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Removal Action Report for the 183.2-KE Flocculation and Sedimentation Basin and the 183.7-KE Pipe Tunnel, 100-K Area

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Signature page for the *Removal Action Report for the 183.2-KE Flocculation and Sedimentation Basins, and the 183.7-KE Pipe Tunnel, 100-K Area* at the U.S. Department of Energy's Hanford Site.

Sept. 25, 2012

Thomas K. Teynor
Federal Project Director for the River Corridor
U.S. Department of Energy, Richland Operations Office

Date

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Executive Summary

This Removal Action Report summarizes the completion of deactivation and demolition (D&D) activities conducted by the U.S. Department of Energy under a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* response action at the 183.2-KE Flocculation and Sedimentation Basins and the 183.7-KE Pipe Tunnel. The deactivation and demolition (D&D) of the 183.2-KE and 183.7-KE Facilities was conducted in accordance with the *Action Memorandum for the Non-Time-Critical Removal Action for the 105-KE and 105-KW Reactor Facilities and Ancillary Facilities* ([Action Memorandum] EPA, 2007) and the *Removal Action Work Plan for 105-KE/105-KW Reactor Facilities and Ancillary Facilities* ([RAWP] DOE/RL-2005-26).

The 183.2-KE Flocculation and Sedimentation Basins and 183.7-KE Pipe Tunnel Facilities were located in the 100-K Area of the Hanford Site, and were part of the 183-KE Water Treatment Plant. The 100-K Area housed two reactors, 105-KE and 105-KW, which were cooled using water from the Columbia River. The 183-KE Water Treatment Plant was a series of facilities that treated water to remove impurities prior to using it for cooling the 105-KE Reactor.

The removal of the 183.2-KE Facility consisted of removal of the internal components and dividing walls of the basin structures, which took place over the period from April 2011 through August 2012. The D&D activities for the 183.7-KE Facility occurred from July 2011 through August 2012 and consisted of removal of the internal piping, roof structure, support columns, and the walls of the facility. The floor was left in place, and backfilling will be conducted following completion of D&D activities at adjacent Water Treatment Plant facilities. The completion of this removal action mitigates the potential threat of release of contaminants to the environment and is consistent with the remedial actions for the 100-KR-1 and 100-KR-2 Operable Units, identified in EPA, 2007.

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Terms

ACM	asbestos-containing material
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
D&D	deactivation and demolition
COC	Contaminant of concern
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
KE	K East
KW	K West
N/A	not applicable
NPL	National Priorities List
OU	Operable Unit
PCB	polychlorinated biphenyl
RAO	removal action objective
RAG	remedial action goals
RAWP	removal action work plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RESRAD	Residual Radioactivity
RO/RO	roll-on/roll-off
ROD	Record of Decision
SARA	*Superfund Amendments and Reauthorization Act of 1986*
UHCM	unquantified hazardous construction materials

1 Introduction

This report documents completion of a removal action conducted by the U.S. Department of Energy, Richland Operations Office (DOE-RL) for the 183.2-KE Flocculation and Sedimentation Basins and the 183.7-KE Pipe Tunnel. The deactivation and demolition (D&D) of the 183.2-KE and 183.7-KE Facilities was conducted in accordance with the *Action Memorandum for the Non-Time-Critical Removal Action for the 105-KE and 105-KW Reactor Facilities and Ancillary Facilities* ([Action Memorandum] EPA, 2007) and the *Removal Action Work Plan for 105-KE/105-KW Reactor Facilities and Ancillary Facilities* ([RAWP] DOE/RL-2005-26).

1.1 Site Description

The Hanford Site, located in southeastern Washington State and situated along the Columbia River, is approximately 1,518 km^2 (586 mi^2) in size. The Hanford Site mission from the early 1940s to approximately 1989 included defense-related nuclear research, development, and weapons material production activities. These activities created chemical and radioactive wastes. The Hanford Site mission now is focused on the cleanup of those wastes and ultimate closure of the site.

The 100 Area, which encompasses approximately 68 km^2 (26 mi^2) bordering the southern shore of the Columbia River, included six reactor areas (i.e., 100-B/C, 100-D/DR, 100-F, 100-H, 100-K, and 100-N) that contained nine reactors. The identified structures described in this report are shown in Figure 1-1 and are included in the 100-K Area.

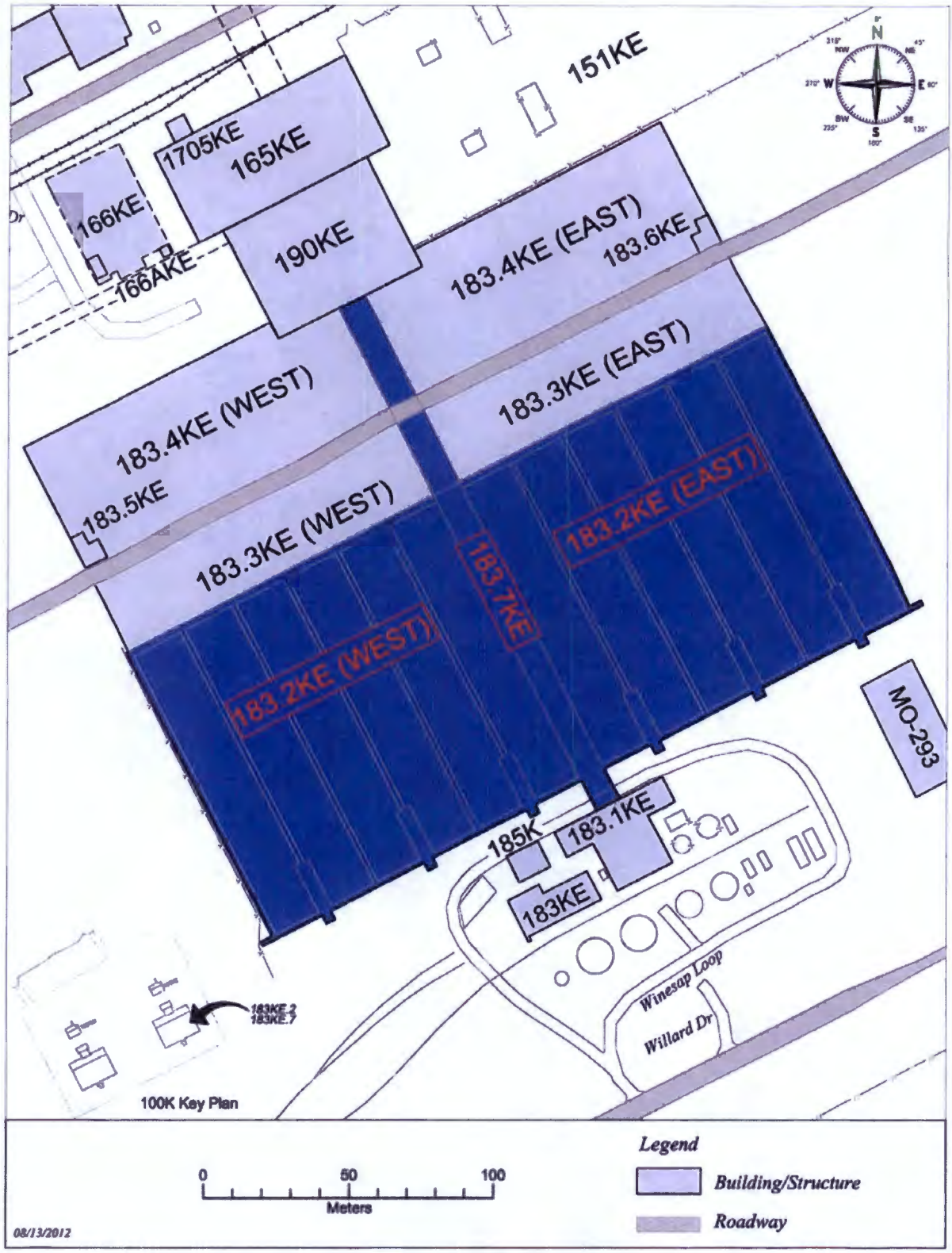

Figure 1-1. Location of the 183.2-KE and 183.7-KE Facilities Within the 100-K Area

1.2 Regulatory and Enforcement History

The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) was enacted to enable the Federal government to conduct cleanup of hazardous substances released into the environment. In 1986, CERCLA was amended by the *Superfund Amendments and Reauthorization Act of 1986*, (SARA) which included Section 120 (42 USC 9620, "Federal Facilities"), developed specifically for federal facility cleanup. Presidential Executive Order 12580 delegated to DOE the primary authority to conduct removal and remedial actions under authority of CERCLA Section 104, "Response Authorities."

In 1987, the Federal government determined that wastes which included a mixture of radioactive and hazardous chemical components were subject to regulation under the *Resource Conservation and Recovery Act of 1976* (RCRA) and its Washington State counterpart. In 1989, DOE, the U.S. Environmental Protection Agency (EPA) and Washington Department of Ecology (Ecology) signed the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989, also known as the Tri-Party Agreement or TPA). The TPA implemented DOE's exercise of CERCLA remedial action authority under EPA oversight, in accordance with CERCLA Section 120, and also included an Ecology Consent Order containing a schedule for bringing all current Hanford hazardous waste operations into compliance with RCRA under the new mixed waste requirements. DOE's authority to conduct removal actions under CERCLA Section 104 is independent of the TPA, but is exercised cooperatively with the respective oversight authorities of EPA and Ecology.

During this timeframe, the Hanford Site was proposed for inclusion on the Superfund National Priorities List (NPL, 53 FR 23988, "National Priorities List for Uncontrolled Hazardous Waste Sites – Update 7"). EPA placed the Hanford Site's 100, 200, 300, and 1100 Areas on the NPL on November 3, 1989 (54 FR 41015, "National Priorities List for Uncontrolled Hazardous Waste Sites – Final Rule 10/04/89"). These areas were then further divided into CERCLA operable units (OUs).

In 2005, alternatives for conducting a non-time-critical removal action for 85 ancillary facilities in the 100-K Area, including the 183.2-KE and 183.7-KE Facilities, were evaluated in the *Engineering Evaluation/Cost Analysis for the 105-KE and 105-KW Reactor Facilities and Ancillary Facilities* ([EE/CA] DOE/RL-2005-86). The EE/CA recommended D&D, which was the selected alternative in the Action Memorandum (EPA, 2007).

In 2007, the removal action work plan (RAWP) (DOE/RL-2005-26) was issued to support removal actions resulting from the Action Memorandum (EPA, 2007). The RAWP applies to the 105-KE and 105-K West (KW) Reactor Buildings and all ancillary facilities in the 100-K Area. Figure 1-2 provides a flow chart that shows alignment of the 183.2-KE and 183.7-KE Facilities with the various decision and implementation documents.

1.3 Environmental Setting

The 100-K Area of the Hanford Site is located on the river corridor area of the Columbia River. Most of the area within the 100-K boundary is highly disturbed, with substrate consisting primarily of compacted gravel. Vegetation consists primarily of widely scattered weedy species, with most of the areas having essentially no vegetation. The 183.2-KE and 183.7-KE Facilities were located approximately 2,000 ft from the Columbia River; groundwater at this location is at a depth of approximately 70 ft below ground surface.

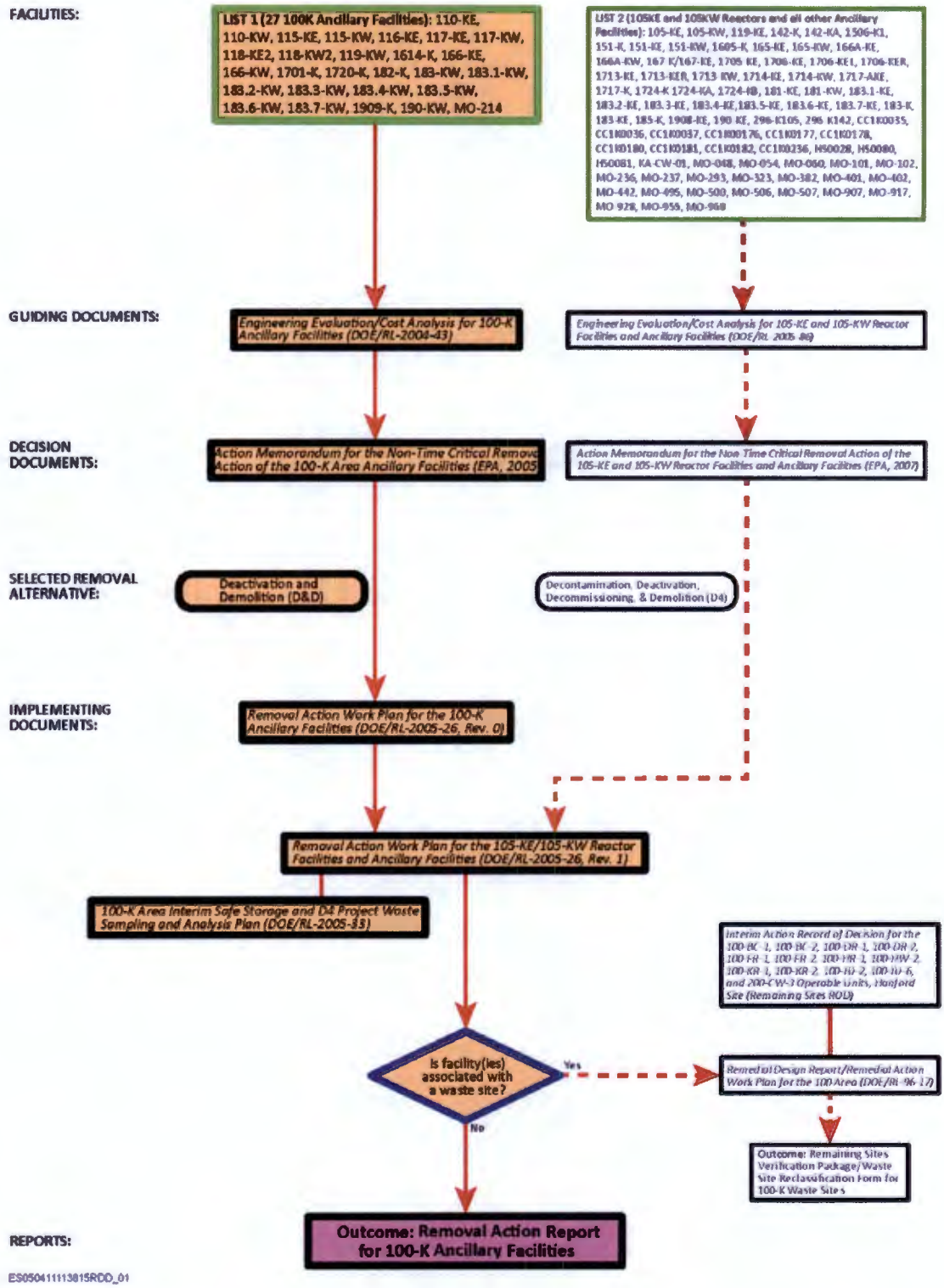

Figure 1-2. Flow Diagram of Decision Documents and Reports for 100-K Ancillary Facilities

2 Site Background for the 183.2-KE and 183.7-KE Facilities

This section provides a summary description of the facilities that are the subject of this RAR, including the physical structures, possible contaminants, and activities conducted to support the removal action.

2.1 Building Descriptions and Background

The 183.2-KE and 183.7-KE Facilities were part of the 183-KE Water Treatment Plant, located south of the 105-KE Reactor. The 183-KE Water Treatment Plant provided cooling water for the 105-KE Reactor and was capable of handling a maximum total water flow of 156,000 gal/min.. Water obtained from the Columbia River was treated before passing through the reactor. Flocculation, settling, chemical treatment, filtering, and pH adjustment were used to purify and prepare the water, which was then stored in the 183.4-KE Clearwells. The water was circulated in a single pass through the 105-KE Reactor before being discharged to the Columbia River (WHC-SD-EN-TI-239, *100-K Technical Baseline Report*).

183.2-KE Flocculation and Sedimentation Basins: Water from the 183.1-KE Head House, containing chlorine and flocculating agents, was received in the flash mixing chambers (inlet boxes to the flocculation basin) of the 183.2-KE Flocculation and Sedimentation Basins, where a short, violent agitation dispersed the chemicals through the water. The water flowed from these chambers to the flocculation basin, where a gentle mixing over a longer period caused the chemicals and sediment in the water to gather into a gelatin-like flake called floc. Water with this suspended floc flowed into the sedimentation basins, where the floc settled to the bottom. The basin discharge flume was equipped with twenty 24-in. disc valves. The relatively clear water flowed over a weir through the disc valves and into the filter distribution flume located under the discharge flume. Water then flowed into the 183.3-KE Sand Filter Basin for filtration (addressed in DOE/RL-2011-63) prior to discharge to the Clearwells (183.4-KE).

The 183.2-KE Flocculation and Sedimentation Basins consisted of 12 flocculation basins and 12 sedimentation basins, six of each located on the west and east sides of the central 183.7-KE Pipe Tunnel. Each side was 290-ft long and 130-ft wide, and contained 17 ft of water under normal operations. The total water-holding capacity of the flocculation and sedimentation basins was 28,200,000 gal., and the total area was 288,000 ft^2 (DOE/RL-2004-43).

183.7-KE Pipe Tunnel: The 183.7-KE Pipe Tunnel contained the raw water piping (to the 183.1-KE Head House), chemical treatment system piping, and drainage sewer piping. The tunnel extended from the 183.1-KE Head House, through the center of the 183.2-KE Flocculation and Sedimentation Basins, 183.3-KE Sand Filter Basin, 183.4-KE Clearwells, 190-KE Main Pump House, and the 165-KE Power Control Building, providing cooling water to the 105-KE Reactor. The tunnel portion subject to removal as described in this report extended from the 183.1-KE Head House to the south side of the 190-KE Pump House. Removal of the remaining portions of the tunnel will be described in other removal action reports. The tunnel contained two 60-in. raw water lines, a 30-in. sewer line, various process chemical lines, and an elevated walkway. The floor of the tunnel was composed of 18-in.-thick reinforced concrete.

Figure 2-1 shows a photograph of the 183.2-KE Facility during operations; the 183.3-KE Sand Filter Basins are at the north end of the Sedimentation Basins, south of the Clearwells. Figure 2-2 shows a pre-demolition photograph of the 183.7-KE Pipe Tunnel, passing through the center of the 183.2KE basins, the 183.4KE clearwell, and into the 190-KE Pumphouse at the right side of the photograph. Although the roof of the pipe tunnel was at a constant elevation throughout the length of the sedimentation basins, and at a lower elevation through the clearwells, the floor of the tunnel sloped downward to the North , dropping from an elevation of 466'10" at the 183.1-KE Head House to 450' where it enters the 190-KE Pump House.

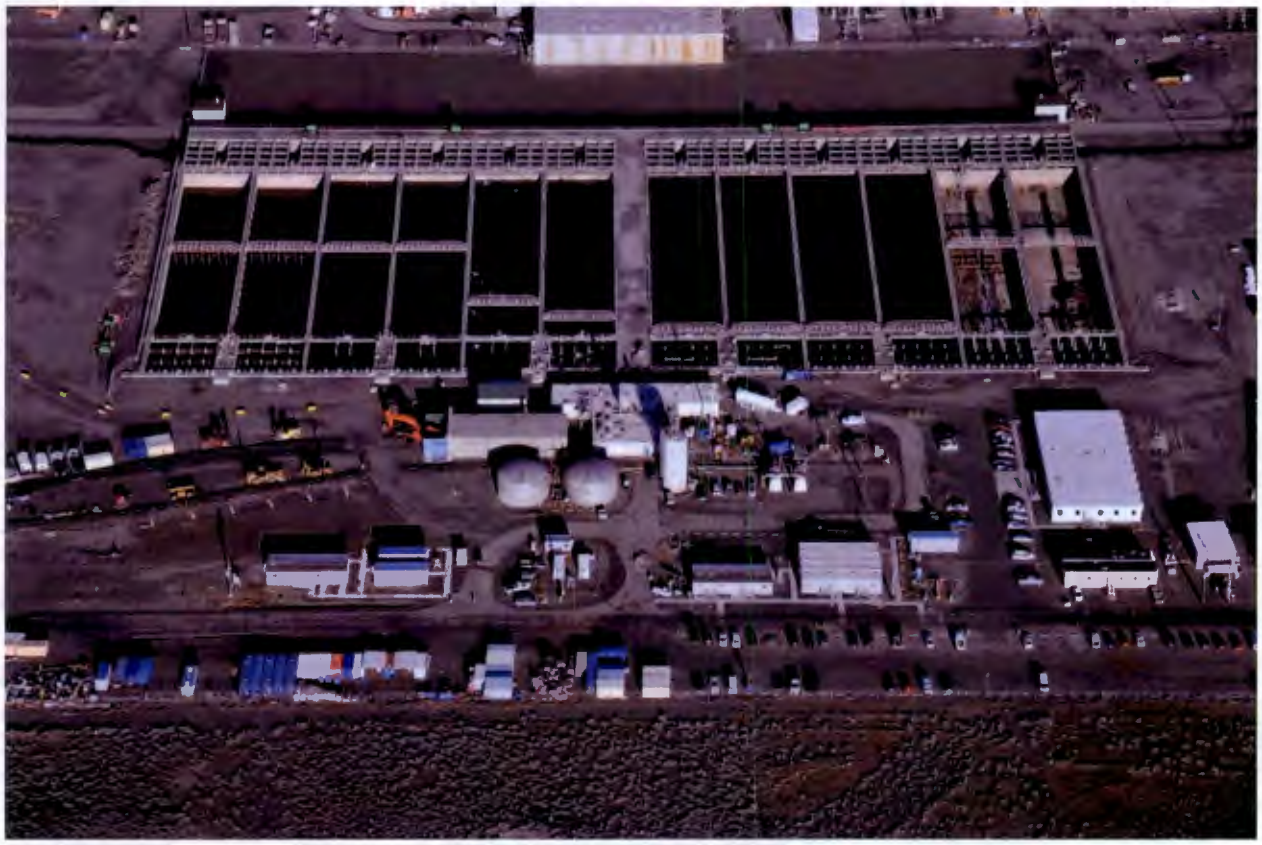

Figure 2-1. Pre-Demolition Aerial Photograph looking north of the 183.2-KE Sedimentation Basins

Figure 2-2. Pre-Demolition Photograph looking west of the 183.7-KE Pipe Tunnel

2.2 Contaminant Identification

The Action Memorandum (EPA, 2007) identified chemical and unquantified hazardous construction materials (UHCM), as contaminants for both the 183.2-KE and 183.7-KE Facilities. Based on process knowledge, a review of the facilities' operational histories, and pre-demolition planning activities, the contaminants of concern (COCs) listed in Table 2-1 were evaluated in the concrete and underlying soil. Lead, mercury, and asbestos were established as UHCM. The UHCM consisted of items such as lead

bricks and piping, paint and coatings, incandescent light bulbs, and asbestos-containing material (ACM). Mercury also was potentially present as a contaminant based on its presence in the sulfuric acid used for treating the water at the Head House (183.1-KE). Hexavalent chromium, as well as chloride and sulfate ions were included as COCs, as they were constituents in the chemical treatment of the reactor cooling water. Antimony, cadmium, total chromium, copper, manganese, vanadium and zinc were also included, as these constituents were detected during the analogous sampling of the 183.2-KW and 183.7-KW Facilities.

Based on the Action Memorandum (EPA, 2007), the facilities were not considered to be radiologically contaminated.

Table 2-1. Contaminants of Concern for the 183.2KE & 183.7KE Facilities

Metals		
Antimony	Cadmium	Chromium (VI)
Chromium (total)	Copper	Lead
Manganese	Mercury	Vanadium
Zinc	PCBs (for soil only)	
Anions		
Chloride	Sulfate	

2.3 Description of the Removal Action

The purpose of this removal action was to mitigate the potential to release contaminants from the 100-K Area ancillary facilities to the environment, and to be consistent with remedial actions for the 100-KR-1 and 100-KR-2 OUs. The Action Memorandum (EPA, 2007) and the RAWP (DOE/RL-2005-26, Rev.1) specify D&D for the 183.2-KE and 183.7-KE Facilities.

2.3.1 Removal Action Objectives

The following removal action objectives (RAOs) were established in the approved RAWP (DOE/RL-2005-26, Rev.1):

- Protect human receptors from exposure to contaminants above acceptable exposure levels within facility structures
- Control the migration of contaminants from the facilities into the environment
- Facilitate, and to the extent practicable, be consistent with anticipated remedial actions within the 100-K Area OUs
- Prevent adverse impacts to cultural resources and nesting migratory birds
- Achieve applicable or relevant and appropriate requirements (ARARs) to the fullest extent practicable
- Safely treat, as appropriate, and dispose of waste streams generated by the removal action

- Take no action that will preclude the eventual final disposition of the 105-KE and 105-KW Reactor blocks

The completion criteria by which the RAOs were achieved for this removal action are documented in Section 5.

2.3.2 Exposure and Land-Use Assumptions

Cleanup activities at the 100-K Area are conducted to achieve compliance with a rural-residential exposure scenario, as stipulated in the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (100 Area Remaining Sites Record of Decision [ROD]; EPA/ROD/R10-99/039).

2.3.3 Design Summary

The removal action was conducted following the provisions in the RAWP (DOE/RL-2005-26, Rev.1). Pre-demolition planning activities performed for the 183.2-KE and 183.7-KE Facilities consisted of walkdowns to identify utility interfaces (i.e., electrical, water, sewer, etc.) and characterization activities to identify UHCM requiring disposition prior to or during demolition.

The removal action called for the following activities

- Isolation of electrical circuits and mechanical piping
- Removal and disposal of UHCM (e.g., light ballasts, gasket material)
- Use of standard demolition techniques (excavator with a hoe-ram, hydraulic shear with steel shear jaws, concrete pulverizer jaws or breaker jaws, etc.)
- Removal, segregation and disposal of metal components of the treatment system, such as mixing systems, sludge collection and removal equipment, and piping, prior to demolition of concrete structures.

Waste characterization and demolition waste load-out activities were planned in accordance with the waste management ARARs identified in the Action Memorandum (EPA, 2007), the RAWP (DOE/RL-2005-26), and the ERDF waste acceptance criteria.

Activities planned for the 183.2-KE Flocculation and Sedimentation Basins, as well as the 183.7-KE Pipe Tunnel are described below:

2.4 ROD Amendments, Significant Differences, or Waivers

No ROD amendments, significant differences, or waivers apply to this removal action.

3 Removal Action Summary

3.1 Summary of Activities

The D&D activities for these 183-KE Water Treatment Plant facilities began in April 2011 and were completed in August 2012.

183.2-KE Flocculation and Sedimentation Basins

Initially, part the eastern and western walls of the facility were removed to floor level to allow access by D&D equipment and personnel to the interior of the flocculation and sedimentation basins, the pipe tunnel, and the sand filter basins.

Figure 3-1 shows the area of the 183.2-KE and 183.7-KE facilities at the start of demolition, following ramp construction at the north wall and the initiation of demolition in the sand filter basins. Figure 3-2 shows an aerial photograph of the 183.2-KE and 183.7-KE Facilities post-demolition, pending removal of demolition debris.

183.2-KE Flocculation and Sedimentation Basins

D&D activities were performed according to the design with no major deviations. The water mixing equipment in the flocculation basins and the track-mounted system in the sedimentation basins that was used to sweep settled solids into sumps for discharge to the sewer system were removed and size-reduced for disposal.

The internal walls and columns of the 183.2-KE Facility, which defined the individual basins, were removed, rubbleized, and set aside for use as backfill at the completion of demolition. The south, east, and west walls were removed to three feet below grade, and the floor left in place. After sampling and analysis of the standing water in the basins, the floor was potholed to allow residual water to drain, and to also prevent pooling of water after the structure is backfilled. Based on sampling results of the concrete floor (as described in Section 3.3), the concrete demolition debris from the 183.2-KE Basins was rubbleized

A total of approximately 1,507 tons of D&D waste, comprised primarily of the metal components from water mixing and sludge handling systems was sent to the ERDF for disposal.

183.7-KE Pipe Tunnel

Demolition of the pipe tunnel that passed through the 183.4-KE clearwells began before the demolition of the 183.2KE sedimentation basins.

The section of the 183.7-KE pipe tunnel that ran through the 183.4-KE clearwell was demolished as part of the 183.4-KE D&D activities. The pipe tunnel within the sedimentation basins was left largely intact until completion of demolition in the sedimentation basins. Piping and other metal components was segregated for disposal, and the concrete was rubbleized for use as backfill. Demolition work included removal of nonfriable asbestos-containing material (ACM) (transite) prior to demolition of the tunnel. The roof of the tunnel was removed and the internal equipment and piping extracted for disposal to ERDF. A total of approximately 1,004 tons of D&D waste from the 183.7-KE facility was sent to the ERDF.

Figure 3-1. Aerial Photograph looking south of the 183.2-KE and 183.7-KE Facilities During Demolition

Figure 3-2. Aerial Photograph looking south of the 183.2-KE and 183.7-KE Facilities Post-Demolition (July 2012)

3.2 Verification Activities

The RAWP (DOE/RL-2005-26) requires verification sampling of subsurface soils if it is believed that impacts may have occurred from prior facility operations or from the D&D activities. The operations at the 183.2-KE and 183.7-KE facilities involved treatment of raw water for use as cooling water in the 105-KE reactor. Several considerations affected the decision to conduct verification sampling:

- The sulfuric acid that was combined with bauxite to create alum was contaminated with mercury and other metals. Therefore, the 183-KE water treatment plant systems and structures that were in contact with the sulfuric acid and alum systems had the potential for chemical contamination.
- The 183.2-KE and 183.7-KE facilities treated and stored Columbia River water prior to use as cooling water for the 105-KE reactor. Therefore, radiological constituents are not considered contaminants of concern (COCs).
- EPA requested that soil samples be analyzed for polychlorinated biphenyls (PCBs).

The sampling and analysis of the concrete floors and the underlying soil of the 183.2 Sedimentation Basins and 183.7-KE Pipe Tunnel were conducted in accordance with requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22). Additionally, samples were collected in accordance with the *In-Process Sampling Instructions for the Substructures of the 183-KE Water Treatment Plant: 183.2-KE Flocculation and Sedimentation Basins, 183.3-KE Sand Filter Basin, and 183.7- KE Pipe Tunnel* (DD-49880) with one exception; analysis for radiological constituents (gross alpha/beta) was removed. As agreed to with EPA at the March 2012 Project Manager Meeting, the COCs for this sampling activity were limited to those identified in the Action Memorandum. In addition, soil samples were analyzed for PCBs as requested by EPA. The revised list of COCs is documented in Section 2.2. The soil and concrete sampling activity was conducted to confirm that no residual contamination remains that would require additional response action.

Within the 183.2KE Sedimentation basins a gasket material was placed in the construction joints and walls. During a walkdown in June 2012 with DOE-RL and EPA a sample of this material was requested. The sample was analyzed by the toxicity characteristic leaching procedure (TCLP) an extraction method for chemical analysis that simulates the leachability out of a media. The analytical results showed that the chemical constituents were bound into the gasket material and would not leach. Given the results the gasket material does not pose a risk to the environment and can remain in place.

The verification sampling for the 183.2-KE and 183.7-KE Facilities met the requirements of DOE/RL-2005-26 to evaluate potential impacts from these facilities. The analytical data for both the soils and the concrete was evaluated separately against the remedial action goals (RAGs) identified in the 100 Area Remaining Sites ROD and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17). Results are discussed in section 5.1.2.

3.2.1 Radiological Surveys

The 183.2KE and 183.7KE facilities presented no risk of radiological contamination as both facilities stored or transported treated water before use in the 105-KE Reactor and were not exposed to a radiological source.

3.2.2 Sampling and Analysis

Concrete samples were planned for collection at the 183.2-KE Flocculation and Sedimentation Basins and the 183.7-KE Pipe Tunnel in accordance with the sample instruction (DD-49880). The sampling approach for the flocculation and sedimentation basins assumed that the water in the basins was

homogeneous during operations. In addition, soils from beneath the structures were sampled at depths from one to ten feet below the concrete. The sampling in the field deviated from the plan following agreement with EPA to modify the contaminants of concern for this sampling activity.

Six concrete samples were collected from the floor of the 183.7-KE pipe tunnel (Figure 3-3) in November 2011. Concrete samples were collected from 12 locations on the floor of the 183.2-KE flocculation and sedimentation basins (Figure 3-4) in March 2012 and June 2012. Concrete samples were collected by scabbling the surface of the concrete floor with a waffle bit attached to a rotary hammer. Additionally, in accordance with the SAP, duplicates, splits and equipment blanks were collected for 5% of the concrete samples. Samples were analyzed for the COCs listed in Table 2-1.

Four soil samples were collected from beneath the 183.7 pipe tunnel in November 2011 (Figure 3-3). Samples collected from locations 1-3 were collected through a core drilled approximately 1.5ft through the concrete floor tunnel. The concrete in sample location 4 was too thick to drill a core through, this section of the floor was potholed approximately 5ft down in order to collect a soil sample. Thirty-two soil samples were collected at various depths from twelve potholes through the floor of the 183.2-KE flocculation and sedimentation basins in May and June of 2012 (Figure 3-5). Soil samples from the potholes were collected from either 2 or 3 depths in each pothole. The first sample in each pothole was collected at the first indication of native soil and ranged 1-2 feet below the floor surface; the second sample was collected 5 feet below the first sample; the third sample, if applicable, was collected 5 feet below the second sample. Three samples were collected at pothole locations 1-8, while two samples were collected at pothole locations 9-12. Additionally, in accordance with the SAP duplicates, splits and equipment blanks were collected for 5% of the soil samples.

Soil samples were collected from the soils beneath seams in the concrete, near sumps, and in the vicinity of the sub-slab drainage system. Soil samples were collected from immediately below the concrete, as well as from depths of 5 feet and 10 feet below the slab.

The verification sampling for the 183.2-KE and 183.7-KE Facilities met the requirements of DOE/RL-2005-26 to evaluate potential impacts from these facilities. Complete sample results are included in Appendix A. Section 5.1.2 presents an analysis of these results.

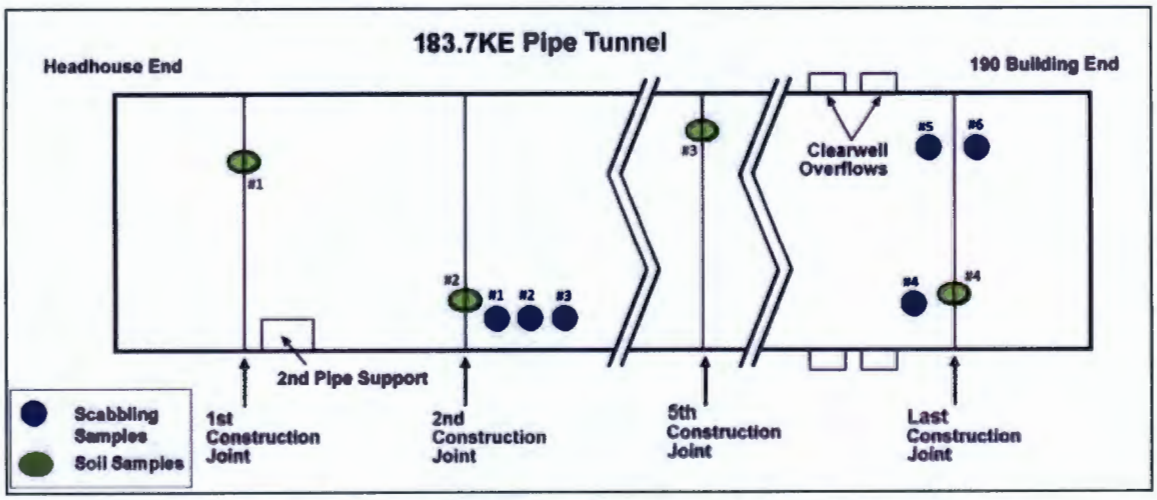

Figure 3-3. Concrete and soil sample locations within the 183.7-KE Facility

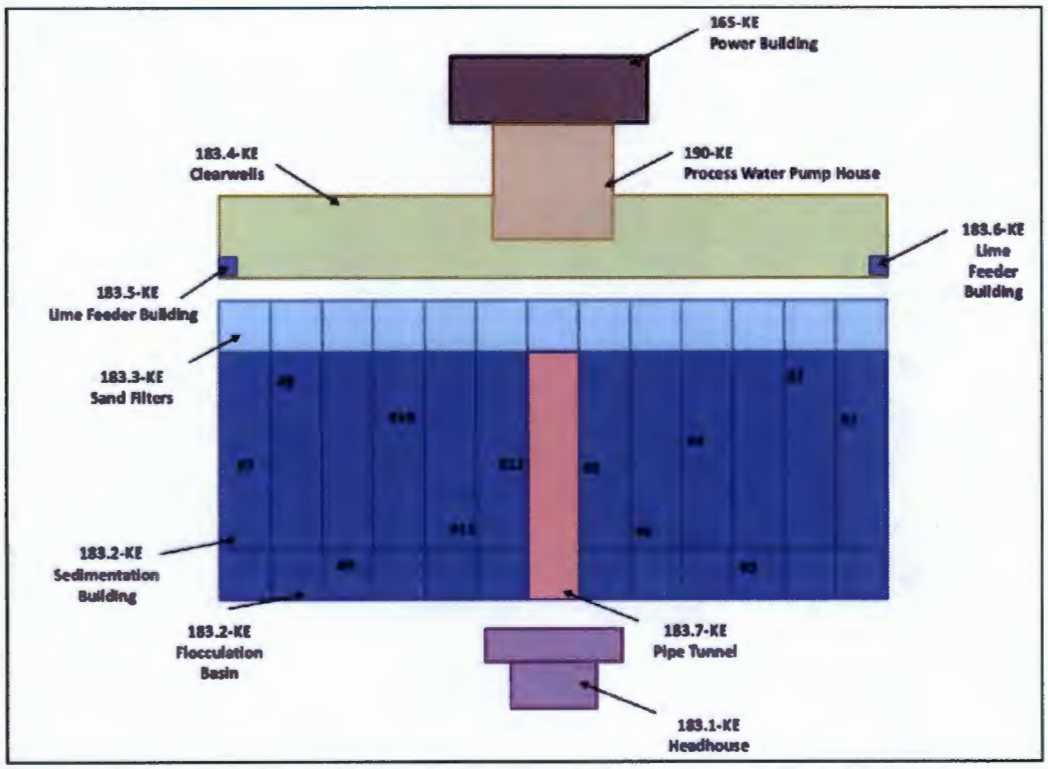

Figure 3-4. Concrete sample locations within the 183.2-KE Facility

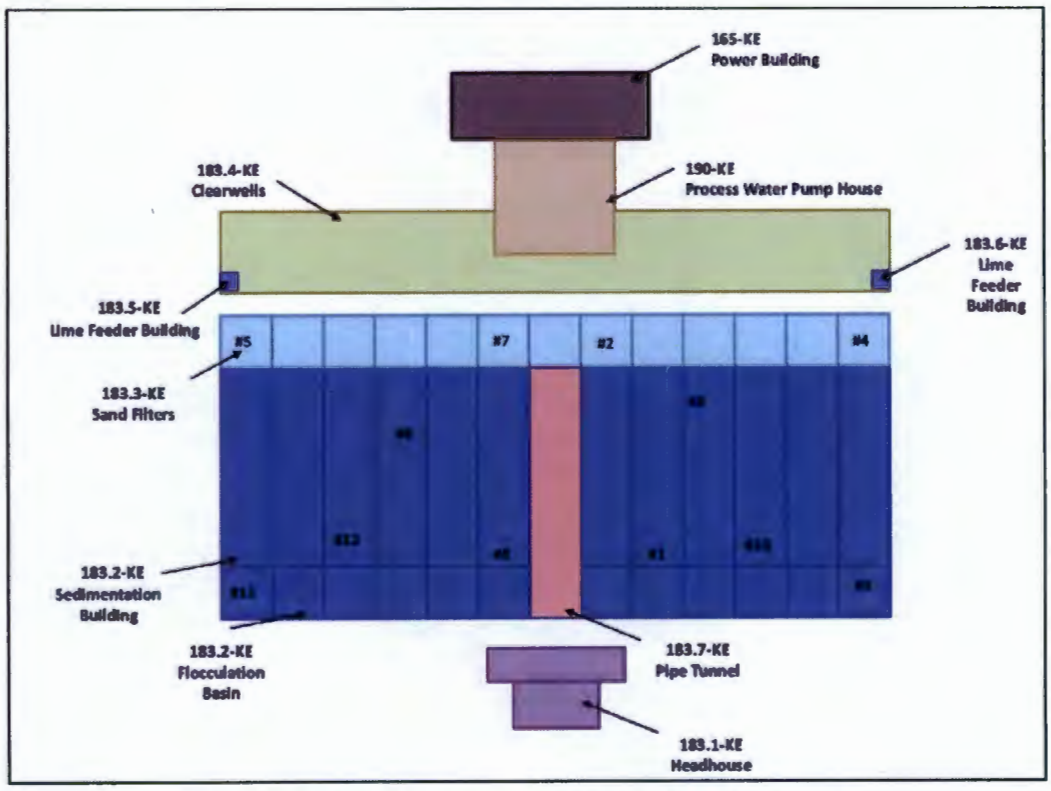

Figure 3-5. Pothole locations within the 183.2-KE Facility

4 Chronology of Events

Table 4-1 presents the chronology of D&D activities associated with the 183.2-KE and 183.7-KE Facilities.

Table 4-1. Chronology of D&D Activities for the 183.2-KE and 183.7-KE Facilities

Date	Event
1955	The 183.2-KE and 183.7-KE Facilities began operation.
1971	Operation of the 183.2-KE and 183.7-KE Facilities ended.
	Demolition of 183.2-KE Flocculation and Sedimentation Basins
April 2011	Access ramp punched in through east and west walls
May 2011	Demolition of the basins begins
March – June 2012	Collect concrete samples
May – June 2012	Collect soil samples
August 2012	Demolition activities complete
September 2012	D&D Waste load out complete
	Demolition of 183.7-KE Pipe Tunnel
	Asbestos abatement activities began
July 2011	Demolition of the Pipe Tunnel begins (Clearwells section)
November 2011	Collect soil and concrete samples
July 2012	Demolition of the Pipe Tunnel begins (Basins section)
August 2012	Demolition activities completed
September 2012	D&D Waste load out complete

5 Performance Standards and Quality Control

5.1 Attainment of Performance Standards

5.1.1 Performance Completion Criteria

The following performance criteria are defined in the RAWP (DOE/RL-2005-26):

> *The Above-Grade* (as a general rule, "grade" is the top of the main foundation) *portion of the demolition is considered complete when the above-grade portions of the building(s) are removed to grade* or *slab on grade. Also, all waste generated during deactivation and demolition must be dispositioned.*

> *The Below-Grade structures portion of the demolition is considered complete after all waste debris has been removed to a minimum of 0.9 meter (3 feet) below the surrounding grade, and the remaining portion will either be removed or left in place, depending on whether cleanup standards can be achieved. ...The decision to leave below-grade structures shall be made on a case-by-case basis and requires the concurrence of the EPA. At completion of the removal action, sites will be stabilized in a manner that allows for future remediation or closed in accordance with the soil cleanup values established in the appropriate ROD.*

Table 5-1 presents the completion criteria developed from the approved RAWP and a summary of the actions taken.

Table 5-1. Completion Criteria for the 183.2-KE and 183.7-KE Facilities

Phase of the Demolition Activities	Completion Criteria*	Criteria Complete?	Description of How the Completion Criteria were Addressed
Above-Grade Structures	Remove interior portions of the building, including ACM, lead bricks, sheeting, PCBs (primarily in motor oils and light ballasts); mercury (primarily in light components and switches); and other hazardous materials for treatment, recycle, or disposal.	Yes	The 183.2-KE Facility was a large below-grade, open-top structure used for water treatment and settling of solids. Interior walls and water mixing/sludge handling components were removed during demolition.
		Yes	Interior portions of the 183.7-KE Facility, including UHCM, were removed, as needed, prior to demolition. The tunnel roof and sidewalls were demolished to slab-on-grade. All substances removed were characterized and disposed in accordance with waste management ARARs and waste disposal facility acceptance criteria.

Table 5-1. Completion Criteria for the 183.2-KE and 183.7-KE Facilities

Phase of the Demolition Activities	Completion Criteria*	Criteria Complete?	Description of How the Completion Criteria were Addressed
	Above-grade portions of the facility will be removed or demolished to grade using standard demolition techniques (e.g., excavator with a hoe-ram, hydraulic shear with steal shear jaws, concrete pulverizer jaws or breaker jaws, crane with wrecking ball, and/or controlled explosives).	Yes	The 183.2-KE and the 183.7-KE Facilities were below-grade structures. The tops of the walls for the 183.2 structure and the roof deck of the 183.7 Tunnel extended slightly above grade level. The roof deck was removed using standard demolition techniques. Side walls for the facilities were demolished to 3 feet below grade.
Below-Grade Structures	Below-grade structures, if present, will be removed to a minimum of 3 ft below surrounding grade, and the remaining portion will either be removed or left in place, depending on whether cleanup standards can be achieved.	Yes (as described)	183.2 Sedementation Basin - The north, east and west walls of the 183.2-KE Basins were removed to 3 ft below grade. The south wall of the 183.2-KE Basins was left in-place to stabilize the adjacent waste site (100-K-101). The south wall will be removed to a minimum of 3 ft below grade during remediation of waste site, scheduled for completion as part of M-016-143. 183.7 Tunnel - The 183.7-KE tunnel was located within the 183.2-KE basins and 183.4-KE clearwells; sidewalls of the tunnel were demolished along with the interior walls of those structures. Concrete and soil sample results demonstrate that the sedimentation basin and tunnel floors can be left in place.

Table 5-1. Completion Criteria for the 183.2-KE and 183.7-KE Facilities

Phase of the Demolition Activities	Completion Criteria*	Criteria Complete?	Description of How the Completion Criteria were Addressed
	Remediate contaminated soils within the footprint of the facilities or defer to a later remedial action (with approval from EPA).	Yes	183.2 Sedimentation Basin - Soil sampling conducted beneath the 183.2-KE Basins showed no COC concentrations above RAGs. In addition, all COCs were below background concentrations, based on 95% UCL calculations, therefore the HQ and excess risk values are not calculated. The 95% UCL for Aroclor 1254, is above the RAGs for protection of groundwater and the Columbia River but has a large enough K_d to be protective. 183.7 Tunnel - The soil beneath the183.7 pipe tunnel floor will be in the deep zone following backfill; therefore the data was not evaluated for direct exposure. The maximum detected values for cadmium, copper, lead, vanadium and zinc are above the RAGs for groundwater and/or river protection. Each of the COCs that exceed RAGs has a soil partitioning (Kd) value that is protective of groundwater. Therefore, the underlying soils can remain in place.
	Upon completion of demolition activities, a minimum of 3 ft of clean fill/soil cover will be placed over any remaining below-grade structure and inert material, and the fill will be graded to match the surrounding terrain.	No	The demolition area for the 183.2-KE and 183.7-KE facilities has not yet been graded to match surrounding terrain due to ongoing D&D activities in the area. The backfilling and grading of the entire area will be coordinated with ongoing D&D activities and the remaining 100-K soil waste site remedial actions.
Waste Management	Conduct waste characterization prior to and during D&D activities in accordance with the data quality objectives process identified in the *100-K Area Interim Safe Storage and D4 Project Waste Sampling and Analysis Plan* (DOE/RL-2005-33). Characterization is conducted to support waste disposal activities, define contaminants present before or after the completion of the removal action, and in some cases, support site closure documentation.	Yes	Waste characterization was performed in accordance with DOE/RL-2005-33 during D&D activities to guide waste removal and disposal. Based on process knowledge, a review of operational history, and pre-demolition planning activities, UHCM present within the 183.2-KE and 183.7-KE Facilities was identified and characterized prior to D&D.

Table 5-1. Completion Criteria for the 183.2-KE and 183.7-KE Facilities

Phase of the Demolition Activities	Completion Criteria*	Criteria Complete?	Description of How the Completion Criteria were Addressed
	Manage and dispose of all waste (including general demolition debris, ACM, lead bricks, sheeting, PCBs, mercury, and other hazardous materials) generated during the removal actions. Waste generated will be characterized in accordance with the contractor's procedures, the requirements of the receiving facility, and the waste characterization sampling and analysis plan.	Yes	All wastes generated during D&D were characterized in accordance with waste management ARARs and the ERDF waste acceptance criteria. The D&D waste from the 183.7-KE Facility was sent to the ERDF for disposal.
Verification	After the removal activities are completed, the site will be characterized to document the condition following the removal of the facility and/or structure.	Yes	Concrete analyses indicate the presence of some COCs above the direct exposure criteria for soils. Because the COCs are solidified within the concrete, there is no pathway for exposure. Much of the concrete with elevated COCs also will be under 15 feet or more of fill. Sampling of soils beneath the floor of the 183.2-KE Basins and 183.7-KE Tunnel was conducted. The results indicated that the contamination levels in the soils are protective of human health and the environment.
Documentation	DOE-RL will provide documentation describing the environmental conditions at the end of the D&D activity.	Yes	The post-D&D environmental conditions for the 183.2-KE and 183.7-KE Facilities are presented in this report.

* Completion criteria were derived from the removal action requirements of DOE/RL-2005-26, *Removal Action Work Plan for 105-KE/105-KW Reactor Facilities and Ancillary Facilities.*

5.1.2 Removal Action Objectives Verification

Removal of the 183.2-KE and 183.7-KE Facilities achieved the following RAOs identified in Section 2.3.1:

- *Protect human receptors from exposure to contaminants above acceptable exposure levels within facility structures*

The physical removal and appropriate disposal of the 183.2-KE and 183.7-KE Facilities eliminated the potential for human exposure to hazardous substances above acceptable levels within the facility structures.

- *Control the migration of contaminants from the facilities into the environment*

Pre-demolition planning and waste characterization activities identified the presence of nonradiological contaminants (i.e., UHCM) within 183.2-KE and 183.7-KE Facilities. During D&D activities, the physical removal and appropriate management and disposal of the 183.2-KE and 183.7-KE Facilities reduced the potential for release of contaminants into the environment.

- *Facilitate and, to the extent practicable, be consistent with anticipated remedial actions within the 100-K Area OUs*

The physical removal and appropriate management and disposal of the 183.2-KE and 183.7-KE Facilities are consistent with the selected remedy of Remove/Treat/Dispose from the 100 Area Remaining Sites ROD (EPA/ROD/R10-99/039).

- *Prevent adverse impacts to cultural resources and nesting migratory birds*

A cultural resources review (HCRC#2003-100-021) conducted in 2003 for various demolition and disposition activities, encompassing the183.2-KE and 183.7-KE Facilities, found no known archaeological sites located on the ground surface within this area. The cultural resources review indicated that the 183-KEfacilities were contributing to the historic district and recommended a photographic record be developed. Completion of the record eliminated any adverse impact to cultural resources.

A blanket biological review was completed in April 2009, which covered all routine maintenance and operations activities within the fenced boundary of the 100-K Area (0901161, "Blanket Biological Review for the 100-K Area, ECR #2009-100-019"). All areas and structures associated with the 183.2-KE and 183.7-KE Facilities were inspected prior to demolition to ensure that no birds were active on or around the building prior to demolition. Demolition activities were postponed until no migratory birds or nests were observed at the 183.2-KE and 183.7-KE Facilities. Therefore, the removal action activities at these facilities did not have an adverse impact to migratory birds.

- *Achieve ARARs to the fullest extent practicable*

The ARARs presented in the Action Memorandum (EPA, 2007) and RAWP (DOE/RL-2005-26, Rev.1) included waste management standards, air emission control standards, protection of cultural and natural resources, and worker safety and health standards. This removal action was completed in accordance with these ARARs.

- *Safely treat, as appropriate, and dispose of waste streams generated by the removal action*

Waste streams generated by this removal action were managed in accordance with the ARARs and treated, as appropriate, to meet the ERDF waste acceptance criteria for disposal. This removal action included the safe physical removal and disposal of the interior and exterior walls and equipment from the 183.2-KE and 183.7-KE Facility to the ERDF. The remaining concrete portions of the 183.2-KE Basins were rubbleized and reserved as recycle backfill for selected, approved Hanford Site facilities.

- *Take no action that will preclude the eventual final disposition of the 105-KE and 105-KW Reactor blocks*

Completion of this removal action provided better access for the remediation of waste sites near the 105-KE Reactor, and does not preclude the eventual disposition of the 105-KE or 105-KW Reactor blocks.

5.1.2.1 183.2 KE Sedimentation Basin Data Evaluation

This section provides an evaluation of the 183.2-KE Sedimentation Basin sampling data for the COCs identified in Table 2-1. The sedimentation basin floor and underlying soils were sampled to determine if

they could be left in place and be protective of human health and the environment. Samples were collected randomly from both sides of the basin as described in Section 3.2. The results were evaluated based on the 95% UCL concentrations listed in Tables 5-1 And 5-2.

For the underlying soils, the 95% UCL for each COC was below the direct exposure RAG and below the Hanford background concentrations for all COCs. The 95% UCL for Aroclor – 1254, a PCB compound, is above the RAGs for protection of groundwater and the Columbia River.

The Analogous Sites Residual Radioactivity (RESRAD) Model from the RDR/RAWP for the 100 Area (DOE/RL-96-17, Appendix C), predicts whether or not contaminants in 100 Area soils will migrate to groundwater within a 1,000-year time frame based on the K_d value and the vertical distance to groundwater.

The top of the concrete floor of 183.2 KE is at an elevation of 144.17 m (473ft) and the depth to groundwater is 24.17 m (79.3 ft). At this depth to groundwater, the RESRAD model predicts constituents present in the soil with a K_d value of 3.1 mL/g or greater will not reach groundwater within 1,000 years. Since the K_d value for Aroclor 1254 is 75.6 mL/g, this contaminant will not reach groundwater within 1,000 years. The residual concentration of Aroclor 1254 is protective of groundwater and the Columbia River.

The residual concentration of all COC in the soils are protective of all exposure scenarios and can remain in place.

Table 5-2. 183.2 KE Sedimentation Basin Soil Sample Results

Contaminant of Concern	Back-ground (mg/kg)	Soil Kd value (mL/g)	Soil Cleanup Levels (mg/kg)[a]			95% UCL (mg/kg)	Exceeds Soil RAGs?
			Direct Exposure	Ground-water Protection	River Protection		
PCBs							
Aroclor - 1016	NA	107	0.5	0.017	0.017	U	No
Aroclor – 1221	NA	10.3	0.5	0.017	0.017	U	No
Aroclor – 1232	NA	10.3	0.5	0.017	0.017	U	No
Aroclor – 1242	NA	44.8	0.5	0.017	0.017	U	No
Aroclor – 1248	NA	43.9	0.5	0.017	0.017	U	No
Aroclor – 1254	NA	75.6	0.5	0.017	0.017	U	No
Aroclor – 1260	NA	822	0.5	0.017	0.017	U	No
Metals							
Antimony	5	3.76	32	5[c]	5[c]	0.37	No
Cadmium	0.81[d]	30	13.9[e]	0.81[c]	0.81[c]	0.06	No
Chromium, Total	18.5	200	80,000	18.5[c]	18.5[c]	3.23	No
Chromium VI	--[b]	0	2.1[c]	4.8	2	0.12[a]	No
Copper	22.0	22	2,960	59.2	22.0[c]	14.74	No
Lead	10.2	30	353	10.2[c]	10.2[c]	3.08	No
Manganese	512	50	3,760	512[c]	512[c]	288	No
Mercury	0.33	30	24	0.33[c]	0.33[c]	0.03[a]	No
Vanadium	85.1	1000	560	85.1[c]	--	51.3	No
Zinc	67.8	30	24,000	480	67.8[c]	40.03	No

Table 5-2. 183.2 KE Sedimentation Basin Soil Sample Results

Contaminant of Concern	Back-ground (mg/kg)	Soil Kd value (mL/g)	Soil Cleanup Levels (mg/kg)[a]			95% UCL (mg/kg)	Exceeds Soil RAGs?
			Direct Exposure	Ground-water Protection	River Protection		
Chloride	100	0	--	25,000	--	20.32	No
Sulfate	237	0	--	25,000	--	29.88	No

[a] RAGs obtained from the RDR/RAWP for the 100 Area (DOE/RL-96-17).

[b] No Hanford Site specific or Washington State background value available.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (Ecology 1996). The arsenic level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in the RDR/RAWP for the 100 Area (DOE/RL-96-17), Section 2.1.2.1.

[d] Hanford Site-specific background not available. Value is from Ecology (1994).

[e] Maximum soil concentration was used where there was not sufficient data to calculate a 95%UCL.

U – Analyzed for but not detected above limiting criteria

For the concrete floor, the 95% UCL result calculated for each COC was below the direct exposure RAG. It is noted that arsenic was detected at levels above the RAGs. However, arsenic was not a COC for the water treatment facilities and its presence is believed to be a result of the use of Hanford soils and fly ash in the original concrete mixture.

The Analogous Sites RESRAD Model from the RDR/RAWP for the 100 Area (DOE/RL-96-17, Appendix C), predicts whether or not contaminants in 100 Area soils will migrate to groundwater within a 1,000-year time frame based on the K_d value and the vertical distance to groundwater. The 95% UCL result calculated for antimony, copper, lead, mercury and zinc in the concrete are above the soil RAGs calculated to be protective of groundwater and the Columbia river.

The top of the concrete floor of 183.2 KE is at an elevation of 144.17 m (473ft) and the depth to groundwater is 24.17 m (79.3 ft). The soil beneath the concrete floor is below all RAGs, therefore the entire depth to groundwater is shown to be uncontaminated. As discussed previously, the RESRAD model predicts constituents present in the soil with a K_d value of 3.1 mL/g or greater will not reach groundwater within 1,000 years. Since the K_d values for antimony, copper, lead, mercury and zinc are all above 3.1 mL/g (3.76 mL/g, 22 mL/g, 30 mL/g, 30 mL/g and 30 mL/g, respectively), the model predicts that if these contaminants were in the soil they will not reach groundwater within 1,000 years. The contaminants, however are not in soil, but in the concrete floor where the K_d values are at least an order of magnitude greater for each of these constituents. Therefore, residual concentrations of antimony, copper, lead, mercury and zinc in the concrete are protective of groundwater and the Columbia River.

Table 5-3 183.2 KE Sedimentation Basin Concrete Sample Results

Contaminant of Concern	Soil Back-ground (mg/kg)	Soil Kd value (mL/g)	Soil Cleanup Levels (mg/kg)[a]			95% UCL in Concrete (mg/kg)	Exceeds Soil RAGs?
			Direct Exposure	Ground-water Protection	River Protection		
Antimony	5	**3.76**	32	**5**[c]	**5**[c]	**22.18**	Yes
Cadmium	0.81[g]	30	13.9[e]	0.81[c]	0.81[c]	0.24	No
Chromium, Total	18.5	200	80,000	18.5[c]	18.5[c]	14.4	No
Chromium VI	--[f]	0	2.1[c]	4.8	2	0.19[a]	No
Copper	22.0	**22**	2,960	59.2	**22.0**[c]	**33.99**	Yes
Lead	10.2	**30**	353	**10.2**[c]	**10.2**[c]	**24.46**	Yes
Manganese	512	50	3,760	512[c]	512[c]	338.61	No
Mercury	0.33	**30**	24	**0.33**[c]	**0.33**[c]	**0.48**	Yes
Vanadium	85.1	1000	560	85.1[c]	--	53.65	No
Zinc	67.8	**30**	24,000	480	67.8[c]	**106.03**	Yes
Chloride	100	0	--	25,000	--	2.66	No
Sulfate	237	0	--	25,000	--	322.30	No

[a] RAGs obtained from the RDR/RAWP for the 100 Area (DOE/RL-96-17).

[b] No Hanford Site specific or Washington State background value available.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (Ecology 1996). The arsenic level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in the RDR/RAWP for the 100 Area (DOE/RL-96-17), Section 2.1.2.1.

[d] Hanford Site-specific background not available. Value is from Ecology (1994).

[e] Maximum soil concentration was used where there was not sufficient data to calculate a 95%UCL.

5.1.2.2 183.7 KE Pipe Tunnel Data Evaluation

This section provides an evaluation of the 183.7 KE pipe tunnel sampling data for the COCs identified in Table 2-1. The pipe tunnel floor and underlying soils were sampled to determine if they could be left in place and be protective of human health and the environment. Discrete samples were collected as described in Section 3.2. The results were evaluated based on the maximum concentrations listed in Tables 5-3 and 5-4 rather than the 95% UCL because the data set consisted of focused samples only.

The floor of the pipe tunnel will be below 15' after final backfill and contouring, therefore the data was not evaluated for compliance with direct exposure RAGs.

For the underlying soils, the maximum detected (Table 5-3) values for cadmium, copper, lead, vanadium and zinc are above the soil concentrations that are protective of groundwater and the Columbia river.

At its deepest location, the top of the concrete floor of 183.7 KE is at an elevation of 139.06 m (456.22 ft) with a thickness of approximately 0.56 m (1.5 ft). The groundwater elevation in this area is 120 m (393.70 ft), therefore the depth to groundwater of the underlying soil is 18.5 m (60.69 ft). Analogous site RESRAD modeling, discussed in Appendix C of the RDR/RAWP for the 100 Area (DOE/RL-96-17) predicts constituents with a soil-partitioning coefficient (K_d value) of 4.9 mL/g or greater will not reach groundwater within 1,000 years. Since the K_d values for cadmium, copper, lead, vanadium and zinc are far above 4.9 mL/g (30 mL/g, 22 mL/g, 30 mL/g, 1,000 m/g and 30 mL/g, respectively), the model predicts that these contaminants will not reach groundwater within 1,000 years. Therefore the soils can remain in place.

Table 5-4 183.7 Pipe Tunnel Soil Sample Results

Contaminant of Concern	Back-ground (mg/kg)	Soil Kd value (mL/g)	Soil Cleanup Levels (mg/kg)[a]			Max Soil Result (mg/kg)	Exceeds Soil RAGs?
			Direct Exposure	Ground-water Protection	River Protection		
PCBs							
Aroclor - 1016	NA	107	0.5	0.017	0.017	U	No
Aroclor – 1221	NA	10.3	0.5	0.017	0.017	U	No
Aroclor – 1232	NA	10.3	0.5	0.017	0.017	U	No
Aroclor – 1242	NA	44.8	0.5	0.017	0.017	U	No
Aroclor – 1248	NA	43.9	0.5	0.017	0.017	U	No
Aroclor – 1254	NA	75.6	0.5	0.017	0.017	U	No
Aroclor – 1260	NA	822	0.5	0.017	0.017	U	No
Metals							
Antimony	5	**3.76**	**32**	**5[c]**	**5[c]**	**0.92**	**No**
Cadmium	**0.81[g]**	30	**13.9[e]**	0.81[c]	0.81[c]	4	**Yes**
Chromium, Total	18.5	200	80,000	18.5[c]	18.5[c]	14.4	No
Chromium VI	-- f	0	2.1 c	4.8	2	0.58	No
Copper	22.0	**22**	2,960	59.2	**22.0[c]**	**24.1**	Yes
Lead	10.2	**30**	353	**10.2[c]**	**10.2[c]**	**21.5**	Yes
Manganese	512	50	3,760	512[c]	512[c]	479	No
Mercury	0.33	30	24	0.33[c]	0.33[c]	0.16	No
Vanadium	85.1	**1000**	560	**85.1[c]**	--	**97.7**	Yes
Zinc	67.8	**30**	24,000	480	**67.8[c]**	**72.6**	Yes
Chloride	100	0	--	25,000	--	10.9	No
Sulfate	237	0	--	25,000	--	43.1	No

[a] RAGs obtained from the RDR/RAWP for the 100 Area (DOE/RL-96-17).

[b] No Hanford Site specific or Washington State background value available.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (Ecology 1996). The arsenic level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in the RDR/RAWP for the 100 Area (DOE/RL-96-17), Section 2.1.2.1.

[d] Hanford Site-specific background not available. Value is from Ecology (1994).

[e] Maximum soil concentration was used where there was not sufficient data to calculate a 95%UCL.

U – Analyzed for but not detected above limiting criteria

For the concrete floor, the maximum detected (Table 5-4) concentration for antimony, cadmium, total chromium, hexavalent chromium, copper, lead, mercury and zinc in the concrete are above the soil concentrations that are protective of groundwater and the Columbia river. The Analogous Sites RESRAD Model from the RDR/RAWP for the 100 Area (DOE/RL-96-17, Appendix C), predicts whether or not contaminants in 100 Area soils will migrate to groundwater within a 1,000-year time frame based on the K_d value and the vertical distance to groundwater.

At its deepest location, the top of the concrete floor of 183.7 KE is at an elevation of 139.06 m (456.22 ft). The groundwater elevation in this area is 120 m (393.70 ft), therefore the depth to groundwater of the concrete floor is 19.06 m (62.53 ft). The analytical results for the soil beneath the concrete floor are

below all RAGs, therefore the entire depth to groundwater is shown to be uncontaminated. The RESRAD model predicts constituents present in the soil with a K_d value of 3.1 mL/g or greater will not reach groundwater within 1,000 years. The K_d values for cadmium, total chromium, copper, lead, mercury and zinc are above 3.9 mL/g (30 mL/g, 200mL/g, 22 mL/g, 30 mL/g, 30 mL/g and 30 mL/g, respectively). The model predicts that if these contaminants were in the soil they will not reach groundwater within 1,000 years. The K_d values for antimony (3.76 mL/g) and hexavalent chromium (0 mL/g) are below 3.9 mL/g, therefore the concentration of these contaminants would not be protective if they were present in soil. The contaminants, however are not in soil, but in the concrete floor where the K_d values are at least an order of magnitude greater for each of these constituents. Antimony and hexavalent chromium have a K_d value in concrete of 45 mL/g and 870 mL/g, respectively. Therefore, residual concentrations of antimony, cadmium, total chromium, hexavalent chromium, copper, lead, mercury and zinc in the concrete are protective of groundwater and the Columbia River.

Table 5-5. 183.7 Pipe Tunnel Concrete Sample Results

Contaminant of Concern	Back-ground (mg/kg)	Soil Kd value (mL/g)	Soil Cleanup Levels (mg/kg)[a]			Max Concrete Result (mg/kg)	Exceeds Soil RAGs?
			Direct Exposure	Ground-water Protection	River Protection		
Antimony	5	3.76	32	5[c]	5[c]	49.3	**Yes**
Cadmium	**0.81[g]**	30	**13.9[e]**	0.81[c]	0.81[c]	12.3	Yes
Chromium, Total	18.5	**200**	80,000	**18.5[c]**	**18.5[c]**	**115**	Yes
Chromium VI	-- f	**0**	2.1 c	**4.8**	**2**	**39.7**	Yes
Copper	22.0	**22**	2,960	**59.2**	**22.0[c]**	**109**	Yes
Lead	10.2	**30**	**353**	**10.2[c]**	**10.2[c]**	**837**	Yes
Manganese	512	50	3,760	512[c]	512[c]	503	No
Mercury	0.33	**30**	24	**0.33[c]**	**0.33[c]**	**19.4**	Yes
Vanadium	85.1	1000	560	85.1[c]	--	85	No
Zinc	67.8	**30**	24,000	**480**	**67.8[c]**	**2,160**	Yes
Chloride	100	0	--	25,000	--	41.2	No
Sulfate	237	0	--	25,000	--	802	No

[a] RAGs obtained from the RDR/RAWP for the 100 Area (DOE/RL-96-17).

[b] No Hanford Site specific or Washington State background value available.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (Ecology 1996). The arsenic level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in the RDR/RAWP for the 100 Area (DOE/RL-96-17), Section 2.1.2.1.

[d] Hanford Site-specific background not available. Value is from Ecology (1994).

[e] Maximum soil concentration was used where there was not sufficient data to calculate a 95%UCL.

5.1.3 Statement of Protectiveness

This removal action mitigates the threat of release of contaminants to the environment and is consistent with interim remedial actions for the 100 Area of the Hanford site. Protection of human health and the environment has been demonstrated by the removal of most of the 183.2-KE and 183.7-KE Facilities, and follow up sampling and analysis to confirm that the remaining structure and underlying soil does not pose a threat to human health or the environment.

In the post-D4 configuration of the 183.2-KE and 183.7-KE footprint, the contaminants in the remaining concrete and underlying soil will not leach to groundwater or the Columbia River within **1,000** years.

5.2 Construction Quality Assurance/Quality Control

Not applicable. No construction-related aspects were implemented as part of this removal action for the 183.2-KE and 183.7-KE Facilities.

5.3 Cleanup Verification Quality Assurance/Quality Control

In accordance with the SAP, duplicates, splits and equipment blanks were collected for 5% of the concrete and soil samples. A Data Quality Assessment (DQA) review was performed to compare the sampling approach and analytical data with the sampling and data requirements specified by the SAP (DOE/RL-96-22). This DQA involve evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use.

A Level C data validation by a third-party validator, based on EPA functional guidelines (i.e., HNF-20433 and HNF-20434) was performed for all of the samples collected. Level C validation is a review of the QC data and specifically requires verification of deliverables requested versus reported analyses, and qualification of the results based on the following:

- Analytical holding times
- Method blank results
- Matrix spike/matrix spike duplicate
- Surrogate recoveries
- Duplicates
- Analytical method blanks.

Calibration of field survey equipment is also conducted and is addressed in Section 5.3.2.

5.3.1 Data Quality Assessment

Field sampling and laboratory analysis of the remaining concrete structure and the soils underneath the183.2-KE sedimentation basins and the 183.7-KE pipe tunnel were conducted to demonstrate protectiveness for the facility footprint and the underlying soil. In accordance with DOE/RL-96-22, minimally 5 percent of all data packages are validated for the 100K Area D&D and soil remediation activities to ensure the laboratory results are of appropriate quality for the intended use. All of the data packages for this specific D&D activity were third-party validated. The validation reports include:

- VSR-12-017, 183.2KE concrete samples
- VSR-12-018, 183.2KE soil samples
- VSR-12-019, 183.7KE concrete samples
- VSR-12-020, 183.7KE soil samples

The 183.2KE and 183.7KE soil and concrete sampling and analysis, were found to be usable for decision making purposes.

200.8, 6020 & 7471A Metal Analysis

183.2KE concrete no major deficiencies, minor deficiencies leading to qualification of chromium and vanadium sample results as non-detects were due to blank contamination, and those leading to qualification of manganese and selenium sample results as estimates were due to matrix spike and/or matrix spike duplicate recoveries < the quality control acceptance limit and poor duplicate precision.

183.2KE soil no major deficiencies, minor deficiencies leading to qualification of sample results as estimates were due to laboratory blank infractions for boron, copper and vanadium and matrix spike infraction for manganese and copper.

183.7KE concrete no major deficiencies, minor deficiencies leading to qualification of sample results as estimates were due to elevated sample temperature for mercury, laboratory blank infractions for boron and tin and matrix spike infractions for several analytes.

183.7KE soil no major deficiencies, minor deficiencies leading to qualification of sample results as estimates were due to a laboratory blank infraction for cadmium and antimony and matrix spike infractions for several analytes.

300.0 & 7196 Analysis

183.2KE concrete no major deficiencies and no minor deficiencies.

183.2KE soil no major deficiencies, a minor deficiency leading to qualification of chloride result for sample B2L1R5 was due to laboratory blank contamination.

183.7KE concrete no major deficiencies, minor deficiencies leading to qualification of chloride and sulfate due to elevated sample temperature and for hexavalent chromium due matrix spike recovery infraction.

183.7KE soil no major deficiencies, a minor deficiency leading to qualification of the hexavalent chromium result for sample B2H165 as an estimate was due to matrix spike infraction.

8082 Analysis

183.2KE soil no major deficiencies and no minor deficiencies.

183.7KE soil no major deficiencies and no minor deficiencies.

5.3.2 Environmental Quality Assurance

Field instrumentation, calibration, and quality assurance checks were performed in accordance with the following procedures:

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory.
- Daily calibration checks are performed and documented for each radiological instrument used for conducting surveys. The calibration checks are made using direct comparison to standard materials that are sufficiently similar to the matrix under consideration and/or certified radioactive sealed sources.

The approval of field data by the radiological control organization provides the data validation and usability review for handheld field radiological measurements.

5.4 Regulatory Oversight

EPA is the lead regulatory agency for this removal action, and provided the necessary oversight.

6 Final Inspection and Certifications

No final inspections or certifications are applicable to or required by the removal action for the 183.2-KE and 183.7-KE Facilities.

7 Operation and Maintenance Activities

Operations and maintenance activities are not applicable.

8 Summary of Project Costs

The total cost for D&D activities associated with the 183.2-KE Facility is estimated at $3,160,525 through completion of demolition and load out activities. The total cost for D&D activities associated with the 183.7-KE Facility is estimated at $4,020,000,. Regrading and revegetation will be conducted as part of the area-wide activities; therefore, facility-specific costs are not included in these estimates.

9 Observations and Lessons Learned

No observations or lessons learned were identified for this removal action.

10 Contact Information

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EPA Project Manager:	**Rod Lobos**
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Appendix A

183.2KE Flocculation and Sedimentation Basins Soil Data

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183.2KE Soil Verification Sample Results

Contaminants of Concern	Pothole #1 Sample #1 HEIS # B2H1B9 (mg/kg)	Pothole #1 Sample #2 HEIS # B2H1C3 (mg/kg)	Pothole #1 Sample #2 (DUP) HEIS # B2L1P6 (mg/kg)	Pothole #1 Sample #3 HEIS # B2H1D1 (mg/kg)	Pothole #2 Sample #1 HEIS # B2H1D5 (mg/kg)	Pothole #2 Sample #2 HEIS # B2H1D9 (mg/kg)
Aroclor-1016	UD 0.02	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1221	UD 0.03	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008
Aroclor-1232	UD 0.02	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1242	UD 0.02	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1248	UD 0.02	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1254	D 0.18	0.12	0.11	0.076	U 0.004	U 0.004
Aroclor-1260	UD 0.02	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Antimony	U 0.15	U 0.31	U 0.32	U 0.33	U 0.3	B 0.383
Arsenic	1.37	B 1.01		B 1.6	2.44	3.39
Barium	43.9	39.4		45.6	49.2	48.3
Beryllium	B 0.136	B 0.232		B 0.152	B 0.2	B 0.277
Boron	B 0.695	U 0.51		U 0.55	B 0.565	U 0.55
Cadmium	B 0.0533	B 0.0539	B 0.0554	B 0.0569	B 0.0651	B 0.0653
Chloride	U 2.7	U 2.9	U 2.9	U 2.9	B 3.71	B 5.46
Chromium	1.87	1.76	2.49	2.04	4.47	5.06
Cobalt	8.12	7.87		9.34	7.74	6.72
Copper	13.5	11.7	12.4	14.8	14.3	12.7
Hexavalent Chromium	U 0.099	U 0.1	U 0.1	U 0.1	U 0.1	B 0.123
Lead	2.87	2.21	2.58	2.98	3.87	4.03
Manganese	275	233	280	289	249	226
Mercury	U 0.026	U 0.051	U 0.053	U 0.055	U 0.051	U 0.055
Molybdenum	0.311	B 0.36		B 0.279	B 0.309	B 0.283
Nickel	5.23	4.65		5.83	7.29	7.17
Selenium	U 0.26	U 0.25		U 0.27	U 0.25	U 0.28
Silver	U 0.026	U 0.051		U 0.055	U 0.051	U 0.055
Strontium	20.8	X 18.1		X 22.3	X 23.2	X 23.8
Sulfate	B 18.2	B 16.6	B 15.5	B 14.7	B 34	70
Tin	0.352	B 0.316		B 0.33	B 0.441	B 0.425
Uranium	0.409	0.343		0.407	0.441	0.416
Vanadium	34.7	53	51.3	43.6	35	32.1
Zinc	32.1	37	38.1	38.1	37.3	36.8

U – Analyzed for but not detected above limiting criteria
C – Analyte was found in the Associated Blank. (Inorganic)
B – Analyte < the PQL (or Estimated Quantitation Limit) but >= the IDL/MDL (inorganic)
D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
HEIS = Hanford Environmental Information System

183.2KE Soil Verification Sample Results

Contaminants of Concern	Pothole #2 Sample #3 HEIS # B2H1F3 (mg/kg)	Pothole #3 Sample #1 HEIS # B2H1F7 (mg/kg)	Pothole #3 Sample #2 HEIS # B2H1H1 (mg/kg)	Pothole #3 Sample #3 HEIS # B2H1H5 (mg/kg)	Pothole #4 Sample #1 HEIS # B2H1H9 (mg/kg)	Pothole #4 Sample #2 HEIS # B2H1J3 (mg/kg)
Aroclor-1016	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1221	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008
Aroclor-1232	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1242	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1248	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1254	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1260	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Antimony	U 0.3	U 0.3	U 0.31	U 0.29	U 0.16	U 0.33
Arsenic	B 1.89	B 1.03	B 1.7	B 1.26	2.9	2.33
Barium	63.4	35.4	49.9	53.8	60.8	56.2
Beryllium	B 0.282	B 0.179	B 0.13	B 0.172	B 0.276	B 0.196
Boron	U 0.5	U 0.49	U 0.51	U 0.48	B 1.12	U 0.54
Cadmium	B 0.0635	B 0.0533	U 0.051	B 0.0491	B 0.0692	B 0.0762
Chloride	B 3.06	B 3.33	U 2.9	U 3	U 2.9	U 3
Chromium	2.96	1.47	1.5	2.16	4.89	3.55
Cobalt	9.67	7.09	8.41	9.03	9.44	8.37
Copper	16	10.5	11.1	13	17.3	16.3
Hexavalent Chromium	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1
Lead	3.37	1.55	1.6	2.01	4.52	3.59
Manganese	321	224	267	311	294	263
Mercury	U 0.05	U 0.049	U 0.051	U 0.048	U 0.027	U 0.054
Molybdenum	B 0.22	B 0.283	B 0.251	B 0.363	0.462	B 0.326
Nickel	7.12	4.45	5.58	6.08	8.32	6.9
Selenium	B 0.257	U 0.25	U 0.25	B 0.251	U 0.27	U 0.27
Silver	U 0.05	U 0.049	U 0.051	U 0.048	B 0.0877	U 0.054
Strontium	X 26.7	X 17.1	X 16.3	X 20.2	30.4	X 27.2
Sulfate	B 20	63.6	B 25.2	B 9.63	B 18.2	B 23.3
Tin	B 0.345	B 0.251	B 0.276	B 0.352	0.534	B 0.449
Uranium	0.453	0.277	0.287	0.352	0.55	0.466
Vanadium	31.9	36.9	39.6	49.7	36.9	36.9
Zinc	37.8	30.8	31.6	38.7	39.5	37.6

U – Analyzed for but not detected above limiting criteria
C – Analyte was found in the Associated Blank. (Inorganic)
B – Analyte < the PQL (or Estimated Quantitation Limit) but >= the IDL/MDL (inorganic)
D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
HEIS = Hanford Environmental Information System

183.2KE Soil Verification Sample Results

Contaminants of Concern	Pothole #4 Sample #3 HEIS # B2H1J7 (mg/kg)	Pothole #5 Sample #1 HEIS # B2H1K1 (mg/kg)	Pothole #5 Sample #2 HEIS # B2H1K5 (mg/kg)	Pothole #5 Sample #3 HEIS # B2H1K9 (mg/kg)	Pothole #6 Sample #1 HEIS # B2H1L3 (mg/kg)	Pothole #6 Sample #2 HEIS # B2H1L7 (mg/kg)
Aroclor-1016	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1221	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008
Aroclor-1232	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1242	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1248	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1254	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1260	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Antimony	U 0.34	B 0.24	B 0.452	U 0.14	U 0.16	U 0.16
Arsenic	2.41	1.73	2.31	1.51	1.19	1.22
Barium	50.7	45.1	40.7	43.4	46.8	43.9
Beryllium	B 0.26	B 0.254	B 0.155	B 0.182	B 0.229	B 0.263
Boron	U 0.56	B 0.25	U 0.25	B 0.362	B 0.457	B 0.403
Cadmium	B 0.0564	B 0.0696	B 0.0407	B 0.0449	B 0.0588	B 0.0464
Chloride	U 2.9	U 2.9	B 3.06	B 3.72	U 3	U 2.9
Chromium	3.42	2.25	2.4	2.85	2.13	1.97
Cobalt	9.42	9.48	9.25	10	9.43	9.37
Copper	14.6	14.6	14	13.4	J+ 14.5	J+ 13.7
Hexavalent Chromium	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1
Lead	3.65	2.41	2.35	2.45	2.18	2.16
Manganese	297	261	269	290	247	252
Mercury	U 0.056	U 0.023	U 0.025	U 0.024	U 0.027	U 0.026
Molybdenum	B 0.344	0.403	0.387	0.401	0.301	0.331
Nickel	6.92	5.69	6.53	6.91	5.54	5.39
Selenium	U 0.28	B 0.321	B 0.316	B 0.315	B 0.293	U 0.26
Silver	U 0.056	B 0.0283	U 0.025	B 0.027	B 0.0329	U 0.026
Strontium	X 23.7	24.5	25.2	22.9	22.1	21.8
Sulfate	B 23.1	B 13.2	B 28.8	B 32.2	B 14.2	B 6.32
Tin	B 0.404	0.488	0.532	0.446	0.359	0.363
Uranium	0.428	0.458	0.426	0.436	0.424	0.402
Vanadium	51.6	58.8	58.1	67.2	45.4	49.9
Zinc	42.9	39.3	38.4	41.4	37.4	36.7

U – Analyzed for but not detected above limiting criteria
C – Analyte was found in the Associated Blank. (Inorganic)
B – Analyte < the PQL (or Estimated Quantitation Limit) but >= the IDL/MDL (inorganic)
D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
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HEIS = Hanford Environmental Information System

183.2KE Soil Verification Sample Results

Contaminants of Concern	Pothole #6 Sample #3 HEIS # B2H1M1 (mg/kg)	Pothole #7 Sample #1 HEIS # B2L1J0 (mg/kg)	Pothole #7 Sample #2 HEIS # B2L1J4 (mg/kg)	Pothole #7 Sample #3 HEIS # B2L1J8 (mg/kg)	Pothole #8 Sample #1 HEIS # B2L1K2 (mg/kg)	Pothole #8 Sample #1 (DUP) HEIS # B2L1R0 (mg/kg)
Aroclor-1016	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1221	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008
Aroclor-1232	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1242	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1248	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1254	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1260	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Antimony	U 0.15	2.17	2.53	B 0.284	U 0.14	U 0.17
Arsenic	2.2	9.11	10.2	2.38	1.41	
Barium	59.7	67.2	67.5	48.5	51.4	
Beryllium	B 0.237	B 0.321	B 0.404	B 0.285	B 0.294	
Boron	B 0.429	B 1.22	B 1.63	B 0.374	U 0.24	
Cadmium	B 0.0636	B 0.0765	B 0.0738	B 0.0362	B 0.0462	B 0.0802
Chloride	U 2.9	B 3.32	B 4.22	U 2.9	U 2.9	U 3
Chromium	4.28	5.49	6.62	3.05	2.43	2.41
Cobalt	12.1	8.95	8.6	10.3	10.6	
Copper	J+ 16.8	18	18.5	15.8	13.5	J+ 15.8
Hexavalent Chromium	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1
Lead	3.84	4.36	5.66	2.58	2.33	2.54
Manganese	362	276	282	297	309	290
Mercury	U 0.026	U 0.027	B 0.0316	U 0.028	U 0.024	U 0.028
Molybdenum	0.4	0.325	0.41	0.423	0.434	
Nickel	8.45	7.89	8.59	7.39	7.38	
Selenium	B 0.353	B 0.286	B 0.261	B 0.305	B 0.329	
Silver	B 0.0333	B 0.0356	B 0.0463	B 0.0289	B 0.0259	
Strontium	27	35.8	39.8	24.7	25.3	
Sulfate	B 12.9	84.2	76.7	B 14.5	B 16.7	B 14.9
Tin	0.528	2.72	1.44	0.484	0.407	
Uranium	0.546	0.577	0.622	0.439	0.448	
Vanadium	60.7	31.8	42.8	69.7	69.8	57.4
Zinc	46.9	46.1	50.4	44.7	42.4	41.1

U – Analyzed for but not detected above limiting criteria
C – Analyte was found in the Associated Blank. (Inorganic)
B – Analyte < the PQL (or Estimated Quantitation Limit) but >= the IDL/MDL (inorganic)
D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
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183.2KE Soil Verification Sample Results

Contaminants of Concern	Pothole #8 Sample #2 HEIS # B2L1K6 (mg/kg)	Pothole #8 Sample #3 HEIS # B2L1L0 (mg/kg)	Pothole #9 Sample #1 HEIS # B2L1L4 (mg/kg)	Pothole #9 Sample #1 HEIS # B2L1L8 (mg/kg)	Pothole #10 Sample #1 HEIS # B2L1M2 (mg/kg)	Pothole #10 Sample #2 HEIS # B2L1M6 (mg/kg)
Aroclor-1016	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1221	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008	U 0.008
Aroclor-1232	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1242	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1248	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1254	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1260	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004	U 0.004
Antimony	U 0.14	U 0.14	U 0.33	U 0.28	U 0.29	U 0.33
Arsenic	1.61	2.11	B 2.17	B 1.29	B 1.25	B 1.37
Barium	47.4	57.2	56.8	42.9	67.8	67.8
Beryllium	B 0.19	B 0.214	B 0.166	B 0.234	B 0.242	B 0.249
Boron	B 0.49	B 0.338	U 0.55	U 0.46	B 0.503	U 0.55
Cadmium	B 0.0503	B 0.0668	B 0.0643	B 0.0462	B 0.0639	B 0.0716
Chloride	U 2.9	U 3	U 2.9	U 2.9	U 3	U 3
Chromium	4.64	1.89	2.63	1.58	2.07	2.48
Cobalt	9.98	8.92	9.98	8.09	9.24	10.8
Copper	13.5	J+ 14.2	16.5	12.1	14	15.3
Hexavalent Chromium	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1	U 0.1
Lead	2.79	2.41	3.68	1.66	2.39	2.41
Manganese	299	235	307	252	311	355
Mercury	U 0.024	U 0.024	U 0.055	U 0.046	U 0.048	U 0.055
Molybdenum	0.357	0.272	B 0.272	B 0.285	B 0.472	B 0.353
Nickel	15.1	5.52	7.49	5.46	6.7	6.19
Selenium	B 0.312	B 0.332	U 0.27	U 0.23	B 0.268	U 0.28
Silver	B 0.0271	B 0.0288	U 0.055	U 0.046	U 0.048	U 0.055
Strontium	24.9	24.8	X 29	X 17.4	X 20.1	X 22.2
Sulfate	B 16.6	B 10.2	B 33.9	U 5.5	B 17.6	B 14.7
Tin	0.383	0.359	B 0.371	B 0.316	B 0.458	B 0.346
Uranium	0.55	0.441	0.434	0.304	0.401	0.359
Vanadium	52.8	38.9	42	46.3	46.9	58.2
Zinc	39.1	32.1	40.4	33.7	38.6	42.3

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C – Analyte was found in the Associated Blank. (Inorganic)
B – Analyte < the PQL (or Estimated Quantitation Limit) but >= the IDL/MDL (inorganic)
D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
HEIS = Hanford Environmental Information System

183.2KE Soil Verification Sample Results

Contaminants of Concern	Pothole #11 Sample #1 HEIS # B2L1N0 (mg/kg)	Pothole #11 Sample #2 HEIS # B2L1N4 (mg/kg)	Pothole #12 Sample #1 HEIS # B2L1N8 (mg/kg)	Pothole #12 Sample #1 HEIS # B2L1P2 (mg/kg)
Aroclor-1016	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1221	U 0.008	U 0.008	U 0.008	U 0.008
Aroclor-1232	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1242	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1248	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1254	U 0.004	U 0.004	U 0.004	U 0.004
Aroclor-1260	U 0.004	U 0.004	U 0.004	U 0.004
Antimony	U 0.15	B 0.2	U 0.16	U 0.16
Arsenic	1.42	1.77	B 0.781	B 0.805
Barium	49.6	48.2	24.4	24.2
Beryllium	B 0.244	B 0.179	B 0.138	B 0.107
Boron	U 0.25	B 0.505	B 0.277	B 0.309
Cadmium	B 0.0485	B 0.0546	B 0.0359	B 0.033
Chloride	U 2.9	B 3.67	U 2.9	U 3
Chromium	2.56	3	C J 1.28	C J 1.24
Cobalt	10.8	10.7	5.88	5.78
Copper	14	J+ 14.7	J+ 8.66	J+ 8.5
Hexavalent Chromium	U 0.1	U 0.1	U 0.1	U 0.1
Lead	2.82	2.58	1.28	1.26
Manganese	307	317	163	159
Mercury	U 0.025	U 0.027	U 0.026	U 0.026
Molybdenum	0.438	0.498	B 0.231	B 0.206
Nickel	6.59	6.43	3.44	3.44
Selenium	B 0.324	B 0.293	U 0.26	U 0.26
Silver	B 0.0335	B 0.0327	U 0.026	U 0.026
Strontium	22.6	22.1	12.9	12.9
Sulfate	B 7.38	B 26.7	B 10.4	B 10.4
Tin	0.449	0.491	B 0.235	B 0.219
Uranium	0.47	0.481	0.239	0.238
Vanadium	68	63.3	31.9	31.3
Zinc	44	43.7	23.6	23.1

U – Analyzed for but not detected above limiting criteria
C – Analyte was found in the Associated Blank. (Inorganic)
B – Analyte < the PQL (or Estimated Quantitation Limit) but >= the IDL/MDL (inorganic)
D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
HEIS = Hanford Environmental Information System

Appendix B

183.2KE Flocculation and Sedimentation Basin Concrete Data

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183.2KE Concrete Verification Sample Results

Contaminants of Concern	Sample #1 HEIS # B2H111 (mg/kg)	Sample #2 HEIS # B2H114 (mg/kg)	Sample #3 HEIS # B2L117 (mg/kg)	Sample #3 (DUP) HEIS # B2L1F6 (mg/kg)	Sample #4 HEIS # B2H1T9 (mg/kg)	Sample #5 HEIS # B2H1V2 (mg/kg)	Sample #6 HEIS # B2H1VS (mg/kg)
Antimony	6.47	B 1.88	B 2.83	B 1.97	B 0.893	21.2	B 0.637
Arsenic	19.8	9.3	12.3	9.44	8.14	54.1	7.66
Barium	72.8	93	139	95	201	94.1	140
Beryllium	B 0.185	B 0.248	B 0.359	B 0.255	B 0.366	B 0.248	B 0.355
Boron	B 4.19	B 2.03	B 3.74	B 3.15	B 2.99	B 3.57	B 3.84
Cadmium	B 0.427	B 0.299	B 0.349	B 0.175	B 0.086	B 0.107	B 0.142
Chloride	B 4.8	B 8.93	B 14.4	B 15.3	B 8.84	B 16.8	U 2.9
Chromium	17.2	11.9	12.3	8.9	12.3	15	9.91
Cobalt	4.76	4.8	7.43	5.52	6.04	7.32	5.74
Copper	30.9	16.5	20.4	15.3	17.6	44.3	14.8
Hexavalent Chromium	U 0.092	U 0.097	U 0.094	U 0.096	U 0.098	B 0.189	U 0.093
Lead	24.7	21.1	5.18	3.34	7.16	73.6	5.08
Manganese	N J- 210	N J- 224	N J- 340	N J- 236	N J- 307	N J- 464	N J- 310
Mercury	1.24	1.04	U 0.055	U 0.046	U 0.05	B 0.159	U 0.051
Molybdenum	1.46	0.779	1.21	0.926	1.11	1.81	1.14
Nickel	9.48	7.55	11.6	7.2	10.2	9.74	7.7
Selenium	UN J 0.25	UN J 0.26	UN J 0.27	UN J 0.23	UN J 0.25	UN J 0.24	UN J 0.25
Silver	U 0.049	B 0.0582	B 0.0633	B 0.048	B 0.075	U 0.049	B 0.0702
Strontium	52.7	64.6	101	61.1	101	52.4	82.6
Sulfate	266	492	370	352	420	269	84.5
Tin	2.27	1.01	1.12	0.807	0.76	9.08	0.65
Uranium	1.16	1.34	1.05	0.738	1.24	1.22	1.09
Vanadium	30.6	36	59.2	41.2	55.4	31.7	45.2
Zinc	141	82.6	70.7	46.4	43.4	118	40

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D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
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183.2KE Concrete Verification Sample Results

Contaminants of Concern	Sample #7 HEIS # B2H1V8 (mg/kg)	Sample #8 HEIS # B2H1W1 (mg/kg)	Sample #9 HEIS # B2L1D4 (mg/kg)	Sample #10 HEIS # B2L1D7 (mg/kg)	Sample #11 HEIS # B2L1F0 (mg/kg)	Sample #12 HEIS # B2L1F3 (mg/kg))
Antimony	44.7	29.3	27.7	30.3	13.4	14.4
Arsenic	65.8	49.2	52.9	42.6	21.8	25.4
Barium	132	137	123	110	117	134
Beryllium	B 0.276	B 0.297	B 0.304	B 0.377	B 0.371	B 0.418
Boron	3.48	3.54	4.57	4.54	3.41	4.12
Cadmium	B 0.0936	B 0.245	B 0.234	B 0.0882	B 0.0595	B 0.0551
Chloride	B 20.5	21.9	B 10.4	37	30.3	B 7.83
Chromium	15.4	18.1	13	12.7	11.2	12
Cobalt	8.85	7.54	9.98	7.95	7.75	7.08
Copper	41.1	39.5	39.4	37.8	27.6	26.3
Hexavalent Chromium	U 0.11	U 0.11	U 0.1	U 0.11	U 0.11	U 0.11
Lead	7.18	23.9	5.59	7.3	5.22	4.95
Manganese	336	278	379	301	260	317
Mercury	B 0.0636	0.606	B 0.0515	0.212	B 0.0295	B 0.0648
Molybdenum	2.22	1.69	1.63	1.79	1.46	1.8
Nickel	10.2	9.25	8.57	9.27	7.7	8.56
Selenium	U 0.27	B 0.268	B 0.281	U 0.3	U 0.27	U 0.25
Silver	B 0.046	B 0.0783	B 0.0456	B 0.0429	B 0.0371	B 0.0505
Strontium	118	103	92	101	88.9	99
Sulfate	219	253	131	169	151	250
Tin	7.47	5.51	5.62	4.58	2.41	2.81
Uranium	1.28	1.76	1.21	2.18	1.13	1.21
Vanadium	62	51	66.4	51.7	45	49.8
Zinc	127	125	130	93.2	61.5	65.2

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N – MS and/or MDS recovery outside control limits.
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Appendix C

183.7KE Pipe Tunnel Soil Data

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183.7KE Soil Verification Sample Results

Contaminants of Concern	Sample #1 HEIS # B2H123, B2H124 (mg/kg)	Sample #1 (DUP) HEIS # B2H167, B2H168 (mg/kg)	Sample #2 HEIS # B2H129, B2H130 (mg/kg)	Sample #3 HEIS # B2H131, B2H132 (mg/kg)	Sample #4 HEIS # B2H165, B2H166 (mg/kg)
Aroclor-1016	U 0.009	U 0.0091	UD 0.018	UD 0.019	U 0.004
Aroclor-1221	U 0.009	U 0.0091	UD 0.018	UD 0.019	U 0.008
Aroclor-1232	U 0.009	U 0.0091	UD 0.018	UD 0.019	U 0.004
Aroclor-1242	U 0.009	U 0.0091	UD 0.018	UD 0.019	U 0.004
Aroclor-1248	U 0.009	U 0.0091	UD 0.018	UD 0.019	U 0.004
Aroclor-1254	U 0.0057	U 0.0057	UD 0.012	UD 0.012	U 0.004
Aroclor-1260	U 0.0057	U 0.0057	UD 0.012	UD 0.012	U 0.004
Antimony	B 0.24	B 0.3	C J 0.92	C J 0.6	U 0.31
Arsenic	1.9	2.1	2.4	2	B 1.45
Barium	74	72.9	70.2	81.7	53
Beryllium	0.28	0.27	0.27	0.37	B 0.248
Boron	B 6.6	B 8.8	UD 17.6	UD 17.8	U 0.52
Cadmium	0.19	0.15	4	1.8	B 0.0538
Chloride	10.5	10.9	3.4	2.7	U 3.1
Chromium	4.2	5.3	5.1	14.4	3.29
Cobalt	32.2	25.7	57.9	87.6	10.2
Copper	16.7	18.2	24.1	23.6	16.3
Hexavalent Chromium	U 0.155	U 0.155	U 0.155	0.582	UN J 0.11
Lead	3.7	4.4	4.7	21.5	2.16
Manganese	479	371	N J+ 388	N J+ 361	299
Mercury	U 0.011	B 0.012	U 0.011	0.16	U 0.052
Molybdenum	0.54	0.57	0.64	0.61	B 0.489
Nickel	7.1	7.4	8.6	10.5	6.53
Selenium	2	1.8	1.8	1.5	U 1
Silver	2.8	2	N J- 18.7	N J- 15.1	U 0.052
Strontium	30.9	29.8	29.6	31.9	23.6
Sulfate	42.4	43.1	29	8.5	B 6.76
Tin	0.84	0.79	1.2	1.1	0.563
Uranium	0.45	0.42	0.5	0.53	0.435
Vanadium	96.1	97.7	93.2	88.8	78.5
Zinc	61.6	61.3	67.2	72.6	47.5

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D – Analyte was reported at a secondary dilution factor.
E – Analyte is an estimate
N – MS and/or MDS recovery outside control limits.
J – Sample estimated and less than the reporting limit
HEIS = Hanford Environmental Information System

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Appendix D

183.7KE Pipe Tunnel Concrete Data

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183.7KE Concrete Verification Sample Results

Contaminants of Concern	Sample #1 HEIS # B2H0T9, B2H0X1 (mg/kg)	Sample #2 HEIS # B2H0V0, B2H0X2 (mg/kg)	Sample #3 HEIS # B2H0V1, B2H0X3 (mg/kg)	Sample #3 (DUP) HEIS # B2H0V5, B2H0X7 (mg/kg)	Sample #4 HEIS # B2H0V2, B2H0X4 (mg/kg)	Sample #5 HEIS # B2H0V3, B2H0X5 (mg/kg)	Sample #6 HEIS # B2H0V4, B2H0X6 (mg/kg)
Antimony	2.9	35.7	2.9	2.2	30	3.8	49.3
Arsenic	7.8	52.8	8.7	6.4	46.5	9.3	55.2
Barium	156	131	119	115	146	147	129
Beryllium	0.36	0.27	0.29	0.31	0.3	0.25	0.27
Boron	B 7.2	U 10.3	J 14.8	U 10.4	C J 12.4	B 5.7	B 3.7
Cadmium	0.58	0.4	0.57	0.8	1.5	12.3	0.51
Chloride	4.5	J 3	J 5	J 5	J 3.9	8	17.5
Chromium	14.4	N J- 38.8	N J- 49.8	N J- 37.2	N J- 30	102	115
Cobalt	9.1	14.6	25.4	30.4	12.7	18.9	12.4
Copper	30.5	64.5	64.1	38.1	55.4	109	53.2
Hexavalent Chromium	1.97	J 11.2	J 33.3	J 26.9	J 4.99	1.71	39.7
Lead	29.4	N 736	N 334	N 326	N 259	837	54.9
Manganese	356	N J+ 407	N J+ 453	N J+ 375	N J+ 357	503	336
Mercury	N 0.2	N J- 0.55	N J- 0.37	N J- 0.31	N J- 0.7	DN 19.4	DN 8.7
Molybdenum	0.75	1.8	1.6	0.95	1.1	2.3	1.3
Nickel	14.6	19.1	31.2	16.6	14.1	23.5	11.9
Selenium	1.3	1.1	1.1	0.98	1.1	3.4	1.3
Silver	B 0.065	B 0.086	1.7	3.5	B 0.068	0.84	B 0.066
Strontium	75.6	68.8	47.2	52	71.6	48.7	104
Sulfate	D 802	D J 379	D J 202	J 197	D J 493	149	D 253
Tin	1.2	6.2	6.1	2.5	5.2	4.9	5.4
Uranium	0.96	0.87	0.67	0.73	0.86	0.73	0.83
Vanadium	80.9	75.7	72	79.4	83.6	85	71.3
Zinc	179	N 516	N 456	N 441	N 731	D 2160	228

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D – Analyte was reported at a secondary dilution factor.
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N – MS and/or MDS recovery outside control limits.
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Appendix E

95% UCL for the 183.2KE Sedimentation Basin Concrete Samples

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	H:\WF23245Laptop\AlaaWork\August2012\Data\183.2KE_ProUCL_mg_units\ProUCL_183_2KE_Concrete.wst		
Full Precision	ON		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Antimony			
	General Statistics		
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.637	Minimum of Log Data	-0.450986
Maximum	44.7	Maximum of Log Data	3.7999735
Mean	15.052308	Mean of log Data	1.9907099
Median	13.4	SD of log Data	1.4667716
SD	14.40883		
Coefficient of Variation	0.9572506		
Skewness	0.7220104		
	Relevant UCL Statistics		
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8807571	Shapiro Wilk Test Statistic	0.9028745
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	22.174847	95% H-UCL	103.60888
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	55.225122
95% Adjusted-CLT UCL (Chen-1995)	22.480706	97.5% Chebyshev (MVUE) UCL	71.075001
95% Modified-t UCL (Johnson-1978)	22.308223	99% Chebyshev (MVUE) UCL	102.20902
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.6825257	**Data appear Normal at 5% Significance Level**	
Theta Star	22.053832		
MLE of Mean	15.052308		
MLE of Standard Deviation	18.219799		
nu star	17.745669		
Approximate Chi Square Value (.05)	9.2073203	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	21.625621
Adjusted Chi Square Value	8.3436337	95% Jackknife UCL	22.174847
		95% Standard Bootstrap UCL	21.282664
Anderson-Darling Test Statistic	0.4698561	95% Bootstrap-t UCL	23.21687
Anderson-Darling 5% Critical Value	0.7666634	95% Hall's Bootstrap UCL	22.275755
Kolmogorov-Smirnov Test Statistic	0.1696208	95% Percentile Bootstrap UCL	21.823308
Kolmogorov-Smirnov 5% Critical Value	0.2450678	95% BCA Bootstrap UCL	22.121538
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	32.471734
		97.5% Chebyshev(Mean, Sd) UCL	40.009134
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	54.814897
95% Approximate Gamma UCL	29.010967		
95% Adjusted Gamma UCL	32.014021		
Potential UCL to Use		Use 95% Student's-t UCL	22.174847

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

Arsenic

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	13

Raw Statistics		**Log-transformed Statistics**	
Minimum	7.66	Minimum of Log Data	2.036012
Maximum	65.8	Maximum of Log Data	4.1866198
Mean	29.110769	Mean of log Data	3.0933322
Median	21.8	SD of log Data	0.8058555
SD	20.892282		
Coefficient of Variation	0.7176822		
Skewness	0.5241998		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8666282	Shapiro Wilk Test Statistic	0.8898553
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	39.438193	95% H-UCL	54.94673
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	60.054658
95% Adjusted-CLT UCL (Chen-1995)	39.541995	97.5% Chebyshev (MVUE) UCL	73.243079
95% Modified-t UCL (Johnson-1978)	39.578599	99% Chebyshev (MVUE) UCL	99.149178

Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.5514399	Data appear Normal at 5% Significance Level	
Theta Star	18.76371		
MLE of Mean	29.110769		
MLE of Standard Deviation	23.371479		
nu star	40.337438		
Approximate Chi Square Value (.05)	26.784555	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	38.641835
Adjusted Chi Square Value	25.218793	95% Jackknife UCL	39.438193
		95% Standard Bootstrap UCL	38.164684
Anderson-Darling Test Statistic	0.6076875	95% Bootstrap-t UCL	41.112782
Anderson-Darling 5% Critical Value	0.743847	95% Hall's Bootstrap UCL	38.164689
Kolmogorov-Smirnov Test Statistic	0.1730336	95% Percentile Bootstrap UCL	38.770769
Kolmogorov-Smirnov 5% Critical Value	0.2395524	95% BCA Bootstrap UCL	39.090769
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	54.368306
		97.5% Chebyshev(Mean, Sd) UCL	65.297263
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	86.765082
95% Approximate Gamma UCL	43.840709		
95% Adjusted Gamma UCL	46.562651		
Potential UCL to Use		Use 95% Student's-t UCL	39.438193

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

Barium

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	72.8	Minimum of Log Data	4.287716
Maximum	201	Maximum of Log Data	5.3033049
Mean	122.14615	Mean of log Data	4.7748795
Median	123	SD of log Data	0.2558374
SD	31.965831		
Coefficient of Variation	0.2617015		
Skewness	0.9581403		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9124624	Shapiro Wilk Test Statistic	0.9527208
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	137.94743	95% H-UCL	140.59831
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	160.17148
95% Adjusted-CLT UCL (Chen-1995)	139.24638	97.5% Chebyshev (MVUE) UCL	176.63537
95% Modified-t UCL (Johnson-1978)	138.34009	99% Chebyshev (MVUE) UCL	208.97548
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	12.855493	**Data appear Normal at 5% Significance Level**	
Theta Star	9.501476		
MLE of Mean	122.14615		
MLE of Standard Deviation	34.067121		
nu star	334.24281		
Approximate Chi Square Value (.05)	292.88197	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	136.72898
Adjusted Chi Square Value	287.36445	95% Jackknife UCL	137.94743
		95% Standard Bootstrap UCL	136.18797
Anderson-Darling Test Statistic	0.3748261	95% Bootstrap-t UCL	140.72454
Anderson-Darling 5% Critical Value	0.7334675	95% Hall's Bootstrap UCL	146.59716
Kolmogorov-Smirnov Test Statistic	0.1807896	95% Percentile Bootstrap UCL	136.7
Kolmogorov-Smirnov 5% Critical Value	0.2363079	95% BCA Bootstrap UCL	138
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	160.79096
		97.5% Chebyshev(Mean, Sd) UCL	177.5126
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	210.35902
95% Approximate Gamma UCL	139.39565		
95% Adjusted Gamma UCL	142.07211		
Potential UCL to Use		Use 95% Student's-t UCL	137.94743

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

Beryllium

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	12

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.185	Minimum of Log Data	-1.687399
Maximum	0.418	Maximum of Log Data	-0.872274
Mean	0.3122308	Mean of log Data	-1.187629
Median	0.304	SD of log Data	0.2316236
SD	0.0677436		
Coefficient of Variation	0.2169664		
Skewness	-0.264427		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9491011	Shapiro Wilk Test Statistic	0.9291632
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.3457176	95% H-UCL	0.3545664
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.4006316
95% Adjusted-CLT UCL (Chen-1995)	0.3416631	97.5% Chebyshev (MVUE) UCL	0.4387339
95% Modified-t UCL (Johnson-1978)	0.345488	99% Chebyshev (MVUE) UCL	0.5135784
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	16.464394	**Data appear Normal at 5% Significance Level**	
Theta Star	0.018964		
MLE of Mean	0.3122308		
MLE of Standard Deviation	0.076949		
nu star	428.07425		
Approximate Chi Square Value (.05)	381.10936	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	0.3431354
Adjusted Chi Square Value	374.79333	95% Jackknife UCL	0.3457176
		95% Standard Bootstrap UCL	0.3425929
Anderson-Darling Test Statistic	0.4171528	95% Bootstrap-t UCL	0.3445459
Anderson-Darling 5% Critical Value	0.7332939	95% Hall's Bootstrap UCL	0.3410941
Kolmogorov-Smirnov Test Statistic	0.2124657	95% Percentile Bootstrap UCL	0.342
Kolmogorov-Smirnov 5% Critical Value	0.236114	95% BCA Bootstrap UCL	0.3406154
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.3941288
		97.5% Chebyshev(Mean, Sd) UCL	0.4295661
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.4991759
95% Approximate Gamma UCL	0.3507076		
95% Adjusted Gamma UCL	0.3566177		
Potential UCL to Use		Use 95% Student's-t UCL	0.3457176

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

Boron

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	2.03	Minimum of Log Data	0.7080358
Maximum	4.57	Maximum of Log Data	1.5195132
Mean	3.6284615	Mean of log Data	1.2697462
Median	3.57	SD of log Data	0.2123137
SD	0.6833843		
Coefficient of Variation	0.18834		
Skewness	-0.793009		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9430784	Shapiro Wilk Test Statistic	0.8766456
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	3.9662704	95% H-UCL	4.0755325
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4.572369
95% Adjusted-CLT UCL (Chen-1995)	3.8956786	97.5% Chebyshev (MVUE) UCL	4.9781091
95% Modified-t UCL (Johnson-1978)	3.9593226	99% Chebyshev (MVUE) UCL	5.775107
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	20.35517	**Data appear Normal at 5% Significance Level**	
Theta Star	0.1782575		
MLE of Mean	3.6284615		
MLE of Standard Deviation	0.8042391		
nu star	529.23442		
Approximate Chi Square Value (.05)	476.88147	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	3.9402217
Adjusted Chi Square Value	469.79753	95% Jackknife UCL	3.9662704
		95% Standard Bootstrap UCL	3.9351729
Anderson-Darling Test Statistic	0.4163076	95% Bootstrap-t UCL	3.9421083
Anderson-Darling 5% Critical Value	0.7331573	95% Hall's Bootstrap UCL	3.9254336
Kolmogorov-Smirnov Test Statistic	0.1703349	95% Percentile Bootstrap UCL	3.9076923
Kolmogorov-Smirnov 5% Critical Value	0.2361292	95% BCA Bootstrap UCL	3.8838462
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	4.4546329
		97.5% Chebyshev(Mean, Sd) UCL	4.8121179
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5.5143279
95% Approximate Gamma UCL	4.0268009		
95% Adjusted Gamma UCL	4.0875199		
Potential UCL to Use		Use 95% Student's-t UCL	3.9662704

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

Cadmium

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.0551	Minimum of Log Data	-2.898606
Maximum	0.427	Maximum of Log Data	-0.850971
Mean	0.1815692	Mean of log Data	-1.913107
Median	0.142	SD of log Data	0.6789192
SD	0.1198911		
Coefficient of Variation	0.660305		
Skewness	0.846371		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8944997	Shapiro Wilk Test Statistic	0.9462139
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.2408335	95% H-UCL	0.2941144
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.3380628
95% Adjusted-CLT UCL (Chen-1995)	0.2446039	97.5% Chebyshev (MVUE) UCL	0.4055712
95% Modified-t UCL (Johnson-1978)	0.2421344	99% Chebyshev (MVUE) UCL	0.5381782
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.0282229	Data appear Normal at 5% Significance Level	
Theta Star	0.0895213		
MLE of Mean	0.1815692		
MLE of Standard Deviation	0.1274924		
nu star	52.733796		
Approximate Chi Square Value (.05)	37.052493	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	0.2362636
Adjusted Chi Square Value	35.186149	95% Jackknife UCL	0.2408335
		95% Standard Bootstrap UCL	0.2337423
Anderson-Darling Test Statistic	0.359899	95% Bootstrap-t UCL	0.2502709
Anderson-Darling 5% Critical Value	0.7408727	95% Hall's Bootstrap UCL	0.2413181
Kolmogorov-Smirnov Test Statistic	0.1744614	95% Percentile Bootstrap UCL	0.2331615
Kolmogorov-Smirnov 5% Critical Value	0.2387331	95% BCA Bootstrap UCL	0.2389077
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.3265105
		97.5% Chebyshev(Mean, Sd) UCL	0.3892267
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.5124205
95% Approximate Gamma UCL	0.2584127		
95% Adjusted Gamma UCL	0.2721194		
Potential UCL to Use		Use 95% Student's-t UCL	0.2408335

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

Chloride			
General Statistics			
Number of Valid Data	13	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	1
		Percent Non-Detects	7.69%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	4.8	Minimum Detected	1.5686159
Maximum Detected	37	Maximum Detected	3.6109179
Mean of Detected	16.416667	Mean of Detected	2.6402104
SD of Detected	9.6622794	SD of Detected	0.5964756
Minimum Non-Detect	2.9	Minimum Non-Detect	1.0647107
Maximum Non-Detect	2.9	Maximum Non-Detect	1.0647107
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.9128734	Shapiro Wilk Test Statistic	0.9804632
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	15.265385	Mean	2.4656991
SD	10.139553	SD	0.8497288
95% DL/2 (t) UCL	20.277544	95% H-Stat (DL/2) UCL	31.942968
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	14.99016	Mean in Log Scale	2.527066
SD	10.24018	SD in Log Scale	0.7018234
95% MLE (t) UCL	20.052062	Mean in Original Scale	15.401526
95% MLE (Tiku) UCL	19.999992	SD in Original Scale	9.9486832
		95% t UCL	20.319336
		95% Percentile Bootstrap UCL	19.777692
		95% BCA Bootstrap UCL	20.504615

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	2.5457091	Data appear Normal at 5% Significance Level	
Theta Star	6.4487599		
nu star	61.097018		
A-D Test Statistic	0.2013838	Nonparametric Statistics	
5% A-D Critical Value	0.7379853	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7379853	Mean	15.523077
5% K-S Critical Value	0.2470866	SD	9.4116232
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	2.7263847
		95% KM (t) UCL	20.382279
Assuming Gamma Distribution		95% KM (z) UCL	20.007581
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	20.28436
Minimum	1E-12	95% KM (bootstrap t) UCL	22.175107
Maximum	37	95% KM (BCA) UCL	20.546154
Mean	15.153846	95% KM (Percentile Bootstrap) UCL	20.240769
Median	14.4	95% KM (Chebyshev) UCL	27.407112
SD	10.310721	97.5% KM (Chebyshev) UCL	32.549344
k star	0.2731146	99% KM (Chebyshev) UCL	42.650262
Theta star	55.485296		
Nu star	7.1009804	Potential UCLs to Use	
AppChi2	2.2261321	95% KM (t) UCL	20.382279
95% Gamma Approximate UCL	48.338175	95% KM (Percentile Bootstrap) UCL	20.240769
95% Adjusted Gamma UCL	57.915865		

Note: DL/2 is not a recommended method.

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

Chromium

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	12
Raw Statistics		**Log-transformed Statistics**	
Minimum	8.9	Minimum of Log Data	2.1860513
Maximum	18.1	Maximum of Log Data	2.8959119
Mean	13.07	Mean of log Data	2.5512264
Median	12.3	SD of log Data	0.2030964
SD	2.6805534		
Coefficient of Variation	0.2050921		
Skewness	0.5274345		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9452374	Shapiro Wilk Test Statistic	0.9635208
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	14.395045	95% H-UCL	14.574511
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.292786
95% Adjusted-CLT UCL (Chen-1995)	14.409076	97.5% Chebyshev (MVUE) UCL	17.687748
95% Modified-t UCL (Johnson-1978)	14.413171	99% Chebyshev (MVUE) UCL	20.427881
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	20.322856	**Data appear Normal at 5% Significance Level**	
Theta Star	0.6431183		
MLE of Mean	13.07		
MLE of Standard Deviation	2.8992337		
nu star	528.39424		
Approximate Chi Square Value (.05)	476.08381	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	14.292869
Adjusted Chi Square Value	469.00593	95% Jackknife UCL	14.395045
		95% Standard Bootstrap UCL	14.242388
Anderson-Darling Test Statistic	0.3279424	95% Bootstrap-t UCL	14.594301
Anderson-Darling 5% Critical Value	0.7331585	95% Hall's Bootstrap UCL	14.61863
Kolmogorov-Smirnov Test Statistic	0.1773602	95% Percentile Bootstrap UCL	14.269231
Kolmogorov-Smirnov 5% Critical Value	0.2361291	95% BCA Bootstrap UCL	14.338462
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	16.310631
		97.5% Chebyshev(Mean, Sd) UCL	17.712855
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	20.467252
95% Approximate Gamma UCL	14.506086		
95% Adjusted Gamma UCL	14.725001		
Potential UCL to Use		Use 95% Student's-t UCL	14.395045

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

Cobalt

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	4.76	Minimum of Log Data	1.5602477
Maximum	9.98	Maximum of Log Data	2.3005831
Mean	6.9815385	Mean of log Data	1.9198925
Median	7.32	SD of log Data	0.2270085
SD	1.5520408		
Coefficient of Variation	0.2223064		
Skewness	0.2089348		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.956053	Shapiro Wilk Test Statistic	0.9497958
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	7.7487396	95% H-UCL	7.9003153
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	8.9119755
95% Adjusted-CLT UCL (Chen-1995)	7.7162333	97.5% Chebyshev (MVUE) UCL	9.7461673
95% Modified-t UCL (Johnson-1978)	7.752897	99% Chebyshev (MVUE) UCL	11.384776
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	16.631329	**Data appear Normal at 5% Significance Level**	
Theta Star	0.4197824		
MLE of Mean	6.9815385		
MLE of Standard Deviation	1.7119365		
nu star	432.41456		
Approximate Chi Square Value (.05)	385.20616	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	7.68958
Adjusted Chi Square Value	378.85543	95% Jackknife UCL	7.7487396
		95% Standard Bootstrap UCL	7.6613004
Anderson-Darling Test Statistic	0.3216097	95% Bootstrap-t UCL	7.79891
Anderson-Darling 5% Critical Value	0.733288	95% Hall's Bootstrap UCL	7.722842
Kolmogorov-Smirnov Test Statistic	0.1698548	95% Percentile Bootstrap UCL	7.6830769
Kolmogorov-Smirnov 5% Critical Value	0.2361147	95% BCA Bootstrap UCL	7.6523077
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	8.8578643
		97.5% Chebyshev(Mean, Sd) UCL	9.6697521
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	11.264548
95% Approximate Gamma UCL	7.837151		
95% Adjusted Gamma UCL	7.9685248		
Potential UCL to Use		Use 95% Student's-t UCL	7.7487396

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

Copper

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	14.8	Minimum of Log Data	2.6946272
Maximum	44.3	Maximum of Log Data	3.7909847
Mean	28.576923	Mean of log Data	3.2782141
Median	27.6	SD of log Data	0.4109078
SD	10.940685		
Coefficient of Variation	0.3828504		
Skewness	0.0466448		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8930971	Shapiro Wilk Test Statistic	0.8871232
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	33.985097	95% H-UCL	36.65516
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	43.165116
95% Adjusted-CLT UCL (Chen-1995)	33.610013	97.5% Chebyshev (MVUE) UCL	49.438862
95% Modified-t UCL (Johnson-1978)	33.991639	99% Chebyshev (MVUE) UCL	61.762421
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	5.3467781	**Data appear Normal at 5% Significance Level**	
Theta Star	5.3446997		
MLE of Mean	28.576923		
MLE of Standard Deviation	12.358603		
nu star	139.01623		
Approximate Chi Square Value (.05)	112.77261	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	33.568067
Adjusted Chi Square Value	109.4073	95% Jackknife UCL	33.985097
		95% Standard Bootstrap UCL	33.33327
Anderson-Darling Test Statistic	0.5952993	95% Bootstrap-t UCL	33.980252
Anderson-Darling 5% Critical Value	0.7351047	95% Hall's Bootstrap UCL	33.309348
Kolmogorov-Smirnov Test Statistic	0.198994	95% Percentile Bootstrap UCL	33.430769
Kolmogorov-Smirnov 5% Critical Value	0.2371611	95% BCA Bootstrap UCL	33.307692
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	41.803566
		97.5% Chebyshev(Mean, Sd) UCL	47.526745
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	58.768823
95% Approximate Gamma UCL	35.227138		
95% Adjusted Gamma UCL	36.310704		
Potential UCL to Use		Use 95% Student's-t UCL	33.985097

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

Hexavalent Chromium			
General Statistics			
Number of Valid Data	13	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	12
		Percent Non-Detects	92.31%
Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!			
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).			
The data set for variable Hexavalent Chromium was not processed!			

Lead

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	3.34	Minimum of Log Data	1.2059708
Maximum	73.6	Maximum of Log Data	4.298645
Mean	14.946154	Mean of log Data	2.2388642
Median	7.16	SD of log Data	0.9007163
SD	19.240439		
Coefficient of Variation	1.287317		
Skewness	2.7112251		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.6037927	Shapiro Wilk Test Statistic	0.8375059
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	24.457042	95% H-UCL	28.258472
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	29.233248
95% Adjusted-CLT UCL (Chen-1995)	28.011281	97.5% Chebyshev (MVUE) UCL	36.034138
95% Modified-t UCL (Johnson-1978)	25.125826	99% Chebyshev (MVUE) UCL	49.393171
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.9847121	Data do not follow a Discernable Distribution (0.05)	
Theta Star	15.178197		
MLE of Mean	14.946154		
MLE of Standard Deviation	15.061729		
nu star	25.602514		
Approximate Chi Square Value (.05)	15.073629	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	23.723648
Adjusted Chi Square Value	13.932782	95% Jackknife UCL	24.457042
		95% Standard Bootstrap UCL	23.376799
Anderson-Darling Test Statistic	1.3313596	95% Bootstrap-t UCL	37.81051
Anderson-Darling 5% Critical Value	0.7543817	95% Hall's Bootstrap UCL	51.648855
Kolmogorov-Smirnov Test Statistic	0.3425041	95% Percentile Bootstrap UCL	24.379231
Kolmogorov-Smirnov 5% Critical Value	0.2421335	95% BCA Bootstrap UCL	27.991538
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	38.20671
		97.5% Chebyshev(Mean, Sd) UCL	48.271571
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	68.042042
95% Approximate Gamma UCL	25.385998		
95% Adjusted Gamma UCL	27.46466		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	38.20671

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

Manganese

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	210	Minimum of Log Data	5.3471075
Maximum	464	Maximum of Log Data	6.1398846
Mean	304.76923	Mean of log Data	5.6972152
Median	307	SD of log Data	0.218679
SD	68.454552		
Coefficient of Variation	0.2246111		
Skewness	0.8320662		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9447144	Shapiro Wilk Test Statistic	0.9738639
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	338.60752	95% H-UCL	342.92859
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	385.65991
95% Adjusted-CLT UCL (Chen-1995)	340.67985	97.5% Chebyshev (MVUE) UCL	420.70137
95% Modified-t UCL (Johnson-1978)	339.33776	99% Chebyshev (MVUE) UCL	489.53352
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	17.39523	**Data appear Normal at 5% Significance Level**	
Theta Star	17.520276		
MLE of Mean	304.76923		
MLE of Standard Deviation	73.072847		
nu star	452.27599		
Approximate Chi Square Value (.05)	403.96859	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	335.99822
Adjusted Chi Square Value	397.46123	95% Jackknife UCL	338.60752
		95% Standard Bootstrap UCL	334.56841
Anderson-Darling Test Statistic	0.2178007	95% Bootstrap-t UCL	345.19408
Anderson-Darling 5% Critical Value	0.7332612	95% Hall's Bootstrap UCL	352.47111
Kolmogorov-Smirnov Test Statistic	0.1208413	95% Percentile Bootstrap UCL	335.38462
Kolmogorov-Smirnov 5% Critical Value	0.2361176	95% BCA Bootstrap UCL	340.53846
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	387.52675
		97.5% Chebyshev(Mean, Sd) UCL	423.33599
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	493.67632
95% Approximate Gamma UCL	341.21416		
95% Adjusted Gamma UCL	346.80062		
Potential UCL to Use		Use 95% Student's-t UCL	338.60752

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

Mercury			
General Statistics			
Number of Valid Data	13	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	4
		Percent Non-Detects	30.77%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0295	Minimum Detected	-3.523365
Maximum Detected	1.24	Maximum Detected	0.2151114
Mean of Detected	0.3851556	Mean of Detected	-1.735299
SD of Detected	0.4654735	SD of Detected	1.3818495
Minimum Non-Detect	0.046	Minimum Non-Detect	-3.079114
Maximum Non-Detect	0.055	Maximum Non-Detect	-2.900422
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	46.15%
Warning: There are only 9 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.7690074	Shapiro Wilk Test Statistic	0.9126477
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.2744154	Mean	-2.33396
SD	0.4175363	SD	1.4655854
95% DL/2 (t) UCL	0.4808109	95% H-Stat (DL/2) UCL	1.3660805
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0571447	Mean in Log Scale	-2.446133
SD	0.6218924	SD in Log Scale	1.5843204
95% MLE (t) UCL	0.3645571	Mean in Original Scale	0.2720772
95% MLE (Tiku) UCL	0.4219698	SD in Original Scale	0.4190623
		95% t UCL	0.4792271
		95% Percentile Bootstrap UCL	0.4480099
		95% BCA Bootstrap UCL	0.5390549

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.5836411	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	0.6599185		
nu star	10.505539		
A-D Test Statistic	0.5428889	**Nonparametric Statistics**	
5% A-D Critical Value	0.7510014	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7510014	Mean	0.2760615
5% K-S Critical Value	0.2891434	SD	0.4001476
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.1177157
		95% KM (t) UCL	0.4858648
Assuming Gamma Distribution		95% KM (z) UCL	0.4696867
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.4779175
Minimum	0.0283423	95% KM (bootstrap t) UCL	0.6953351
Maximum	1.24	95% KM (BCA) UCL	0.4922385
Mean	0.2803694	95% KM (Percentile Bootstrap) UCL	0.4762308
Median	0.0648	95% KM (Chebyshev) UCL	0.7891725
SD	0.4140919	97.5% KM (Chebyshev) UCL	1.011196
k star	0.5536843	99% KM (Chebyshev) UCL	1.4473182
Theta star	0.5063705		
Nu star	14.395791	**Potential UCLs to Use**	
AppChi2	6.8432036	95% KM (BCA) UCL	0.4922385
95% Gamma Approximate UCL	0.5898026		
95% Adjusted Gamma UCL	0.6599924		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Molybdenum

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	12
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.779	Minimum of Log Data	-0.249744
Maximum	2.22	Maximum of Log Data	0.7975072
Mean	1.4634615	Mean of log Data	0.3408001
Median	1.46	SD of log Data	0.3021863
SD	0.4125693		
Coefficient of Variation	0.2819133		
Skewness	-0.008979		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9670787	Shapiro Wilk Test Statistic	0.9500804
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.6674018	95% H-UCL	1.7387261
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.0075677
95% Adjusted-CLT UCL (Chen-1995)	1.6513713	97.5% Chebyshev (MVUE) UCL	2.2417252
95% Modified-t UCL (Johnson-1978)	1.6673543	99% Chebyshev (MVUE) UCL	2.7016823
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	9.7920563	**Data appear Normal at 5% Significance Level**	
Theta Star	0.149454		
MLE of Mean	1.4634615		
MLE of Standard Deviation	0.4676752		
nu star	254.59346		
Approximate Chi Square Value (.05)	218.64837	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	1.6516758
Adjusted Chi Square Value	213.90228	95% Jackknife UCL	1.6674018
		95% Standard Bootstrap UCL	1.6462223
Anderson-Darling Test Statistic	0.3153573	95% Bootstrap-t UCL	1.6765828
Anderson-Darling 5% Critical Value	0.7336308	95% Hall's Bootstrap UCL	1.6511652
Kolmogorov-Smirnov Test Statistic	0.1494281	95% Percentile Bootstrap UCL	1.6515385
Kolmogorov-Smirnov 5% Critical Value	0.2365429	95% BCA Bootstrap UCL	1.6450769
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.9622335
		97.5% Chebyshev(Mean, Sd) UCL	2.1780525
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.6019872
95% Approximate Gamma UCL	1.7040499		
95% Adjusted Gamma UCL	1.7418596		
Potential UCL to Use		Use 95% Student's-t UCL	1.6674018

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

Nickel

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	11
Raw Statistics		**Log-transformed Statistics**	
Minimum	7.2	Minimum of Log Data	1.974081
Maximum	11.6	Maximum of Log Data	2.4510051
Mean	9.0015385	Mean of log Data	2.1881577
Median	9.25	SD of log Data	0.1412665
SD	1.2797906		
Coefficient of Variation	0.1421747		
Skewness	0.3783689		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9535563	Shapiro Wilk Test Statistic	0.9580999
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	9.6341615	95% H-UCL	9.6900479
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	10.542007
95% Adjusted-CLT UCL (Chen-1995)	9.6251801	97.5% Chebyshev (MVUE) UCL	11.208698
95% Modified-t UCL (Johnson-1978)	9.6403697	99% Chebyshev (MVUE) UCL	12.518284
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	41.814023	**Data appear Normal at 5% Significance Level**	
Theta Star	0.2152756		
MLE of Mean	9.0015385		
MLE of Standard Deviation	1.392053		
nu star	1087.1646		
Approximate Chi Square Value (.05)	1011.6193	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	9.5853794
Adjusted Chi Square Value	1001.2289	95% Jackknife UCL	9.6341615
		95% Standard Bootstrap UCL	9.561803
Anderson-Darling Test Statistic	0.2924981	95% Bootstrap-t UCL	9.6858935
Anderson-Darling 5% Critical Value	0.7325046	95% Hall's Bootstrap UCL	9.6974852
Kolmogorov-Smirnov Test Statistic	0.166667	95% Percentile Bootstrap UCL	9.5607692
Kolmogorov-Smirnov 5% Critical Value	0.2361854	95% BCA Bootstrap UCL	9.5884615
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	10.54873
		97.5% Chebyshev(Mean, Sd) UCL	11.218201
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	12.533247
95% Approximate Gamma UCL	9.6737516		
95% Adjusted Gamma UCL	9.7741421		
Potential UCL to Use		Use 95% Student's-t UCL	9.6341615

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

Selenium

General Statistics			
Number of Valid Data	13	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	11
		Percent Non-Detects	84.62%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.268	Minimum Detected	-1.316768
Maximum Detected	0.281	Maximum Detected	-1.269401
Mean of Detected	0.2745	Mean of Detected	-1.293084
SD of Detected	0.0091924	SD of Detected	0.033494
Minimum Non-Detect	0.23	Minimum Non-Detect	-1.469676
Maximum Non-Detect	0.3	Maximum Non-Detect	-1.203973
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	13
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

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

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

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

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

UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.1514615	Mean	-1.933216
SD	0.0553453	SD	0.2916959
95% DL/2 (t) UCL	0.1788197	95% H-Stat (DL/2) UCL	0.1771931
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.2690833
5% K-S Critical Value	N/A	SD	0.003593
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0014668
		95% KM (t) UCL	0.2716977
Assuming Gamma Distribution		95% KM (z) UCL	0.2714961
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.2778876
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	0.281
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	0.2754771
SD	N/A	97.5% KM (Chebyshev) UCL	0.2782437
k star	N/A	99% KM (Chebyshev) UCL	0.2836782
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	95% KM (t) UCL	0.2716977
95% Gamma Approximate UCL	N/A	95% KM (% Bootstrap) UCL	N/A
95% Adjusted Gamma UCL	N/A		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Silver

General Statistics			
Number of Valid Data	13	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	2
		Percent Non-Detects	15.38%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0371	Minimum Detected	-3.294138
Maximum Detected	0.0783	Maximum Detected	-2.547208
Mean of Detected	0.0559182	Mean of Detected	-2.911813
SD of Detected	0.0139614	SD of Detected	0.2473153
Minimum Non-Detect	0.049	Minimum Non-Detect	-3.015935
Maximum Non-Detect	0.049	Maximum Non-Detect	-3.015935

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.9248212	Shapiro Wilk Test Statistic	0.944468
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0510846	Mean	-3.03447
SD	0.0173678	SD	0.3749827
95% DL/2 (t) UCL	0.0596698	95% H-Stat (DL/2) UCL	0.0639253
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0480943	Mean in Log Scale	-2.944115
SD	0.019863	SD in Log Scale	0.2411311
95% MLE (t) UCL	0.0579129	Mean in Original Scale	0.0541162
95% MLE (Tiku) UCL	0.0607074	SD in Original Scale	0.0135515
		95% t UCL	0.0608149
		95% Percentile Bootstrap UCL	0.0605652
		95% BCA Bootstrap UCL	0.0611287

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	13.192254	Data appear Normal at 5% Significance Level	
Theta Star	0.0042387		
nu star	290.22959		
A-D Test Statistic	0.3584903	Nonparametric Statistics	
5% A-D Critical Value	0.7288302	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7288302	Mean	0.0540723
5% K-S Critical Value	0.255098	SD	0.0130719
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0038365
		95% KM (t) UCL	0.06091
Assuming Gamma Distribution		95% KM (z) UCL	0.0603828
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.060889
Minimum	0.0371	95% KM (bootstrap t) UCL	0.0621787
Maximum	0.0783	95% KM (BCA) UCL	0.0603423
Mean	0.0548929	95% KM (Percentile Bootstrap) UCL	0.0598808
Median	0.0505	95% KM (Chebyshev) UCL	0.0707952
SD	0.0132098	97.5% KM (Chebyshev) UCL	0.0780312
k star	15.099402	99% KM (Chebyshev) UCL	0.092245
Theta star	0.0036354		
Nu star	392.58445	Potential UCLs to Use	
AppChi2	347.65894	95% KM (t) UCL	0.06091
95% Gamma Approximate UCL	0.0619863	95% KM (Percentile Bootstrap) UCL	0.0598808
95% Adjusted Gamma UCL	0.0630796		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Strontium

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	11
Raw Statistics		**Log-transformed Statistics**	
Minimum	52.4	Minimum of Log Data	3.9589066
Maximum	118	Maximum of Log Data	4.7706846
Mean	85.946154	Mean of log Data	4.4210349
Median	92	SD of log Data	0.2748999
SD	21.464607		
Coefficient of Variation	0.2497448		
Skewness	-0.487979		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8934744	Shapiro Wilk Test Statistic	0.8602994
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	96.556488	95% H-UCL	100.34847
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	114.99259
95% Adjusted-CLT UCL (Chen-1995)	94.877398	97.5% Chebyshev (MVUE) UCL	127.4826
95% Modified-t UCL (Johnson-1978)	96.422202	99% Chebyshev (MVUE) UCL	152.01681
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	11.945015	Data appear Normal at 5% Significance Level	
Theta Star	7.1951481		
MLE of Mean	85.946154		
MLE of Standard Deviation	24.867555		
nu star	310.5704		
Approximate Chi Square Value (.05)	270.74432	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	95.738314
Adjusted Chi Square Value	265.44544	95% Jackknife UCL	96.556488
		95% Standard Bootstrap UCL	95.215845
Anderson-Darling Test Statistic	0.8170931	95% Bootstrap-t UCL	95.846317
Anderson-Darling 5% Critical Value	0.7335161	95% Hall's Bootstrap UCL	94.633971
Kolmogorov-Smirnov Test Statistic	0.2047573	95% Percentile Bootstrap UCL	95.184615
Kolmogorov-Smirnov 5% Critical Value	0.2363778	95% BCA Bootstrap UCL	94.084615
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	111.8956
		97.5% Chebyshev(Mean, Sd) UCL	123.12394
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	145.17985
95% Approximate Gamma UCL	98.588702		
95% Adjusted Gamma UCL	100.55675		
Potential UCL to Use		Use 95% Student's-t UCL	96.556488

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

Sulfate

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	84.5	Minimum of Log Data	4.4367515
Maximum	492	Maximum of Log Data	6.1984787
Mean	263.57692	Mean of log Data	5.4690096
Median	253	SD of log Data	0.4992633
SD	118.80373		
Coefficient of Variation	0.4507365		
Skewness	0.4231518		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9679051	Shapiro Wilk Test Statistic	0.9648736
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	322.3037	95% H-UCL	364.27524
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	430.56253
95% Adjusted-CLT UCL (Chen-1995)	321.90725	97.5% Chebyshev (MVUE) UCL	501.81139
95% Modified-t UCL (Johnson-1978)	322.94822	99% Chebyshev (MVUE) UCL	641.76597
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.8261189	**Data appear Normal at 5% Significance Level**	
Theta Star	68.888847		
MLE of Mean	263.57692		
MLE of Standard Deviation	134.74981		
nu star	99.479092		
Approximate Chi Square Value (.05)	77.469372	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	317.77522
Adjusted Chi Square Value	74.705819	95% Jackknife UCL	322.3037
		95% Standard Bootstrap UCL	315.46362
Anderson-Darling Test Statistic	0.1880112	95% Bootstrap-t UCL	327.64907
Anderson-Darling 5% Critical Value	0.7360505	95% Hall's Bootstrap UCL	326.07297
Kolmogorov-Smirnov Test Statistic	0.1296036	95% Percentile Bootstrap UCL	315.76923
Kolmogorov-Smirnov 5% Critical Value	0.2374613	95% BCA Bootstrap UCL	320.15385
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	407.20363
		97.5% Chebyshev(Mean, Sd) UCL	469.35102
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	591.42754
95% Approximate Gamma UCL	338.46141		
95% Adjusted Gamma UCL	350.98194		
Potential UCL to Use		Use 95% Student's-t UCL	322.3037

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

Tin

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.65	Minimum of Log Data	-0.430783
Maximum	9.08	Maximum of Log Data	2.2060742
Mean	3.3920769	Mean of log Data	0.8544449
Median	2.41	SD of log Data	0.9336617
SD	2.804323		
Coefficient of Variation	0.8267274		
Skewness	0.8490857		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8750139	Shapiro Wilk Test Statistic	0.9168831
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	4.7783033	95% H-UCL	7.5942861
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	7.6797707
95% Adjusted-CLT UCL (Chen-1995)	4.8671216	97.5% Chebyshev (MVUE) UCL	9.4986721
95% Modified-t UCL (Johnson-1978)	4.8088303	99% Chebyshev (MVUE) UCL	13.071552
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.2108317	**Data appear Normal at 5% Significance Level**	
Theta Star	2.8014437		
MLE of Mean	3.3920769		
MLE of Standard Deviation	3.082647		
nu star	31.481625		
Approximate Chi Square Value (.05)	19.661407	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	4.67141
Adjusted Chi Square Value	18.339519	95% Jackknife UCL	4.7783033
		95% Standard Bootstrap UCL	4.6146414
Anderson-Darling Test Statistic	0.4489844	95% Bootstrap-t UCL	5.090231
Anderson-Darling 5% Critical Value	0.7502232	95% Hall's Bootstrap UCL	4.8842121
Kolmogorov-Smirnov Test Statistic	0.1891357	95% Percentile Bootstrap UCL	4.6130769
Kolmogorov-Smirnov 5% Critical Value	0.2409073	95% BCA Bootstrap UCL	4.7551538
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	6.7823382
		97.5% Chebyshev(Mean, Sd) UCL	8.2493069
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	11.130883
95% Approximate Gamma UCL	5.4313557		
95% Adjusted Gamma UCL	5.8228406		
Potential UCL to Use		Use 95% Student's-t UCL	4.7783033

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

Uranium

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	12
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.738	Minimum of Log Data	-0.303811
Maximum	2.18	Maximum of Log Data	0.7793249
Mean	1.2775385	Mean of log Data	0.2139358
Median	1.21	SD of log Data	0.2543116
SD	0.3510206		
Coefficient of Variation	0.2747632		
Skewness	1.5174503		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.82443	Shapiro Wilk Test Statistic	0.8899039
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.4510541	95% H-UCL	1.4676466
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.6711398
95% Adjusted-CLT UCL (Chen-1995)	1.481455	97.5% Chebyshev (MVUE) UCL	1.8421215
95% Modified-t UCL (Johnson-1978)	1.457883	99% Chebyshev (MVUE) UCL	2.177982
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	12.585349	Data appear Lognormal at 5% Significance Level	
Theta Star	0.10151		
MLE of Mean	1.2775385		
MLE of Standard Deviation	0.3601151		
nu star	327.21909		
Approximate Chi Square Value (.05)	286.30778	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	1.4376742
Adjusted Chi Square Value	280.8543	95% Jackknife UCL	1.4510541
		95% Standard Bootstrap UCL	1.4280507
Anderson-Darling Test Statistic	0.8794972	95% Bootstrap-t UCL	1.6055306
Anderson-Darling 5% Critical Value	0.7334819	95% Hall's Bootstrap UCL	2.65683
Kolmogorov-Smirnov Test Statistic	0.2371984	95% Percentile Bootstrap UCL	1.4323077
Kolmogorov-Smirnov 5% Critical Value	0.2363286	95% BCA Bootstrap UCL	1.4683077
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.7019016
		97.5% Chebyshev(Mean, Sd) UCL	1.8855239
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.2462143
95% Approximate Gamma UCL	1.4600895		
95% Adjusted Gamma UCL	1.4884407		
Potential UCL to Use		Use 95% Student's-t UCL	1.4510541
		or 95% Modified-t UCL	1.457883
		or 95% H-UCL	1.4676466

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

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

Vanadium

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	30.6	Minimum of Log Data	3.421
Maximum	66.4	Maximum of Log Data	4.1956971
Mean	48.092308	Mean of log Data	3.846205
Median	49.8	SD of log Data	0.2460432
SD	11.240215		
Coefficient of Variation	0.2337217		
Skewness	-0.086193		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9689864	Shapiro Wilk Test Statistic	0.9494404
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	53.648544	95% H-UCL	55.087885
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	62.555379
95% Adjusted-CLT UCL (Chen-1995)	53.140466	97.5% Chebyshev (MVUE) UCL	68.793419
95% Modified-t UCL (Johnson-1978)	53.636123	99% Chebyshev (MVUE) UCL	81.04684
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	14.46711	**Data appear Normal at 5% Significance Level**	
Theta Star	3.3242512		
MLE of Mean	48.092308		
MLE of Standard Deviation	12.644007		
nu star	376.14485		
Approximate Chi Square Value (.05)	332.19528	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	53.220097
Adjusted Chi Square Value	326.30892	95% Jackknife UCL	53.648544
		95% Standard Bootstrap UCL	52.986403
Anderson-Darling Test Statistic	0.2387671	95% Bootstrap-t UCL	53.864588
Anderson-Darling 5% Critical Value	0.7333816	95% Hall's Bootstrap UCL	53.016732
Kolmogorov-Smirnov Test Statistic	0.1289522	95% Percentile Bootstrap UCL	53.046154
Kolmogorov-Smirnov 5% Critical Value	0.2361843	95% BCA Bootstrap UCL	52.976923
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	61.681065
		97.5% Chebyshev(Mean, Sd) UCL	67.560931
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	79.11079
95% Approximate Gamma UCL	54.45494		
95% Adjusted Gamma UCL	55.437265		
Potential UCL to Use		Use 95% Student's-t UCL	53.648544

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

Zinc

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	13
Raw Statistics		**Log-transformed Statistics**	
Minimum	40	Minimum of Log Data	3.6888795
Maximum	141	Maximum of Log Data	4.9487599
Mean	88	Mean of log Data	4.3892168
Median	82.6	SD of log Data	0.4492472
SD	36.474078		
Coefficient of Variation	0.4144782		
Skewness	0.107531		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9052634	Shapiro Wilk Test Statistic	0.9092814
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	106.02978	95% H-UCL	116.35068
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	137.42426
95% Adjusted-CLT UCL (Chen-1995)	104.96186	97.5% Chebyshev (MVUE) UCL	158.64154
95% Modified-t UCL (Johnson-1978)	106.08006	99% Chebyshev (MVUE) UCL	200.3188
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.5402507	**Data appear Normal at 5% Significance Level**	
Theta Star	19.38219		
MLE of Mean	88		
MLE of Standard Deviation	41.299306		
nu star	118.04652		
Approximate Chi Square Value (.05)	93.959823	**Nonparametric Statistics**	
Adjusted Level of Significance	0.03009	95% CLT UCL	104.63949
Adjusted Chi Square Value	90.901172	95% Jackknife UCL	106.02978
		95% Standard Bootstrap UCL	103.90494
Anderson-Darling Test Statistic	0.477744	95% Bootstrap-t UCL	106.62673
Anderson-Darling 5% Critical Value	0.735564	95% Hall's Bootstrap UCL	103.93547
Kolmogorov-Smirnov Test Statistic	0.195203	95% Percentile Bootstrap UCL	103.52308
Kolmogorov-Smirnov 5% Critical Value	0.2373163	95% BCA Bootstrap UCL	103.59231
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	132.09501
		97.5% Chebyshev(Mean, Sd) UCL	151.17496
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	188.65381
95% Approximate Gamma UCL	110.55889		
95% Adjusted Gamma UCL	114.27898		
Potential UCL to Use		Use 95% Student's-t UCL	106.02978

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

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Appendix F

95% UCL for the 183.2KE Sedimentation Basin Soil Samples

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	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	H:\WF23245Laptop\AlaaWork\August2012\Data\183.2KE_ProUCL_mg_units\ProUCL_183_2KE_Soil.wst		
Full Precision	ON		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Antimony			
	General Statistics		
Number of Valid Data	34	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	27
		Percent Non-Detects	79.41%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.2	Minimum Detected	-1.609438
Maximum Detected	2.53	Maximum Detected	0.9282193
Mean of Detected	0.8941429	Mean of Detected	-0.620883
SD of Detected	1.0035445	SD of Detected	1.042946
Minimum Non-Detect	0.14	Minimum Non-Detect	-1.966113
Maximum Non-Detect	0.34	Maximum Non-Detect	-1.07881
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	30
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	88.24%
Warning: There are only 7 Detected Values in this data			
Note: It should be noted that even though bootstrap may be performed on this data set			
the resulting calculations may not be reliable enough to draw conclusions			
It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.			
	UCL Statistics		
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.702831	Shapiro Wilk Test Statistic	0.8205956
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.2773235	Mean	-1.879639
SD	0.5348595	SD	0.8536199
95% DL/2 (t) UCL	0.4325598	95% H-Stat (DL/2) UCL	0.3083219
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-3.209051
		SD in Log Scale	1.6441398
		Mean in Original Scale	0.2083809
		SD in Original Scale	0.5561566
		95% t UCL	0.3697984
		95% Percentile Bootstrap UCL	0.3721196
		95% BCA Bootstrap UCL	0.4517289

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.7350008	**Data appear Lognormal at 5% Significance Level**	
Theta Star	1.2165196		
nu star	10.290011		
A-D Test Statistic	0.8494167	**Nonparametric Statistics**	
5% A-D Critical Value	0.7260028	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7260028	Mean	0.3458391
5% K-S Critical Value	0.3189806	SD	0.5058223
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0937569
		95% KM (t) UCL	0.5045096
Assuming Gamma Distribution		95% KM (z) UCL	0.5000555
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.4759777
Minimum	0.2	95% KM (bootstrap t) UCL	1.3998953
Maximum	2.53	95% KM (BCA) UCL	0.6172059
Mean	0.975047	95% KM (Percentile Bootstrap) UCL	0.5420865
Median	0.8638789	95% KM (Chebyshev) UCL	0.754516
SD	0.5622718	97.5% KM (Chebyshev) UCL	0.9313509
k star	2.7333314	99% KM (Chebyshev) UCL	1.2787087
Theta star	0.3567248		
Nu star	185.86654	**Potential UCLs to Use**	
AppChi2	155.33018	95% KM (BCA) UCL	0.6172059
95% Gamma Approximate UCL	1.1667315		
95% Adjusted Gamma UCL	1.1771755		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Aroclor-1016

General Statistics

Number of Valid Data	34	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	34
		Percent Non-Detects	100.00%

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 Aroclor-1016 was not processed!

Aroclor-1221

General Statistics

Number of Valid Data	34	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	34
		Percent Non-Detects	100.00%

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 Aroclor-1221 was not processed!

Aroclor-1232

General Statistics

Number of Valid Data	34	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	34
		Percent Non-Detects	100.00%

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 Aroclor-1232 was not processed!

Aroclor-1242

General Statistics

Number of Valid Data	34	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	34
		Percent Non-Detects	100.00%

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 Aroclor-1242 was not processed!

Aroclor-1248

General Statistics

Number of Valid Data	34	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	34
		Percent Non-Detects	100.00%

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 Aroclor-1248 was not processed!

Aroclor-1254

General Statistics

Number of Valid Data	34	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	30
		Percent Non-Detects	88.24%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.076	Minimum Detected	-2.577022
Maximum Detected	0.18	Maximum Detected	-1.714798
Mean of Detected	0.1215	Mean of Detected	-2.15484
SD of Detected	0.043309	SD of Detected	0.3539393
Minimum Non-Detect	0.004	Minimum Non-Detect	-5.521461
Maximum Non-Detect	0.004	Maximum Non-Detect	-5.521461

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

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

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.9508278	Shapiro Wilk Test Statistic	0.9807504
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0160588	Mean	-5.736988
SD	0.0412045	SD	1.3319682
95% DL/2 (t) UCL	0.0280179	95% H-Stat (DL/2) UCL	0.0152708
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-4.066469
		SD in Log Scale	1.1232449
		Mean in Original Scale	0.0310744
		SD in Original Scale	0.0387842
		95% t UCL	0.042331
		95% Percentile Bootstrap UCL	0.0423526
		95% BCA Bootstrap UCL	0.0454883

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	2.8673145	**Data appear Normal at 5% Significance Level**	
Theta Star	0.0423741		
nu star	22.938516		
A-D Test Statistic	0.2513805	**Nonparametric Statistics**	
5% A-D Critical Value	0.6570992	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.6570992	Mean	0.0813529
5% K-S Critical Value	0.3948746	SD	0.019504
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0038624
		95% KM (t) UCL	0.0878894
Assuming Gamma Distribution		95% KM (z) UCL	0.087706
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.1027199
Minimum	0.0702414	95% KM (bootstrap t) UCL	0.0877982
Maximum	0.4425497	95% KM (BCA) UCL	0.1270588
Mean	0.2835014	95% KM (Percentile Bootstrap) UCL	0.1235294
Median	0.3029157	95% KM (Chebyshev) UCL	0.0981886
SD	0.1142926	97.5% KM (Chebyshev) UCL	0.1054734
k star	4.3785848	99% KM (Chebyshev) UCL	0.119783
Theta star	0.0647473		
Nu star	297.74376	**Potential UCLs to Use**	
AppChi2	258.7738	95% KM (t) UCL	0.0878894
95% Gamma Approximate UCL	0.3261953	95% KM (Percentile Bootstrap) UCL	0.1235294
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

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

Aroclor-1260

General Statistics

Number of Valid Data	34	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	34
		Percent Non-Detects	100.00%

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 Aroclor-1260 was not processed!

Arsenic

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	32
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.781	Minimum of Log Data	-0.24718
Maximum	10.2	Maximum of Log Data	2.3223877
Mean	2.1825294	Mean of log Data	0.5850824
Median	1.655	SD of log Data	0.5468203
SD	1.9902384		
Coefficient of Variation	0.9118953		
Skewness	3.4044123		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.5337658	Shapiro Wilk Test Statistic	0.8593834
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	2.760171	95% H-UCL	2.5162692
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.9680963
95% Adjusted-CLT UCL (Chen-1995)	2.9568917	97.5% Chebyshev (MVUE) UCL	3.3548676
95% Modified-t UCL (Johnson-1978)	2.7933847	99% Chebyshev (MVUE) UCL	4.114605
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.4940964	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.8750782		
MLE of Mean	2.1825294		
MLE of Standard Deviation	1.3819855		
nu star	169.59855		
Approximate Chi Square Value (.05)	140.48367	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	2.7439559
Adjusted Chi Square Value	139.17529	95% Jackknife UCL	2.760171
		95% Standard Bootstrap UCL	2.73863
Anderson-Darling Test Statistic	2.5393637	95% Bootstrap-t UCL	3.8479583
Anderson-Darling 5% Critical Value	0.7551491	95% Hall's Bootstrap UCL	5.8585331
Kolmogorov-Smirnov Test Statistic	0.2309329	95% Percentile Bootstrap UCL	2.7510294
Kolmogorov-Smirnov 5% Critical Value	0.1522378	95% BCA Bootstrap UCL	2.9063235
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	3.6703222
		97.5% Chebyshev(Mean, Sd) UCL	4.3140913
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5.578651
95% Approximate Gamma UCL	2.6348531		
95% Adjusted Gamma UCL	2.6596232		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	3.6703222

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

Barium			
General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	32
Raw Statistics		**Log-transformed Statistics**	
Minimum	24.2	Minimum of Log Data	3.1863526
Maximum	67.8	Maximum of Log Data	4.2165622
Mean	49.938235	Mean of log Data	3.8846652
Median	48.85	SD of log Data	0.2421553
SD	10.836862		
Coefficient of Variation	0.2170053		
Skewness	-0.310361		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9498709	Shapiro Wilk Test Statistic	0.8925395
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	53.083498	95% H-UCL	53.973615
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	59.216423
95% Adjusted-CLT UCL (Chen-1995)	52.889507	97.5% Chebyshev (MVUE) UCL	63.181076
95% Modified-t UCL (Johnson-1978)	53.067011	99% Chebyshev (MVUE) UCL	70.968869
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	17.622471	**Data appear Normal at 5% Significance Level**	
Theta Star	2.8337816		
MLE of Mean	49.938235		
MLE of Standard Deviation	11.895968		
nu star	1198.328		
Approximate Chi Square Value (.05)	1118.9561	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	52.995207
Adjusted Chi Square Value	1115.1792	95% Jackknife UCL	53.083498
		95% Standard Bootstrap UCL	52.942009
Anderson-Darling Test Statistic	0.6380599	95% Bootstrap-t UCL	53.085037
Anderson-Darling 5% Critical Value	0.7463422	95% Hall's Bootstrap UCL	52.874439
Kolmogorov-Smirnov Test Statistic	0.1228212	95% Percentile Bootstrap UCL	52.973529
Kolmogorov-Smirnov 5% Critical Value	0.1506652	95% BCA Bootstrap UCL	52.7
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	58.039278
		97.5% Chebyshev(Mean, Sd) UCL	61.544605
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	68.430142
95% Approximate Gamma UCL	53.480549		
95% Adjusted Gamma UCL	53.661677		
Potential UCL to Use		Use 95% Student's-t UCL	53.083498
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Beryllium

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	33
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.107	Minimum of Log Data	-2.234926
Maximum	0.404	Maximum of Log Data	-0.90634
Mean	0.2191471	Mean of log Data	-1.55789
Median	0.2215	SD of log Data	0.2897158
SD	0.0625746		
Coefficient of Variation	0.2855371		
Skewness	0.6029522		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9694524	Shapiro Wilk Test Statistic	0.9850913
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.2373086	95% H-UCL	0.2403912
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.2675834
95% Adjusted-CLT UCL (Chen-1995)	0.2379845	97.5% Chebyshev (MVUE) UCL	0.2884651
95% Modified-t UCL (Johnson-1978)	0.2374935	99% Chebyshev (MVUE) UCL	0.3294834
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	11.601453	**Data appear Normal at 5% Significance Level**	
Theta Star	0.0188896		
MLE of Mean	0.2191471		
MLE of Standard Deviation	0.0643398		
nu star	788.89881		
Approximate Chi Square Value (.05)	724.71938	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	0.2367987
Adjusted Chi Square Value	721.68903	95% Jackknife UCL	0.2373086
		95% Standard Bootstrap UCL	0.2364174
Anderson-Darling Test Statistic	0.2194841	95% Bootstrap-t UCL	0.2393742
Anderson-Darling 5% Critical Value	0.7473156	95% Hall's Bootstrap UCL	0.2382282
Kolmogorov-Smirnov Test Statistic	0.0991918	95% Percentile Bootstrap UCL	0.2369706
Kolmogorov-Smirnov 5% Critical Value	0.150829	95% BCA Bootstrap UCL	0.2377059
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.2659244
		97.5% Chebyshev(Mean, Sd) UCL	0.286165
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.3259237
95% Approximate Gamma UCL	0.2385542		
95% Adjusted Gamma UCL	0.2395559		
Potential UCL to Use		Use 95% Student's-t UCL	0.2373086

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

Boron			
General Statistics			
Number of Valid Data	34	Number of Detected Data	18
Number of Distinct Detected Data	18	Number of Non-Detect Data	16
		Percent Non-Detects	47.06%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.25	Minimum Detected	-1.386294
Maximum Detected	1.63	Maximum Detected	0.48858
Mean of Detected	0.5683889	Mean of Detected	-0.7153
SD of Detected	0.3759291	SD of Detected	0.525025
Minimum Non-Detect	0.24	Minimum Non-Detect	-1.427116
Maximum Non-Detect	0.56	Maximum Non-Detect	-0.579818
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	85.29%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.7432749	Shapiro Wilk Test Statistic	0.8989897
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.4115	Mean	-1.077982
SD	0.3206587	SD	0.5806544
95% DL/2 (t) UCL	0.5045672	95% H-Stat (DL/2) UCL	0.4933023
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.982052
		SD in Log Scale	0.5274643
		Mean in Original Scale	0.4384012
		SD in Original Scale	0.3102444
		95% t UCL	0.5284458
		95% Percentile Bootstrap UCL	0.5276188
		95% BCA Bootstrap UCL	0.552365

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	2.9398719	Data appear Lognormal at 5% Significance Level	
Theta Star	0.193338		
nu star	105.83539		
A-D Test Statistic	1.0884102	Nonparametric Statistics	
5% A-D Critical Value	0.7442231	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7442231	Mean	0.4553039
5% K-S Critical Value	0.204817	SD	0.2974645
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0538754
		95% KM (t) UCL	0.5464805
Assuming Gamma Distribution		95% KM (z) UCL	0.5439211
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.5425405
Minimum	0.2455044	95% KM (bootstrap t) UCL	0.5845412
Maximum	1.63	95% KM (BCA) UCL	0.5589415
Mean	0.5569398	95% KM (Percentile Bootstrap) UCL	0.5492392
Median	0.5122221	95% KM (Chebyshev) UCL	0.6901414
SD	0.2875787	97.5% KM (Chebyshev) UCL	0.7917558
k star	4.7234622	99% KM (Chebyshev) UCL	0.9913575
Theta star	0.1179092		
Nu star	321.19543	Potential UCLs to Use	
AppChi2	280.6735	95% KM (t) UCL	0.5464805
95% Gamma Approximate UCL	0.6373473	95% KM (% Bootstrap) UCL	0.5492392
95% Adjusted Gamma UCL	0.6416181		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Cadmium

General Statistics			
Number of Valid Data	34	Number of Detected Data	33
Number of Distinct Detected Data	31	Number of Non-Detect Data	1
		Percent Non-Detects	2.94%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.033	Minimum Detected	-3.411248
Maximum Detected	0.0802	Maximum Detected	-2.523232
Mean of Detected	0.0572606	Mean of Detected	-2.884612
SD of Detected	0.0124313	SD of Detected	0.2293023
Minimum Non-Detect	0.051	Minimum Non-Detect	-2.97593
Maximum Non-Detect	0.051	Maximum Non-Detect	-2.97593

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.9731559	Shapiro Wilk Test Statistic	0.9562063
5% Shapiro Wilk Critical Value	0.931	5% Shapiro Wilk Critical Value	0.931
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0563265	Mean	-2.907685
SD	0.0133986	SD	0.2628417
95% DL/2 (t) UCL	0.0602153	95% H-Stat (DL/2) UCL	0.0613126
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0565388	Mean in Log Scale	-2.891441
SD	0.0128617	SD in Log Scale	0.2292852
95% MLE (t) UCL	0.0602718	Mean in Original Scale	0.0568794
95% MLE (Tiku) UCL	0.0606457	SD in Original Scale	0.0124417
		95% t UCL	0.0604904
		95% Percentile Bootstrap UCL	0.0603441
		95% BCA Bootstrap UCL	0.060247
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	18.746355	Data appear Normal at 5% Significance Level	
Theta Star	0.0030545		
nu star	1237.2594		
A-D Test Statistic	0.313126	Nonparametric Statistics	
5% A-D Critical Value	0.7457349	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7457349	Mean	0.0568529
5% K-S Critical Value	0.1529028	SD	0.0123242
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0021537
		95% KM (t) UCL	0.0604977
Assuming Gamma Distribution		95% KM (z) UCL	0.0603954
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0604986
Minimum	0.033	95% KM (bootstrap t) UCL	0.0605499
Maximum	0.0802	95% KM (BCA) UCL	0.0601225
Mean	0.056926	95% KM (Percentile Bootstrap) UCL	0.0604253
Median	0.0559	95% KM (Chebyshev) UCL	0.0662406
SD	0.0123961	97.5% KM (Chebyshev) UCL	0.0703027
k star	18.85093	99% KM (Chebyshev) UCL	0.0782818
Theta star	0.0030198		
Nu star	1281.8632	Potential UCLs to Use	
AppChi2	1199.7314	95% KM (t) UCL	0.0604977
95% Gamma Approximate UCL	0.060823	95% KM (Percentile Bootstrap) UCL	0.0604253
95% Adjusted Gamma UCL	0.061022		

Note: DL/2 is not a recommended method.

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

Chloride

General Statistics

Number of Valid Data	34	Number of Detected Data	9
Number of Distinct Detected Data	8	Number of Non-Detect Data	25
		Percent Non-Detects	73.53%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	3.06	Minimum Detected	1.1184149
Maximum Detected	5.46	Maximum Detected	1.6974488
Mean of Detected	3.7277778	Mean of Detected	1.300222
SD of Detected	0.7469066	SD of Detected	0.1813824
Minimum Non-Detect	2.7	Minimum Non-Detect	0.9932518
Maximum Non-Detect	3	Maximum Non-Detect	1.0986123
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	25
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	73.53%

Warning: There are only 9 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

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

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.8126744	Shapiro Wilk Test Statistic	0.8678055
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.0617647	Mean	0.62326
SD	1.0796	SD	0.4223032
95% DL/2 (t) UCL	2.375105	95% H-Stat (DL/2) UCL	2.341269
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	2.1786566	Mean in Log Scale	0.7883066
SD	1.2740879	SD in Log Scale	0.3946869
95% MLE (t) UCL	2.5484445	Mean in Original Scale	2.3757919
95% MLE (Tiku) UCL	2.8914696	SD in Original Scale	0.987602
		95% t UCL	2.6624309
		95% Percentile Bootstrap UCL	2.6613528
		95% BCA Bootstrap UCL	2.7042905

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	21.565445	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.1728588		
nu star	388.178		
A-D Test Statistic	0.569444	Nonparametric Statistics	
5% A-D Critical Value	0.7207864	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7207864	Mean	3.2367647
5% K-S Critical Value	0.2788011	SD	0.4669659
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0849419
		95% KM (t) UCL	3.380517
Assuming Gamma Distribution		95% KM (z) UCL	3.3764817
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.3743339
Minimum	2.9558579	95% KM (bootstrap t) UCL	3.5020062
Maximum	5.46	95% KM (BCA) UCL	3.5591176
Mean	3.9730543	95% KM (Percentile Bootstrap) UCL	3.485
Median	4.0604073	95% KM (Chebyshev) UCL	3.6070179
SD	0.553581	97.5% KM (Chebyshev) UCL	3.7672267
k star	47.850977	99% KM (Chebyshev) UCL	4.081926
Theta star	0.0830297		
Nu star	3253.8665	Potential UCLs to Use	
AppChi2	3122.322	95% KM (t) UCL	3.380517
95% Gamma Approximate UCL	4.1404404		
95% Adjusted Gamma UCL	4.1488662		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Melchie, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Chromium

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	34
Raw Statistics		**Log-transformed Statistics**	
Minimum	1.24	Minimum of Log Data	0.2151114
Maximum	6.62	Maximum of Log Data	1.8900954
Mean	2.8497059	Mean of log Data	0.9557251
Median	2.455	SD of log Data	0.4259817
SD	1.3122141		
Coefficient of Variation	0.4604735		
Skewness	1.1895386		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8832814	Shapiro Wilk Test Statistic	0.9660617
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	3.2305595	95% H-UCL	3.2743474
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.7740197
95% Adjusted-CLT UCL (Chen-1995)	3.2689236	97.5% Chebyshev (MVUE) UCL	4.1784626
95% Modified-t UCL (Johnson-1978)	3.2382111	99% Chebyshev (MVUE) UCL	4.9729123
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	5.1495774	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.5533864		
MLE of Mean	2.8497059		
MLE of Standard Deviation	1.255782		
nu star	350.17127		
Approximate Chi Square Value (.05)	307.80821	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	3.2198685
Adjusted Chi Square Value	305.84955	95% Jackknife UCL	3.2305595
		95% Standard Bootstrap UCL	3.210944
Anderson-Darling Test Statistic	0.6481955	95% Bootstrap-t UCL	3.2882036
Anderson-Darling 5% Critical Value	0.7489036	95% Hall's Bootstrap UCL	3.2592354
Kolmogorov-Smirnov Test Statistic	0.1359192	95% Percentile Bootstrap UCL	3.2514706
Kolmogorov-Smirnov 5% Critical Value	0.1512371	95% BCA Bootstrap UCL	3.2776471
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	3.830645
		97.5% Chebyshev(Mean, Sd) UCL	4.2550982
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5.0888542
95% Approximate Gamma UCL	3.2419055		
95% Adjusted Gamma UCL	3.2626666		
Potential UCL to Use		Use 95% Approximate Gamma UCL	3.2419055

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

Cobalt

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	32
Raw Statistics		**Log-transformed Statistics**	
Minimum	5.78	Minimum of Log Data	1.7544037
Maximum	12.1	Maximum of Log Data	2.4932055
Mean	9.0797059	Mean of log Data	2.1935518
Median	9.295	SD of log Data	0.1647171
SD	1.3910787		
Coefficient of Variation	0.1532075		
Skewness	-0.528789		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9645105	Shapiro Wilk Test Statistic	0.9233598
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	9.483449	95% H-UCL	9.5519463
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	10.21043
95% Adjusted-CLT UCL (Chen-1995)	9.4489982	97.5% Chebyshev (MVUE) UCL	10.697054
95% Modified-t UCL (Johnson-1978)	9.4798431	99% Chebyshev (MVUE) UCL	11.652934
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	36.670605	Data appear Normal at 5% Significance Level	
Theta Star	0.2476017		
MLE of Mean	9.0797059		
MLE of Standard Deviation	1.4993836		
nu star	2493.6012		
Approximate Chi Square Value (.05)	2378.5895	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	9.4721154
Adjusted Chi Square Value	2373.061	95% Jackknife UCL	9.483449
		95% Standard Bootstrap UCL	9.4644535
Anderson-Darling Test Statistic	0.7019589	95% Bootstrap-t UCL	9.4796356
Anderson-Darling 5% Critical Value	0.7451493	95% Hall's Bootstrap UCL	9.4683609
Kolmogorov-Smirnov Test Statistic	0.1302351	95% Percentile Bootstrap UCL	9.4470588
Kolmogorov-Smirnov 5% Critical Value	0.1505376	95% BCA Bootstrap UCL	9.4261765
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	10.1196
		97.5% Chebyshev(Mean, Sd) UCL	10.569563
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	11.453428
95% Approximate Gamma UCL	9.5187359		
95% Adjusted Gamma UCL	9.5409114		
Potential UCL to Use		Use 95% Student's-t UCL	9.483449

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

Copper

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	28
Raw Statistics		**Log-transformed Statistics**	
Minimum	8.5	Minimum of Log Data	2.1400662
Maximum	18.5	Maximum of Log Data	2.9177707
Mean	14.066471	Mean of log Data	2.6293946
Median	14.1	SD of log Data	0.1773197
SD	2.3064165		
Coefficient of Variation	0.1639655		
Skewness	-0.482205		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9672702	Shapiro Wilk Test Statistic	0.9223538
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	14.735879	95% H-UCL	14.860586
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.955941
95% Adjusted-CLT UCL (Chen-1995)	14.682136	97.5% Chebyshev (MVUE) UCL	16.768324
95% Modified-t UCL (Johnson-1978)	14.730427	99% Chebyshev (MVUE) UCL	18.364092
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	31.830745	Data appear Normal at 5% Significance Level	
Theta Star	0.4419146		
MLE of Mean	14.066471		
MLE of Standard Deviation	2.4932265		
nu star	2164.4906		
Approximate Chi Square Value (.05)	2057.4164	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	14.717088
Adjusted Chi Square Value	2052.2781	95% Jackknife UCL	14.735879
		95% Standard Bootstrap UCL	14.69951
Anderson-Darling Test Statistic	0.59395	95% Bootstrap-t UCL	14.739231
Anderson-Darling 5% Critical Value	0.745436	95% Hall's Bootstrap UCL	14.712644
Kolmogorov-Smirnov Test Statistic	0.1452292	95% Percentile Bootstrap UCL	14.707647
Kolmogorov-Smirnov 5% Critical Value	0.1505666	95% BCA Bootstrap UCL	14.652941
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	15.790621
		97.5% Chebyshev(Mean, Sd) UCL	16.536662
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	18.002115
95% Approximate Gamma UCL	14.798533		
95% Adjusted Gamma UCL	14.835584		
Potential UCL to Use		Use 95% Student's-t UCL	14.735879

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

Hexavalent Chromium

General Statistics

Number of Valid Data	34	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	33
		Percent Non-Detects	97.06%

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Hexavalent Chromium was not processed!

Lead

General Statistics

Number of Valid Observations	34	Number of Distinct Observations	30

Raw Statistics		**Log-transformed Statistics**	
Minimum	1.26	Minimum of Log Data	0.2311117
Maximum	5.66	Maximum of Log Data	1.7334239
Mean	2.7932353	Mean of log Data	0.9683031
Median	2.56	SD of log Data	0.3508664
SD	0.9836011		
Coefficient of Variation	0.3521368		
Skewness	0.8478007		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9391679	Shapiro Wilk Test Statistic	0.9703896
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	3.0787131	95% H-UCL	3.1320295
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.545519
95% Adjusted-CLT UCL (Chen-1995)	3.0969062	97.5% Chebyshev (MVUE) UCL	3.8701329
95% Modified-t UCL (Johnson-1978)	3.0828008	99% Chebyshev (MVUE) UCL	4.507774

Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	7.9087799	**Data appear Normal at 5% Significance Level**	
Theta Star	0.3531816		
MLE of Mean	2.7932353		
MLE of Standard Deviation	0.9932367		
nu star	537.79704		
Approximate Chi Square Value (.05)	485.01273	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	3.0706994
Adjusted Chi Square Value	482.54222	95% Jackknife UCL	3.0787131
		95% Standard Bootstrap UCL	3.0789416
Anderson-Darling Test Statistic	0.4590063	95% Bootstrap-t UCL	3.1069992
Anderson-Darling 5% Critical Value	0.7480805	95% Hall's Bootstrap UCL	3.1186773
Kolmogorov-Smirnov Test Statistic	0.134486	95% Percentile Bootstrap UCL	3.0717647
Kolmogorov-Smirnov 5% Critical Value	0.1510011	95% BCA Bootstrap UCL	3.0882353
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	3.5285213
		97.5% Chebyshev(Mean, Sd) UCL	3.8466802
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	4.4716417
95% Approximate Gamma UCL	3.0972252		
95% Adjusted Gamma UCL	3.1130823		

Potential UCL to Use		Use 95% Student's-t UCL	3.0787131

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

Manganese

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	29
Raw Statistics		**Log-transformed Statistics**	
Minimum	159	Minimum of Log Data	5.0689042
Maximum	362	Maximum of Log Data	5.8916442
Mean	275.55882	Mean of log Data	5.6047666
Median	281	SD of log Data	0.1766403
SD	43.895324		
Coefficient of Variation	0.1592957		
Skewness	-0.737703		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9457435	Shapiro Wilk Test Statistic	0.8824229
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	288.29889	95% H-UCL	291.12406
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	312.50809
95% Adjusted-CLT UCL (Chen-1995)	286.9236	97.5% Chebyshev (MVUE) UCL	328.36472
95% Modified-t UCL (Johnson-1978)	288.14015	99% Chebyshev (MVUE) UCL	359.51199
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	32.653862	Data appear Normal at 5% Significance Level	
Theta Star	8.438782		
MLE of Mean	275.55882		
MLE of Standard Deviation	48.222203		
nu star	2220.4626		
Approximate Chi Square Value (.05)	2111.9979	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	287.94126
Adjusted Chi Square Value	2106.7912	95% Jackknife UCL	288.29889
		95% Standard Bootstrap UCL	287.73115
Anderson-Darling Test Statistic	0.8796654	95% Bootstrap-t UCL	287.64147
Anderson-Darling 5% Critical Value	0.7453872	95% Hall's Bootstrap UCL	287.47218
Kolmogorov-Smirnov Test Statistic	0.1056324	95% Percentile Bootstrap UCL	287.17647
Kolmogorov-Smirnov 5% Critical Value	0.1505617	95% BCA Bootstrap UCL	287.17647
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	308.37255
		97.5% Chebyshev(Mean, Sd) UCL	322.57108
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	350.46134
95% Approximate Gamma UCL	289.71055		
95% Adjusted Gamma UCL	290.42653		
Potential UCL to Use		Use 95% Student's-t UCL	288.29889

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

Mercury

General Statistics

Number of Valid Data	34	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	33
		Percent Non-Detects	97.06%

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Mercury was not processed!

Molybdenum

General Statistics

Number of Valid Observations	34	Number of Distinct Observations	32

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.206	Minimum of Log Data	-1.579879
Maximum	0.498	Maximum of Log Data	-0.697155
Mean	0.3451471	Mean of log Data	-1.087214
Median	0.3485	SD of log Data	0.2226541
SD	0.0743273		
Coefficient of Variation	0.2153498		
Skewness	0.0936416		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9802731	Shapiro Wilk Test Statistic	0.9736903
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.3667196	95% H-UCL	0.3699833
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.4033883
95% Adjusted-CLT UCL (Chen-1995)	0.3663328	97.5% Chebyshev (MVUE) UCL	0.4284978
95% Modified-t UCL (Johnson-1978)	0.3667538	99% Chebyshev (MVUE) UCL	0.4778204
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	19.628413	Data appear Normal at 5% Significance Level	
Theta Star	0.0175841		
MLE of Mean	0.3451471		
MLE of Standard Deviation	0.0779043		
nu star	1334.7321		
Approximate Chi Square Value (.05)	1250.8998	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	0.3661141
Adjusted Chi Square Value	1246.9037	95% Jackknife UCL	0.3667196
		95% Standard Bootstrap UCL	0.365816
Anderson-Darling Test Statistic	0.1912733	95% Bootstrap-t UCL	0.3684076
Anderson-Darling 5% Critical Value	0.7461587	95% Hall's Bootstrap UCL	0.3666836
Kolmogorov-Smirnov Test Statistic	0.078618	95% Percentile Bootstrap UCL	0.3662647
Kolmogorov-Smirnov 5% Critical Value	0.1506398	95% BCA Bootstrap UCL	0.3645
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.4007101
		97.5% Chebyshev(Mean, Sd) UCL	0.4247523
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.4719784
95% Approximate Gamma UCL	0.368278		
95% Adjusted Gamma UCL	0.3694582		
Potential UCL to Use		Use 95% Student's-t UCL	0.3667196

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

Nickel			
General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	33
Raw Statistics		**Log-transformed Statistics**	
Minimum	3.44	Minimum of Log Data	1.2354715
Maximum	15.1	Maximum of Log Data	2.7146947
Mean	6.5511765	Mean of log Data	1.8431309
Median	6.48	SD of log Data	0.2681527
SD	1.9716256		
Coefficient of Variation	0.3009575		
Skewness	2.363113		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.8076648	Shapiro Wilk Test Statistic	0.9334488
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	7.123416	95% H-UCL	7.1152001
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	7.8694055
95% Adjusted-CLT UCL (Chen-1995)	7.2537759	97.5% Chebyshev (MVUE) UCL	8.4444861
95% Modified-t UCL (Johnson-1978)	7.1462551	99% Chebyshev (MVUE) UCL	9.5741206
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	12.654899	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	0.5176791		
MLE of Mean	6.5511765		
MLE of Standard Deviation	1.8415773		
nu star	860.53316		
Approximate Chi Square Value (.05)	793.45099	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	7.1073525
Adjusted Chi Square Value	790.27802	95% Jackknife UCL	7.123416
		95% Standard Bootstrap UCL	7.1015945
Anderson-Darling Test Statistic	0.7508407	95% Bootstrap-t UCL	7.3306557
Anderson-Darling 5% Critical Value	0.7471453	95% Hall's Bootstrap UCL	8.8441211
Kolmogorov-Smirnov Test Statistic	0.1276583	95% Percentile Bootstrap UCL	7.1144118
Kolmogorov-Smirnov 5% Critical Value	0.1508003	95% BCA Bootstrap UCL	7.2926471
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	8.0250554
		97.5% Chebyshev(Mean, Sd) UCL	8.6628039
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9.9155375
95% Approximate Gamma UCL	7.1050444		
95% Adjusted Gamma UCL	7.1335713		
Potential UCL to Use		Use 95% Approximate Gamma UCL	7.1050444
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)			
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.			

Selenium

General Statistics			
Number of Valid Data	34	Number of Detected Data	17
Number of Distinct Detected Data	16	Number of Non-Detect Data	17
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.251	Minimum Detected	-1.382302
Maximum Detected	0.359	Maximum Detected	-1.024433
Mean of Detected	0.3044118	Mean of Detected	-1.194745
SD of Detected	0.032191	SD of Detected	0.1074373
Minimum Non-Detect	0.23	Minimum Non-Detect	-1.469676
Maximum Non-Detect	0.28	Maximum Non-Detect	-1.272966
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	21
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	13
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	61.76%

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.959949	Shapiro Wilk Test Statistic	0.9520849
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.2177941	Mean	-1.613614
SD	0.0908538	SD	0.4332327
95% DL/2 (t) UCL	0.2441633	95% H-Stat (DL/2) UCL	0.2522503
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.2675509	Mean in Log Scale	-1.322938
SD	0.0488606	SD in Log Scale	0.1594687
95% MLE (t) UCL	0.2817321	Mean in Original Scale	0.2696887
95% MLE (Tiku) UCL	0.2880215	SD in Original Scale	0.043643
		95% t UCL	0.2823555
		95% Percentile Bootstrap UCL	0.2817773
		95% BCA Bootstrap UCL	0.2824266
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	76.837643	Data appear Normal at 5% Significance Level	
Theta Star	0.0039618		
nu star	2612.4799		
A-D Test Statistic	0.328807	Nonparametric Statistics	
5% A-D Critical Value	0.736308	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.736308	Mean	0.2784661
5% K-S Critical Value	0.2084327	SD	0.034181
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0060738
		95% KM (t) UCL	0.2887451
Assuming Gamma Distribution		95% KM (z) UCL	0.2884566
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.2875379
Minimum	0.251	95% KM (bootstrap t) UCL	0.2890597
Maximum	0.359	95% KM (BCA) UCL	0.2943529
Mean	0.3032669	95% KM (Percentile Bootstrap) UCL	0.2918113
Median	0.3062372	95% KM (Chebyshev) UCL	0.3049411
SD	0.0239099	97.5% KM (Chebyshev) UCL	0.3163969
k star	149.3114	99% KM (Chebyshev) UCL	0.3388996
Theta star	0.0020311		
Nu star	10153.175	Potential UCLs to Use	
AppChi2	9919.9256	95% KM (t) UCL	0.2887451
95% Gamma Approximate UCL	0.3103976	95% KM (Percentile Bootstrap) UCL	0.2918113
95% Adjusted Gamma UCL	0.3107529		

Note: DL/2 is not a recommended method.

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

Silver			
General Statistics			
Number of Valid Data	34	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	21
		Percent Non-Detects	61.76%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.0259	Minimum Detected	-3.653512
Maximum Detected	0.0877	Maximum Detected	-2.433833
Mean of Detected	0.036	Mean of Detected	-3.384982
SD of Detected	0.0164239	SD of Detected	0.3246401
Minimum Non-Detect	0.025	Minimum Non-Detect	-3.688879
Maximum Non-Detect	0.056	Maximum Non-Detect	-2.882404
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	33
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.06%
UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.5761138	Shapiro Wilk Test Statistic	0.7143385
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0275	Mean	-3.672233
SD	0.0129075	SD	0.391321
95% DL/2 (t) UCL	0.0312462	95% H-Stat (DL/2) UCL	0.0311466
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-3.591904
		SD in Log Scale	0.3112969
		Mean in Original Scale	0.029099
		SD in Original Scale	0.012128
		95% t UCL	0.032619
		95% Percentile Bootstrap UCL	0.0327525
		95% BCA Bootstrap UCL	0.0342341

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	6.5083856	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	0.0055313		
nu star	169.21803		
A-D Test Statistic	1.6460646	**Nonparametric Statistics**	
5% A-D Critical Value	0.7344433	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7344433	Mean	0.031431
5% K-S Critical Value	0.2369377	SD	0.0109881
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0021125
		95% KM (t) UCL	0.0350061
Assuming Gamma Distribution		95% KM (z) UCL	0.0349057
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0347204
Minimum	0.0188154	95% KM (bootstrap t) UCL	0.0399282
Maximum	0.0877	95% KM (BCA) UCL	0.0359879
Mean	0.0372482	95% KM (Percentile Bootstrap) UCL	0.0352371
Median	0.0343622	95% KM (Chebyshev) UCL	0.0406391
SD	0.0121576	97.5% KM (Chebyshev) UCL	0.0446234
k star	10.759815	99% KM (Chebyshev) UCL	0.0524498
Theta star	0.0034618		
Nu star	731.66742	**Potential UCLs to Use**	
AppChi2	669.90329	95% KM (t) UCL	0.0350061
95% Gamma Approximate UCL	0.0406825	95% KM (% Bootstrap) UCL	0.0352371
95% Adjusted Gamma UCL	0.0408601		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Strontium

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	32
Raw Statistics		**Log-transformed Statistics**	
Minimum	12.9	Minimum of Log Data	2.5572273
Maximum	39.8	Maximum of Log Data	3.6838669
Mean	23.311765	Mean of log Data	3.1221792
Median	23.05	SD of log Data	0.2371255
SD	5.4880457		
Coefficient of Variation	0.2354196		
Skewness	0.739636		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9442173	Shapiro Wilk Test Statistic	0.9580526
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	24.904601	95% H-UCL	25.107084
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	27.501961
95% Adjusted-CLT UCL (Chen-1995)	24.987455	97.5% Chebyshev (MVUE) UCL	29.310147
95% Modified-t UCL (Johnson-1978)	24.924499	99% Chebyshev (MVUE) UCL	32.861979
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	17.19407	**Data appear Normal at 5% Significance Level**	
Theta Star	1.3558026		
MLE of Mean	23.311765		
MLE of Standard Deviation	5.6219348		
nu star	1169.1968		
Approximate Chi Square Value (.05)	1090.8098	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	24.859888
Adjusted Chi Square Value	1087.0813	95% Jackknife UCL	24.904601
		95% Standard Bootstrap UCL	24.845667
Anderson-Darling Test Statistic	0.5274465	95% Bootstrap-t UCL	25.019292
Anderson-Darling 5% Critical Value	0.7464115	95% Hall's Bootstrap UCL	25.135162
Kolmogorov-Smirnov Test Statistic	0.1225365	95% Percentile Bootstrap UCL	24.876471
Kolmogorov-Smirnov 5% Critical Value	0.1506769	95% BCA Bootstrap UCL	24.994118
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	27.414326
		97.5% Chebyshev(Mean, Sd) UCL	29.189507
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	32.676508
95% Approximate Gamma UCL	24.986977		
95% Adjusted Gamma UCL	25.072677		
Potential UCL to Use		Use 95% Student's-t UCL	24.904601

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

Sulfate

General Statistics			
Number of Valid Data	34	Number of Detected Data	33
Number of Distinct Detected Data	29	Number of Non-Detect Data	1
		Percent Non-Detects	2.94%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	6.32	Minimum Detected	1.8437192
Maximum Detected	84.2	Maximum Detected	4.4331949
Mean of Detected	24.682727	Mean of Detected	2.9803912
SD of Detected	19.972889	SD of Detected	0.6398403
Minimum Non-Detect	5.5	Minimum Non-Detect	1.7047481
Maximum Non-Detect	5.5	Maximum Non-Detect	1.7047481

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.7188245	Shapiro Wilk Test Statistic	0.9329211
5% Shapiro Wilk Critical Value	0.931	5% Shapiro Wilk Critical Value	0.931
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	24.037647	Mean	2.9224856
SD	20.024393	SD	0.7148382
95% DL/2 (t) UCL	29.849475	95% H-Stat (DL/2) UCL	31.293119
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	23.797349	Mean in Log Scale	2.9335331
SD	20.095072	SD in Log Scale	0.6867626
95% MLE (t) UCL	29.62969	Mean in Original Scale	24.07452
95% MLE (Tiku) UCL	29.292431	SD in Original Scale	19.985121
		95% t UCL	29.87495
		95% Percentile Bootstrap UCL	30.095402
		95% BCA Bootstrap UCL	30.771393

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	2.1733929	Data appear Lognormal at 5% Significance Level	
Theta Star	11.356772		
nu star	143.44393		
A-D Test Statistic	1.5680593	Nonparametric Statistics	
5% A-D Critical Value	0.7569927	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.7569927	Mean	24.142647
5% K-S Critical Value	0.1548828	SD	19.623361
Data not Gamma Distributed at 5% Significance Level		SE of Mean	3.4175582
		95% KM (t) UCL	29.926387
Assuming Gamma Distribution		95% KM (z) UCL	29.76403
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	29.901131
Minimum	1E-12	95% KM (bootstrap t) UCL	32.262709
Maximum	84.2	95% KM (BCA) UCL	30.164118
Mean	23.956765	95% KM (Percentile Bootstrap) UCL	29.994118
Median	16.65	95% KM (Chebyshev) UCL	39.039438
SD	20.118317	97.5% KM (Chebyshev) UCL	45.485291
k star	0.5377051	99% KM (Chebyshev) UCL	58.146922
Theta star	44.553724		
Nu star	36.563947	Potential UCLs to Use	
AppChi2	23.7231	95% KM (Chebyshev) UCL	39.039438
95% Gamma Approximate UCL	36.924089		
95% Adjusted Gamma UCL	37.739124		
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

Tin

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	30
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.219	Minimum of Log Data	-1.518684
Maximum	2.72	Maximum of Log Data	1.0006319
Mean	0.4894118	Mean of log Data	-0.869292
Median	0.3935	SD of log Data	0.4597149
SD	0.441011		
Coefficient of Variation	0.9011041		
Skewness	4.4509984		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.4294203	Shapiro Wilk Test Statistic	0.7450169
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.6174096	95% H-UCL	0.5428497
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.6302172
95% Adjusted-CLT UCL (Chen-1995)	0.6755057	97.5% Chebyshev (MVUE) UCL	0.7019706
95% Modified-t UCL (Johnson-1978)	0.6270319	99% Chebyshev (MVUE) UCL	0.8429161
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.1093903	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.157398		
MLE of Mean	0.4894118		
MLE of Standard Deviation	0.2775472		
nu star	211.43854		
Approximate Chi Square Value (.05)	178.7884	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	0.6138166
Adjusted Chi Square Value	177.30657	95% Jackknife UCL	0.6174096
		95% Standard Bootstrap UCL	0.6132487
Anderson-Darling Test Statistic	4.1046184	95% Bootstrap-t UCL	1.034305
Anderson-Darling 5% Critical Value	0.7528667	95% Hall's Bootstrap UCL	1.2863117
Kolmogorov-Smirnov Test Statistic	0.3066908	95% Percentile Bootstrap UCL	0.6219118
Kolmogorov-Smirnov 5% Critical Value	0.1518357	95% BCA Bootstrap UCL	0.7374706
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.8190873
		97.5% Chebyshev(Mean, Sd) UCL	0.9617382
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1.2419482
95% Approximate Gamma UCL	0.5787876		
95% Adjusted Gamma UCL	0.5836248		
Potential UCL to Use		Use 95% Student's-t UCL	0.6174096
		or 95% Modified-t UCL	0.6270319

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

Uranium

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	32
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.238	Minimum of Log Data	-1.435485
Maximum	0.622	Maximum of Log Data	-0.474815
Mean	0.4232941	Mean of log Data	-0.884076
Median	0.431	SD of log Data	0.2304994
SD	0.090791		
Coefficient of Variation	0.2144867		
Skewness	-0.12669		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9651237	Shapiro Wilk Test Statistic	0.9315861
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.4496451	95% H-UCL	0.4552884
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.4976592
95% Adjusted-CLT UCL (Chen-1995)	0.4485439	97.5% Chebyshev (MVUE) UCL	0.5295846
95% Modified-t UCL (Johnson-1978)	0.4495887	99% Chebyshev (MVUE) UCL	0.5922959
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	18.863601	Data appear Normal at 5% Significance Level	
Theta Star	0.0224397		
MLE of Mean	0.4232941		
MLE of Standard Deviation	0.0974608		
nu star	1282.7249		
Approximate Chi Square Value (.05)	1200.565	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	0.4489054
Adjusted Chi Square Value	1196.6511	95% Jackknife UCL	0.4496451
		95% Standard Bootstrap UCL	0.4478523
Anderson-Darling Test Statistic	0.7274595	95% Bootstrap-t UCL	0.4504409
Anderson-Darling 5% Critical Value	0.7462039	95% Hall's Bootstrap UCL	0.4496511
Kolmogorov-Smirnov Test Statistic	0.1677815	95% Percentile Bootstrap UCL	0.4486765
Kolmogorov-Smirnov 5% Critical Value	0.1506444	95% BCA Bootstrap UCL	0.4480588
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.4911645
		97.5% Chebyshev(Mean, Sd) UCL	0.520532
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.5782189
95% Approximate Gamma UCL	0.452262		
95% Adjusted Gamma UCL	0.4537412		
Potential UCL to Use		Use 95% Student's-t UCL	0.4496451

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

Vanadium

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	31
Raw Statistics		**Log-transformed Statistics**	
Minimum	31.3	Minimum of Log Data	3.4436181
Maximum	69.8	Maximum of Log Data	4.245634
Mean	47.776471	Mean of log Data	3.8349046
Median	46.6	SD of log Data	0.2561829
SD	12.15132		
Coefficient of Variation	0.2543369		
Skewness	0.310923		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9293798	Shapiro Wilk Test Statistic	0.9347314
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	51.303238	95% H-UCL	51.773181
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	57.051805
95% Adjusted-CLT UCL (Chen-1995)	51.322972	97.5% Chebyshev (MVUE) UCL	61.061277
95% Modified-t UCL (Johnson-1978)	51.321758	99% Chebyshev (MVUE) UCL	68.937108
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	14.583539	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	3.2760547		
MLE of Mean	47.776471		
MLE of Standard Deviation	12.510729		
nu star	991.68063		
Approximate Chi Square Value (.05)	919.58169	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	51.204237
Adjusted Chi Square Value	916.1622	95% Jackknife UCL	51.303238
		95% Standard Bootstrap UCL	51.215842
Anderson-Darling Test Statistic	0.5071656	95% Bootstrap-t UCL	51.47479
Anderson-Darling 5% Critical Value	0.7468335	95% Hall's Bootstrap UCL	51.351715
Kolmogorov-Smirnov Test Statistic	0.1112809	95% Percentile Bootstrap UCL	51.088235
Kolmogorov-Smirnov 5% Critical Value	0.1507479	95% BCA Bootstrap UCL	51.397059
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	56.860129
		97.5% Chebyshev(Mean, Sd) UCL	60.790636
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	68.511354
95% Approximate Gamma UCL	51.52234		
95% Adjusted Gamma UCL	51.714642		
Potential UCL to Use		Use 95% Approximate Gamma UCL	51.52234

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

Zinc

General Statistics			
Number of Valid Observations	34	Number of Distinct Observations	32
Raw Statistics		**Log-transformed Statistics**	
Minimum	23.1	Minimum of Log Data	3.1398326
Maximum	50.4	Maximum of Log Data	3.9199912
Mean	38.344118	Mean of log Data	3.6340181
Median	38.5	SD of log Data	0.1665865
SD	5.8214958		
Coefficient of Variation	0.1518224		
Skewness	-0.712076		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.9459672	Shapiro Wilk Test Statistic	0.8878872
Shapiro Wilk Critical Value	0.933	Shapiro Wilk Critical Value	0.933
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	40.033733	95% H-UCL	40.370846
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	43.18265
95% Adjusted-CLT UCL (Chen-1995)	39.856028	97.5% Chebyshev (MVUE) UCL	45.261693
95% Modified-t UCL (Johnson-1978)	40.013413	99% Chebyshev (MVUE) UCL	49.345571
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	36.400861	Data appear Normal at 5% Significance Level	
Theta Star	1.0533849		
MLE of Mean	38.344118		
MLE of Standard Deviation	6.3554005		
nu star	2475.2585		
Approximate Chi Square Value (.05)	2360.6749	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0422	95% CLT UCL	39.986304
Adjusted Chi Square Value	2355.1675	95% Jackknife UCL	40.033733
		95% Standard Bootstrap UCL	39.961079
Anderson-Darling Test Statistic	1.0070244	95% Bootstrap-t UCL	39.827701
Anderson-Darling 5% Critical Value	0.7451653	95% Hall's Bootstrap UCL	39.95028
Kolmogorov-Smirnov Test Statistic	0.2063402	95% Percentile Bootstrap UCL	39.964706
Kolmogorov-Smirnov 5% Critical Value	0.1505392	95% BCA Bootstrap UCL	39.861765
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	42.695948
		97.5% Chebyshev(Mean, Sd) UCL	44.578988
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	48.277856
95% Approximate Gamma UCL	40.205284		
95% Adjusted Gamma UCL	40.299301		
Potential UCL to Use		Use 95% Student's-t UCL	40.033733

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

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