		0.363	**Lilliefors GOF Test**					
2801				5% Lilliefors Critical Value		0.425	Detected Data appear Lognormal at 5% Significance Level					
2802	**Detected Data appear Lognormal at 5% Significance Level**											
2803												
2804	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2805				Mean in Original Scale		0.0423	Mean in Log Scale					-5.887
2806				SD in Original Scale		0.16	SD in Log Scale					2.532
2807				95% t UCL (assumes normality of ROS data)		0.0639	95% Percentile Bootstrap UCL					0.067
2808				95% BCA Bootstrap UCL		0.0771	95% Bootstrap t UCL					0.0843
2809				95% H-UCL (Log ROS)		0.156						
2810												
2811	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2812				KM Mean (logged)		-3.151	KM Geo Mean					0.0428
2813				KM SD (logged)		0.568	95% Critical H Value (KM-Log)					1.871
2814				KM Standard Error of Mean (logged)		0.145	95% H-UCL (KM -Log)					0.0549

2815				KM SD (logged)	0.568			95% Critical H Value (KM-Log)				1.871
2816				KM Standard Error of Mean (logged)	0.145							
2817												
2818				**DL/2 Statistics**								
2819				**DL/2 Normal**				**DL/2 Log-Transformed**				
2820				Mean in Original Scale	2.121			Mean in Log Scale				0.195
2821				SD in Original Scale	0.892			SD in Log Scale				1.721
2822				95% t UCL (Assumes normality)	2.241			95% H-Stat UCL				8.13
2823				**DL/2 is not a recommended method, provided for comparisons and historical reasons**								
2824												
2825				**Nonparametric Distribution Free UCL Statistics**								
2826				**Detected Data appear Normal Distributed at 5% Significance Level**								
2827												
2828				**Suggested UCL to Use**								
2829				95% KM (t) UCL	0.089							
2830												
2831	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2832	Recommendations are based upon data size, data distribution, and skewness.											
2833	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2834	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2835												
2836	**Result (eu8_cobalt)**											
2837												
2838				**General Statistics**								
2839				Total Number of Observations	50			Number of Distinct Observations				37
2840				Number of Detects	38			Number of Non-Detects				12
2841				Number of Distinct Detects	36			Number of Distinct Non-Detects				1
2842				Minimum Detect	0.06			Minimum Non-Detect				0.5
2843				Maximum Detect	27			Maximum Non-Detect				0.5
2844				Variance Detects	54.52			Percent Non-Detects				24%
2845				Mean Detects	6.366			SD Detects				7.384
2846				Median Detects	2.41			CV Detects				1.16
2847				Skewness Detects	1.519			Kurtosis Detects				1.761
2848				Mean of Logged Detects	1.034			SD of Logged Detects				1.475
2849												
2850				**Normal GOF Test on Detects Only**								
2851				Shapiro Wilk Test Statistic	0.779			**Shapiro Wilk GOF Test**				
2852				5% Shapiro Wilk Critical Value	0.938			Detected Data Not Normal at 5% Significance Level				
2853				Lilliefors Test Statistic	0.227			**Lilliefors GOF Test**				
2854				5% Lilliefors Critical Value	0.142			Detected Data Not Normal at 5% Significance Level				
2855				**Detected Data Not Normal at 5% Significance Level**								
2856												
2857				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
2858				KM Mean	4.903			KM Standard Error of Mean				0.984
2859				KM SD	6.864			95% KM (BCA) UCL				6.584
2860				95% KM (t) UCL	6.553			95% KM (Percentile Bootstrap) UCL				6.584
2861				95% KM (z) UCL	6.522			95% KM Bootstrap t UCL				6.949
2862				90% KM Chebyshev UCL	7.856			95% KM Chebyshev UCL				9.193
2863				97.5% KM Chebyshev UCL	11.05			99% KM Chebyshev UCL				14.69
2864												
2865				**Gamma GOF Tests on Detected Observations Only**								
2866				A-D Test Statistic	0.656			**Anderson-Darling GOF Test**				
2867				5% A-D Critical Value	0.79			Detected data appear Gamma Distributed at 5% Significance Lev				
2868				K-S Test Statistic	0.14			**Kolmogorov-Smirnov GOF**				
2869				5% K-S Critical Value	0.149			Detected data appear Gamma Distributed at 5% Significance Lev				
2870				**Detected data appear Gamma Distributed at 5% Significance Level**								
2871												
2872				**Gamma Statistics on Detected Data Only**								
2873				k hat (MLE)	0.735			k star (bias corrected MLE)				0.694
2874				Theta hat (MLE)	8.665			Theta star (bias corrected MLE)				9.17
2875				nu hat (MLE)	55.83			nu star (bias corrected)				52.76
2876				Mean (detects)	6.366							
2877												
2878				**Gamma ROS Statistics using Imputed Non-Detects**								
2879	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
2880	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)											
2881	For such situations, GROS method may yield incorrect values of UCLs and BTVs											

2882	This is especially true when the sample size is small.											
2883	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
2884					Minimum	0.01			Mean	4.84		
2885					Maximum	27			Median	1.24		
2886					SD	6.977			CV	1.442		
2887					k hat (MLE)	0.354			k star (bias corrected MLE)	0.346		
2888					Theta hat (MLE)	13.68			Theta star (bias corrected MLE)	13.99		
2889					nu hat (MLE)	35.39			nu star (bias corrected)	34.6		
2890					Adjusted Level of Significance (β)	0.0452						
2891					Approximate Chi Square Value (34.60, α)	22.15			Adjusted Chi Square Value (34.60, β)	21.85		
2892					95% Gamma Approximate UCL (use when n>=50)	7.563			95% Gamma Adjusted UCL (use when n<50)	7.666		
2893												
2894	**Estimates of Gamma Parameters using KM Estimates**											
2895					Mean (KM)	4.903			SD (KM)	6.864		
2896					Variance (KM)	47.12			SE of Mean (KM)	0.984		
2897					k hat (KM)	0.51			k star (KM)	0.493		
2898					nu hat (KM)	51.03			nu star (KM)	49.3		
2899					theta hat (KM)	9.61			theta star (KM)	9.947		
2900					80% gamma percentile (KM)	8.048			90% gamma percentile (KM)	13.31		
2901					95% gamma percentile (KM)	18.93			99% gamma percentile (KM)	32.79		
2902												
2903	**Gamma Kaplan-Meier (KM) Statistics**											
2904					Approximate Chi Square Value (49.30, α)	34.18			Adjusted Chi Square Value (49.30, β)	33.8		
2905	5% Gamma Approximate KM-UCL (use when n>=50)					7.073			95% Gamma Adjusted KM-UCL (use when n<50)	7.151		
2906												
2907	**Lognormal GOF Test on Detected Observations Only**											
2908					Shapiro Wilk Test Statistic	0.956			**Shapiro Wilk GOF Test**			
2909					5% Shapiro Wilk Critical Value	0.938			Detected Data appear Lognormal at 5% Significance Level			
2910					Lilliefors Test Statistic	0.145			**Lilliefors GOF Test**			
2911					5% Lilliefors Critical Value	0.142			Detected Data Not Lognormal at 5% Significance Level			
2912	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
2913												
2914	**Lognormal ROS Statistics Using Imputed Non-Detects**											
2915					Mean in Original Scale	4.901			Mean in Log Scale	0.405		
2916					SD in Original Scale	6.936			SD in Log Scale	1.751		
2917					95% t UCL (assumes normality of ROS data)	6.546			95% Percentile Bootstrap UCL	6.534		
2918					95% BCA Bootstrap UCL	6.838			95% Bootstrap t UCL	6.946		
2919					95% H-UCL (Log ROS)	15.77						
2920												
2921	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
2922					KM Mean (logged)	0.417			KM Geo Mean	1.517		
2923					KM SD (logged)	1.721			95% Critical H Value (KM-Log)	3.234		
2924					KM Standard Error of Mean (logged)	0.27			95% H-UCL (KM -Log)	14.77		
2925					KM SD (logged)	1.721			95% Critical H Value (KM-Log)	3.234		
2926					KM Standard Error of Mean (logged)	0.27						
2927												
2928	**DL/2 Statistics**											
2929	**DL/2 Normal**								**DL/2 Log-Transformed**			
2930					Mean in Original Scale	4.898			Mean in Log Scale	0.453		
2931					SD in Original Scale	6.937			SD in Log Scale	1.653		
2932					95% t UCL (Assumes normality)	6.543			95% H-Stat UCL	12.97		
2933	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
2934												
2935	**Nonparametric Distribution Free UCL Statistics**											
2936	**Detected Data appear Gamma Distributed at 5% Significance Level**											
2937												
2938	**Suggested UCL to Use**											
2939					95% KM Approximate Gamma UCL	7.073						
2940												
2941	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
2942	Recommendations are based upon data size, data distribution, and skewness.											
2943	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
2944	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
2945												
2946	**Result (eu8_copper)**											
2947												
2948	**General Statistics**											

2949				Total Number of Observations	149			Number of Distinct Observations	128			
2950				Number of Detects	141			Number of Non-Detects	8			
2951				Number of Distinct Detects	126			Number of Distinct Non-Detects	2			
2952				Minimum Detect	3.05			Minimum Non-Detect	0.073			
2953				Maximum Detect	318			Maximum Non-Detect	2.5			
2954				Variance Detects	3029			Percent Non-Detects	5.369%			
2955				Mean Detects	28.51			SD Detects	55.03			
2956				Median Detects	11.8			CV Detects	1.931			
2957				Skewness Detects	3.816			Kurtosis Detects	14.59			
2958				Mean of Logged Detects	2.647			SD of Logged Detects	0.978			
2959												
2960				**Normal GOF Test on Detects Only**								
2961				Shapiro Wilk Test Statistic	0.442			**Normal GOF Test on Detected Observations Only**				
2962				5% Shapiro Wilk P Value	0			Detected Data Not Normal at 5% Significance Level				
2963				Lilliefors Test Statistic	0.343			**Lilliefors GOF Test**				
2964				5% Lilliefors Critical Value	0.075			Detected Data Not Normal at 5% Significance Level				
2965				**Detected Data Not Normal at 5% Significance Level**								
2966												
2967				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
2968				KM Mean	26.98			KM Standard Error of Mean	4.417			
2969				KM SD	53.73			95% KM (BCA) UCL	35.36			
2970				95% KM (t) UCL	34.29			95% KM (Percentile Bootstrap) UCL	34.56			
2971				95% KM (z) UCL	34.25			95% KM Bootstrap t UCL	36.53			
2972				90% KM Chebyshev UCL	40.23			95% KM Chebyshev UCL	46.24			
2973				97.5% KM Chebyshev UCL	54.57			99% KM Chebyshev UCL	70.93			
2974												
2975				**Gamma GOF Tests on Detected Observations Only**								
2976				A-D Test Statistic	13.36			**Anderson-Darling GOF Test**				
2977				5% A-D Critical Value	0.791			Detected Data Not Gamma Distributed at 5% Significance Level				
2978				K-S Test Statistic	0.255			**Kolmogorov-Smirnov GOF**				
2979				5% K-S Critical Value	0.0817			Detected Data Not Gamma Distributed at 5% Significance Level				
2980				**Detected Data Not Gamma Distributed at 5% Significance Level**								
2981												
2982				**Gamma Statistics on Detected Data Only**								
2983				k hat (MLE)	0.838			k star (bias corrected MLE)	0.825			
2984				Theta hat (MLE)	34			Theta star (bias corrected MLE)	34.54			
2985				nu hat (MLE)	236.4			nu star (bias corrected)	232.7			
2986				Mean (detects)	28.51							
2987												
2988				**Gamma ROS Statistics using Imputed Non-Detects**								
2989				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
2990				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)								
2991				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
2992				This is especially true when the sample size is small.								
2993				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
2994				Minimum	0.01			Mean	26.98			
2995				Maximum	318			Median	11.2			
2996				SD	53.91			CV	1.998			
2997				k hat (MLE)	0.596			k star (bias corrected MLE)	0.588			
2998				Theta hat (MLE)	45.27			Theta star (bias corrected MLE)	45.85			
2999				nu hat (MLE)	177.6			nu star (bias corrected)	175.4			
3000				Adjusted Level of Significance (β)	0.0484							
3001				Approximate Chi Square Value (175.35, α)	145.7			Adjusted Chi Square Value (175.35, β)	145.5			
3002				95% Gamma Approximate UCL (use when n>=50)	32.46			95% Gamma Adjusted UCL (use when n<50)	32.52			
3003												
3004				**Estimates of Gamma Parameters using KM Estimates**								
3005				Mean (KM)	26.98			SD (KM)	53.73			
3006				Variance (KM)	2887			SE of Mean (KM)	4.417			
3007				k hat (KM)	0.252			k star (KM)	0.252			
3008				nu hat (KM)	75.14			nu star (KM)	74.96			
3009				theta hat (KM)	107			theta star (KM)	107.3			
3010				80% gamma percentile (KM)	39.27			90% gamma percentile (KM)	80.95			
3011				95% gamma percentile (KM)	130.4			99% gamma percentile (KM)	261.8			
3012												
3013				**Gamma Kaplan-Meier (KM) Statistics**								
3014				Approximate Chi Square Value (74.96, α)	56.02			Adjusted Chi Square Value (74.96, β)	55.86			
3015				5% Gamma Approximate KM-UCL (use when n>=50)	36.1			95% Gamma Adjusted KM-UCL (use when n<50)	36.21			

3016												
3017	**Lognormal GOF Test on Detected Observations Only**											
3018					Shapiro Wilk Approximate Test Statistic		0.872	**Shapiro Wilk GOF Test**				
3019					5% Shapiro Wilk P Value		0	Detected Data Not Lognormal at 5% Significance Level				
3020					Lilliefors Test Statistic		0.146	**Lilliefors GOF Test**				
3021					5% Lilliefors Critical Value		0.075	Detected Data Not Lognormal at 5% Significance Level				
3022	**Detected Data Not Lognormal at 5% Significance Level**											
3023												
3024	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3025					Mean in Original Scale		27.06			Mean in Log Scale		2.527
3026					SD in Original Scale		53.87			SD in Log Scale		1.079
3027					95% t UCL (assumes normality of ROS data)		34.37			95% Percentile Bootstrap UCL		34.67
3028					95% BCA Bootstrap UCL		36.72			95% Bootstrap t UCL		37.2
3029					95% H-UCL (Log ROS)		27.4					
3030												
3031	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
3032					KM Mean (logged)		2.364			KM Geo Mean		10.63
3033					KM SD (logged)		1.519			95% Critical H Value (KM-Log)		2.733
3034					KM Standard Error of Mean (logged)		0.125			95% H-UCL (KM -Log)		47.4
3035					KM SD (logged)		1.519			95% Critical H Value (KM-Log)		2.733
3036					KM Standard Error of Mean (logged)		0.125					
3037												
3038	**DL/2 Statistics**											
3039	**DL/2 Normal**							**DL/2 Log-Transformed**				
3040					Mean in Original Scale		27.04			Mean in Log Scale		2.493
3041					SD in Original Scale		53.88			SD in Log Scale		1.183
3042					95% t UCL (Assumes normality)		34.34			95% H-Stat UCL		30.68
3043	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3044												
3045	**Nonparametric Distribution Free UCL Statistics**											
3046	**Data do not follow a Discernible Distribution at 5% Significance Level**											
3047												
3048	**Suggested UCL to Use**											
3049					95% KM (Chebyshev) UCL		46.24					
3050												
3051	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3052	Recommendations are based upon data size, data distribution, and skewness.											
3053	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3054	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3055												
3056	**Result (eu8_iron)**											
3057												
3058	**General Statistics**											
3059					Total Number of Observations		149			Number of Distinct Observations		132
3060					Number of Detects		134			Number of Non-Detects		15
3061					Number of Distinct Detects		130			Number of Distinct Non-Detects		2
3062					Minimum Detect		106			Minimum Non-Detect		2.1
3063					Maximum Detect		16900			Maximum Non-Detect		100
3064					Variance Detects		8656881			Percent Non-Detects		10.07%
3065					Mean Detects		2423			SD Detects		2942
3066					Median Detects		1380			CV Detects		1.214
3067					Skewness Detects		2.197			Kurtosis Detects		6.1
3068					Mean of Logged Detects		7.07			SD of Logged Detects		1.283
3069												
3070	**Normal GOF Test on Detects Only**											
3071					Shapiro Wilk Test Statistic		0.751	**Normal GOF Test on Detected Observations Only**				
3072					5% Shapiro Wilk P Value		0	Detected Data Not Normal at 5% Significance Level				
3073					Lilliefors Test Statistic		0.215	**Lilliefors GOF Test**				
3074					5% Lilliefors Critical Value		0.0769	Detected Data Not Normal at 5% Significance Level				
3075	**Detected Data Not Normal at 5% Significance Level**											
3076												
3077	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
3078					KM Mean		2180			KM Standard Error of Mean		236.3
3079					KM SD		2874			95% KM (BCA) UCL		2636
3080					95% KM (t) UCL		2571			95% KM (Percentile Bootstrap) UCL		2586
3081					95% KM (z) UCL		2568			95% KM Bootstrap t UCL		2627
3082					90% KM Chebyshev UCL		2889			95% KM Chebyshev UCL		3210

3083				97.5% KM Chebyshev UCL	3655				99% KM Chebyshev UCL	4531		
3084												
3085				**Gamma GOF Tests on Detected Observations Only**								
3086				A-D Test Statistic	2.342	**Anderson-Darling GOF Test**						
3087				5% A-D Critical Value	0.792	Detected Data Not Gamma Distributed at 5% Significance Level						
3088				K-S Test Statistic	0.131	**Kolmogorov-Smirnov GOF**						
3089				5% K-S Critical Value	0.0836	Detected Data Not Gamma Distributed at 5% Significance Level						
3090				**Detected Data Not Gamma Distributed at 5% Significance Level**								
3091												
3092				**Gamma Statistics on Detected Data Only**								
3093				k hat (MLE)	0.819	k star (bias corrected MLE)	0.805					
3094				Theta hat (MLE)	2960	Theta star (bias corrected MLE)	3009					
3095				nu hat (MLE)	219.4	nu star (bias corrected)	215.8					
3096				Mean (detects)	2423							
3097												
3098				**Gamma ROS Statistics using Imputed Non-Detects**								
3099				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
3100				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)								
3101				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
3102				This is especially true when the sample size is small.								
3103				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
3104				Minimum	0.01	Mean	2179					
3105				Maximum	16900	Median	866					
3106				SD	2884	CV	1.323					
3107				k hat (MLE)	0.372	k star (bias corrected MLE)	0.369					
3108				Theta hat (MLE)	5865	Theta star (bias corrected MLE)	5913					
3109				nu hat (MLE)	110.7	nu star (bias corrected)	109.8					
3110				Adjusted Level of Significance (β)	0.0484							
3111				Approximate Chi Square Value (109.84, α)	86.65	Adjusted Chi Square Value (109.84, β)	86.45					
3112				95% Gamma Approximate UCL (use when n>=50)	2763	95% Gamma Adjusted UCL (use when n<50)	2769					
3113												
3114				**Estimates of Gamma Parameters using KM Estimates**								
3115				Mean (KM)	2180	SD (KM)	2874					
3116				Variance (KM)	8258049	SE of Mean (KM)	236.3					
3117				k hat (KM)	0.575	k star (KM)	0.568					
3118				nu hat (KM)	171.4	nu star (KM)	169.3					
3119				theta hat (KM)	3789	theta star (KM)	3836					
3120				80% gamma percentile (KM)	3592	90% gamma percentile (KM)	5738					
3121				95% gamma percentile (KM)	7998	99% gamma percentile (KM)	13492					
3122												
3123				**Gamma Kaplan-Meier (KM) Statistics**								
3124				Approximate Chi Square Value (169.31, α)	140.2	Adjusted Chi Square Value (169.31, β)	140					
3125	5% Gamma Approximate KM-UCL (use when n>=50)				2632	95% Gamma Adjusted KM-UCL (use when n<50)	2637					
3126												
3127				**Lognormal GOF Test on Detected Observations Only**								
3128				Shapiro Wilk Approximate Test Statistic	0.941	**Shapiro Wilk GOF Test**						
3129				5% Shapiro Wilk P Value	1.0559E-5	Detected Data Not Lognormal at 5% Significance Level						
3130				Lilliefors Test Statistic	0.105	**Lilliefors GOF Test**						
3131				5% Lilliefors Critical Value	0.0769	Detected Data Not Lognormal at 5% Significance Level						
3132				**Detected Data Not Lognormal at 5% Significance Level**								
3133												
3134				**Lognormal ROS Statistics Using Imputed Non-Detects**								
3135				Mean in Original Scale	2187	Mean in Log Scale	6.777					
3136				SD in Original Scale	2878	SD in Log Scale	1.508					
3137				95% t UCL (assumes normality of ROS data)	2577	95% Percentile Bootstrap UCL	2587					
3138				95% BCA Bootstrap UCL	2645	95% Bootstrap t UCL	2616					
3139				95% H-UCL (Log ROS)	3832							
3140												
3141				**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**								
3142				KM Mean (logged)	6.433	KM Geo Mean	622.1					
3143				KM SD (logged)	2.257	95% Critical H Value (KM-Log)	3.61					
3144				KM Standard Error of Mean (logged)	0.186	95% H-UCL (KM -Log)	15520					
3145				KM SD (logged)	2.257	95% Critical H Value (KM-Log)	3.61					
3146				KM Standard Error of Mean (logged)	0.186							
3147												
3148				**DL/2 Statistics**								
3149				**DL/2 Normal**					**DL/2 Log-Transformed**			

3150				Mean in Original Scale	2184					Mean in Log Scale	6.7	
3151				SD in Original Scale	2880					SD in Log Scale	1.698	
3152				95% t UCL (Assumes normality)	2574					95% H-Stat UCL	5174	
3153				**DL/2 is not a recommended method, provided for comparisons and historical reasons**								
3154												
3155				**Nonparametric Distribution Free UCL Statistics**								
3156				**Data do not follow a Discernible Distribution at 5% Significance Level**								
3157												
3158				**Suggested UCL to Use**								
3159				95% KM (Chebyshev) UCL	3210							
3160												
3161	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3162	Recommendations are based upon data size, data distribution, and skewness.											
3163	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3164	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3165												
3166	**Result (eu8_lead)**											
3167												
3168				**General Statistics**								
3169				Total Number of Observations	149					Number of Distinct Observations	131	
3170				Number of Detects	138					Number of Non-Detects	11	
3171				Number of Distinct Detects	129					Number of Distinct Non-Detects	2	
3172				Minimum Detect	0.59					Minimum Non-Detect	0.03	
3173				Maximum Detect	778					Maximum Non-Detect	0.5	
3174				Variance Detects	12152					Percent Non-Detects	7.383%	
3175				Mean Detects	36.34					SD Detects	110.2	
3176				Median Detects	8.69					CV Detects	3.034	
3177				Skewness Detects	5.41					Kurtosis Detects	31.05	
3178				Mean of Logged Detects	2.27					SD of Logged Detects	1.373	
3179												
3180				**Normal GOF Test on Detects Only**								
3181				Shapiro Wilk Test Statistic	0.327					**Normal GOF Test on Detected Observations Only**		
3182				5% Shapiro Wilk P Value	0					Detected Data Not Normal at 5% Significance Level		
3183				Lilliefors Test Statistic	0.379					**Lilliefors GOF Test**		
3184				5% Lilliefors Critical Value	0.0758					Detected Data Not Normal at 5% Significance Level		
3185				**Detected Data Not Normal at 5% Significance Level**								
3186												
3187				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
3188				KM Mean	33.66					KM Standard Error of Mean	8.726	
3189				KM SD	106.1					95% KM (BCA) UCL	48.81	
3190				95% KM (t) UCL	48.1					95% KM (Percentile Bootstrap) UCL	48.5	
3191				95% KM (z) UCL	48.01					95% KM Bootstrap t UCL	58.66	
3192				90% KM Chebyshev UCL	59.84					95% KM Chebyshev UCL	71.69	
3193				97.5% KM Chebyshev UCL	88.15					99% KM Chebyshev UCL	120.5	
3194												
3195				**Gamma GOF Tests on Detected Observations Only**								
3196				A-D Test Statistic	12.18					**Anderson-Darling GOF Test**		
3197				5% A-D Critical Value	0.824					Detected Data Not Gamma Distributed at 5% Significance Level		
3198				K-S Test Statistic	0.238					**Kolmogorov-Smirnov GOF**		
3199				5% K-S Critical Value	0.0844					Detected Data Not Gamma Distributed at 5% Significance Level		
3200				**Detected Data Not Gamma Distributed at 5% Significance Level**								
3201												
3202				**Gamma Statistics on Detected Data Only**								
3203				k hat (MLE)	0.483					k star (bias corrected MLE)	0.477	
3204				Theta hat (MLE)	75.28					Theta star (bias corrected MLE)	76.18	
3205				nu hat (MLE)	133.2					nu star (bias corrected)	131.7	
3206				Mean (detects)	36.34							
3207												
3208				**Gamma ROS Statistics using Imputed Non-Detects**								
3209	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
3210	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)											
3211	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
3212	This is especially true when the sample size is small.											
3213	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
3214				Minimum	0.01					Mean	33.66	
3215				Maximum	778					Median	7.55	
3216				SD	106.5					CV	3.164	

3217					k hat (MLE)	0.379				k star (bias corrected MLE)		0.375
3218					Theta hat (MLE)	88.91				Theta star (bias corrected MLE)		89.66
3219					nu hat (MLE)	112.8				nu star (bias corrected)		111.9
3220					Adjusted Level of Significance (β)	0.0484						
3221					Approximate Chi Square Value (111.86, α)	88.45				Adjusted Chi Square Value (111.86, β)		88.24
3222					95% Gamma Approximate UCL (use when n>=50)	42.57				95% Gamma Adjusted UCL (use when n<50)		42.66
3223												
3224					**Estimates of Gamma Parameters using KM Estimates**							
3225					Mean (KM)	33.66				SD (KM)		106.1
3226					Variance (KM)	11264				SE of Mean (KM)		8.726
3227					k hat (KM)	0.101				k star (KM)		0.103
3228					nu hat (KM)	29.97				nu star (KM)		30.7
3229					theta hat (KM)	334.7				theta star (KM)		326.7
3230					80% gamma percentile (KM)	24.36				90% gamma percentile (KM)		90.66
3231					95% gamma percentile (KM)	195				99% gamma percentile (KM)		526.7
3232												
3233					**Gamma Kaplan-Meier (KM) Statistics**							
3234					Approximate Chi Square Value (30.70, α)	19.04				Adjusted Chi Square Value (30.70, β)		18.95
3235	5% Gamma Approximate KM-UCL (use when n>=50)					54.26				95% Gamma Adjusted KM-UCL (use when n<50)		54.51
3236												
3237					**Lognormal GOF Test on Detected Observations Only**							
3238					Shapiro Wilk Approximate Test Statistic	0.943				**Shapiro Wilk GOF Test**		
3239					5% Shapiro Wilk P Value	1.3836E-5				Detected Data Not Lognormal at 5% Significance Level		
3240					Lilliefors Test Statistic	0.0918				**Lilliefors GOF Test**		
3241					5% Lilliefors Critical Value	0.0758				Detected Data Not Lognormal at 5% Significance Level		
3242					**Detected Data Not Lognormal at 5% Significance Level**							
3243												
3244					**Lognormal ROS Statistics Using Imputed Non-Detects**							
3245					Mean in Original Scale	33.69				Mean in Log Scale		2.037
3246					SD in Original Scale	106.5				SD in Log Scale		1.562
3247					95% t UCL (assumes normality of ROS data)	48.13				95% Percentile Bootstrap UCL		48.39
3248					95% BCA Bootstrap UCL	54.18				95% Bootstrap t UCL		57.46
3249					95% H-UCL (Log ROS)	37.14						
3250												
3251					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
3252					KM Mean (logged)	1.843				KM Geo Mean		6.317
3253					KM SD (logged)	2.003				95% Critical H Value (KM-Log)		3.298
3254					KM Standard Error of Mean (logged)	0.165				95% H-UCL (KM -Log)		80.89
3255					KM SD (logged)	2.003				95% Critical H Value (KM-Log)		3.298
3256					KM Standard Error of Mean (logged)	0.165						
3257												
3258					**DL/2 Statistics**							
3259					**DL/2 Normal**					**DL/2 Log-Transformed**		
3260					Mean in Original Scale	33.67				Mean in Log Scale		1.962
3261					SD in Original Scale	106.5				SD in Log Scale		1.74
3262					95% t UCL (Assumes normality)	48.11				95% H-Stat UCL		49.51
3263					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
3264												
3265					**Nonparametric Distribution Free UCL Statistics**							
3266					**Data do not follow a Discernible Distribution at 5% Significance Level**							
3267												
3268					**Suggested UCL to Use**							
3269					95% KM (Chebyshev) UCL	71.69						
3270												
3271	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3272	Recommendations are based upon data size, data distribution, and skewness.											
3273	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3274	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3275												
3276	**Result (eu8_manganese)**											
3277												
3278					**General Statistics**							
3279					Total Number of Observations	149				Number of Distinct Observations		130
3280					Number of Detects	147				Number of Non-Detects		2
3281					Number of Distinct Detects	129				Number of Distinct Non-Detects		1
3282					Minimum Detect	6.95				Minimum Non-Detect		2
3283					Maximum Detect	3610				Maximum Non-Detect		2

3284				Variance Detects	371885			Percent Non-Detects	1.342%			
3285				Mean Detects	408.5			SD Detects	609.8			
3286				Median Detects	228			CV Detects	1.493			
3287				Skewness Detects	3.461			Kurtosis Detects	12.59			
3288				Mean of Logged Detects	5.427			SD of Logged Detects	1.059			
3289												
3290				**Normal GOF Test on Detects Only**								
3291				Shapiro Wilk Test Statistic	0.547		**Normal GOF Test on Detected Observations Only**					
3292				5% Shapiro Wilk P Value	0		Detected Data Not Normal at 5% Significance Level					
3293				Lilliefors Test Statistic	0.285		**Lilliefors GOF Test**					
3294				5% Lilliefors Critical Value	0.0735		Detected Data Not Normal at 5% Significance Level					
3295				**Detected Data Not Normal at 5% Significance Level**								
3296												
3297				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
3298				KM Mean	403.1			KM Standard Error of Mean	49.77			
3299				KM SD	605.5			95% KM (BCA) UCL	494.6			
3300				95% KM (t) UCL	485.5			95% KM (Percentile Bootstrap) UCL	482.5			
3301				95% KM (z) UCL	484.9			95% KM Bootstrap t UCL	510.6			
3302				90% KM Chebyshev UCL	552.4			95% KM Chebyshev UCL	620			
3303				97.5% KM Chebyshev UCL	713.9			99% KM Chebyshev UCL	898.3			
3304												
3305				**Gamma GOF Tests on Detected Observations Only**								
3306				A-D Test Statistic	5.545		**Anderson-Darling GOF Test**					
3307				5% A-D Critical Value	0.784		Detected Data Not Gamma Distributed at 5% Significance Level					
3308				K-S Test Statistic	0.15		**Kolmogorov-Smirnov GOF**					
3309				5% K-S Critical Value	0.0797		Detected Data Not Gamma Distributed at 5% Significance Level					
3310				**Detected Data Not Gamma Distributed at 5% Significance Level**								
3311												
3312				**Gamma Statistics on Detected Data Only**								
3313				k hat (MLE)	0.987			k star (bias corrected MLE)	0.971			
3314				Theta hat (MLE)	414			Theta star (bias corrected MLE)	420.6			
3315				nu hat (MLE)	290.1			nu star (bias corrected)	285.5			
3316				Mean (detects)	408.5							
3317												
3318				**Gamma ROS Statistics using Imputed Non-Detects**								
3319				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
3320				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)								
3321				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
3322				This is especially true when the sample size is small.								
3323				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
3324				Minimum	0.01			Mean	403			
3325				Maximum	3610			Median	223			
3326				SD	607.5			CV	1.507			
3327				k hat (MLE)	0.835			k star (bias corrected MLE)	0.823			
3328				Theta hat (MLE)	482.8			Theta star (bias corrected MLE)	490			
3329				nu hat (MLE)	248.8			nu star (bias corrected)	245.1			
3330				Adjusted Level of Significance (β)	0.0484							
3331				Approximate Chi Square Value (245.11, α)	209.9			Adjusted Chi Square Value (245.11, β)	209.5			
3332				95% Gamma Approximate UCL (use when n>=50)	470.7			95% Gamma Adjusted UCL (use when n<50)	471.4			
3333												
3334				**Estimates of Gamma Parameters using KM Estimates**								
3335				Mean (KM)	403.1			SD (KM)	605.5			
3336				Variance (KM)	366586			SE of Mean (KM)	49.77			
3337				k hat (KM)	0.443			k star (KM)	0.439			
3338				nu hat (KM)	132.1			nu star (KM)	130.7			
3339				theta hat (KM)	909.5			theta star (KM)	918.7			
3340				80% gamma percentile (KM)	656.6			90% gamma percentile (KM)	1119			
3341				95% gamma percentile (KM)	1622			99% gamma percentile (KM)	2873			
3342												
3343				**Gamma Kaplan-Meier (KM) Statistics**								
3344				Approximate Chi Square Value (130.74, α)	105.3			Adjusted Chi Square Value (130.74, β)	105.1			
3345				5% Gamma Approximate KM-UCL (use when n>=50)	500.3			95% Gamma Adjusted KM-UCL (use when n<50)	501.4			
3346												
3347				**Lognormal GOF Test on Detected Observations Only**								
3348				Shapiro Wilk Approximate Test Statistic	0.959		**Shapiro Wilk GOF Test**					
3349				5% Shapiro Wilk P Value	0.00268		Detected Data Not Lognormal at 5% Significance Level					
3350				Lilliefors Test Statistic	0.0913		**Lilliefors GOF Test**					

3351				5% Lilliefors Critical Value	0.0735	Detected Data Not Lognormal at 5% Significance Level						
3352	**Detected Data Not Lognormal at 5% Significance Level**											
3353												
3354	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3355				Mean in Original Scale	403.2				Mean in Log Scale	5.39		
3356				SD in Original Scale	607.4				SD in Log Scale	1.1		
3357			95% t UCL (assumes normality of ROS data)		485.6				95% Percentile Bootstrap UCL	490.2		
3358				95% BCA Bootstrap UCL	503.4				95% Bootstrap t UCL	510.9		
3359				95% H-UCL (Log ROS)	493.6							
3360												
3361	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
3362				KM Mean (logged)	5.363				KM Geo Mean	213.4		
3363				KM SD (logged)	1.182				95% Critical H Value (KM-Log)	2.376		
3364				KM Standard Error of Mean (logged)	0.0971				95% H-UCL (KM -Log)	540.2		
3365				KM SD (logged)	1.182				95% Critical H Value (KM-Log)	2.376		
3366				KM Standard Error of Mean (logged)	0.0971							
3367												
3368	**DL/2 Statistics**											
3369	**DL/2 Normal**								**DL/2 Log-Transformed**			
3370				Mean in Original Scale	403.1				Mean in Log Scale	5.354		
3371				SD in Original Scale	607.5				SD in Log Scale	1.225		
3372				95% t UCL (Assumes normality)	485.4				95% H-Stat UCL	570.8		
3373	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3374												
3375	**Nonparametric Distribution Free UCL Statistics**											
3376	**Data do not follow a Discernible Distribution at 5% Significance Level**											
3377												
3378	**Suggested UCL to Use**											
3379				95% KM (Chebyshev) UCL	620							
3380												
3381	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3382	Recommendations are based upon data size, data distribution, and skewness.											
3383	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3384	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3385												
3386												
3387	**Result (eu8_strontium)**											
3388												
3389	**General Statistics**											
3390				Total Number of Observations	99				Number of Distinct Observations	92		
3391									Number of Missing Observations	0		
3392				Minimum	140				Mean	527.3		
3393				Maximum	1780				Median	448		
3394				SD	355.6				Std. Error of Mean	35.73		
3395				Coefficient of Variation	0.674				Skewness	0.998		
3396												
3397	**Normal GOF Test**											
3398				Shapiro Wilk Test Statistic	0.878				**Shapiro Wilk GOF Test**			
3399				5% Shapiro Wilk P Value	2.384E-11				Data Not Normal at 5% Significance Level			
3400				Lilliefors Test Statistic	0.179				**Lilliefors GOF Test**			
3401				5% Lilliefors Critical Value	0.0893				Data Not Normal at 5% Significance Level			
3402	**Data Not Normal at 5% Significance Level**											
3403												
3404	**Assuming Normal Distribution**											
3405	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
3406				95% Student's-t UCL	586.6				95% Adjusted-CLT UCL (Chen-1995)	589.9		
3407									95% Modified-t UCL (Johnson-1978)	587.2		
3408												
3409	**Gamma GOF Test**											
3410				A-D Test Statistic	2.472				**Anderson-Darling Gamma GOF Test**			
3411				5% A-D Critical Value	0.763				Data Not Gamma Distributed at 5% Significance Level			
3412				K-S Test Statistic	0.168				**Kolmogorov-Smirnov Gamma GOF Test**			
3413				5% K-S Critical Value	0.0909				Data Not Gamma Distributed at 5% Significance Level			
3414	**Data Not Gamma Distributed at 5% Significance Level**											
3415												
3416	**Gamma Statistics**											
3417				k hat (MLE)	2.324				k star (bias corrected MLE)	2.26		

3418					Theta hat (MLE)	226.9				Theta star (bias corrected MLE)		233.3
3419					nu hat (MLE)	460.1				nu star (bias corrected)		447.5
3420					MLE Mean (bias corrected)	527.3				MLE Sd (bias corrected)		350.7
3421										Approximate Chi Square Value (0.05)		399.5
3422					Adjusted Level of Significance	0.0476				Adjusted Chi Square Value		398.8
3423												
3424					**Assuming Gamma Distribution**							
3425					95% Approximate Gamma UCL (use when n>=50))	590.7				95% Adjusted Gamma UCL (use when n<50)		591.7
3426												
3427					**Lognormal GOF Test**							
3428					Shapiro Wilk Test Statistic	0.915				**Shapiro Wilk Lognormal GOF Test**		
3429					5% Shapiro Wilk P Value	4.4513E-7				Data Not Lognormal at 5% Significance Level		
3430					Lilliefors Test Statistic	0.15				**Lilliefors Lognormal GOF Test**		
3431					5% Lilliefors Critical Value	0.0893				Data Not Lognormal at 5% Significance Level		
3432					**Data Not Lognormal at 5% Significance Level**							
3433												
3434					**Lognormal Statistics**							
3435					Minimum of Logged Data	4.942				Mean of logged Data		6.037
3436					Maximum of Logged Data	7.484				SD of logged Data		0.695
3437												
3438					**Assuming Lognormal Distribution**							
3439					95% H-UCL	614.4				90% Chebyshev (MVUE) UCL		654.3
3440					95% Chebyshev (MVUE) UCL	709.9				97.5% Chebyshev (MVUE) UCL		787.1
3441					99% Chebyshev (MVUE) UCL	938.7						
3442												
3443					**Nonparametric Distribution Free UCL Statistics**							
3444					**Data do not follow a Discernible Distribution (0.05)**							
3445												
3446					**Nonparametric Distribution Free UCLs**							
3447					95% CLT UCL	586				95% Jackknife UCL		586.6
3448					95% Standard Bootstrap UCL	585.5				95% Bootstrap-t UCL		592.4
3449					95% Hall's Bootstrap UCL	591				95% Percentile Bootstrap UCL		587.3
3450					95% BCA Bootstrap UCL	589.2						
3451					90% Chebyshev(Mean, Sd) UCL	634.5				95% Chebyshev(Mean, Sd) UCL		683
3452					97.5% Chebyshev(Mean, Sd) UCL	750.4				99% Chebyshev(Mean, Sd) UCL		882.8
3453												
3454					**Suggested UCL to Use**							
3455					95% Chebyshev (Mean, Sd) UCL	683						
3456												
3457	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3458	Recommendations are based upon data size, data distribution, and skewness.											
3459	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3460	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3461												
3462	**Result (eu8_thallium)**											
3463												
3464					**General Statistics**							
3465					Total Number of Observations	149				Number of Distinct Observations		12
3466					Number of Detects	9				Number of Non-Detects		140
3467					Number of Distinct Detects	9				Number of Distinct Non-Detects		3
3468					Minimum Detect	5.85				Minimum Non-Detect		0.031
3469					Maximum Detect	12.8				Maximum Non-Detect		5
3470					Variance Detects	5.739				Percent Non-Detects		93.96%
3471					Mean Detects	9.218				SD Detects		2.396
3472					Median Detects	8.75				CV Detects		0.26
3473					Skewness Detects	0.156				Kurtosis Detects		-0.98
3474					Mean of Logged Detects	2.19				SD of Logged Detects		0.268
3475												
3476					**Normal GOF Test on Detects Only**							
3477					Shapiro Wilk Test Statistic	0.961				**Shapiro Wilk GOF Test**		
3478					5% Shapiro Wilk Critical Value	0.829				Detected Data appear Normal at 5% Significance Level		
3479					Lilliefors Test Statistic	0.133				**Lilliefors GOF Test**		
3480					5% Lilliefors Critical Value	0.274				Detected Data appear Normal at 5% Significance Level		
3481					**Detected Data appear Normal at 5% Significance Level**							
3482												
3483					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
3484					KM Mean	0.586				KM Standard Error of Mean		0.196

3485					KM SD	2.258				95% KM (BCA) UCL		0.958
3486					95% KM (t) UCL	0.911				95% KM (Percentile Bootstrap) UCL		0.911
3487					95% KM (z) UCL	0.909				95% KM Bootstrap t UCL		0.935
3488					90% KM Chebyshev UCL	1.174				95% KM Chebyshev UCL		1.441
3489					97.5% KM Chebyshev UCL	1.811				99% KM Chebyshev UCL		2.538
3490												
3491					**Gamma GOF Tests on Detected Observations Only**							
3492					A-D Test Statistic	0.193	**Anderson-Darling GOF Test**					
3493					5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Lev					
3494					K-S Test Statistic	0.123	**Kolmogorov-Smirnov GOF**					
3495					5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Lev					
3496					**Detected data appear Gamma Distributed at 5% Significance Level**							
3497												
3498					**Gamma Statistics on Detected Data Only**							
3499					k hat (MLE)	16.21	k star (bias corrected MLE)					10.88
3500					Theta hat (MLE)	0.569	Theta star (bias corrected MLE)					0.847
3501					nu hat (MLE)	291.8	nu star (bias corrected)					195.8
3502					Mean (detects)	9.218						
3503												
3504					**Gamma ROS Statistics using Imputed Non-Detects**							
3505					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
3506					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)							
3507					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
3508					This is especially true when the sample size is small.							
3509					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
3510					Minimum	0.01	Mean					1.04
3511					Maximum	12.8	Median					0.01
3512					SD	2.465	CV					2.37
3513					k hat (MLE)	0.224	k star (bias corrected MLE)					0.224
3514					Theta hat (MLE)	4.649	Theta star (bias corrected MLE)					4.649
3515					nu hat (MLE)	66.67	nu star (bias corrected)					66.66
3516					Adjusted Level of Significance (β)	0.0484						
3517					Approximate Chi Square Value (66.66, α)	48.87	Adjusted Chi Square Value (66.66, β)					48.72
3518					95% Gamma Approximate UCL (use when n>=50)	1.419	95% Gamma Adjusted UCL (use when n<50)					1.423
3519												
3520					**Estimates of Gamma Parameters using KM Estimates**							
3521					Mean (KM)	0.586	SD (KM)					2.258
3522					Variance (KM)	5.098	SE of Mean (KM)					0.196
3523					k hat (KM)	0.0673	k star (KM)					0.0705
3524					nu hat (KM)	20.07	nu star (KM)					21
3525					theta hat (KM)	8.701	theta star (KM)					8.316
3526					80% gamma percentile (KM)	0.213	90% gamma percentile (KM)					1.271
3527					95% gamma percentile (KM)	3.373	99% gamma percentile (KM)					11.01
3528												
3529					**Gamma Kaplan-Meier (KM) Statistics**							
3530					Approximate Chi Square Value (21.00, α)	11.59	Adjusted Chi Square Value (21.00, β)					11.52
3531	5% Gamma Approximate KM-UCL (use when n>=50)					1.062	95% Gamma Adjusted KM-UCL (use when n<50)					1.068
3532												
3533					**Lognormal GOF Test on Detected Observations Only**							
3534					Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**					
3535					5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level					
3536					Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**					
3537					5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level					
3538					**Detected Data appear Lognormal at 5% Significance Level**							
3539												
3540					**Lognormal ROS Statistics Using Imputed Non-Detects**							
3541					Mean in Original Scale	2.402	Mean in Log Scale					0.543
3542					SD in Original Scale	2.231	SD in Log Scale					0.819
3543					95% t UCL (assumes normality of ROS data)	2.704	95% Percentile Bootstrap UCL					2.716
3544					95% BCA Bootstrap UCL	2.734	95% Bootstrap t UCL					2.742
3545					95% H-UCL (Log ROS)	2.761						
3546												
3547					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
3548					KM Mean (logged)	-3.132	KM Geo Mean					0.0436
3549					KM SD (logged)	1.351	95% Critical H Value (KM-Log)					2.549
3550					KM Standard Error of Mean (logged)	0.117	95% H-UCL (KM -Log)					0.144
3551					KM SD (logged)	1.351	95% Critical H Value (KM-Log)					2.549

3552				KM Standard Error of Mean (logged)		0.117						
3553												
3554						**DL/2 Statistics**						
3555				**DL/2 Normal**					**DL/2 Log-Transformed**			
3556				Mean in Original Scale		2.505			Mean in Log Scale			0.199
3557				SD in Original Scale		2.009			SD in Log Scale			1.899
3558				95% t UCL (Assumes normality)		2.778			95% H-Stat UCL			12.16
3559				**DL/2 is not a recommended method, provided for comparisons and historical reasons**								
3560												
3561						**Nonparametric Distribution Free UCL Statistics**						
3562						**Detected Data appear Normal Distributed at 5% Significance Level**						
3563												
3564						**Suggested UCL to Use**						
3565				95% KM (t) UCL		0.911						
3566												
3567	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3568	Recommendations are based upon data size, data distribution, and skewness.											
3569	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3570	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3571												
3572	**Result (eu8_zinc)**											
3573												
3574						**General Statistics**						
3575				Total Number of Observations		149			Number of Distinct Observations			134
3576				Number of Detects		148			Number of Non-Detects			1
3577				Number of Distinct Detects		133			Number of Distinct Non-Detects			1
3578				Minimum Detect		14.2			Minimum Non-Detect			10
3579				Maximum Detect		6370			Maximum Non-Detect			10
3580				Variance Detects		1064453			Percent Non-Detects			0.671%
3581				Mean Detects		479.3			SD Detects			1032
3582				Median Detects		181.5			CV Detects			2.153
3583				Skewness Detects		3.758			Kurtosis Detects			14.13
3584				Mean of Logged Detects		5.303			SD of Logged Detects			1.11
3585												
3586						**Normal GOF Test on Detects Only**						
3587				Shapiro Wilk Test Statistic		0.42			**Normal GOF Test on Detected Observations Only**			
3588				5% Shapiro Wilk P Value		0			Detected Data Not Normal at 5% Significance Level			
3589				Lilliefors Test Statistic		0.4			**Lilliefors GOF Test**			
3590				5% Lilliefors Critical Value		0.0732			Detected Data Not Normal at 5% Significance Level			
3591						**Detected Data Not Normal at 5% Significance Level**						
3592												
3593						**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**						
3594				KM Mean		476.2			KM Standard Error of Mean			84.3
3595				KM SD		1025			95% KM (BCA) UCL			646
3596				95% KM (t) UCL		615.7			95% KM (Percentile Bootstrap) UCL			627.2
3597				95% KM (z) UCL		614.8			95% KM Bootstrap t UCL			667.3
3598				90% KM Chebyshev UCL		729			95% KM Chebyshev UCL			843.6
3599				97.5% KM Chebyshev UCL		1003			99% KM Chebyshev UCL			1315
3600												
3601						**Gamma GOF Tests on Detected Observations Only**						
3602				A-D Test Statistic		14.97			**Anderson-Darling GOF Test**			
3603				5% A-D Critical Value		0.801			Detected Data Not Gamma Distributed at 5% Significance Level			
3604				K-S Test Statistic		0.285			**Kolmogorov-Smirnov GOF**			
3605				5% K-S Critical Value		0.0804			Detected Data Not Gamma Distributed at 5% Significance Level			
3606						**Detected Data Not Gamma Distributed at 5% Significance Level**						
3607												
3608						**Gamma Statistics on Detected Data Only**						
3609				k hat (MLE)		0.696			k star (bias corrected MLE)			0.686
3610				Theta hat (MLE)		688.6			Theta star (bias corrected MLE)			698.2
3611				nu hat (MLE)		206			nu star (bias corrected)			203.2
3612				Mean (detects)		479.3						
3613												
3614						**Gamma ROS Statistics using Imputed Non-Detects**						
3615	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
3616	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)											
3617	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
3618	This is especially true when the sample size is small.											

3619	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
3620					Minimum	0.01			Mean	476.1		
3621					Maximum	6370			Median	177		
3622					SD	1029			CV	2.161		
3623					k hat (MLE)	0.657			k star (bias corrected MLE)	0.648		
3624					Theta hat (MLE)	725			Theta star (bias corrected MLE)	734.8		
3625					nu hat (MLE)	195.7			nu star (bias corrected)	193.1		
3626					Adjusted Level of Significance (β)	0.0484						
3627					Approximate Chi Square Value (193.08, α)	161.9			Adjusted Chi Square Value (193.08, β)	161.7		
3628					95% Gamma Approximate UCL (use when n>=50)	567.7			95% Gamma Adjusted UCL (use when n<50)	568.6		
3629												
3630	**Estimates of Gamma Parameters using KM Estimates**											
3631					Mean (KM)	476.2			SD (KM)	1025		
3632					Variance (KM)	1051633			SE of Mean (KM)	84.3		
3633					k hat (KM)	0.216			k star (KM)	0.216		
3634					nu hat (KM)	64.25			nu star (KM)	64.29		
3635					theta hat (KM)	2209			theta star (KM)	2207		
3636					80% gamma percentile (KM)	651.3			90% gamma percentile (KM)	1439		
3637					95% gamma percentile (KM)	2404			99% gamma percentile (KM)	5029		
3638												
3639	**Gamma Kaplan-Meier (KM) Statistics**											
3640					Approximate Chi Square Value (64.29, α)	46.84			Adjusted Chi Square Value (64.29, β)	46.69		
3641	5% Gamma Approximate KM-UCL (use when n>=50)					653.5			95% Gamma Adjusted KM-UCL (use when n<50)	655.5		
3642												
3643	**Lognormal GOF Test on Detected Observations Only**											
3644					Shapiro Wilk Approximate Test Statistic	0.906			**Shapiro Wilk GOF Test**			
3645					5% Shapiro Wilk P Value	1.648E-13			Detected Data Not Lognormal at 5% Significance Level			
3646					Lilliefors Test Statistic	0.158			**Lilliefors GOF Test**			
3647					5% Lilliefors Critical Value	0.0732			Detected Data Not Lognormal at 5% Significance Level			
3648	**Detected Data Not Lognormal at 5% Significance Level**											
3649												
3650	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3651					Mean in Original Scale	476.2			Mean in Log Scale	5.283		
3652					SD in Original Scale	1029			SD in Log Scale	1.133		
3653					95% t UCL (assumes normality of ROS data)	615.7			95% Percentile Bootstrap UCL	624.1		
3654					95% BCA Bootstrap UCL	650.1			95% Bootstrap t UCL	650.6		
3655					95% H-UCL (Log ROS)	465.1						
3656												
3657	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
3658					KM Mean (logged)	5.283			KM Geo Mean	197		
3659					KM SD (logged)	1.129			95% Critical H Value (KM-Log)	2.325		
3660					KM Standard Error of Mean (logged)	0.0928			95% H-UCL (KM -Log)	462.5		
3661					KM SD (logged)	1.129			95% Critical H Value (KM-Log)	2.325		
3662					KM Standard Error of Mean (logged)	0.0928						
3663												
3664	**DL/2 Statistics**											
3665	**DL/2 Normal**								**DL/2 Log-Transformed**			
3666					Mean in Original Scale	476.1			Mean in Log Scale	5.279		
3667					SD in Original Scale	1029			SD in Log Scale	1.147		
3668					95% t UCL (Assumes normality)	615.6			95% H-Stat UCL	471.9		
3669	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3670												
3671	**Nonparametric Distribution Free UCL Statistics**											
3672	**Data do not follow a Discernible Distribution at 5% Significance Level**											
3673												
3674	**Suggested UCL to Use**											
3675					95% KM (Chebyshev) UCL	843.6						
3676												
3677	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3678	Recommendations are based upon data size, data distribution, and skewness.											
3679	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3680	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3681												
3682	**Result (eu9_aluminum)**											
3683												
3684	**General Statistics**											
3685					Total Number of Observations	216			Number of Distinct Observations	189		

3686					Number of Detects	214					Number of Non-Detects	2
3687					Number of Distinct Detects	188					Number of Distinct Non-Detects	1
3688					Minimum Detect	20.1					Minimum Non-Detect	20
3689					Maximum Detect	2070					Maximum Non-Detect	20
3690					Variance Detects	75438					Percent Non-Detects	0.926%
3691					Mean Detects	276.6					SD Detects	274.7
3692					Median Detects	175					CV Detects	0.993
3693					Skewness Detects	2.746					Kurtosis Detects	11.58
3694					Mean of Logged Detects	5.227					SD of Logged Detects	0.911
3695												
3696					**Normal GOF Test on Detects Only**							
3697					Shapiro Wilk Test Statistic	0.758					**Normal GOF Test on Detected Observations Only**	
3698					5% Shapiro Wilk P Value	0					Detected Data Not Normal at 5% Significance Level	
3699					Lilliefors Test Statistic	0.175					**Lilliefors GOF Test**	
3700					5% Lilliefors Critical Value	0.061					Detected Data Not Normal at 5% Significance Level	
3701					**Detected Data Not Normal at 5% Significance Level**							
3702												
3703					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
3704					KM Mean	274.3					KM Standard Error of Mean	18.68
3705					KM SD	273.9					95% KM (BCA) UCL	305.2
3706					95% KM (t) UCL	305.1					95% KM (Percentile Bootstrap) UCL	307
3707					95% KM (z) UCL	305					95% KM Bootstrap t UCL	311.7
3708					90% KM Chebyshev UCL	330.3					95% KM Chebyshev UCL	355.7
3709					97.5% KM Chebyshev UCL	390.9					99% KM Chebyshev UCL	460.1
3710												
3711					**Gamma GOF Tests on Detected Observations Only**							
3712					A-D Test Statistic	1.687					**Anderson-Darling GOF Test**	
3713					5% A-D Critical Value	0.774					Detected Data Not Gamma Distributed at 5% Significance Level	
3714					K-S Test Statistic	0.0914					**Kolmogorov-Smirnov GOF**	
3715					5% K-S Critical Value	0.0633					Detected Data Not Gamma Distributed at 5% Significance Level	
3716					**Detected Data Not Gamma Distributed at 5% Significance Level**							
3717												
3718					**Gamma Statistics on Detected Data Only**							
3719					k hat (MLE)	1.407					k star (bias corrected MLE)	1.39
3720					Theta hat (MLE)	196.7					Theta star (bias corrected MLE)	199
3721					nu hat (MLE)	602.1					nu star (bias corrected)	595
3722					Mean (detects)	276.6						
3723												
3724					**Gamma ROS Statistics using Imputed Non-Detects**							
3725					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
3726					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)							
3727					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
3728					This is especially true when the sample size is small.							
3729					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
3730					Minimum	0.01					Mean	274.1
3731					Maximum	2070					Median	174.5
3732					SD	274.7					CV	1.002
3733					k hat (MLE)	1.186					k star (bias corrected MLE)	1.173
3734					Theta hat (MLE)	231.1					Theta star (bias corrected MLE)	233.7
3735					nu hat (MLE)	512.4					nu star (bias corrected)	506.6
3736					Adjusted Level of Significance (β)	0.0489						
3737					Approximate Chi Square Value (506.57, α)	455.4					Adjusted Chi Square Value (506.57, β)	455.1
3738					95% Gamma Approximate UCL (use when n>=50)	304.9					95% Gamma Adjusted UCL (use when n<50)	305.1
3739												
3740					**Estimates of Gamma Parameters using KM Estimates**							
3741					Mean (KM)	274.3					SD (KM)	273.9
3742					Variance (KM)	74994					SE of Mean (KM)	18.68
3743					k hat (KM)	1.003					k star (KM)	0.992
3744					nu hat (KM)	433.3					nu star (KM)	428.6
3745					theta hat (KM)	273.4					theta star (KM)	276.4
3746					80% gamma percentile (KM)	441.7					90% gamma percentile (KM)	632.7
3747					95% gamma percentile (KM)	823.9					99% gamma percentile (KM)	1268
3748												
3749					**Gamma Kaplan-Meier (KM) Statistics**							
3750					Approximate Chi Square Value (428.61, α)	381.6					Adjusted Chi Square Value (428.61, β)	381.3
3751					5% Gamma Approximate KM-UCL (use when n>=50)	308					95% Gamma Adjusted KM-UCL (use when n<50)	308.3
3752												

	A	B	C	D	E	F	G	H	I	J	K	L
3753	**Lognormal GOF Test on Detected Observations Only**											
3754					Shapiro Wilk Approximate Test Statistic	0.978	**Shapiro Wilk GOF Test**					
3755					5% Shapiro Wilk P Value	0.177	Detected Data appear Lognormal at 5% Significance Level					
3756					Lilliefors Test Statistic	0.0538	**Lilliefors GOF Test**					
3757					5% Lilliefors Critical Value	0.061	Detected Data appear Lognormal at 5% Significance Level					
3758	**Detected Data appear Lognormal at 5% Significance Level**											
3759												
3760	**Lognormal ROS Statistics Using Imputed Non-Detects**											
3761					Mean in Original Scale	274.2			Mean in Log Scale	5.204		
3762					SD in Original Scale	274.5			SD in Log Scale	0.939		
3763					95% t UCL (assumes normality of ROS data)	305.1			95% Percentile Bootstrap UCL	305.6		
3764					95% BCA Bootstrap UCL	312.9			95% Bootstrap t UCL	310.1		
3765					95% H-UCL (Log ROS)	323.3						
3766												
3767	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
3768					KM Mean (logged)	5.206			KM Geo Mean	182.4		
3769					KM SD (logged)	0.93			95% Critical H Value (KM-Log)	2.09		
3770					KM Standard Error of Mean (logged)	0.0634			95% H-UCL (KM -Log)	320.9		
3771					KM SD (logged)	0.93			95% Critical H Value (KM-Log)	2.09		
3772					KM Standard Error of Mean (logged)	0.0634						
3773												
3774	**DL/2 Statistics**											
3775					**DL/2 Normal**				**DL/2 Log-Transformed**			
3776					Mean in Original Scale	274.2			Mean in Log Scale	5.2		
3777					SD in Original Scale	274.6			SD in Log Scale	0.95		
3778					95% t UCL (Assumes normality)	305			95% H-Stat UCL	326.1		
3779	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
3780												
3781	**Nonparametric Distribution Free UCL Statistics**											
3782	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
3783												
3784	**Suggested UCL to Use**											
3785					KM H-UCL	320.9						
3786												
3787	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3788	Recommendations are based upon data size, data distribution, and skewness.											
3789	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3790	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3791												
3792	**Result (eu9_antimony)**											
3793												
3794	**General Statistics**											
3795					Total Number of Observations	194			Number of Distinct Observations	6		
3796					Number of Detects	3			Number of Non-Detects	191		
3797					Number of Distinct Detects	3			Number of Distinct Non-Detects	3		
3798					Minimum Detect	4.42			Minimum Non-Detect	0.047		
3799					Maximum Detect	5.04			Maximum Non-Detect	2.5		
3800					Variance Detects	0.105			Percent Non-Detects	98.45%		
3801					Mean Detects	4.783			SD Detects	0.323		
3802					Median Detects	4.89			CV Detects	0.0676		
3803					Skewness Detects	-1.323			Kurtosis Detects	N/A		
3804					Mean of Logged Detects	1.564			SD of Logged Detects	0.0687		
3805												
3806	**Warning: Data set has only 3 Detected Values.**											
3807	**This is not enough to compute meaningful or reliable statistics and estimates.**											
3808												
3809												
3810	**Normal GOF Test on Detects Only**											
3811					Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**					
3812					5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level					
3813					Lilliefors Test Statistic	0.296	**Lilliefors GOF Test**					
3814					5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level					
3815	**Detected Data appear Normal at 5% Significance Level**											
3816												
3817	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
3818					KM Mean	0.12			KM Standard Error of Mean	0.0515		
3819					KM SD	0.585			95% KM (BCA) UCL	N/A		

3820				95% KM (t) UCL	0.205			95% KM (Percentile Bootstrap) UCL				N/A
3821				95% KM (z) UCL	0.205			95% KM Bootstrap t UCL				N/A
3822				90% KM Chebyshev UCL	0.275			95% KM Chebyshev UCL				0.345
3823				97.5% KM Chebyshev UCL	0.442			99% KM Chebyshev UCL				0.632
3824												
3825					**Gamma GOF Tests on Detected Observations Only**							
3826					**Not Enough Data to Perform GOF Test**							
3827												
3828					**Gamma Statistics on Detected Data Only**							
3829				k hat (MLE)	321			k star (bias corrected MLE)				N/A
3830				Theta hat (MLE)	0.0149			Theta star (bias corrected MLE)				N/A
3831				nu hat (MLE)	1926			nu star (bias corrected)				N/A
3832				Mean (detects)	4.783							
3833												
3834					**Gamma ROS Statistics using Imputed Non-Detects**							
3835					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
3836					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)							
3837					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
3838					This is especially true when the sample size is small.							
3839					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
3840				Minimum	0.01			Mean				1.429
3841				Maximum	5.04			Median				1.282
3842				SD	1.162			CV				0.814
3843				k hat (MLE)	0.679			k star (bias corrected MLE)				0.672
3844				Theta hat (MLE)	2.105			Theta star (bias corrected MLE)				2.127
3845				nu hat (MLE)	263.4			nu star (bias corrected)				260.6
3846				Adjusted Level of Significance (β)	0.0488							
3847				Approximate Chi Square Value (260.63, α)	224.3			Adjusted Chi Square Value (260.63, β)				224
3848				95% Gamma Approximate UCL (use when n>=50)	1.66			95% Gamma Adjusted UCL (use when n<50)				N/A
3849												
3850					**Estimates of Gamma Parameters using KM Estimates**							
3851				Mean (KM)	0.12			SD (KM)				0.585
3852				Variance (KM)	0.343			SE of Mean (KM)				0.0515
3853				k hat (KM)	0.0422			k star (KM)				0.045
3854				nu hat (KM)	16.37			nu star (KM)				17.45
3855				theta hat (KM)	2.849			theta star (KM)				2.673
3856				80% gamma percentile (KM)	0.0109			90% gamma percentile (KM)				0.158
3857				95% gamma percentile (KM)	0.613			99% gamma percentile (KM)				2.724
3858												
3859					**Gamma Kaplan-Meier (KM) Statistics**							
3860				Approximate Chi Square Value (17.45, α)	8.997			Adjusted Chi Square Value (17.45, β)				8.952
3861				5% Gamma Approximate KM-UCL (use when n>=50)	0.233			95% Gamma Adjusted KM-UCL (use when n<50)				0.234
3862												
3863					**Lognormal GOF Test on Detected Observations Only**							
3864				Shapiro Wilk Test Statistic	0.911			**Shapiro Wilk GOF Test**				
3865				5% Shapiro Wilk Critical Value	0.767			Detected Data appear Lognormal at 5% Significance Level				
3866				Lilliefors Test Statistic	0.301			**Lilliefors GOF Test**				
3867				5% Lilliefors Critical Value	0.425			Detected Data appear Lognormal at 5% Significance Level				
3868					**Detected Data appear Lognormal at 5% Significance Level**							
3869												
3870					**Lognormal ROS Statistics Using Imputed Non-Detects**							
3871				Mean in Original Scale	2.317			Mean in Log Scale				0.794
3872				SD in Original Scale	0.724			SD in Log Scale				0.305
3873				95% t UCL (assumes normality of ROS data)	2.403			95% Percentile Bootstrap UCL				2.403
3874				95% BCA Bootstrap UCL	2.414			95% Bootstrap t UCL				2.41
3875				95% H-UCL (Log ROS)	2.407							
3876												
3877					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
3878				KM Mean (logged)	-2.986			KM Geo Mean				0.0505
3879				KM SD (logged)	0.57			95% Critical H Value (KM-Log)				1.856
3880				KM Standard Error of Mean (logged)	0.0501			95% H-UCL (KM -Log)				0.0641
3881				KM SD (logged)	0.57			95% Critical H Value (KM-Log)				1.856
3882				KM Standard Error of Mean (logged)	0.0501							
3883												
3884					**DL/2 Statistics**							
3885					**DL/2 Normal**							**DL/2 Log-Transformed**
3886				Mean in Original Scale	1.241			Mean in Log Scale				0.0394

3887					SD in Original Scale	0.522				SD in Log Scale		0.9
3888					95% t UCL (Assumes normality)	1.303				95% H-Stat UCL		1.785
3889					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
3890												
3891					**Nonparametric Distribution Free UCL Statistics**							
3892					**Detected Data appear Normal Distributed at 5% Significance Level**							
3893												
3894					**Suggested UCL to Use**							
3895					95% KM (t) UCL	0.205						
3896												
3897	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
3898	Recommendations are based upon data size, data distribution, and skewness.											
3899	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
3900	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
3901												
3902	**Result (eu9_arsenic)**											
3903												
3904					**General Statistics**							
3905					Total Number of Observations	213				Number of Distinct Observations		9
3906					Number of Detects	7				Number of Non-Detects		206
3907					Number of Distinct Detects	7				Number of Distinct Non-Detects		2
3908					Minimum Detect	0.17				Minimum Non-Detect		0.026
3909					Maximum Detect	3.17				Maximum Non-Detect		2.5
3910					Variance Detects	1.874				Percent Non-Detects		96.71%
3911					Mean Detects	1.351				SD Detects		1.369
3912					Median Detects	0.37				CV Detects		1.013
3913					Skewness Detects	0.441				Kurtosis Detects		-2.507
3914					Mean of Logged Detects	-0.343				SD of Logged Detects		1.302
3915												
3916					**Normal GOF Test on Detects Only**							
3917					Shapiro Wilk Test Statistic	0.76				**Shapiro Wilk GOF Test**		
3918					5% Shapiro Wilk Critical Value	0.803				Detected Data Not Normal at 5% Significance Level		
3919					Lilliefors Test Statistic	0.335				**Lilliefors GOF Test**		
3920					5% Lilliefors Critical Value	0.304				Detected Data Not Normal at 5% Significance Level		
3921					**Detected Data Not Normal at 5% Significance Level**							
3922												
3923					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
3924					KM Mean	0.159				KM Standard Error of Mean		0.0485
3925					KM SD	0.341				95% KM (BCA) UCL		0.243
3926					95% KM (t) UCL	0.239				95% KM (Percentile Bootstrap) UCL		0.24
3927					95% KM (z) UCL	0.239				95% KM Bootstrap t UCL		0.238
3928					90% KM Chebyshev UCL	0.305				95% KM Chebyshev UCL		0.371
3929					97.5% KM Chebyshev UCL	0.462				99% KM Chebyshev UCL		0.642
3930												
3931					**Gamma GOF Tests on Detected Observations Only**							
3932					A-D Test Statistic	0.819				**Anderson-Darling GOF Test**		
3933					5% A-D Critical Value	0.731				Detected Data Not Gamma Distributed at 5% Significance Level		
3934					K-S Test Statistic	0.31				**Kolmogorov-Smirnov GOF**		
3935					5% K-S Critical Value	0.321				Detected data appear Gamma Distributed at 5% Significance Lev		
3936					**Detected data follow Appr. Gamma Distribution at 5% Significance Level**							
3937												
3938					**Gamma Statistics on Detected Data Only**							
3939					k hat (MLE)	0.907				k star (bias corrected MLE)		0.614
3940					Theta hat (MLE)	1.489				Theta star (bias corrected MLE)		2.202
3941					nu hat (MLE)	12.7				nu star (bias corrected)		8.592
3942					Mean (detects)	1.351						
3943												
3944					**Gamma ROS Statistics using Imputed Non-Detects**							
3945	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
3946	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)											
3947	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
3948	This is especially true when the sample size is small.											
3949	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
3950					Minimum	0.01				Mean		0.208
3951					Maximum	3.17				Median		0.01
3952					SD	0.476				CV		2.292
3953					k hat (MLE)	0.347				k star (bias corrected MLE)		0.345

3954					Theta hat (MLE)	0.599				Theta star (bias corrected MLE)		0.602
3955					nu hat (MLE)	147.9				nu star (bias corrected)		147.2
3956					Adjusted Level of Significance (β)	0.0489						
3957					Approximate Chi Square Value (147.17, α)	120.1				Adjusted Chi Square Value (147.17, β)		120
3958					95% Gamma Approximate UCL (use when n>=50)	0.255				95% Gamma Adjusted UCL (use when n<50)		0.255
3959												
3960					**Estimates of Gamma Parameters using KM Estimates**							
3961					Mean (KM)	0.159				SD (KM)		0.341
3962					Variance (KM)	0.116				SE of Mean (KM)		0.0485
3963					k hat (KM)	0.218				k star (KM)		0.218
3964					nu hat (KM)	93.01				nu star (KM)		93.03
3965					theta hat (KM)	0.73				theta star (KM)		0.73
3966					80% gamma percentile (KM)	0.219				90% gamma percentile (KM)		0.481
3967					95% gamma percentile (KM)	0.802				99% gamma percentile (KM)		1.672
3968												
3969					**Gamma Kaplan-Meier (KM) Statistics**							
3970					Approximate Chi Square Value (93.03, α)	71.79				Adjusted Chi Square Value (93.03, β)		71.66
3971	5% Gamma Approximate KM-UCL (use when n>=50)					0.206				95% Gamma Adjusted KM-UCL (use when n<50)		0.207
3972												
3973					**Lognormal GOF Test on Detected Observations Only**							
3974					Shapiro Wilk Test Statistic	0.809				**Shapiro Wilk GOF Test**		
3975					5% Shapiro Wilk Critical Value	0.803				Detected Data appear Lognormal at 5% Significance Level		
3976					Lilliefors Test Statistic	0.268				**Lilliefors GOF Test**		
3977					5% Lilliefors Critical Value	0.304				Detected Data appear Lognormal at 5% Significance Level		
3978					**Detected Data appear Lognormal at 5% Significance Level**							
3979												
3980					**Lognormal ROS Statistics Using Imputed Non-Detects**							
3981					Mean in Original Scale	0.205				Mean in Log Scale		-2.501
3982					SD in Original Scale	0.389				SD in Log Scale		1.366
3983					95% t UCL (assumes normality of ROS data)	0.249				95% Percentile Bootstrap UCL		0.252
3984					95% BCA Bootstrap UCL	0.258				95% Bootstrap t UCL		0.263
3985					95% H-UCL (Log ROS)	0.263						
3986												
3987					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
3988					KM Mean (logged)	-2.684				KM Geo Mean		0.0683
3989					KM SD (logged)	1.209				95% Critical H Value (KM-Log)		2.33
3990					KM Standard Error of Mean (logged)	0.383				95% H-UCL (KM -Log)		0.172
3991					KM SD (logged)	1.209				95% Critical H Value (KM-Log)		2.33
3992					KM Standard Error of Mean (logged)	0.383						
3993												
3994					**DL/2 Statistics**							
3995					**DL/2 Normal**					**DL/2 Log-Transformed**		
3996					Mean in Original Scale	1.218				Mean in Log Scale		0.0759
3997					SD in Original Scale	0.309				SD in Log Scale		0.792
3998					95% t UCL (Assumes normality)	1.254				95% H-Stat UCL		1.644
3999					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
4000												
4001					**Nonparametric Distribution Free UCL Statistics**							
4002					**Detected Data appear Approximate Gamma Distributed at 5% Significance Level**							
4003												
4004					**Suggested UCL to Use**							
4005					95% KM Approximate Gamma UCL	0.206						
4006												
4007					When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test							
4008					When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL							
4009												
4010					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
4011					Recommendations are based upon data size, data distribution, and skewness.							
4012					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
4013	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4014												
4015	**Result (eu9_beryllium)**											
4016												
4017					**General Statistics**							
4018					Total Number of Observations	213				Number of Distinct Observations		6
4019					Number of Detects	4				Number of Non-Detects		209
4020					Number of Distinct Detects	4				Number of Distinct Non-Detects		2

4021					Minimum Detect	0.11					Minimum Non-Detect	0.043
4022					Maximum Detect	0.73					Maximum Non-Detect	2
4023					Variance Detects	0.0653					Percent Non-Detects	98.12%
4024					Mean Detects	0.39					SD Detects	0.256
4025					Median Detects	0.36					CV Detects	0.655
4026					Skewness Detects	0.69					Kurtosis Detects	1.738
4027					Mean of Logged Detects	-1.142					SD of Logged Detects	0.785
4028												
4029					**Normal GOF Test on Detects Only**							
4030					Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**					
4031					5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level					
4032					Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**					
4033					5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level					
4034					**Detected Data appear Normal at 5% Significance Level**							
4035												
4036					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
4037					KM Mean	0.182	KM Standard Error of Mean	0.0804				
4038					KM SD	0.22	95% KM (BCA) UCL	N/A				
4039					95% KM (t) UCL	0.315	95% KM (Percentile Bootstrap) UCL	N/A				
4040					95% KM (z) UCL	0.314	95% KM Bootstrap t UCL	N/A				
4041					90% KM Chebyshev UCL	0.423	95% KM Chebyshev UCL	0.532				
4042					97.5% KM Chebyshev UCL	0.684	99% KM Chebyshev UCL	0.982				
4043												
4044					**Gamma GOF Tests on Detected Observations Only**							
4045					A-D Test Statistic	0.308	**Anderson-Darling GOF Test**					
4046					5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Lev					
4047					K-S Test Statistic	0.264	**Kolmogorov-Smirnov GOF**					
4048					5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Lev					
4049					**Detected data appear Gamma Distributed at 5% Significance Level**							
4050												
4051					**Gamma Statistics on Detected Data Only**							
4052					k hat (MLE)	2.656	k star (bias corrected MLE)	0.831				
4053					Theta hat (MLE)	0.147	Theta star (bias corrected MLE)	0.469				
4054					nu hat (MLE)	21.25	nu star (bias corrected)	6.645				
4055					Mean (detects)	0.39						
4056												
4057					**Gamma ROS Statistics using Imputed Non-Detects**							
4058					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
4059					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)							
4060					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
4061					This is especially true when the sample size is small.							
4062					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
4063					Minimum	0.01	Mean	0.182				
4064					Maximum	1.706	Median	0.01				
4065					SD	0.307	CV	1.684				
4066					k hat (MLE)	0.43	k star (bias corrected MLE)	0.427				
4067					Theta hat (MLE)	0.424	Theta star (bias corrected MLE)	0.427				
4068					nu hat (MLE)	183.1	nu star (bias corrected)	181.9				
4069					Adjusted Level of Significance (β)	0.0489						
4070					Approximate Chi Square Value (181.86, α)	151.7	Adjusted Chi Square Value (181.86, β)	151.5				
4071					95% Gamma Approximate UCL (use when n>=50)	0.219	95% Gamma Adjusted UCL (use when n<50)	N/A				
4072												
4073					**Estimates of Gamma Parameters using KM Estimates**							
4074					Mean (KM)	0.182	SD (KM)	0.22				
4075					Variance (KM)	0.0485	SE of Mean (KM)	0.0804				
4076					k hat (KM)	0.681	k star (KM)	0.675				
4077					nu hat (KM)	290.3	nu star (KM)	287.6				
4078					theta hat (KM)	0.267	theta star (KM)	0.269				
4079					80% gamma percentile (KM)	0.299	90% gamma percentile (KM)	0.46				
4080					95% gamma percentile (KM)	0.627	99% gamma percentile (KM)	1.026				
4081												
4082					**Gamma Kaplan-Meier (KM) Statistics**							
4083					Approximate Chi Square Value (287.56, α)	249.3	Adjusted Chi Square Value (287.56, β)	249				
4084					5% Gamma Approximate KM-UCL (use when n>=50)	0.21	95% Gamma Adjusted KM-UCL (use when n<50)	0.21				
4085												
4086					**Lognormal GOF Test on Detected Observations Only**							
4087					Shapiro Wilk Test Statistic	0.928	**Shapiro Wilk GOF Test**					

4088				5% Shapiro Wilk Critical Value		0.748	Detected Data appear Lognormal at 5% Significance Level					
4089				Lilliefors Test Statistic		0.296	**Lilliefors GOF Test**					
4090				5% Lilliefors Critical Value		0.375	Detected Data appear Lognormal at 5% Significance Level					
4091	**Detected Data appear Lognormal at 5% Significance Level**											
4092												
4093	**Lognormal ROS Statistics Using Imputed Non-Detects**											
4094				Mean in Original Scale		0.266	Mean in Log Scale					-2.741
4095				SD in Original Scale		0.665	SD in Log Scale					1.745
4096			95% t UCL (assumes normality of ROS data)			0.342	95% Percentile Bootstrap UCL					0.348
4097				95% BCA Bootstrap UCL		0.366	95% Bootstrap t UCL					0.372
4098				95% H-UCL (Log ROS)		0.417						
4099												
4100	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
4101				KM Mean (logged)		-2.345	KM Geo Mean					0.0959
4102				KM SD (logged)		1.072	95% Critical H Value (KM-Log)					2.208
4103				KM Standard Error of Mean (logged)		0.392	95% H-UCL (KM -Log)					0.2
4104				KM SD (logged)		1.072	95% Critical H Value (KM-Log)					2.208
4105				KM Standard Error of Mean (logged)		0.392						
4106												
4107	**DL/2 Statistics**											
4108	**DL/2 Normal**						**DL/2 Log-Transformed**					
4109				Mean in Original Scale		0.961	Mean in Log Scale					-0.13
4110				SD in Original Scale		0.183	SD in Log Scale					0.659
4111				95% t UCL (Assumes normality)		0.982	95% H-Stat UCL					1.189
4112	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
4113												
4114	**Nonparametric Distribution Free UCL Statistics**											
4115	**Detected Data appear Normal Distributed at 5% Significance Level**											
4116												
4117	**Suggested UCL to Use**											
4118				95% KM (t) UCL		0.315						
4119												
4120	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4121	Recommendations are based upon data size, data distribution, and skewness.											
4122	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4123	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4124												
4125	**Result (eu9_cadmium)**											
4126												
4127	**General Statistics**											
4128				Total Number of Observations		216	Number of Distinct Observations					156
4129				Number of Detects		191	Number of Non-Detects					25
4130				Number of Distinct Detects		154	Number of Distinct Non-Detects					2
4131				Minimum Detect		0.506	Minimum Non-Detect					0.05
4132				Maximum Detect		23.7	Maximum Non-Detect					0.5
4133				Variance Detects		6.968	Percent Non-Detects					11.57%
4134				Mean Detects		1.614	SD Detects					2.64
4135				Median Detects		1.06	CV Detects					1.636
4136				Skewness Detects		6.474	Kurtosis Detects					45.07
4137				Mean of Logged Detects		0.168	SD of Logged Detects					0.6
4138												
4139	**Normal GOF Test on Detects Only**											
4140				Shapiro Wilk Test Statistic		0.329	**Normal GOF Test on Detected Observations Only**					
4141				5% Shapiro Wilk P Value		0	Detected Data Not Normal at 5% Significance Level					
4142				Lilliefors Test Statistic		0.337	**Lilliefors GOF Test**					
4143				5% Lilliefors Critical Value		0.0645	Detected Data Not Normal at 5% Significance Level					
4144	**Detected Data Not Normal at 5% Significance Level**											
4145												
4146	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
4147				KM Mean		1.433	KM Standard Error of Mean					0.172
4148				KM SD		2.526	95% KM (BCA) UCL					1.738
4149				95% KM (t) UCL		1.717	95% KM (Percentile Bootstrap) UCL					1.742
4150				95% KM (z) UCL		1.716	95% KM Bootstrap t UCL					1.896
4151				90% KM Chebyshev UCL		1.95	95% KM Chebyshev UCL					2.184
4152				97.5% KM Chebyshev UCL		2.509	99% KM Chebyshev UCL					3.147
4153												
4154	**Gamma GOF Tests on Detected Observations Only**											

4155				A-D Test Statistic	17.62	**Anderson-Darling GOF Test**						
4156				5% A-D Critical Value	0.769	Detected Data Not Gamma Distributed at 5% Significance Level						
4157				K-S Test Statistic	0.216	**Kolmogorov-Smirnov GOF**						
4158				5% K-S Critical Value	0.067	Detected Data Not Gamma Distributed at 5% Significance Level						
4159				**Detected Data Not Gamma Distributed at 5% Significance Level**								
4160												
4161				**Gamma Statistics on Detected Data Only**								
4162				k hat (MLE)	1.759	k star (bias corrected MLE)	1.735					
4163				Theta hat (MLE)	0.918	Theta star (bias corrected MLE)	0.93					
4164				nu hat (MLE)	671.9	nu star (bias corrected)	662.6					
4165				Mean (detects)	1.614							
4166												
4167				**Gamma ROS Statistics using Imputed Non-Detects**								
4168				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
4169				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)								
4170				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
4171				This is especially true when the sample size is small.								
4172				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
4173				Minimum	0.01	Mean	1.428					
4174				Maximum	23.7	Median	0.973					
4175				SD	2.534	CV	1.775					
4176				k hat (MLE)	0.801	k star (bias corrected MLE)	0.793					
4177				Theta hat (MLE)	1.783	Theta star (bias corrected MLE)	1.801					
4178				nu hat (MLE)	346.1	nu star (bias corrected)	342.6					
4179				Adjusted Level of Significance (β)	0.0489							
4180				Approximate Chi Square Value (342.60, α)	300.7	Adjusted Chi Square Value (342.60, β)	300.4					
4181				95% Gamma Approximate UCL (use when n>=50)	1.627	95% Gamma Adjusted UCL (use when n<50)	1.628					
4182												
4183				**Estimates of Gamma Parameters using KM Estimates**								
4184				Mean (KM)	1.433	SD (KM)	2.526					
4185				Variance (KM)	6.38	SE of Mean (KM)	0.172					
4186				k hat (KM)	0.322	k star (KM)	0.32					
4187				nu hat (KM)	139	nu star (KM)	138.4					
4188				theta hat (KM)	4.453	theta star (KM)	4.472					
4189				80% gamma percentile (KM)	2.231	90% gamma percentile (KM)	4.19					
4190				95% gamma percentile (KM)	6.416	99% gamma percentile (KM)	12.15					
4191												
4192				**Gamma Kaplan-Meier (KM) Statistics**								
4193				Approximate Chi Square Value (138.40, α)	112.2	Adjusted Chi Square Value (138.40, β)	112.1					
4194				5% Gamma Approximate KM-UCL (use when n>=50)	1.767	95% Gamma Adjusted KM-UCL (use when n<50)	1.769					
4195												
4196				**Lognormal GOF Test on Detected Observations Only**								
4197				Shapiro Wilk Approximate Test Statistic	0.824	**Shapiro Wilk GOF Test**						
4198				5% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 5% Significance Level						
4199				Lilliefors Test Statistic	0.129	**Lilliefors GOF Test**						
4200				5% Lilliefors Critical Value	0.0645	Detected Data Not Lognormal at 5% Significance Level						
4201				**Detected Data Not Lognormal at 5% Significance Level**								
4202												
4203				**Lognormal ROS Statistics Using Imputed Non-Detects**								
4204				Mean in Original Scale	1.466	Mean in Log Scale	0.0201					
4205				SD in Original Scale	2.515	SD in Log Scale	0.702					
4206				95% t UCL (assumes normality of ROS data)	1.749	95% Percentile Bootstrap UCL	1.768					
4207				95% BCA Bootstrap UCL	1.843	95% Bootstrap t UCL	1.892					
4208				95% H-UCL (Log ROS)	1.431							
4209												
4210				**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**								
4211				KM Mean (logged)	-0.198	KM Geo Mean	0.82					
4212				KM SD (logged)	1.158	95% Critical H Value (KM-Log)	2.285					
4213				KM Standard Error of Mean (logged)	0.079	95% H-UCL (KM -Log)	1.921					
4214				KM SD (logged)	1.158	95% Critical H Value (KM-Log)	2.285					
4215				KM Standard Error of Mean (logged)	0.079							
4216												
4217				**DL/2 Statistics**								
4218				**DL/2 Normal**		**DL/2 Log-Transformed**						
4219				Mean in Original Scale	1.452	Mean in Log Scale	-0.0545					
4220				SD in Original Scale	2.522	SD in Log Scale	0.884					
4221				95% t UCL (Assumes normality)	1.735	95% H-Stat UCL	1.584					

	A	B	C	D	E	F	G	H	I	J	K	L
4222	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
4223												
4224	**Nonparametric Distribution Free UCL Statistics**											
4225	**Data do not follow a Discernible Distribution at 5% Significance Level**											
4226												
4227	**Suggested UCL to Use**											
4228	95% KM (Chebyshev) UCL					2.184						
4229												
4230	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4231	Recommendations are based upon data size, data distribution, and skewness.											
4232	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4233	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4234												
4235	**Result (eu9_chromium)**											
4236												
4237	**General Statistics**											
4238	Total Number of Observations					216			Number of Distinct Observations			4
4239	Number of Detects					1			Number of Non-Detects			215
4240	Number of Distinct Detects					1			Number of Distinct Non-Detects			3
4241												
4242	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
4243	**gested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, B**											
4244												
4245	**The data set for variable Result (eu9_chromium) was not processed!**											
4246												
4247												
4248	**Result (eu9_cobalt)**											
4249												
4250	**General Statistics**											
4251	Total Number of Observations					126			Number of Distinct Observations			35
4252	Number of Detects					36			Number of Non-Detects			90
4253	Number of Distinct Detects					34			Number of Distinct Non-Detects			1
4254	Minimum Detect					0.06			Minimum Non-Detect			0.5
4255	Maximum Detect					1.38			Maximum Non-Detect			0.5
4256	Variance Detects					0.0882			Percent Non-Detects			71.43%
4257	Mean Detects					0.69			SD Detects			0.297
4258	Median Detects					0.682			CV Detects			0.431
4259	Skewness Detects					-0.0115			Kurtosis Detects			-0.0739
4260	Mean of Logged Detects					-0.508			SD of Logged Detects			0.62
4261												
4262	**Normal GOF Test on Detects Only**											
4263	Shapiro Wilk Test Statistic					0.981			**Shapiro Wilk GOF Test**			
4264	5% Shapiro Wilk Critical Value					0.935			Detected Data appear Normal at 5% Significance Level			
4265	Lilliefors Test Statistic					0.0912			**Lilliefors GOF Test**			
4266	5% Lilliefors Critical Value					0.145			Detected Data appear Normal at 5% Significance Level			
4267	**Detected Data appear Normal at 5% Significance Level**											
4268												
4269	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
4270	KM Mean					0.393			KM Standard Error of Mean			0.0473
4271	KM SD					0.272			95% KM (BCA) UCL			0.48
4272	95% KM (t) UCL					0.471			95% KM (Percentile Bootstrap) UCL			0.472
4273	95% KM (z) UCL					0.471			95% KM Bootstrap t UCL			0.495
4274	90% KM Chebyshev UCL					0.535			95% KM Chebyshev UCL			0.599
4275	97.5% KM Chebyshev UCL					0.688			99% KM Chebyshev UCL			0.864
4276												
4277	**Gamma GOF Tests on Detected Observations Only**											
4278	A-D Test Statistic					0.982			**Anderson-Darling GOF Test**			
4279	5% A-D Critical Value					0.753			Detected Data Not Gamma Distributed at 5% Significance Level			
4280	K-S Test Statistic					0.158			**Kolmogorov-Smirnov GOF**			
4281	5% K-S Critical Value					0.148			Detected Data Not Gamma Distributed at 5% Significance Level			
4282	**Detected Data Not Gamma Distributed at 5% Significance Level**											
4283												
4284	**Gamma Statistics on Detected Data Only**											
4285	k hat (MLE)					3.817			k star (bias corrected MLE)			3.518
4286	Theta hat (MLE)					0.181			Theta star (bias corrected MLE)			0.196
4287	nu hat (MLE)					274.9			nu star (bias corrected)			253.3
4288	Mean (detects)					0.69						

4289												
4290	**Gamma ROS Statistics using Imputed Non-Detects**											
4291	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
4292	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)											
4293	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
4294	This is especially true when the sample size is small.											
4295	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
4296						Minimum	0.01				Mean	0.372
4297						Maximum	1.38				Median	0.322
4298						SD	0.29				CV	0.778
4299						k hat (MLE)	1.205				k star (bias corrected MLE)	1.182
4300						Theta hat (MLE)	0.309				Theta star (bias corrected MLE)	0.315
4301						nu hat (MLE)	303.8				nu star (bias corrected)	297.9
4302						Adjusted Level of Significance (β)	0.0481					
4303						Approximate Chi Square Value (297.88, α)	258.9				Adjusted Chi Square Value (297.88, β)	258.5
4304						95% Gamma Approximate UCL (use when n>=50)	0.428				95% Gamma Adjusted UCL (use when n<50)	0.429
4305												
4306	**Estimates of Gamma Parameters using KM Estimates**											
4307						Mean (KM)	0.393				SD (KM)	0.272
4308						Variance (KM)	0.0741				SE of Mean (KM)	0.0473
4309						k hat (KM)	2.082				k star (KM)	2.038
4310						nu hat (KM)	524.8				nu star (KM)	513.6
4311						theta hat (KM)	0.189				theta star (KM)	0.193
4312						80% gamma percentile (KM)	0.587				90% gamma percentile (KM)	0.761
4313						95% gamma percentile (KM)	0.926				99% gamma percentile (KM)	1.293
4314												
4315	**Gamma Kaplan-Meier (KM) Statistics**											
4316						Approximate Chi Square Value (513.62, α)	462.1				Adjusted Chi Square Value (513.62, β)	461.5
4317						5% Gamma Approximate KM-UCL (use when n>=50)	0.437				95% Gamma Adjusted KM-UCL (use when n<50)	0.437
4318												
4319	**Lognormal GOF Test on Detected Observations Only**											
4320						Shapiro Wilk Test Statistic	0.836				**Shapiro Wilk GOF Test**	
4321						5% Shapiro Wilk Critical Value	0.935				Detected Data Not Lognormal at 5% Significance Level	
4322						Lilliefors Test Statistic	0.204				**Lilliefors GOF Test**	
4323						5% Lilliefors Critical Value	0.145				Detected Data Not Lognormal at 5% Significance Level	
4324	**Detected Data Not Lognormal at 5% Significance Level**											
4325												
4326	**Lognormal ROS Statistics Using Imputed Non-Detects**											
4327						Mean in Original Scale	0.373				Mean in Log Scale	-1.236
4328						SD in Original Scale	0.273				SD in Log Scale	0.726
4329						95% t UCL (assumes normality of ROS data)	0.414				95% Percentile Bootstrap UCL	0.415
4330						95% BCA Bootstrap UCL	0.414				95% Bootstrap t UCL	0.416
4331						95% H-UCL (Log ROS)	0.43					
4332												
4333	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
4334						KM Mean (logged)	-1.199				KM Geo Mean	0.301
4335						KM SD (logged)	0.783				95% Critical H Value (KM-Log)	2.009
4336						KM Standard Error of Mean (logged)	0.202				95% H-UCL (KM -Log)	0.472
4337						KM SD (logged)	0.783				95% Critical H Value (KM-Log)	2.009
4338						KM Standard Error of Mean (logged)	0.202					
4339												
4340	**DL/2 Statistics**											
4341	**DL/2 Normal**										**DL/2 Log-Transformed**	
4342						Mean in Original Scale	0.376				Mean in Log Scale	-1.135
4343						SD in Original Scale	0.254				SD in Log Scale	0.516
4344						95% t UCL (Assumes normality)	0.413				95% H-Stat UCL	0.399
4345	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
4346												
4347	**Nonparametric Distribution Free UCL Statistics**											
4348	**Detected Data appear Normal Distributed at 5% Significance Level**											
4349												
4350	**Suggested UCL to Use**											
4351						95% KM (t) UCL	0.471					
4352												
4353	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4354	Recommendations are based upon data size, data distribution, and skewness.											
4355	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

	A	B	C	D	E	F	G	H	I	J	K	L
4356	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4357												
4358	**Result (eu9_copper)**											
4359												
4360	**General Statistics**											
4361	Total Number of Observations					216		Number of Distinct Observations				163
4362	Number of Detects					190		Number of Non-Detects				26
4363	Number of Distinct Detects					163		Number of Distinct Non-Detects				1
4364	Minimum Detect					2.1		Minimum Non-Detect				2.5
4365	Maximum Detect					110		Maximum Non-Detect				2.5
4366	Variance Detects					194.9		Percent Non-Detects				12.04%
4367	Mean Detects					14.82		SD Detects				13.96
4368	Median Detects					11.55		CV Detects				0.942
4369	Skewness Detects					3.509		Kurtosis Detects				16.43
4370	Mean of Logged Detects					2.42		SD of Logged Detects				0.722
4371												
4372	**Normal GOF Test on Detects Only**											
4373	Shapiro Wilk Test Statistic					0.676		**Normal GOF Test on Detected Observations Only**				
4374	5% Shapiro Wilk P Value					0		Detected Data Not Normal at 5% Significance Level				
4375	Lilliefors Test Statistic					0.196		**Lilliefors GOF Test**				
4376	5% Lilliefors Critical Value					0.0647		Detected Data Not Normal at 5% Significance Level				
4377	**Detected Data Not Normal at 5% Significance Level**											
4378												
4379	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
4380	KM Mean					13.31		KM Standard Error of Mean				0.934
4381	KM SD					13.69		95% KM (BCA) UCL				14.92
4382	95% KM (t) UCL					14.85		95% KM (Percentile Bootstrap) UCL				14.99
4383	95% KM (z) UCL					14.85		95% KM Bootstrap t UCL				15.21
4384	90% KM Chebyshev UCL					16.11		95% KM Chebyshev UCL				17.38
4385	97.5% KM Chebyshev UCL					19.14		99% KM Chebyshev UCL				22.6
4386												
4387	**Gamma GOF Tests on Detected Observations Only**											
4388	A-D Test Statistic					2.466		**Anderson-Darling GOF Test**				
4389	5% A-D Critical Value					0.767		Detected Data Not Gamma Distributed at 5% Significance Level				
4390	K-S Test Statistic					0.0884		**Kolmogorov-Smirnov GOF**				
4391	5% K-S Critical Value					0.0671		Detected Data Not Gamma Distributed at 5% Significance Level				
4392	**Detected Data Not Gamma Distributed at 5% Significance Level**											
4393												
4394	**Gamma Statistics on Detected Data Only**											
4395	k hat (MLE)					1.963		k star (bias corrected MLE)				1.936
4396	Theta hat (MLE)					7.552		Theta star (bias corrected MLE)				7.659
4397	nu hat (MLE)					746		nu star (bias corrected)				735.5
4398	Mean (detects)					14.82						
4399												
4400	**Gamma ROS Statistics using Imputed Non-Detects**											
4401	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
4402	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)											
4403	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
4404	This is especially true when the sample size is small.											
4405	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
4406	Minimum					0.01		Mean				13.04
4407	Maximum					110		Median				10.65
4408	SD					13.95		CV				1.07
4409	k hat (MLE)					0.619		k star (bias corrected MLE)				0.614
4410	Theta hat (MLE)					21.06		Theta star (bias corrected MLE)				21.25
4411	nu hat (MLE)					267.5		nu star (bias corrected)				265.1
4412	Adjusted Level of Significance (β)					0.0489						
4413	Approximate Chi Square Value (265.09, α)					228.4		Adjusted Chi Square Value (265.09, β)				228.2
4414	95% Gamma Approximate UCL (use when n>=50)					15.14		95% Gamma Adjusted UCL (use when n<50)				15.15
4415												
4416	**Estimates of Gamma Parameters using KM Estimates**											
4417	Mean (KM)					13.31		SD (KM)				13.69
4418	Variance (KM)					187.3		SE of Mean (KM)				0.934
4419	k hat (KM)					0.946		k star (KM)				0.936
4420	nu hat (KM)					408.7		nu star (KM)				404.3
4421	theta hat (KM)					14.07		theta star (KM)				14.22
4422	80% gamma percentile (KM)					21.53		90% gamma percentile (KM)				31.15

4423					95% gamma percentile (KM)	40.82				99% gamma percentile (KM)		63.39
4424												
4425					**Gamma Kaplan-Meier (KM) Statistics**							
4426					Approximate Chi Square Value (404.31, α)	358.7				Adjusted Chi Square Value (404.31, β)		358.4
4427	5% Gamma Approximate KM-UCL (use when n>=50)					15				95% Gamma Adjusted KM-UCL (use when n<50)		15.02
4428												
4429					**Lognormal GOF Test on Detected Observations Only**							
4430					Shapiro Wilk Approximate Test Statistic	0.976				**Shapiro Wilk GOF Test**		
4431					5% Shapiro Wilk P Value	0.148				Detected Data appear Lognormal at 5% Significance Level		
4432					Lilliefors Test Statistic	0.0514				**Lilliefors GOF Test**		
4433					5% Lilliefors Critical Value	0.0647				Detected Data appear Lognormal at 5% Significance Level		
4434					**Detected Data appear Lognormal at 5% Significance Level**							
4435												
4436					**Lognormal ROS Statistics Using Imputed Non-Detects**							
4437					Mean in Original Scale	13.33				Mean in Log Scale		2.229
4438					SD in Original Scale	13.7				SD in Log Scale		0.86
4439					95% t UCL (assumes normality of ROS data)	14.87				95% Percentile Bootstrap UCL		14.96
4440					95% BCA Bootstrap UCL	15.33				95% Bootstrap t UCL		15.21
4441					95% H-UCL (Log ROS)	15.16						
4442												
4443					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
4444					KM Mean (logged)	2.226				KM Geo Mean		9.267
4445					KM SD (logged)	0.856				95% Critical H Value (KM-Log)		2.032
4446					KM Standard Error of Mean (logged)	0.0587				95% H-UCL (KM -Log)		15.05
4447					KM SD (logged)	0.856				95% Critical H Value (KM-Log)		2.032
4448					KM Standard Error of Mean (logged)	0.0587						
4449												
4450					**DL/2 Statistics**							
4451					**DL/2 Normal**					**DL/2 Log-Transformed**		
4452					Mean in Original Scale	13.19				Mean in Log Scale		2.156
4453					SD in Original Scale	13.82				SD in Log Scale		0.986
4454					95% t UCL (Assumes normality)	14.74				95% H-Stat UCL		16.21
4455					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
4456												
4457					**Nonparametric Distribution Free UCL Statistics**							
4458					**Detected Data appear Lognormal Distributed at 5% Significance Level**							
4459												
4460					**Suggested UCL to Use**							
4461					KM H-UCL	15.05						
4462												
4463	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4464	Recommendations are based upon data size, data distribution, and skewness.											
4465	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4466	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4467												
4468	**Result (eu9_iron)**											
4469												
4470					**General Statistics**							
4471					Total Number of Observations	213				Number of Distinct Observations		132
4472					Number of Detects	153				Number of Non-Detects		60
4473					Number of Distinct Detects	130				Number of Distinct Non-Detects		2
4474					Minimum Detect	9				Minimum Non-Detect		2.1
4475					Maximum Detect	8690				Maximum Non-Detect		100
4476					Variance Detects	1157866				Percent Non-Detects		28.17%
4477					Mean Detects	470.2				SD Detects		1076
4478					Median Detects	232				CV Detects		2.288
4479					Skewness Detects	5.918				Kurtosis Detects		36.8
4480					Mean of Logged Detects	5.589				SD of Logged Detects		0.831
4481												
4482					**Normal GOF Test on Detects Only**							
4483					Shapiro Wilk Test Statistic	0.306				**Normal GOF Test on Detected Observations Only**		
4484					5% Shapiro Wilk P Value	0				Detected Data Not Normal at 5% Significance Level		
4485					Lilliefors Test Statistic	0.378				**Lilliefors GOF Test**		
4486					5% Lilliefors Critical Value	0.072				Detected Data Not Normal at 5% Significance Level		
4487					**Detected Data Not Normal at 5% Significance Level**							
4488												
4489					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							

4490					KM Mean	343.1				KM Standard Error of Mean		64.1
4491					KM SD	931.5				95% KM (BCA) UCL		465.3
4492					95% KM (t) UCL	449				95% KM (Percentile Bootstrap) UCL		461.5
4493					95% KM (z) UCL	448.5				95% KM Bootstrap t UCL		518.2
4494					90% KM Chebyshev UCL	535.4				95% KM Chebyshev UCL		622.5
4495					97.5% KM Chebyshev UCL	743.4				99% KM Chebyshev UCL		980.9
4496												
4497					**Gamma GOF Tests on Detected Observations Only**							
4498					A-D Test Statistic	14.56				**Anderson-Darling GOF Test**		
4499					5% A-D Critical Value	0.783				Detected Data Not Gamma Distributed at 5% Significance Level		
4500					K-S Test Statistic	0.228				**Kolmogorov-Smirnov GOF**		
4501					5% K-S Critical Value	0.078				Detected Data Not Gamma Distributed at 5% Significance Level		
4502					**Detected Data Not Gamma Distributed at 5% Significance Level**							
4503												
4504					**Gamma Statistics on Detected Data Only**							
4505					k hat (MLE)	1.02				k star (bias corrected MLE)		1.004
4506					Theta hat (MLE)	461				Theta star (bias corrected MLE)		468.2
4507					nu hat (MLE)	312.1				nu star (bias corrected)		307.3
4508					Mean (detects)	470.2						
4509												
4510					**Gamma ROS Statistics using Imputed Non-Detects**							
4511					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
4512					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)							
4513					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
4514					This is especially true when the sample size is small.							
4515					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
4516					Minimum	0.01				Mean		337.8
4517					Maximum	8690				Median		176
4518					SD	935.5				CV		2.769
4519					k hat (MLE)	0.232				k star (bias corrected MLE)		0.231
4520					Theta hat (MLE)	1459				Theta star (bias corrected MLE)		1460
4521					nu hat (MLE)	98.65				nu star (bias corrected)		98.59
4522					Adjusted Level of Significance (β)	0.0489						
4523					Approximate Chi Square Value (98.59, α)	76.69				Adjusted Chi Square Value (98.59, β)		76.56
4524					95% Gamma Approximate UCL (use when n>=50)	434.3				95% Gamma Adjusted UCL (use when n<50)		435
4525												
4526					**Estimates of Gamma Parameters using KM Estimates**							
4527					Mean (KM)	343.1				SD (KM)		931.5
4528					Variance (KM)	867684				SE of Mean (KM)		64.1
4529					k hat (KM)	0.136				k star (KM)		0.137
4530					nu hat (KM)	57.8				nu star (KM)		58.32
4531					theta hat (KM)	2529				theta star (KM)		2506
4532					80% gamma percentile (KM)	344.7				90% gamma percentile (KM)		1002
4533					95% gamma percentile (KM)	1920				99% gamma percentile (KM)		4636
4534												
4535					**Gamma Kaplan-Meier (KM) Statistics**							
4536					Approximate Chi Square Value (58.32, α)	41.76				Adjusted Chi Square Value (58.32, β)		41.67
4537					5% Gamma Approximate KM-UCL (use when n>=50)	479.1				95% Gamma Adjusted KM-UCL (use when n<50)		480.2
4538												
4539					**Lognormal GOF Test on Detected Observations Only**							
4540					Shapiro Wilk Approximate Test Statistic	0.886				**Shapiro Wilk GOF Test**		
4541					5% Shapiro Wilk P Value	0				Detected Data Not Lognormal at 5% Significance Level		
4542					Lilliefors Test Statistic	0.107				**Lilliefors GOF Test**		
4543					5% Lilliefors Critical Value	0.072				Detected Data Not Lognormal at 5% Significance Level		
4544					**Detected Data Not Lognormal at 5% Significance Level**							
4545												
4546					**Lognormal ROS Statistics Using Imputed Non-Detects**							
4547					Mean in Original Scale	351.7				Mean in Log Scale		5.081
4548					SD in Original Scale	930.7				SD in Log Scale		1.11
4549					95% t UCL (assumes normality of ROS data)	457.1				95% Percentile Bootstrap UCL		465.1
4550					95% BCA Bootstrap UCL	500.4				95% Bootstrap t UCL		520.5
4551					95% H-UCL (Log ROS)	353.4						
4552												
4553					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
4554					KM Mean (logged)	4.531				KM Geo Mean		92.84
4555					KM SD (logged)	1.986				95% Critical H Value (KM-Log)		3.14
4556					KM Standard Error of Mean (logged)	0.207				95% H-UCL (KM -Log)		1023

4557				KM SD (logged)	1.986			95% Critical H Value (KM-Log)				3.14
4558			KM Standard Error of Mean (logged)		0.207							
4559												
4560					DL/2 Statistics							
4561				DL/2 Normal				DL/2 Log-Transformed				
4562				Mean in Original Scale	350.9			Mean in Log Scale				5.044
4563				SD in Original Scale	931			SD in Log Scale				1.232
4564			95% t UCL (Assumes normality)		456.3			95% H-Stat UCL				404.2
4565				DL/2 is not a recommended method, provided for comparisons and historical reasons								
4566												
4567					Nonparametric Distribution Free UCL Statistics							
4568					Data do not follow a Discernible Distribution at 5% Significance Level							
4569												
4570					Suggested UCL to Use							
4571				95% KM (Chebyshev) UCL	622.5							
4572												
4573	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4574	Recommendations are based upon data size, data distribution, and skewness.											
4575	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4576	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4577												
4578	**Result (eu9_lead)**											
4579												
4580					General Statistics							
4581				Total Number of Observations	216			Number of Distinct Observations				188
4582				Number of Detects	208			Number of Non-Detects				8
4583				Number of Distinct Detects	185			Number of Distinct Non-Detects				3
4584				Minimum Detect	0.513			Minimum Non-Detect				0.03
4585				Maximum Detect	58.2			Maximum Non-Detect				0.5
4586				Variance Detects	72.96			Percent Non-Detects				3.704%
4587				Mean Detects	6.528			SD Detects				8.542
4588				Median Detects	2.775			CV Detects				1.308
4589				Skewness Detects	2.579			Kurtosis Detects				8.635
4590				Mean of Logged Detects	1.25			SD of Logged Detects				1.085
4591												
4592					Normal GOF Test on Detects Only							
4593				Shapiro Wilk Test Statistic	0.684			Normal GOF Test on Detected Observations Only				
4594				5% Shapiro Wilk P Value	0			Detected Data Not Normal at 5% Significance Level				
4595				Lilliefors Test Statistic	0.241			Lilliefors GOF Test				
4596				5% Lilliefors Critical Value	0.0619			Detected Data Not Normal at 5% Significance Level				
4597					Detected Data Not Normal at 5% Significance Level							
4598												
4599					Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs							
4600				KM Mean	6.287			KM Standard Error of Mean				0.576
4601				KM SD	8.451			95% KM (BCA) UCL				7.22
4602				95% KM (t) UCL	7.24			95% KM (Percentile Bootstrap) UCL				7.218
4603				95% KM (z) UCL	7.235			95% KM Bootstrap t UCL				7.338
4604				90% KM Chebyshev UCL	8.017			95% KM Chebyshev UCL				8.8
4605				97.5% KM Chebyshev UCL	9.887			99% KM Chebyshev UCL				12.02
4606												
4607					Gamma GOF Tests on Detected Observations Only							
4608				A-D Test Statistic	7.81			Anderson-Darling GOF Test				
4609				5% A-D Critical Value	0.787			Detected Data Not Gamma Distributed at 5% Significance Level				
4610				K-S Test Statistic	0.166			Kolmogorov-Smirnov GOF				
4611				5% K-S Critical Value	0.0647			Detected Data Not Gamma Distributed at 5% Significance Level				
4612					Detected Data Not Gamma Distributed at 5% Significance Level							
4613												
4614					Gamma Statistics on Detected Data Only							
4615				k hat (MLE)	0.93			k star (bias corrected MLE)				0.92
4616				Theta hat (MLE)	7.016			Theta star (bias corrected MLE)				7.094
4617				nu hat (MLE)	387			nu star (bias corrected)				382.8
4618				Mean (detects)	6.528							
4619												
4620					Gamma ROS Statistics using Imputed Non-Detects							
4621	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
4622	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)											
4623	For such situations, GROS method may yield incorrect values of UCLs and BTVs											

4624	This is especially true when the sample size is small.											
4625	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
4626					Minimum	0.01			Mean	6.287		
4627					Maximum	58.2			Median	2.715		
4628					SD	8.471			CV	1.348		
4629					k hat (MLE)	0.744			k star (bias corrected MLE)	0.737		
4630					Theta hat (MLE)	8.445			Theta star (bias corrected MLE)	8.528		
4631					nu hat (MLE)	321.6			nu star (bias corrected)	318.5		
4632					Adjusted Level of Significance (β)	0.0489						
4633					Approximate Chi Square Value (318.46, α)	278.1			Adjusted Chi Square Value (318.46, β)	277.9		
4634					95% Gamma Approximate UCL (use when n>=50)	7.198			95% Gamma Adjusted UCL (use when n<50)	7.205		
4635												
4636	**Estimates of Gamma Parameters using KM Estimates**											
4637					Mean (KM)	6.287			SD (KM)	8.451		
4638					Variance (KM)	71.42			SE of Mean (KM)	0.576		
4639					k hat (KM)	0.553			k star (KM)	0.549		
4640					nu hat (KM)	239.1			nu star (KM)	237.1		
4641					theta hat (KM)	11.36			theta star (KM)	11.46		
4642					80% gamma percentile (KM)	10.36			90% gamma percentile (KM)	16.68		
4643					95% gamma percentile (KM)	23.36			99% gamma percentile (KM)	39.65		
4644												
4645	**Gamma Kaplan-Meier (KM) Statistics**											
4646					Approximate Chi Square Value (237.11, α)	202.5			Adjusted Chi Square Value (237.11, β)	202.2		
4647	5% Gamma Approximate KM-UCL (use when n>=50)					7.363			95% Gamma Adjusted KM-UCL (use when n<50)	7.371		
4648												
4649	**Lognormal GOF Test on Detected Observations Only**											
4650					Shapiro Wilk Approximate Test Statistic	0.94			**Shapiro Wilk GOF Test**			
4651					5% Shapiro Wilk P Value	7.069E-10			Detected Data Not Lognormal at 5% Significance Level			
4652					Lilliefors Test Statistic	0.0988			**Lilliefors GOF Test**			
4653					5% Lilliefors Critical Value	0.0619			Detected Data Not Lognormal at 5% Significance Level			
4654	**Detected Data Not Lognormal at 5% Significance Level**											
4655												
4656	**Lognormal ROS Statistics Using Imputed Non-Detects**											
4657					Mean in Original Scale	6.296			Mean in Log Scale	1.153		
4658					SD in Original Scale	8.465			SD in Log Scale	1.175		
4659					95% t UCL (assumes normality of ROS data)	7.247			95% Percentile Bootstrap UCL	7.258		
4660					95% BCA Bootstrap UCL	7.356			95% Bootstrap t UCL	7.351		
4661					95% H-UCL (Log ROS)	7.602						
4662												
4663	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
4664					KM Mean (logged)	1.074			KM Geo Mean	2.927		
4665					KM SD (logged)	1.391			95% Critical H Value (KM-Log)	2.506		
4666					KM Standard Error of Mean (logged)	0.0949			95% H-UCL (KM -Log)	9.777		
4667					KM SD (logged)	1.391			95% Critical H Value (KM-Log)	2.506		
4668					KM Standard Error of Mean (logged)	0.0949						
4669												
4670	**DL/2 Statistics**											
4671	**DL/2 Normal**								**DL/2 Log-Transformed**			
4672					Mean in Original Scale	6.292			Mean in Log Scale	1.116		
4673					SD in Original Scale	8.467			SD in Log Scale	1.293		
4674					95% t UCL (Assumes normality)	7.244			95% H-Stat UCL	8.704		
4675	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
4676												
4677	**Nonparametric Distribution Free UCL Statistics**											
4678	**Data do not follow a Discernible Distribution at 5% Significance Level**											
4679												
4680	**Suggested UCL to Use**											
4681					95% KM (Chebyshev) UCL	8.8						
4682												
4683	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4684	Recommendations are based upon data size, data distribution, and skewness.											
4685	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4686	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4687												
4688												
4689	**Result (eu9_manganese)**											
4690												

4691	**General Statistics**											
4692					Total Number of Observations	216				Number of Distinct Observations		188
4693										Number of Missing Observations		0
4694					Minimum	2.12				Mean		1111
4695					Maximum	33500				Median		444.5
4696					SD	3598				Std. Error of Mean		244.8
4697					Coefficient of Variation	3.24				Skewness		7.661
4698												
4699	**Normal GOF Test**											
4700					Shapiro Wilk Test Statistic	0.232				**Shapiro Wilk GOF Test**		
4701					5% Shapiro Wilk P Value	0				Data Not Normal at 5% Significance Level		
4702					Lilliefors Test Statistic	0.379				**Lilliefors GOF Test**		
4703					5% Lilliefors Critical Value	0.0607				Data Not Normal at 5% Significance Level		
4704	**Data Not Normal at 5% Significance Level**											
4705												
4706	**Assuming Normal Distribution**											
4707					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
4708					95% Student's-t UCL	1515				95% Adjusted-CLT UCL (Chen-1995)		1650
4709										95% Modified-t UCL (Johnson-1978)		1536
4710												
4711	**Gamma GOF Test**											
4712					A-D Test Statistic	17.55				**Anderson-Darling Gamma GOF Test**		
4713					5% A-D Critical Value	0.802				Data Not Gamma Distributed at 5% Significance Level		
4714					K-S Test Statistic	0.186				**Kolmogorov-Smirnov Gamma GOF Test**		
4715					5% K-S Critical Value	0.0646				Data Not Gamma Distributed at 5% Significance Level		
4716	**Data Not Gamma Distributed at 5% Significance Level**											
4717												
4718	**Gamma Statistics**											
4719					k hat (MLE)	0.689				k star (bias corrected MLE)		0.682
4720					Theta hat (MLE)	1613				Theta star (bias corrected MLE)		1628
4721					nu hat (MLE)	297.5				nu star (bias corrected)		294.7
4722					MLE Mean (bias corrected)	1111				MLE Sd (bias corrected)		1345
4723										Approximate Chi Square Value (0.05)		255.9
4724					Adjusted Level of Significance	0.0489				Adjusted Chi Square Value		255.7
4725												
4726	**Assuming Gamma Distribution**											
4727	95% Approximate Gamma UCL (use when n>=50))					1279				95% Adjusted Gamma UCL (use when n<50)		1280
4728												
4729	**Lognormal GOF Test**											
4730					Shapiro Wilk Test Statistic	0.833				**Shapiro Wilk Lognormal GOF Test**		
4731					5% Shapiro Wilk P Value	0				Data Not Lognormal at 5% Significance Level		
4732					Lilliefors Test Statistic	0.188				**Lilliefors Lognormal GOF Test**		
4733					5% Lilliefors Critical Value	0.0607				Data Not Lognormal at 5% Significance Level		
4734	**Data Not Lognormal at 5% Significance Level**											
4735												
4736	**Lognormal Statistics**											
4737					Minimum of Logged Data	0.751				Mean of logged Data		6.133
4738					Maximum of Logged Data	10.42				SD of logged Data		1.262
4739												
4740	**Assuming Lognormal Distribution**											
4741					95% H-UCL	1255				90% Chebyshev (MVUE) UCL		1360
4742					95% Chebyshev (MVUE) UCL	1517				97.5% Chebyshev (MVUE) UCL		1734
4743					99% Chebyshev (MVUE) UCL	2160						
4744												
4745	**Nonparametric Distribution Free UCL Statistics**											
4746	**Data do not follow a Discernible Distribution (0.05)**											
4747												
4748	**Nonparametric Distribution Free UCLs**											
4749					95% CLT UCL	1513				95% Jackknife UCL		1515
4750					95% Standard Bootstrap UCL	1508				95% Bootstrap-t UCL		1911
4751					95% Hall's Bootstrap UCL	1571				95% Percentile Bootstrap UCL		1545
4752					95% BCA Bootstrap UCL	1674						
4753					90% Chebyshev(Mean, Sd) UCL	1845				95% Chebyshev(Mean, Sd) UCL		2178
4754					97.5% Chebyshev(Mean, Sd) UCL	2639				99% Chebyshev(Mean, Sd) UCL		3546
4755												
4756	**Suggested UCL to Use**											
4757					95% Chebyshev (Mean, Sd) UCL	2178						

4758												
4759	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4760	Recommendations are based upon data size, data distribution, and skewness.											
4761	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4762	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4763												
4764												
4765	**Result (eu9_strontium)**											
4766												
4767	**General Statistics**											
4768						Total Number of Observations	87				Number of Distinct Observations	77	
4769											Number of Missing Observations	0
4770						Minimum	94				Mean	341.1
4771						Maximum	901				Median	337
4772						SD	179.4				Std. Error of Mean	19.23
4773						Coefficient of Variation	0.526				Skewness	0.694
4774												
4775	**Normal GOF Test**											
4776						Shapiro Wilk Test Statistic	0.89				**Shapiro Wilk GOF Test**	
4777						5% Shapiro Wilk P Value	1.7414E-8				Data Not Normal at 5% Significance Level	
4778						Lilliefors Test Statistic	0.187				**Lilliefors GOF Test**	
4779						5% Lilliefors Critical Value	0.0951				Data Not Normal at 5% Significance Level	
4780	**Data Not Normal at 5% Significance Level**											
4781												
4782	**Assuming Normal Distribution**											
4783						**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**	
4784						95% Student's-t UCL	373.1				95% Adjusted-CLT UCL (Chen-1995)	374.3
4785											95% Modified-t UCL (Johnson-1978)	373.3
4786												
4787	**Gamma GOF Test**											
4788						A-D Test Statistic	3.209				**Anderson-Darling Gamma GOF Test**	
4789						5% A-D Critical Value	0.757				Data Not Gamma Distributed at 5% Significance Level	
4790						K-S Test Statistic	0.186				**Kolmogorov-Smirnov Gamma GOF Test**	
4791						5% K-S Critical Value	0.0964				Data Not Gamma Distributed at 5% Significance Level	
4792	**Data Not Gamma Distributed at 5% Significance Level**											
4793												
4794	**Gamma Statistics**											
4795						k hat (MLE)	3.579				k star (bias corrected MLE)	3.464
4796						Theta hat (MLE)	95.3				Theta star (bias corrected MLE)	98.48
4797						nu hat (MLE)	622.8				nu star (bias corrected)	602.7
4798						MLE Mean (bias corrected)	341.1				MLE Sd (bias corrected)	183.3
4799											Approximate Chi Square Value (0.05)	546.7
4800						Adjusted Level of Significance	0.0472				Adjusted Chi Square Value	545.8
4801												
4802	**Assuming Gamma Distribution**											
4803	95% Approximate Gamma UCL (use when n>=50))						376				95% Adjusted Gamma UCL (use when n<50)	376.6
4804												
4805	**Lognormal GOF Test**											
4806						Shapiro Wilk Test Statistic	0.904				**Shapiro Wilk Lognormal GOF Test**	
4807						5% Shapiro Wilk P Value	3.8127E-7				Data Not Lognormal at 5% Significance Level	
4808						Lilliefors Test Statistic	0.185				**Lilliefors Lognormal GOF Test**	
4809						5% Lilliefors Critical Value	0.0951				Data Not Lognormal at 5% Significance Level	
4810	**Data Not Lognormal at 5% Significance Level**											
4811												
4812	**Lognormal Statistics**											
4813						Minimum of Logged Data	4.543				Mean of logged Data	5.686
4814						Maximum of Logged Data	6.804				SD of logged Data	0.559
4815												
4816	**Assuming Lognormal Distribution**											
4817						95% H-UCL	385.9				90% Chebyshev (MVUE) UCL	409.7
4818						95% Chebyshev (MVUE) UCL	439.6				97.5% Chebyshev (MVUE) UCL	481
4819						99% Chebyshev (MVUE) UCL	562.5					
4820												
4821	**Nonparametric Distribution Free UCL Statistics**											
4822	**Data do not follow a Discernible Distribution (0.05)**											
4823												
4824	**Nonparametric Distribution Free UCLs**											

4825					95% CLT UCL	372.7				95% Jackknife UCL		373.1
4826					95% Standard Bootstrap UCL	373.3				95% Bootstrap-t UCL		376.2
4827					95% Hall's Bootstrap UCL	374.3				95% Percentile Bootstrap UCL		372.6
4828					95% BCA Bootstrap UCL	373.7						
4829					90% Chebyshev(Mean, Sd) UCL	398.8				95% Chebyshev(Mean, Sd) UCL		424.9
4830					97.5% Chebyshev(Mean, Sd) UCL	461.2				99% Chebyshev(Mean, Sd) UCL		532.5
4831												
4832					**Suggested UCL to Use**							
4833					95% Chebyshev (Mean, Sd) UCL	424.9						
4834												
4835	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4836	Recommendations are based upon data size, data distribution, and skewness.											
4837	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4838	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4839												
4840	**Result (eu9_thallium)**											
4841												
4842					**General Statistics**							
4843					Total Number of Observations	213				Number of Distinct Observations		31
4844					Number of Detects	27				Number of Non-Detects		186
4845					Number of Distinct Detects	27				Number of Distinct Non-Detects		4
4846					Minimum Detect	6.09				Minimum Non-Detect		0.031
4847					Maximum Detect	28.3				Maximum Non-Detect		5
4848					Variance Detects	18.06				Percent Non-Detects		87.32%
4849					Mean Detects	9.973				SD Detects		4.25
4850					Median Detects	8.79				CV Detects		0.426
4851					Skewness Detects	3.268				Kurtosis Detects		13.56
4852					Mean of Logged Detects	2.243				SD of Logged Detects		0.316
4853												
4854					**Normal GOF Test on Detects Only**							
4855					Shapiro Wilk Test Statistic	0.665				**Shapiro Wilk GOF Test**		
4856					5% Shapiro Wilk Critical Value	0.923				Detected Data Not Normal at 5% Significance Level		
4857					Lilliefors Test Statistic	0.227				**Lilliefors GOF Test**		
4858					5% Lilliefors Critical Value	0.167				Detected Data Not Normal at 5% Significance Level		
4859					**Detected Data Not Normal at 5% Significance Level**							
4860												
4861					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
4862					KM Mean	1.291				KM Standard Error of Mean		0.253
4863					KM SD	3.626				95% KM (BCA) UCL		1.705
4864					95% KM (t) UCL	1.709				95% KM (Percentile Bootstrap) UCL		1.738
4865					95% KM (z) UCL	1.708				95% KM Bootstrap t UCL		1.818
4866					90% KM Chebyshev UCL	2.051				95% KM Chebyshev UCL		2.395
4867					97.5% KM Chebyshev UCL	2.872				99% KM Chebyshev UCL		3.81
4868												
4869					**Gamma GOF Tests on Detected Observations Only**							
4870					A-D Test Statistic	1.21				**Anderson-Darling GOF Test**		
4871					5% A-D Critical Value	0.744				Detected Data Not Gamma Distributed at 5% Significance Level		
4872					K-S Test Statistic	0.2				**Kolmogorov-Smirnov GOF**		
4873					5% K-S Critical Value	0.168				Detected Data Not Gamma Distributed at 5% Significance Level		
4874					**Detected Data Not Gamma Distributed at 5% Significance Level**							
4875												
4876					**Gamma Statistics on Detected Data Only**							
4877					k hat (MLE)	8.912				k star (bias corrected MLE)		7.946
4878					Theta hat (MLE)	1.119				Theta star (bias corrected MLE)		1.255
4879					nu hat (MLE)	481.2				nu star (bias corrected)		429.1
4880					Mean (detects)	9.973						
4881												
4882					**Gamma ROS Statistics using Imputed Non-Detects**							
4883	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
4884	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)											
4885	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
4886	This is especially true when the sample size is small.											
4887	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
4888					Minimum	0.01				Mean		1.706
4889					Maximum	28.3				Median		0.01
4890					SD	3.66				CV		2.145
4891					k hat (MLE)	0.218				k star (bias corrected MLE)		0.218

4892					Theta hat (MLE)	7.817			Theta star (bias corrected MLE)			7.815
4893					nu hat (MLE)	92.99			nu star (bias corrected)			93.01
4894				Adjusted Level of Significance (β)		0.0489						
4895				Approximate Chi Square Value (93.01, α)		71.77			Adjusted Chi Square Value (93.01, β)			71.64
4896			95% Gamma Approximate UCL (use when n>=50)			2.211			95% Gamma Adjusted UCL (use when n<50)			2.215
4897												
4898					**Estimates of Gamma Parameters using KM Estimates**							
4899					Mean (KM)	1.291			SD (KM)			3.626
4900					Variance (KM)	13.15			SE of Mean (KM)			0.253
4901					k hat (KM)	0.127			k star (KM)			0.128
4902					nu hat (KM)	54.03			nu star (KM)			54.6
4903					theta hat (KM)	10.18			theta star (KM)			10.07
4904				80% gamma percentile (KM)		1.216			90% gamma percentile (KM)			3.72
4905				95% gamma percentile (KM)		7.302			99% gamma percentile (KM)			18.06
4906												
4907					**Gamma Kaplan-Meier (KM) Statistics**							
4908				Approximate Chi Square Value (54.60, α)		38.62			Adjusted Chi Square Value (54.60, β)			38.53
4909	5% Gamma Approximate KM-UCL (use when n>=50)					1.825			95% Gamma Adjusted KM-UCL (use when n<50)			1.83
4910												
4911					**Lognormal GOF Test on Detected Observations Only**							
4912					Shapiro Wilk Test Statistic	0.877			**Shapiro Wilk GOF Test**			
4913					5% Shapiro Wilk Critical Value	0.923			Detected Data Not Lognormal at 5% Significance Level			
4914					Lilliefors Test Statistic	0.179			**Lilliefors GOF Test**			
4915					5% Lilliefors Critical Value	0.167			Detected Data Not Lognormal at 5% Significance Level			
4916					**Detected Data Not Lognormal at 5% Significance Level**							
4917												
4918					**Lognormal ROS Statistics Using Imputed Non-Detects**							
4919					Mean in Original Scale	3.526			Mean in Log Scale			0.964
4920					SD in Original Scale	3.179			SD in Log Scale			0.767
4921				95% t UCL (assumes normality of ROS data)		3.886			95% Percentile Bootstrap UCL			3.902
4922					95% BCA Bootstrap UCL	3.955			95% Bootstrap t UCL			3.959
4923					95% H-UCL (Log ROS)	3.901						
4924												
4925					**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**							
4926					KM Mean (logged)	-2.749			KM Geo Mean			0.064
4927					KM SD (logged)	1.905			95% Critical H Value (KM-Log)			3.05
4928				KM Standard Error of Mean (logged)		0.133			95% H-UCL (KM -Log)			0.585
4929					KM SD (logged)	1.905			95% Critical H Value (KM-Log)			3.05
4930				KM Standard Error of Mean (logged)		0.133						
4931												
4932					**DL/2 Statistics**							
4933					**DL/2 Normal**				**DL/2 Log-Transformed**			
4934					Mean in Original Scale	2.996			Mean in Log Scale			0.663
4935					SD in Original Scale	3.129			SD in Log Scale			1.223
4936				95% t UCL (Assumes normality)		3.35			95% H-Stat UCL			4.987
4937					**DL/2 is not a recommended method, provided for comparisons and historical reasons**							
4938												
4939					**Nonparametric Distribution Free UCL Statistics**							
4940					**Data do not follow a Discernible Distribution at 5% Significance Level**							
4941												
4942					**Suggested UCL to Use**							
4943					95% KM (t) UCL	1.709			KM H-UCL			0.585
4944					95% KM (BCA) UCL	1.705						
4945												
4946	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
4947	Recommendations are based upon data size, data distribution, and skewness.											
4948	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
4949	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
4950												
4951	**Result (eu9_zinc)**											
4952												
4953					**General Statistics**							
4954					Total Number of Observations	216			Number of Distinct Observations			168
4955					Number of Detects	215			Number of Non-Detects			1
4956					Number of Distinct Detects	167			Number of Distinct Non-Detects			1
4957					Minimum Detect	10.5			Minimum Non-Detect			10
4958					Maximum Detect	13400			Maximum Non-Detect			10

4959				Variance Detects	2185107			Percent Non-Detects	0.463%			
4960				Mean Detects	590			SD Detects	1478			
4961				Median Detects	344			CV Detects	2.506			
4962				Skewness Detects	7.429			Kurtosis Detects	56.56			
4963				Mean of Logged Detects	5.891			SD of Logged Detects	0.811			
4964												
4965				**Normal GOF Test on Detects Only**								
4966				Shapiro Wilk Test Statistic	0.221			**Normal GOF Test on Detected Observations Only**				
4967				5% Shapiro Wilk P Value	0			Detected Data Not Normal at 5% Significance Level				
4968				Lilliefors Test Statistic	0.397			**Lilliefors GOF Test**				
4969				5% Lilliefors Critical Value	0.0608			Detected Data Not Normal at 5% Significance Level				
4970				**Detected Data Not Normal at 5% Significance Level**								
4971												
4972				**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**								
4973				KM Mean	587.3			KM Standard Error of Mean	100.4			
4974				KM SD	1472			95% KM (BCA) UCL	782.1			
4975				95% KM (t) UCL	753.1			95% KM (Percentile Bootstrap) UCL	773.3			
4976				95% KM (z) UCL	752.4			95% KM Bootstrap t UCL	891.6			
4977				90% KM Chebyshev UCL	888.4			95% KM Chebyshev UCL	1025			
4978				97.5% KM Chebyshev UCL	1214			99% KM Chebyshev UCL	1586			
4979												
4980				**Gamma GOF Tests on Detected Observations Only**								
4981				A-D Test Statistic	29.93			**Anderson-Darling GOF Test**				
4982				5% A-D Critical Value	0.78			Detected Data Not Gamma Distributed at 5% Significance Level				
4983				K-S Test Statistic	0.26			**Kolmogorov-Smirnov GOF**				
4984				5% K-S Critical Value	0.0635			Detected Data Not Gamma Distributed at 5% Significance Level				
4985				**Detected Data Not Gamma Distributed at 5% Significance Level**								
4986												
4987				**Gamma Statistics on Detected Data Only**								
4988				k hat (MLE)	1.162			k star (bias corrected MLE)	1.148			
4989				Theta hat (MLE)	507.9			Theta star (bias corrected MLE)	513.7			
4990				nu hat (MLE)	499.5			nu star (bias corrected)	493.8			
4991				Mean (detects)	590							
4992												
4993				**Gamma ROS Statistics using Imputed Non-Detects**								
4994				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
4995				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)								
4996				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
4997				This is especially true when the sample size is small.								
4998				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
4999				Minimum	0.01			Mean	587.2			
5000				Maximum	13400			Median	344			
5001				SD	1475			CV	2.512			
5002				k hat (MLE)	1.075			k star (bias corrected MLE)	1.063			
5003				Theta hat (MLE)	546.4			Theta star (bias corrected MLE)	552.5			
5004				nu hat (MLE)	464.3			nu star (bias corrected)	459.2			
5005				Adjusted Level of Significance (β)	0.0489							
5006				Approximate Chi Square Value (459.19, α)	410.5			Adjusted Chi Square Value (459.19, β)	410.2			
5007				95% Gamma Approximate UCL (use when n>=50)	656.9			95% Gamma Adjusted UCL (use when n<50)	657.4			
5008												
5009				**Estimates of Gamma Parameters using KM Estimates**								
5010				Mean (KM)	587.3			SD (KM)	1472			
5011				Variance (KM)	2166424			SE of Mean (KM)	100.4			
5012				k hat (KM)	0.159			k star (KM)	0.16			
5013				nu hat (KM)	68.78			nu star (KM)	69.16			
5014				theta hat (KM)	3689			theta star (KM)	3669			
5015				80% gamma percentile (KM)	672.7			90% gamma percentile (KM)	1755			
5016				95% gamma percentile (KM)	3190			99% gamma percentile (KM)	7300			
5017												
5018				**Gamma Kaplan-Meier (KM) Statistics**								
5019				Approximate Chi Square Value (69.16, α)	51.01			Adjusted Chi Square Value (69.16, β)	50.91			
5020				5% Gamma Approximate KM-UCL (use when n>=50)	796.2			95% Gamma Adjusted KM-UCL (use when n<50)	797.8			
5021												
5022				**Lognormal GOF Test on Detected Observations Only**								
5023				Shapiro Wilk Approximate Test Statistic	0.72			**Shapiro Wilk GOF Test**				
5024				5% Shapiro Wilk P Value	0			Detected Data Not Lognormal at 5% Significance Level				
5025				Lilliefors Test Statistic	0.217			**Lilliefors GOF Test**				

5026	5% Lilliefors Critical Value					0.0608	Detected Data Not Lognormal at 5% Significance Level					
5027	**Detected Data Not Lognormal at 5% Significance Level**											
5028												
5029	**Lognormal ROS Statistics Using Imputed Non-Detects**											
5030	Mean in Original Scale					587.5	Mean in Log Scale					5.882
5031	SD in Original Scale					1475	SD in Log Scale					0.82
5032	95% t UCL (assumes normality of ROS data)					753.3	95% Percentile Bootstrap UCL					770.7
5033	95% BCA Bootstrap UCL					837.3	95% Bootstrap t UCL					936.6
5034	95% H-UCL (Log ROS)					561.6						
5035												
5036	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
5037	KM Mean (logged)					5.875	KM Geo Mean					356
5038	KM SD (logged)					0.843	95% Critical H Value (KM-Log)					2.023
5039	KM Standard Error of Mean (logged)					0.0575	95% H-UCL (KM -Log)					570.6
5040	KM SD (logged)					0.843	95% Critical H Value (KM-Log)					2.023
5041	KM Standard Error of Mean (logged)					0.0575						
5042												
5043	**DL/2 Statistics**											
5044	**DL/2 Normal**						**DL/2 Log-Transformed**					
5045	Mean in Original Scale					587.3	Mean in Log Scale					5.872
5046	SD in Original Scale					1475	SD in Log Scale					0.86
5047	95% t UCL (Assumes normality)					753.1	95% H-Stat UCL					578.7
5048	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
5049												
5050	**Nonparametric Distribution Free UCL Statistics**											
5051	**Data do not follow a Discernible Distribution at 5% Significance Level**											
5052												
5053	**Suggested UCL to Use**											
5054	95% KM (Chebyshev) UCL					1025						
5055												
5056	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
5057	Recommendations are based upon data size, data distribution, and skewness.											
5058	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
5059	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia											
5060												

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.14/23/2019 10:29:47 AM
From File	BkgCompare_FishEU8_Input_Pb_v3.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Lead

Sample 2 Data: BkgLead

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	8	5
Number of Distinct Observations	8	5
Minimum	0.0108	0.0159
Maximum	0.0685	0.142
Mean	0.0368	0.0762
Median	0.0413	0.0976
SD	0.0224	0.0545
SE of Mean	0.00793	0.0244

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	46
WMW U-Stat	10
Mean (U)	20
SD(U) - Adj ties	6.831
WMW U-Stat Critical Value (0.05)	9
Standardized WMW U-Stat	-1.537
Approximate P-Value	0.0621

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.14/23/2019 10:25:20 AM
From File	BkgCompare_FishEU9_Input_Pb_v3.xls
Full Precision	OFF
Confidence Coefficient	95%
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Lead

Sample 2 Data: BkgLead

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	5	5
Number of Non-Detects	1	4
Number of Detect Data	4	1
Minimum Non-Detect	0.0101	0.0104
Maximum Non-Detect	0.0101	0.0112
Percent Non-detects	20.00%	80.00%
Minimum Detect	0.0119	0.0117
Maximum Detect	0.0609	0.0117
Mean of Detects	0.0264	0.0117
Median of Detects	0.0164	0.0117
SD of Detects	0.0232	N/A

WMW test is meant for a Single Detection Limit Case

of Gehan or T-W test is suggested when multiple detection limits are prese

All observations <= 0.0112 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	37
WMW U-Stat	22
Mean (U)	12.5
SD(U) - Adj ties	4.787
WMW U-Stat Critical Value (0.05)	5
Standardized WMW U-Stat	2.006
Approximate P-Value	0.978

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.14/23/2019 9:59:50 AM
From File	BPMD_HHRA_ATVGuide_SoilInput_Pb_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Lead

Sample 2 Data: BkgLead

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	34
Number of Distinct Observations	36	33
Minimum	46.7	10
Maximum	2540	431
Mean	336.8	100.4
Median	220.5	62.85
SD	451.1	119.8
SE of Mean	75.18	20.54

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1670
Standardized WMW U-Stat	4.595
Mean (U)	612
SD(U) - Adj ties	85.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.14/23/2019 10:03:20 AM
From File	BPMD_HHRA_ATVGuide_SoilInput_Smithetal_Pb_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Lead

Sample 2 Data: BkgLead

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	36	36
Number of Distinct Observations	36	36
Minimum	46.7	15.9
Maximum	2540	312
Mean	336.8	45.57
Median	220.5	30.25
SD	451.1	54.17
SE of Mean	75.18	9.029

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1907
Standardized WMW U-Stat	6.673
Mean (U)	648
SD(U) - Adj ties	88.79
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.14/23/2019 10:02:02 AM
From File	BPMD_HHRA_ATVRec_SoilInput_Pb_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Lead

Sample 2 Data: BkgLead

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	83	34
Number of Distinct Observations	81	33
Minimum	13.7	10
Maximum	18300	431
Mean	1252	100.4
Median	346	62.85
SD	2882	119.8
SE of Mean	316.3	20.54

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	5879
Standardized WMW U-Stat	5.889
Mean (U)	1411
SD(U) - Adj ties	166.6
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Uncensor Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.14/23/2019 10:04:39 AM
From File	BPMD_HHRA_ATVRec_SoilInput_Smithetal_Pb_v2.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Selected Null Hypothesis	Sample 1 Mean/Median >= Sample 2 Mean/Median (Form 2)
Alternative Hypothesis	Sample 1 Mean/Median < Sample 2 Mean/Median

Sample 1 Data: Lead

Sample 2 Data: BkgLead

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	83	36
Number of Distinct Observations	81	36
Minimum	13.7	15.9
Maximum	18300	312
Mean	1252	45.57
Median	346	30.25
SD	2882	54.17
SE of Mean	316.3	9.029

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6292
Standardized WMW U-Stat	7.584
Mean (U)	1494
SD(U) - Adj ties	172.9
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)

Appendix C

Derivation of Particulate Emission Factor for ATV Riding

1.0 Introduction

One pathway that humans may be exposed to contaminants in soil is by inhalation of particles of soil that become re-suspended in air. When reliable site-specific measurements of contaminant levels in air due to re-suspended soil particles are not available[1], the concentration of contaminants may be estimated as follows (U.S. Environmental Protection Agency [EPA] 1996, 2002):

$$C_{air} = C_{soil} \cdot PEF$$

where:

C_{air}	=	Concentration of contaminant in air (mg/m^3)
C_{soil}	=	Concentration of contaminant in soil (mg/kg)
PEF	=	Soil to air particulate emission factor (kg/m^3)

Note, the particulate emission factor (PEF) term in this equation is the inverse of the value presented in EPA (1996, 2002), which has units of m^3/kg.

The value of the PEF depends on a number of site-specific factors, such as soil conditions (e.g., soil moisture, vegetation cover, presence of rocks, soil type), as well as the nature of the soil disturbance activity (wind, mechanical disturbance) that leads to soil particle re-suspension in air. The following sections present the derivation of the PEF value used to estimate contaminant concentrations in air from the re-suspension of soil attributable to riding all-terrain vehicles (ATVs).

2.0 Estimation of the PEF

Site-specific data on particulate emissions during ATV riding were collected in the fall of 2018 in accordance with (EPA 2018a, 2018b). The ATV activity-based sampling (ABS) was conducted with single operators on two ATVs driven on the Alpine Loop within the confines of the Site and a remote roadway while the operators wore appropriate PPE in accordance with the governing SAP. The first ATV was the leader and the second ATV rider was the follower. The follower maintained a safe following distance, similar to what would be expected under normal ATV riding conditions (i.e., as if the operators were not wearing respirators). The distance between ATVs

[1] Site-specific measurements of contaminant levels in air due to re-suspended soil particles are available for ATV guides because samples from the entire Alpine Loop within the Site were collected in the fall of 2018. However, recreational ATV rider risk is evaluated based on all roadways at the Site, not just the Alpine Loop; therefore, it is necessary to predict air concentrations while riding outside the Alpine Loop.

depended on the terrain and amount of dust generated by the lead ATV; the following distance was less than 50 yards under less dusty conditions and was as much as 200 yards under very dry, dusty conditions. ATVs were operated at appropriate speeds depending on terrain and safety considerations. SKC-brand personal air samplers with cyclones were attached to each ATV to obtain the respirable dust (e.g., 4 microns); the intakes for these samplers were placed near the breathing zone of the ATV operator. Roadway soil and ATV ABS air samples were collected throughout the Alpine Loop and along remote location off of the Alpine Loop (on and near County Road 4). Site conditions during the sampling include the following:

- Roadways consisted of hard-packed soil with exposed bedrock, roadways are not graded/maintained with the exception of maintaining a stable shoulder.
- Wind speeds averaged about 8 miles per hour on both ATV ABS sampling days.

The PEF for ATV riding was estimated by taking the mean concentration in air generated during ATV use and dividing by the mean soil concentration for the corresponding roadways traversed during the ABS activity. This calculation is as follows:

$$PEF_{atv} = C_{air} / C_{soil}$$

where:

PEF_{atv}	=	Particulate emission factor for ATV riding (kg/m^3)
C_{air}	=	Concentration in air based on respirable dust ($\mu g/m^3$)
C_{soil}	=	Concentration in roadway soil ($\mu g/kg$)

For this evaluation, the PEF was calculated using air and soil data for manganese. This was because other metals analyzed in the ATV ABS air samples were either not detected, not selected as chemicals of potential concern, or lacking inhalation-specific toxicity information. It is not anticipated that release of metals in dust to air would be chemical-specific; thus, the manganese-specific PEF can be applied to all metals. When calculating the PEF, focus was also placed on the following rider because air concentrations for the leader were often non-detect. Use of a follower-specific PEF will provide conservative estimates of air concentrations for a leader rider. The detailed analytical results used to compute the PEF are presented in **Attachment 1.**

PEF values were calculated separately for both the Alpine loop and the remote location based on the inputs presented in **Table C-1** below. Based on these inputs, the resulting PEF for ATV riding is estimated to be 5.6E-07 kg/m^3 and 2.0E-07 kg/m^3 for the Alpine Loop and remote location, respectively.

Table C-1. Inputs Used to Calculate PEF for Recreational ATV Riding

Location	Parameter	Parameter Definition	Value	Units	Notes
Alpine Loop	C_{air}	Concentration in air based on PM10 dust	0.762	µg/m^3	Mean manganese air concentration for following rider from the Alpine Loop.
	C_{soil}	Concentration in roadway soil	1.35E+06	µg/kg	Mean roadway soil concentration for samples from the Alpine Loop.
Remote Location	C_{air}	Concentration in air based on PM10 dust	0.585	µg/m^3	Mean manganese air concentration for following rider from the remote location.
	C_{soil}	Concentration in roadway soil	2.92E+06	µg/kg	Mean roadway soil concentration for samples from the remote location.

Note, the PEF values for both locations are generally similar (within a factor of 3 of each other). This is expected because the road conditions for the Alpine Loop and the remote location were generally similar. For the purposes of estimating air concentrations for use in the risk calculations, the PEF for the Alpine Loop (5.6E-07 kg/m^3) was selected because it will result in higher predicted air concentrations and, hence, more conservative risk estimates.

3.0 References

EPA. 1996. U.S. Environmental Protection Agency. *Soil Screening Guidance: Technical Background Document.* Office of Solid Waste and Emergency Response, Washington, D.C. EPA/540/R-95/128. May.

EPA. 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.* OSWER 9355.4-24. December.

EPA. 2018a. *Bonita Peak Mining District Quality Assurance Project Plan.* Prepared for the U.S. Environmental Protection Agency by CDM Federal Programs Corporation. Revision 2 - July.

EPA. 2018b. *Bonita Peak Mining District, Field Sampling Plan: 2018 All-Terrain Vehicle Activity-Based Sampling Investigation, Revision 0.* September.

ATTACHMENT 1. ANALYTICAL RESULTS FOR ROADWAY SOIL AND ATV ABS AIR

Bonita Peak Mining District

Panel A. Roadway Soil - Alpine Loop

Samp_No	Sample Date	Location	Sub_Location	Analytical Method	Extraction_Method	CAS_NO	Analyte	Result	Result_ Qualifier	Lab_Result _Qualifier	Result_ Units	MDL	MDL_Units
MH1E32	7/26/16	RD1CR1	RD1CR1	ISM02.3	3050B	7439-96-5	Manganese	1370			mg/kg	0.063	mg/kg
MH1E33	7/27/16	RD1CR2	RD1CR2	ISM02.3	3050B	7439-96-5	Manganese	1930		D*	mg/kg	0.12	mg/kg
MH1E35	7/27/16	RD1CR3	RD1CR3	ISM02.3	3050B	7439-96-5	Manganese	1340		*	mg/kg	0.061	mg/kg
MH1E40	7/27/16	RD2CR1	RD2CR1	ISM02.3	3050B	7439-96-5	Manganese	1180		*	mg/kg	0.063	mg/kg
MH1E41	7/27/16	RD2CR2	RD2CR2	ISM02.3	3050B	7439-96-5	Manganese	1310		*	mg/kg	0.063	mg/kg
MH1E43	7/27/16	RD2CR3	RD2CR3	ISM02.3	3050B	7439-96-5	Manganese	1070		*	mg/kg	0.063	mg/kg
MH1E45	7/27/16	RD2CR5	RD2CR5	ISM02.3	3050B	7439-96-5	Manganese	1360		*	mg/kg	0.065	mg/kg
MH1E57	7/27/16	RDCC2	RDCC2	ISM02.3	3050B	7439-96-5	Manganese	424	J	*	mg/kg	0.064	mg/kg
MH1E58	7/27/16	RDCC3	RDCC3	ISM02.3	3050B	7439-96-5	Manganese	713	J	*	mg/kg	0.065	mg/kg
MH1E59	7/27/16	RDCC4	RDCC4	ISM02.3	3050B	7439-96-5	Manganese	1180	J	*	mg/kg	0.064	mg/kg
MH1E66	7/27/16	RDCC4	RDCC4	ISM02.3	3050B	7439-96-5	Manganese	900	J	*	mg/kg	0.064	mg/kg
MH1E60	7/27/16	RDCC5	RDCC5	ISM02.3	3050B	7439-96-5	Manganese	796	J	*	mg/kg	0.064	mg/kg
MH1E61	7/27/16	RDCC6	RDCC6	ISM02.3	3050B	7439-96-5	Manganese	847	J	*	mg/kg	0.064	mg/kg
MH1E63	7/27/16	RDCC7	RDCC7	ISM02.3	3050B	7439-96-5	Manganese	817	J	*	mg/kg	0.064	mg/kg
MH1E64	7/27/16	RDCC8	RDCC8	ISM02.3	3050B	7439-96-5	Manganese	925	J	*	mg/kg	0.064	mg/kg
MH1E65	7/27/16	RDCC9	RDCC9	ISM02.3	3050B	7439-96-5	Manganese	680	J	*	mg/kg	0.069	mg/kg
MH1E67	7/26/16	RDEK1	RDEK1	ISM02.3	3050B	7439-96-5	Manganese	787	J	*	mg/kg	0.064	mg/kg
MH1E68	7/26/16	RDEK2	RDEK2	ISM02.3	3050B	7439-96-5	Manganese	547	J	*	mg/kg	0.063	mg/kg
MH1E69	7/26/16	RDEK3	RDEK3	ISM02.3	3050B	7439-96-5	Manganese	711	J	*	mg/kg	0.063	mg/kg
MH1E70	7/26/16	RDEK4	RDEK4	ISM02.3	3050B	7439-96-5	Manganese	847	J	*	mg/kg	0.072	mg/kg
MH1E71	7/26/16	RDEK5	RDEK5	ISM02.3	3050B	7439-96-5	Manganese	8990	J	D*	mg/kg	0.38	mg/kg
MH1E73	7/26/16	RDEK6	RDEK6	ISM02.3	3050B	7439-96-5	Manganese	3000	J	D*	mg/kg	0.069	mg/kg
MH1E74	7/26/16	RDEK7	RDEK7	ISM02.3	3050B	7439-96-5	Manganese	2520	J	D*	mg/kg	0.07	mg/kg
MH1E97	7/26/16	RDPWML1	RDPWML1	ISM02.3	3050B	7439-96-5	Manganese	792			mg/kg	0.023	mg/kg
MH1E98	7/26/16	RDPWML2	RDPWML2	ISM02.3	3050B	7439-96-5	Manganese	835			mg/kg	0.023	mg/kg
MH1E99	7/26/16	RDPWML3	RDPWML3	ISM02.3	3050B	7439-96-5	Manganese	634			mg/kg	0.023	mg/kg
MH1F01	7/26/16	RDPWML4	RDPWML4	ISM02.3	3050B	7439-96-5	Manganese	779			mg/kg	0.023	mg/kg
MH1F02	7/26/16	RDPWML5	RDPWML5	ISM02.3	3050B	7439-96-5	Manganese	623			mg/kg	0.023	mg/kg
A8M5-6036	9/27/18	RDAN1	RDAN1-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	982	D	D	mg/kg dry wt	0.998	mg/kg dry wt
A8M5-6037	9/27/18	RDAN2	RDAN2-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	530	D	D	mg/kg dry wt	1.01	mg/kg dry wt
A8M5-6038	9/27/18	RDAN3	RDAN3-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	477	D	D	mg/kg dry wt	1	mg/kg dry wt
A8M5-6040	9/27/18	RDAN4	RDAN4-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	687	D	D	mg/kg dry wt	1	mg/kg dry wt
A8M5-6041	9/25/18	RDAN5	RDAN5-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	1490	D	D	mg/kg dry wt	1	mg/kg dry wt
A8M5-6042	9/25/18	RDAN6	RDAN6-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	1980	D	D	mg/kg dry wt	1.01	mg/kg dry wt
A8M5-6043	9/25/18	RDAN7	RDAN7-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	2690	D	D	mg/kg dry wt	1.01	mg/kg dry wt
A8M5-6044	9/25/18	RDAN8	RDAN8-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	1970	D	D	mg/kg dry wt	0.997	mg/kg dry wt

ATTACHMENT 1. ANALYTICAL RESULTS FOR ROADWAY SOIL AND ATV ABS AIR

Bonita Peak Mining District

Panel B. Roadway Soil - Remote Location

Samp_No	Sample Date	Location	Sub_Location	Analytical Method	Extraction_Method	CAS_NO	Analyte	Result	Result_Qualifier	Lab_Result_Qualifier	Result_Units	MDL	MDL_Units
MH1E38	7/27/16	RD1PWMN1	RD1PWMN1	ISM02.3	3050B	7439-96-5	Manganese	3780		D*	mg/kg	0.2	mg/kg
MH1E39	7/26/16	RD1PWMN5	RD1PWMN5	ISM02.3	3050B	7439-96-5	Manganese	6830		D*	mg/kg	0.32	mg/kg
MH1E46	7/26/16	RD2PWMN1	RD2PWMN1	ISM02.3	3050B	7439-96-5	Manganese	1620		*	mg/kg	0.063	mg/kg
MH1E47	7/26/16	RD2PWMN2	RD2PWMN2	ISM02.3	3050B	7439-96-5	Manganese	1560		*	mg/kg	0.065	mg/kg
MH1E48	7/26/16	RD2PWMN3	RD2PWMN3	ISM02.3	3050B	7439-96-5	Manganese	4640		D*	mg/kg	0.5	mg/kg
MH1E49	7/26/16	RD2PWMN4	RD2PWMN4	ISM02.3	3050B	7439-96-5	Manganese	4340		D*	mg/kg	0.43	mg/kg
MH1E50	7/26/16	RD2PWMN5	RD2PWMN5	ISM02.3	3050B	7439-96-5	Manganese	2070		D*	mg/kg	0.12	mg/kg
A8M5-6045	9/27/18	RDAN9	RDAN9-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	627	D	D	mg/kg dry wt	0.994	mg/kg dry wt
A8M5-6046	9/27/18	RDANCR21	RDANCR21-10	EPA 200.2/200.7	200.2 - TR Metals	7439-96-5	Manganese	816	D	D	mg/kg dry wt	1.01	mg/kg dry wt

Panel C. ATV ABS Air - Alpine Loop (Follower)

Samp_No	Sample Date	SampleTime	Location	Analytical Method	Extraction_Method	CAS_NO	Analyte	Result	Result_Qualifier	Lab_Result_Qualifier	Result_Units	Reporting_Limit	Reporting_Limit_Units
A8M5-6436	9/27/18	13:05	AL05F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00044			mg/m³	0.0002	mg/m³
A8M5-6435	9/27/18	13:05	AL04F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00047			mg/m³	0.0002	mg/m³
A8M5-6434	9/27/18	13:05	AL03F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00055			mg/m³	0.0002	mg/m³
A8M5-6426	9/26/18	12:00	AL01F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00085			mg/m³	0.0005	mg/m³
A8M5-6428	9/26/18	13:32	AL02F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.0015			mg/m³	0.0005	mg/m³

Panel D. ATV ABS Air - Remote Loop (Follower)

Samp_No	Sample Date	SampleTime	Location	Analytical Method	Extraction_Method	CAS_NO	Analyte	Result	Result_Qualifier	Lab_Result_Qualifier	Result_Units	Reporting_Limit	Reporting_Limit_Units
A8M5-6441	9/27/18	15:30	RL06F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00051			mg/m³	0.0005	mg/m³
A8M5-6440	9/27/18	15:30	RL05F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00053			mg/m³	0.0005	mg/m³
A8M5-6430	9/26/18	16:20	RL01F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	0.00086			mg/m³	0.0006	mg/m³
A8M5-6439	9/27/18	15:30	RL04F	NIOSH 7300, MCE	NIOSH 7300, MCE Prep	7439-96-5	Manganese	[0.00044]	J	J	mg/m³	0.0005	mg/m³

Appendix D

Non-Lead Risk Calculations

This page intentionally left blank.

APPENDIX D

Bonita Peak Mining District

Footnotes:

[a] All samples were non-detect.
[b] Low detection frequency; value shown is the maximum detected concentration.
[c] 95 UCL exceeded maximum concentration; value shown is the UCL.
[d] Samples were not analyzed for this chemical.
[e] One sample was analyzed; value shown is the detected concentration.

TABLE D-1a
DETAILED RISK CALCULATIONS FOR THE ATV GUIDE IN EU5a
Bonita Peak Mining District

Panel A. CTE Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		Non Cancer Hazard				Cancer Risk			
			TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	--	[d]	2.92E-03	--	NA	--	5.01E-04	--	NA	--
Arsenic	--	[a]	2.92E-03	--	1.50E-05	--	5.01E-04	--	4.30E-03	--
Cadmium	--	[a]	2.92E-03	--	1.00E-05	--	5.01E-04	--	1.80E-03	--
Chromium(III)	--	[a]	2.92E-03	--	NA	--	5.01E-04	--	NA	--
Chromium(VI)	--	[a]	2.92E-03	--	1.00E-04	--	5.01E-04	--	8.40E-02	--
Cobalt	--	[d]	2.92E-03	--	6.00E-06	--	5.01E-04	--	9.00E-03	--
Iron	1.46E-02		2.92E-03	4.26E-05	NA	--	5.01E-04	1.1E-04	NA	--
Manganese	7.62E-04		2.92E-03	2.23E-06	5.00E-05	4E-02	5.01E-04	2.9E-07	NA	--
Thallium	--	[d]	2.92E-03	--	NA	--	5.01E-04	--	NA	--
Zinc	2.13E-04		2.92E-03	6.22E-07	NA	--	5.01E-04	2.3E-08	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	2.45E+00		1.0	4.38E-08	1.1E-07	4.00E-04	3E-04	7.51E-09	1.8E-08	NA	--
Arsenic	2.47E+01		0.08	4.38E-08	8.7E-08	3.00E-04	3E-04	7.51E-09	1.5E-08	1.50E+00	2E-08
Cadmium	1.85E+00		1.0	4.38E-08	8.1E-08	1.00E-03	8E-05	7.51E-09	1.4E-08	NA	--
Chromium(III)	4.80E+00		1.0	4.38E-08	2.1E-07	1.50E+00	1E-07	7.51E-09	3.6E-08	NA	--
Chromium(VI)	5.33E-01		1.0	4.38E-08	2.3E-08	3.00E-03	8E-06	7.51E-09	4.0E-09	5.00E-01	2E-09
Cobalt	6.54E+00		1.0	4.38E-08	2.9E-07	3.00E-04	1E-03	7.51E-09	4.9E-08	NA	--
Iron	3.63E+04		1.0	4.38E-08	1.6E-03	7.00E-01	2E-03	7.51E-09	2.7E-04	NA	--
Manganese	1.57E+03		1.0	4.38E-08	6.9E-05	2.40E-02	3E-03	7.51E-09	1.2E-05	NA	--
Thallium	1.90E-01		1.0	4.38E-08	8.3E-09	1.00E-05	8E-04	7.51E-09	1.4E-09	NA	--
Zinc	7.52E+02		1.0	4.38E-08	3.3E-05	3.00E-01	1E-04	7.51E-09	5.6E-06	NA	--

TABLE D-1a
DETAILED RISK CALCULATIONS FOR THE ATV GUIDE IN EU5a
Bonita Peak Mining District

Panel B. RME Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		Non Cancer Hazard				Cancer Risk			
			TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC (µg/m^3)	iUR (µg/m^3)$^{-1}$	Risk
Antimony	--	[d]	1.97E-02	--	NA	--	5.64E-03	--	NA	--
Arsenic	--	[a]	1.97E-02	--	1.50E-05	--	5.64E-03	--	4.30E-03	--
Cadmium	--	[a]	1.97E-02	--	1.00E-05	--	5.64E-03	--	1.80E-03	--
Chromium(III)	--	[a]	1.97E-02	--	NA	--	5.64E-03	--	NA	--
Chromium(VI)	--	[a]	1.97E-02	--	1.00E-04	--	5.64E-03	--	8.40E-02	--
Cobalt	--	[d]	1.97E-02	--	6.00E-06	--	5.64E-03	--	9.00E-03	--
Iron	1.46E-02		1.97E-02	2.88E-04	NA	--	5.64E-03	1.2E-03	NA	--
Manganese	7.62E-04		1.97E-02	1.50E-05	5.00E-05	3E-01	5.64E-03	3.3E-06	NA	--
Thallium	--	[d]	1.97E-02	--	NA	--	5.64E-03	--	NA	--
Zinc	2.13E-04		1.97E-02	4.20E-06	NA	--	5.64E-03	2.6E-07	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d)$^{-1}$	Risk
Antimony	2.45E+00		1.0	1.97E-07	4.8E-07	4.00E-04	1E-03	5.64E-08	1.4E-07	NA	--
Arsenic	2.47E+01		0.08	1.97E-07	3.9E-07	3.00E-04	1E-03	5.64E-08	1.1E-07	1.50E+00	2E-07
Cadmium	1.85E+00		1.0	1.97E-07	3.6E-07	1.00E-03	4E-04	5.64E-08	1.0E-07	NA	--
Chromium(III)	4.80E+00		1.0	1.97E-07	9.5E-07	1.50E+00	6E-07	5.64E-08	2.7E-07	NA	--
Chromium(VI)	5.33E-01		1.0	1.97E-07	1.1E-07	3.00E-03	4E-05	5.64E-08	3.0E-08	5.00E-01	2E-08
Cobalt	6.54E+00		1.0	1.97E-07	1.3E-06	3.00E-04	4E-03	5.64E-08	3.7E-07	NA	--
Iron	3.63E+04		1.0	1.97E-07	7.2E-03	7.00E-01	1E-02	5.64E-08	2.0E-03	NA	--
Manganese	1.57E+03		1.0	1.97E-07	3.1E-04	2.40E-02	1E-02	5.64E-08	8.9E-05	NA	--
Thallium	1.90E-01		1.0	1.97E-07	3.7E-08	1.00E-05	4E-03	5.64E-08	1.1E-08	NA	--
Zinc	7.52E+02		1.0	1.97E-07	1.5E-04	3.00E-01	5E-04	5.64E-08	4.2E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

µg - microgram
Cair = air concentration
Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
EC = exposure concentration
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
m = meter
mg = milligram
NC = non-cancer
PEF = particulate emission factor
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-1b
RME RISK SUMMARY FOR THE ATV GUIDE
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	Soil Inhalation	Incidental Soil Ingestion	Total HI
Antimony	--	1E-03	1E-03
Arsenic	--	1E-03	1E-03
Cadmium	--	4E-04	4E-04
Chromium(III)	--	6E-07	6E-07
Chromium(VI)	--	4E-05	4E-05
Cobalt	--	4E-03	4E-03
Iron	--	1E-02	1E-02
Manganese	3E-01	1E-02	3E-01
Thallium	--	4E-03	4E-03
Zinc	--	5E-04	5E-04
Total	**3E-01**	**3E-02**	**3E-01**

Panel B: RME Cancer Risks

Chemical of Potential Concern	Soil Inhalation	Incidental Soil Ingestion	Total Risk
Antimony	--	--	--
Arsenic	--	2E-07	2E-07
Cadmium	--	--	--
Chromium(III)	--	--	--
Chromium(VI)	--	2E-08	2E-08
Cobalt	--	--	--
Iron	--	--	--
Manganese	--	--	--
Thallium	--	--	--
Zinc	--	--	--
Total	**0E+00**	**2E-07**	**2E-07**

Notes:

-- = not calculated

HI = hazard index

RME = reasonable maximum exposure

TABLE D-2a
DETAILED RISK CALCULATIONS FOR THE ATV REC IN EU5b
Bonita Peak Mining District

Panel A. CTE Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	PEF (kg/m^3)	Cair (mg/m^3)	Non Cancer Hazard				Cancer Risk			
						TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	1.60E+01		1.0	5.60E-07	8.98E-06	3.65E-03	3.28E-08	NA	--	6.26E-04	5.6E-06	NA	--
Arsenic	4.69E+01		1.0	5.60E-07	2.63E-05	3.65E-03	9.60E-08	1.50E-05	6E-03	6.26E-04	1.6E-05	4.30E-03	7E-08
Cadmium	5.12E+00		1.0	5.60E-07	2.87E-06	3.65E-03	1.05E-08	1.00E-05	1E-03	6.26E-04	1.8E-06	1.80E-03	3E-09
Chromium(III)	4.63E+00		1.0	5.60E-07	2.59E-06	3.65E-03	9.46E-09	NA	--	6.26E-04	1.6E-06	NA	--
Chromium(VI)	5.14E-01		1.0	5.60E-07	2.88E-07	3.65E-03	1.05E-09	1.00E-04	1E-05	6.26E-04	1.8E-07	8.40E-02	3E-08
Cobalt	8.55E+00		1.0	5.60E-07	4.79E-06	3.65E-03	1.75E-08	6.00E-06	3E-03	6.26E-04	3.0E-06	9.00E-03	3E-08
Iron	3.18E+04		1.0	5.60E-07	1.78E-02	3.65E-03	6.50E-05	NA	--	6.26E-04	1.1E-02	NA	--
Manganese	4.43E+03		1.0	5.60E-07	2.48E-03	3.65E-03	9.06E-06	5.00E-05	2E-01	6.26E-04	1.6E-03	NA	--
Thallium	6.14E-01		1.0	5.60E-07	3.44E-07	3.65E-03	1.26E-09	NA	--	6.26E-04	2.2E-07	NA	--
Zinc	1.06E+03		1.0	5.60E-07	5.91E-04	3.65E-03	2.16E-06	NA	--	6.26E-04	3.7E-04	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.60E+01		1.0	7.72E-08	1.2E-06	4.00E-04	3E-03	1.32E-08	2.1E-07	NA	--
Arsenic	4.69E+01		0.08	7.72E-08	2.9E-07	3.00E-04	1E-03	1.32E-08	5.0E-08	1.50E+00	7E-08
Cadmium	5.12E+00		1.0	7.72E-08	4.0E-07	1.00E-03	4E-04	1.32E-08	6.8E-08	NA	--
Chromium(III)	4.63E+00		1.0	7.72E-08	3.6E-07	1.50E+00	2E-07	1.32E-08	6.1E-08	NA	--
Chromium(VI)	5.14E-01		1.0	7.72E-08	4.0E-08	3.00E-03	1E-05	1.32E-08	6.8E-09	5.00E-01	7E-09
Cobalt	8.55E+00		1.0	7.72E-08	6.6E-07	3.00E-04	2E-03	1.32E-08	1.1E-07	NA	--
Iron	3.18E+04		1.0	7.72E-08	2.5E-03	7.00E-01	4E-03	1.32E-08	4.2E-04	NA	--
Manganese	4.43E+03		1.0	7.72E-08	3.4E-04	2.40E-02	1E-02	1.32E-08	5.9E-05	NA	--
Thallium	6.14E-01		1.0	7.72E-08	4.7E-08	1.00E-05	5E-03	1.32E-08	8.1E-09	NA	--
Zinc	1.06E+03		1.0	7.72E-08	8.2E-05	3.00E-01	3E-04	1.32E-08	1.4E-05	NA	--

TABLE D-2a
DETAILED RISK CALCULATIONS FOR THE ATV REC IN EU5b
Bonita Peak Mining District

Panel B. RME Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	PEF (kg/m^3)	Cair (mg/m^3)	Non Cancer Hazard				Cancer Risk			
						TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	1.60E+01		1.0	5.60E-07	8.98E-06	1.64E-02	1.48E-07	NA	--	4.70E-03	4.2E-05	NA	--
Arsenic	4.69E+01		1.0	5.60E-07	2.63E-05	1.64E-02	4.32E-07	1.50E-05	3E-02	4.70E-03	1.2E-04	4.30E-03	5E-07
Cadmium	5.12E+00		1.0	5.60E-07	2.87E-06	1.64E-02	4.71E-08	1.00E-05	5E-03	4.70E-03	1.3E-05	1.80E-03	2E-08
Chromium(III)	4.63E+00		1.0	5.60E-07	2.59E-06	1.64E-02	4.26E-08	NA	--	4.70E-03	1.2E-05	NA	--
Chromium(VI)	5.14E-01		1.0	5.60E-07	2.88E-07	1.64E-02	4.73E-09	1.00E-04	5E-05	4.70E-03	1.4E-06	8.40E-02	2E-07
Cobalt	8.55E+00		1.0	5.60E-07	4.79E-06	1.64E-02	7.87E-08	6.00E-06	1E-02	4.70E-03	2.2E-05	9.00E-03	2E-07
Iron	3.18E+04		1.0	5.60E-07	1.78E-02	1.64E-02	2.93E-04	NA	--	4.70E-03	8.4E-02	NA	--
Manganese	4.43E+03		1.0	5.60E-07	2.48E-03	1.64E-02	4.08E-05	5.00E-05	8E-01	4.70E-03	1.2E-02	NA	--
Thallium	6.14E-01		1.0	5.60E-07	3.44E-07	1.64E-02	5.65E-09	NA	--	4.70E-03	1.6E-06	NA	--
Zinc	1.06E+03		1.0	5.60E-07	5.91E-04	1.64E-02	9.72E-06	NA	--	4.70E-03	2.8E-03	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.60E+01		1.0	3.09E-07	5.0E-06	4.00E-04	1E-02	8.82E-08	1.4E-06	NA	--
Arsenic	4.69E+01		0.08	3.09E-07	1.2E-06	3.00E-04	4E-03	8.82E-08	3.3E-07	1.50E+00	5E-07
Cadmium	5.12E+00		1.0	3.09E-07	1.6E-06	1.00E-03	2E-03	8.82E-08	4.5E-07	NA	--
Chromium(III)	4.63E+00		1.0	3.09E-07	1.4E-06	1.50E+00	1E-06	8.82E-08	4.1E-07	NA	--
Chromium(VI)	5.14E-01		1.0	3.09E-07	1.6E-07	3.00E-03	5E-05	8.82E-08	4.5E-08	5.00E-01	5E-08
Cobalt	8.55E+00		1.0	3.09E-07	2.6E-06	3.00E-04	9E-03	8.82E-08	7.5E-07	NA	--
Iron	3.18E+04		1.0	3.09E-07	9.8E-03	7.00E-01	1E-02	8.82E-08	2.8E-03	NA	--
Manganese	4.43E+03		1.0	3.09E-07	1.4E-03	2.40E-02	6E-02	8.82E-08	3.9E-04	NA	--
Thallium	6.14E-01		1.0	3.09E-07	1.9E-07	1.00E-05	2E-02	8.82E-08	5.4E-08	NA	--
Zinc	1.06E+03		1.0	3.09E-07	3.3E-04	3.00E-01	1E-03	8.82E-08	9.3E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

µg - microgram
Cair = air concentration
Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
EC = exposure concentration
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
m = meter
mg = milligram
NC = non-cancer
PEF = particulate emission factor
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-2b
RME RISK SUMMARY FOR THE ATV REC
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	Soil Inhalation	Incidental Soil Ingestion	Total HI
Antimony	--	1E-02	1E-02
Arsenic	3E-02	4E-03	3E-02
Cadmium	5E-03	2E-03	6E-03
Chromium(III)	--	1E-06	1E-06
Chromium(VI)	5E-05	5E-05	1E-04
Cobalt	1E-02	9E-03	2E-02
Iron	--	1E-02	1E-02
Manganese	8E-01	6E-02	9E-01
Thallium	--	2E-02	2E-02
Zinc	--	1E-03	1E-03
Total	**9E-01**	**1E-01**	**1E+00**

Panel B: RME Cancer Risks

Chemical of Potential Concern	Soil Inhalation	Incidental Soil Ingestion	Total Risk
Antimony	--	--	--
Arsenic	5E-07	5E-07	1E-06
Cadmium	2E-08	--	2E-08
Chromium(III)	--	--	--
Chromium(VI)	2E-07	5E-08	3E-07
Cobalt	2E-07	--	2E-07
Iron	--	--	--
Manganese	--	--	--
Thallium	--	--	--
Zinc	--	--	--
Total	**1E-06**	**5E-07**	**2E-06**

Notes:

-- = not calculated

HI = hazard index

RME = reasonable maximum exposure

TABLE D-3a
DETAILED RISK CALCULATIONS FOR THE HIKER IN EU1
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Antimony	2.85E+00		1.0	7.72E-08	2.2E-07	4.00E-04	5E-04	1.32E-08	3.8E-08	NA	--
Arsenic	4.28E+01		**	7.72E-08	3.3E-06	3.00E-04	1E-02	1.32E-08	5.7E-07	1.50E+00	8E-07
Cadmium	1.42E+01		1.0	7.72E-08	1.1E-06	1.00E-03	1E-03	1.32E-08	1.9E-07	NA	--
Chromium(III)	2.65E+00		1.0	7.72E-08	2.0E-07	1.50E+00	1E-07	1.32E-08	3.5E-08	NA	--
Chromium(VI)	2.95E-01		1.0	7.72E-08	2.3E-08	3.00E-03	8E-06	1.32E-08	3.9E-09	5.00E-01	4E-09
Cobalt	9.79E+00		1.0	7.72E-08	7.6E-07	3.00E-04	3E-03	1.32E-08	1.3E-07	NA	--
Iron	2.02E+04		1.0	7.72E-08	1.6E-03	7.00E-01	2E-03	1.32E-08	2.7E-04	NA	--
Manganese	5.89E+03		1.0	7.72E-08	4.5E-04	2.40E-02	2E-02	1.32E-08	7.8E-05	NA	--
Thallium	3.68E-01		1.0	7.72E-08	2.8E-08	1.00E-05	3E-03	1.32E-08	4.9E-09	NA	--
Zinc	1.12E+03		1.0	7.72E-08	8.7E-05	3.00E-01	3E-04	1.32E-08	1.5E-05	NA	--

Panel B. RME Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Antimony	2.85E+00		1.0	3.09E-07	8.8E-07	4.00E-04	2E-03	8.82E-08	2.5E-07	NA	--
Arsenic	4.28E+01		**	3.09E-07	1.3E-05	3.00E-04	4E-02	8.82E-08	3.8E-06	1.50E+00	6E-06
Cadmium	1.42E+01		1.0	3.09E-07	4.4E-06	1.00E-03	4E-03	8.82E-08	1.2E-06	NA	--
Chromium(III)	2.65E+00		1.0	3.09E-07	8.2E-07	1.50E+00	5E-07	8.82E-08	2.3E-07	NA	--
Chromium(VI)	2.95E-01		1.0	3.09E-07	9.1E-08	3.00E-03	3E-05	8.82E-08	2.6E-08	5.00E-01	3E-08
Cobalt	9.79E+00		1.0	3.09E-07	3.0E-06	3.00E-04	1E-02	8.82E-08	8.6E-07	NA	--
Iron	2.02E+04		1.0	3.09E-07	6.2E-03	7.00E-01	9E-03	8.82E-08	1.8E-03	NA	--
Manganese	5.89E+03		1.0	3.09E-07	1.8E-03	2.40E-02	8E-02	8.82E-08	5.2E-04	NA	--
Thallium	3.68E-01		1.0	3.09E-07	1.1E-07	1.00E-05	1E-02	8.82E-08	3.2E-08	NA	--
Zinc	1.12E+03		1.0	3.09E-07	3.5E-04	3.00E-01	1E-03	8.82E-08	9.9E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-4a
DETAILED RISK CALCULATIONS FOR THE HIKER IN EU2
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Antimony	1.49E+01		1.0	7.72E-08	1.1E-06	4.00E-04	3E-03	1.32E-08	2.0E-07	NA	--
Arsenic	2.20E+01		**	7.72E-08	1.7E-06	3.00E-04	6E-03	1.32E-08	2.9E-07	1.50E+00	4E-07
Cadmium	4.90E+00		1.0	7.72E-08	3.8E-07	1.00E-03	4E-04	1.32E-08	6.5E-08	NA	--
Chromium(III)	2.84E+00		1.0	7.72E-08	2.2E-07	1.50E+00	1E-07	1.32E-08	3.8E-08	NA	--
Chromium(VI)	3.16E-01		1.0	7.72E-08	2.4E-08	3.00E-03	8E-06	1.32E-08	4.2E-09	5.00E-01	4E-09
Cobalt	7.17E+00		1.0	7.72E-08	5.5E-07	3.00E-04	2E-03	1.32E-08	9.5E-08	NA	--
Iron	2.21E+04		1.0	7.72E-08	1.7E-03	7.00E-01	2E-03	1.32E-08	2.9E-04	NA	--
Manganese	6.52E+03		1.0	7.72E-08	5.0E-04	2.40E-02	2E-02	1.32E-08	8.6E-05	NA	--
Thallium	2.33E-01		1.0	7.72E-08	1.8E-08	1.00E-05	2E-03	1.32E-08	3.1E-09	NA	--
Zinc	1.35E+03		1.0	7.72E-08	1.0E-04	3.00E-01	3E-04	1.32E-08	1.8E-05	NA	--

Panel B. RME Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Antimony	1.49E+01		1.0	3.09E-07	4.6E-06	4.00E-04	1E-02	8.82E-08	1.3E-06	NA	--
Arsenic	2.20E+01		**	3.09E-07	6.8E-06	3.00E-04	2E-02	8.82E-08	1.9E-06	1.50E+00	3E-06
Cadmium	4.90E+00		1.0	3.09E-07	1.5E-06	1.00E-03	2E-03	8.82E-08	4.3E-07	NA	--
Chromium(III)	2.84E+00		1.0	3.09E-07	8.8E-07	1.50E+00	6E-07	8.82E-08	2.5E-07	NA	--
Chromium(VI)	3.16E-01		1.0	3.09E-07	9.8E-08	3.00E-03	3E-05	8.82E-08	2.8E-08	5.00E-01	3E-08
Cobalt	7.17E+00		1.0	3.09E-07	2.2E-06	3.00E-04	7E-03	8.82E-08	6.3E-07	NA	--
Iron	2.21E+04		1.0	3.09E-07	6.8E-03	7.00E-01	1E-02	8.82E-08	1.9E-03	NA	--
Manganese	6.52E+03		1.0	3.09E-07	2.0E-03	2.40E-02	8E-02	8.82E-08	5.8E-04	NA	--
Thallium	2.33E-01		1.0	3.09E-07	7.2E-08	1.00E-05	7E-03	8.82E-08	2.1E-08	NA	--
Zinc	1.35E+03		1.0	3.09E-07	4.2E-04	3.00E-01	1E-03	8.82E-08	1.2E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-5a
DETAILED RISK CALCULATIONS FOR THE HIKER IN EU3
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)	RBA (unitless)	Non Cancer Hazard				Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d)[1]	Risk
Antimony	1.76E+00	1.0	7.72E-08	1.4E-07	4.00E-04	3E-04	1.32E-08	2.3E-08	NA	--
Arsenic	2.30E+01	**	7.72E-08	1.8E-06	3.00E-04	6E-03	1.32E-08	3.0E-07	1.50E+00	5E-07
Cadmium	4.02E+00	1.0	7.72E-08	3.1E-07	1.00E-03	3E-04	1.32E-08	5.3E-08	NA	--
Chromium(III)	2.73E+00	1.0	7.72E-08	2.1E-07	1.50E+00	1E-07	1.32E-08	3.6E-08	NA	--
Chromium(VI)	3.03E-01	1.0	7.72E-08	2.3E-08	3.00E-03	8E-06	1.32E-08	4.0E-09	5.00E-01	4E-09
Cobalt	4.96E+00	1.0	7.72E-08	3.8E-07	3.00E-04	1E-03	1.32E-08	6.6E-08	NA	--
Iron	3.03E+04	1.0	7.72E-08	2.3E-03	7.00E-01	3E-03	1.32E-08	4.0E-04	NA	--
Manganese	1.54E+03	1.0	7.72E-08	1.2E-04	2.40E-02	5E-03	1.32E-08	2.0E-05	NA	--
Thallium	5.43E-01	1.0	7.72E-08	4.2E-08	1.00E-05	4E-03	1.32E-08	7.2E-09	NA	--
Zinc	6.69E+02	1.0	7.72E-08	5.2E-05	3.00E-01	2E-04	1.32E-08	8.9E-06	NA	--

Panel B. RME Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)	RBA (unitless)	Non Cancer Hazard				Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d)[1]	Risk
Antimony	1.76E+00	1.0	3.09E-07	5.4E-07	4.00E-04	1E-03	8.82E-08	1.6E-07	NA	--
Arsenic	2.30E+01	**	3.09E-07	7.1E-06	3.00E-04	2E-02	8.82E-08	2.0E-06	1.50E+00	3E-06
Cadmium	4.02E+00	1.0	3.09E-07	1.2E-06	1.00E-03	1E-03	8.82E-08	3.5E-07	NA	--
Chromium(III)	2.73E+00	1.0	3.09E-07	8.4E-07	1.50E+00	6E-07	8.82E-08	2.4E-07	NA	--
Chromium(VI)	3.03E-01	1.0	3.09E-07	9.4E-08	3.00E-03	3E-05	8.82E-08	2.7E-08	5.00E-01	3E-08
Cobalt	4.96E+00	1.0	3.09E-07	1.5E-06	3.00E-04	5E-03	8.82E-08	4.4E-07	NA	--
Iron	3.03E+04	1.0	3.09E-07	9.4E-03	7.00E-01	1E-02	8.82E-08	2.7E-03	NA	--
Manganese	1.54E+03	1.0	3.09E-07	4.8E-04	2.40E-02	2E-02	8.82E-08	1.4E-04	NA	--
Thallium	5.43E-01	1.0	3.09E-07	1.7E-07	1.00E-05	2E-02	8.82E-08	4.8E-08	NA	--
Zinc	6.69E+02	1.0	3.09E-07	2.1E-04	3.00E-01	7E-04	8.82E-08	5.9E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-6a
DETAILED RISK CALCULATIONS FOR THE HIKER IN EU4
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)	RBA (unitless)	Non Cancer Hazard				Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d)[1]	Risk
Antimony	1.83E+00	1.0	7.72E-08	1.4E-07	4.00E-04	4E-04	1.32E-08	2.4E-08	NA	--
Arsenic	9.27E+01	**	7.72E-08	7.2E-06	3.00E-04	2E-02	1.32E-08	1.2E-06	1.50E+00	2E-06
Cadmium	2.60E+00	1.0	7.72E-08	2.0E-07	1.00E-03	2E-04	1.32E-08	3.4E-08	NA	--
Chromium(III)	2.35E+00	1.0	7.72E-08	1.8E-07	1.50E+00	1E-07	1.32E-08	3.1E-08	NA	--
Chromium(VI)	2.61E-01	1.0	7.72E-08	2.0E-08	3.00E-03	7E-06	1.32E-08	3.4E-09	5.00E-01	3E-09
Cobalt	8.73E+00	1.0	7.72E-08	6.7E-07	3.00E-04	2E-03	1.32E-08	1.2E-07	NA	--
Iron	3.39E+04	1.0	7.72E-08	2.6E-03	7.00E-01	4E-03	1.32E-08	4.5E-04	NA	--
Manganese	1.40E+03	1.0	7.72E-08	1.1E-04	2.40E-02	5E-03	1.32E-08	1.9E-05	NA	--
Thallium	7.28E-02	1.0	7.72E-08	5.6E-09	1.00E-05	6E-04	1.32E-08	9.6E-10	NA	--
Zinc	5.59E+02	1.0	7.72E-08	4.3E-05	3.00E-01	1E-04	1.32E-08	7.4E-06	NA	--

Panel B. RME Scenario
Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)	RBA (unitless)	Non Cancer Hazard				Cancer Risk			
			HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d)[1]	Risk
Antimony	1.83E+00	1.0	3.09E-07	5.7E-07	4.00E-04	1E-03	8.82E-08	1.6E-07	NA	--
Arsenic	9.27E+01	**	3.09E-07	2.9E-05	3.00E-04	1E-01	8.82E-08	8.2E-06	1.50E+00	1E-05
Cadmium	2.60E+00	1.0	3.09E-07	8.0E-07	1.00E-03	8E-04	8.82E-08	2.3E-07	NA	--
Chromium(III)	2.35E+00	1.0	3.09E-07	7.2E-07	1.50E+00	5E-07	8.82E-08	2.1E-07	NA	--
Chromium(VI)	2.61E-01	1.0	3.09E-07	8.0E-08	3.00E-03	3E-05	8.82E-08	2.3E-08	5.00E-01	2E-08
Cobalt	8.73E+00	1.0	3.09E-07	2.7E-06	3.00E-04	9E-03	8.82E-08	7.7E-07	NA	--
Iron	3.39E+04	1.0	3.09E-07	1.0E-02	7.00E-01	1E-02	8.82E-08	3.0E-03	NA	--
Manganese	1.40E+03	1.0	3.09E-07	4.3E-04	2.40E-02	2E-02	8.82E-08	1.2E-04	NA	--
Thallium	7.28E-02	1.0	3.09E-07	2.2E-08	1.00E-05	2E-03	8.82E-08	6.4E-09	NA	--
Zinc	5.59E+02	1.0	3.09E-07	1.7E-04	3.00E-01	6E-04	8.82E-08	4.9E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-6b
RME RISK SUMMARY FOR THE HIKER
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	Total HI[1]			
	EU1	EU2	EU3	EU4
Antimony	2E-03	1E-02	1E-03	1E-03
Arsenic	4E-02	2E-02	2E-02	1E-01
Cadmium	4E-03	2E-03	1E-03	8E-04
Chromium(III)	5E-07	6E-07	6E-07	5E-07
Chromium(VI)	3E-05	3E-05	3E-05	3E-05
Cobalt	1E-02	7E-03	5E-03	9E-03
Iron	9E-03	1E-02	1E-02	1E-02
Manganese	8E-02	8E-02	2E-02	2E-02
Thallium	1E-02	7E-03	2E-02	2E-03
Zinc	1E-03	1E-03	7E-04	6E-04
Total	**2E-01**	**1E-01**	**8E-02**	**1E-01**

Panel B: RME Cancer Risks

Chemical of Potential Concern	Total Risk[1]			
	EU1	EU2	EU3	EU4
Antimony	--	--	--	--
Arsenic	6E-06	3E-06	3E-06	1E-05
Cadmium	--	--	--	--
Chromium(III)	--	--	--	--
Chromium(VI)	3E-08	3E-08	3E-08	2E-08
Cobalt	--	--	--	--
Iron	--	--	--	--
Manganese	--	--	--	--
Thallium	--	--	--	--
Zinc	--	--	--	--
Total	**6E-06**	**3E-06**	**3E-06**	**1E-05**

Notes:
[1] Based on incidental soil ingestion only.
-- = not calculated
HI = hazard index
RME = reasonable maximum exposure

TABLE D-7a
DETAILED RISK CALCULATIONS FOR THE CAMPER (USFS) IN EU6
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d)$^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Aluminum	8.80E-01		1.0	3.55E-07	3.13E-06	3.1E-07	2.8E-06	3.1E-06	1.00E+00	3E-06	6.08E-08	8.95E-08	5.4E-08	7.9E-08	1.3E-07	NA	--
Antimony	--	[a]	1.0	3.55E-07	3.13E-06	--	--	--	4.00E-04	--	6.08E-08	8.95E-08	--	--	--	NA	--
Arsenic	1.30E-04	[b]	1.0	3.55E-07	3.13E-06	4.6E-11	4.1E-10	--	3.00E-04	--	6.08E-08	8.95E-08	7.9E-12	1.2E-11	--	1.50E+00	--
Beryllium	--	[a]	1.0	3.55E-07	3.13E-06	--	--	--	2.00E-03	--	6.08E-08	8.95E-08	--	--	--	NA	--
Cadmium	2.40E-04	[b]	1.0	3.55E-07	3.13E-06	8.5E-11	7.5E-10	--	5.00E-04	--	6.08E-08	8.95E-08	1.5E-11	2.1E-11	--	NA	--
Chromium(III)	--		1.0	3.55E-07	3.13E-06	--	--	--	1.50E+00	--	6.08E-08	8.95E-08	--	--	--	NA	--
Chromium(VI)	--		1.0	3.55E-07	3.13E-06	--	--	--	3.00E-03	--	6.08E-08	8.95E-08	--	--	--	5.00E-01	--
Cobalt	9.70E-01		1.0	3.55E-07	3.13E-06	3.4E-07	3.0E-06	--	3.00E-04	--	6.08E-08	8.95E-08	5.9E-08	8.7E-08	--	NA	--
Copper	--	[a]	1.0	3.55E-07	3.13E-06	--	--	--	4.00E-02	--	6.08E-08	8.95E-08	--	--	--	NA	--
Iron	1.76E-01		1.0	3.55E-07	3.13E-06	6.3E-08	5.5E-07	6.2E-07	7.00E-01	9E-07	6.08E-08	8.95E-08	1.1E-08	1.6E-08	2.7E-08	NA	--
Manganese	1.38E-01		1.0	3.55E-07	3.13E-06	4.9E-08	4.3E-07	4.8E-07	2.40E-02	2E-05	6.08E-08	8.95E-08	8.4E-09	1.2E-08	2.1E-08	NA	--
Strontium	1.94E-01		1.0	3.55E-07	3.13E-06	6.9E-08	6.1E-07	6.8E-07	6.00E-01	1E-06	6.08E-08	8.95E-08	1.2E-08	1.7E-08	2.9E-08	NA	--
Thallium	8.53E-03	[b]	1.0	3.55E-07	3.13E-06	3.0E-09	2.7E-08	3.0E-08	1.00E-05	3E-03	6.08E-08	8.95E-08	5.2E-10	7.6E-10	1.3E-09	NA	--
Zinc	6.05E-02		1.0	3.55E-07	3.13E-06	2.1E-08	1.9E-07	2.1E-07	3.00E-01	7E-07	6.08E-08	8.95E-08	3.7E-09	5.4E-09	9.1E-09	NA	--

Ingestion of Groundwater (as drinking water)

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d)$^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Chromium(III)	1.80E-03		1.0	4.73E-04	6.39E-04	8.5E-07	1.2E-06	2.0E-06	1.50E+00	1E-06	8.11E-05	1.83E-05	1.5E-07	3.3E-08	1.8E-07	NA	--
Chromium(VI)	2.00E-04		1.0	4.73E-04	6.39E-04	9.5E-08	1.3E-07	2.2E-07	3.00E-03	7E-05	8.11E-05	1.83E-05	1.6E-08	3.7E-09	2.0E-08	5.00E-01	3E-08

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF (mg/kg d)$^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Arsenic	2.81E+01		0.06	1.69E-08	6.39E-08	2.8E-08	1.1E-07	1.4E-07	3.00E-04	5E-04	2.90E-09	1.83E-09	4.9E-09	3.1E-09	8.0E-09	1.50E+00	1E-08
Cadmium	3.62E+00		1.0	1.69E-08	6.39E-08	6.1E-08	2.3E-07	2.9E-07	1.00E-03	3E-04	2.90E-09	1.83E-09	1.0E-08	6.6E-09	1.7E-08	NA	--
Chromium(III)	3.13E+00		1.0	1.69E-08	6.39E-08	5.3E-08	2.0E-07	2.5E-07	1.50E+00	2E-07	2.90E-09	1.83E-09	9.1E-09	5.7E-09	1.5E-08	NA	--
Chromium(VI)	3.47E-01		1.0	1.69E-08	6.39E-08	5.9E-09	2.2E-08	2.8E-08	3.00E-03	9E-06	2.90E-09	1.83E-09	1.0E-09	6.3E-10	1.6E-09	5.00E-01	4E-09
Cobalt	3.41E+01	[c]	1.0	1.69E-08	6.39E-08	5.8E-07	2.2E-06	2.8E-06	3.00E-04	9E-03	2.90E-09	1.83E-09	9.9E-08	6.2E-08	1.6E-07	NA	--
Copper	2.47E+01	[c]	1.0	1.69E-08	6.39E-08	4.2E-07	1.6E-06	2.0E-06	4.00E-02	5E-05	2.90E-09	1.83E-09	7.1E-08	4.5E-08	1.2E-07	NA	--
Iron	3.30E+04		1.0	1.69E-08	6.39E-08	5.6E-04	2.1E-03	2.7E-03	7.00E-01	4E-03	2.90E-09	1.83E-09	9.6E-05	6.0E-05	1.6E-04	NA	--
Manganese	2.88E+03	[c]	1.0	1.69E-08	6.39E-08	4.9E-05	1.8E-04	2.3E-04	2.40E-02	1E-02	2.90E-09	1.83E-09	8.3E-06	5.3E-06	1.4E-05	NA	--
Thallium	--	[a]	1.0	1.69E-08	6.39E-08	--	--	--	1.00E-05	--	2.90E-09	1.83E-09	--	--	--	NA	--
Zinc	1.02E+03		1.0	1.69E-08	6.39E-08	1.7E-05	6.5E-05	8.2E-05	3.00E-01	3E-04	2.90E-09	1.83E-09	2.9E-06	1.9E-06	4.8E-06	NA	--

TABLE D-7a
DETAILED RISK CALCULATIONS FOR THE CAMPER (USFS) IN EU6
Bonita Peak Mining District

Incidental Ingestion of Soil

Chemical of Potential Concern	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Antimony	8.00E-01	[e]	1.0	3.38E-08	2.60E-07	2.7E-08	2.1E-07	2.3E-07	4.00E-04	6E-04	5.79E-09	7.42E-09	4.6E-09	5.9E-09	1.1E-08	NA	--
Arsenic	1.87E+01	[e]	0.07	3.38E-08	2.60E-07	4.4E-08	3.4E-07	3.8E-07	3.00E-04	1E-03	5.79E-09	7.42E-09	7.6E-09	9.7E-09	1.7E-08	1.50E+00	3E-08
Cadmium	1.10E+00	[e]	1.0	3.38E-08	2.60E-07	3.7E-08	2.9E-07	3.2E-07	1.00E-03	3E-04	5.79E-09	7.42E-09	6.4E-09	8.2E-09	1.5E-08	NA	--
Chromium(III)	4.32E+00		1.0	3.38E-08	2.60E-07	1.5E-07	1.1E-06	1.3E-06	1.50E+00	8E-07	5.79E-09	7.42E-09	2.5E-08	3.2E-08	5.7E-08	NA	--
Chromium(VI)	4.80E-01		1.0	3.38E-08	2.60E-07	1.6E-08	1.2E-07	1.4E-07	3.00E-03	5E-05	5.79E-09	7.42E-09	2.8E-09	3.6E-09	6.3E-09	5.00E-01	2E-08
Cobalt	9.40E+00	[e]	1.0	3.38E-08	2.60E-07	3.2E-07	2.4E-06	2.8E-06	3.00E-04	9E-03	5.79E-09	7.42E-09	5.4E-08	7.0E-08	1.2E-07	NA	--
Iron	2.21E+04	[e]	1.0	3.38E-08	2.60E-07	7.5E-04	5.7E-03	6.5E-03	7.00E-01	9E-03	5.79E-09	7.42E-09	1.3E-04	1.6E-04	2.9E-04	NA	--
Manganese	1.40E+03	[e]	1.0	3.38E-08	2.60E-07	4.7E-05	3.6E-04	4.1E-04	2.40E-02	2E-02	5.79E-09	7.42E-09	8.1E-06	1.0E-05	1.8E-05	NA	--
Thallium	9.90E-02	[e]	1.0	3.38E-08	2.60E-07	3.3E-09	2.6E-08	2.9E-08	1.00E-05	3E-03	5.79E-09	7.42E-09	5.7E-10	7.3E-10	1.3E-09	NA	--
Zinc	2.70E+02	[e]	1.0	3.38E-08	2.60E-07	9.1E-06	7.0E-05	7.9E-05	3.00E-01	3E-04	5.79E-09	7.42E-09	1.6E-06	2.0E-06	3.6E-06	NA	--

Panel B. RME Scenario

Incidental Ingestion of Surface Water

Chemical of Potential Concern	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Aluminum	8.80E-01		1.0	7.20E-06	3.13E-06	6.3E-06	2.8E-06	9.1E-06	1.00E+00	9E-06	2.06E-06	8.95E-08	1.8E-06	7.9E-08	1.9E-06	NA	--
Antimony	--	[a]	1.0	7.20E-06	3.13E-06	--	--	--	4.00E-04	--	2.06E-06	8.95E-08	--	--	--	NA	--
Arsenic	1.30E-04	[b]	1.0	7.20E-06	3.13E-06	9.4E-10	4.1E-10	--	3.00E-04	--	2.06E-06	8.95E-08	2.7E-10	1.2E-11	--	1.50E+00	--
Beryllium	--	[a]	1.0	7.20E-06	3.13E-06	--	--	--	2.00E-03	--	2.06E-06	8.95E-08	--	--	--	NA	--
Cadmium	2.40E-04	[b]	1.0	7.20E-06	3.13E-06	1.7E-09	7.5E-10	--	5.00E-04	--	2.06E-06	8.95E-08	4.9E-10	2.1E-11	--	NA	--
Chromium(III)	--		1.0	7.20E-06	3.13E-06	--	--	--	1.50E+00	--	2.06E-06	8.95E-08	--	--	--	NA	--
Chromium(VI)	--		1.0	7.20E-06	3.13E-06	--	--	--	3.00E-03	--	2.06E-06	8.95E-08	--	--	--	5.00E-01	--
Cobalt	9.70E-01		1.0	7.20E-06	3.13E-06	7.0E-06	3.0E-06	--	3.00E-04	--	2.06E-06	8.95E-08	2.0E-06	8.7E-08	--	NA	--
Copper	--	[a]	1.0	7.20E-06	3.13E-06	--	--	--	4.00E-02	--	2.06E-06	8.95E-08	--	--	--	NA	--
Iron	1.76E-01		1.0	7.20E-06	3.13E-06	1.3E-06	5.5E-07	1.8E-06	7.00E-01	3E-06	2.06E-06	8.95E-08	3.6E-07	1.6E-08	3.8E-07	NA	--
Manganese	1.38E-01		1.0	7.20E-06	3.13E-06	9.9E-07	4.3E-07	1.4E-06	2.40E-02	6E-05	2.06E-06	8.95E-08	2.8E-07	1.2E-08	2.9E-07	NA	--
Strontium	1.94E-01		1.0	7.20E-06	3.13E-06	1.4E-06	6.1E-07	2.0E-06	6.00E-01	3E-06	2.06E-06	8.95E-08	4.0E-07	1.7E-08	4.2E-07	NA	--
Thallium	8.53E-03	[b]	1.0	7.20E-06	3.13E-06	6.1E-08	2.7E-08	8.8E-08	1.00E-05	9E-03	2.06E-06	8.95E-08	1.8E-08	7.6E-10	1.8E-08	NA	--
Zinc	6.05E-02		1.0	7.20E-06	3.13E-06	4.4E-07	1.9E-07	6.3E-07	3.00E-01	2E-06	2.06E-06	8.95E-08	1.2E-07	5.4E-09	1.3E-07	NA	--

Ingestion of Groundwater (as drinking water)

Chemical of Potential Concern	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Chromium(III)	1.80E-03		1.0	1.69E-03	6.39E-04	3.0E-06	1.2E-06	4.2E-06	1.50E+00	3E-06	4.83E-04	1.83E-05	8.7E-07	3.3E-08	9.0E-07	NA	--
Chromium(VI)	2.00E-04		1.0	1.69E-03	6.39E-04	3.4E-07	1.3E-07	4.7E-07	3.00E-03	2E-04	4.83E-04	1.83E-05	9.7E-08	3.7E-09	1.0E-07	5.00E-01	1E-07

TABLE D-7a
DETAILED RISK CALCULATIONS FOR THE CAMPER (USFS) IN EU6
Bonita Peak Mining District

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Arsenic	2.81E+01		0.06	6.76E-08	6.39E-08	1.1E-07	1.1E-07	2.2E-07	3.00E-04	7E-04	1.93E-08	1.83E-09	3.3E-08	3.1E-09	3.6E-08	1.50E+00	5E-08
Cadmium	3.62E+00		1.0	6.76E-08	6.39E-08	2.4E-07	2.3E-07	4.8E-07	1.00E-03	5E-04	1.93E-08	1.83E-09	7.0E-08	6.6E-09	7.6E-08	NA	--
Chromium(III)	3.13E+00		1.0	6.76E-08	6.39E-08	2.1E-07	2.0E-07	4.1E-07	1.50E+00	3E-07	1.93E-08	1.83E-09	6.0E-08	5.7E-09	6.6E-08	NA	--
Chromium(VI)	3.47E-01		1.0	6.76E-08	6.39E-08	2.3E-08	2.2E-08	4.6E-08	3.00E-03	2E-05	1.93E-08	1.83E-09	6.7E-09	6.3E-10	7.3E-09	5.00E-01	8E-09
Cobalt	3.41E+01	[c]	1.0	6.76E-08	6.39E-08	2.3E-06	2.2E-06	4.5E-06	3.00E-04	1E-02	1.93E-08	1.83E-09	6.6E-07	6.2E-08	7.2E-07	NA	--
Copper	2.47E+01	[c]	1.0	6.76E-08	6.39E-08	1.7E-06	1.6E-06	3.2E-06	4.00E-02	8E-05	1.93E-08	1.83E-09	4.8E-07	4.5E-08	5.2E-07	NA	--
Iron	3.30E+04		1.0	6.76E-08	6.39E-08	2.2E-03	2.1E-03	4.3E-03	7.00E-01	6E-03	1.93E-08	1.83E-09	6.4E-04	6.0E-05	7.0E-04	NA	--
Manganese	2.88E+03	[c]	1.0	6.76E-08	6.39E-08	1.9E-04	1.8E-04	3.8E-04	2.40E-02	2E-02	1.93E-08	1.83E-09	5.6E-05	5.3E-06	6.1E-05	NA	--
Thallium	--	[a]	1.0	6.76E-08	6.39E-08	--	--	--	1.00E-05	--	1.93E-08	1.83E-09	--	--	--	NA	--
Zinc	1.02E+03		1.0	6.76E-08	6.39E-08	6.9E-05	6.5E-05	1.3E-04	3.00E-01	4E-04	1.93E-08	1.83E-09	2.0E-05	1.9E-06	2.1E-05	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Antimony	8.00E-01	[e]	1.0	1.35E-07	2.60E-07	1.1E-07	2.1E-07	3.2E-07	4.00E-04	8E-04	3.86E-08	7.42E-09	3.1E-08	5.9E-09	3.7E-08	NA	--
Arsenic	1.87E+01	[e]	0.07	1.35E-07	2.60E-07	1.8E-07	3.4E-07	5.2E-07	3.00E-04	2E-03	3.86E-08	7.42E-09	5.1E-08	9.7E-09	6.0E-08	1.50E+00	9E-08
Cadmium	1.10E+00	[e]	1.0	1.35E-07	2.60E-07	1.5E-07	2.9E-07	4.3E-07	1.00E-03	4E-04	3.86E-08	7.42E-09	4.2E-08	8.2E-09	5.1E-08	NA	--
Chromium(III)	4.32E+00		1.0	1.35E-07	2.60E-07	5.8E-07	1.1E-06	1.7E-06	1.50E+00	1E-06	3.86E-08	7.42E-09	1.7E-07	3.2E-08	2.0E-07	NA	--
Chromium(VI)	4.80E-01		1.0	1.35E-07	2.60E-07	6.5E-08	1.2E-07	1.9E-07	3.00E-03	6E-05	3.86E-08	7.42E-09	1.9E-08	3.6E-09	2.2E-08	5.00E-01	3E-08
Cobalt	9.40E+00	[e]	1.0	1.35E-07	2.60E-07	1.3E-06	2.4E-06	3.7E-06	3.00E-04	1E-02	3.86E-08	7.42E-09	3.6E-07	7.0E-08	4.3E-07	NA	--
Iron	2.21E+04	[e]	1.0	1.35E-07	2.60E-07	3.0E-03	5.7E-03	8.7E-03	7.00E-01	1E-02	3.86E-08	7.42E-09	8.5E-04	1.6E-04	1.0E-03	NA	--
Manganese	1.40E+03	[e]	1.0	1.35E-07	2.60E-07	1.9E-04	3.6E-04	5.5E-04	2.40E-02	2E-02	3.86E-08	7.42E-09	5.4E-05	1.0E-05	6.4E-05	NA	--
Thallium	9.90E-02	[e]	1.0	1.35E-07	2.60E-07	1.3E-08	2.6E-08	3.9E-08	1.00E-05	4E-03	3.86E-08	7.42E-09	3.8E-09	7.3E-10	4.6E-09	NA	--
Zinc	2.70E+02	[e]	1.0	1.35E-07	2.60E-07	3.6E-05	7.0E-05	1.1E-04	3.00E-01	4E-04	3.86E-08	7.42E-09	1.0E-05	2.0E-06	1.2E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

Csediment = sediment concentration
Csoil = soil concentration
Cwater = water concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
L = liter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

RME RISK SUMMARY FOR THE ADULT CAMPER (USFS)

Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	Incidental SW Ingestion	Ingestion of GW (as drinking water)	Incidental Sed Ingestion	Incidental Soil Ingestion	Total HI
Aluminum	9E-06	--	--	--	9E-06
Antimony	--	--	--	8E-04	8E-04
Arsenic	--	--	7E-04	2E-03	2E-03
Beryllium	--	--	--	--	--
Cadmium	--	--	5E-04	4E-04	9E-04
Chromium(III)	--	3E-06	3E-07	1E-06	4E-06
Chromium(VI)	--	2E-04	2E-05	6E-05	2E-04
Cobalt	--	--	1E-02	1E-02	3E-02
Copper	--	--	8E-05	--	--
Iron	3E-06	--	6E-03	1E-02	2E-02
Manganese	6E-05	--	2E-02	2E-02	4E-02
Strontium	3E-06	--	--	--	3E-06
Thallium	9E-03	--	--	4E-03	1E-02
Zinc	2E-06	--	4E-04	4E-04	8E-04
Total	**9E-03**	**2E-04**	**4E-02**	**6E-02**	**1E-01**

Panel B: RME Cancer Risks

Chemical of Potential Concern	Incidental SW Ingestion	Ingestion of GW (as drinking water)	Incidental Sed Ingestion	Incidental Soil Ingestion	Total Risk
Aluminum	--	--	--	--	--
Antimony	--	--	--	--	--
Arsenic	--	--	5E-08	9E-08	1E-07
Beryllium	--	--	--	--	--
Cadmium	--	--	--	--	--
Chromium(III)	--	--	--	--	--
Chromium(VI)	--	1E-07	8E-09	3E-08	1E-07
Cobalt	--	--	--	--	--
Copper	--	--	--	--	--
Iron	--	--	--	--	--
Manganese	--	--	--	--	--
Strontium	--	--	--	--	--
Thallium	--	--	--	--	--
Zinc	--	--	--	--	--
Total	**--**	**1E-07**	**6E-08**	**1E-07**	**3E-07**

Notes:

-- = not calculated

GW = groundwater

HI = hazard index

RME = reasonable maximum exposure

TABLE D-8a
DETAILED RISK CALCULATIONS FOR THE CAMPER (DISPERSED) IN EU7
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Aluminum	1.16E+00		1.0	7.09E-07	3.13E-06	8.2E-07	3.6E-06	4.4E-06	1.00E+00	4E-06	1.22E-07	8.95E-08	1.4E-07	1.0E-07	2.4E-07	NA	--
Antimony	5.04E-03	[b]	1.0	7.09E-07	3.13E-06	3.6E-09	1.6E-08	1.9E-08	4.00E-04	5E-05	1.22E-07	8.95E-08	6.1E-10	4.5E-10	1.1E-09	NA	--
Arsenic	7.67E-04		1.0	7.09E-07	3.13E-06	5.4E-10	2.4E-09	2.9E-09	3.00E-04	1E-05	1.22E-07	8.95E-08	9.3E-11	6.9E-11	1.6E-10	1.50E+00	2E-10
Beryllium	4.63E-03	[b]	1.0	7.09E-07	3.13E-06	3.3E-09	1.5E-08	1.8E-08	2.00E-03	9E-06	1.22E-07	8.95E-08	5.6E-10	4.1E-10	9.8E-10	NA	--
Cadmium	4.83E-03		1.0	7.09E-07	3.13E-06	3.4E-09	1.5E-08	1.9E-08	5.00E-04	4E-05	1.22E-07	8.95E-08	5.9E-10	4.3E-10	1.0E-09	NA	--
Chromium(III)	7.88E-03		1.0	7.09E-07	3.13E-06	5.6E-09	2.5E-08	3.0E-08	1.50E+00	2E-08	1.22E-07	8.95E-08	9.6E-10	7.1E-10	1.7E-09	NA	--
Chromium(VI)	8.76E-04		1.0	7.09E-07	3.13E-06	6.2E-10	2.7E-09	3.4E-09	3.00E-03	1E-06	1.22E-07	8.95E-08	1.1E-10	7.8E-11	1.8E-10	5.00E-01	5E-10
Cobalt	3.06E-03		1.0	7.09E-07	3.13E-06	2.2E-09	9.6E-09	1.2E-08	3.00E-04	4E-05	1.22E-07	8.95E-08	3.7E-10	2.7E-10	6.5E-10	NA	--
Copper	3.01E-02		1.0	7.09E-07	3.13E-06	2.1E-08	9.4E-08	1.2E-07	4.00E-02	3E-06	1.22E-07	8.95E-08	3.7E-09	2.7E-09	6.4E-09	NA	--
Iron	3.09E+00		1.0	7.09E-07	3.13E-06	2.2E-06	9.7E-06	1.2E-05	7.00E-01	2E-05	1.22E-07	8.95E-08	3.8E-07	2.8E-07	6.5E-07	NA	--
Manganese	8.43E-01		1.0	7.09E-07	3.13E-06	6.0E-07	2.6E-06	3.2E-06	2.40E-02	1E-04	1.22E-07	8.95E-08	1.0E-07	7.5E-08	1.8E-07	NA	--
Strontium	4.92E-01		1.0	7.09E-07	3.13E-06	3.5E-07	1.5E-06	1.9E-06	6.00E-01	3E-06	1.22E-07	8.95E-08	6.0E-08	4.4E-08	1.0E-07	NA	--
Thallium	1.36E-03		1.0	7.09E-07	3.13E-06	9.7E-10	4.3E-09	5.2E-09	1.00E-05	5E-04	1.22E-07	8.95E-08	1.7E-10	1.2E-10	2.9E-10	NA	--
Zinc	1.18E+00		1.0	7.09E-07	3.13E-06	8.4E-07	3.7E-06	4.5E-06	3.00E-01	2E-05	1.22E-07	8.95E-08	1.4E-07	1.1E-07	2.5E-07	NA	--

Ingestion of Surface Water (as drinking water)

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Aluminum	1.16E+00		1.0	9.46E-04	6.39E-04	1.1E-03	7.4E-04	1.8E-03	1.00E+00	2E-03	1.62E-04	1.83E-05	1.9E-04	2.1E-05	2.1E-04	NA	--
Antimony	5.04E-03	[b]	1.0	9.46E-04	6.39E-04	4.8E-06	3.2E-06	8.0E-06	4.00E-04	2E-02	1.62E-04	1.83E-05	8.2E-07	9.2E-08	9.1E-07	NA	--
Arsenic	7.67E-04		1.0	9.46E-04	6.39E-04	7.3E-07	4.9E-07	1.2E-06	3.00E-04	4E-03	1.62E-04	1.83E-05	1.2E-07	1.4E-08	1.4E-07	1.50E+00	2E-07
Beryllium	4.63E-03	[b]	1.0	9.46E-04	6.39E-04	4.4E-06	3.0E-06	7.3E-06	2.00E-03	4E-03	1.62E-04	1.83E-05	7.5E-07	8.5E-08	8.4E-07	NA	--
Cadmium	4.83E-03		1.0	9.46E-04	6.39E-04	4.6E-06	3.1E-06	7.7E-06	5.00E-04	2E-02	1.62E-04	1.83E-05	7.8E-07	8.8E-08	8.7E-07	NA	--
Chromium(III)	7.88E-03		1.0	9.46E-04	6.39E-04	7.5E-06	5.0E-06	1.2E-05	1.50E+00	8E-06	1.62E-04	1.83E-05	1.3E-06	1.4E-07	1.4E-06	NA	--
Chromium(VI)	8.76E-04		1.0	9.46E-04	6.39E-04	8.3E-07	5.6E-07	1.4E-06	3.00E-03	5E-04	1.62E-04	1.83E-05	1.4E-07	1.6E-08	1.6E-07	5.00E-01	2E-07
Cobalt	3.06E-03		1.0	9.46E-04	6.39E-04	2.9E-06	2.0E-06	4.9E-06	3.00E-04	2E-02	1.62E-04	1.83E-05	5.0E-07	5.6E-08	5.5E-07	NA	--
Copper	3.01E-02		1.0	9.46E-04	6.39E-04	2.8E-05	1.9E-05	4.8E-05	4.00E-02	1E-03	1.62E-04	1.83E-05	4.9E-06	5.5E-07	5.4E-06	NA	--
Iron	3.09E+00		1.0	9.46E-04	6.39E-04	2.9E-03	2.0E-03	4.9E-03	7.00E-01	7E-03	1.62E-04	1.83E-05	5.0E-04	5.6E-05	5.6E-04	NA	--
Manganese	8.43E-01		1.0	9.46E-04	6.39E-04	8.0E-04	5.4E-04	1.3E-03	2.40E-02	6E-02	1.62E-04	1.83E-05	1.4E-04	1.5E-05	1.5E-04	NA	--
Strontium	4.92E-01		1.0	9.46E-04	6.39E-04	4.7E-04	3.1E-04	7.8E-04	6.00E-01	1E-03	1.62E-04	1.83E-05	8.0E-05	9.0E-06	8.9E-05	NA	--
Thallium	1.36E-03		1.0	9.46E-04	6.39E-04	1.3E-06	8.7E-07	2.2E-06	1.00E-05	2E-01	1.62E-04	1.83E-05	2.2E-07	2.5E-08	2.5E-07	NA	--
Zinc	1.18E+00		1.0	9.46E-04	6.39E-04	1.1E-03	7.6E-04	1.9E-03	3.00E-01	6E-03	1.62E-04	1.83E-05	1.9E-04	2.2E-05	2.1E-04	NA	--

TABLE D-8a
DETAILED RISK CALCULATIONS FOR THE CAMPER (DISPERSED) IN EU7
Bonita Peak Mining District

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Arsenic	3.23E+01		0.06	3.38E-08	6.39E-08	6.6E-08	1.2E-07	1.9E-07	3.00E-04	6E-04	5.79E-09	1.83E-09	1.1E-08	3.5E-09	1.5E-08	1.50E+00	2E-08
Cadmium	4.12E+01		1.0	3.38E-08	6.39E-08	1.4E-06	2.6E-06	4.0E-06	1.00E-03	4E-03	5.79E-09	1.83E-09	2.4E-07	7.5E-08	3.1E-07	NA	--
Chromium(III)	3.66E+00		1.0	3.38E-08	6.39E-08	1.2E-07	2.3E-07	3.6E-07	1.50E+00	2E-07	5.79E-09	1.83E-09	2.1E-08	6.7E-09	2.8E-08	NA	--
Chromium(VI)	4.06E-01		1.0	3.38E-08	6.39E-08	1.4E-08	2.6E-08	4.0E-08	3.00E-03	1E-05	5.79E-09	1.83E-09	2.4E-09	7.4E-10	3.1E-09	5.00E-01	6E-09
Cobalt	1.24E+01		1.0	3.38E-08	6.39E-08	4.2E-07	7.9E-07	1.2E-06	3.00E-04	4E-03	5.79E-09	1.83E-09	7.2E-08	2.3E-08	9.4E-08	NA	--
Copper	9.33E+02		1.0	3.38E-08	6.39E-08	3.2E-05	6.0E-05	9.1E-05	4.00E-02	2E-03	5.79E-09	1.83E-09	5.4E-06	1.7E-06	7.1E-06	NA	--
Iron	7.01E+04		1.0	3.38E-08	6.39E-08	2.4E-03	4.5E-03	6.9E-03	7.00E-01	1E-02	5.79E-09	1.83E-09	4.1E-04	1.3E-04	5.3E-04	NA	--
Manganese	7.95E+03		1.0	3.38E-08	6.39E-08	2.7E-04	5.1E-04	7.8E-04	2.40E-02	3E-02	5.79E-09	1.83E-09	4.6E-05	1.5E-05	6.1E-05	NA	--
Thallium	1.72E-01		1.0	3.38E-08	6.39E-08	5.8E-09	1.1E-08	1.7E-08	1.00E-05	2E-03	5.79E-09	1.83E-09	1.0E-09	3.1E-10	1.3E-09	NA	--
Zinc	3.21E+03		1.0	3.38E-08	6.39E-08	1.1E-04	2.1E-04	3.1E-04	3.00E-01	1E-03	5.79E-09	1.83E-09	1.9E-05	5.9E-06	2.4E-05	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Antimony	5.08E+01		1.0	6.76E-08	2.60E-07	3.4E-06	1.3E-05	1.7E-05	4.00E-04	4E-02	1.16E-08	7.42E-09	5.9E-07	3.8E-07	9.6E-07	NA	--
Arsenic	4.49E+01		0.07	6.76E-08	2.60E-07	2.1E-07	8.2E-07	1.0E-06	3.00E-04	3E-03	1.16E-08	7.42E-09	3.6E-08	2.3E-08	6.0E-08	1.50E+00	9E-08
Cadmium	1.44E+01		1.0	6.76E-08	2.60E-07	9.7E-07	3.7E-06	4.7E-06	1.00E-03	5E-03	1.16E-08	7.42E-09	1.7E-07	1.1E-07	2.7E-07	NA	--
Chromium(III)	6.63E+00		1.0	6.76E-08	2.60E-07	4.5E-07	1.7E-06	2.2E-06	1.50E+00	1E-06	1.16E-08	7.42E-09	7.7E-08	4.9E-08	1.3E-07	NA	--
Chromium(VI)	7.37E-01		1.0	6.76E-08	2.60E-07	5.0E-08	1.9E-07	2.4E-07	3.00E-03	8E-05	1.16E-08	7.42E-09	8.5E-09	5.5E-09	1.4E-08	5.00E-01	4E-08
Cobalt	1.27E+01		1.0	6.76E-08	2.60E-07	8.6E-07	3.3E-06	4.1E-06	3.00E-04	1E-02	1.16E-08	7.42E-09	1.5E-07	9.4E-08	2.4E-07	NA	--
Iron	3.41E+04		1.0	6.76E-08	2.60E-07	2.3E-03	8.9E-03	1.1E-02	7.00E-01	2E-02	1.16E-08	7.42E-09	4.0E-04	2.5E-04	6.5E-04	NA	--
Manganese	3.29E+03		1.0	6.76E-08	2.60E-07	2.2E-04	8.5E-04	1.1E-03	2.40E-02	4E-02	1.16E-08	7.42E-09	3.8E-05	2.4E-05	6.3E-05	NA	--
Thallium	3.42E-01		1.0	6.76E-08	2.60E-07	2.3E-08	8.9E-08	1.1E-07	1.00E-05	1E-02	1.16E-08	7.42E-09	4.0E-09	2.5E-09	6.5E-09	NA	--
Zinc	2.21E+03		1.0	6.76E-08	2.60E-07	1.5E-04	5.7E-04	7.2E-04	3.00E-01	2E-03	1.16E-08	7.42E-09	2.6E-05	1.6E-05	4.2E-05	NA	--

TABLE D-8a
DETAILED RISK CALCULATIONS FOR THE CAMPER (DISPERSED) IN EU7
Bonita Peak Mining District

Panel B. RME Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d)$^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Aluminum	1.16E+00		1.0	1.44E-05	3.13E-06	1.7E-05	3.6E-06	2.0E-05	1.00E+00	2E-05	4.11E-06	8.95E-08	4.8E-06	1.0E-07	4.9E-06	NA	--
Antimony	5.04E-03	[b]	1.0	1.44E-05	3.13E-06	7.3E-08	1.6E-08	8.8E-08	4.00E-04	2E-04	4.11E-06	8.95E-08	2.1E-08	4.5E-10	2.1E-08	NA	--
Arsenic	7.67E-04		1.0	1.44E-05	3.13E-06	1.1E-08	2.4E-09	1.3E-08	3.00E-04	4E-05	4.11E-06	8.95E-08	3.2E-09	6.9E-11	3.2E-09	1.50E+00	5E-09
Beryllium	4.63E-03	[b]	1.0	1.44E-05	3.13E-06	6.7E-08	1.5E-08	8.1E-08	2.00E-03	4E-05	4.11E-06	8.95E-08	1.9E-08	4.1E-10	1.9E-08	NA	--
Cadmium	4.83E-03		1.0	1.44E-05	3.13E-06	7.0E-08	1.5E-08	8.5E-08	5.00E-04	2E-04	4.11E-06	8.95E-08	2.0E-08	4.3E-10	2.0E-08	NA	--
Chromium(III)	7.88E-03		1.0	1.44E-05	3.13E-06	1.1E-07	2.5E-08	1.4E-07	1.50E+00	9E-08	4.11E-06	8.95E-08	3.2E-08	7.1E-10	3.3E-08	NA	--
Chromium(VI)	8.76E-04		1.0	1.44E-05	3.13E-06	1.3E-08	2.7E-09	1.5E-08	3.00E-03	5E-06	4.11E-06	8.95E-08	3.6E-09	7.8E-11	3.7E-09	5.00E-01	4E-09
Cobalt	3.06E-03		1.0	1.44E-05	3.13E-06	4.4E-08	9.6E-09	5.4E-08	3.00E-04	2E-04	4.11E-06	8.95E-08	1.3E-08	2.7E-10	1.3E-08	NA	--
Copper	3.01E-02		1.0	1.44E-05	3.13E-06	4.3E-07	9.4E-08	5.3E-07	4.00E-02	1E-05	4.11E-06	8.95E-08	1.2E-07	2.7E-09	1.3E-07	NA	--
Iron	3.09E+00		1.0	1.44E-05	3.13E-06	4.5E-05	9.7E-06	5.4E-05	7.00E-01	8E-05	4.11E-06	8.95E-08	1.3E-05	2.8E-07	1.3E-05	NA	--
Manganese	8.43E-01		1.0	1.44E-05	3.13E-06	1.2E-05	2.6E-06	1.5E-05	2.40E-02	6E-04	4.11E-06	8.95E-08	3.5E-06	7.5E-08	3.5E-06	NA	--
Strontium	4.92E-01		1.0	1.44E-05	3.13E-06	7.1E-06	1.5E-06	8.6E-06	6.00E-01	1E-05	4.11E-06	8.95E-08	2.0E-06	4.4E-08	2.1E-06	NA	--
Thallium	1.36E-03		1.0	1.44E-05	3.13E-06	2.0E-08	4.3E-09	2.4E-08	1.00E-05	2E-03	4.11E-06	8.95E-08	5.6E-09	1.2E-10	5.7E-09	NA	--
Zinc	1.18E+00		1.0	1.44E-05	3.13E-06	1.7E-05	3.7E-06	2.1E-05	3.00E-01	7E-05	4.11E-06	8.95E-08	4.9E-06	1.1E-07	--	NA	--

Ingestion of Surface Water (as drinking water)

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard							Cancer Risk						
				HIFNC (L/kg d)		DI (L/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)		DI (L/kg d)			Oral SF (mg/kg d)$^{-1}$	Risk
				Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Aluminum	1.16E+00		1.0	3.38E-03	6.39E-04	3.9E-03	7.4E-04	4.6E-03	1.00E+00	5E-03	9.65E-04	1.83E-05	1.1E-03	2.1E-05	1.1E-03	NA	--
Antimony	5.04E-03	[b]	1.0	3.38E-03	6.39E-04	1.7E-05	3.2E-06	2.0E-05	4.00E-04	5E-02	9.65E-04	1.83E-05	4.9E-06	9.2E-08	5.0E-06	NA	--
Arsenic	7.67E-04		1.0	3.38E-03	6.39E-04	2.6E-06	4.9E-07	3.1E-06	3.00E-04	1E-02	9.65E-04	1.83E-05	7.4E-07	1.4E-08	7.5E-07	1.50E+00	1E-06
Beryllium	4.63E-03	[b]	1.0	3.38E-03	6.39E-04	1.6E-05	3.0E-06	1.9E-05	2.00E-03	9E-03	9.65E-04	1.83E-05	4.5E-06	8.5E-08	4.6E-06	NA	--
Cadmium	4.83E-03		1.0	3.38E-03	6.39E-04	1.6E-05	3.1E-06	1.9E-05	5.00E-04	4E-02	9.65E-04	1.83E-05	4.7E-06	8.8E-08	4.7E-06	NA	--
Chromium(III)	7.88E-03		1.0	3.38E-03	6.39E-04	2.7E-05	5.0E-06	3.2E-05	1.50E+00	2E-05	9.65E-04	1.83E-05	7.6E-06	1.4E-07	7.8E-06	NA	--
Chromium(VI)	8.76E-04		1.0	3.38E-03	6.39E-04	3.0E-06	5.6E-07	3.5E-06	3.00E-03	1E-03	9.65E-04	1.83E-05	8.5E-07	1.6E-08	8.6E-07	5.00E-01	9E-07
Cobalt	3.06E-03		1.0	3.38E-03	6.39E-04	1.0E-05	2.0E-06	1.2E-05	3.00E-04	4E-02	9.65E-04	1.83E-05	3.0E-06	5.6E-08	3.0E-06	NA	--
Copper	3.01E-02		1.0	3.38E-03	6.39E-04	1.0E-04	1.9E-05	1.2E-04	4.00E-02	3E-03	9.65E-04	1.83E-05	2.9E-05	5.5E-07	3.0E-05	NA	--
Iron	3.09E+00		1.0	3.38E-03	6.39E-04	1.0E-02	2.0E-03	1.2E-02	7.00E-01	2E-02	9.65E-04	1.83E-05	3.0E-03	5.6E-05	3.0E-03	NA	--
Manganese	8.43E-01		1.0	3.38E-03	6.39E-04	2.8E-03	5.4E-04	3.4E-03	2.40E-02	1E-01	9.65E-04	1.83E-05	8.1E-04	1.5E-05	8.3E-04	NA	--
Strontium	4.92E-01		1.0	3.38E-03	6.39E-04	1.7E-03	3.1E-04	2.0E-03	6.00E-01	3E-03	9.65E-04	1.83E-05	4.8E-04	9.0E-06	4.8E-04	NA	--
Thallium	1.36E-03		1.0	3.38E-03	6.39E-04	4.6E-06	8.7E-07	5.5E-06	1.00E-05	5E-01	9.65E-04	1.83E-05	1.3E-06	2.5E-08	1.3E-06	NA	--
Zinc	1.18E+00		1.0	3.38E-03	6.39E-04	4.0E-03	7.6E-04	4.8E-03	3.00E-01	2E-02	9.65E-04	1.83E-05	1.1E-03	2.2E-05	1.2E-03	NA	--

TABLE D-8a
DETAILED RISK CALCULATIONS FOR THE CAMPER (DISPERSED) IN EU7
Bonita Peak Mining District

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)	RBA (unitless)	Non Cancer Hazard							Cancer Risk						
			HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
			Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Arsenic	3.23E+01	0.06	1.35E-07	6.39E-08	2.6E-07	1.2E-07	3.9E-07	3.00E-04	1E-03	3.86E-08	1.83E-09	7.5E-08	3.5E-09	7.8E-08	1.50E+00	1E-07
Cadmium	4.12E+01	1.0	1.35E-07	6.39E-08	5.6E-06	2.6E-06	8.2E-06	1.00E-03	8E-03	3.86E-08	1.83E-09	1.6E-06	7.5E-08	1.7E-06	NA	--
Chromium(III)	3.66E+00	1.0	1.35E-07	6.39E-08	4.9E-07	2.3E-07	7.3E-07	1.50E+00	5E-07	3.86E-08	1.83E-09	1.4E-07	6.7E-09	1.5E-07	NA	--
Chromium(VI)	4.06E-01	1.0	1.35E-07	6.39E-08	5.5E-08	2.6E-08	8.1E-08	3.00E-03	3E-05	3.86E-08	1.83E-09	1.6E-08	7.4E-10	1.6E-08	5.00E-01	2E-08
Cobalt	1.24E+01	1.0	1.35E-07	6.39E-08	1.7E-06	7.9E-07	2.5E-06	3.00E-04	8E-03	3.86E-08	1.83E-09	4.8E-07	2.3E-08	5.0E-07	NA	--
Copper	9.33E+02	1.0	1.35E-07	6.39E-08	1.3E-04	6.0E-05	1.9E-04	4.00E-02	5E-03	3.86E-08	1.83E-09	3.6E-05	1.7E-06	3.8E-05	NA	--
Iron	7.01E+04	1.0	1.35E-07	6.39E-08	9.5E-03	4.5E-03	1.4E-02	7.00E-01	2E-02	3.86E-08	1.83E-09	2.7E-03	1.3E-04	2.8E-03	NA	--
Manganese	7.95E+03	1.0	1.35E-07	6.39E-08	1.1E-03	5.1E-04	1.6E-03	2.40E-02	7E-02	3.86E-08	1.83E-09	3.1E-04	1.5E-05	3.2E-04	NA	--
Thallium	1.72E-01	1.0	1.35E-07	6.39E-08	2.3E-08	1.1E-08	3.4E-08	1.00E-05	3E-03	3.86E-08	1.83E-09	6.6E-09	3.1E-10	7.0E-09	NA	--
Zinc	3.21E+03	1.0	1.35E-07	6.39E-08	4.3E-04	2.1E-04	--	3.00E-01	--	3.86E-08	1.83E-09	1.2E-04	5.9E-06	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)	RBA (unitless)	Non Cancer Hazard							Cancer Risk						
			HIFNC (kg/kg d)		DI (mg/kg d)			Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)		DI (mg/kg d)			Oral SF $(mg/kg\ d)^{-1}$	Risk
			Adult	Child	Adult	Child	Total			Adult	Child	Adult	Child	Total		
Antimony	5.08E+01	1.0	2.70E-07	2.60E-07	1.4E-05	1.3E-05	2.7E-05	4.00E-04	7E-02	7.72E-08	7.42E-09	3.9E-06	3.8E-07	4.3E-06	NA	--
Arsenic	4.49E+01	0.07	2.70E-07	2.60E-07	8.5E-07	8.2E-07	1.7E-06	3.00E-04	6E-03	7.72E-08	7.42E-09	2.4E-07	2.3E-08	2.7E-07	1.50E+00	4E-07
Cadmium	1.44E+01	1.0	2.70E-07	2.60E-07	3.9E-06	3.7E-06	7.6E-06	1.00E-03	8E-03	7.72E-08	7.42E-09	1.1E-06	1.1E-07	1.2E-06	NA	--
Chromium(III)	6.63E+00	1.0	2.70E-07	2.60E-07	1.8E-06	1.7E-06	3.5E-06	1.50E+00	2E-06	7.72E-08	7.42E-09	5.1E-07	4.9E-08	5.6E-07	NA	--
Chromium(VI)	7.37E-01	1.0	2.70E-07	2.60E-07	2.0E-07	1.9E-07	3.9E-07	3.00E-03	1E-04	7.72E-08	7.42E-09	5.7E-08	5.5E-09	6.2E-08	5.00E-01	8E-08
Cobalt	1.27E+01	1.0	2.70E-07	2.60E-07	3.4E-06	3.3E-06	6.7E-06	3.00E-04	2E-02	7.72E-08	7.42E-09	9.8E-07	9.4E-08	1.1E-06	NA	--
Iron	3.41E+04	1.0	2.70E-07	2.60E-07	9.2E-03	8.9E-03	1.8E-02	7.00E-01	3E-02	7.72E-08	7.42E-09	2.6E-03	2.5E-04	2.9E-03	NA	--
Manganese	3.29E+03	1.0	2.70E-07	2.60E-07	8.9E-04	8.5E-04	1.7E-03	2.40E-02	7E-02	7.72E-08	7.42E-09	2.5E-04	2.4E-05	2.8E-04	NA	--
Thallium	3.42E-01	1.0	2.70E-07	2.60E-07	9.2E-08	8.9E-08	1.8E-07	1.00E-05	2E-02	7.72E-08	7.42E-09	2.6E-08	2.5E-09	2.9E-08	NA	--
Zinc	2.21E+03	1.0	2.70E-07	2.60E-07	6.0E-04	5.7E-04	1.2E-03	3.00E-01	4E-03	7.72E-08	7.42E-09	1.7E-04	1.6E-05	1.9E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

Csediment = sediment concentration
Csoil = soil concentration
Cwater = water concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
L = liter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-8b
RME RISK SUMMARY FOR THE ADULT CAMPER (DISPERSED)
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	Incidental SW Ingestion	SW Ingestion (as drinking water)	Incidental Sed Ingestion	Incidental Soil Ingestion	Total HI
Aluminum	2E-05	5E-03	--	--	5E-03
Antimony	2E-04	5E-02	--	7E-02	1E-01
Arsenic	4E-05	1E-02	1E-03	6E-03	2E-02
Beryllium	4E-05	9E-03	--	--	9E-03
Cadmium	2E-04	4E-02	8E-03	8E-03	5E-02
Chromium(III)	9E-08	2E-05	5E-07	2E-06	2E-05
Chromium(VI)	5E-06	1E-03	3E-05	1E-04	1E-03
Cobalt	2E-04	4E-02	8E-03	2E-02	7E-02
Copper	1E-05	3E-03	5E-03	--	8E-03
Iron	8E-05	2E-02	2E-02	3E-02	6E-02
Manganese	6E-04	1E-01	7E-02	7E-02	3E-01
Strontium	1E-05	3E-03	--	--	3E-03
Thallium	2E-03	5E-01	3E-03	2E-02	6E-01
Zinc	7E-05	2E-02	--	4E-03	2E-02
Total	**4E-03**	**9E-01**	**1E-01**	**2E-01**	**1E+00**

Panel B: RME Cancer Risks

Chemical of Potential Concern	Incidental SW Ingestion	SW Ingestion (as drinking water)	Incidental Sed Ingestion	Incidental Soil Ingestion	Total Risk
Aluminum	--	--	--	--	--
Antimony	--	--	--	--	--
Arsenic	5E-09	1E-06	1E-07	4E-07	2E-06
Beryllium	--	--	--	--	--
Cadmium	--	--	--	--	--
Chromium(III)	--	--	--	--	--
Chromium(VI)	4E-09	9E-07	2E-08	8E-08	1E-06
Cobalt	--	--	--	--	--
Copper	--	--	--	--	--
Iron	--	--	--	--	--
Manganese	--	--	--	--	--
Strontium	--	--	--	--	--
Thallium	--	--	--	--	--
Zinc	--	--	--	--	--
Total	**9E-09**	**2E-06**	**1E-07**	**5E-07**	**3E-06**

Notes:

-- = not calculated
HI = hazard index
RME = reasonable maximum exposure
Sed = sediment
SW = surface water

TABLE D-9a
DETAILED RISK CALCULATIONS FOR THE RECREATIONAL FISHERMAN IN EU8
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (L/kg d)	DI (L/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)	DI (L/kg d)	Oral SF (mg/kg d) [1]	Risk
Aluminum	3.35E+00		1.0	3.04E-06	1.0E-05	1.00E+00	1E-05	5.21E-07	1.7E-06	NA	--
Antimony	--	[a]	1.0	3.04E-06	--	4.00E-04	--	5.21E-07	--	NA	--
Arsenic	2.39E-03		1.0	3.04E-06	7.3E-09	3.00E-04	2E-05	5.21E-07	1.2E-09	1.50E+00	2E-09
Beryllium	1.65E-04		1.0	3.04E-06	5.0E-10	2.00E-03	3E-07	5.21E-07	8.6E-11	NA	--
Cadmium	2.10E-03		1.0	3.04E-06	6.4E-09	5.00E-04	1E-05	5.21E-07	1.1E-09	NA	--
Chromium(III)	3.60E-04		1.0	3.04E-06	1.1E-09	1.50E+00	7E-10	5.21E-07	1.9E-10	NA	--
Chromium(VI)	4.00E-05		1.0	3.04E-06	1.2E-10	3.00E-03	4E-08	5.21E-07	2.1E-11	5.00E-01	2E-11
Cobalt	7.07E-03		1.0	3.04E-06	2.2E-08	3.00E-04	7E-05	5.21E-07	3.7E-09	NA	--
Copper	4.62E-02		1.0	3.04E-06	1.4E-07	4.00E-02	4E-06	5.21E-07	2.4E-08	NA	--
Iron	3.21E+00		1.0	3.04E-06	9.8E-06	7.00E-01	1E-05	5.21E-07	1.7E-06	NA	--
Manganese	6.20E-01		1.0	3.04E-06	1.9E-06	2.40E-02	8E-05	5.21E-07	3.2E-07	NA	--
Strontium	6.83E-01		1.0	3.04E-06	2.1E-06	6.00E-01	3E-06	5.21E-07	3.6E-07	NA	--
Thallium	9.11E-04		1.0	3.04E-06	2.8E-09	1.00E-05	3E-04	5.21E-07	4.7E-10	NA	--
Zinc	8.44E-01		1.0	3.04E-06	2.6E-06	3.00E-01	9E-06	5.21E-07	4.4E-07	NA	--

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Arsenic	1.54E+02		0.06	7.24E-08	6.7E-07	3.00E-04	2E-03	1.24E-08	1.1E-07	1.50E+00	2E-07
Cadmium	3.72E+00		1.0	7.24E-08	2.7E-07	1.00E-03	3E-04	1.24E-08	4.6E-08	NA	--
Chromium(III)	2.96E+00		1.0	7.24E-08	2.1E-07	1.50E+00	1E-07	1.24E-08	3.7E-08	NA	--
Chromium(VI)	3.28E-01		1.0	7.24E-08	2.4E-08	3.00E-03	8E-06	1.24E-08	4.1E-09	5.00E-01	4E-09
Cobalt	1.80E+01		1.0	7.24E-08	1.3E-06	3.00E-04	4E-03	1.24E-08	2.2E-07	NA	--
Copper	2.59E+02		1.0	7.24E-08	1.9E-05	4.00E-02	5E-04	1.24E-08	3.2E-06	NA	--
Iron	6.12E+04		1.0	7.24E-08	4.4E-03	7.00E-01	6E-03	1.24E-08	7.6E-04	NA	--
Manganese	1.93E+03		1.0	7.24E-08	1.4E-04	2.40E-02	6E-03	1.24E-08	2.4E-05	NA	--
Thallium	1.84E-01		1.0	7.24E-08	1.3E-08	1.00E-05	1E-03	1.24E-08	2.3E-09	NA	--
Zinc	1.35E+03		1.0	7.24E-08	9.8E-05	3.00E-01	3E-04	1.24E-08	1.7E-05	NA	--

TABLE D-9a
DETAILED RISK CALCULATIONS FOR THE RECREATIONAL FISHERMAN IN EU8
Bonita Peak Mining District

Ingestion of Fish

Chemical of Potential Concern*	Cfish (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d)[1]	Risk
Aluminum	--	[a]	1.0	2.03E-05	--	1.00E+00	--	3.47E-06	--	NA	--
Antimony	--	[a]	1.0	2.03E-05	--	4.00E-04	--	3.47E-06	--	NA	--
Arsenic	4.30E-01		1.0	2.03E-05	8.7E-06	3.00E-04	3E-02	3.47E-06	1.5E-06	1.50E+00	2E-06
Beryllium	--	[a]	1.0	2.03E-05	--	2.00E-03	--	3.47E-06	--	NA	--
Cadmium	4.48E-02		1.0	2.03E-05	9.1E-07	1.00E-03	9E-04	3.47E-06	1.6E-07	NA	--
Chromium(III)	7.75E-01		1.0	2.03E-05	1.6E-05	1.50E+00	1E-05	3.47E-06	2.7E-06	NA	--
Chromium(VI)	8.61E-02		1.0	2.03E-05	1.7E-06	3.00E-03	6E-04	3.47E-06	3.0E-07	5.00E-01	3E-07
Copper	5.37E-01		1.0	2.03E-05	1.1E-05	4.00E-02	3E-04	3.47E-06	1.9E-06	NA	--
Iron	--	[a]	1.0	2.03E-05	--	7.00E-01	--	3.47E-06	--	NA	--
Manganese	--	[a]	1.0	2.03E-05	--	1.40E-01	--	3.47E-06	--	NA	--
Mercury	4.55E-02		1.0	2.03E-05	9.2E-07	3.00E-04	3E-03	3.47E-06	1.6E-07	NA	--
Strontium	6.24E-01		1.0	2.03E-05	1.3E-05	6.00E-01	2E-05	3.47E-06	2.2E-06	NA	--
Thallium	--	[a]	1.0	2.03E-05	--	1.00E-05	--	3.47E-06	--	NA	--
Zinc	1.01E+01		1.0	2.03E-05	2.0E-04	3.00E-01	7E-04	3.47E-06	3.5E-05	NA	--

Panel B. RME Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (L/kg d)	DI (L/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)	DI (L/kg d)	Oral SF (mg/kg d)[1]	Risk
Aluminum	3.35E+00		1.0	2.06E-05	6.9E-05	1.00E+00	7E-05	5.87E-06	2.0E-05	NA	--
Antimony	--	[a]	1.0	2.06E-05	--	4.00E-04	--	5.87E-06	--	NA	--
Arsenic	2.39E-03		1.0	2.06E-05	4.9E-08	3.00E-04	2E-04	5.87E-06	1.4E-08	1.50E+00	2E-08
Beryllium	1.65E-04		1.0	2.06E-05	3.4E-09	2.00E-03	2E-06	5.87E-06	9.7E-10	NA	--
Cadmium	2.10E-03		1.0	2.06E-05	4.3E-08	5.00E-04	9E-05	5.87E-06	1.2E-08	NA	--
Chromium(III)	3.60E-04		1.0	2.06E-05	7.4E-09	1.50E+00	5E-09	5.87E-06	2.1E-09	NA	--
Chromium(VI)	4.00E-05		1.0	2.06E-05	8.2E-10	3.00E-03	3E-07	5.87E-06	2.3E-10	5.00E-01	2E-10
Cobalt	7.07E-03		1.0	2.06E-05	1.5E-07	3.00E-04	5E-04	5.87E-06	4.2E-08	NA	--
Copper	4.62E-02		1.0	2.06E-05	9.5E-07	4.00E-02	2E-05	5.87E-06	2.7E-07	NA	--
Iron	3.21E+00		1.0	2.06E-05	6.6E-05	7.00E-01	9E-05	5.87E-06	1.9E-05	NA	--
Manganese	6.20E-01		1.0	2.06E-05	1.3E-05	2.40E-02	5E-04	5.87E-06	3.6E-06	NA	--
Strontium	6.83E-01		1.0	2.06E-05	1.4E-05	6.00E-01	2E-05	5.87E-06	4.0E-06	NA	--
Thallium	9.11E-04		1.0	2.06E-05	1.9E-08	1.00E-05	2E-03	5.87E-06	5.4E-09	NA	--
Zinc	8.44E-01		1.0	2.06E-05	1.7E-05	3.00E-01	6E-05	5.87E-06	5.0E-06	NA	--

TABLE D-9a
DETAILED RISK CALCULATIONS FOR THE RECREATIONAL FISHERMAN IN EU8
Bonita Peak Mining District

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Arsenic	1.54E+02		0.06	2.90E-07	2.7E-06	3.00E-04	9E-03	8.27E-08	7.7E-07	1.50E+00	1E-06
Cadmium	3.72E+00		1.0	2.90E-07	1.1E-06	1.00E-03	1E-03	8.27E-08	3.1E-07	NA	--
Chromium(III)	2.96E+00		1.0	2.90E-07	8.6E-07	1.50E+00	6E-07	8.27E-08	2.4E-07	NA	--
Chromium(VI)	3.28E-01		1.0	2.90E-07	9.5E-08	3.00E-03	3E-05	8.27E-08	2.7E-08	5.00E-01	3E-08
Cobalt	1.80E+01		1.0	2.90E-07	5.2E-06	3.00E-04	2E-02	8.27E-08	1.5E-06	NA	--
Copper	2.59E+02		1.0	2.90E-07	7.5E-05	4.00E-02	2E-03	8.27E-08	2.1E-05	NA	--
Iron	6.12E+04		1.0	2.90E-07	1.8E-02	7.00E-01	3E-02	8.27E-08	5.1E-03	NA	--
Manganese	1.93E+03		1.0	2.90E-07	5.6E-04	2.40E-02	2E-02	8.27E-08	1.6E-04	NA	--
Thallium	1.84E-01		1.0	2.90E-07	5.3E-08	1.00E-05	5E-03	8.27E-08	1.5E-08	NA	--
Zinc	1.35E+03		1.0	2.90E-07	3.9E-04	3.00E-01	1E-03	8.27E-08	1.1E-04	NA	--

Ingestion of Fish

Chemical of Potential Concern*	Cfish (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF (mg/kg d) [1]	Risk
Aluminum	--	[a]	1.0	1.45E-04	--	1.00E+00	--	4.15E-05	--	NA	--
Antimony	--	[a]	1.0	1.45E-04	--	4.00E-04	--	4.15E-05	--	NA	--
Arsenic	4.30E-01		1.0	1.45E-04	6.2E-05	3.00E-04	2E-01	4.15E-05	1.8E-05	1.50E+00	3E-05
Beryllium	--	[a]	1.0	1.45E-04	--	2.00E-03	--	4.15E-05	--	NA	--
Cadmium	4.48E-02		1.0	1.45E-04	6.5E-06	1.00E-03	7E-03	4.15E-05	1.9E-06	NA	--
Chromium(III)	7.75E-01		1.0	1.45E-04	1.1E-04	1.50E+00	8E-05	4.15E-05	3.2E-05	NA	--
Chromium(VI)	8.61E-02		1.0	1.45E-04	1.3E-05	3.00E-03	4E-03	4.15E-05	3.6E-06	5.00E-01	4E-06
Copper	5.37E-01		1.0	1.45E-04	7.8E-05	4.00E-02	2E-03	4.15E-05	2.2E-05	NA	--
Iron	--	[a]	1.0	1.45E-04	--	7.00E-01	--	4.15E-05	--	NA	--
Manganese	--	[a]	1.0	1.45E-04	--	1.40E-01	--	4.15E-05	--	NA	--
Mercury	4.55E-02		2.0	1.45E-04	1.3E-05	3.00E-04	4E-02	4.15E-05	3.8E-06	NA	--
Strontium	6.24E-01		1.0	1.45E-04	9.1E-05	6.00E-01	2E-04	4.15E-05	2.6E-05	NA	--
Thallium	--	[a]	1.0	1.45E-04	--	1.00E-05	--	4.15E-05	--	NA	--
Zinc	1.01E+01		1.0	1.45E-04	1.5E-03	3.00E-01	5E-03	4.15E-05	4.2E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

Csediment = sediment concentration
Cwater = surface water concentration
Cfish = fish tissue concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
L = liter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-10a
DETAILED RISK CALCULATIONS FOR THE RECREATIONAL FISHERMAN IN EU9
Bonita Peak Mining District

Panel A. CTE Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (L/kg d)	DI (L/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)	DI (L/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Aluminum	3.21E-01		1.0	3.04E-06	9.8E-07	1.00E+00	1E-06	5.21E-07	1.7E-07	NA	--
Antimony	5.04E-03	[b]	1.0	3.04E-06	1.5E-08	4.00E-04	4E-05	5.21E-07	2.6E-09	NA	--
Arsenic	2.06E-04		1.0	3.04E-06	6.3E-10	3.00E-04	2E-06	5.21E-07	1.1E-10	1.50E+00	2E-10
Beryllium	3.15E-04		1.0	3.04E-06	9.6E-10	2.00E-03	5E-07	5.21E-07	1.6E-10	NA	--
Cadmium	2.18E-03		1.0	3.04E-06	6.6E-09	5.00E-04	1E-05	5.21E-07	1.1E-09	NA	--
Chromium(III)	1.62E-03		1.0	3.04E-06	4.9E-09	1.50E+00	3E-09	5.21E-07	8.4E-10	NA	--
Chromium(VI)	1.80E-04		1.0	3.04E-06	5.5E-10	3.00E-03	2E-07	5.21E-07	9.4E-11	5.00E-01	9E-11
Cobalt	4.71E-04		1.0	3.04E-06	1.4E-09	3.00E-04	5E-06	5.21E-07	2.5E-10	NA	--
Copper	1.51E-02		1.0	3.04E-06	4.6E-08	4.00E-02	1E-06	5.21E-07	7.8E-09	NA	--
Iron	6.23E-01		1.0	3.04E-06	1.9E-06	7.00E-01	3E-06	5.21E-07	3.2E-07	NA	--
Manganese	2.18E+00		1.0	3.04E-06	6.6E-06	2.40E-02	3E-04	5.21E-07	1.1E-06	NA	--
Strontium	4.25E-01		1.0	3.04E-06	1.3E-06	6.00E-01	2E-06	5.21E-07	2.2E-07	NA	--
Thallium	1.71E-03		1.0	3.04E-06	5.2E-09	1.00E-05	5E-04	5.21E-07	8.9E-10	NA	--
Zinc	1.03E+00		1.0	3.04E-06	3.1E-06	3.00E-01	1E-05	5.21E-07	5.3E-07	NA	--

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csed (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Arsenic	3.76E+01		0.06	7.24E-08	1.6E-07	3.00E-04	5E-04	1.24E-08	2.8E-08	1.50E+00	4E-08
Cadmium	1.24E+01		1.0	7.24E-08	9.0E-07	1.00E-03	9E-04	1.24E-08	1.5E-07	NA	--
Chromium(III)	5.01E+00		1.0	7.24E-08	3.6E-07	1.50E+00	2E-07	1.24E-08	6.2E-08	NA	--
Chromium(VI)	5.57E-01		1.0	7.24E-08	4.0E-08	3.00E-03	1E-05	1.24E-08	6.9E-09	5.00E-01	7E-09
Cobalt	1.25E+01		1.0	7.24E-08	9.0E-07	3.00E-04	3E-03	1.24E-08	1.6E-07	NA	--
Copper	6.01E+02		1.0	7.24E-08	4.3E-05	4.00E-02	1E-03	1.24E-08	7.5E-06	NA	--
Iron	2.78E+04		1.0	7.24E-08	2.0E-03	7.00E-01	3E-03	1.24E-08	3.4E-04	NA	--
Manganese	1.35E+04		1.0	7.24E-08	9.8E-04	2.40E-02	4E-02	1.24E-08	1.7E-04	NA	--
Thallium	1.83E+01		1.0	2.90E-07	5.3E-06	1.00E-05	5E-01	8.27E-08	1.5E-06	NA	--
Zinc	2.94E+03		1.0	7.24E-08	2.1E-04	3.00E-01	7E-04	1.24E-08	3.6E-05	NA	--

TABLE D-10a
DETAILED RISK CALCULATIONS FOR THE RECREATIONAL FISHERMAN IN EU9
Bonita Peak Mining District

Ingestion of Fish

Chemical of Potential Concern	Cfish (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Aluminum	--	[a]	1.0	2.03E-05	--	1.00E+00	--	3.47E-06	--	NA	--
Antimony	--	[a]	1.0	2.03E-05	--	4.00E-04	--	3.47E-06	--	NA	--
Arsenic	--	[a]	1.0	2.03E-05	--	3.00E-04	--	3.47E-06	--	1.50E+00	--
Beryllium	--	[a]	1.0	2.03E-05	--	2.00E-03	--	3.47E-06	--	NA	--
Cadmium	8.14E-02	[c]	1.0	2.03E-05	1.6E-06	1.00E-03	2E-03	3.47E-06	2.8E-07	NA	--
Chromium(III)	1.14E+00		1.0	2.03E-05	2.3E-05	1.50E+00	2E-05	3.47E-06	4.0E-06	NA	--
Chromium(VI)	1.27E-01		1.0	2.03E-05	2.6E-06	3.00E-03	9E-04	3.47E-06	4.4E-07	5.00E-01	4E-07
Copper	5.83E-01		1.0	2.03E-05	1.2E-05	4.00E-02	3E-04	3.47E-06	2.0E-06	NA	--
Iron	--	[a]	1.0	2.03E-05	--	7.00E-01	--	3.47E-06	--	NA	--
Manganese	3.62E-01		1.0	2.03E-05	7.3E-06	1.40E-01	5E-05	3.47E-06	1.3E-06	NA	--
Mercury	2.53E-02		1.0	2.03E-05	5.1E-07	3.00E-04	2E-03	3.47E-06	8.8E-08	NA	--
Strontium	7.12E-01		1.0	2.03E-05	1.4E-05	6.00E-01	2E-05	3.47E-06	2.5E-06	NA	--
Thallium	--	[a]	1.0	2.03E-05	--	1.00E-05	--	3.47E-06	--	NA	--
Zinc	1.81E+01		1.0	2.03E-05	3.7E-04	3.00E-01	1E-03	3.47E-06	6.3E-05	NA	--

Panel B. RME Scenario
Incidental Ingestion of Surface Water

Chemical of Potential Concern*	Cwater (mg/L)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (L/kg d)	DI (L/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (L/kg d)	DI (L/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Aluminum	3.21E-01		1.0	2.06E-05	6.6E-06	1.00E+00	7E-06	5.87E-06	1.9E-06	NA	--
Antimony	5.04E-03	[b]	1.0	2.06E-05	1.0E-07	4.00E-04	3E-04	5.87E-06	3.0E-08	NA	--
Arsenic	2.06E-04		1.0	2.06E-05	4.2E-09	3.00E-04	1E-05	5.87E-06	1.2E-09	1.50E+00	2E-09
Beryllium	3.15E-04		1.0	2.06E-05	6.5E-09	2.00E-03	3E-06	5.87E-06	1.9E-09	NA	--
Cadmium	2.18E-03		1.0	2.06E-05	4.5E-08	5.00E-04	9E-05	5.87E-06	1.3E-08	NA	--
Chromium(III)	1.62E-03		1.0	2.06E-05	3.3E-08	1.50E+00	2E-08	5.87E-06	9.5E-09	NA	--
Chromium(VI)	1.80E-04		1.0	2.06E-05	3.7E-09	3.00E-03	1E-06	5.87E-06	1.1E-09	5.00E-01	1E-09
Cobalt	4.71E-04		1.0	2.06E-05	9.7E-09	3.00E-04	3E-05	5.87E-06	2.8E-09	NA	--
Copper	1.51E-02		1.0	2.06E-05	3.1E-07	4.00E-02	8E-06	5.87E-06	8.8E-08	NA	--
Iron	6.23E-01		1.0	2.06E-05	1.3E-05	7.00E-01	2E-05	5.87E-06	3.7E-06	NA	--
Manganese	2.18E+00		1.0	2.06E-05	4.5E-05	2.40E-02	2E-03	5.87E-06	1.3E-05	NA	--
Strontium	4.25E-01		1.0	2.06E-05	8.7E-06	6.00E-01	1E-05	5.87E-06	2.5E-06	NA	--
Thallium	1.71E-03		1.0	2.06E-05	3.5E-08	1.00E-05	4E-03	5.87E-06	1.0E-08	NA	--
Zinc	1.03E+00		1.0	2.06E-05	2.1E-05	3.00E-01	7E-05	5.87E-06	6.0E-06	NA	--

TABLE D-10a
DETAILED RISK CALCULATIONS FOR THE RECREATIONAL FISHERMAN IN EU9
Bonita Peak Mining District

Incidental Ingestion of Sediment

Chemical of Potential Concern*	Csediment (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Arsenic	3.76E+01		0.06	2.90E-07	6.5E-07	3.00E-04	2E-03	8.27E-08	1.9E-07	1.50E+00	3E-07
Cadmium	1.24E+01		1.0	2.90E-07	3.6E-06	1.00E-03	4E-03	8.27E-08	1.0E-06	NA	--
Chromium(III)	5.01E+00		1.0	2.90E-07	1.5E-06	1.50E+00	1E-06	8.27E-08	4.1E-07	NA	--
Chromium(VI)	5.57E-01		1.0	2.90E-07	1.6E-07	3.00E-03	5E-05	8.27E-08	4.6E-08	5.00E-01	5E-08
Cobalt	1.25E+01		1.0	2.90E-07	3.6E-06	3.00E-04	1E-02	8.27E-08	1.0E-06	NA	--
Copper	6.01E+02		1.0	2.90E-07	1.7E-04	4.00E-02	4E-03	8.27E-08	5.0E-05	NA	--
Iron	2.78E+04		1.0	2.90E-07	8.0E-03	7.00E-01	1E-02	8.27E-08	2.3E-03	NA	--
Manganese	1.35E+04		1.0	2.90E-07	3.9E-03	2.40E-02	2E-01	8.27E-08	1.1E-03	NA	--
Thallium	1.83E+01		1.0	2.90E-07	5.3E-06	1.00E-05	5E-01	8.27E-08	1.5E-06	NA	--
Zinc	2.94E+03		1.0	2.90E-07	8.5E-04	3.00E-01	3E-03	8.27E-08	2.4E-04	NA	--

Ingestion of Fish

Chemical of Potential Concern*	Cfish (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Aluminum	--	[a]	1.0	1.45E-04	--	1.00E+00	--	4.15E-05	--	NA	--
Antimony	--	[a]	1.0	1.45E-04	--	4.00E-04	--	4.15E-05	--	NA	--
Arsenic	--	[a]	1.0	1.45E-04	--	3.00E-04	--	4.15E-05	--	1.50E+00	--
Beryllium	--	[a]	1.0	1.45E-04	--	2.00E-03	--	4.15E-05	--	NA	--
Cadmium	8.14E-02	[c]	1.0	1.45E-04	1.2E-05	1.00E-03	1E-02	4.15E-05	3.4E-06	NA	--
Chromium(III)	1.14E+00		1.0	1.45E-04	1.7E-04	1.50E+00	1E-04	4.15E-05	4.7E-05	NA	--
Chromium(VI)	1.27E-01		1.0	1.45E-04	1.8E-05	3.00E-03	6E-03	4.15E-05	5.3E-06	5.00E-01	5E-06
Copper	5.83E-01		1.0	1.45E-04	8.5E-05	4.00E-02	2E-03	4.15E-05	2.4E-05	NA	--
Iron	--	[a]	1.0	1.45E-04	--	7.00E-01	--	4.15E-05	--	NA	--
Manganese	3.62E-01		1.0	1.45E-04	5.3E-05	1.40E-01	4E-04	4.15E-05	1.5E-05	NA	--
Mercury	2.53E-02		2.0	1.45E-04	7.3E-06	3.00E-04	2E-02	4.15E-05	2.1E-06	NA	--
Strontium	7.12E-01		1.0	1.45E-04	1.0E-04	6.00E-01	2E-04	4.15E-05	3.0E-05	NA	--
Thallium	--	[a]	1.0	1.45E-04	--	1.00E-05	--	4.15E-05	--	NA	--
Zinc	1.81E+01		1.0	1.45E-04	2.6E-03	3.00E-01	9E-03	4.15E-05	7.5E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

Csediment = sediment concentration
Cwater = surface water concentration
Cfish = fish tissue concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
L = liter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-10b
RME RISK SUMMARY FOR THE RECREATIONAL FISHERMAN
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	EU8 (Mineral Creek)				EU9 (Animas River)			
	Incidental SW Ingestion	Incidental Sed Ingestion	Fish Ingestion	Total HI	Incidental SW Ingestion	Incidental Sed Ingestion	Fish Ingestion	Total HI
Aluminum	7E-05	--	--	7E-05	7E-06	--	--	7E-06
Antimony	--	--	--	--	3E-04	--	--	3E-04
Arsenic	2E-04	9E-03	2E-01	2E-01	1E-05	2E-03	--	2E-03
Beryllium	2E-06	--	--	--	3E-06	--	--	3E-06
Cadmium	9E-05	1E-03	7E-03	8E-03	9E-05	4E-03	1E-02	2E-02
Chromium(III)	5E-09	6E-07	8E-05	8E-05	2E-08	1E-06	1E-04	1E-04
Chromium(VI)	3E-07	3E-05	4E-03	4E-03	1E-06	5E-05	6E-03	6E-03
Cobalt	5E-04	2E-02	--	2E-02	3E-05	1E-02	--	1E-02
Copper	2E-05	2E-03	2E-03	4E-03	8E-06	4E-03	2E-03	6E-03
Iron	9E-05	3E-02	--	3E-02	2E-05	1E-02	--	1E-02
Manganese	5E-04	2E-02	--	2E-02	2E-03	2E-01	4E-04	2E-01
Mercury	--	--	4E-02	4E-02	--	--	2E-02	2E-02
Thallium	2E-05	5E-03	2E-04	6E-03	1E-05	5E-01	2E-04	5E-01
Strontium	2E-03	--	--	2E-03	4E-03	--	--	4E-03
Zinc	6E-05	1E-03	5E-03	6E-03	7E-05	3E-03	9E-03	1E-02
Total	**3E-03**	**8E-02**	**3E-01**	**4E-01**	**6E-03**	**7E-01**	**5E-02**	**8E-01**

Panel B: RME Cancer Risks

Chemical of Potential Concern	EU8 (Mineral Creek)				EU9 (Animas River)			
	Incidental SW Ingestion	Incidental Sed Ingestion	Fish Ingestion	Total Risk	Incidental SW Ingestion	Incidental Sed Ingestion	Fish Ingestion	Total HI
Aluminum	--	--	--	--	--	--	--	--
Antimony	--	--	--	--	--	--	--	--
Arsenic	2E-08	1E-06	3E-05	3E-05	2E-09	3E-07	--	3E-07
Beryllium	--	--	--	--	--	--	--	--
Cadmium	--	--	--	--	--	--	--	--
Chromium(III)	--	--	--	--	--	--	--	--
Chromium(VI)	2E-10	3E-08	4E-06	4E-06	1E-09	5E-08	5E-06	5E-06
Cobalt	--	--	--	--	--	--	--	--
Copper	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--
Strontium	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--
Total	**2E-08**	**1E-06**	**3E-05**	**3E-05**	**3E-09**	**3E-07**	**5E-06**	**6E-06**

Notes:
-- = not calculated
HI = hazard index
RME = reasonable maximum exposure
Sed = sediment
SW = surface water

TABLE D-11a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU1
Bonita Peak Mining District

Panel A. CTE Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	3.42E-05	--	4.00E-04	--	5.87E-06	--	NA	--
Arsenic	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	3.42E-05	7.9E-07	1.00E-03	8E-04	5.87E-06	1.4E-07	NA	--
Chromium(III)	8.03E-01		1.0	3.42E-05	2.7E-05	1.50E+00	2E-05	5.87E-06	4.7E-06	NA	--
Chromium(VI)	8.92E-02		1.0	3.42E-05	3.1E-06	3.00E-03	1E-03	5.87E-06	5.2E-07	5.00E-01	5E-07
Cobalt	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Iron	--	[a]	1.0	3.42E-05	--	7.00E-01	--	5.87E-06	--	NA	--
Manganese	--	[a]	1.0	3.42E-05	--	1.40E-01	--	5.87E-06	--	NA	--
Mercury	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Thallium	--	[a]	1.0	3.42E-05	--	1.00E-05	--	5.87E-06	--	NA	--
Zinc	4.92E+00	[c]	1.0	3.42E-05	1.7E-04	3.00E-01	6E-04	5.87E-06	2.9E-05	NA	--

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	2.74E-04	--	4.00E-04	--	4.69E-05	--	NA	--
Arsenic	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	1.50E+00	--
Cadmium	--	[a]	1.0	2.74E-04	--	1.00E-03	--	4.69E-05	--	NA	--
Chromium(III)	6.98E-01		1.0	2.74E-04	1.9E-04	1.50E+00	1E-04	4.69E-05	3.3E-05	NA	--
Chromium(VI)	7.76E-02		1.0	2.74E-04	2.1E-05	3.00E-03	7E-03	4.69E-05	3.6E-06	5.00E-01	4E-06
Cobalt	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Iron	2.95E+01		1.0	2.74E-04	8.1E-03	7.00E-01	1E-02	4.69E-05	1.4E-03	NA	--
Manganese	3.45E-01	[b]	1.0	2.74E-04	9.4E-05	1.40E-01	7E-04	4.69E-05	1.6E-05	NA	--
Mercury	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Thallium	--	[a]	1.0	2.74E-04	--	1.00E-05	--	4.69E-05	--	NA	--
Zinc	4.08E+01		1.0	2.74E-04	1.1E-02	3.00E-01	4E-02	4.69E-05	1.9E-03	NA	--

TABLE D-11a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU1
Bonita Peak Mining District

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	2.85E+00		1.0	2.41E-08	6.9E-08	4.00E-04	2E-04	4.14E-09	1.2E-08	NA	--
Arsenic	4.28E+01		**	2.41E-08	1.0E-06	3.00E-04	3E-03	4.14E-09	1.8E-07	1.50E+00	3E-07
Cadmium	1.42E+01		1.0	2.41E-08	3.4E-07	1.00E-03	3E-04	4.14E-09	5.9E-08	NA	--
Chromium(III)	2.65E+00		1.0	2.41E-08	6.4E-08	1.50E+00	4E-08	4.14E-09	1.1E-08	NA	--
Chromium(VI)	2.95E-01		1.0	2.41E-08	7.1E-09	3.00E-03	2E-06	4.14E-09	1.2E-09	5.00E-01	1E-09
Cobalt	9.79E+00		1.0	2.41E-08	2.4E-07	3.00E-04	8E-04	4.14E-09	4.0E-08	NA	--
Iron	2.02E+04		1.0	2.41E-08	4.9E-04	7.00E-01	7E-04	4.14E-09	8.4E-05	NA	--
Manganese	5.89E+03		1.0	2.41E-08	1.4E-04	2.40E-02	6E-03	4.14E-09	2.4E-05	NA	--
Thallium	3.68E-01		1.0	2.41E-08	8.9E-09	1.00E-05	9E-04	4.14E-09	1.5E-09	NA	--
Zinc	1.12E+03		1.0	2.41E-08	2.7E-05	3.00E-01	9E-05	4.14E-09	4.6E-06	NA	--

Panel B. RME Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.37E-04	--	4.00E-04	--	3.91E-05	--	NA	--
Arsenic	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	1.37E-04	3.2E-06	1.00E-03	3E-03	3.91E-05	9.0E-07	NA	--
Chromium(III)	8.03E-01		1.0	1.37E-04	1.1E-04	1.50E+00	7E-05	3.91E-05	3.1E-05	NA	--
Chromium(VI)	8.92E-02		1.0	1.37E-04	1.2E-05	3.00E-03	4E-03	3.91E-05	3.5E-06	5.00E-01	3E-06
Cobalt	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Iron	--	[a]	1.0	1.37E-04	--	7.00E-01	--	3.91E-05	--	NA	--
Manganese	--	[a]	1.0	1.37E-04	--	1.40E-01	--	3.91E-05	--	NA	--
Mercury	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Thallium	--	[a]	1.0	1.37E-04	--	1.00E-05	--	3.91E-05	--	NA	--
Zinc	4.92E+00	[c]	1.0	1.37E-04	6.7E-04	3.00E-01	2E-03	3.91E-05	1.9E-04	NA	--

TABLE D-11a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU1
Bonita Peak Mining District

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.10E-03	--	4.00E-04	--	3.13E-04	--	NA	--
Arsenic	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	1.50E+00	--
Cadmium	--	[a]	1.0	1.10E-03	--	1.00E-03	--	3.13E-04	--	NA	--
Chromium(III)	6.98E-01		1.0	1.10E-03	7.7E-04	1.50E+00	5E-04	3.13E-04	2.2E-04	NA	--
Chromium(VI)	7.76E-02		1.0	1.10E-03	8.5E-05	3.00E-03	3E-02	3.13E-04	2.4E-05	5.00E-01	2E-05
Cobalt	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Iron	2.95E+01		1.0	1.10E-03	3.2E-02	7.00E-01	5E-02	3.13E-04	9.2E-03	NA	--
Manganese	3.45E-01	[b]	1.0	1.10E-03	3.8E-04	1.40E-01	3E-03	3.13E-04	1.1E-04	NA	--
Mercury	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Thallium	--	[a]	1.0	1.10E-03	--	1.00E-05	--	3.13E-04	--	NA	--
Zinc	4.08E+01		1.0	1.10E-03	4.5E-02	3.00E-01	1E-01	3.13E-04	1.3E-02	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	2.85E+00		1.0	9.65E-08	2.7E-07	4.00E-04	7E-04	2.76E-08	7.8E-08	NA	--
Arsenic	4.28E+01		**	9.65E-08	4.1E-06	3.00E-04	1E-02	2.76E-08	1.2E-06	1.50E+00	2E-06
Cadmium	1.42E+01		1.0	9.65E-08	1.4E-06	1.00E-03	1E-03	2.76E-08	3.9E-07	NA	--
Chromium(III)	2.65E+00		1.0	9.65E-08	2.6E-07	1.50E+00	2E-07	2.76E-08	7.3E-08	NA	--
Chromium(VI)	2.95E-01		1.0	9.65E-08	2.8E-08	3.00E-03	9E-06	2.76E-08	8.1E-09	5.00E-01	8E-09
Cobalt	9.79E+00		1.0	9.65E-08	9.4E-07	3.00E-04	3E-03	2.76E-08	2.7E-07	NA	--
Iron	2.02E+04		1.0	9.65E-08	2.0E-03	7.00E-01	3E-03	2.76E-08	5.6E-04	NA	--
Manganese	5.89E+03		1.0	9.65E-08	5.7E-04	2.40E-02	2E-02	2.76E-08	1.6E-04	NA	--
Thallium	3.68E-01		1.0	9.65E-08	3.6E-08	1.00E-05	4E-03	2.76E-08	1.0E-08	NA	--
Zinc	1.12E+03		1.0	9.65E-08	1.1E-04	3.00E-01	4E-04	2.76E-08	3.1E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Ctissue = game tissue concentration
Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-12a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU2
Bonita Peak Mining District

Panel A. CTE Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	3.42E-05	--	4.00E-04	--	5.87E-06	--	NA	--
Arsenic	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	3.42E-05	7.9E-07	1.00E-03	8E-04	5.87E-06	1.4E-07	NA	--
Chromium(III)	8.03E-01		1.0	3.42E-05	2.7E-05	1.50E+00	2E-05	5.87E-06	4.7E-06	NA	--
Chromium(VI)	8.92E-02		1.0	3.42E-05	3.1E-06	3.00E-03	1E-03	5.87E-06	5.2E-07	5.00E-01	5E-07
Cobalt	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Iron	--	[a]	1.0	3.42E-05	--	7.00E-01	--	5.87E-06	--	NA	--
Manganese	--	[a]	1.0	3.42E-05	--	1.40E-01	--	5.87E-06	--	NA	--
Mercury	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Thallium	--	[a]	1.0	3.42E-05	--	1.00E-05	--	5.87E-06	--	NA	--
Zinc	4.92E+00	[c]	1.0	3.42E-05	1.7E-04	3.00E-01	6E-04	5.87E-06	2.9E-05	NA	--

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	2.74E-04	--	4.00E-04	--	4.69E-05	--	NA	--
Arsenic	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	1.50E+00	--
Cadmium	--	[a]	1.0	2.74E-04	--	1.00E-03	--	4.69E-05	--	NA	--
Chromium(III)	6.98E-01		1.0	2.74E-04	1.9E-04	1.50E+00	1E-04	4.69E-05	3.3E-05	NA	--
Chromium(VI)	7.76E-02		1.0	2.74E-04	2.1E-05	3.00E-03	7E-03	4.69E-05	3.6E-06	5.00E-01	4E-06
Cobalt	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Iron	2.95E+01		1.0	2.74E-04	8.1E-03	7.00E-01	1E-02	4.69E-05	1.4E-03	NA	--
Manganese	3.45E-01	[b]	1.0	2.74E-04	9.4E-05	1.40E-01	7E-04	4.69E-05	1.6E-05	NA	--
Mercury	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Thallium	--	[a]	1.0	2.74E-04	--	1.00E-05	--	4.69E-05	--	NA	--
Zinc	4.08E+01		1.0	2.74E-04	1.1E-02	3.00E-01	4E-02	4.69E-05	1.9E-03	NA	--

TABLE D-12a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU2
Bonita Peak Mining District

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.49E+01		1.0	2.41E-08	3.6E-07	4.00E-04	9E-04	4.14E-09	6.1E-08	NA	--
Arsenic	2.20E+01		**	2.41E-08	5.3E-07	3.00E-04	2E-03	4.14E-09	9.1E-08	1.50E+00	1E-07
Cadmium	4.90E+00		1.0	2.41E-08	1.2E-07	1.00E-03	1E-04	4.14E-09	2.0E-08	NA	--
Chromium(III)	2.84E+00		1.0	2.41E-08	6.9E-08	1.50E+00	5E-08	4.14E-09	1.2E-08	NA	--
Chromium(VI)	3.16E-01		1.0	2.41E-08	7.6E-09	3.00E-03	3E-06	4.14E-09	1.3E-09	5.00E-01	1E-09
Cobalt	7.17E+00		1.0	2.41E-08	1.7E-07	3.00E-04	6E-04	4.14E-09	3.0E-08	NA	--
Iron	2.21E+04		1.0	2.41E-08	5.3E-04	7.00E-01	8E-04	4.14E-09	9.1E-05	NA	--
Manganese	6.52E+03		1.0	2.41E-08	1.6E-04	2.40E-02	7E-03	4.14E-09	2.7E-05	NA	--
Thallium	2.33E-01		1.0	2.41E-08	5.6E-09	1.00E-05	6E-04	4.14E-09	9.6E-10	NA	--
Zinc	1.35E+03		1.0	2.41E-08	3.3E-05	3.00E-01	1E-04	4.14E-09	5.6E-06	NA	--

Panel B. RME Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.37E-04	--	4.00E-04	--	3.91E-05	--	NA	--
Arsenic	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	1.37E-04	3.2E-06	1.00E-03	3E-03	3.91E-05	9.0E-07	NA	--
Chromium(III)	8.03E-01		1.0	1.37E-04	1.1E-04	1.50E+00	7E-05	3.91E-05	3.1E-05	NA	--
Chromium(VI)	8.92E-02		1.0	1.37E-04	1.2E-05	3.00E-03	4E-03	3.91E-05	3.5E-06	5.00E-01	3E-06
Cobalt	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Iron	--	[a]	1.0	1.37E-04	--	7.00E-01	--	3.91E-05	--	NA	--
Manganese	--	[a]	1.0	1.37E-04	--	1.40E-01	--	3.91E-05	--	NA	--
Mercury	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Thallium	--	[a]	1.0	1.37E-04	--	1.00E-05	--	3.91E-05	--	NA	--
Zinc	4.92E+00	[c]	1.0	1.37E-04	6.7E-04	3.00E-01	2E-03	3.91E-05	1.9E-04	NA	--

TABLE D-12a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU2
Bonita Peak Mining District

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.10E-03	--	4.00E-04	--	3.13E-04	--	NA	--
Arsenic	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	1.50E+00	--
Cadmium	--	[a]	1.0	1.10E-03	--	1.00E-03	--	3.13E-04	--	NA	--
Chromium(III)	6.98E-01		1.0	1.10E-03	7.7E-04	1.50E+00	5E-04	3.13E-04	2.2E-04	NA	--
Chromium(VI)	7.76E-02		1.0	1.10E-03	8.5E-05	3.00E-03	3E-02	3.13E-04	2.4E-05	5.00E-01	2E-05
Cobalt	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Iron	2.95E+01		1.0	1.10E-03	3.2E-02	7.00E-01	5E-02	3.13E-04	9.2E-03	NA	--
Manganese	3.45E-01	[b]	1.0	1.10E-03	3.8E-04	1.40E-01	3E-03	3.13E-04	1.1E-04	NA	--
Mercury	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Thallium	--	[a]	1.0	1.10E-03	--	1.00E-05	--	3.13E-04	--	NA	--
Zinc	4.08E+01		1.0	1.10E-03	4.5E-02	3.00E-01	1E-01	3.13E-04	1.3E-02	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.49E+01		1.0	9.65E-08	1.4E-06	4.00E-04	4E-03	2.76E-08	4.1E-07	NA	--
Arsenic	2.20E+01		**	9.65E-08	2.1E-06	3.00E-04	7E-03	2.76E-08	6.1E-07	1.50E+00	9E-07
Cadmium	4.90E+00		1.0	9.65E-08	4.7E-07	1.00E-03	5E-04	2.76E-08	1.4E-07	NA	--
Chromium(III)	2.84E+00		1.0	9.65E-08	2.7E-07	1.50E+00	2E-07	2.76E-08	7.8E-08	NA	--
Chromium(VI)	3.16E-01		1.0	9.65E-08	3.0E-08	3.00E-03	1E-05	2.76E-08	8.7E-09	5.00E-01	9E-09
Cobalt	7.17E+00		1.0	9.65E-08	6.9E-07	3.00E-04	2E-03	2.76E-08	2.0E-07	NA	--
Iron	2.21E+04		1.0	9.65E-08	2.1E-03	7.00E-01	3E-03	2.76E-08	6.1E-04	NA	--
Manganese	6.52E+03		1.0	9.65E-08	6.3E-04	2.40E-02	3E-02	2.76E-08	1.8E-04	NA	--
Thallium	2.33E-01		1.0	9.65E-08	2.2E-08	1.00E-05	2E-03	2.76E-08	6.4E-09	NA	--
Zinc	1.35E+03		1.0	9.65E-08	1.3E-04	3.00E-01	4E-04	2.76E-08	3.7E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Ctissue = game tissue concentration
Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-13a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU3
Bonita Peak Mining District

Panel A. CTE Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	3.42E-05	--	4.00E-04	--	5.87E-06	--	NA	--
Arsenic	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	3.42E-05	7.9E-07	1.00E-03	8E-04	5.87E-06	1.4E-07	NA	--
Chromium(III)	8.03E-01		1.0	3.42E-05	2.7E-05	1.50E+00	2E-05	5.87E-06	4.7E-06	NA	--
Chromium(VI)	8.92E-02		1.0	3.42E-05	3.1E-06	3.00E-03	1E-03	5.87E-06	5.2E-07	5.00E-01	5E-07
Cobalt	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Iron	--	[a]	1.0	3.42E-05	--	7.00E-01	--	5.87E-06	--	NA	--
Manganese	--	[a]	1.0	3.42E-05	--	1.40E-01	--	5.87E-06	--	NA	--
Mercury	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Thallium	--	[a]	1.0	3.42E-05	--	1.00E-05	--	5.87E-06	--	NA	--
Zinc	4.92E+00	[c]	1.0	3.42E-05	1.7E-04	3.00E-01	6E-04	5.87E-06	2.9E-05	NA	--

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	2.74E-04	--	4.00E-04	--	4.69E-05	--	NA	--
Arsenic	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	1.50E+00	--
Cadmium	--	[a]	1.0	2.74E-04	--	1.00E-03	--	4.69E-05	--	NA	--
Chromium(III)	6.98E-01		1.0	2.74E-04	1.9E-04	1.50E+00	1E-04	4.69E-05	3.3E-05	NA	--
Chromium(VI)	7.76E-02		1.0	2.74E-04	2.1E-05	3.00E-03	7E-03	4.69E-05	3.6E-06	5.00E-01	4E-06
Cobalt	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Iron	2.95E+01		1.0	2.74E-04	8.1E-03	7.00E-01	1E-02	4.69E-05	1.4E-03	NA	--
Manganese	3.45E-01	[b]	1.0	2.74E-04	9.4E-05	1.40E-01	7E-04	4.69E-05	1.6E-05	NA	--
Mercury	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Thallium	--	[a]	1.0	2.74E-04	--	1.00E-05	--	4.69E-05	--	NA	--
Zinc	4.08E+01		1.0	2.74E-04	1.1E-02	3.00E-01	4E-02	4.69E-05	1.9E-03	NA	--

TABLE D-13a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU3
Bonita Peak Mining District

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.76E+00		1.0	2.41E-08	4.2E-08	4.00E-04	1E-04	4.14E-09	7.3E-09	NA	--
Arsenic	2.30E+01		**	2.41E-08	5.6E-07	3.00E-04	2E-03	4.14E-09	9.5E-08	1.50E+00	1E-07
Cadmium	4.02E+00		1.0	2.41E-08	9.7E-08	1.00E-03	1E-04	4.14E-09	1.7E-08	NA	--
Chromium(III)	2.73E+00		1.0	2.41E-08	6.6E-08	1.50E+00	4E-08	4.14E-09	1.1E-08	NA	--
Chromium(VI)	3.03E-01		1.0	2.41E-08	7.3E-09	3.00E-03	2E-06	4.14E-09	1.3E-09	5.00E-01	1E-09
Cobalt	4.96E+00		1.0	2.41E-08	1.2E-07	3.00E-04	4E-04	4.14E-09	2.1E-08	NA	--
Iron	3.03E+04		1.0	2.41E-08	7.3E-04	7.00E-01	1E-03	4.14E-09	1.3E-04	NA	--
Manganese	1.54E+03		1.0	2.41E-08	3.7E-05	2.40E-02	2E-03	4.14E-09	6.4E-06	NA	--
Thallium	5.43E-01		1.0	2.41E-08	1.3E-08	1.00E-05	1E-03	4.14E-09	2.2E-09	NA	--
Zinc	6.69E+02		1.0	2.41E-08	1.6E-05	3.00E-01	5E-05	4.14E-09	2.8E-06	NA	--

Panel B. RME Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.37E-04	--	4.00E-04	--	3.91E-05	--	NA	--
Arsenic	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	1.37E-04	3.2E-06	1.00E-03	3E-03	3.91E-05	9.0E-07	NA	--
Chromium(III)	8.03E-01		1.0	1.37E-04	1.1E-04	1.50E+00	7E-05	3.91E-05	3.1E-05	NA	--
Chromium(VI)	8.92E-02		1.0	1.37E-04	1.2E-05	3.00E-03	4E-03	3.91E-05	3.5E-06	5.00E-01	3E-06
Cobalt	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Iron	--	[a]	1.0	1.37E-04	--	7.00E-01	--	3.91E-05	--	NA	--
Manganese	--	[a]	1.0	1.37E-04	--	1.40E-01	--	3.91E-05	--	NA	--
Mercury	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Thallium	--	[a]	1.0	1.37E-04	--	1.00E-05	--	3.91E-05	--	NA	--
Zinc	4.92E+00	[c]	1.0	1.37E-04	6.7E-04	3.00E-01	2E-03	3.91E-05	1.9E-04	NA	--

TABLE D-13a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU3
Bonita Peak Mining District

Ingestion of Deer

Chemical of Potential Concern	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.10E-03	--	4.00E-04	--	3.13E-04	--	NA	--
Arsenic	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	1.50E+00	--
Cadmium	--	[a]	1.0	1.10E-03	--	1.00E-03	--	3.13E-04	--	NA	--
Chromium(III)	6.98E-01		1.0	1.10E-03	7.7E-04	1.50E+00	5E-04	3.13E-04	2.2E-04	NA	--
Chromium(VI)	7.76E-02		1.0	1.10E-03	8.5E-05	3.00E-03	3E-02	3.13E-04	2.4E-05	5.00E-01	2E-05
Cobalt	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Iron	2.95E+01		1.0	1.10E-03	3.2E-02	7.00E-01	5E-02	3.13E-04	9.2E-03	NA	--
Manganese	3.45E-01	[b]	1.0	1.10E-03	3.8E-04	1.40E-01	3E-03	3.13E-04	1.1E-04	NA	--
Mercury	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Thallium	--	[a]	1.0	1.10E-03	--	1.00E-05	--	3.13E-04	--	NA	--
Zinc	4.08E+01		1.0	1.10E-03	4.5E-02	3.00E-01	1E-01	3.13E-04	1.3E-02	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.76E+00		1.0	9.65E-08	1.7E-07	4.00E-04	4E-04	2.76E-08	4.9E-08	NA	--
Arsenic	2.30E+01		**	9.65E-08	2.2E-06	3.00E-04	7E-03	2.76E-08	6.3E-07	1.50E+00	1E-06
Cadmium	4.02E+00		1.0	9.65E-08	3.9E-07	1.00E-03	4E-04	2.76E-08	1.1E-07	NA	--
Chromium(III)	2.73E+00		1.0	9.65E-08	2.6E-07	1.50E+00	2E-07	2.76E-08	7.5E-08	NA	--
Chromium(VI)	3.03E-01		1.0	9.65E-08	2.9E-08	3.00E-03	1E-05	2.76E-08	8.4E-09	5.00E-01	8E-09
Cobalt	4.96E+00		1.0	9.65E-08	4.8E-07	3.00E-04	2E-03	2.76E-08	1.4E-07	NA	--
Iron	3.03E+04		1.0	9.65E-08	2.9E-03	7.00E-01	4E-03	2.76E-08	8.4E-04	NA	--
Manganese	1.54E+03		1.0	9.65E-08	1.5E-04	2.40E-02	6E-03	2.76E-08	4.2E-05	NA	--
Thallium	5.43E-01		1.0	9.65E-08	5.2E-08	1.00E-05	5E-03	2.76E-08	1.5E-08	NA	--
Zinc	6.69E+02		1.0	9.65E-08	6.5E-05	3.00E-01	2E-04	2.76E-08	1.8E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Ctissue = game tissue concentration
Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-14a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU4
Bonita Peak Mining District

Panel A. CTE Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	3.42E-05	--	4.00E-04	--	5.87E-06	--	NA	--
Arsenic	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	3.42E-05	7.9E-07	1.00E-03	8E-04	5.87E-06	1.4E-07	NA	--
Chromium(III)	8.03E-01		1.0	3.42E-05	2.7E-05	1.50E+00	2E-05	5.87E-06	4.7E-06	NA	--
Chromium(VI)	8.92E-02		1.0	3.42E-05	3.1E-06	3.00E-03	1E-03	5.87E-06	5.2E-07	5.00E-01	5E-07
Cobalt	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Iron	--	[a]	1.0	3.42E-05	--	7.00E-01	--	5.87E-06	--	NA	--
Manganese	--	[a]	1.0	3.42E-05	--	1.40E-01	--	5.87E-06	--	NA	--
Mercury	--	[a]	1.0	3.42E-05	--	3.00E-04	--	5.87E-06	--	NA	--
Thallium	--	[a]	1.0	3.42E-05	--	1.00E-05	--	5.87E-06	--	NA	--
Zinc	4.92E+00	[c]	1.0	3.42E-05	1.7E-04	3.00E-01	6E-04	5.87E-06	2.9E-05	NA	--

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	2.74E-04	--	4.00E-04	--	4.69E-05	--	NA	--
Arsenic	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	1.50E+00	--
Cadmium	--	[a]	1.0	2.74E-04	--	1.00E-03	--	4.69E-05	--	NA	--
Chromium(III)	6.98E-01		1.0	2.74E-04	1.9E-04	1.50E+00	1E-04	4.69E-05	3.3E-05	NA	--
Chromium(VI)	7.76E-02		1.0	2.74E-04	2.1E-05	3.00E-03	7E-03	4.69E-05	3.6E-06	5.00E-01	4E-06
Cobalt	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Iron	2.95E+01		1.0	2.74E-04	8.1E-03	7.00E-01	1E-02	4.69E-05	1.4E-03	NA	--
Manganese	3.45E-01	[b]	1.0	2.74E-04	9.4E-05	1.40E-01	7E-04	4.69E-05	1.6E-05	NA	--
Mercury	--	[a]	1.0	2.74E-04	--	3.00E-04	--	4.69E-05	--	NA	--
Thallium	--	[a]	1.0	2.74E-04	--	1.00E-05	--	4.69E-05	--	NA	--
Zinc	4.08E+01		1.0	2.74E-04	1.1E-02	3.00E-01	4E-02	4.69E-05	1.9E-03	NA	--

TABLE D-14a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU4
Bonita Peak Mining District

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.83E+00		1.0	2.41E-08	4.4E-08	4.00E-04	1E-04	4.14E-09	7.6E-09	NA	--
Arsenic	9.27E+01		**	2.41E-08	2.2E-06	3.00E-04	7E-03	4.14E-09	3.8E-07	1.50E+00	6E-07
Cadmium	2.60E+00		1.0	2.41E-08	6.3E-08	1.00E-03	6E-05	4.14E-09	1.1E-08	NA	--
Chromium(III)	2.35E+00		1.0	2.41E-08	5.7E-08	1.50E+00	4E-08	4.14E-09	9.7E-09	NA	--
Chromium(VI)	2.61E-01		1.0	2.41E-08	6.3E-09	3.00E-03	2E-06	4.14E-09	1.1E-09	5.00E-01	1E-09
Cobalt	8.73E+00		1.0	2.41E-08	2.1E-07	3.00E-04	7E-04	4.14E-09	3.6E-08	NA	--
Iron	3.39E+04		1.0	2.41E-08	8.2E-04	7.00E-01	1E-03	4.14E-09	1.4E-04	NA	--
Manganese	1.40E+03		1.0	2.41E-08	3.4E-05	2.40E-02	1E-03	4.14E-09	5.8E-06	NA	--
Thallium	7.28E-02		1.0	2.41E-08	1.8E-09	1.00E-05	2E-04	4.14E-09	3.0E-10	NA	--
Zinc	5.59E+02		1.0	2.41E-08	1.3E-05	3.00E-01	4E-05	4.14E-09	2.3E-06	NA	--

Panel B. RME Scenario
Ingestion of Grouse

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.37E-04	--	4.00E-04	--	3.91E-05	--	NA	--
Arsenic	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	1.50E+00	--
Cadmium	2.31E-02	[b]	1.0	1.37E-04	3.2E-06	1.00E-03	3E-03	3.91E-05	9.0E-07	NA	--
Chromium(III)	8.03E-01		1.0	1.37E-04	1.1E-04	1.50E+00	7E-05	3.91E-05	3.1E-05	NA	--
Chromium(VI)	8.92E-02		1.0	1.37E-04	1.2E-05	3.00E-03	4E-03	3.91E-05	3.5E-06	5.00E-01	3E-06
Cobalt	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Iron	--	[a]	1.0	1.37E-04	--	7.00E-01	--	3.91E-05	--	NA	--
Manganese	--	[a]	1.0	1.37E-04	--	1.40E-01	--	3.91E-05	--	NA	--
Mercury	--	[a]	1.0	1.37E-04	--	3.00E-04	--	3.91E-05	--	NA	--
Thallium	--	[a]	1.0	1.37E-04	--	1.00E-05	--	3.91E-05	--	NA	--
Zinc	4.92E+00	[c]	1.0	1.37E-04	6.7E-04	3.00E-01	2E-03	3.91E-05	1.9E-04	NA	--

TABLE D-14a
DETAILED RISK CALCULATIONS FOR THE HUNTER IN EU4
Bonita Peak Mining District

Ingestion of Deer

Chemical of Potential Concern*	Ctissue (mg/kg, wet weight)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	--	[a]	1.0	1.10E-03	--	4.00E-04	--	3.13E-04	--	NA	--
Arsenic	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	1.50E+00	--
Cadmium	--	[a]	1.0	1.10E-03	--	1.00E-03	--	3.13E-04	--	NA	--
Chromium(III)	6.98E-01		1.0	1.10E-03	7.7E-04	1.50E+00	5E-04	3.13E-04	2.2E-04	NA	--
Chromium(VI)	7.76E-02		1.0	1.10E-03	8.5E-05	3.00E-03	3E-02	3.13E-04	2.4E-05	5.00E-01	2E-05
Cobalt	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Iron	2.95E+01		1.0	1.10E-03	3.2E-02	7.00E-01	5E-02	3.13E-04	9.2E-03	NA	--
Manganese	3.45E-01	[b]	1.0	1.10E-03	3.8E-04	1.40E-01	3E-03	3.13E-04	1.1E-04	NA	--
Mercury	--	[a]	1.0	1.10E-03	--	3.00E-04	--	3.13E-04	--	NA	--
Thallium	--	[a]	1.0	1.10E-03	--	1.00E-05	--	3.13E-04	--	NA	--
Zinc	4.08E+01		1.0	1.10E-03	4.5E-02	3.00E-01	1E-01	3.13E-04	1.3E-02	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.83E+00		1.0	9.65E-08	1.8E-07	4.00E-04	4E-04	2.76E-08	5.0E-08	NA	--
Arsenic	9.27E+01		**	9.65E-08	8.9E-06	3.00E-04	3E-02	2.76E-08	2.6E-06	1.50E+00	4E-06
Cadmium	2.60E+00		1.0	9.65E-08	2.5E-07	1.00E-03	3E-04	2.76E-08	7.2E-08	NA	--
Chromium(III)	2.35E+00		1.0	9.65E-08	2.3E-07	1.50E+00	2E-07	2.76E-08	6.5E-08	NA	--
Chromium(VI)	2.61E-01		1.0	9.65E-08	2.5E-08	3.00E-03	8E-06	2.76E-08	7.2E-09	5.00E-01	7E-09
Cobalt	8.73E+00		1.0	9.65E-08	8.4E-07	3.00E-04	3E-03	2.76E-08	2.4E-07	NA	--
Iron	3.39E+04		1.0	9.65E-08	3.3E-03	7.00E-01	5E-03	2.76E-08	9.4E-04	NA	--
Manganese	1.40E+03		1.0	9.65E-08	1.4E-04	2.40E-02	6E-03	2.76E-08	3.9E-05	NA	--
Thallium	7.28E-02		1.0	9.65E-08	7.0E-09	1.00E-05	7E-04	2.76E-08	2.0E-09	NA	--
Zinc	5.59E+02		1.0	9.65E-08	5.4E-05	3.00E-01	2E-04	2.76E-08	1.5E-05	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.
**The EPC value for arsenic represents the time-weighted concentration, adjusted for the soil-specific RBA for waste rock (0.06) and overbank (0.60)

Ctissue = game tissue concentration
Csoil = soil concentration
CTE = cental tendency exposure
d = day
DI = dietary intake
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfD = reference dose
RME = reasonable maximum exposure
SF = slope factor
NA = not available
-- = not calculated

TABLE D-14b
RME RISK SUMMARY FOR THE HUNTER
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	EU1				EU2				EU3				EU4			
	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total HI	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total HI	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total HI	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total HI
Antimony	--	--	7E-04	7E-04	--	--	4E-03	4E-03	--	--	4E-04	4E-04	--	--	4E-04	4E-04
Arsenic	--	--	1E-02	1E-02	--	--	7E-03	7E-03	--	--	7E-03	7E-03	--	--	3E-02	3E-02
Cadmium	3E-03	--	1E-03	5E-03	3E-03	--	5E-04	4E-03	3E-03	--	4E-04	4E-03	3E-03	--	3E-04	3E-03
Chromium(III)	7E-05	5E-04	2E-07	6E-04	7E-05	5E-04	2E-07	6E-04	7E-05	5E-04	2E-07	6E-04	7E-05	5E-04	2E-07	6E-04
Chromium(VI)	4E-03	3E-02	9E-06	3E-02	4E-03	3E-02	1E-05	3E-02	4E-03	3E-02	1E-05	3E-02	4E-03	3E-02	8E-06	3E-02
Cobalt	--	--	3E-03	3E-03	--	--	2E-03	2E-03	--	--	2E-03	2E-03	--	--	3E-03	3E-03
Iron	--	5E-02	3E-03	5E-02	--	5E-02	3E-03	5E-02	--	5E-02	4E-03	5E-02	--	5E-02	5E-03	5E-02
Manganese	--	3E-03	2E-02	3E-02	--	3E-03	3E-02	3E-02	--	3E-03	6E-03	9E-03	--	3E-03	6E-03	8E-03
Mercury	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	--	--	4E-03	4E-03	--	--	2E-03	2E-03	--	--	5E-03	5E-03	--	--	7E-04	7E-04
Zinc	2E-03	1E-01	4E-04	2E-01	2E-03	1E-01	4E-04	2E-01	2E-03	1E-01	2E-04	2E-01	2E-03	1E-01	2E-04	2E-01
Total	**1E-02**	**2E-01**	**5E-02**	**3E-01**	**1E-02**	**2E-01**	**5E-02**	**3E-01**	**1E-02**	**2E-01**	**3E-02**	**3E-01**	**1E-02**	**2E-01**	**4E-02**	**3E-01**

Panel B: RME Cancer Risks

Chemical of Potential Concern	EU1				EU2				EU3				EU4			
	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total Risk	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total Risk	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total Risk	Ingestion of Grouse	Ingestion of Deer	Incidental Soil Ingestion	Total Risk
Antimony	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	--	--	2E-06	2E-06	--	--	9E-07	9E-07	--	--	1E-06	1E-06	--	--	4E-06	4E-06
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium(III)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chromium(VI)	3E-06	2E-05	8E-09	3E-05	3E-06	2E-05	9E-09	3E-05	3E-06	2E-05	8E-09	3E-05	3E-06	2E-05	7E-09	3E-05
Cobalt	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	**3E-06**	**2E-05**	**2E-06**	**3E-05**	**3E-06**	**2E-05**	**9E-07**	**3E-05**	**3E-06**	**2E-05**	**1E-06**	**3E-05**	**3E-06**	**2E-05**	**4E-06**	**3E-05**

Notes:
-- = not calculated
HI = hazard index
RME = reasonable maximum exposure

TABLE D-15a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU1
Bonita Peak Mining District

Panel A. CTE Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Arsenic	--	[a]	1.0	6.85E-02	--	1.50E-05	--	4.89E-03	--	4.30E-03	--
Cadmium	--	[d]	1.0	6.85E-02	--	1.00E-05	--	4.89E-03	--	1.80E-03	--
Chromium(III)	2.06E-04		1.0	6.85E-02	1.41E-05	NA	--	4.89E-03	1.0E-03	NA	--
Chromium(VI)	2.29E-05		1.0	6.85E-02	1.57E-06	1.00E-04	2E-02	4.89E-03	1.1E-04	8.40E-02	9E-06
Cobalt	--	[d]	1.0	6.85E-02	--	6.00E-06	--	4.89E-03	--	9.00E-03	--
Iron	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Manganese	1.87E-04	[c]	1.0	6.85E-02	1.28E-05	5.00E-05	3E-01	4.89E-03	9.1E-04	NA	--
Thallium	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Zinc	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.44E+01		1.0	5.65E-07	8.1E-06	4.00E-04	2E-02	4.04E-08	5.8E-07	NA	--
Arsenic	7.95E+01		0.08	5.65E-07	3.6E-06	3.00E-04	1E-02	4.04E-08	2.6E-07	1.50E+00	4E-07
Cadmium	4.23E+00		1.0	5.65E-07	2.4E-06	1.00E-03	2E-03	4.04E-08	1.7E-07	NA	--
Chromium(III)	5.17E+00		1.0	5.65E-07	2.9E-06	1.50E+00	2E-06	4.04E-08	2.1E-07	NA	--
Chromium(VI)	5.74E-01		1.0	5.65E-07	3.2E-07	3.00E-03	1E-04	4.04E-08	2.3E-08	5.00E-01	1E-08
Cobalt	1.19E+01		1.0	5.65E-07	6.7E-06	3.00E-04	2E-02	4.04E-08	4.8E-07	NA	--
Iron	3.11E+04		1.0	5.65E-07	1.8E-02	7.00E-01	3E-02	4.04E-08	1.3E-03	NA	--
Manganese	7.80E+03		1.0	5.65E-07	4.4E-03	2.40E-02	2E-01	4.04E-08	3.1E-04	NA	--
Thallium	9.48E-01		1.0	5.65E-07	5.4E-07	1.00E-05	5E-02	4.04E-08	3.8E-08	NA	--
Zinc	1.08E+03		1.0	5.65E-07	6.1E-04	3.00E-01	2E-03	4.04E-08	4.3E-05	NA	--

TABLE D-15a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU1
Bonita Peak Mining District

Panel B. RME Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Arsenic	--	[a]	1.0	9.13E-02	--	1.50E-05	--	1.30E-02	--	4.30E-03	--
Cadmium	--	[d]	1.0	9.13E-02	--	1.00E-05	--	1.30E-02	--	1.80E-03	--
Chromium(III)	2.06E-04		1.0	9.13E-02	1.88E-05	NA	--	1.30E-02	2.7E-03	NA	--
Chromium(VI)	2.29E-05		1.0	9.13E-02	2.09E-06	1.00E-04	2E-02	1.30E-02	3.0E-04	8.40E-02	3E-05
Cobalt	--	[d]	1.0	9.13E-02	--	6.00E-06	--	1.30E-02	--	9.00E-03	--
Iron	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Manganese	1.87E-04	[c]	1.0	9.13E-02	1.71E-05	5.00E-05	3E-01	1.30E-02	2.4E-03	NA	--
Thallium	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Zinc	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.44E+01		1.0	1.13E-06	1.6E-05	4.00E-04	4E-02	1.61E-07	2.3E-06	NA	--
Arsenic	7.95E+01		0.08	1.13E-06	7.2E-06	3.00E-04	2E-02	1.61E-07	1.0E-06	1.50E+00	2E-06
Cadmium	4.23E+00		1.0	1.13E-06	4.8E-06	1.00E-03	5E-03	1.61E-07	6.8E-07	NA	--
Chromium(III)	5.17E+00		1.0	1.13E-06	5.8E-06	1.50E+00	4E-06	1.61E-07	8.3E-07	NA	--
Chromium(VI)	5.74E-01		1.0	1.13E-06	6.5E-07	3.00E-03	2E-04	1.61E-07	9.3E-08	5.00E-01	5E-08
Cobalt	1.19E+01		1.0	1.13E-06	1.3E-05	3.00E-04	4E-02	1.61E-07	1.9E-06	NA	--
Iron	3.11E+04		1.0	1.13E-06	3.5E-02	7.00E-01	5E-02	1.61E-07	5.0E-03	NA	--
Manganese	7.80E+03		1.0	1.13E-06	8.8E-03	2.40E-02	4E-01	1.61E-07	1.3E-03	NA	--
Thallium	9.48E-01		1.0	1.13E-06	1.1E-06	1.00E-05	1E-01	1.61E-07	1.5E-07	NA	--
Zinc	1.08E+03		1.0	1.13E-06	1.2E-03	3.00E-01	4E-03	1.61E-07	1.7E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

µg - microgram
Cair = air concentration
Csoil = soil concentration
d = day
DI = dietary intake
EC = exposure concentration
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
m = meter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-16a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU2
Bonita Peak Mining District

Panel A. CTE Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC (ug/m^3)	iUR $(ug/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Arsenic	--	[a]	1.0	6.85E-02	--	1.50E-05	--	4.89E-03	--	4.30E-03	--
Cadmium	--	[d]	1.0	6.85E-02	--	1.00E-05	--	4.89E-03	--	1.80E-03	--
Chromium(III)	2.06E-04		1.0	6.85E-02	1.41E-05	NA	--	4.89E-03	1.0E-03	NA	--
Chromium(VI)	2.29E-05		1.0	6.85E-02	1.57E-06	1.00E-04	2E-02	4.89E-03	1.1E-04	8.40E-02	9E-06
Cobalt	--	[d]	1.0	6.85E-02	--	6.00E-06	--	4.89E-03	--	9.00E-03	--
Iron	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Manganese	1.87E-04	[c]	1.0	6.85E-02	1.28E-05	5.00E-05	3E-01	4.89E-03	9.1E-04	NA	--
Thallium	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Zinc	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	3.78E+00		1.0	5.65E-07	2.1E-06	4.00E-04	5E-03	4.04E-08	1.5E-07	NA	--
Arsenic	3.43E+01		0.08	5.65E-07	1.5E-06	3.00E-04	5E-03	4.04E-08	1.1E-07	1.50E+00	2E-07
Cadmium	7.88E+00		1.0	5.65E-07	4.5E-06	1.00E-03	4E-03	4.04E-08	3.2E-07	NA	--
Chromium(III)	4.19E+00		1.0	5.65E-07	2.4E-06	1.50E+00	2E-06	4.04E-08	1.7E-07	NA	--
Chromium(VI)	4.65E-01		1.0	5.65E-07	2.6E-07	3.00E-03	9E-05	4.04E-08	1.9E-08	5.00E-01	9E-09
Cobalt	6.80E+00		1.0	5.65E-07	3.8E-06	3.00E-04	1E-02	4.04E-08	2.7E-07	NA	--
Iron	2.51E+04		1.0	5.65E-07	1.4E-02	7.00E-01	2E-02	4.04E-08	1.0E-03	NA	--
Manganese	2.44E+03		1.0	5.65E-07	1.4E-03	2.40E-02	6E-02	4.04E-08	9.8E-05	NA	--
Thallium	2.06E-01		1.0	5.65E-07	1.2E-07	1.00E-05	1E-02	4.04E-08	8.3E-09	NA	--
Zinc	1.98E+03		1.0	5.65E-07	1.1E-03	3.00E-01	4E-03	4.04E-08	8.0E-05	NA	--

TABLE D-16a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU2
Bonita Peak Mining District

Panel B. RME Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Arsenic	--	[a]	1.0	9.13E-02	--	1.50E-05	--	1.30E-02	--	4.30E-03	--
Cadmium	--	[d]	1.0	9.13E-02	--	1.00E-05	--	1.30E-02	--	1.80E-03	--
Chromium(III)	2.06E-04		1.0	9.13E-02	1.88E-05	NA	--	1.30E-02	2.7E-03	NA	--
Chromium(VI)	2.29E-05		1.0	9.13E-02	2.09E-06	1.00E-04	2E-02	1.30E-02	3.0E-04	8.40E-02	3E-05
Cobalt	--	[d]	1.0	9.13E-02	--	6.00E-06	--	1.30E-02	--	9.00E-03	--
Iron	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Manganese	1.87E-04	[c]	1.0	9.13E-02	1.71E-05	5.00E-05	3E-01	1.30E-02	2.4E-03	NA	--
Thallium	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Zinc	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	3.78E+00		1.0	1.13E-06	4.3E-06	4.00E-04	1E-02	1.61E-07	6.1E-07	NA	--
Arsenic	3.43E+01		0.08	1.13E-06	3.1E-06	3.00E-04	1E-02	1.61E-07	4.4E-07	1.50E+00	7E-07
Cadmium	7.88E+00		1.0	1.13E-06	8.9E-06	1.00E-03	9E-03	1.61E-07	1.3E-06	NA	--
Chromium(III)	4.19E+00		1.0	1.13E-06	4.7E-06	1.50E+00	3E-06	1.61E-07	6.8E-07	NA	--
Chromium(VI)	4.65E-01		1.0	1.13E-06	5.3E-07	3.00E-03	2E-04	1.61E-07	7.5E-08	5.00E-01	4E-08
Cobalt	6.80E+00		1.0	1.13E-06	7.7E-06	3.00E-04	3E-02	1.61E-07	1.1E-06	NA	--
Iron	2.51E+04		1.0	1.13E-06	2.8E-02	7.00E-01	4E-02	1.61E-07	4.0E-03	NA	--
Manganese	2.44E+03		1.0	1.13E-06	2.8E-03	2.40E-02	1E-01	1.61E-07	3.9E-04	NA	--
Thallium	2.06E-01		1.0	1.13E-06	2.3E-07	1.00E-05	2E-02	1.61E-07	3.3E-08	NA	--
Zinc	1.98E+03		1.0	1.13E-06	2.2E-03	3.00E-01	7E-03	1.61E-07	3.2E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

µg - microgram
Cair = air concentration
Csoil = soil concentration
d = day
DI = dietary intake
EC = exposure concentration
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
m = meter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-17a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU3
Bonita Peak Mining District

Panel A. CTE Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC (ug/m^3)	iUR $(ug/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Arsenic	--	[a]	1.0	6.85E-02	--	1.50E-05	--	4.89E-03	--	4.30E-03	--
Cadmium	--	[d]	1.0	6.85E-02	--	1.00E-05	--	4.89E-03	--	1.80E-03	--
Chromium(III)	2.12E-04		1.0	6.85E-02	1.45E-05	NA	--	4.89E-03	1.0E-03	NA	--
Chromium(VI)	2.36E-05		1.0	6.85E-02	1.62E-06	1.00E-04	2E-02	4.89E-03	1.2E-04	8.40E-02	1E-05
Cobalt	--	[d]	1.0	6.85E-02	--	6.00E-06	--	4.89E-03	--	9.00E-03	--
Iron	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Manganese	4.74E-04	[c]	1.0	6.85E-02	3.25E-05	5.00E-05	6E-01	4.89E-03	2.3E-03	NA	--
Thallium	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Zinc	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.73E+00		1.0	5.65E-07	9.8E-07	4.00E-04	2E-03	4.04E-08	7.0E-08	NA	--
Arsenic	1.92E+01		0.08	5.65E-07	8.7E-07	3.00E-04	3E-03	4.04E-08	6.2E-08	1.50E+00	9E-08
Cadmium	1.58E+00		1.0	5.65E-07	8.9E-07	1.00E-03	9E-04	4.04E-08	6.4E-08	NA	--
Chromium(III)	6.22E+00		1.0	5.65E-07	3.5E-06	1.50E+00	2E-06	4.04E-08	2.5E-07	NA	--
Chromium(VI)	6.91E-01		1.0	5.65E-07	3.9E-07	3.00E-03	1E-04	4.04E-08	2.8E-08	5.00E-01	1E-08
Cobalt	8.09E+00		1.0	5.65E-07	4.6E-06	3.00E-04	2E-02	4.04E-08	3.3E-07	NA	--
Iron	1.22E+05		1.0	5.65E-07	6.9E-02	7.00E-01	1E-01	4.04E-08	4.9E-03	NA	--
Manganese	9.36E+02		1.0	5.65E-07	5.3E-04	2.40E-02	2E-02	4.04E-08	3.8E-05	NA	--
Thallium	2.05E-01		1.0	5.65E-07	1.2E-07	1.00E-05	1E-02	4.04E-08	8.3E-09	NA	--
Zinc	6.59E+02		1.0	5.65E-07	3.7E-04	3.00E-01	1E-03	4.04E-08	2.7E-05	NA	--

TABLE D-17a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU3
Bonita Peak Mining District

Panel B. RME Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Arsenic	--	[a]	1.0	9.13E-02	--	1.50E-05	--	1.30E-02	--	4.30E-03	--
Cadmium	--	[d]	1.0	9.13E-02	--	1.00E-05	--	1.30E-02	--	1.80E-03	--
Chromium(III)	2.12E-04		1.0	9.13E-02	1.94E-05	NA	--	1.30E-02	2.8E-03	NA	--
Chromium(VI)	2.36E-05		1.0	9.13E-02	2.16E-06	1.00E-04	2E-02	1.30E-02	3.1E-04	8.40E-02	3E-05
Cobalt	--	[d]	1.0	9.13E-02	--	6.00E-06	--	1.30E-02	--	9.00E-03	--
Iron	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Manganese	4.74E-04	[c]	1.0	9.13E-02	4.33E-05	5.00E-05	9E-01	1.30E-02	6.2E-03	NA	--
Thallium	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Zinc	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	1.73E+00		1.0	1.13E-06	2.0E-06	4.00E-04	5E-03	1.61E-07	2.8E-07	NA	--
Arsenic	1.92E+01		0.08	1.13E-06	1.7E-06	3.00E-04	6E-03	1.61E-07	2.5E-07	1.50E+00	4E-07
Cadmium	1.58E+00		1.0	1.13E-06	1.8E-06	1.00E-03	2E-03	1.61E-07	2.6E-07	NA	--
Chromium(III)	6.22E+00		1.0	1.13E-06	7.0E-06	1.50E+00	5E-06	1.61E-07	1.0E-06	NA	--
Chromium(VI)	6.91E-01		1.0	1.13E-06	7.8E-07	3.00E-03	3E-04	1.61E-07	1.1E-07	5.00E-01	6E-08
Cobalt	8.09E+00		1.0	1.13E-06	9.1E-06	3.00E-04	3E-02	1.61E-07	1.3E-06	NA	--
Iron	1.22E+05		1.0	1.13E-06	1.4E-01	7.00E-01	2E-01	1.61E-07	2.0E-02	NA	--
Manganese	9.36E+02		1.0	1.13E-06	1.1E-03	2.40E-02	4E-02	1.61E-07	1.5E-04	NA	--
Thallium	2.05E-01		1.0	1.13E-06	2.3E-07	1.00E-05	2E-02	1.61E-07	3.3E-08	NA	--
Zinc	6.59E+02		1.0	1.13E-06	7.4E-04	3.00E-01	2E-03	1.61E-07	1.1E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

µg - microgram
Cair = air concentration
Csoil = soil concentration
d = day
DI = dietary intake
EC = exposure concentration
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
m = meter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-18a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU4
Bonita Peak Mining District

Panel A. CTE Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC (ug/m^3)	iUR $(ug/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Arsenic	--	[a]	1.0	6.85E-02	--	1.50E-05	--	4.89E-03	--	4.30E-03	--
Cadmium	--	[d]	1.0	6.85E-02	--	1.00E-05	--	4.89E-03	--	1.80E-03	--
Chromium(III)	2.18E-04		1.0	6.85E-02	1.49E-05	NA	--	4.89E-03	1.1E-03	NA	--
Chromium(VI)	2.42E-05		1.0	6.85E-02	1.66E-06	1.00E-04	2E-02	4.89E-03	1.2E-04	8.40E-02	1E-05
Cobalt	--	[d]	1.0	6.85E-02	--	6.00E-06	--	4.89E-03	--	9.00E-03	--
Iron	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Manganese	5.58E-05	[c]	1.0	6.85E-02	3.82E-06	5.00E-05	8E-02	4.89E-03	2.7E-04	NA	--
Thallium	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--
Zinc	--	[d]	1.0	6.85E-02	--	NA	--	4.89E-03	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	6.62E-01		1.0	5.65E-07	3.7E-07	4.00E-04	9E-04	4.04E-08	2.7E-08	NA	--
Arsenic	1.54E+01		0.08	5.65E-07	7.0E-07	3.00E-04	2E-03	4.04E-08	5.0E-08	1.50E+00	7E-08
Cadmium	6.48E+01	[c]	1.0	5.65E-07	3.7E-05	1.00E-03	4E-02	4.04E-08	2.6E-06	NA	--
Chromium(III)	6.66E+00		1.0	5.65E-07	3.8E-06	1.50E+00	3E-06	4.04E-08	2.7E-07	NA	--
Chromium(VI)	7.40E-01		1.0	5.65E-07	4.2E-07	3.00E-03	1E-04	4.04E-08	3.0E-08	5.00E-01	1E-08
Cobalt	2.03E+01		1.0	5.65E-07	1.1E-05	3.00E-04	4E-02	4.04E-08	8.2E-07	NA	--
Iron	3.13E+04		1.0	5.65E-07	1.8E-02	7.00E-01	3E-02	4.04E-08	1.3E-03	NA	--
Manganese	1.98E+04	[c]	1.0	5.65E-07	1.1E-02	2.40E-02	5E-01	4.04E-08	8.0E-04	NA	--
Thallium	1.10E-01		1.0	5.65E-07	6.2E-08	1.00E-05	6E-03	4.04E-08	4.4E-09	NA	--
Zinc	5.97E+03	[c]	1.0	5.65E-07	3.4E-03	3.00E-01	1E-02	4.04E-08	2.4E-04	NA	--

TABLE D-18a
DETAILED RISK CALCULATIONS FOR THE ROAD WORKER IN EU4
Bonita Peak Mining District

Panel B. RME Scenario
Inhalation Caused by Human Disturbance

Chemical of Potential Concern*	Cair (mg/m^3)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				TWF (unitless)	EC (mg/m^3)	iRfC (mg/kg)	HQ	TWF (unitless)	EC ($\mu g/m^3$)	iUR $(\mu g/m^3)^{-1}$	Risk
Antimony	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Arsenic	--	[a]	1.0	9.13E-02	--	1.50E-05	--	1.30E-02	--	4.30E-03	--
Cadmium	--	[d]	1.0	9.13E-02	--	1.00E-05	--	1.30E-02	--	1.80E-03	--
Chromium(III)	2.18E-04		1.0	9.13E-02	1.99E-05	NA	--	1.30E-02	2.8E-03	NA	--
Chromium(VI)	2.42E-05		1.0	9.13E-02	2.21E-06	1.00E-04	2E-02	1.30E-02	3.2E-04	8.40E-02	3E-05
Cobalt	--	[d]	1.0	9.13E-02	--	6.00E-06	--	1.30E-02	--	9.00E-03	--
Iron	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Manganese	5.58E-05	[c]	1.0	9.13E-02	5.10E-06	5.00E-05	1E-01	1.30E-02	7.3E-04	NA	--
Thallium	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--
Zinc	--	[d]	1.0	9.13E-02	--	NA	--	1.30E-02	--	NA	--

Incidental Ingestion of Soil

Chemical of Potential Concern*	Csoil (mg/kg)		RBA (unitless)	Non Cancer Hazard				Cancer Risk			
				HIFNC (kg/kg d)	DI (mg/kg d)	Oral RfD (mg/kg d)	HQ	HIFCancer (kg/kg d)	DI (mg/kg d)	Oral SF $(mg/kg\ d)^{-1}$	Risk
Antimony	6.62E-01		1.0	1.13E-06	7.5E-07	4.00E-04	2E-03	1.61E-07	1.1E-07	NA	--
Arsenic	1.54E+01		0.08	1.13E-06	1.4E-06	3.00E-04	5E-03	1.61E-07	2.0E-07	1.50E+00	3E-07
Cadmium	6.48E+01	[c]	1.0	1.13E-06	7.3E-05	1.00E-03	7E-02	1.61E-07	1.0E-05	NA	--
Chromium(III)	6.66E+00		1.0	1.13E-06	7.5E-06	1.50E+00	5E-06	1.61E-07	1.1E-06	NA	--
Chromium(VI)	7.40E-01		1.0	1.13E-06	8.4E-07	3.00E-03	3E-04	1.61E-07	1.2E-07	5.00E-01	6E-08
Cobalt	2.03E+01		1.0	1.13E-06	2.3E-05	3.00E-04	8E-02	1.61E-07	3.3E-06	NA	--
Iron	3.13E+04		1.0	1.13E-06	3.5E-02	7.00E-01	5E-02	1.61E-07	5.1E-03	NA	--
Manganese	1.98E+04	[c]	1.0	1.13E-06	2.2E-02	2.40E-02	9E-01	1.61E-07	3.2E-03	NA	--
Thallium	1.10E-01		1.0	1.13E-06	1.2E-07	1.00E-05	1E-02	1.61E-07	1.8E-08	NA	--
Zinc	5.97E+03	[c]	1.0	1.13E-06	6.7E-03	3.00E-01	2E-02	1.61E-07	9.6E-04	NA	--

*The EPC values for chromium were assumed to be 10% hexavalent chromium and 90% trivalent chromium.

µg - microgram
Cair = air concentration
Csoil = soil concentration
d = day
DI = dietary intake
EC = exposure concentration
HIF = human intake factor
HQ = hazard quotient
kg = kilogram
m = meter
mg = milligram
NC = non-cancer
RBA = relative bioavailabilty
RfC = reference concentration
RfD = reference dose
SF = slope factor
TWF =time-weighting factor
NA = not available
-- = not calculated

TABLE D-18b
RME RISK SUMMARY FOR THE ROAD WORKER
Bonita Peak Mining District

Panel A: RME Non-Cancer Risks

Chemical of Potential Concern	EU1			EU2			EU3			EU4		
	Soil Inhalation	Incidental Soil Ingestion	Total HI	Soil Inhalation	Incidental Soil Ingestion	Total HI	Soil Inhalation	Incidental Soil Ingestion	Total HI	Soil Inhalation	Incidental Soil Ingestion	Total HI
Antimony	--	4E-02	4E-02	--	1E-02	1E-02	--	5E-03	5E-03	--	2E-03	2E-03
Arsenic	--	2E-02	2E-02	--	1E-02	1E-02	--	6E-03	6E-03	--	5E-03	5E-03
Cadmium	--	5E-03	5E-03	--	9E-03	9E-03	--	2E-03	2E-03	--	7E-02	7E-02
Chromium(III)	--	4E-06	4E-06	--	3E-06	3E-06	--	5E-06	5E-06	--	5E-06	5E-06
Chromium(VI)	2E-02	2E-04	2E-02	2E-02	2E-04	2E-02	2E-02	3E-04	2E-02	2E-02	3E-04	2E-02
Cobalt	--	4E-02	4E-02	--	3E-02	3E-02	--	3E-02	3E-02	--	8E-02	8E-02
Iron	--	5E-02	5E-02	--	4E-02	4E-02	--	2E-01	2E-01	--	5E-02	5E-02
Manganese	3E-01	4E-01	7E-01	3E-01	1E-01	5E-01	9E-01	4E-02	9E-01	1E-01	9E-01	1E+00
Thallium	--	1E-01	1E-01	--	2E-02	2E-02	--	2E-02	2E-02	--	1E-02	1E-02
Zinc	--	4E-03	4E-03	--	7E-03	7E-03	--	2E-03	2E-03	--	2E-02	2E-02
Total	**4E-01**	**6E-01**	**1E+00**	**4E-01**	**2E-01**	**6E-01**	**9E-01**	**3E-01**	**1E+00**	**1E-01**	**1E+00**	**1E+00**

Panel B: RME Cancer Risks

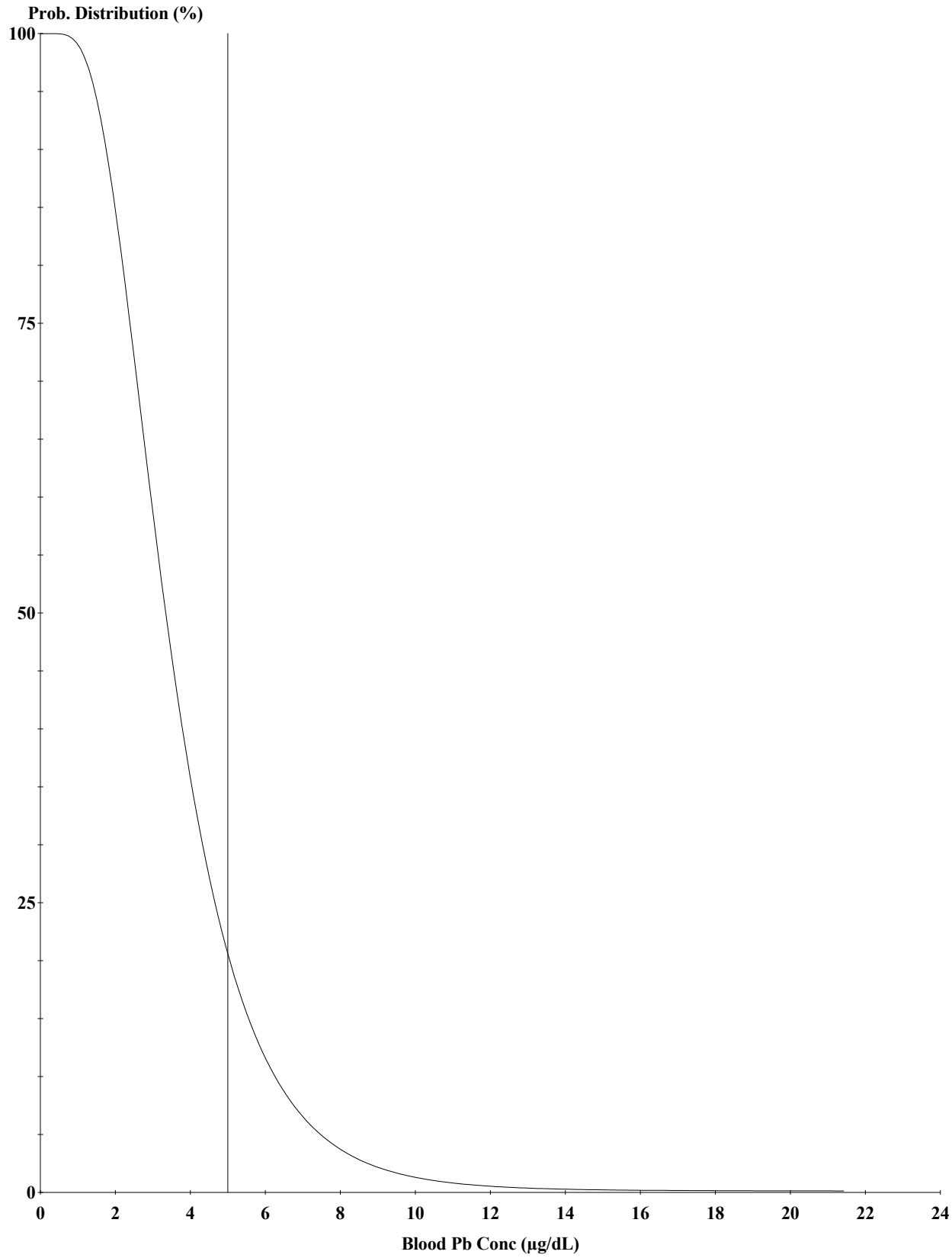
Chemical of Potential Concern	EU1			EU2			EU3			EU4		
	Soil Inhalation	Incidental Soil Ingestion	Total Risk	Soil Inhalation	Incidental Soil Ingestion	Total Risk	Soil Inhalation	Incidental Soil Ingestion	Total Risk	Soil Inhalation	Incidental Soil Ingestion	Total Risk
Antimony	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	--	2E-06	2E-06	--	7E-07	7E-07	--	4E-07	4E-07	--	3E-07	3E-07
Cadmium	--	--	--	--	--	--	--	--	--	--	--	--
Chromium(III)	--	--	--	--	--	--	--	--	--	--	--	--
Chromium(VI)	3E-05	5E-08	3E-05	3E-05	4E-08	3E-05	3E-05	6E-08	3E-05	3E-05	6E-08	3E-05
Cobalt	--	--	--	--	--	--	--	--	--	--	--	--
Iron	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	--	--	--	--	--	--	--	--	--	--	--	--
Total	**3E-05**	**2E-06**	**3E-05**	**3E-05**	**7E-07**	**3E-05**	**3E-05**	**4E-07**	**3E-05**	**3E-05**	**4E-07**	**3E-05**

Notes:
-- = not calculated
HI = hazard index
RME = reasonable maximum exposure

Appendix E

IEUBK Output Files

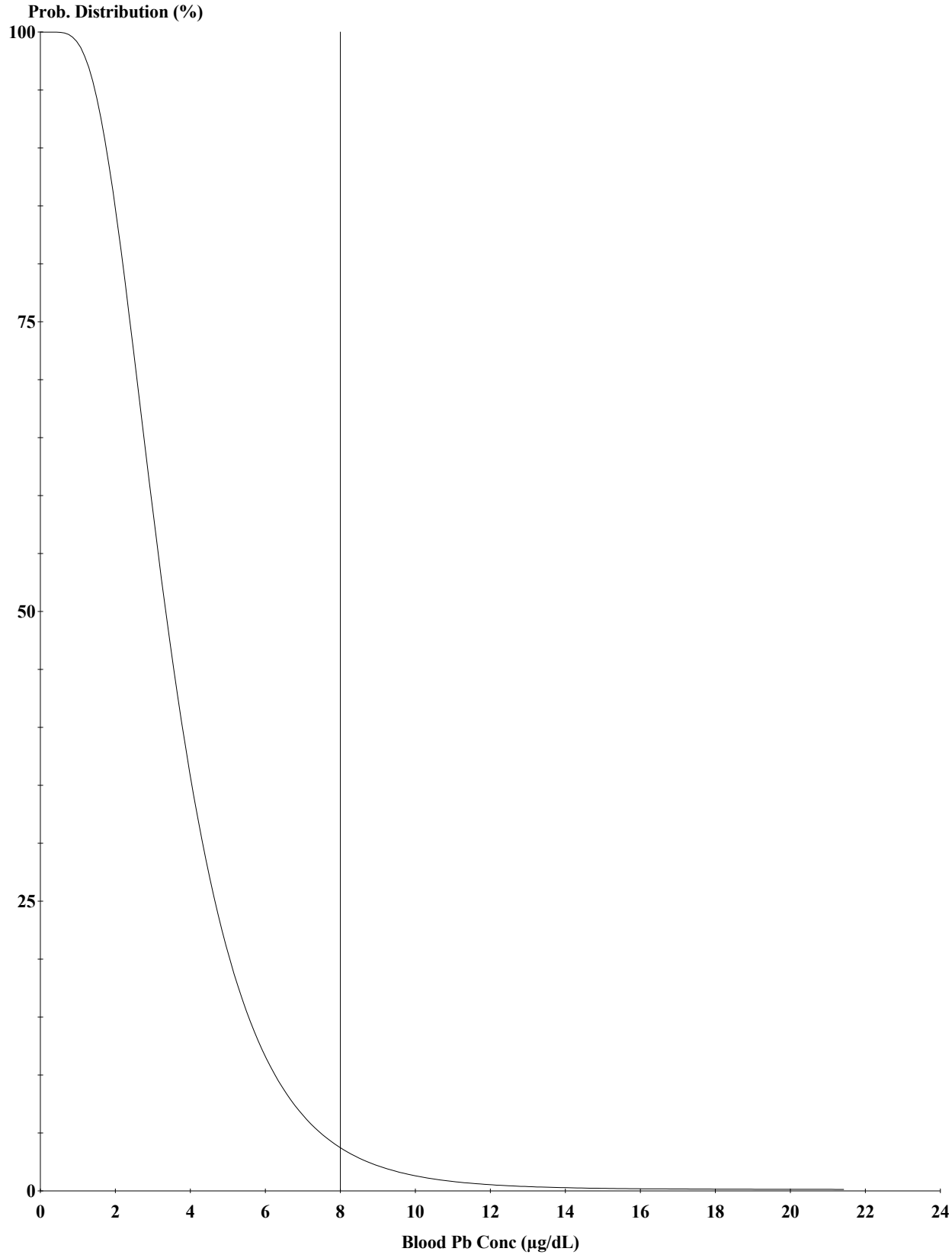
This page intentionally left blank.



Cutoff = 5.000 µg/dl
Geo Mean = 3.504
GSD = 1.600
% Above = 22.478
Dispersed Camper

Age Range = User Designated: Ages 12 - 72 months

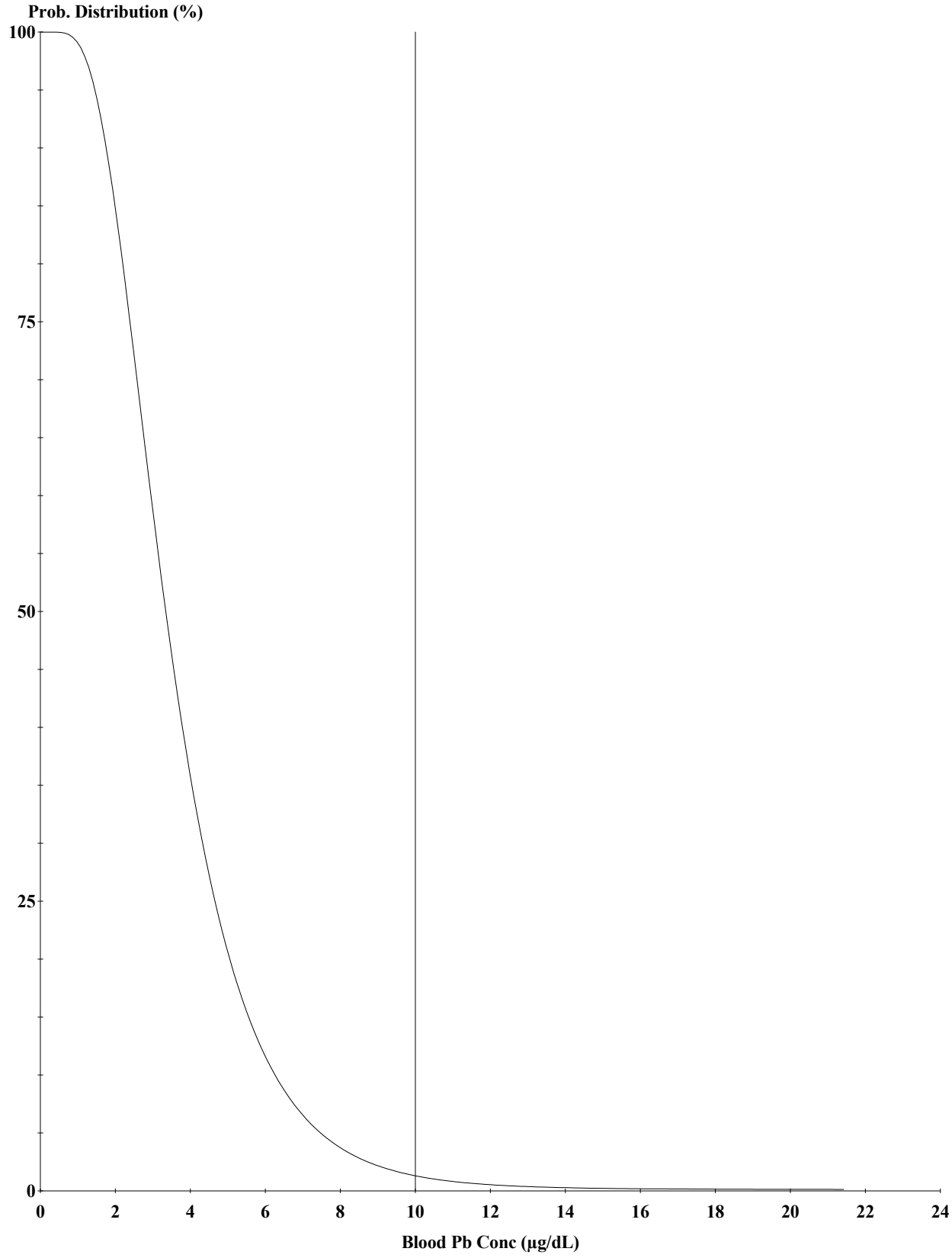
Run Mode = Research



Cutoff = 8.000 µg/dl
Geo Mean = 3.504
GSD = 1.600
% Above = 3.953
Dispersed Camper

Age Range = User Designated: Ages 12 - 72 months

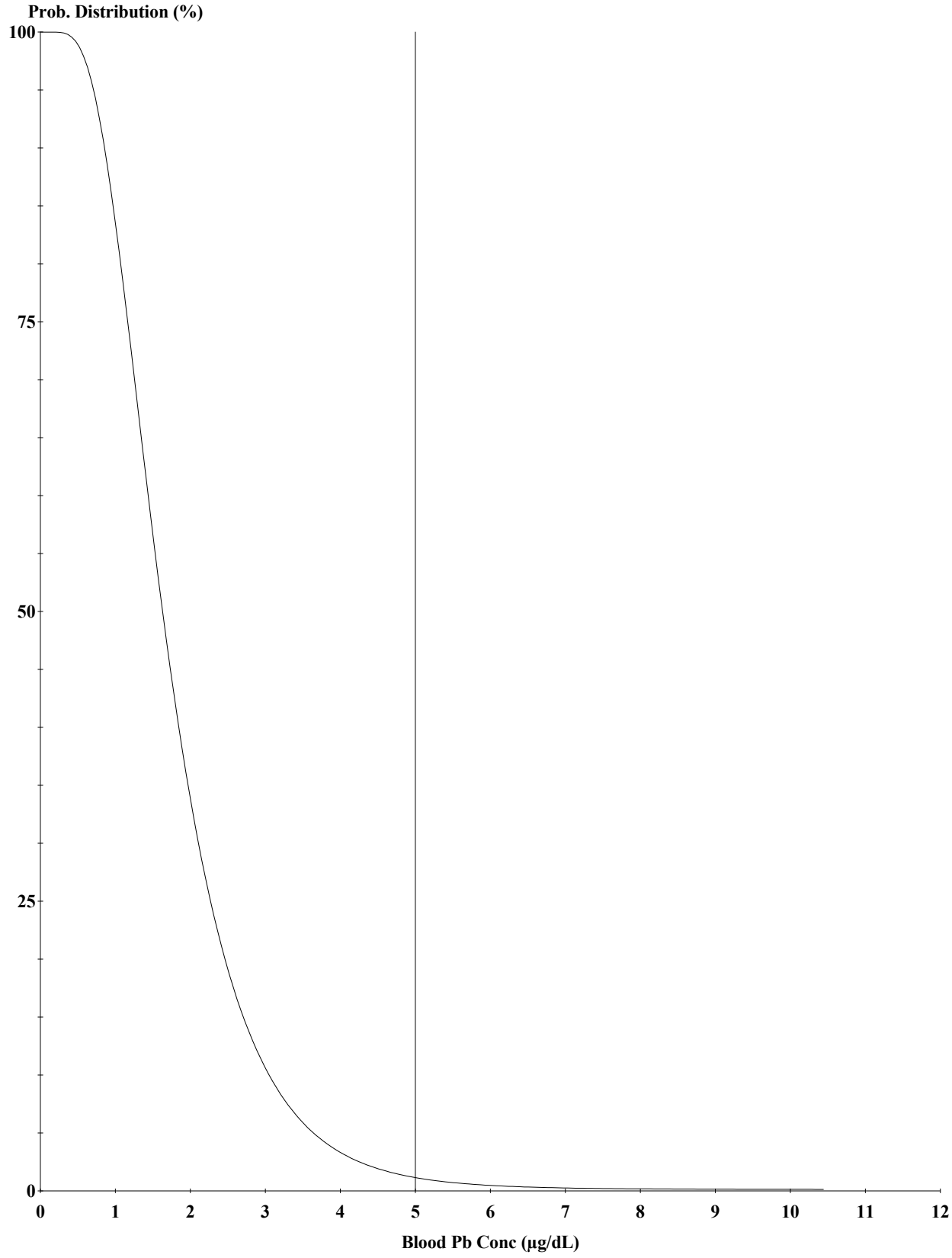
Run Mode = Research



Cutoff = 10.000 µg/dl
Geo Mean = 3.504
GSD = 1.600
% Above = 1.284
Dispersed Camper

Age Range = User Designated: Ages 12 - 72 months

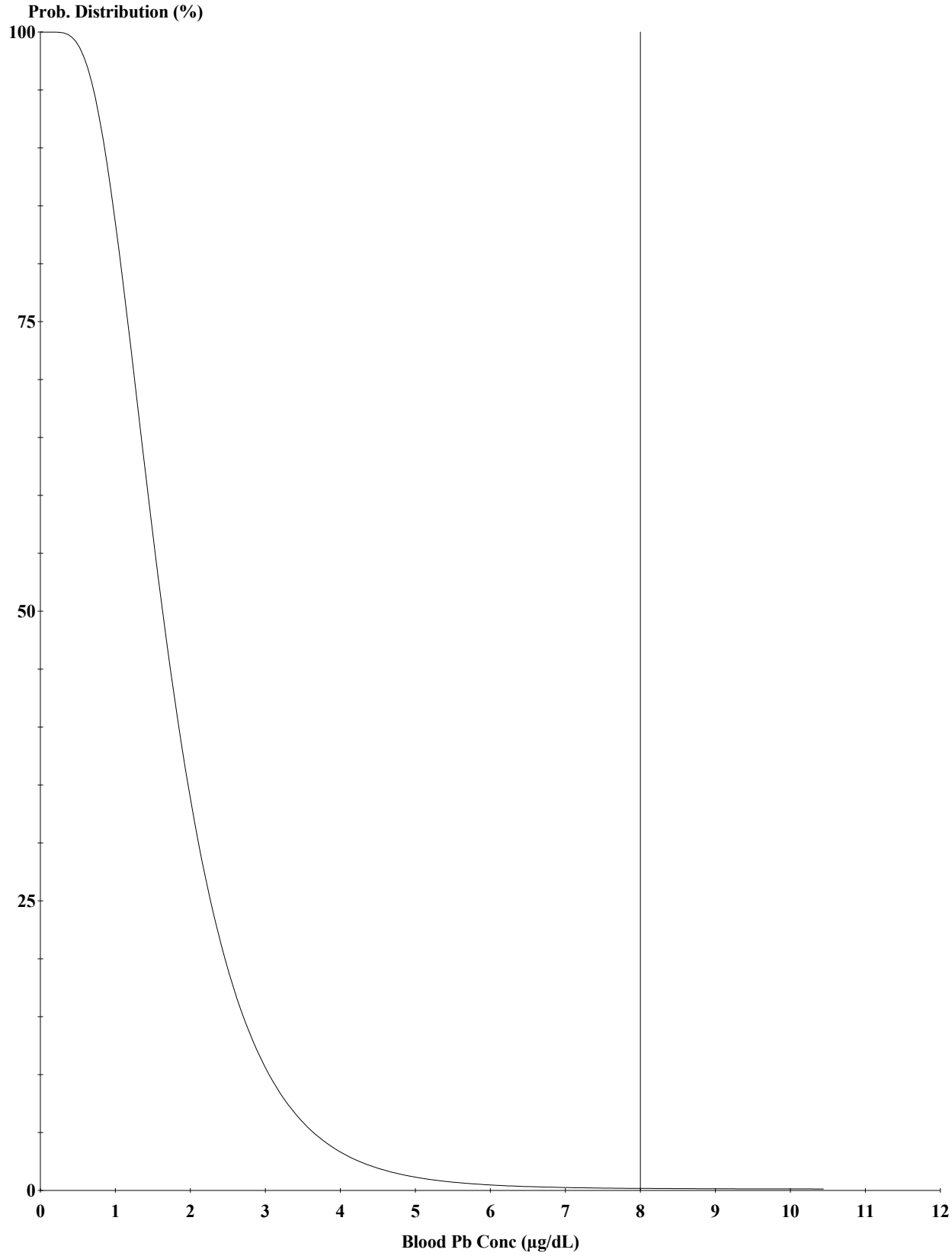
Run Mode = Research



Cutoff = 5.000 µg/dl
Geo Mean = 1.708
GSD = 1.600
% Above = 1.114
USFS Camper

Age Range = User Designated: Ages 12 - 72 months

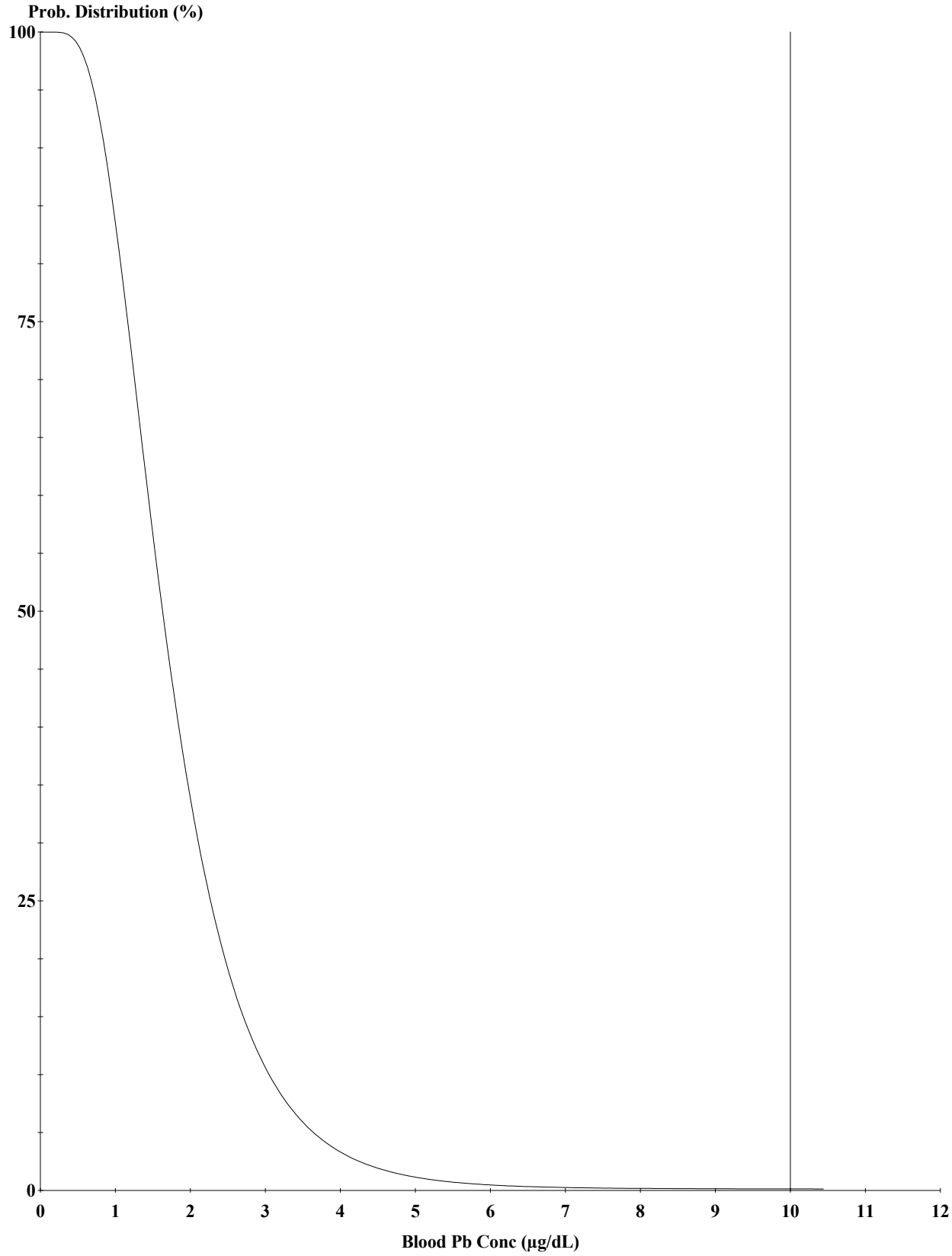
Run Mode = Research



Cutoff = 8.000 µg/dl
Geo Mean = 1.708
GSD = 1.600
% Above = 0.051
USFS Camper

Age Range = User Designated: Ages 12 - 72 months

Run Mode = Research



Cutoff = 10.000 µg/dl
Geo Mean = 1.708
GSD = 1.600
% Above = 0.008
USFS Camper

Age Range = User Designated: Ages 12 - 72 months

Run Mode = Research

Appendix F

Screening-Level Acute Risk Evaluation

1.0 Introduction

Because acute screening levels are not readily available for evaluating Site media, acute screening levels were derived for lead and arsenic in soil/waste rock based on a camping exposure scenario. Soil/waste rock were evaluated because they represent the majority of exposure for a receptor; exposure to surface water is considered minor relative to solid media exposure. Lead and arsenic were selected for evaluation because soil concentrations are notably elevated at several locations within the mining districts and both are often important human health risk drivers for mining-related contamination. The camping scenario was selected for the derivation of acute screening levels because the camper is anticipated to be the most sedentary of receptors (i.e., not moving about being exposed to a variety of soil/mine waste sources, in contrast with hiker, hunter, fisherman, all-terrain vehicle rider/guide, and road worker receptors). Derivation of screening levels for a sedentary receptor allows for the application of these screening levels to smaller exposure areas, such as individual campgrounds and dispersed areas suitable for camping.

Focus was placed on evaluating acute exposures to children because children are often more vulnerable to pollutants than adults due to differences in behavior and biology that can lead to greater exposure and/or unique windows of susceptibility during development. Additionally, soil ingestion rates for young children are higher than adults due to increased frequency of contact through hand-to-mouth or object-to-mouth activity. Thus, exposure parameters used in the derivation of the acute screening levels were tailored for children two years of age. Two exposure scenarios for a child that may camp within the mining districts were evaluated:

- Scenario 1: Child, based on central tendency exposure (CTE) soil intake rates specific to a camping exposure scenario
- Scenario 2: Child, based on reasonable maximum exposure (RME) soil intake rates specific to a camping exposure scenario

The derivation of, and differences between, exposure estimates for these two scenarios are described further below. Section 2.1 describes the approach for lead and Section 2.2 describes the approach for arsenic.

2.0 Derivation and Application of Acute Screening Levels

As noted above, acute screening levels have been developed for two exposure scenarios resulting in a range of acute screening levels for consideration in risk management decision-making. The sections below present the approach and assumptions used in the derivation of the acute screening levels for lead and arsenic for application to soil/waste rock.

Acute screening levels were developed based on exposure durations of 2 days and 14 days. An exposure duration of 2 days represents a camping duration of a weekend, while 14 days represents the maximum allowable time that may be spent camping in one location in the national forest (U.S. Forest Service [USFS] 2018).

2.1 Lead

The U.S. Environmental Protection Agency (EPA) recommends the use of the Integrated Exposure Uptake Biokinetic (IEUBK) model to evaluate exposures from lead-contaminated media in children in a residential setting for continuous exposure of sufficient duration to result in a quasi-steady state (EPA 1994). The IEUBK model was not designed to assess short-term (less than 90 days), periodic (less frequent than one exposure per week), or acute (less than or equal to 14 days) exposures (EPA 2016). Because of this, an alternate model was selected to evaluate acute exposure to lead from a short-term camping scenario. EPA has recommended the use of the All Ages Lead Model (AALM) for evaluating short-term exposure scenarios (EPA 2016). The AALM is still in development, however, a beta version (FORTRAN 1.0) of this model is available (upon EPA request) and was used in researching effects of lead exposures at various life stages to support the development of the acute screening levels. The version of the model used to derive acute lead screening levels in this appendix was provided by EPA on November 16, 2018.

The AALM was used to evaluate a "pulse" exposure occurring for either 2 days or 14 days, by a child due to incidental ingestion of soil/waste rock encountered at a specific location (e.g., campground or other suitable area for camping). The model output includes predicted lead concentrations in various body compartments including the blood, plasma, kidney, liver, bone, etc. for specified time step intervals (e.g., daily) with interpolated changes between steps. The AALM was run using a time step of 0.01 days to allow for maximum precision. This output can be used to determine peak blood lead (PbB) concentrations following a pulse exposure.

Table F-1 presents the general input parameters used to derive the acute screening levels for lead, recognizing that several of the assumptions may differ from those typically used in an evaluation of chronic exposure to lead.

Table F-1. General Parameters Used to Calculate the Acute Lead Screening Levels

Parameter	Value	Source
Target PbB level (µg/dL)	19.5	EPA 2016
Maternal PbB level (µg/dL)	0.6	EPA 2017b
Default drinking water concentration (µg/L)	0.9	EPA 2017a
Background soil lead concentration (mg/kg)	100	Site-specific Scribe database
Air lead concentration (µg/m^3)	0.10	IEUBK default
Dust lead concentration (mg/kg)	0.7 * soil concentration	IEUBK assumption
RBA (dispersed campsite soil)	0.54	Site-specific average
RBA (waste rock)	0.23	Site-specific average
Receptor gender	Female	AALM model

mg/kg – milligrams per kilogram
PbB – blood lead
RBA – relative bioavailability

µg/dL – micrograms per deciliter
µg/L – micrograms per liter

The rationale for the selection of each input provided in **Table F-1** is presented below:

- Target PbB level – An acute blood lead threshold of 20 micrograms per deciliter (µg/dL) was identified in Office of Land and Emergency Management (OLEM) Directive 9285.6-54, *Recommendations for Assessing Short-term Exposure Involving Lead at Superfund Sites* (EPA 2016). Per EPA (2016), a PbB level of 20 µg/dL could be considered as a short-term elevation in PbB that would trigger a response action. This is based on the interpretation of the Center for Disease Control (CDC) recommendation that PbB levels in the range of 20 to 44 µg/dL would result in a home visit by a public health agency within 24 hours of a referral from a physician (CDC 2012). For the purposes of this evaluation, 19.5 µg/dL was selected as target PbB for establishing an acute screening level, to account for rounding to two significant digits.
- Maternal PbB level – A maternal PbB level of 0.6 µg/dL was selected based the recommendation provided in OLEM Directive 9285.6-56 (EPA 2017b).
- Default drinking water concentration – A default lead drinking water concentration of 0.9 micrograms per liter (µg/L) was selected based the value used in the *Headquarters Lead Consultation Intake Form for the Colorado Smelter Superfund Site* (EPA 2017a).
- Background soil lead concentration – A background soil lead concentration of 100 milligrams per kilogram (mg/kg) was selected based on the mean soil lead concentration measured in upland reference soil collected within the mining districts.
- Air lead concentration – The default outdoor air lead concentration of 0.1 µg/m^3 in the IEUBK model was selected.
- Dust lead concentration – The background dust concentration was assumed to be 70% of the concentration in soil (i.e., 100 mg/kg · 0.7 = 70 mg/kg), as is usually assumed in the IEUBK model.
- Relative bioavailability (RBA) – Lead RBA was determined by measuring in vitro bioaccessability for campsite soil and waste rock samples collected within the mining districts. The mean estimate of RBA for lead was 0.54 and 0.23 for campsite soil and waste rock, respectively. Because of the variability between the mean RBA values for campsite soil and waste rock samples, screening levels were developed for each media type using their respective RBA values.
- Receptor gender – A female receptor was selected because female children have a lower body weight than male children (per default inputs in the AALM). A receptor with a lower body weight is more sensitive to exposure compared to a receptor with a higher body weight.

Table F-2 presents the scenario-specific input parameters used to derive the acute screening level for lead.

Table F-2. Scenario-Specific Parameters Used to Calculate the Acute Lead Screening Levels

Parameter	Scenario 1 CTE Camping	Scenario 2 RME Camping	Source
Soil intake rate during pulse exposure (g soil/day)	0.367	1.592	EPA 2008 (Table 5-6)
Soil intake rate prior to pulse exposure (g soil/day)	0.094	0.094	EPA 2017a
Water intake rate (L water/day)	0.51	0.51	EPA 2017a
Diet intake rate (µg Pb/day)	5.21	5.21	EPA 2017a
Receptor age at first pulse exposure	2 years old (730 days)	2 years old (730 days)	EPA 2008 (Table 5-6)

CTE – central tendency exposure
g – grams
L – liters
Pb – lead
RME – reasonable maximum exposure
µg – micrograms

The rationale for the selection of each input provided in **Table F-2** is presented below:

- Soil intake rate during pulse exposure – Soil intake rates were selected for use in the model to present a range of acute screening levels. In each case, the most conservative soil intake rate available for each scenario was selected so that the most sensitive receptor was used in the model.
  - Scenario 1 – The soil intake rate selected for a CTE child while camping was 0.367 g/day because this is the highest geometric mean intake rate provided in the *Child-Specific Exposure Factors Handbook* (EPA 2008, Table 5-6). This value corresponds to a 2-year-old to 3-year-old girl. The study upon which this value is based evaluated soil intake using a tracer element methodology for 78 children aged 1 to 5 years old at campgrounds (Van Wïjnen et al. 1990).
  - Scenario 2 – The soil intake rate selected for an RME child while camping was 1.592 g/day because this is the 95th percentile (computed using the reported geomean and geometric standard deviation) for the intake rates provided for the 2-year-old to 3-year-old girl (EPA 2008, Table 5-6).
- Soil intake rate prior to pulse exposure – The soil intake rate prior to the pulse selected for use in the model was the soil intake rate provided in the *Headquarters Lead Consultation Intake Form for the Colorado Smelter Superfund Site* (EPA 2017a) for the age group prior to the pulse. The soil intake rate prior to pulse was 0.094 g/day (soil intake rate for a 1-year old to 2-year old).
- Water intake rate – The drinking water intake rate selected for use in the model was 0.51 liters per day (L/day), based the values provided in the *Headquarters Lead Consultation Intake Form for the Colorado Smelter Superfund Site* (EPA 2017a).

- Dietary intake rate – The dietary lead intake rate selected for use in the model was 5.21 micrograms per day (µg/day), based the values provided in the *Headquarters Lead Consultation Intake Form for the Colorado Smelter Superfund Site* (EPA 2017a).

- Receptor age at first pulse exposure – The age at first pulse exposure was 730 days (2 years old).

Table F-3 presents the acute screening levels for lead based on a 2-day and 14-day exposure to soil/waste rock that were derived based on the inputs provided in the tables above and for the scenarios that have been described. The acute screening levels were derived by determining the soil/waste rock concentration that would result in a predicted peak PbB concentration of 19.5 µg/dL.

Table F-3. Acute Lead Screening Levels (mg/kg)

Panel A. Dispersed Campsite Soil (RBA = 0.54)

Scenario	2 Day Exposure	14 Day Exposure
Scenario 1	2,594	1,331
Scenario 2	596	306

Panel B. Waste Rock (RBA = 0.23)

Scenario	2 Day Exposure	14 Day Exposure
Scenario 1	6,090	3,125
Scenario 2	1,400	719

mg/kg – milligrams per kilogram

As seen in **Panel A** and **Panel B** in **Table F-3**, the change in screening level is inversely proportional to the change in RBA; decreasing the RBA by a factor of 2.35 increases the screening level by 2.35.

For demonstration purposes, **Figure F-1** presents a graphical display of the predicted PbB concentrations based on the acute screening levels for waste rock developed for a 2-day and 14-day exposure for Scenario 1 (CTE). As seen, the predicted PbB concentrations rise sharply for the 2-day exposure to soils containing 6,090 mg/kg to reach 19.5 µg/dL. In contrast, the predicted PbB concentrations have a more gradual rise for the 14-day exposure to soils containing 3,125 mg/kg to reach 19.5 µg/dL.

A comparison of the applicable lead screening levels to data collected from campgrounds and waste rock was performed. The lead soil concentrations used in the evaluation were based on the fine (250-µm) size fraction. An adjustment factor was applied to estimate the fine fraction from the 2-mm result (EPA 2000, 2017a). The adjustment factor was determined by performing a regression analysis of the lead results for samples sieved to 2-mm and to 250-µm. The regression analysis is presented in Figure 5-1 in the main document. As shown, lead concentrations for the fine fraction were estimated as follows[1]:

[1] In order to be conservative, for cases where the predicted concentration of lead in soil for the fine fraction resulted in a value less than what was measured in the bulk fraction, the concentration in the bulk fraction

$$C_{soil,\ 250\text{-}\mu m} = 1.625 \cdot C_{soil,\ 2\text{-}mm} - 226.36$$

where:

$C_{soil,\ 250\text{-}\mu m}$ = Estimated lead concentration in soil for the fine (250-µm) fraction

$C_{soil,\ 2\text{-}mm}$ = Measured lead concentration in soil for the bulk (2-mm) fraction

Figure F-2 presents the comparison of the applicable lead screening levels to samples collected from campgrounds/dispersed campsites[2] and waste rock. **Panel A** presents the comparison using a linear scale so that the magnitude of exceedances can be observed; **Panel B** presents the comparison using a log scale so that exceedances of screening levels can be seen easier. For the acute risk evaluation, exposure was evaluated for individual samples rather than assume that exposure occurs evenly across an exposure area as was done for the chronic risk evaluation. For campgrounds, the 14-day screening level was selected; for waste rock, the 2-day screening level was selected. Samples collected from waste rock areas are more remote (i.e., less accessible) and are not representative of areas that are frequently used for camping. Concentrations of lead in upland reference soil have also been included for comparison purposes. As seen, there are multiple campground samples with lead concentrations that exceed the 14-day CTE and RME screening levels. Samples collected from dispersed campsites 2, 3, 4, and 7 had the greatest exceedance margin. For waste rock, there were many samples that exceeded the 2-day CTE and RME screening levels. For the upland reference samples, there were a few exceedances of the RME screening level, but no exceedances of the CTE screening level as presented in **Figure F-2**.

2.2 Arsenic

Acute toxicity information is generally lacking for arsenic, and acute arsenic screening levels specific to the type of receptors present within the mining districts (i.e., recreational visitors) are not available. A review of *Toxicological Profile for Arsenic* developed by the Agency for Toxic Substances and Disease Registry (ATSDR) reveals oral doses as low as 0.02 to 0.06 milligrams of arsenic per kilogram body weight per day (mg/kg BW/day) have been reported to cause toxic effects in some individuals (ATSDR 1989). Severe exposures can result in acute encephalopathy, congestive heart failure, stupor, convulsions, paralysis, coma, and death. The acute lethal dose to humans has been estimated to be about 0.6 mg/kg BW/day (ATSDR 1989).

Washington State Department of Health (WSDOH) provides a synopsis of published scientific information related to soil exposure and acute toxicity in *Hazards of Short-term Exposure to Arsenic Contaminated Soil* (WSDOH 1999). The most sensitive reported indicators of acute toxicity appear to be edema, conjunctivitis, liver enlargement, irritation of the mucous membranes, and gastrointestinal problems such as vomiting, diarrhea, cramps, and pain. Transient adverse health effects commonly occur when doses between 0.035 and 0.071 milligrams of arsenic per kilogram of body weight (mg/kg BW) are ingested. The best estimate of an acute threshold for transient effects is 0.05 mg/kg BW. Using the acute transient effect dose

was adopted. This situation occurs at low concentration levels because the fine fraction and the bulk fraction become approximately equivalent.

[2] A "dispersed" campsite is an area that is suitable for camping or where camping is known to occur but may not be a formal campground.

information, acute arsenic screening levels can be derived for the same two exposure scenarios that were evaluated for lead (see Section 2.1). The equation used to derive the acute arsenic screening level is as follows:

$$ASL_{As} = (ATE / SF) / (IR / CF_{IR} / BW \cdot ED \cdot RBA)$$

where:

ASL_{As} = Acute screening level for arsenic (mg/kg soil)

ATE = Acute transient effect dose (mg/kg BW)

SF = Toxicity safety factor (unitless)

IR = Soil intake rate (g soil/day)

CF_{IR} = Conversion factor for intake rate, convert g to kg

BW = Body weight (kg)

ED = Exposure duration (days)

RBA = Relative bioavailability

When possible, consistent exposure parameters were used for arsenic and lead. **Table F-4** presents the general input parameters used to derive the acute screening levels for arsenic, recognizing that several of the assumptions may differ from those typically used in an evaluation of chronic exposures.

Table F-4. General Parameters Used to Calculate the Acute Arsenic Screening Levels

Parameter	Value	Source
Receptor gender	Female	EPA 2008 (Table 8-10)
Acute transient effect dose (mg arsenic/kg body weight)	0.05	WSDOH 1999
Toxicity safety factor (unitless)	10	WSDOH 1999
RBA (disperse campsite soil)	0.07	Site-specific average
RBA (waste rock)	0.05	Site-specific average

mg– milligrams
kg – kilograms
RBA – relative bioavailability

The rationale for the selection of each input provided in **Table F-4** is presented below:

- Receptor gender – A female receptor was selected because female children have a lower body weight than male children (EPA 2008). A receptor with a lower body weight is more sensitive to exposure compared to a receptor with a higher body weight.
- Acute transient effect dose – The best estimate acute transient effect dose was selected to represent the dose at which edema, conjunctivitis, liver enlargement, irritation of the

mucous membranes, and/or gastrointestinal problems (vomiting, diarrhea, cramps, and pain) may occur (WSDOH 1999).

- Toxicity safety factor – A no-effect level is typically estimated by dividing the dose observed to cause health effects by a safety factor. There is little scientific information available to guide the selection of a safety factor for short-term exposure to arsenic in soil. The selection must be based on judgement of the margin of safety desired for protection from the potential adverse consequences of this type of event. For the two scenarios, a safety factor of 10 was considered adequate to estimate a no-effect level from an acute effect level for the purposes of calculating soil arsenic concentrations protective of human health. This choice was based on consideration of documented variability in human sensitivity to the toxic effects of arsenic as well as consideration of likelihood of occurrence of the various scenarios (WSDOH 1999).

- RBA – Arsenic RBA was determined by measuring in vitro bioaccessability for dispersed campsite soil and waste rock samples collected within the mining districts. The mean estimate of RBA for arsenic was 0.07 and 0.05 for dispersed campsite soil and waste rock, respectively. Screening levels were developed for each media type using their respective RBA values.

Table F-5 presents the scenario-specific input parameters used to derive the acute screening level for arsenic.

Table F-5. Scenario-Specific Parameters Used to Calculate the Acute Arsenic Screening Levels

Parameter	Scenario 1 CTE Camping	Scenario 2 RME Camping	Source
Soil intake rate during exposure (g soil/day)	0.367	1.592	EPA 2008 (Table 5-6)
Receptor age at exposure	2 years old	2 years old	EPA 2008 (Table 5-6)
Receptor body weight (kg)	12.5	12.5	EPA 2008 (Table 8-10)

CTE – central tendency exposure
g – grams
kg – kilograms
RME – reasonable maximum exposure

The rationale for the selection of each input provided in **Table F-5** is presented below:

- Soil intake rate during pulse exposure – Similar to the approach for deriving acute screening levels for lead, multiple soil intake rates were selected for use in the calculations to present a range of acute screening levels. In each case, the most conservative soil intake rate available for each scenario was selected so that the most sensitive receptor was used in the calculations. The soil intake rates used for arsenic are the same as those selected for lead during the pulse exposure. See Section 2.1 for the basis of the selected soil intake values for each scenario.

- Receptor age at exposure – Similar to the approach for deriving acute screening levels for lead, the age at exposure was 2 years old.

- Receptor body weight – The receptor body was selected to correlate to the age and gender of the receptor. The mean female body weight for a 2-year old was selected (EPA 2008, Table 8-10).

Table F-6 presents the acute screening levels for arsenic based on a 2-day and 14-day exposure to soil/waste rock that were derived based on the inputs provided in the tables above and for the scenarios that have been described.

Table F-6. Acute Arsenic Screening Levels (mg/kg)

Panel A. Dispersed Campsite Soil (RBA = 0.07)

Scenario	2 Day Exposure	14 Day Exposure
Scenario 1	1,216	174
Scenario 2	280	40

Panel B. Waste Rock (RBA = 0.05)

Scenario	2 Day Exposure	14 Day Exposure
Scenario 1	1,703	243
Scenario 2	393	56

mg/kg – milligrams per kilogram
RBA – relative bioavailability

As seen, the change in screening level is inversely proportional to the change in RBA; decreasing the RBA by a factor of 1.4 increases the screening level by 1.4.

Review of the available campsite and waste rock data for arsenic was performed. **Figure F-3** presents a comparison of the applicable arsenic screening levels to samples collected from campgrounds/dispersed campsites and waste rock. **Panel A** presents the comparison using a linear scale so that the magnitude of exceedances can be observed; **Panel B** presents the comparison using a log scale so that exceedances of screening levels can be seen easier. For the acute risk evaluation, exposure was evaluated for individual samples representative of individual campgrounds rather than assume that exposure occurs evenly across campsites within an exposure area as was done for the chronic risk evaluation. Similar to the acute evaluation for lead, the 14-day screening level was selected for application to campgrounds; for waste rock, the 2-day screening level was selected. Concentrations for upland reference soil samples are also included in **Figure F-3** for comparison to the screening levels. For campground soil samples, concentrations of arsenic do not exceed the CTE screening levels, but there were some locations with soil concentrations greater than the RME screening level. For waste rock, there were four samples (collected from the Koehler Mine, Junction Mine, and Longfellow Mine) that exceeded the CTE screening level and three additional samples that exceeded the RME screening level. For all upland reference soil samples, the concentrations of arsenic observed are below the range of possible screening levels.

3.0 Uncertainty Assessment

Similar to the chronic risk evaluation, quantitative evaluation of acute risks to humans from environmental contamination is limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with

contaminated media, and the true acute effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of the acute evaluation are uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of this evaluation. The following sections review the main sources of uncertainty.

3.1 Relative Bioavailability

An assumed average bioavailability was used in deriving the screening levels. Sample-specific bioavailability could be either higher or lower. For lead, sample-specific bioavailability was measured at the four campsite locations with the highest lead concentrations. The RBA for these locations ranged from 37% to 59%. Applying a sample-specific bioavailability would not change the conclusion that these locations are above both the 2-day and 14-day screening level.

For arsenic, there were several locations that exceeded the CTE screening level using the average RBA. Because sample-specific RBA information is not available at these locations, it is not possible to determine if use of this information would alter conclusions. With the exception of one sample collected from the Junction Mine, an alternate RBA value would not have the potential to change the conclusions because concentrations of arsenic are significantly above the screening level. If the sample-specific RBA for the Junction Mine were available and the RBA was lower, it would be possible that this sample could be below the CTE screening level.

3.2 Background Lead Concentration

The derivation of the lead screening levels required an assumed background concentration for lead in soil. Site-specific measurements of lead in upland reference soil indicate average lead concentrations in the mining districts is 100 mg/kg. Campers that may visit the mining districts may be exposed to soil with concentrations of lead that are higher or lower than this value when they are not visiting the Site (e.g., when they are at their residence) resulting in a different baseline blood lead level than was assumed for this acute evaluation.

3.3 AALM Model

The AALM model used to derive the lead screening levels is currently undergoing testing, therefore, screening levels derived using the model could require revision in the future if adjustments are made to the model. However, at this time, this is the best model available to evaluate acute lead exposure. The model incorporates time-varying media concentrations, media intake rates, and relative absorption factors to estimate total inhalation and total ingestion uptakes at each model time step. As part of coding and testing the AALM, a number of datasets were simulated, including adult and childhood datasets used during the original Leggett code calibration and validation. Additional datasets identified during a literature search were also included in coding and testing. Based on these tests, parameters with the AALM were adjusted by the model developers to ensure the best overall fit against all datasets (ICF 2016).

3.4 Exposure Assumptions

Screening levels were developed for a range of exposure durations and intake rates. **Figure F-2** and **Figure F-3** present screening levels for campgrounds based on a 14-day exposure and screening levels for waste rock based on a 2-day exposure. Acute exposure duration and soil

ingestion rates are likely to be variable. A camper could spend between 1 to 14 days in one location based on the maximum allowable number of days specified in USFS guidelines (USFS 2018). This exposure duration also considers the annual limit of 14 days for use of Bureau of Land Management land for dispersed camping. This maximum exposure duration combined with RME soil ingestion rates may result in overly conservative screening levels.

4.0 Conclusions

The screening levels for lead and arsenic presented in this appendix are to be considered in risk management decision-making within the mining districts. A range of values have been provided based on the understanding there may be differences in the applicable exposure scenario depending upon the type of location being evaluated. Evaluation of the locations from which samples were collected is a critical step in the risk management decision process. For example, the 2-day exposure screening levels may be more applicable to remote areas that are more difficult to access, whereas the 14-day exposure screening levels may be more applicable to dispersed campsites with that are easily accessible. In addition, when applying the screening levels, the physical attributes of the location from which samples have been collected should be considered. For example, samples collected from a steep slope are not representative of areas where camping may occur. Application of the screening levels to these areas would be inappropriate.

4.1 Lead

For the camping area soils, there are multiple samples with lead concentrations that exceed the 14-day CTE and RME acute screening levels. Because it may be unreasonable to assume that RME soil ingestion rates, which are specific to a camping scenario, are realistic for 14 days, it may be more appropriate to focus on samples that exceed the CTE acute screening level. Given this consideration, samples collected from dispersed campsites 2, 3, 4, and 7 had the greatest exceedance margin of the CTE screening level.

For waste rock, there were many samples that exceeded the 2-day CTE and RME acute screening levels. However, evaluation of the locations where samples were collected is a critical step in the risk management decision process. When evaluating samples in exceedance of the acute screening levels, the physical attributes of the location from which sample was collected should be considered. For example, samples collected from the steep slopes of a waste pile are not representative of areas where camping may occur. Thus, application of the acute camping screening levels to these areas would be inappropriate.

For the upland reference soils, there were a few exceedances of the RME screening level, but no exceedances of the CTE screening level. This indicates that lead concentration in areas at the Site that are not impacted by mining activities would not pose an acute risk to campers based on "typical" soil ingestion rates. However, if the soil ingestion rate were to be at an RME level for 14 consecutive days, acute risks have the potential to be unacceptable in upland reference areas. Because unacceptable exposures are not expected in unimpacted areas, this further supports the conclusion that the 14-day RME screening level is likely to be overly conservative. This should be taken into consideration during risk management decision-making.

4.2 Arsenic

For the camping area soil, concentrations of arsenic do not exceed the 14-day CTE acute screening levels, but there were some locations with soil concentrations greater than the RME screening level. For waste rock, there were four samples (collected from three mining areas, including the Koehler Mine, Junction Mine, and Longfellow Mine) that exceeded the 2-day CTE acute screening level and three additional samples that exceeded the RME screening level. For the upland reference soils, the measured arsenic concentrations are below the range of possible screening levels for all samples.

5.0 References

ATSDR. 1999. *Toxicological Profile for Arsenic*. Atlanta, Georgia: Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. ATSDR/TP-88/02.

CDC. 2012. *CDC Recommendations for Children's Blood Lead Levels (BLLs)*. Atlanta, Georgia: Centers for Disease Control and Prevention: Atlanta, GA.

Colorado Geological Survey 2017a. San Juan County. Accessed at http://coloradogeologicalsurvey.org/mineral-resources/historic-mining-districts/san-juan-county/ on June 20, 2017.

EPA. 1994. *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA/540/R-93/081.

EPA. 2000. Short Sheet: TRW Recommendations for Sampling and Analysis of Soil at Lead (Pb) Sites. EPA 540-F-00-010. April.

EPA. 2008. *Child-Specific Exposure Factors Handbook*. U.S. Environmental Protection Agency. EPA/600/R-06/096F. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=199243.

EPA. 2016. *Recommendations for Assessing Short-term Exposure Involving Lead at Superfund Sites*. U.S. Environmental Protection Agency, Office of Land and Emergency Management. OLEM Directive 9285.6-54.

EPA. 2017a. *Headquarters Lead Consultation Intake Form for the Colorado Smelter Superfund Site*. Submitted 4/11/17. https://semspub.epa.gov/work/08/1884173.pdf

EPA. 2017b. *Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters and the Integrated Exposure Uptake Biokinetic Model's Default Maternal Blood Lead Concentration at Birth Variable*. U.S. Environmental Protection Agency, Office of Land and Emergency Management. OLEM Directive 9285.6-56.

ICF. 2016. Users Guide for the FORTRAN Version of the All Ages Lead Model. December 9.

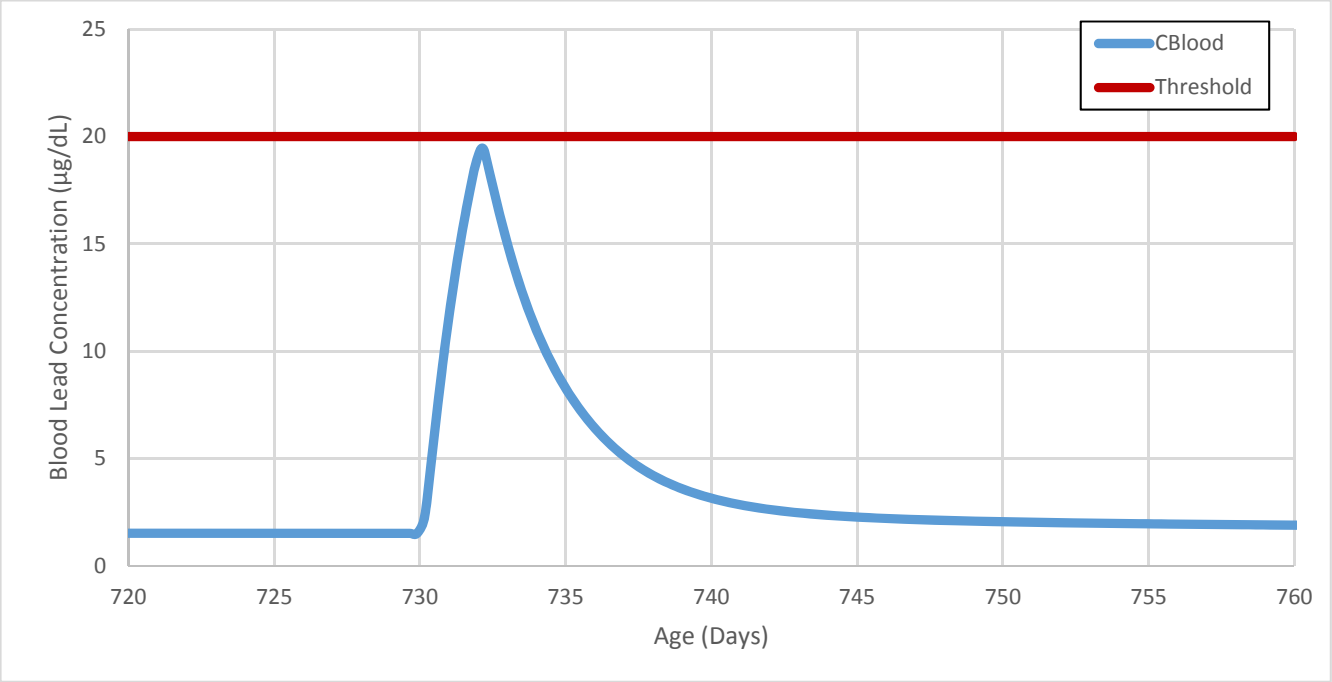
USFS. 2018. *San Juan National Forest Guidelines for Dispersed Camping*, at https://www.fs.usda.gov/activity/sanjuan/recreation/camping-cabins/?recid=42728&actid=34.

Van Wïjnen, J.H.; P. Clausing, and B. Brunekreff. 1990. "Estimated soil ingestion by children." *Environmental Research* 51:147162.

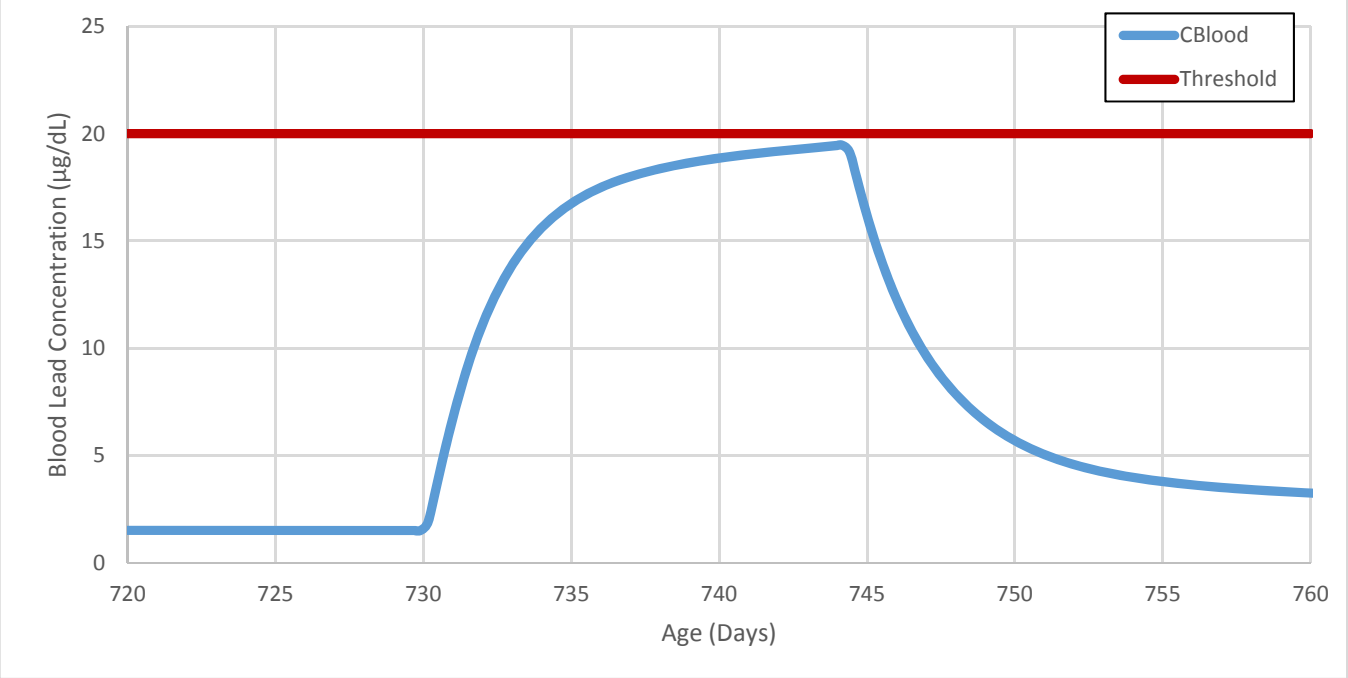
WSDOH. 1999. *Hazards of Short-Term Exposure to Arsenic Contaminated Soil.* Washington State Department of Health, accessed February 13, 2018 at https://www.doh.wa.gov/Portals/1/Documents/Pubs/334-284.pdf.

FIGURE F-1. EXAMPLE AALM OUPUT DATA – 2-DAY VERSUS 14-DAY EXPOSURE DURATION
Bonita Peak Mining District

Panel A. Blood Lead Concentration for a 2-Year-Old Female - Single-Pulse Soil Concentration of 6,090 (2 Days)



Panel A. Blood Lead Concentration for a 2-Year-Old Female - Single-Pulse Soil Concentration of 3,125 (14 Days)

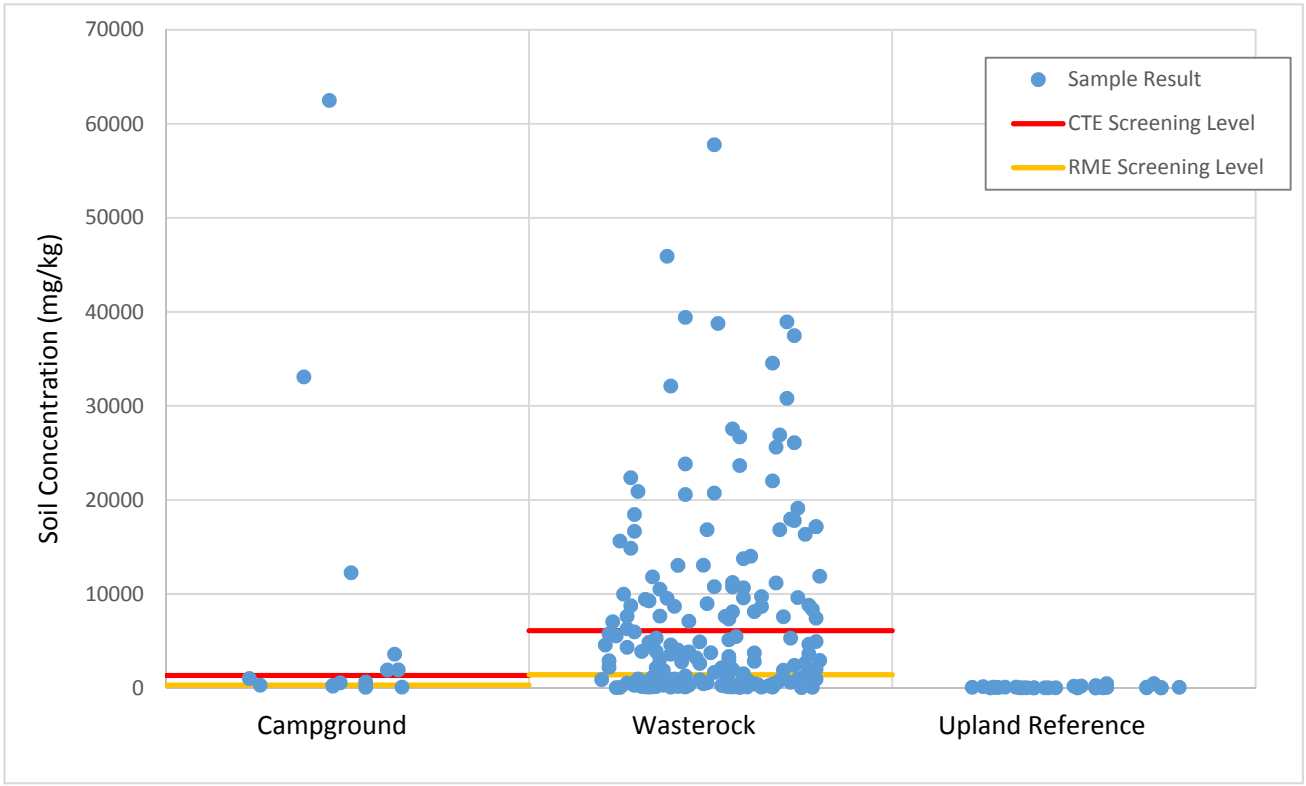


AALM - All Ages Lead Model
mg/kg - milligrams per kilogram
µg/dL - micrograms per deciliter
Cblood - concentration of lead in blood

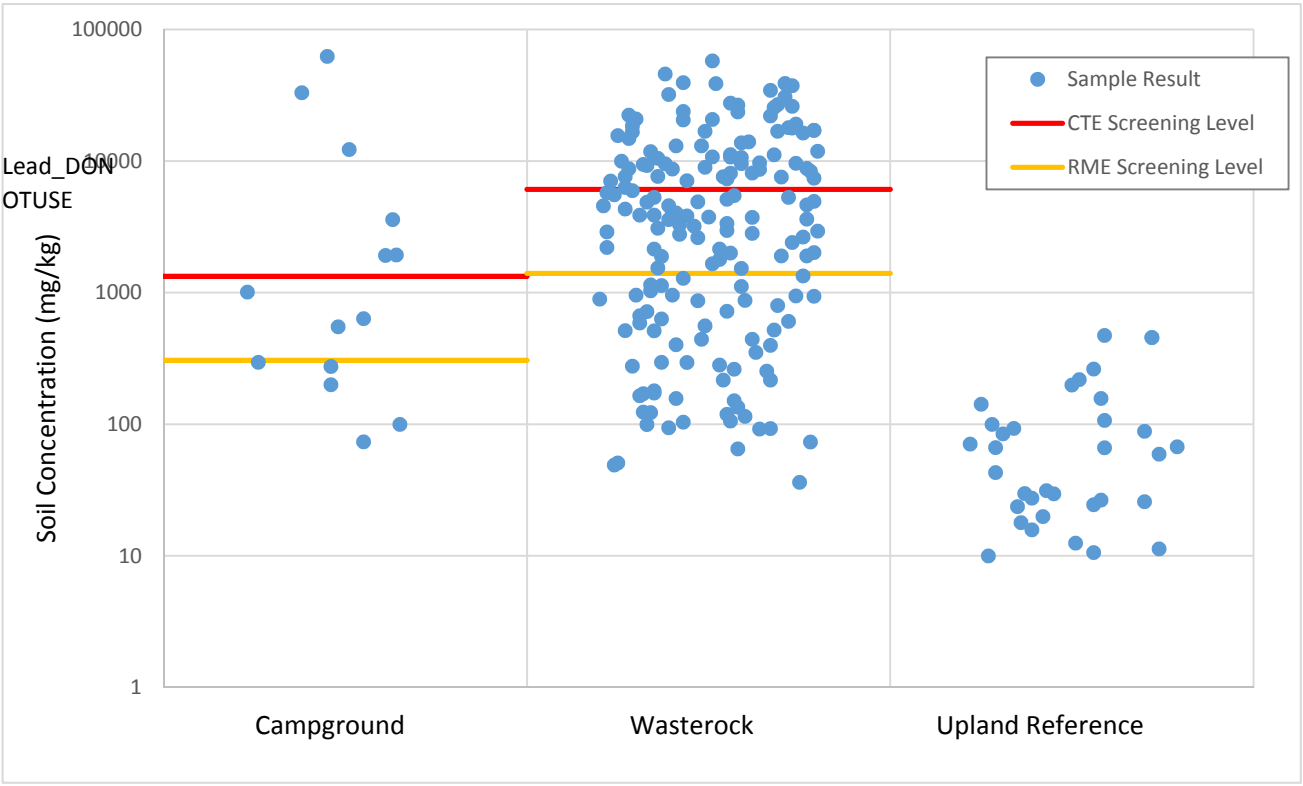
FIGURE F-2. ACUTE SCREENING LEVEL COMPARISON TO SITE MATERIALS

Bonita Peak Mining District

Panel A. Linear Scale



Panel B. Log Scale

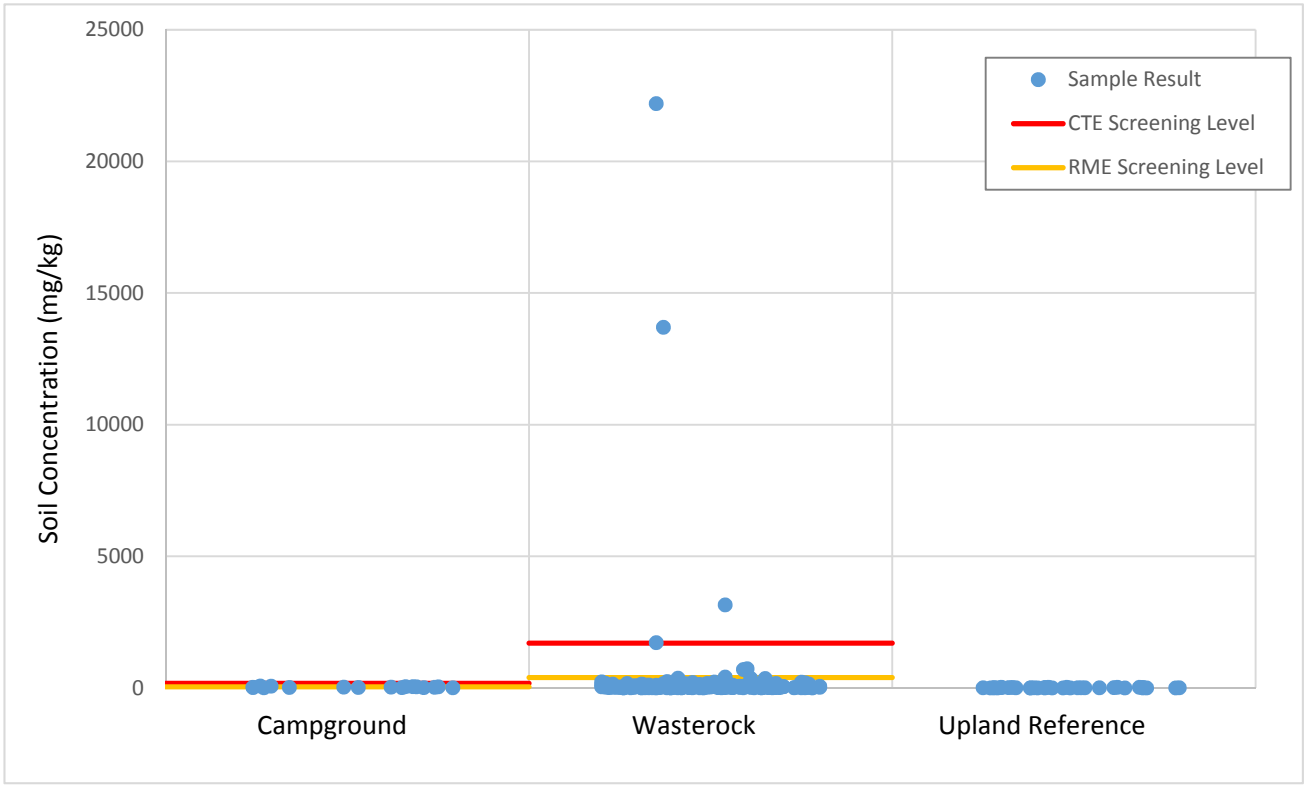


CTE - central tendency exposure
RME - reasonable maximum exposure
mg/kg - milligram per kilogram

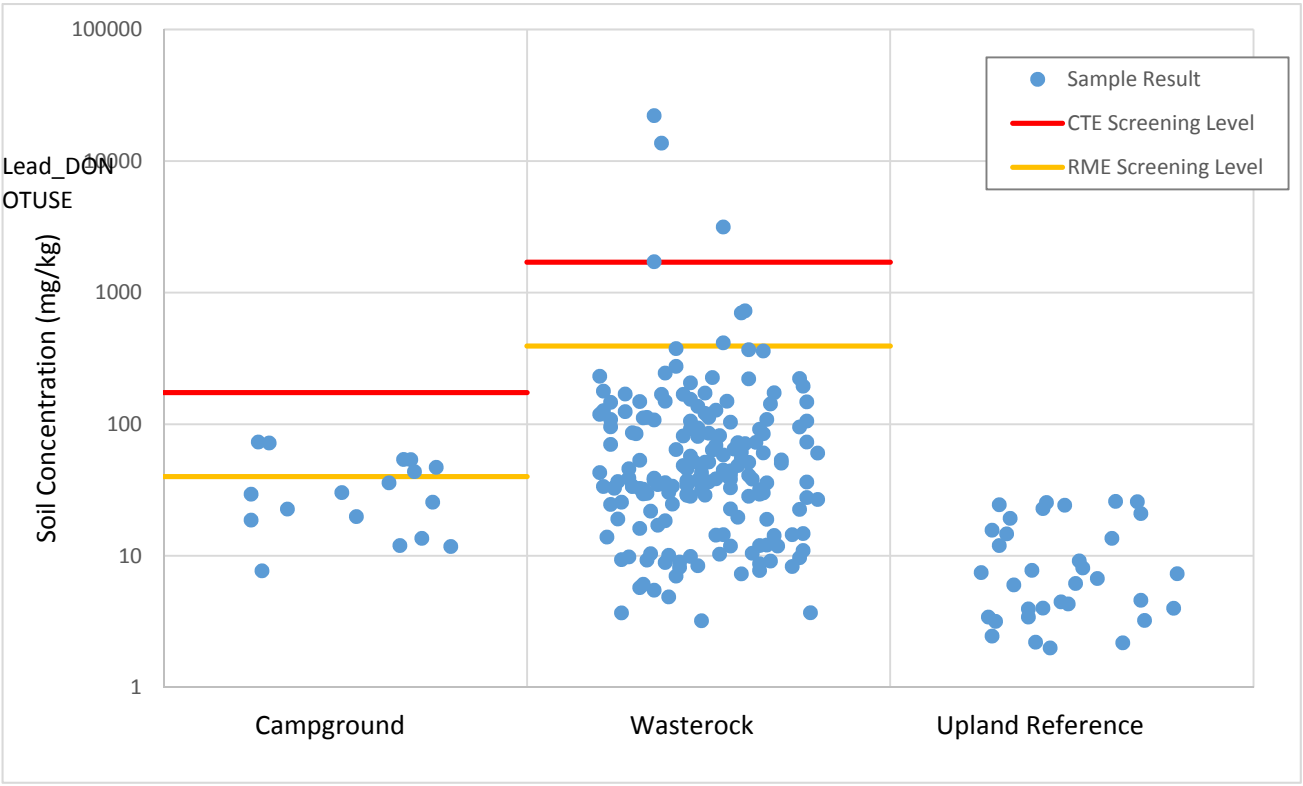
FIGURE F-3. ACUTE SCREENING LEVEL COMPARISON TO SITE MATERIALS

Bonita Peak Mining District

Panel A. Linear Scale



Panel B. Log Scale



CTE - central tendency exposure
RME - reasonable maximum exposure
mg/kg - milligram per kilogram