APPENDIX A

FIELD LOGS

TEST PIT INFORMATION

Site ID: 026EP001-01
Geol./Eng. R. McDonald
Date: 07/13/2010

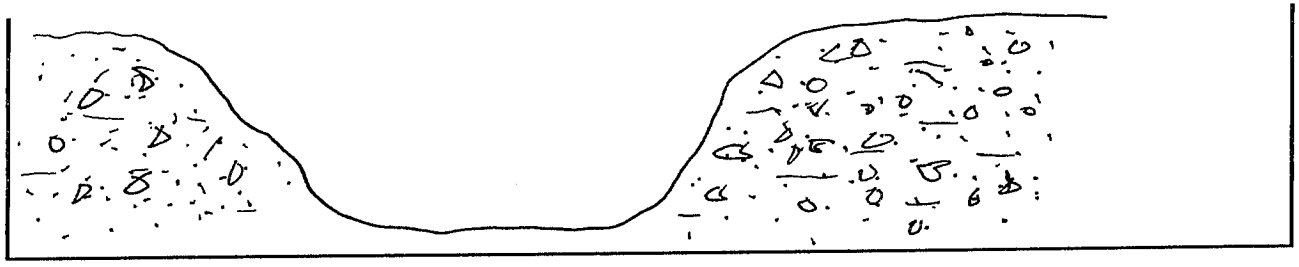
Depth: 14.6'
Width: 32"
Length: 14'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations

Note: Not to scale.

Depth



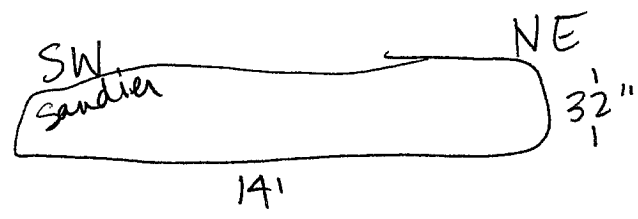
Depth

Depth	Lithology	Depth	Lithology
0-14.6'	Silt's Sand w/ Gravel (SM-GM), dry, loose, lt. reddish brown, higher sand/silt content to southwest, weakly bedded, gravel is subround to v. angular, no visible staining or debris		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thiodiglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	026EP001-01-071320	0.2-0.7	/	dry, loose SM-GM		X	X											

Location Map

N



TEST PIT INFORMATION

Site ID: 028EPU02
Geol./Eng.: R. McDonald
Date: 7/13/2010

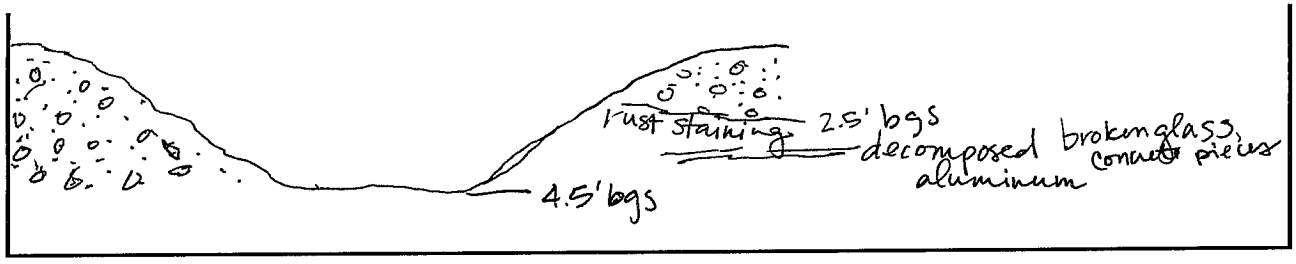
Depth: 4.5'
Width: 32"
Length: 12'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations

Note: Not to scale.

Depth



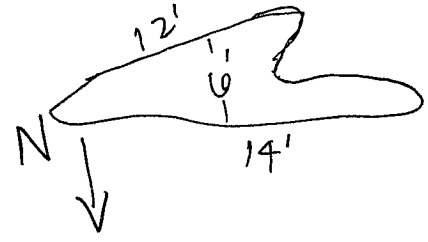
Depth

Depth	Lithology	Depth	Lithology
0-	silt, sand, gravel (pea-cobble-sized), angular to subround (TM)		

Site ID	Field Sample #	Depth (07/13/2010)	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thiodiglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	028EP002-01	0-6"																
	028EP002-02-07132010-FD-MS-SA	2.5-3'																
	028EP002-03-07132010	4.5'																

Location Map

N



TEST PIT INFORMATION

Site ID: 028EP003-01
Geol./Eng. R. McDonald
Date: 07/32/10

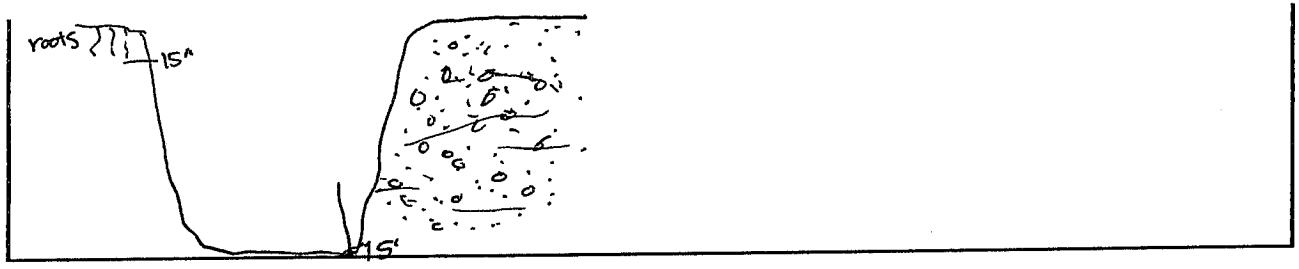
Depth: 15'
Width: 32"
Length: 13'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations

Note: Not to scale.

Depth



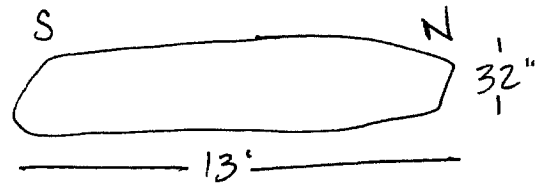
Depth

Depth	Lithology	Depth	Lithology
0'-15'	· Silt, sand, & gravel (GM) dry light reddish brown,		
	- gravel is pea to cobble-sized, subround to v. angular		
	- some poorly-defined bedding		
	- root zone to 15"		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thiodiglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	028EP003-01-07132010	0-15'	–	dry, GM, gravel-rich		X	X											

Location Map

N



TEST PIT INFORMATION

Site ID: 028EP004-01
Geol./Eng. R. McDonald
Date: 07142010

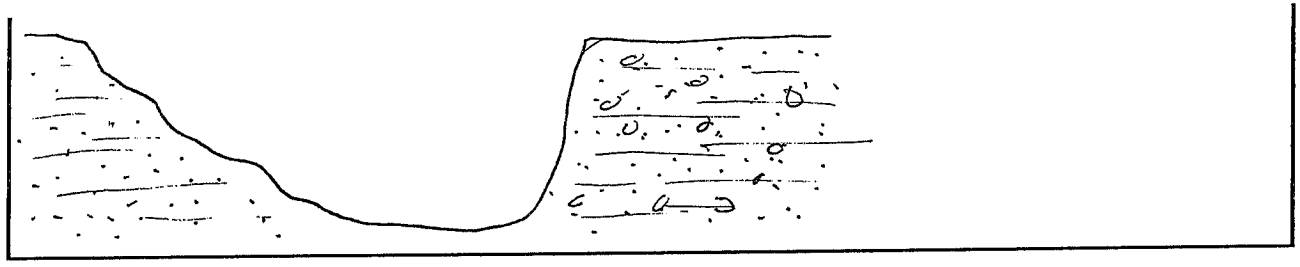
Depth: 7.5'
Width: 32"
Length: 14'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations

Note: Not to scale.

Depth



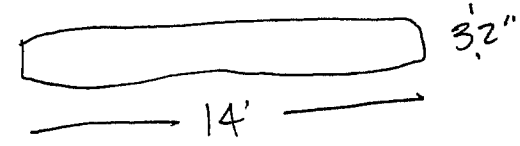
Depth

Depth	Lithology	Depth	Lithology
0-7.5'	Silty Sand & Gravel (GM), loose, dry, root zone to 15", lt reddish brown, weakly bedded, gravel is subround to angular, pea to cobble sized, coarse to med. sand		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/EMPA	Thioglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	028EP004-01-07142010	0.2-0.7	/	as above		X	X											

Location Map

N



TEST PIT INFORMATION

Site ID: 028EP005-01
Geol./Eng. R. McDonald
Date: 07192010

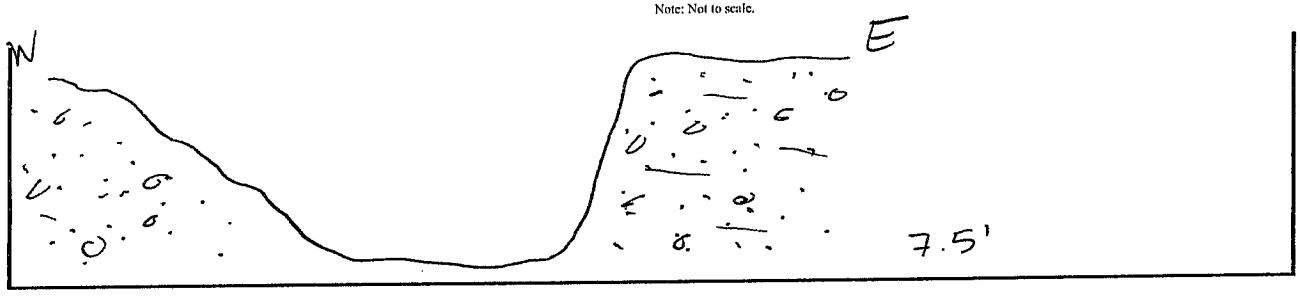
Depth: 7.5'
Width: 32"
Length: 13'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations

Note: Not to scale.

Depth



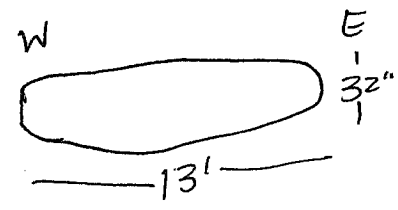
Depth

Depth	Lithology	Depth	Lithology
0-7.5	Silty Sand & Gravel (GM), dry, loose, weakly bedded gravel is subround to angular, pea to cobble sized, max zone to 18", lt reddish brown		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thiodiglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	028EP005-01-07192010	0.2'-0.7'	/	dry, loose, sandy,		X	X											

Location Map

N



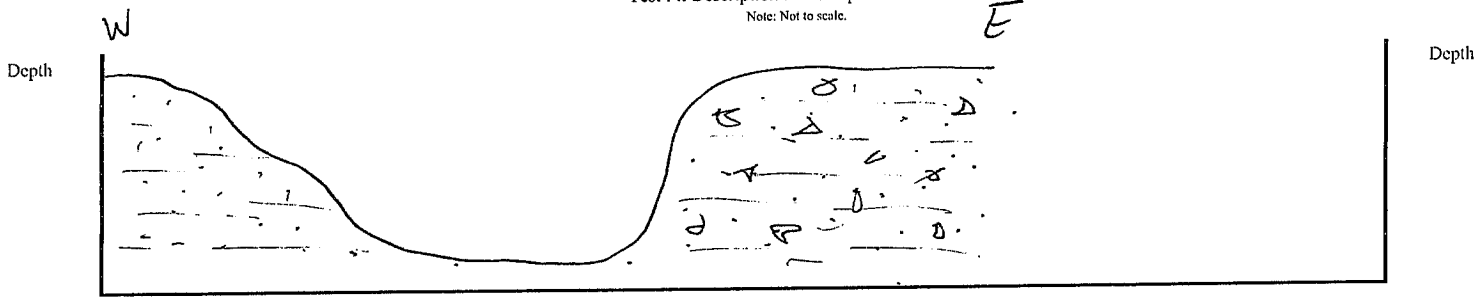
TEST PIT INFORMATION

Site ID: 028BG001
Geol./Eng. R. McDonald
Date: 07142010

Depth: 9'
Width: 32"
Length: 15.5'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations
Note: Not to scale.

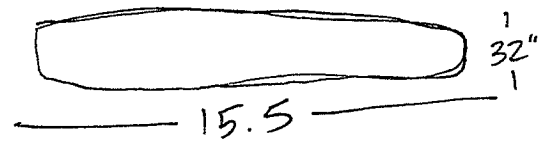


Depth	Lithology	Depth	Lithology
0-9'	silty sand & gravel lt. reddish brown, subround to angular pea to cobble sized, weakly bedded, loose, dry		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thioduglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	028BG001-01-07142010	0.2-0.7	/	SAA				X										
	-02	9.0-5.5	/	SAA				X										

Location Map

N



APPENDIX B

SITE PHOTOGRAPHS

APPENDIX B – TEST PITS

Photograph B-1
Test Pit- 028EP001 – No debris, waste, or contamination observed.
Orientated: Southwest - Northeast
Length – 14 ft; Width – 2.7 ft; Depth – 14.6 ft

Photograph B-2
Test Pit- 028EP002 – Debris on Bottom and Sidewall.
Orientated: East – West
Length – 12 ft; Width – 2.7 ft; Depth – 4.5 ft

Photograph B-3

Test Pit-028EP002 – Encountered debris included (Concrete, broken glass, decomposed aluminum, and rust staining).

Photograph B-4
Test Pit- 028EP003 – No debris, waste, or contamination observed.
Orientated: South - North
Length – 13 ft; Width – 2.7 ft; Depth – 15 ft

Photograph B-5
Test Pit- 028EP004 – No debris, waste, or contamination observed.
Orientated: South - North
Length – 14 ft; Width – 2.7 ft; Depth – 7.5 ft

Photograph B-6
Test Pit- 028EP005 – No debris, waste, or contamination observed.
Orientated: West - East
Length – 13 ft; Width – 2.7 ft; Depth – 7.5 ft

APPENDIX C

ANALYTICAL DATA AND QUALITY CONTROL TABLES

APPENDIX C
DATA QUALITY ASSESSMENT

The purpose of this section is to assess the analytical data quality for the soil samples collected in support of the YPG-028 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). Site-specific quality control (QC) issues are discussed here in terms of precision, accuracy, representation, comparability, and completeness. Data, including data validation flags, are presented in Table C.1. Table C.2 contains explanatory information for Table C.1.

C.1 PRECISION

Precision is controlled through the use of field duplicates and matrix spike duplicates.

C.1.1 Field Duplicates

In accordance with Section A.3.5 of the QAPP (Appendix A of Parsons, 2010), field duplicates are required at a rate of one per 20 samples of the same matrix. Field duplicate frequency was measured program-wide and not per individual site. Thirty-two soil samples were collected at this site during the RFI. One field duplicate was collected associated with these samples. However, a total of 14 field duplicates were collected in association with 240 normal field samples collected program-wide at the inactive landfills and Muggins Mountain OB/OD sites. Therefore, overall field duplicate frequency was met for the RFI. Table C.3 presents the results of the field duplicate sample (028EP002-02) collected at this site.

The field duplicate acceptance limit is defined as 35 Relative Percent Difference (RPD) for soil samples. If excessive exceedances of the RPD limit are identified, required action is to evaluate the sampling program to determine if field sampling protocols are being followed and implement corrective action if required.

One hundred and sixty distinct analytes were tested for in the one field duplicate, generating 169 duplicate pair results (the greater number of results comes from the same analytes being tested for in two methods). Soil test panels included: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), explosives, and metals. The RPD is evaluated when

the concentration in the sample (parent or field duplicate) is greater than or equal to 5 times the Reporting Limit (RL). When concentrations in the parent or field duplicate sample are between the RL and 5 times the RL, these are evaluated by calculating the difference between the parent and field duplicate concentrations (parent - field duplicate). This difference then must be less than 2 times the RL to be in control. Parent and field duplicate concentrations less than the RL are not evaluated. Precision limits were not exceeded for results generated during the YPG-028 RFI sampling, resulting in 100-percent compliance.

Precision was well controlled with respect to field duplicates, since 100-percent of duplicate results met established criteria.

C.1.2 Matrix Spike Duplicates

In accordance with the QAPP (Parsons, 2010), the frequency requirement for matrix spike duplicates is set at one per 20 samples of the same matrix. Because this frequency is not site-specific, and because matrix effects are not generally expected on a site-specific basis, matrix spike duplicates were evaluated on a program basis. Anomalies resulting in data flagged "J" or "UJ" are considered minor, and by definition these anomalies result in 'flagged' usable data. Matrix spike and matrix spike duplicate results associated with YPG-028 are presented on Table C.4.

A program-wide evaluation of matrix spike duplicate precision was conducted for the inactive landfill and Muggins Mountain OB/OD sites. In all, 24 matrix spike and matrix spike duplicate pairs were collected, generating 2,406 result pairs. Of the 2,406 spike duplicate pair results 29 (1.2-percent) were outside control limits (precision was only required to be evaluated when there was a detection in the parent sample). Based on the program-wide evaluation of the spike duplicate precision, it was determined that spike precision was well controlled during the RFIs, since only 1.2-percent of matrix spike duplicate pair results were qualified for RPD exceedances. As shown on Table C.4, 2 of 168 (1.2-percent) results were qualified for matrix spike duplicate precision at YPG-028, which is well within tolerable limits for the purpose of evaluating data usability.

C.2 ACCURACY

Field control of accuracy is monitored by matrix spikes. In accordance with the QAPP (Appendix A of Parsons, 2010), matrix spikes are required at a frequency of one per 20 samples of the same matrix. Matrix spikes were evaluated on a program-wide basis and not per individual site. Of the 240 normal field samples, 24 matrix spike and matrix spike duplicate pairs were collected, meeting the overall frequency requirement for matrix spikes. There were four spike pairs collected in association with the YPG-028 samples. Data flagged as a result of matrix spike recovery issues for YPG-028 during the data evaluation and validation process are summarized in Section C.5 below. Anomalies resulting in data flagged "J" or "UJ" are considered minor, and by definition these anomalies result in usable data. No results flagged for matrix spike recoveries were determined to be unusable data at YPG-028.

A program-wide matrix spike recovery issue with antimony was identified when reviewing the data. Antimony results displayed a matrix effect in soils that biased the concentrations low. Low antimony recoveries have been well documented as an issue with the preparation and analytical method in some soils. The laboratory control samples (or laboratory fortified blanks) were in control, indicating the analysis and sample preparation were in control with respect to antimony. Although a low bias was identified, the data required only 'J' or 'UJ' flagging and are still considered usable results.

Accuracy was determined to be in control with respect to matrix spike and matrix spike duplicate results since no results were 'rejected' ('R'-flagged) and no wide-spread matrix effects were identified, except the antimony issue discussed above.

C.3 REPRESENTATION

Representation is controlled through the Data Quality Objective (DQO) process, and is detailed in the RFI Work Plan (Appendix A of Parsons, 2010). QC guidelines as established in the work plan and associated Standard Operating Procedures (SOPs), and QAPP (Parsons, 2010), describe management of sampling procedures, use of appropriate sample containers, adherence to holding times, use of proper preservation, and sampling of equipment blanks. Table A.3.2 of the QAPP (Parsons, 2010) describes requirements for containers, preservation, and holding

times. Containers and preservation were used in accordance with Table A.3.2. Holding times and equipment blanks were assessed for each analytical result and are discussed here.

C.3.1 Holding Time

Holding times were not exceeded for any of the YPG-028 sampling results.

C.3.2 Field Blanks

Equipment blanks were required at a frequency of one per sampling technique per 20 samples. For purposes of meeting the frequency requirement, "technique" was interpreted in terms of reusable equipment that came in contact with the sample during sampling. One equipment blank was collected in association with the two soil boring samples. Soil samples were collected using one technique which uses reusable equipment, and therefore sufficient equipment blanks were collected. Test panels included VOCs, SVOCs, explosives, and metals. Detections are shown on Table C.5. The impact of blank contamination is dependent on the level of contamination observed and the levels of the corresponding analytes in field samples. Mineral-related chemical species at USAGYPG including sodium, magnesium, and calcium commonly occur at levels orders of magnitude in excess of their MDLs. It is normal for blanks to contain low levels of these analytes under such conditions.

Sample results associated with equipment detections are qualified as non-detect (ND) at or below the level of the detection if they are observed at levels up to five times (10 times for "common laboratory contaminants" [USEPA 1994]) the value contained in the blank. No results were qualified for equipment blank detections. No trip blanks were collected at this site because no water samples were analyzed for VOCs as part of this RFI. Results were deemed representative, consistent with the sample design.

C.4 ANALYTICAL COMPLETENESS

A total of 11.5-percent (169 of 1,474) of analytical results for normal and field duplicate samples were flagged for QC issues; however, no results were rejected. All other results met QC criteria. Completeness is defined in the QAPP (Appendix A of Parsons, 2010) as the percent of usable data. The completeness goal is 95-percent. A total of 1,474 out of 1,474 analytical results were usable, resulting in 100-percent analytical completeness and meeting the goal for this site.

C.5 SUMMARY OF QUALIFIED RESULTS

Results were considered qualified in terms of data usability if they were flagged "U", "UJ", "J", "NJ" or "R" during data validation as outline on Tables A.5.15 and A.5.16 of the QAPP (Appendix A of Parsons, 2010). Flags are defined in Table C.2. Results may be qualified "U" simply because no analyte was detected. Results may be qualified "J" simply because the detected value is between the MDL (method detection limit) and RL (practical quantitation limit [PQL]), (i.e., is a trace value). Flags are also applied due to QC exceedances. This summary does not consider routine flagging of non-detects and trace results. Qualified results were classified as minor if flagged "U", "UJ", or "J", and major if flagged "R" or "NJ". All results are presented in Table C.1.

C.5.1 Minor Data Quality Issues

A total of 169 results were flagged due to minor QC issues. Note that the sum of results below equals more than 169, since some results were flagged for more than one QC issue; however, a total of 169 results were affected. These issues are presented below:

- 41 results (1 1,2,4-trimethylbenzene, 8 2-hexanone, 8 4-bromophenyl phenyl ether, 8 acetone, 7 chloromethane, 1 dichlorodifluoromethane, 7 methyl ethyl ketone [2-butanone], and 1 methylene chloride) were flagged "UJ" or "J" due to calibration issues.
- 25 results (1 1,1-Dichloroethane, 1 1,2-Dichlorobenzene, 1 1,3,5-Trimethylbenzene [Mesitylene], 1 2-Chlorotoluene, 1 4-Chlorotoluene, 1 Acetone, 1 Antimony, 1 Cadmium, 1 Chlorobenzene, 1 Ethylbenzene, 1 Hexachlorobutadiene, 1 Isopropylbenzene [Cumene], 1 Nickel, 1 Selenium, 1 Styrene, 1 Tetrachloroethylene [PCE], 1 Thallium, 1 Trichloroethylene [TCE], 1 Xylenes [Total], 1 m,p-Xylene [Sum Of Isomers], 1 n-Butylbenzene, 1 n-Propylbenzene, 1 p-Cymene [p-Isopropyltoluene], 1 sec-Butylbenzene, 1 trans-1,2-Dichloroethene) were flagged "UJ" or "J" due to matrix spike recoveries.
- 2 results (1 acetone and 1 methyl ethyl ketone [2-butanone]) were flagged "J" due to matrix spike duplicate precision.
- 1 p-cymene (p-isopropyltoluene) results was flagged "UJ" due to laboratory control sample duplicate precision.
- 7 results (3 acetone, 1 methylene chloride, and 3 methyl ethyl ketone [2-butanone]) were flagged "J" due to surrogate recoveries.
- 102 results (8 barium, 8 beryllium, 8 calcium, 8 chromium [total], 8 cobalt, 8 iron, 8 lead, 8 magnesium, 8 manganese, 7 nickel, 8 potassium, 7 sodium, and 8 vanadium) were flagged "J" due to inductively coupled plasma (ICP) serial dilution issues.

C.5.2 Major Data Quality Issue - Acetone and Methyl Ethyl Ketone Results

A total of 16 acetone and methyl ethyl ketone (MEK) results were flagged "NJ" based on professional judgment due to an anomalous issue identified during sampling and analysis of soil samples collected during this RFI. These issues are discussed in the following paragraphs.

C.5.2.1 Introduction

During the summer 2010 RFI activities, soil samples were collected at three of the six inactive landfill sites. The types of samples collected included surface and subsurface (test pit) samples, which were analyzed for VOCs, SVOCs, explosives, and metals. VOC samples were collected using EnCore® samplers and shipped to the laboratory pre-frozen, but on ice, for overnight shipping. Sample receipt temperature was generally low at around 2-3 degrees Celsius. Once at the laboratory, the EnCores® were immediately placed into a freezer.

The VOC laboratory was experiencing a relatively high sample volume during the time these samples were being shipped (throughout most of July 2010). Due to the high sample volume, the laboratory chose to preserve the samples in a sodium bisulfate solution within the 48 hour time period from sample collection, which correctly follows the purge and trap VOC preparation USEPA SW-826 method 5035. Samples were then analyzed by SW-846 method 8260B within the 14 day hold time.

During this sampling event, 64 soil samples were analyzed for VOCs and reported by the laboratory. Upon review of these data, it was noted there were detections of acetone in all 64 samples and MEK was detected in 56 of the 64 samples. Acetone concentrations ranged from 0.0123 to 0.144 mg/kg and MEK concentrations ranged from non-detect to 0.0357 mg/kg. The detections of these constituents appeared to be due to laboratory contamination, since these are common laboratory contaminants. Further evidence to suggest these VOC detections were laboratory contamination was based on the fact that 36 of the 64 samples were collected from the surface soil at USAGYPG where the average surface temperature in July ranges from a high of 107 to a low of 81 degrees Fahrenheit. Additionally, the highest concentrations of acetone were in surface soil samples and the soil type in the surface is mostly sand with very low organic carbon. Under these conditions, it is nearly impossible for concentrations of these volatile chemicals to be present in site soils.

As part of the laboratory's corrective action, a study was conducted to identify the possible source of VOCs in the laboratory. Based upon the results of the study, it was concluded that the concentrations of these VOCs were not due to laboratory contamination. Since laboratory contamination was ruled out, a review of the scientific literature was conducted, which revealed that acetone and MEK production with the addition of sodium bisulfate as a preservative has been documented previously in soils with high organic carbon content. However, at USAGYPG, the organic carbon content in soil is low and consists mostly of sand. Previous studies have postulated the production of the methyl ketones may be the result of microbial activity. However, this has not been proven and may have been overlooked due to the low pH of the sodium bisulfate solution (<2), which should effectively stop all microbial activity.

To verify the detections of these constituents were not laboratory contamination, five sample locations (with previously high acetone and MEK detections) were re-sampled in November 2010 and sent to two separate laboratories (the original and a confirmation laboratory). Both laboratories conducted the same experiment. One set of EnCores® were frozen upon receipt and the other set were placed in sodium bisulfate. The sodium bisulfate samples were held in the refrigerator for 5 days and then analyzed. The frozen samples were analyzed using a deionized (DI) water purge. The confirmation laboratory reported no VOCs in the frozen samples and significant detections of acetone and MEK in the sodium bisulfate samples. The original laboratory did have detections of VOCs in the frozen sample, but were most-likely lab contamination. Based on these results, it was concluded that laboratory contamination was not the source of acetone, but was in fact, an anomalous, unexplained observation. However, it was unknown at this time if the production of methyl ketones was a biotic or abiotic process.

Parsons, in association with Gulf Coast Analytical Laboratories (GCAL) and EMAX laboratories, have documented 64 sample locations at USAGYPG where methyl ketone production has occurred in samples after the addition of sodium bisulfate. However, the mechanism by which these constituents are being produced is unknown. The purpose of this follow-on study is to determine if the production of acetone and MEK are the result of microbial activity or if there is some abiotic process that is occurring.

C.5.2.2 Methods

To determine if this process is biotic or abiotic, the previous five re-sampled locations were sampled a third time in duplicate, collecting two aliquots from each location placing each in a 4 ounce (oz) jar. One set of splits were irradiated with a heavy dose of gamma radiation (39-42.1 kilograys) to ensure the samples were adequately sterilized. Samples did not contain residual radiation - the method used to irradiate the samples is a sterilization technique used for medical equipment and devices used with human patients. The other set of samples was stored in a refrigerator and did not undergo irradiation sterilization.

Both sets of samples were analyzed by EMAX Laboratories following the procedures outlined below. Irradiated and non-irradiated sample splits were treated identically to the greatest extent possible.

1) One five gram aliquot from each sample was placed in a sodium bisulfate solution and the pH of the samples was recorded after one minute of the sodium bisulfate addition (samples maintained pH <2). Sodium bisulfate samples were then placed in the refrigerator for 5 days. After the five days, the samples were pH checked again (samples maintained pH<2 and one at 3) and then analyzed for VOCs using the USEPA SW-846 method 8260B. Methods adhered to the USAGYPG QAPP (Appendix A of Parsons, 2010) and Department of Defense (DoD) Quality Systems Manual (QSM) v.3 for the QA/QC program, with the exception of the sample preparation method (5035) that has been superseded here for the purpose of this experiment.

2) The above procedure (1) was followed a second time; however DI water was used in place of sodium bisulfate.

3) Each sample was also analyzed using a DI water purge method following the methods and procedures described above, with the exception of holding the samples for 5 days.

This sampling designed allowed for differentiation between biotic (non-irradiated samples) and abiotic (irradiated samples) processes. In addition, evaluation of samples stored in sodium bisulfate and DI water enabled an evaluation of the role of sodium bisulfate in the acetone and MEK production.

C.5.2.3 Results

Concentrations of acetone and MEK were elevated in the irradiated samples compared to the non-irradiated samples and were higher than any of the previously reported results. Re-analysis of the samples was conducted to confirm the elevated concentrations, which yielded similar results. In an attempt to remove the acetone and MEK from the irradiated soil samples, both irradiated and non-irradiated samples were placed over-night in an oven and baked for 12 hours at 130 degrees Celsius. The samples were then placed in sodium bisulfate and an additional split sample was also analyzed immediately after removal from the oven. Following the oven treatment, the concentration of acetone increased another 2 fold (approximately 800-µg/kg). The samples were then placed into the oven again and baked for 24 hours at the same temperature and analyzed immediately after. The results of this analysis showed acetone at approximately 1700-µg/kg, another 2-fold increase.

C.5.2.4 Discussion

This experiment was conducted to determine whether biotic or abiotic processes are responsible for the production of acetone and MEK in USAGYPG soils. Parsons and the associated laboratories have repeatedly demonstrated that a process of methyl ketone production is occurring and that this process is somehow related to the sodium bisulfate preservation method. The observed acetone and MEK production in non-irradiated sodium bisulfate samples provides further evidence to support that this process occurs independent of the sampling technique and field preservation, but is a trait inherent to the soil at these USAGYPG sites. The lack of acetone and MEK in the DI preserved samples indicates the phenomenon is related to the sodium bisulfate preservation method. Finally, the elevated concentrations of acetone and MEK in the irradiated samples, along with the increases in acetone after serial oven-treatments, indicate that heat and radiation also cause production of these compounds.

Overall, these results indicate that the addition of radiation, heat, or sodium bisulfate to these soils produced methyl ketones via abiotic processes. Although it is unknown how this reaction is occurring, it has been demonstrated that the acetone and MEK concentrations identified in soils during the RFI are not related to site contamination, but are the result of the inherent naturally occurring complex of the soil matrix reacting with heat, radiation, or sodium bisulfate to produce these constituents.

Independent data validators have reviewed these findings and have qualified the acetone and MEK results with an 'NJ' flag, which indicates the results are potentially false positives. Nevertheless, results were conservatively treated as detections for the purpose of the nature and extent evaluation (Section 4.0) and Risk Assessment (Section 5.0).

C.6 DATA QUALITY CONCLUSIONS

Several minor QC anomalies occurred at YPG-028 that did not significantly impact data usability. Precision, accuracy, representation, and completeness were all substantially under control. While the potentially false positive results for acetone and MEK represented major data quality issues, treatment of the results as valid detections is a conservative approach; data flagged as 'NJ' are considered usable. Overall, the data are suitable for decision-making purposes related to this project such as site characterization, human and ecological risk assessment, and in the determination of corrective action measures.

TABLE C.1
ANALYTICAL DATA
YPG-28
US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location ID	Sample Depth	Sample Type	Sample Date	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-Dinitrotolu	2-Nitrotoluene	3-Nitrotoluene	4-Amino-2,6-Dinitrotolu	4-Nitrotoluene	Hexahydro-1,3,5-Trinitr	Nitrobenzene	Nitroglycerin	Octahydro-1,3,5,7-Tetra	Pentaerythritol Tetranit	Tetryl
028EP001	0.2-0.7	N	13-Jul-10	0.058 J	<0.0042 U	0.023 J	<0.0054 U	<0.0074 U	<0.013 U	<0.013 U	<0.016 U	<0.01 U	<0.018 U	<0.012 U	<0.018 U	<0.015 U	<0.012 U	<0.025 U	<0.01 U
028EP002	0.2-0.7	N	13-Jul-10	<0.01 U	<0.0042 U	<0.019 U	<0.0053 U	<0.0073 U	<0.012 U	<0.013 U	<0.016 U	<0.01 U	<0.018 U	<0.012 U	<0.018 U	<0.015 U	<0.012 U	<0.025 U	<0.01 U
028EP002	2.5-3	N	13-Jul-10	<0.0098 U	<0.0041 U	<0.019 U	<0.0052 U	<0.0072 U	<0.012 U	<0.013 U	<0.015 U	<0.0098 U	<0.018 U	<0.012 U	<0.017 U	<0.015 U	<0.012 U	<0.024 U	<0.0098 U
028EP002	2.5-3	FD	13-Jul-10	<0.01 U	<0.0042 U	<0.02 U	<0.0054 U	<0.0074 U	<0.013 U	<0.013 U	<0.016 U	<0.01 U	<0.018 U	<0.012 U	<0.018 U	<0.015 U	<0.012 U	<0.025 U	<0.01 U
028EP002	4-4.5	N	13-Jul-10	<0.0094 U	<0.0039 U	<0.018 U	<0.005 U	<0.0069 U	<0.012 U	<0.012 U	<0.015 U	<0.0094 U	<0.017 U	<0.011 U	<0.017 U	<0.014 U	<0.011 U	<0.024 U	<0.0094 U
028EP003	0.2-0.7	N	13-Jul-10	<0.01 U	<0.0042 U	<0.02 U	<0.0054 U	<0.0074 U	<0.013 U	<0.013 U	<0.016 U	<0.01 U	<0.018 U	<0.012 U	<0.018 U	<0.015 U	<0.012 U	<0.025 U	<0.01 U
028EP004	0.2-0.7	N	14-Jul-10	<0.01 U	<0.0042 U	<0.019 U	<0.0053 U	<0.0073 U	<0.012 U	<0.013 U	<0.016 U	<0.01 U	<0.018 U	<0.012 U	<0.018 U	<0.015 U	<0.012 U	<0.025 U	<0.01 U
028EP005	0.2-0.7	N	14-Jul-10	<0.0098 U	<0.0041 U	<0.019 U	0.0091 J	<0.0072 U	<0.012 U	<0.013 U	<0.015 U	<0.0098 U	<0.018 U	<0.012 U	<0.017 U	<0.015 U	<0.012 U	<0.024 U	<0.0098 U

Note: Results are in units of mg/kg. See Table C.2 for flag definitions. Sample Type N = Normal; FD = Field Duplicate.

TABLE C.2
USEPA FLAGS FOR ANALYTICAL DATA

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Flag	Description
U	The analyte was not detected above the associated value. [a/]
J	The analyte was detected. The associated value is considered approximate, but usable for decision making purposes.
UJ	The analyte was not detected above the associated value; however, the associated value is considered approximate.
NJ	The analyte was detected at the associated value; however, based on professional judgment the value is considered to be a false positive.
R	The data is unusable for all purposes.

[a/] Associated value is the method detection limit (MDL) unless qualified 'U' based on laboratory/field blank contamination during the data validation. In this case, the value is the result reported by the laboratory.

TABLE C.3

RFI FIELD DUPLICATE RESULTS FOR SOIL

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	2,4-Dinitrophenol	7/13/2010	0	0	1.66	MG/KG	NA
028EP002-02-07132010	Iron	7/13/2010	13800	14800	4.02	MG/KG	6.99
028EP002-02-07132010	1,1,2-Trichloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Bromoform	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	2-Hexanone	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Mercury	7/13/2010	0.019	0.0051	0.01	MG/KG	<5xRL (0.0139)
028EP002-02-07132010	Hexachlorobutadiene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Hexachlorobutadiene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Ethylbenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,2,4-Trichlorobenzene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	2,4-Dinitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	Trichloroethylene (TCE)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Di-n-Octyl Phthalate	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Styrene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Antimony	7/13/2010	0	0	2.41	MG/KG	NA
028EP002-02-07132010	Pyrene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Phenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Phenanthrene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Fluoranthene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	3-Nitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	2,4-Dinitrotoluene	7/13/2010	0	0	0.331	MG/KG	NA

TABLE C.3 (CONTINUED)

RFI FIELD DUPLICATE RESULTS FOR SOIL

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	2-Chlorotoluene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	4-Amino-2,6-Dinitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	Naphthalene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Sodium	7/13/2010	455	449	40.2	MG/KG	1.33
028EP002-02-07132010	2-Methylnaphthalene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Molybdenum	7/13/2010	0.27	0.27	1.2	MG/KG	<5xRL (0)
028EP002-02-07132010	Manganese	7/13/2010	248	271	0.6	MG/KG	8.86
028EP002-02-07132010	Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Magnesium	7/13/2010	4710	5060	4.02	MG/KG	7.16
028EP002-02-07132010	1,2,4-Trichlorobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Chloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Dichlorodifluoromethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	2-Methylphenol (o-Cresol)	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Potassium	7/13/2010	2180	2320	8.03	MG/KG	6.22
028EP002-02-07132010	Isophorone	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Isopropylbenzene (Cumene)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Indeno(1,2,3-c,d)pyrene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Tetryl	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	2,4,5-Trichlorophenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Chloroform	7/13/2010	0	0	0.005	MG/KG	NA

TABLE C.3 (CONTINUED)
RFI FIELD DUPLICATE RESULTS FOR SOIL
YPG-28
US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	Chloromethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Beryllium	7/13/2010	0.41	0.44	0.2	MG/KG	<5xRL (0.03)
028EP002-02-07132010	Fluorene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Copper	7/13/2010	135	136	0.4	MG/KG	0.74
028EP002-02-07132010	2-Chloronaphthalene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	2-Chlorophenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	4-Chlorotoluene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Chlorobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Chrysene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Carbon Disulfide	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	bis(2-Chloroisopropyl) Ether	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Calcium	7/13/2010	28300	28100	30.1	MG/KG	0.71
028EP002-02-07132010	Dibenz(a,h)anthracene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Barium	7/13/2010	153	125	0.4	MG/KG	20.14
028EP002-02-07132010	Arsenic	7/13/2010	5.86	6.12	1.61	MG/KG	<5xRL (0.26)
028EP002-02-07132010	Anthracene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Aluminum	7/13/2010	10700	10900	8.03	MG/KG	1.85
028EP002-02-07132010	Silver	7/13/2010	0	0	0.4	MG/KG	NA
028EP002-02-07132010	Acenaphthylene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Acenaphthene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Acetone	7/13/2010	0.0756	0.0699	0.025	MG/KG	<5xRL (0.0057)

TABLE C.3 (CONTINUED)

RFI FIELD DUPLICATE RESULTS FOR SOIL

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	Cadmium	7/13/2010	0.34	0.69	0.2	MG/KG	<5xRL (0.35)
028EP002-02-07132010	1,2-Dichloropropane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Trichlorofluoromethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Toluene	7/13/2010	0.0018	0.00192	0.005	MG/KG	<5xRL (0.00012)
028EP002-02-07132010	Benzo(k)fluoranthene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Benzo(b)fluoranthene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Benzo(a)anthracene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	sec-Butylbenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	n-Butylbenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Bromomethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,3-Dinitrobenzene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	bis(2-Ethylhexyl) Phthalate	7/13/2010	0.0339	0.0233	0.331	MG/KG	<5xRL (0.0106)
028EP002-02-07132010	4-Nitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	trans-1,3-Dichloropropene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	trans-1,2-Dichloroethene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,3-Dichlorobenzene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,3-Dichlorobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,2-Dichloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,1-Dichloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,2-Dibromo-3-Chloropropane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Dibromochloromethane	7/13/2010	0	0	0.005	MG/KG	NA

TABLE C.3 (CONTINUED)

RFI FIELD DUPLICATE RESULTS FOR SOIL

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	Bromochloromethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	2,6-Dinitrotoluene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,2,4-Trimethylbenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Methylene Chloride	7/13/2010	0	0	0.01	MG/KG	NA
028EP002-02-07132010	Cresols, m & p	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Methyl Ethyl Ketone (2-Butanone)	7/13/2010	0.00842	0.00967	0.005	MG/KG	<5xRL (0.00125)
028EP002-02-07132010	1,2,3-Trichloropropane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,2,3-Trichlorobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,1,1-Trichloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,1,1,2-Tetrachloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	N-Nitrosodi-n-Propylamine	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,2-Dibromoethane (Ethylene Dibromide)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	4-Nitroaniline	7/13/2010	0	0	1.66	MG/KG	NA
028EP002-02-07132010	2,6-Dinitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	Selenium	7/13/2010	0	0	1.61	MG/KG	NA
028EP002-02-07132010	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	1,2-Dichlorobenzene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,2-Dichlorobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Chromium, Total	7/13/2010	11.8	11.8	0.4	MG/KG	0
028EP002-02-07132010	Vanadium	7/13/2010	19.3	20.1	0.8	MG/KG	4.06
028EP002-02-07132010	Naphthalene	7/13/2010	0	0	0.331	MG/KG	NA

TABLE C.3 (CONTINUED)
RFI FIELD DUPLICATE RESULTS FOR SOIL
YPG-28
US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	1,3,5-Trimethylbenzene (Mesitylene)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	4-Chlorophenyl Phenyl Ether	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Thallium	7/13/2010	0	0	0.8	MG/KG	NA
028EP002-02-07132010	Benzyl Alcohol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	N-Nitrosodimethylamine	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,3-Dichloropropane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Bromobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Dimethyl Phthalate	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	4-Nitrophenol	7/13/2010	0	0	1.66	MG/KG	NA
028EP002-02-07132010	2-Nitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	N-Nitrosodiphenylamine	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,1-Dichloroethene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	p-Cymene (p-Isopropyltoluene)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Cobalt	7/13/2010	4.16	4.5	0.4	MG/KG	7.85
028EP002-02-07132010	Benzo(g,h,i)perylene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Benzo(a)pyrene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Benzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	4-Bromophenyl Phenyl Ether	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Benzyl Butyl Phthalate	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Hexachlorobenzene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	4,6-Dinitro-2-Methylphenol	7/13/2010	0	0	1.66	MG/KG	NA

TABLE C.3 (CONTINUED)
RFI FIELD DUPLICATE RESULTS FOR SOIL
YPG-28
US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	cis-1,3-Dichloropropene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Pentachlorophenol	7/13/2010	0	0	1.66	MG/KG	NA
028EP002-02-07132010	1,3,5-Trinitrobenzene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	4-Chloro-3-Methylphenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	t-Butylbenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	o-Xylene (1,2-Dimethylbenzene)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	2,4,6-Trinitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	2,4-Dimethylphenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Zinc	7/13/2010	246	345	0.8	MG/KG	33.5
028EP002-02-07132010	m,p-Xylene (Sum Of Isomers)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Dibromomethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Vinyl Chloride	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,4-Dichlorobenzene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Tetrachloroethylene (PCE)	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Lead	7/13/2010	17.1	18.8	0.6	MG/KG	9.47
028EP002-02-07132010	Nitroglycerin	7/13/2010	0	0	0.49	MG/KG	NA
028EP002-02-07132010	Nitrobenzene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Nitrobenzene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	3-Nitroaniline	7/13/2010	0	0	1.66	MG/KG	NA
028EP002-02-07132010	2-Nitroaniline	7/13/2010	0	0	1.66	MG/KG	NA
028EP002-02-07132010	Nickel	7/13/2010	10	11.4	1.61	MG/KG	13.08

TABLE C.3 (CONTINUED)

RFI FIELD DUPLICATE RESULTS FOR SOIL

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	Xylenes, Total	7/13/2010	0	0	0.01	MG/KG	NA
028EP002-02-07132010	Carbazole	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Carbon Tetrachloride	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	bis(2-Chloroethoxy) Methane	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Di-n-Butyl Phthalate	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	Hexachloroethane	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Pentaerythritol Tetranitrate	7/13/2010	0	0	0.49	MG/KG	NA
028EP002-02-07132010	1,1,2,2-Tetrachloroethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	Dibenzofuran	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	2-Nitrophenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	2,4,6-Trichlorophenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	Bromodichloromethane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	2-Amino-4,6-Dinitrotoluene	7/13/2010	0	0	0.24	MG/KG	NA
028EP002-02-07132010	Diethyl Phthalate	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	2,2-Dichloropropane	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	2,4-Dichlorophenol	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	1,1-Dichloropropene	7/13/2010	0	0	0.005	MG/KG	NA

TABLE C.3 (CONTINUED)

RFI FIELD DUPLICATE RESULTS FOR SOIL

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	LOGDATE	RESULT 1[a/]	RESULT 2	RL[b/]	UNITS	RPD[c/]
028EP002-02-07132010	cis-1,2-Dichloroethylene	7/13/2010	0	0	0.005	MG/KG	NA
028EP002-02-07132010	1,4-Dichlorobenzene	7/13/2010	0	0	0.331	MG/KG	NA
028EP002-02-07132010	n-Propylbenzene	7/13/2010	0	0	0.005	MG/KG	NA

a/ Entries are shown when RESULT 1 is a detection.
b/ MDL is method detection limit.
c/ RPD is relative percent difference. RPD is calculated when RESULT 1 or 2 is >= 5 times the RL. The control limit is 35%. For detections >RL but < 5 times the RL, <5xRL is displayed and the difference between RESULT 1 and RESULT 2 (shown in parentheses [R1-R2]) must be within 2 times the RL. For non-detect results, no RPD is calculated and 'NA' is displayed. Bold RPDs are above the control limit.

TABLE C.4

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE RESULTS
RCRA FACILITY INVESTIGATION - INACTIVE LANDFILLS AND MUGGINS MOUNTAIN OB/OD FACILITY

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Method	Location	Date	Analyte	Matrix	Flag	Matrix Spike % Recovery		Spike Duplicate % Recovery		Spike Limits	RPD	RPD Limits
SW8260B	028EP002	7/13/2010	Acetone	Soil	NJ	* -12		* -109		20-160	**45.69**	30
SW8260B	028EP002	7/13/2010	Benzene	Soil	U	100		77		75-125	79.47	30
SW8260B	028EP002	7/13/2010	Bromobenzene	Soil	U	86		75		65-120	68.64	30
SW8260B	028EP002	7/13/2010	Bromochloromethane	Soil	U	104		89		70-125	70.26	30
SW8260B	028EP002	7/13/2010	Bromodichloromethane	Soil	U	102		85		70-130	72.54	30
SW8260B	028EP002	7/13/2010	Bromoform (tribromomethane)	Soil	U	102		104		55-135	54.85	30
SW8260B	028EP002	7/13/2010	Bromomethane (methyl bromide)	Soil	U	70		57		30-160	74.54	30
SW8260B	028EP002	7/13/2010	n-Butylbenzene	Soil	UJ	77		* 63		65-140	74.75	30
SW8260B	028EP002	7/13/2010	sec-Butylbenzene	Soil	UJ	77		* 61		65-130	76.66	30
SW8260B	028EP002	7/13/2010	tert-Butylbenzene	Soil	U	77		66		65-130	70.22	30
SW8260B	028EP002	7/13/2010	Carbon disulfide	Soil	U	88		64		45-160	83.89	30
SW8260B	028EP002	7/13/2010	Carbon tetrachloride	Soil	U	85		67		65-135	78.40	30
SW8260B	028EP002	7/13/2010	Chlorobenzene	Soil	UJ	90		* 74		75-125	74.14	30
SW8260B	028EP002	7/13/2010	Chloroethane	Soil	U	80		64		40-155	76.22	30
SW8260B	028EP002	7/13/2010	Chloroform	Soil	U	98		73		70-125	82.13	30
SW8260B	028EP002	7/13/2010	Chloromethane	Soil	UJ	86		60		50-130	87.07	30
SW8260B	028EP002	7/13/2010	2-Chlorotoluene	Soil	UJ	82		* 64		70-130	77.96	30
SW8260B	028EP002	7/13/2010	4-Chlorotoluene	Soil	UJ	82		* 67		75-125	74.48	30
SW8260B	028EP002	7/13/2010	p-Cymene (p-Isopropyltoluene)	Soil	UJ	83		* 67		75-135	75.91	30
SW8260B	028EP002	7/13/2010	Dibromochloromethane	Soil	U	104		101		65-130	59.13	30

Method	Location	Date	Analyte	Matrix	Flag	Matrix Spike % Recovery		Spike Duplicate % Recovery	Spike Limits	RPD	RPD Limits
SW8260B	028EP002	7/13/2010	1,2-Dibromo-3-chloropropane	Soil	U	99		138	40-135	24.41	30
SW8260B	028EP002	7/13/2010	1,2-Dibromoethane	Soil	U	106		105	70-125	57.34	30
SW8260B	028EP002	7/13/2010	Dibromomethane (Methylene bromide)	Soil	U	116		112	75-130	59.77	30
SW8260B	028EP002	7/13/2010	1,2-Dichlorobenzene	Soil	UJ	87	*	74	75-120	71.55	30
SW8260B	028EP002	7/13/2010	1,3-Dichlorobenzene	Soil	U	84		75	70-125	66.67	30
SW8260B	028EP002	7/13/2010	1,4-Dichlorobenzene	Soil	U	85		71	70-125	73.52	30
SW8260B	028EP002	7/13/2010	Dichlorodifluoromethane	Soil	U	113		93	35-135	74.46	30
SW8260B	028EP002	7/13/2010	1,1-Dichloroethane	Soil	UJ	91	*	70	75-125	80.58	30
SW8260B	028EP002	7/13/2010	1,2-Dichloroethane	Soil	U	120		100	70-135	72.40	30
SW8260B	028EP002	7/13/2010	1,1-Dichloroethylene	Soil	U	84		71	65-135	72.15	30
SW8260B	028EP002	7/13/2010	cis-1,2-Dichloroethylene	Soil	U	95		80	65-125	71.91	30
SW8260B	028EP002	7/13/2010	trans-1,2-Dichloroethylene	Soil	UJ	87	*	64	65-135	83.15	30
SW8260B	028EP002	7/13/2010	1,2-Dichloropropane	Soil	U	101		86	70-120	71.55	30
SW8260B	028EP002	7/13/2010	1,3-Dichloropropane	Soil	U	101		97	75-125	59.83	30
SW8260B	028EP002	7/13/2010	2,2-Dichloropropane	Soil	U	85		67	65-135	77.40	30
SW8260B	028EP002	7/13/2010	1,1-Dichloropropene	Soil	U	93		70	70-135	81.88	30
SW8260B	028EP002	7/13/2010	cis-1,3-Dichloropropene	Soil	U	108		95	70-125	68.07	30
SW8260B	028EP002	7/13/2010	trans-1,3-Dichloropropene	Soil	U	104		93	65-125	66.83	30
SW8260B	028EP002	7/13/2010	Ethylbenzene	Soil	UJ	83	*	68	75-125	74.41	30
SW8260B	028EP002	7/13/2010	Hexachlorobutadiene	Soil	UJ	61	*	53	55-140	68.06	30
SW8260B	028EP002	7/13/2010	2-Hexanone	Soil	UJ	68		77	45-145	45.42	30
SW8260B	028EP002	7/13/2010	Cumene (isopropylbenzene)	Soil	UJ	90	*	73	75-130	75.36	30
SW8260B	028EP002	7/13/2010	Methylene chloride	Soil	U	102		83	55-140	75.13	30
SW8260B	028EP002	7/13/2010	Methyl ethyl ketone (2-Butanone)	Soil	NJ	58		59	30-160	**40.37**	30
SW8260B	028EP002	7/13/2010	Methyl isobutyl ketone (4-Methyl-2-pentanone)	Soil	U	119		137	45-145	43.24	30
SW8260B	028EP002	7/13/2010	Naphthalene	Soil	U	95		101	40-125	50.75	30

Method	Location	Date	Analyte	Matrix	Flag	Matrix Spike % Recovery		Spike Duplicate % Recovery	Spike Limits	RPD	RPD Limits
SW8260B	028EP002	7/13/2010	n-Propylbenzene	Soil	UJ	75	*	63	65-135	72.14	30
SW8260B	028EP002	7/13/2010	Styrene	Soil	UJ	84	*	72	75-125	70.50	30
SW8260B	028EP002	7/13/2010	1,1,1,2-Tetrachloroethane	Soil	U	89		78	75-125	67.62	30
SW8260B	028EP002	7/13/2010	1,1,2,2-Tetrachloroethane	Soil	U	110		107	55-130	58.98	30
SW8260B	028EP002	7/13/2010	Tetrachloroethylene (PCE)	Soil	UJ	68	*	61	65-140	66.17	30
SW8260B	028EP002	7/13/2010	Toluene	Soil	J	80	*	62	70-125	**75.16**	30
SW8260B	028EP002	7/13/2010	1,2,3-Trichlorobenzene	Soil	U	90		80	60-135	67.23	30
SW8260B	028EP002	7/13/2010	1,2,4-Trichlorobenzene	Soil	U	91		76	65-130	72.14	30
SW8260B	028EP002	7/13/2010	1,1,1-Trichloroethane	Soil	U	91		70	70-135	80.41	30
SW8260B	028EP002	7/13/2010	1,1,2-Trichloroethane	Soil	U	101		99	60-125	58.94	30
SW8260B	028EP002	7/13/2010	Trichloroethylene (TCE)	Soil	UJ	86	*	73	75-125	72.02	30
SW8260B	028EP002	7/13/2010	Trichlorofluoromethane	Soil	U	83		61	25-185	83.04	30
SW8260B	028EP002	7/13/2010	1,2,3-Trichloropropane	Soil	U	113		102	65-130	65.18	30
SW8260B	028EP002	7/13/2010	1,2,4-Trimethylbenzene	Soil	U	88		75	65-135	70.95	30
SW8260B	028EP002	7/13/2010	1,3,5-Trimethylbenzene	Soil	UJ	82	*	64	65-135	78.01	30
SW8260B	028EP002	7/13/2010	Vinyl chloride	Soil	U	76		62	60-125	75.30	30
SW8260B	028EP002	7/13/2010	o-Xylene	Soil	U	88		77	75-125	69.35	30
SW8260B	028EP002	7/13/2010	m,p-Xylene (Sum Of Isomers)	Soil	UJ	84	*	71	75-125	71.01	30
SW8260B	028EP002	7/13/2010	m,p-Xylene (Sum Of Isomers)	Soil	UJ	82	*	69	75-125	71.92	30
SW8270C	028EP002	7/13/2010	Acenaphthene	Soil	U	90		91	45-110	0.99	30
SW8270C	028EP002	7/13/2010	Acenaphthylene	Soil	U	100		104	45-105	4.41	30
SW8270C	028EP002	7/13/2010	Anthracene	Soil	U	94		96	55-105	2.20	30
SW8270C	028EP002	7/13/2010	Benzo[a]anthracene	Soil	U	92		92	50-110	0.65	30
SW8270C	028EP002	7/13/2010	Benzo[a]pyrene	Soil	U	88		92	50-110	3.66	30
SW8270C	028EP002	7/13/2010	Benzo[b]fluoranthene	Soil	U	92		94	45-115	2.58	30
SW8270C	028EP002	7/13/2010	Benzo[g,h,i]perylene	Soil	U	94		92	40-125	1.29	30

Method	Location	Date	Analyte	Matrix	Flag	Matrix Spike % Recovery	Spike Duplicate % Recovery	Spike Limits	RPD	RPD Limits
SW8270C	028EP002	7/13/2010	Benzo[k]fluoranthene	Soil	U	81	83	45-125	1.83	30
SW8270C	028EP002	7/13/2010	Benzyl alcohol	Soil	U	85	87	20-125	3.13	30
SW8270C	028EP002	7/13/2010	Butyl benzyl phthalate	Soil	U	104	103	50-125	0.29	30
SW8270C	028EP002	7/13/2010	bis(2-Chloroethoxy) methane	Soil	U	98	101	45-110	3.00	30
SW8270C	028EP002	7/13/2010	bis(2-Chloroethyl)ether	Soil	U	93	94	45-105	1.92	30
SW8270C	028EP002	7/13/2010	bis(2-Chloroisopropyl) Ether	Soil	U	91	95	20-115	4.19	30
SW8270C	028EP002	7/13/2010	bis(2-ethylhexyl)phthalate	Soil	J	101	101	45-125	0.00	30
SW8270C	028EP002	7/13/2010	4-Bromophenyl phenyl ether	Soil	UJ	127	127	45-115	0.24	30
SW8270C	028EP002	7/13/2010	Carbazole	Soil	U	97	97	45-115	0.62	30
SW8270C	028EP002	7/13/2010	4-Chloro-3-methylphenol	Soil	U	84	88	45-115	4.86	30
SW8270C	028EP002	7/13/2010	2-Chloronaphthalene	Soil	U	92	95	45-105	2.89	30
SW8270C	028EP002	7/13/2010	2-Chlorophenol	Soil	U	82	86	45-105	5.00	30
SW8270C	028EP002	7/13/2010	4-Chlorophenyl phenyl ether	Soil	U	104	106	45-110	2.27	30
SW8270C	028EP002	7/13/2010	Chrysene	Soil	U	91	90	55-110	0.34	30
SW8270C	028EP002	7/13/2010	Cresols, m & p	Soil	U	80	80	40-105	1.12	30
SW8270C	028EP002	7/13/2010	Dibenz[a,h]anthracene	Soil	U	97	96	40-125	0.00	30
SW8270C	028EP002	7/13/2010	Dibenzofuran	Soil	U	92	92	50-105	0.65	30
SW8270C	028EP002	7/13/2010	1,2-Dichlorobenzene	Soil	U	87	89	45-100	2.73	30
SW8270C	028EP002	7/13/2010	1,3-Dichlorobenzene	Soil	U	84	88	40-100	5.22	30
SW8270C	028EP002	7/13/2010	1,4-Dichlorobenzene	Soil	U	85	90	35-105	5.81	30
SW8270C	028EP002	7/13/2010	2,4-Dichlorophenol	Soil	U	89	90	45-110	1.68	30
SW8270C	028EP002	7/13/2010	Diethyl phthalate	Soil	U	103	103	50-115	0.00	30
SW8270C	028EP002	7/13/2010	2,4-Dimethylphenol	Soil	U	69	64	30-105	7.24	30
SW8270C	028EP002	7/13/2010	Dimethyl phthalate	Soil	U	106	106	50-110	0.57	30
SW8270C	028EP002	7/13/2010	Di-n-Butyl Phthalate	Soil	U	106	105	55-110	0.28	30
SW8270C	028EP002	7/13/2010	4,6-Dinitro-2-methylphenol	Soil	U	73	74	30-135	2.04	30

Method	Location	Date	Analyte	Matrix	Flag	Matrix Spike %Recovery	Spike Duplicate %Recovery	Spike Limits	RPD	RPD Limits
SW8270C	028EP002	7/13/2010	2,4-Dinitrophenol	Soil	U	32	32	15-130	0.94	30
SW8270C	028EP002	7/13/2010	2,4-Dinitrotoluene	Soil	U	90	92	50-115	2.96	30
SW8270C	028EP002	7/13/2010	2,6-Dinitrotoluene	Soil	U	91	95	50-110	4.53	30
SW8270C	028EP002	7/13/2010	di-n-Octyl phthalate	Soil	U	102	101	40-130	0.89	30
SW8270C	028EP002	7/13/2010	Fluoranthene	Soil	U	97	97	55-115	0.00	30
SW8270C	028EP002	7/13/2010	Fluorene	Soil	U	91	91	50-110	0.33	30
SW8270C	028EP002	7/13/2010	Hexachlorobenzene	Soil	U	99	98	45-120	0.91	30
SW8270C	028EP002	7/13/2010	Hexachlorobutadiene	Soil	U	95	96	40-115	1.57	30
SW8270C	028EP002	7/13/2010	Hexachloroethane	Soil	U	81	86	35-110	6.47	30
SW8270C	028EP002	7/13/2010	Indeno[1,2,3-cd]pyrene	Soil	U	98	95	40-120	2.17	30
SW8270C	028EP002	7/13/2010	Isophorone	Soil	U	89	92	45-110	2.98	30
SW8270C	028EP002	7/13/2010	2-Methylnaphthalene	Soil	U	87	88	45-105	1.37	30
SW8270C	028EP002	7/13/2010	2-Methylphenol	Soil	U	79	83	40-105	4.07	30
SW8270C	028EP002	7/13/2010	Naphthalene	Soil	U	87	90	40-105	4.07	30
SW8270C	028EP002	7/13/2010	2-Nitroaniline	Soil	U	90	92	45-120	2.62	30
SW8270C	028EP002	7/13/2010	3-Nitroaniline	Soil	U	60	62	25-110	3.44	30
SW8270C	028EP002	7/13/2010	4-Nitroaniline	Soil	U	72	64	35-115	12.23	30
SW8270C	028EP002	7/13/2010	Nitrobenzene	Soil	U	86	88	40-115	2.40	30
SW8270C	028EP002	7/13/2010	2-Nitrophenol	Soil	U	88	90	40-110	3.37	30
SW8270C	028EP002	7/13/2010	4-Nitrophenol	Soil	U	76	78	15-140	3.89	30
SW8270C	028EP002	7/13/2010	N-Nitrosodimethylamine	Soil	U	94	96	20-115	2.20	30
SW8270C	028EP002	7/13/2010	N-Nitrosodi-n-propylamine	Soil	U	92	94	40-115	2.25	30
SW8270C	028EP002	7/13/2010	N-Nitrosodiphenylamine	Soil	U	110	108	50-115	1.39	30
SW8270C	028EP002	7/13/2010	Pentachlorophenol	Soil	U	75	74	25-120	1.21	30
SW8270C	028EP002	7/13/2010	Phenanthrene	Soil	U	94	95	50-110	0.95	30
SW8270C	028EP002	7/13/2010	Phenol	Soil	U	79	82	40-100	4.46	30

Method	Location	Date	Analyte	Matrix	Flag		Matrix Spike % Recovery		Spike Duplicate % Recovery	Spike Limits	RPD	RPD Limits
SW8270C	028EP002	7/13/2010	Pyrene	Soil	U		92		93	45-125	1.29	30
SW8270C	028EP002	7/13/2010	1,2,4-Trichlorobenzene	Soil	U		92		94	45-110	1.93	30
SW8270C	028EP002	7/13/2010	2,4,5-Trichlorophenol	Soil	U		82		90	50-110	9.36	30
SW8270C	028EP002	7/13/2010	2,4,6-Trichlorophenol	Soil	U		88		87	45-110	1.02	30
SW8330	028EP002	7/13/2010	2-Amino-4,6-Dinitrotoluene	Soil	U		99		98	80-125	3.65	20
SW8330	028EP002	7/13/2010	4-Amino-2,6-Dinitrotoluene	Soil	U		102		101	80-125	2.75	20
SW8330	028EP002	7/13/2010	1,3-Dinitrobenzene	Soil	U		96		97	80-125	2.48	20
SW8330	028EP002	7/13/2010	2,4-Dinitrotoluene	Soil	U		98		99	80-125	1.83	20
SW8330	028EP002	7/13/2010	2,6-Dinitrotoluene	Soil	U		94		98	80-120	1.87	20
SW8330	028EP002	7/13/2010	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	Soil	U		92		91	70-135	3.72	20
SW8330	028EP002	7/13/2010	Nitrobenzene	Soil	U		89		103	75-125	11.67	20
SW8330	028EP002	7/13/2010	Nitroglycerin	Soil	U		101		100	70-135	3.56	20
SW8330	028EP002	7/13/2010	2-Nitrotoluene	Soil	U		84		98	80-125	12.51	20
SW8330	028EP002	7/13/2010	3-Nitrotoluene	Soil	U		84		98	75-120	12.75	20
SW8330	028EP002	7/13/2010	4-Nitrotoluene	Soil	U		83		97	75-125	13.13	20
SW8330	028EP002	7/13/2010	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine	Soil	U		99		98	75-125	3.23	20
SW8330	028EP002	7/13/2010	Pentaerythritol Tetranitrate	Soil	U		98		98	70-135	3.05	20
SW8330	028EP002	7/13/2010	Tetryl	Soil	U		98		98	10-150	3.25	20
SW8330	028EP002	7/13/2010	1,3,5-Trinitrobenzene	Soil	U		97		96	75-125	3.91	20
SW8330	028EP002	7/13/2010	2,4,6-Trinitrotoluene	Soil	U		98		97	55-140	3.49	20
SW6010B	028EP002	7/13/2010	Aluminum	Soil			1743		1195	80-120	8.06	20
SW6010B	028EP002	7/13/2010	Antimony	Soil	UJ	*	19	*	18	80-120	2.14	20
SW6010B	028EP002	7/13/2010	Arsenic	Soil			91		95	80-120	3.25	20
SW6010B	028EP002	7/13/2010	Barium	Soil	J		35		-20	80-120	7.12	20
SW6010B	028EP002	7/13/2010	Beryllium	Soil	J		87		85	80-120	2.83	20
SW6010B	028EP002	7/13/2010	Cadmium	Soil	J	*	77	*	76	80-120	1.27	20

Method	Location	Date	Analyte	Matrix	Flag	Matrix Spike %Recovery		Spike Duplicate %Recovery		Spike Limits	RPD	RPD Limits
SW6010B	028EP002	7/13/2010	Calcium	Soil	J		-1593		-2141	80-120	4.48	20
SW6010B	028EP002	7/13/2010	Chromium, Total	Soil	J		89		91	80-120	1.01	20
SW6010B	028EP002	7/13/2010	Cobalt	Soil	J		82		80	80-120	2.44	20
SW6010B	028EP002	7/13/2010	Copper	Soil			189		154	80-120	4.13	20
SW6010B	028EP002	7/13/2010	Iron	Soil	J		996		847	80-120	1.92	20
SW6010B	028EP002	7/13/2010	Lead	Soil	J	*	79		101	80-120	12.50	20
SW6010B	028EP002	7/13/2010	Magnesium	Soil	J		408		219	80-120	7.12	20
SW6010B	028EP002	7/13/2010	Manganese	Soil	J		194		134	80-120	4.27	20
SW7471A	028EP002	7/13/2010	Mercury	Soil			108		108	80-120	0.00	20
SW6010B	028EP002	7/13/2010	Molybdenum	Soil	J	*	70	*	70	80-120	0.00	20
SW6010B	028EP002	7/13/2010	Nickel	Soil	J		83		80	80-120	2.66	20
SW6010B	028EP002	7/13/2010	Potassium	Soil	J		202		154	80-120	6.56	20
SW6010B	028EP002	7/13/2010	Selenium	Soil	UJ	*	77	*	74	80-120	3.97	20
SW6010B	028EP002	7/13/2010	Silver	Soil	U		87		85	75-120	2.31	20
SW6010B	028EP002	7/13/2010	Sodium	Soil	J		89		83	80-120	4.37	20
SW6010B	028EP002	7/13/2010	Thallium	Soil	UJ	*	72	*	71	80-120	2.09	20
SW6010B	028EP002	7/13/2010	Vanadium	Soil	J		102		98	80-120	2.04	20
SW6010B	028EP002	7/13/2010	Zinc	Soil			-5		-60	80-120	4.59	20

Notes:
1) Flag definitions are on Tables C.2.
2) "*" = matrix spike and/or matrix spike duplicate %Recovery is outside control limits.
3) RPD = Relative Percent Difference.
4) Bold RPD results are outside control limit.

TABLE C.5

EQUIPMENT BLANK DETECTED RESULTS

YPG-28

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

SAMPLE ID	ANALYTE	QUALIFIER	RESULT	MDL	RL	UNITS	FLAG
28EB001-01-0714201	Calcium	=	130	28	100	UG/L	
28EB001-01-0714201	Copper	TR	2.6	1.1	10	UG/L	J
28EB001-01-0714201	Diethyl Phthalate	TR	0.239	0.1	10.2	UG/L	J
28EB001-01-0714201	Manganese	TR	1.3	0.6	15	UG/L	J
28EB001-01-0714201	Nickel	TR	1.4	1.2	40	UG/L	J
28EB001-01-0714201	Sodium	TR	170	59	1000	UG/L	J
28EB001-01-0714201	Thallium	TR	5.1	1.5	20	UG/L	J
28EB001-01-0714201	Vanadium	TR	3.3	1.1	20	UG/L	J
28EB001-01-0714201	Zinc	TR	14	4	20	UG/L	J

Notes:
1) 'TR' means a trace detection between the MDL and RL.
2) '=' means detected above the RL.
3) MDL is method detection limit.
4) RL is reporting limit.
5) UG/L is micrograms per liter.
6) Flag definitions are on Table C.2.

APPENDIX D

CALCULATION OF BACKGROUND THRESHOLD VALUES

APPENDIX D

CALCULATION OF BACKGROUND THRESHOLD VALUES

Metals at a site may occur naturally in soils or can be related to past waste disposal or OB/OD activities. When evaluating samples collected from a site, the samples are assumed to come from the same distribution as the background data set until significant evidence of contamination can be shown. One common method to test this is to derive a Background Threshold Value (BTV) for each metal constituent and compare the maximum detected concentrations found at the site to their respective BTVs. If the maximum detected concentration of a chemical at the site exceeds the BTV, the concentration of that chemical is assumed to be at a level which may represent contamination; i.e., it is elevated over background.

This memo presents the results of the calculations of the BTVs for metals in soils at the six inactive landfills at USAGYPG. It is anticipated that the methods for calculating BTVs presented in the RFI Work Plan (Parsons, 2010) are to be used as the remedial goal(s) if the risk-based remedial concentration(s) are below the BTV. The BTV methods presented in the RFI Work Plan (Parsons, 2010) were developed following USEPA (1989a, 1992, 2007) and US Navy (2002) guidance, and have been used to calculate a BTV for 24 metals.

Background samples have been collected as part of the RFIs being conducted at the inactive landfills and Muggins Mountain sites. These data will be used to develop BTVs for use in evaluating remediation goals. All background soil samples will be analyzed for metals using EPA Method 6010B/7471.

To calculate BTVs, the following procedures were followed. For metals that were detected only once, the one detected value was used as the BTV. For chemicals with more than one detect but including non-detects, the upper tolerance limit (UTL) on the 95th percentile with 95% confidence was used as the BTV. The UTL was calculated using the Kaplan-Meier method (USEPA 2006a, 2007b). For chemicals without non-detects, the following steps were followed:

1. The distribution of each metal was tested using the following method the Shapiro-Wilk's test for normal and lognormal distributions (USEPA 2002, 2006b, 2007b) and the Anderson-Darling test for gamma distribution (USEPA 2007b).
2. The UTL was calculated as appropriate for the distribution of each metal (USEPA 1989, 2007b).

All calculations described above were performed using the current version of ProUCL (USEPA, 2007b); i.e., v4.00.002. The outputs for these calculations from ProUCL are provided as Attachment 1 to this Appendix. The data for each background sample is provided as Table D.1 Summary statistics of the ProUCL calculation and the selection of the BTV for each metal for the Inactive Landfills are provided as Table D.1. Attachment 2 has the background test pit logs.

TABLE D.1
BACKGROUND INORGANIC ANALYTICAL RESULTS

US ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location ID	Sample Depth	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
Background Threshold Value				12,000	--	6.6	290	0.92	0.65	37,000	14	7.9	15	15,000	14	6,100	920	0.016	0.49	14	2,500	--	0.062	8400	0.57	26	44
027BG001	0.2-0.7	N	21-Jul-10	2,000	<0.34 U	1.38 J	88.1	<0.00	<0.008	5,120	2.39	1.39	1.94	3,620	3.09	841	93.9	<0.0032	0.15 J	2.58	439	<0.25 U	0.052 J	184 J	<0.09	9.35	11.4
027BG001	9-9.5	N	21-Jul-10	2,190	<0.33 U	1.49 J	61.5	<0.00	0.096 J	9,470	4.26	1.69	2.59	5,270	3.81	1,490	131	<0.0032	0.17 J	2.98	703	<0.25 U	0.056 J	25.1 J	<0.09	13.1	15.2
028BG001	0.2-0.7	N	14-Jul-10	5,140	<0.34 U	5.24	82 J	0.27 J	0.081 J	17,700 J	8.28 J	3.03 J	7.1	9,370 J	5.95 J	3,200 J	158 J	<0.0033	0.075 J	6.32 J	1,480 J	<0.25 U	<0.031	211 J	<0.09	18.8 J	25
028BG001	9-9.5	N	14-Jul-10	5,630	<0.34 U	4.69	69.3 J	0.3 J	0.75	18,200 J	9.13 J	3.41 J	8.13	10,500 J	6.94 J	3,570 J	189 J	<0.0033	0.11 J	7.16 J	1,680 J	<0.25 U	<0.031	753 J	<0.09	17.9 J	27.6
029BG001	0.2-0.7	N	13-Dec-10	4,580	<0.12 U	3.51	71.8	<0.00	0.033 J	12,100	7.37	2.95	5.83	7,810	6.27	3,850	170	<0.0034	0.22 J	6.74	1,100 J	<0.19 U	<0.035	62.4 J	<0.1 U	17	20.7
029BG001	7-7.5	N	13-Dec-10	8,060	<0.13 U	1.6 J	223	0.56	0.079 J	27,100	11	2.34	9.7	7,440	6.06	4,240	113	<0.0038	0.11 J	10.7	1,360 J	<0.22 U	<0.039	1,450 J	<0.11	15.9	30.9
141BG001	0.2-0.7	N	28-Jul-10	3,700	<0.34 UJ	2.89	83.6	<0.00	<0.008	14,300	7.31	2.37	4.02	7,700	4.36 J	2,830	189 J	<0.011 U	0.24 J	4.58	1,280 J	<0.25 U	0.057 J	<59.2 U	0.47 J	21.7	18.7
141BG001	9.5-10	N	28-Jul-10	3,050	<0.34 U	2.35	137	<0.00	0.013 J	14,300	6.04	2.66	3.46	7,110	4.76 J	1,850	218 J	<0.016 U	0.21 J	4.2	900	<0.25 U	<0.031	<66.3 U	0.59 J	21.2	16.2
178BG001	0.2-0.7	N	20-Dec-10	3,150	<0.12 U	2.55	111	<0.00	0.015 J	11,300	5.8	2.29	3.5	6,820	4.51	1,540	157	0.0072 J	0.12 J	3.9	771	<0.19 U	<0.035	93.4	<0.1 U	19.7	15.2
178BG001	7.5-8	N	20-Dec-10	10,800	<0.14 U	4.41	190	0.98	0.15 J	29,800	8.97	7.56	12.9	13,400	12.5	4,330	918	0.012 J	0.41 J	11.4	2,110	<0.23 U	<0.042	2,320	<0.12	16.5	38.8
178BG002	0.2-0.7	N	16-Dec-10	2,790	<0.12 U	1.87	52.9	<0.00	0.029 J	9,420	4.88	1.87	3.25 J	5,460	3.17	2,010	118	<0.0034	0.14 J	3.7	855	<0.19 U	<0.035	49.1	<0.1 U	13.6	13.8
178BG002	8-8.5	N	16-Dec-10	1,370	<0.12 U	1.08 J	60.9	<0.00	<0.009	2,050	3.65	1.32	1.4 J	4,500	2.56	665	88	<0.0035	0.08 J	2.27	284	<0.2 U	0.039 J	43.9	<0.1 U	16	10.3

TABLE D.2

BACKGROUND THRESHOLD VALUES SELECTED FOR THE METALS AT SIX INACTIVE LANDFILLS

YUMA PROVING GROUND, YUMA ARIZONA

Analyte	# of Detections (12 Samples)	BTV (mg/kg)	Distribution Type	Maximum Detection	Minimum Detection	nr_SRL	GPL
Aluminum	12	12000	N	10800	1370	920000	--
Antimony	0	ND	--	--		410	35
Arsenic	12	6.6	N	5.24	1.08	10	290
Barium	12	290	G	223	52.9	170000	12000
Beryllium	4	0.92	N	0.98	0.27	1900	23
Cadmium	9	0.65	G	0.75	0.013	510	29
Calcium	12	37000	N	29800	2050	--	--
Chromium	12	14	N	11	2.39	140000	590
Cobalt	12	7.9	G	7.56	1.32	13000	--
Copper	12	15	N	12.9	1.4	41000	--
Iron	12	15000	N	13400	3620	--	--
Lead	12	14	G	12.5	2.56	800	290
Magnesium	12	6100	N	4330	665	--	--
Manganese	12	920	NP	918	88	32000	--
Mercury	4	0.016	N	0.016	0.0072	310	12
Molybdenum	12	0.49	G	0.41	0.075	5100	--
Nickel	12	14	N	11.4	2.27	20000	590
Potassium	12	2500	N	2110	284	--	--
Selenium	0	ND	--	--		5100	290
Silver	4	0.062	N	0.057	0.039	5100	--
Sodium	12	8400	LN	2320	25.1	--	--
Thallium	2	0.57	NP	0.59	0.47	67	12
Vanadium	12	26	N	21.7	9.35	1000	--
Zinc	12	44	N	38.8	10.3	310000	--

Notes:

Distribution Types:

G = Gamma

N = Normal

NP = Non-parametric

ND = Non-detect

nrSRL = non-residential Soil Remediation Level

GPL = Groundwater Protection Level

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Aluminum

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	1370	Minimum	7.222566
Maximum	10800	Maximum	9.2873014
Second Largest	8060	Second Largest	8.9946688
First Quartile	2640	First Quartile	7.8732619
Median	3425	Median	8.1356229
Third Quartile	5262.5	Third Quartile	8.5675724
Mean	4371.6667	Mean	8.2195969
SD	2742.4436	SD	0.5928981
Coefficient of Variation	0.6273222		
Skewness	1.3704411		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.8765385	Shapiro Wilk Test Statistic	0.9881579
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	11874.992	95% UTL with 95% Coverage	18802.896
95% UPL (t)	9497.8866	95% UPL (t)	11246.943
90% Percentile (z)	7886.2496	90% Percentile (z)	7938.0776
95% Percentile (z)	8882.585	95% Percentile (z)	9846.0685
99% Percentile (z)	10751.545	99% Percentile (z)	14748.316

Gamma Distribution Test		Data Distribution Test
k star	2.4697053	Data appear Normal at 5% Significance Level
Theta Star	1770.1168	
MLE of Mean	4371.6667	
MLE of Standard Deviation	2781.7909	
nu star	59.272926	
A-D Test Statistic	0.2196814	
5% A-D Critical Value	0.7383096	
K-S Test Statistic	0.142838	
5% K-S Critical Value	0.2471889	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	7817
95% Percentile	9293
99% Percentile	10498.6

Assuming Gamma Distribution			
90% Percentile	8097.9575	95% UTL with 95% Coverage	10800
95% Percentile	9714.8976	95% Percentile Bootstrap UTL with 95% Coverage	10800
99% Percentile	13257.555	95% BCA Bootstrap UTL with 95% Coverage	10800
		95% UPL	10800
		95% Chebyshev UPL	16813.82
95% WH Approx. Gamma UPL	10217.111	Upper Threshold Limit Based upon IQR	9196.25
95% HW Approx. Gamma UPL	10406.208		
95% WH Approx. Gamma UTL with 95% Coverage	14616.081		
95% HW Approx. Gamma UTL with 95% Coverage	15328.384		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Antimony

General Statistics

Number of Valid Data	12	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	12

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 Antimony was not processed!

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Arsenic

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	1.08	Minimum	0.076961
Maximum	5.24	Maximum	1.6563215
Second Largest	4.69	Second Largest	1.5454326
First Quartile	1.5725	First Quartile	0.4521968
Median	2.45	Median	0.8952543
Third Quartile	3.735	Third Quartile	1.3126807
Mean	2.755	Mean	0.8905644
SD	1.4099162	SD	0.5228338
Coefficient of Variation	0.5117663		
Skewness	0.6198176		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9123491	Shapiro Wilk Test Statistic	0.9536108
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	6.6125307	95% UTL with 95% Coverage	10.186237
95% UPL (t)	5.3904381	95% UPL (t)	6.4743855
90% Percentile (z)	4.5618803	90% Percentile (z)	4.7616907
95% Percentile (z)	5.0741057	95% Percentile (z)	5.757765
99% Percentile (z)	6.0349555	99% Percentile (z)	8.2223625

Gamma Distribution Test		Data Distribution Test
k star	3.2276131	Data appear Normal at 5% Significance Level
Theta Star	0.8535719	
MLE of Mean	2.755	
MLE of Standard Deviation	1.5334897	
nu star	77.462715	
A-D Test Statistic	0.2963862	**Nonparametric Statistics**
5% A-D Critical Value	0.7349337	90% Percentile 4.662
K-S Test Statistic	0.1372346	95% Percentile 4.9375
5% K-S Critical Value	0.2462922	99% Percentile 5.1795
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	4.8112782	95% UTL with 95% Coverage	5.24
95% Percentile	5.6626965	95% Percentile Bootstrap UTL with 95% Coverage	5.24
99% Percentile	7.5011387	95% BCA Bootstrap UTL with 95% Coverage	5.24
		95% UPL	5.24
		95% Chebyshev UPL	9.1516288
95% WH Approx. Gamma UPL	5.9187702	Upper Threshold Limit Based upon IQR	6.97875
95% HW Approx. Gamma UPL	6.0294445		
95% WH Approx. Gamma UTL with 95% Coverage	8.1809278		
95% HW Approx. Gamma UTL with 95% Coverage	8.5450894		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Barium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	52.9	Minimum	3.9684033
Maximum	223	Maximum	5.4071718
Second Largest	190	Second Largest	5.2470241
First Quartile	67.35	First Quartile	4.208593
Median	82.8	Median	4.4163814
Third Quartile	117.5	Third Quartile	4.7621429
Mean	102.59167	Mean	4.5253288
SD	54.221909	SD	0.4580784
Coefficient of Variation	0.5285216		
Skewness	1.440906		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.8109006	Shapiro Wilk Test Statistic	0.9086069
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	250.94281	95% UTL with 95% Coverage	323.31635
95% UPL (t)	203.94414	95% UPL (t)	217.36464
90% Percentile (z)	172.07984	90% Percentile (z)	166.0651
95% Percentile (z)	191.77877	95% Percentile (z)	196.13451
99% Percentile (z)	228.73069	99% Percentile (z)	267.99772

Gamma Distribution Test		Data Distribution Test
k star	3.7329013	Data appear Gamma Distributed at 5% Significance Level
Theta Star	27.483091	
MLE of Mean	102.59167	
MLE of Standard Deviation	53.099304	
nu star	89.589632	
A-D Test Statistic	0.6492775	
5% A-D Critical Value	0.7323601	
K-S Test Statistic	0.2364604	
5% K-S Critical Value	0.2459755	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	184.7
95% Percentile	204.85
99% Percentile	219.37

Assuming Gamma Distribution			
90% Percentile	173.78127	95% UTL with 95% Coverage	223
95% Percentile	202.57654	95% Percentile Bootstrap UTL with 95% Coverage	223
99% Percentile	264.29023	95% BCA Bootstrap UTL with 95% Coverage	223
		95% UPL	223
		95% Chebyshev UPL	348.59028
95% WH Approx. Gamma UPL	210.30181	Upper Threshold Limit Based upon IQR	192.725
95% HW Approx. Gamma UPL	211.72456		
95% WH Approx. Gamma UTL with 95% Coverage	285.56558		
95% HW Approx. Gamma UTL with 95% Coverage	292.9403		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Beryllium

General Statistics

Number of Valid Data	12	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	8
Tolerance Factor	2.736	Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.27	Minimum Detected	-1.309333
Maximum Detected	0.98	Maximum Detected	-0.020203
Mean of Detected	0.5275	Mean of Detected	-0.778332
SD of Detected	0.3285701	SD of Detected	0.5992496
Minimum Non-Detect	0.0028	Minimum Non-Detect	-5.878136
Maximum Non-Detect	0.0047	Maximum Non-Detect	-5.360193

Data with Multiple Detection Limits

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

Single Detection Limit Scenario

Number treated as Non-Detect with Single DL	8
Number treated as Detected with Single DL	4
Single DL Non-Detect Percentage	66.67%

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.

Background Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.8722721
5% Shapiro Wilk Critical Value	0.748

Data appear Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.9108061
5% Shapiro Wilk Critical Value	0.748

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

Mean		0.1770708
SD		0.3105245
95% UTL	95% Coverage	1.0266659
95% UPL (t)		0.7575083
90% Percentile (z)		0.575024
95% Percentile (z)		0.6878382
99% Percentile (z)		0.8994589

Maximum Likelihood Estimate(MLE) Method

Mean		0.5514494
SD		0.2845501
95% UTL with	95% Coverage	1.3299785
95% UPL (t)		1.0833351
90% Percentile (z)		0.916115
95% Percentile (z)		1.0194927
99% Percentile (z)		1.2134119

Assuming Lognormal Distribution

DL/2 Substitution Method

Mean (Log Scale)		-4.473028
SD (Log Scale)		2.7549289
95% UTL	95% Coverage	21.422833
95% UPL (t)		1.9670393
90% Percentile (z)		0.389674
95% Percentile (z)		1.0601672
99% Percentile (z)		6.9302429

Log ROS Method

Mean in Original Scale		0.2118161
SD in Original Scale		0.2906383
95% UTL with	95% Coverage	3.3918216
95% BCA UTL with	95% Coverage	0.98
95% Bootstrap (%) UTL with	95% Coverage	0.98
95% UPL (t)		1.1033496
90% Percentile (z)		0.5152849
95% Percentile (z)		0.8250293
99% Percentile (z)		1.994945

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Beryllium (Continued)

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	1.1073651
Theta Star	0.476356
nu star	8.8589212
A-D Test Statistic	0.3595217
5% A-D Critical Value	0.6590057
K-S Test Statistic	0.2941955
5% K-S Critical Value	0.3962549

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics with Extrapolated Data

Mean	0.175834
Median	0.000001
SD	0.311286
k star	0.1338997
Theta star	1.3131771
Nu star	3.2135924
95% Percentile of Chisquare (2k)	1.5041274
90% Percentile	0.5113994
95% Percentile	0.9875928
99% Percentile	2.4036689

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	0.3558333
SD	0.2042653
SE of Mean	0.0680884
95% KM UTL with 95% Coverage	0.9147031
95% KM Chebyshev UPL	1.2825616
95% KM UPL (t)	0.7376493
90% Percentile (z)	0.6176098
95% Percentile (z)	0.6918198
99% Percentile (z)	0.8310254

Gamma ROS Limits with Extrapolated Data

95% Wilson Hilferty (WH) Approx. Gamma UPL	0.9897952
95% Hawkins Wixley (HW) Approx. Gamma UPL	1.1844015
95% WH Approx. Gamma UTL with 95% Coverage	2.3768517
95% HW Approx. Gamma UTL with 95% Coverage	3.720839

Note: DL/2 is not a recommended method.

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Cadmium

General Statistics

Number of Valid Data	12	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	3
Tolerance Factor	2.736	Percent Non-Detects	25.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.013	Minimum Detected	-4.342806
Maximum Detected	0.75	Maximum Detected	-0.287682
Mean of Detected	0.1384444	Mean of Detected	-2.786005
SD of Detected	0.2336772	SD of Detected	1.2622229
Minimum Non-Detect	0.0083	Minimum Non-Detect	-4.7915
Maximum Non-Detect	0.0099	Maximum Non-Detect	-4.615221

Data with Multiple Detection Limits

Note: Data have multiple DLs - Use of KM Method is recommended

For all methods (except KM, DL/2, and ROS Methods),

Observations < Largest ND are treated as NDs

Single Detection Limit Scenario

Number treated as Non-Detect with Single DL	3
Number treated as Detected with Single DL	9
Single DL Non-Detect Percentage	25.00%

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.

Background Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.5620921
5% Shapiro Wilk Critical Value	0.829

Data not Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.9372008
5% Shapiro Wilk Critical Value	0.829

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

	Mean	0.1049417
	SD	0.2082936
95% UTL	95% Coverage	0.6748329
	95% UPL (t)	0.4942874
	90% Percentile (z)	0.3718806
	95% Percentile (z)	0.4475541
	99% Percentile (z)	0.589505

Maximum Likelihood Estimate(MLE) Method

	Mean	0.0626422
	SD	0.2414162
95% UTL with	95% Coverage	0.7231568
	95% UPL (t)	0.5139012
	90% Percentile (z)	0.3720294
	95% Percentile (z)	0.4597364
	99% Percentile (z)	0.6242601

Assuming Lognormal Distribution

DL/2 Substitution Method

	Mean (Log Scale)	-3.444977
	SD (Log Scale)	1.6067436
95% UTL	95% Coverage	2.5884865
	95% UPL (t)	0.64299
	90% Percentile (z)	0.2501105
	95% Percentile (z)	0.4483778
	99% Percentile (z)	1.3402651

Log ROS Method

	Mean in Original Scale	0.1045703
	SD in Original Scale	0.20849
95% UTL with	95% Coverage	3.4279085
95% BCA UTL with	95% Coverage	0.75
95% Bootstrap (%) UTL with	95% Coverage	0.75
	95% UPL (t)	0.7544292
	90% Percentile (z)	0.2703368
	95% Percentile (z)	0.5098602
	99% Percentile (z)	1.6762132

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Cadmium (Continued)

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.5683331
Theta Star	0.2435973
nu star	10.229997
A-D Test Statistic	0.6508479
5% A-D Critical Value	0.7521224
K-S Test Statistic	0.2366253
5% K-S Critical Value	0.2894453

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics with Extrapolated Data

Mean	0.1038336
Median	0.031
SD	0.2088856
k star	0.2212892
Theta star	0.4692212
Nu star	5.3109407
95% Percentile of Chisquare (2k)	2.219049
90% Percentile	0.3136301
95% Percentile	0.5206124
99% Percentile	1.0814547

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	0.1070833
SD	0.1983782
SE of Mean	0.0607407
95% KM UTL with 95% Coverage	0.6498461
95% KM Chebyshev UPL	1.0071026
95% KM UPL (t)	0.4778951
90% Percentile (z)	0.3613152
95% Percentile (z)	0.4333864
99% Percentile (z)	0.56858

Gamma ROS Limits with Extrapolated Data

95% Wilson Hilferty (WH) Approx. Gamma UPL	0.5280195
95% Hawkins Wixley (HW) Approx. Gamma UPL	0.6710645
95% WH Approx. Gamma UTL with 95% Coverage	1.1003193
95% HW Approx. Gamma UTL with 95% Coverage	1.6860863

Note: DL/2 is not a recommended method.

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Calcium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	2050	Minimum	7.6255951
Maximum	29800	Maximum	10.302264
Second Largest	27100	Second Largest	10.207289
First Quartile	9457.5	First Quartile	9.1545607
Median	13200	Median	9.4844878
Third Quartile	17825	Third Quartile	9.7882842
Mean	14238.333	Mean	9.3702148
SD	8124.7801	SD	0.7284687
Coefficient of Variation	0.5706272		
Skewness	0.6459131		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9461078	Shapiro Wilk Test Statistic	0.9063006
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	36467.732	95% UTL with 95% Coverage	86103.493
95% UPL (t)	29425.304	95% UPL (t)	45792.717
90% Percentile (z)	24650.658	90% Percentile (z)	29845.371
95% Percentile (z)	27602.407	95% Percentile (z)	38887.931
99% Percentile (z)	33139.398	99% Percentile (z)	63887.979

Gamma Distribution Test		Data Distribution Test
k star	2.1101902	Data appear Normal at 5% Significance Level
Theta Star	6747.4171	
MLE of Mean	14238.333	
MLE of Standard Deviation	9801.6312	
nu star	50.644565	
A-D Test Statistic	0.2672138	**Nonparametric Statistics**
5% A-D Critical Value	0.7396638	90% Percentile 26210
K-S Test Statistic	0.1666181	95% Percentile 28315
5% K-S Critical Value	0.247707	99% Percentile 29503
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	27345.984	95% UTL with 95% Coverage	29800
95% Percentile	33207.436	95% Percentile Bootstrap UTL with 95% Coverage	29800
99% Percentile	46166.767	95% BCA Bootstrap UTL with 95% Coverage	29800
		95% UPL	29800
		95% Chebyshev UPL	51099.533
95% WH Approx. Gamma UPL	35191.405	Upper Threshold Limit Based upon IQR	30376.25
95% HW Approx. Gamma UPL	36882.011		
95% WH Approx. Gamma UTL with 95% Coverage	51325.736		
95% HW Approx. Gamma UTL with 95% Coverage	56077.938		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Chromium, Total

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	2.39	Minimum	0.8712934
Maximum	11	Maximum	2.3978953
Second Largest	9.13	Second Largest	2.2115657
First Quartile	4.725	First Quartile	1.5511762
Median	6.675	Median	1.8938236
Third Quartile	8.4525	Third Quartile	2.1338536
Mean	6.59	Mean	1.8050456
SD	2.5425506	SD	0.4414583
Coefficient of Variation	0.3858195		
Skewness	0.0232294		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9837728	Shapiro Wilk Test Statistic	0.9500903
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	13.546418	95% UTL with 95% Coverage	20.34582
95% UPL (t)	11.342577	95% UPL (t)	13.876914
90% Percentile (z)	9.8484097	90% Percentile (z)	10.705923
95% Percentile (z)	10.772124	95% Percentile (z)	12.568326
99% Percentile (z)	12.504857	99% Percentile (z)	16.979915

Gamma Distribution Test		Data Distribution Test
k star	4.8350186	Data appear Normal at 5% Significance Level
Theta Star	1.362973	
MLE of Mean	6.59	
MLE of Standard Deviation	2.9969972	
nu star	116.04045	
A-D Test Statistic	0.2065787	**Nonparametric Statistics**
5% A-D Critical Value	0.7315261	90% Percentile 9.114
K-S Test Statistic	0.1545819	95% Percentile 9.9715
5% K-S Critical Value	0.245779	99% Percentile 10.7943
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	10.603197	95% UTL with 95% Coverage	11
95% Percentile	12.165485	95% Percentile Bootstrap UTL with 95% Coverage	11
99% Percentile	15.471989	95% BCA Bootstrap UTL with 95% Coverage	11
		95% UPL	11
		95% Chebyshev UPL	18.125262
95% WH Approx. Gamma UPL	12.585702	Upper Threshold Limit Based upon IQR	14.04375
95% HW Approx. Gamma UPL	12.843276		
95% WH Approx. Gamma UTL with 95% Coverage	16.585234		
95% HW Approx. Gamma UTL with 95% Coverage	17.277713		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Cobalt

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	1.32	Minimum	0.2776317
Maximum	7.56	Maximum	2.0228712
Second Largest	3.41	Second Largest	1.2267123
First Quartile	1.825	First Quartile	0.600636
Median	2.355	Median	0.8565204
Third Quartile	2.97	Third Quartile	1.0884945
Mean	2.74	Mean	0.8931227
SD	1.6518199	SD	0.4658952
Coefficient of Variation	0.602854		
Skewness	2.5407354		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.7077319	Shapiro Wilk Test Statistic	0.9142055
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	7.2593793	95% UTL with 95% Coverage	8.7391408
95% UPL (t)	5.8276085	95% UPL (t)	5.8356257
90% Percentile (z)	4.8568924	90% Percentile (z)	4.4379448
95% Percentile (z)	5.457002	95% Percentile (z)	5.2564299
99% Percentile (z)	6.5827078	99% Percentile (z)	7.2207364

Gamma Distribution Test		Data Distribution Test
k star	3.4410957	Data appear Gamma Distributed at 5% Significance Level
Theta Star	0.796258	
MLE of Mean	2.74	
MLE of Standard Deviation	1.4770738	
nu star	82.586298	
A-D Test Statistic	0.5969176	
5% A-D Critical Value	0.7338463	
K-S Test Statistic	0.1876387	
5% K-S Critical Value	0.2461584	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	3.372
95% Percentile	5.2775
99% Percentile	7.1035

Assuming Gamma Distribution			
90% Percentile	4.720588	95% UTL with 95% Coverage	7.56
95% Percentile	5.5321243	95% Percentile Bootstrap UTL with 95% Coverage	7.56
99% Percentile	7.2786256	95% BCA Bootstrap UTL with 95% Coverage	7.56
		95% UPL	7.56
		95% Chebyshev UPL	10.234119
95% WH Approx. Gamma UPL	5.7339326	Upper Threshold Limit Based upon IQR	4.6875
95% HW Approx. Gamma UPL	5.7459539		
95% WH Approx. Gamma UTL with 95% Coverage	7.8572836		
95% HW Approx. Gamma UTL with 95% Coverage	8.0177069		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Copper

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	1.4	Minimum	0.3364722
Maximum	12.9	Maximum	2.5572273
Second Largest	9.7	Second Largest	2.2721259
First Quartile	3.085	First Quartile	1.1219057
Median	3.76	Median	1.3220224
Third Quartile	7.3575	Third Quartile	1.9939613
Mean	5.3183333	Mean	1.471901
SD	3.5026739	SD	0.6700549
Coefficient of Variation	0.6586037		
Skewness	1.0292768		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9001081	Shapiro Wilk Test Statistic	0.9761986
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	14.901649	95% UTL with 95% Coverage	27.253207
95% UPL (t)	11.865588	95% UPL (t)	15.246934
90% Percentile (z)	9.8071905	90% Percentile (z)	10.284222
95% Percentile (z)	11.079719	95% Percentile (z)	13.11876
99% Percentile (z)	13.466771	99% Percentile (z)	20.711349

Gamma Distribution Test		Data Distribution Test
k star	2.0537007	Data appear Normal at 5% Significance Level
Theta Star	2.5896341	
MLE of Mean	5.3183333	
MLE of Standard Deviation	3.711137	
nu star	49.288816	
A-D Test Statistic	0.2506016	**Nonparametric Statistics**
5% A-D Critical Value	0.7398529	90% Percentile 9.543
K-S Test Statistic	0.1729224	95% Percentile 11.14
5% K-S Critical Value	0.2477928	99% Percentile 12.548
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	10.279298	95% UTL with 95% Coverage	12.9
95% Percentile	12.509723	95% Percentile Bootstrap UTL with 95% Coverage	12.9
99% Percentile	17.448989	95% BCA Bootstrap UTL with 95% Coverage	12.9
		95% UPL	12.9
		95% Chebyshev UPL	21.209565
95% WH Approx. Gamma UPL	13.269134	Upper Threshold Limit Based upon IQR	13.76625
95% HW Approx. Gamma UPL	13.625642		
95% WH Approx. Gamma UTL with 95% Coverage	19.474075		
95% HW Approx. Gamma UTL with 95% Coverage	20.721625		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Iron

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	3620	Minimum	8.1942293
Maximum	13400	Maximum	9.50301
Second Largest	10500	Second Largest	9.2591305
First Quartile	5412.5	First Quartile	8.5963495
Median	7275	Median	8.8919418
Third Quartile	8200	Third Quartile	9.0086873
Mean	7416.6667	Mean	8.8510079
SD	2716.3924	SD	0.3654514
Coefficient of Variation	0.3662552		
Skewness	0.8375724		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9488168	Shapiro Wilk Test Statistic	0.9845832
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	14848.716	95% UTL with 95% Coverage	18975.101
95% UPL (t)	12494.191	95% UPL (t)	13823.365
90% Percentile (z)	10897.864	90% Percentile (z)	11151.761
95% Percentile (z)	11884.735	95% Percentile (z)	12735.16
99% Percentile (z)	13735.94	99% Percentile (z)	16336.791

Gamma Distribution Test		Data Distribution Test
k star	6.378659	Data appear Normal at 5% Significance Level
Theta Star	1162.7313	
MLE of Mean	7416.6667	
MLE of Standard Deviation	2936.5951	
nu star	153.08782	
A-D Test Statistic	0.182938	
5% A-D Critical Value	0.7308304	
K-S Test Statistic	0.1451334	
5% K-S Critical Value	0.2455526	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	10387
95% Percentile	11805
99% Percentile	13081

Assuming Gamma Distribution			
90% Percentile	11340.423	95% UTL with 95% Coverage	13400
95% Percentile	12812.772	95% Percentile Bootstrap UTL with 95% Coverage	13400
99% Percentile	15890.445	95% BCA Bootstrap UTL with 95% Coverage	13400
		95% UPL	13400
		95% Chebyshev UPL	19740.629
95% WH Approx. Gamma UPL	13168.403	Upper Threshold Limit Based upon IQR	12381.25
95% HW Approx. Gamma UPL	13304.229		
95% WH Approx. Gamma UTL with 95% Coverage	16859.565		
95% HW Approx. Gamma UTL with 95% Coverage	17278.682		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Lead

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	2.56	Minimum	0.9400073
Maximum	12.5	Maximum	2.5257286
Second Largest	6.94	Second Largest	1.9373018
First Quartile	3.65	First Quartile	1.2916548
Median	4.635	Median	1.5332724
Third Quartile	6.1125	Third Quartile	1.8102264
Mean	5.3316667	Mean	1.581872
SD	2.652727	SD	0.4316504
Coefficient of Variation	0.4975418		
Skewness	1.9058126		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.8187344	Shapiro Wilk Test Statistic	0.9579494
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	12.589528	95% UTL with 95% Coverage	15.845214
95% UPL (t)	10.290187	95% UPL (t)	10.899533
90% Percentile (z)	8.7312731	90% Percentile (z)	8.4575053
95% Percentile (z)	9.6950143	95% Percentile (z)	9.8934581
99% Percentile (z)	11.502833	99% Percentile (z)	13.277104

Gamma Distribution Test		Data Distribution Test
k star	4.2619065	Data appear Gamma Distributed at 5% Significance Level
Theta Star	1.2510051	
MLE of Mean	5.3316667	
MLE of Standard Deviation	2.5826231	
nu star	102.28576	
A-D Test Statistic	0.3463001	
5% A-D Critical Value	0.7317843	
K-S Test Statistic	0.1315017	
5% K-S Critical Value	0.2458631	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	6.873
95% Percentile	9.442
99% Percentile	11.8884

Assuming Gamma Distribution			
90% Percentile	8.7924511	95% UTL with 95% Coverage	12.5
95% Percentile	10.164398	95% Percentile Bootstrap UTL with 95% Coverage	12.5
99% Percentile	13.085546	95% BCA Bootstrap UTL with 95% Coverage	12.5
		95% UPL	12.5
		95% Chebyshev UPL	17.366786
95% WH Approx. Gamma UPL	10.511917	Upper Threshold Limit Based upon IQR	9.80625
95% HW Approx. Gamma UPL	10.584486		
95% WH Approx. Gamma UTL with 95% Coverage	14.050304		
95% HW Approx. Gamma UTL with 95% Coverage	14.391282		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Magnesium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	665	Minimum	6.499787
Maximum	4330	Maximum	8.3733228
Second Largest	4240	Second Largest	8.3523185
First Quartile	1527.5	First Quartile	7.3312861
Median	2420	Median	7.776961
Third Quartile	3640	Third Quartile	8.1991978
Mean	2534.6667	Mean	7.6825006
SD	1302.1725	SD	0.626058
Coefficient of Variation	0.5137451		
Skewness	0.0231388		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9286626	Shapiro Wilk Test Statistic	0.9099391
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	6097.4106	95% UTL with 95% Coverage	12032.845
95% UPL (t)	4968.7085	95% UPL (t)	6993.5133
90% Percentile (z)	4203.4678	90% Percentile (z)	4840.7561
95% Percentile (z)	4676.5498	95% Percentile (z)	6077.0482
99% Percentile (z)	5563.9728	99% Percentile (z)	9310.7906

Gamma Distribution Test		Data Distribution Test
k star	2.5881387	Data appear Normal at 5% Significance Level
Theta Star	979.33959	
MLE of Mean	2534.6667	
MLE of Standard Deviation	1575.5315	
nu star	62.115328	
A-D Test Statistic	0.3668971	
5% A-D Critical Value	0.7378043	
K-S Test Statistic	0.150688	
5% K-S Critical Value	0.2470295	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	4201
95% Percentile	4280.5
99% Percentile	4320.1

Assuming Gamma Distribution			
90% Percentile	4645.8341	95% UTL with 95% Coverage	4330
95% Percentile	5554.0997	95% Percentile Bootstrap UTL with 95% Coverage	4330
99% Percentile	7538.8537	95% BCA Bootstrap UTL with 95% Coverage	4330
		95% UPL	4330
		95% Chebyshev UPL	8442.4746
95% WH Approx. Gamma UPL	5857.5598	Upper Threshold Limit Based upon IQR	6808.75
95% HW Approx. Gamma UPL	6065.3979		
95% WH Approx. Gamma UTL with 95% Coverage	8323.4554		
95% HW Approx. Gamma UTL with 95% Coverage	8917.8745		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Manganese

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	88	Minimum	4.4773368
Maximum	918	Maximum	6.8221974
Second Largest	218	Second Largest	5.3844951
First Quartile	116.75	First Quartile	4.7598604
Median	157.5	Median	5.0594204
Third Quartile	189	Third Quartile	5.241747
Mean	211.90833	Mean	5.1114719
SD	225.98401	SD	0.6095261
Coefficient of Variation	1.0664234		
Skewness	3.2681929		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.497047	Shapiro Wilk Test Statistic	0.778352
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	830.20059	95% UTL with 95% Coverage	879.30804
95% UPL (t)	634.3213	95% UPL (t)	518.43151
90% Percentile (z)	501.5185	90% Percentile (z)	362.35015
95% Percentile (z)	583.61895	95% Percentile (z)	452.16769
99% Percentile (z)	737.62576	99% Percentile (z)	685.01561

Gamma Distribution Test		Data Distribution Test
k star	1.702281	Data do not follow a Discernable Distribution (0.05)
Theta Star	124.48493	
MLE of Mean	211.90833	
MLE of Standard Deviation	162.41735	
nu star	40.854744	
A-D Test Statistic	1.5089305	
5% A-D Critical Value	0.741029	
K-S Test Statistic	0.3108029	
5% K-S Critical Value	0.248327	
Data not Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	215.1
95% Percentile	533
99% Percentile	841

Assuming Gamma Distribution			
90% Percentile	428.24654	95% UTL with 95% Coverage	918
95% Percentile	529.38203	95% Percentile Bootstrap UTL with 95% Coverage	918
99% Percentile	755.92226	95% BCA Bootstrap UTL with 95% Coverage	918
		95% UPL	918
		95% Chebyshev UPL	1237.172
95% WH Approx. Gamma UPL	551.1761	Upper Threshold Limit Based upon IQR	297.375
95% HW Approx. Gamma UPL	541.82764		
95% WH Approx. Gamma UTL with 95% Coverage	830.0071		
95% HW Approx. Gamma UTL with 95% Coverage	836.59023		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Mercury

General Statistics

Number of Valid Data	12	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	8
Tolerance Factor	2.736	Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0072	Minimum Detected	-4.933674
Maximum Detected	0.016	Maximum Detected	-4.135167
Mean of Detected	0.01155	Mean of Detected	-4.500387
SD of Detected	0.0036162	SD of Detected	0.3302654
Minimum Non-Detect	0.0032	Minimum Non-Detect	-5.744604
Maximum Non-Detect	0.0038	Maximum Non-Detect	-5.572754

Data with Multiple Detection Limits

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

Single Detection Limit Scenario

Number treated as Non-Detect with Single DL	8
Number treated as Detected with Single DL	4
Single DL Non-Detect Percentage	66.67%

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.

Background Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.9846284
5% Shapiro Wilk Critical Value	0.748

Data appear Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.9697786
5% Shapiro Wilk Critical Value	0.748

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

	Mean	0.0049792
	SD	0.005208
95% UTL	95% Coverage	0.0192282
	95% UPL (t)	0.014714
	90% Percentile (z)	0.0116534
	95% Percentile (z)	0.0135455
	99% Percentile (z)	0.0170947

Maximum Likelihood Estimate(MLE) Method

	Mean	0.0116347
	SD	0.0031317
95% UTL with	95% Coverage	0.0202031
	95% UPL (t)	0.0174886
	90% Percentile (z)	0.0156482
	95% Percentile (z)	0.0167859
	99% Percentile (z)	0.0189202

Assuming Lognormal Distribution

DL/2 Substitution Method

	Mean (Log Scale)	-5.754942
	SD (Log Scale)	0.9435336
95% UTL	95% Coverage	0.0418596
	95% UPL (t)	0.0184762
	90% Percentile (z)	0.0106122
	95% Percentile (z)	0.0149511
	99% Percentile (z)	0.0284401

Log ROS Method

	Mean in Original Scale	0.0060963
	SD in Original Scale	0.0044936
95% UTL with	95% Coverage	0.0294091
95% BCA UTL with	95% Coverage	0.016
95% Bootstrap (%) UTL with	95% Coverage	0.016
	95% UPL (t)	0.0167029
	90% Percentile (z)	0.011382
	95% Percentile (z)	0.0144277
	99% Percentile (z)	0.0225095

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Mercury (Continued)

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	3.387021
Theta Star	0.0034101
nu star	27.096168
A-D Test Statistic	0.2433494
5% A-D Critical Value	0.6570971
K-S Test Statistic	0.2180047
5% K-S Critical Value	0.3947312

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics with Extrapolated Data

Mean	0.0038507
Median	0.000001
SD	0.0059917
k star	0.1675388
Theta star	0.0229837
Nu star	4.0209313
95% Percentile of Chisquare (2k)	1.8021629
90% Percentile	0.0115582
95% Percentile	0.0207102
99% Percentile	0.0466989

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	0.00865
SD	0.0027339
SE of Mean	0.0009113
95% KM UTL with 95% Coverage	0.0161299
95% KM Chebyshev UPL	0.0210534
95% KM UPL (t)	0.0137602
90% Percentile (z)	0.0121536
95% Percentile (z)	0.0131469
99% Percentile (z)	0.01501

Gamma ROS Limits with Extrapolated Data

95% Wilson Hilferty (WH) Approx. Gamma UPL	0.0219134
95% Hawkins Wixley (HW) Approx. Gamma UPL	0.0259129
95% WH Approx. Gamma UTL with 95% Coverage	0.0514241
95% HW Approx. Gamma UTL with 95% Coverage	0.0772426

Note: DL/2 is not a recommended method.

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Molybdenum

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	0.075	Minimum	-2.590267
Maximum	0.41	Maximum	-0.891598
Second Largest	0.24	Second Largest	-1.427116
First Quartile	0.11	First Quartile	-2.207275
Median	0.145	Median	-1.931616
Third Quartile	0.2125	Third Quartile	-1.549018
Mean	0.1695833	Mean	-1.889957
SD	0.0927964	SD	0.4889201
Coefficient of Variation	0.5472024		
Skewness	1.678649		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.8467186	Shapiro Wilk Test Statistic	0.9672022
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	0.4234743	95% UTL with 95% Coverage	0.5756405
95% UPL (t)	0.3430399	95% UPL (t)	0.3767927
90% Percentile (z)	0.2885067	90% Percentile (z)	0.2826966
95% Percentile (z)	0.3222198	95% Percentile (z)	0.3376466
99% Percentile (z)	0.3854601	99% Percentile (z)	0.4711592

Gamma Distribution Test		Data Distribution Test
k star	3.4209594	Data appear Gamma Distributed at 5% Significance Level
Theta Star	0.0495719	
MLE of Mean	0.1695833	
MLE of Standard Deviation	0.0916873	
nu star	82.103026	
A-D Test Statistic	0.2829741	
5% A-D Critical Value	0.7339489	
K-S Test Statistic	0.1212111	
5% K-S Critical Value	0.246171	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	0.238
95% Percentile	0.3165
99% Percentile	0.3913

Assuming Gamma Distribution			
90% Percentile	0.2925263	95% UTL with 95% Coverage	0.41
95% Percentile	0.3429493	95% Percentile Bootstrap UTL with 95% Coverage	0.41
99% Percentile	0.4514972	95% BCA Bootstrap UTL with 95% Coverage	0.41
		95% UPL	0.41
		95% Chebyshev UPL	0.5905901
95% WH Approx. Gamma UPL	0.356808	Upper Threshold Limit Based upon IQR	0.36625
95% HW Approx. Gamma UPL	0.3605989		
95% WH Approx. Gamma UTL with 95% Coverage	0.4895036		
95% HW Approx. Gamma UTL with 95% Coverage	0.5053578		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Nickel

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	2.27	Minimum	0.8197798
Maximum	11.4	Maximum	2.4336134
Second Largest	10.7	Second Largest	2.3702437
First Quartile	3.52	First Quartile	1.2542304
Median	4.39	Median	1.4783918
Third Quartile	6.845	Third Quartile	1.9231724
Mean	5.5441667	Mean	1.5841443
SD	3.0217137	SD	0.5259678
Coefficient of Variation	0.5450258		
Skewness	0.9972125		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.879071	Shapiro Wilk Test Statistic	0.9547631
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	13.811575	95% UTL with 95% Coverage	20.55681
95% UPL (t)	11.192403	95% UPL (t)	13.030488
90% Percentile (z)	9.4166486	90% Percentile (z)	9.5658473
95% Percentile (z)	10.514443	95% Percentile (z)	11.580057
99% Percentile (z)	12.573724	99% Percentile (z)	16.57223

Gamma Distribution Test		Data Distribution Test
k star	3.0908995	Data appear Normal at 5% Significance Level
Theta Star	1.7937066	
MLE of Mean	5.5441667	
MLE of Standard Deviation	3.1535073	
nu star	74.181587	
A-D Test Statistic	0.3270361	
5% A-D Critical Value	0.73563	
K-S Test Statistic	0.1639467	
5% K-S Critical Value	0.2463779	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	10.346
95% Percentile	11.015
99% Percentile	11.323

Assuming Gamma Distribution			
90% Percentile	9.7725877	95% UTL with 95% Coverage	11.4
95% Percentile	11.536109	95% Percentile Bootstrap UTL with 95% Coverage	11.4
99% Percentile	15.352735	95% BCA Bootstrap UTL with 95% Coverage	11.4
		95% UPL	11.4
		95% Chebyshev UPL	19.253337
95% WH Approx. Gamma UPL	12.059895	Upper Threshold Limit Based upon IQR	11.8325
95% HW Approx. Gamma UPL	12.251022		
95% WH Approx. Gamma UTL with 95% Coverage	16.75919		
95% HW Approx. Gamma UTL with 95% Coverage	17.449877		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Potassium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	284	Minimum	5.6489742
Maximum	2110	Maximum	7.6544432
Second Largest	1680	Second Largest	7.4265491
First Quartile	754	First Quartile	6.6246055
Median	1000	Median	6.9027301
Third Quartile	1390	Third Quartile	7.2363793
Mean	1080.1667	Mean	6.8536438
SD	527.84568	SD	0.5720427
Coefficient of Variation	0.4886706		
Skewness	0.3954455		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9803606	Shapiro Wilk Test Statistic	0.9531182
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	2524.3524	95% UTL with 95% Coverage	4531.2481
95% UPL (t)	2066.8243	95% UPL (t)	2759.805
90% Percentile (z)	1756.6281	90% Percentile (z)	1971.8866
95% Percentile (z)	1948.3955	95% Percentile (z)	2427.3863
99% Percentile (z)	2308.1193	99% Percentile (z)	3584.643

Gamma Distribution Test		Data Distribution Test
k star	3.0324555	Data appear Normal at 5% Significance Level
Theta Star	356.20198	
MLE of Mean	1080.1667	
MLE of Standard Deviation	620.28825	
nu star	72.778932	
A-D Test Statistic	0.1621481	**Nonparametric Statistics**
5% A-D Critical Value	0.7359086	90% Percentile 1660
K-S Test Statistic	0.1129891	95% Percentile 1873.5
5% K-S Critical Value	0.2464311	99% Percentile 2062.7
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	1911.8623	95% UTL with 95% Coverage	2110
95% Percentile	2259.8551	95% Percentile Bootstrap UTL with 95% Coverage	2110
99% Percentile	3013.7496	95% BCA Bootstrap UTL with 95% Coverage	2110
		95% UPL	2110
		95% Chebyshev UPL	3474.9423
95% WH Approx. Gamma UPL	2367.3131	Upper Threshold Limit Based upon IQR	2344
95% HW Approx. Gamma UPL	2439.3583		
95% WH Approx. Gamma UTL with 95% Coverage	3294.8446		
95% HW Approx. Gamma UTL with 95% Coverage	3498.1881		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Selenium

General Statistics

Number of Valid Data	12	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	12

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 Selenium was not processed!

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Silver

General Statistics

Number of Valid Data	12	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	8
Tolerance Factor	2.736	Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.039	Minimum Detected	-3.244194
Maximum Detected	0.057	Maximum Detected	-2.864704
Mean of Detected	0.051	Mean of Detected	-2.986953
SD of Detected	0.0082865	SD of Detected	0.1760443
Minimum Non-Detect	0.031	Minimum Non-Detect	-3.473768
Maximum Non-Detect	0.042	Maximum Non-Detect	-3.170086

Data with Multiple Detection Limits

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

Single Detection Limit Scenario

Number treated as Non-Detect with Single DL	9
Number treated as Detected with Single DL	3
Single DL Non-Detect Percentage	75.00%

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.

Background Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.8254953
5% Shapiro Wilk Critical Value	0.748

Data appear Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.8028565
5% Shapiro Wilk Critical Value	0.748

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

	Mean	0.028625
	SD	0.0171572
95% UTL	95% Coverage	0.0755671
	95% UPL (t)	0.0606955
	90% Percentile (z)	0.0506128
	95% Percentile (z)	0.0568461
	99% Percentile (z)	0.0685386

Maximum Likelihood Estimate(MLE) Method

	Mean	0.0434623
	SD	0.0124361
95% UTL with	95% Coverage	0.0774875
	95% UPL (t)	0.0667081
	90% Percentile (z)	0.0593998
	95% Percentile (z)	0.0639179
	99% Percentile (z)	0.072393

Assuming Lognormal Distribution

DL/2 Substitution Method

	Mean (Log Scale)	-3.698816
	SD (Log Scale)	0.5412049
95% UTL	95% Coverage	0.1088179
	95% UPL (t)	0.0680721
	90% Percentile (z)	0.0495271
	95% Percentile (z)	0.0602885
	99% Percentile (z)	0.0871795

Log ROS Method

	Mean in Original Scale	0.0366153
	SD in Original Scale	0.0118848
95% UTL with	95% Coverage	0.0805629
95% BCA UTL with	95% Coverage	0.057
95% Bootstrap (%) UTL with	95% Coverage	0.057
	95% UPL (t)	0.0618791
	90% Percentile (z)	0.0517432
	95% Percentile (z)	0.057794
	99% Percentile (z)	0.0711177

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Silver (Continued)

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	11.547537
Theta Star	0.0044165
nu star	92.380298
A-D Test Statistic	0.5371719
5% A-D Critical Value	0.6561116
K-S Test Statistic	0.3217342
5% K-S Critical Value	0.3938827

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics with Extrapolated Data

Mean	0.0207403
Median	0.0125627
SD	0.0238505
k star	0.1961284
Theta star	0.1057486
Nu star	4.707082
95% Percentile of Chisquare (2k)	2.0313944
90% Percentile	0.0627173
95% Percentile	0.1074085
99% Percentile	0.2308435

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	0.043
SD	0.0070119
SE of Mean	0.0023373
95% KM UTL with 95% Coverage	0.0621845
95% KM Chebyshev UPL	0.0748122
95% KM UPL (t)	0.0561067
90% Percentile (z)	0.0519861
95% Percentile (z)	0.0545335
99% Percentile (z)	0.0593121

Gamma ROS Limits with Extrapolated Data

95% Wilson Hilferty (WH) Approx. Gamma UPL	0.1241347
95% Hawkins Wixley (HW) Approx. Gamma UPL	0.1714757
95% WH Approx. Gamma UTL with 95% Coverage	0.2663301
95% HW Approx. Gamma UTL with 95% Coverage	0.4588943

Note: DL/2 is not a recommended method.

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Sodium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	25.1	Minimum	3.2228678
Maximum	2320	Maximum	7.7493225
Second Largest	1450	Second Largest	7.2793188
First Quartile	56.675	First Quartile	4.0341559
Median	79.85	Median	4.3655406
Third Quartile	346.5	Third Quartile	5.6699099
Mean	443.11667	Mean	5.0053091
SD	726.10687	SD	1.473586
Coefficient of Variation	1.6386359		
Skewness	2.0592615		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.63915	Shapiro Wilk Test Statistic	0.8833943
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 95% Coverage	2429.7451	95% UTL with 95% Coverage	8408.8536
95% UPL (t)	1800.3674	95% UPL (t)	2344.3417
90% Percentile (z)	1373.6601	90% Percentile (z)	986.12742
95% Percentile (z)	1637.4562	95% Percentile (z)	1684.3625
99% Percentile (z)	2132.2939	99% Percentile (z)	4598.028

Gamma Distribution Test		Data Distribution Test
k star	0.4843431	Data appear Lognormal at 5% Significance Level
Theta Star	914.88185	
MLE of Mean	443.11667	
MLE of Standard Deviation	636.70982	
nu star	11.624233	
A-D Test Statistic	1.0990082	
5% A-D Critical Value	0.779392	
K-S Test Statistic	0.2650851	
5% K-S Critical Value	0.2575698	
Data not Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	1380.3
95% Percentile	1841.5
99% Percentile	2224.3

Assuming Gamma Distribution			
90% Percentile	1206.7332	95% UTL with 95% Coverage	2320
95% Percentile	1721.5877	95% Percentile Bootstrap UTL with 95% Coverage	2320
99% Percentile	2991.5713	95% BCA Bootstrap UTL with 95% Coverage	2320
		95% UPL	2320
		95% Chebyshev UPL	3737.3807
95% WH Approx. Gamma UPL	1866.3954	Upper Threshold Limit Based upon IQR	781.2375
95% HW Approx. Gamma UPL	1922.8458		
95% WH Approx. Gamma UTL with 95% Coverage	3542.7997		
95% HW Approx. Gamma UTL with 95% Coverage	4013.7332		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Thallium

General Statistics

Number of Valid Data	12	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	10

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful and reliable test statistics and estimates.

No statistics will be produced!

Tolerance Factor	2.736	Percent Non-Detects	83.33%

Raw Statistics

Minimum Detected	0.47
Maximum Detected	0.59
Mean of Detected	0.53
SD of Detected	0.0848528
Minimum Non-Detect	0.092
Maximum Non-Detect	0.12

Log-transformed Statistics

Minimum Detected	-0.755023
Maximum Detected	-0.527633
Mean of Detected	-0.641328
SD of Detected	0.1607889
Minimum Non-Detect	-2.385967
Maximum Non-Detect	-2.120264

Data with Multiple Detection Limits

Note: Data have multiple DLs - Use of KM Method is recommended

For all methods (except KM, DL/2, and ROS Methods),

Observations < Largest ND are treated as NDs

Single Detection Limit Scenario

Number treated as Non-Detect with Single DL	10
Number treated as Detected with Single DL	2
Single DL Non-Detect Percentage	83.33%

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.

Background Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A

Data not Normal at 5% Significance Level

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method

	Mean	0.130125
	SD	0.1885666
95% UTL	95% Coverage	0.6460433
	95% UPL (t)	0.4825968
	90% Percentile (z)	0.3717828
	95% Percentile (z)	0.4402895
	99% Percentile (z)	0.5687966

Assuming Lognormal Distribution

DL/2 Substitution Method

	Mean (Log Scale)	-2.603504
	SD (Log Scale)	0.920888
95% UTL	95% Coverage	0.919473
	95% UPL (t)	0.4138857
	90% Percentile (z)	0.2409084
	95% Percentile (z)	0.3366275
	99% Percentile (z)	0.6305276

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Thallium (Continued)

Maximum Likelihood Estimate(MLE) Method	N/A

Log ROS Method		
Mean in Original Scale		N/A
SD in Original Scale		N/A
Mean in Log Scale		N/A
SD in Log Scale		N/A
95% UTL	95% Coverage	N/A
95% UPL (t)		N/A
90% Percentile (z)		N/A
95% Percentile (z)		N/A
99% Percentile (z)		N/A

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	N/A
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics with Extrapolated Data

Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
95% Percentile of Chisquare (2k)	N/A
90% Percentile	N/A
95% Percentile	N/A
99% Percentile	N/A

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean		0.48
SD		0.0331662
SE of Mean		0.0135401
95% KM UTL with	95% Coverage	0.5707429
95% KM Chebyshev UPL		0.6304715
95% KM UPL (t)		0.5419949
90% Percentile (z)		0.5225043
95% Percentile (z)		0.5345536
99% Percentile (z)		0.5571562

Gamma ROS Limits with Extrapolated Data

95% Wilson Hilferty (WH) Approx. Gamma UPL		N/A
95% Hawkins Wixley (HW) Approx. Gamma UPL		N/A
95% WH Approx. Gamma UTL with	95% Coverage	N/A
95% HW Approx. Gamma UTL with	95% Coverage	N/A

Note: DL/2 is not a recommended method.

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Vanadium

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	9.35	Minimum	2.2353763
Maximum	21.7	Maximum	3.0773123
Second Largest	21.2	Second Largest	3.0540012
First Quartile	15.325	First Quartile	2.7272568
Median	16.75	Median	2.8182869
Third Quartile	19.025	Third Quartile	2.9455473
Mean	16.729167	Mean	2.7936775
SD	3.5412157	SD	0.2351498
Coefficient of Variation	0.2116791		
Skewness	-0.570676		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9648825	Shapiro Wilk Test Statistic	0.9144844
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	26.417933	95% UTL with 95% Coverage	31.095008
95% UPL (t)	23.348464	95% UPL (t)	25.361271
90% Percentile (z)	21.267417	90% Percentile (z)	22.087991
95% Percentile (z)	22.553948	95% Percentile (z)	24.057925
99% Percentile (z)	24.967266	99% Percentile (z)	28.239386

Gamma Distribution Test		Data Distribution Test
k star	16.153164	Data appear Normal at 5% Significance Level
Theta Star	1.0356588	
MLE of Mean	16.729167	
MLE of Standard Deviation	4.1624162	
nu star	387.67594	
A-D Test Statistic	0.305188	
5% A-D Critical Value	0.7317512	
K-S Test Statistic	0.1859669	
5% K-S Critical Value	0.2451878	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	21.05
95% Percentile	21.425
99% Percentile	21.645

Assuming Gamma Distribution			
90% Percentile	22.235847	95% UTL with 95% Coverage	21.7
95% Percentile	24.112166	95% Percentile Bootstrap UTL with 95% Coverage	21.7
99% Percentile	27.901344	95% BCA Bootstrap UTL with 95% Coverage	21.7
		95% UPL	21.7
95% WH Approx. Gamma UPL	24.483125	95% Chebyshev UPL	32.795258
95% HW Approx. Gamma UPL	24.676999	Upper Threshold Limit Based upon IQR	24.575
95% WH Approx. Gamma UTL with 95% Coverage	28.941838		
95% HW Approx. Gamma UTL with 95% Coverage	29.400197		

Attachment 1
ProUCL Output

Note: Highlighted UTL is the Selected Background Threshold Value (BTV)

Zinc

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
Tolerance Factor	2.736		

Raw Statistics		Log-Transformed Statistics	
Minimum	10.3	Minimum	2.3321439
Maximum	38.8	Maximum	3.6584202
Second Largest	30.9	Second Largest	3.4307562
First Quartile	14.85	First Quartile	2.6971387
Median	17.45	Median	2.8567674
Third Quartile	25.65	Third Quartile	3.2436108
Mean	20.316667	Mean	2.9335461
SD	8.6497329	SD	0.4079079
Coefficient of Variation	0.4257457		
Skewness	0.9535136		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.9164597	Shapiro Wilk Test Statistic	0.9695311
Shapiro Wilk Critical Value	0.859	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	
95% UTL with 95% Coverage	43.982336	95% UTL with 95% Coverage	57.373469
95% UPL (t)	36.484887	95% UPL (t)	40.286405
90% Percentile (z)	31.401745	90% Percentile (z)	31.699504
95% Percentile (z)	34.544211	95% Percentile (z)	36.763107
99% Percentile (z)	40.438954	99% Percentile (z)	48.544537

Gamma Distribution Test		Data Distribution Test
k star	4.9913405	Data appear Normal at 5% Significance Level
Theta Star	4.0703828	
MLE of Mean	20.316667	
MLE of Standard Deviation	9.0937677	
nu star	119.79217	
A-D Test Statistic	0.2657316	
5% A-D Critical Value	0.7314556	
K-S Test Statistic	0.1653392	
5% K-S Critical Value	0.2457561	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	30.57
95% Percentile	34.455
99% Percentile	37.931

Assuming Gamma Distribution			
90% Percentile	32.49131	95% UTL with 95% Coverage	38.8
95% Percentile	37.209765	95% Percentile Bootstrap UTL with 95% Coverage	38.8
99% Percentile	47.181375	95% BCA Bootstrap UTL with 95% Coverage	38.8
		95% UPL	38.8
		95% Chebyshev UPL	59.559517
95% WH Approx. Gamma UPL	38.424727	Upper Threshold Limit Based upon IQR	41.85
95% HW Approx. Gamma UPL	38.811575		
95% WH Approx. Gamma UTL with 95% Coverage	50.478588		
95% HW Approx. Gamma UTL with 95% Coverage	51.83657		

TEST PIT INFORMATION

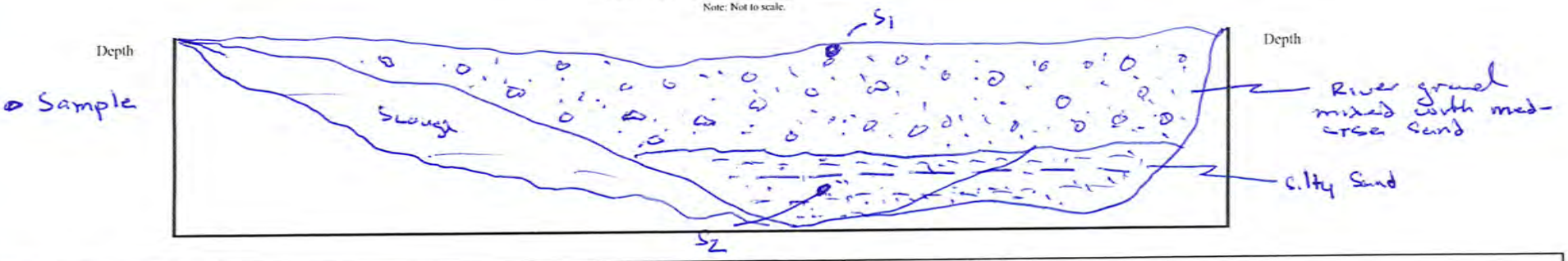
Site ID: 027BG001
Geol./Eng.: R McDonald/E. Staes
Date: 07212010

Depth: 11'
Width: 3 1/2'
Length: 16'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations

Note: Not to scale.

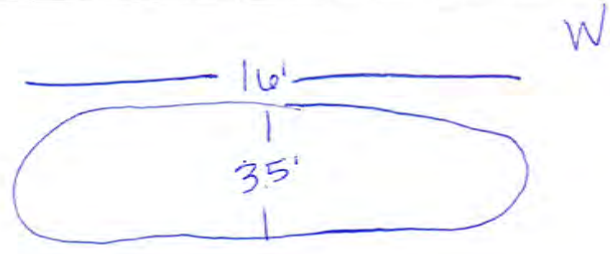


Depth	Lithology	Depth	Lithology
0-7	River gravel mixed with med-crse sand 25% gravel, 75% sand, LT gray-tan, dry		
7-11	Silty sand LT tan-buff fn-med crse sand 90% sand 10% silt, Dry		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/EMPA	Thioglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	027BG001-01-072110	0.2-0.7	✓	SAA				X										
	027BG001-02-072110	10.5-11	✓	SAA				X										

Location Map

N



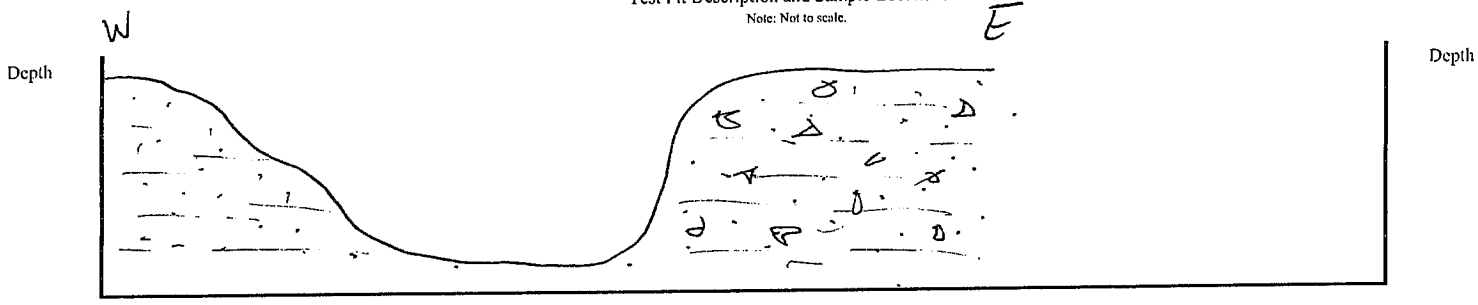
TEST PIT INFORMATION

Site ID: 028BG001
Geol./Eng. R. McDonald
Date: 07142010

Depth: 9'
Width: 32"
Length: 15.5'

	North Stake	South Stake
Northing		
Easting		
Elevation		

Test Pit Description and Sample Locations
Note: Not to scale.

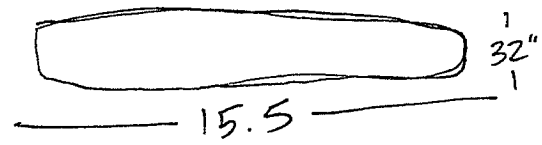


Depth	Lithology	Depth	Lithology
0-9'	silty sand & gravel lt. reddish brown, subround to angular pea to cobble sized, weakly bedded, loose, dry		

Site ID	Field Sample # 07142010	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thioduglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
	028BG001-01	0.2-0.7	/	SAA				X										
	-02	9.0-5.5	/	SAA				X										

Location Map

N

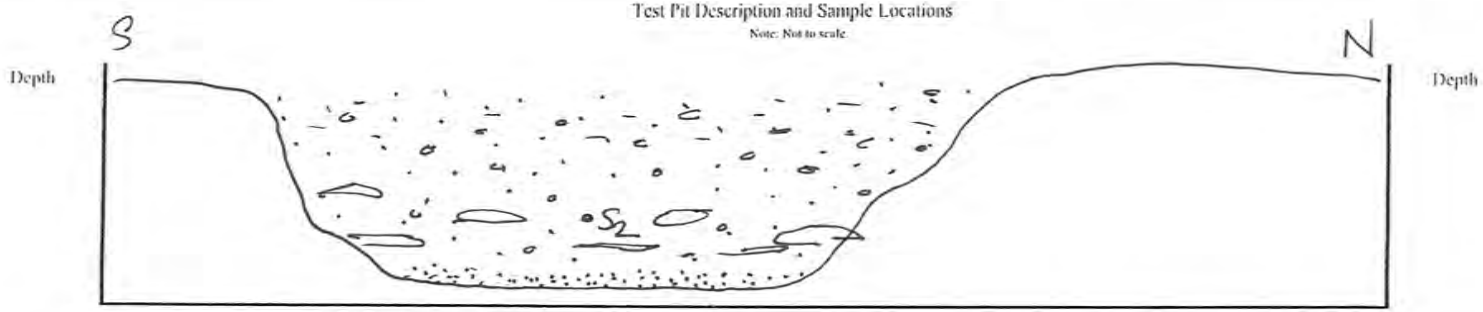


TEST PIT INFORMATION

Site ID:	YPG 029BG001	Depth:	9.5'		~~North Stake~~	~~South Stake~~
Geol./Eng.	R. McDonald	Width:	30"	Northing	3637585	
Date:	13 Dec. 2010	Length:	16'	Easting	0747760	
				Elevation		

Test Pit Description and Sample Locations

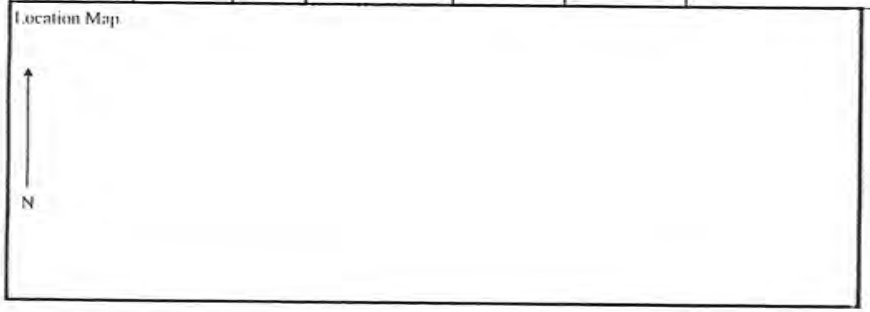
Note: Not to scale

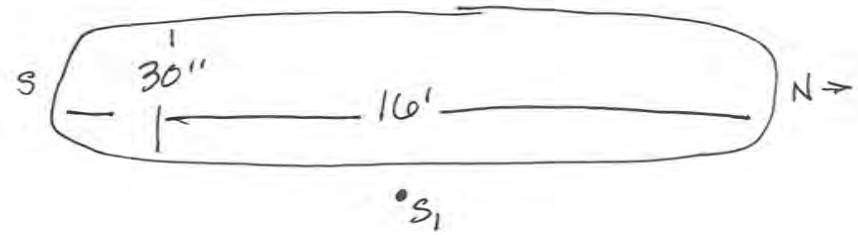


Depth	Lithology	Depth	Lithology
0-9.5'	Silty sand and gravel (GM); sand is med-coarse, gravel is pebble & cobble size subround-subang., dry, loose, lt. brn-lt. reddish brn.		
	0-3' are siltier		
	Intermittant hard clay (caliche?) from 7.5-9.5'		
	no visible staining		
@9.5'	Sand (SW), fine-med, lt tan-white, little silt		
	no visible staining		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/EMPA	Thiodiglycol	DMP	pH	Asbestos	Glass A & B	Total Phos	MT LAB
	029BG001-01-121310	0.2-0.7	—	GM as above														
	029BG001-02-121310	7-7.5	—	clay (caliche) as above														

Location Map





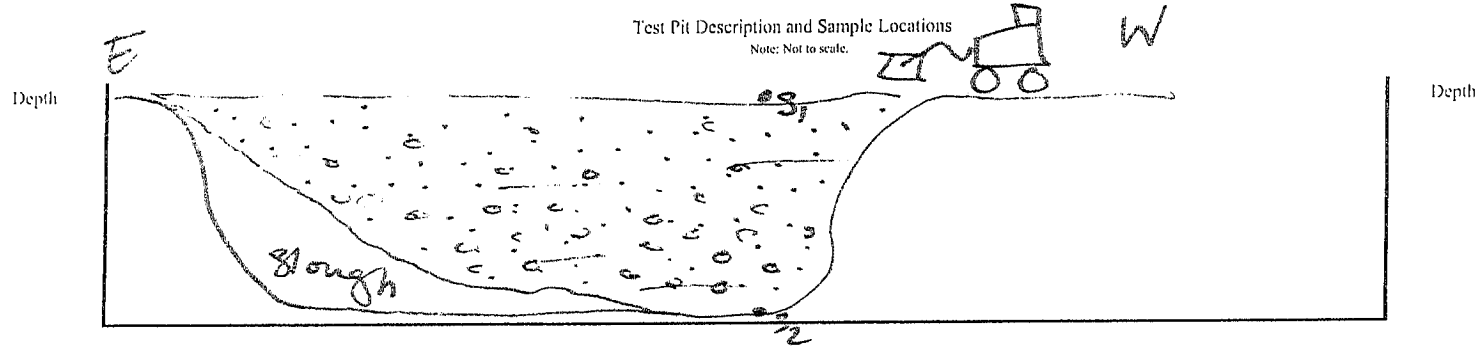
Background

TEST PIT INFORMATION

					North Stake	South Stake
Site ID:	141BG001-01	Depth:	10'	Northing		
Geol./Eng.	R McDonald	Width:	3'	Easting		
Date:	072812010	Length:	13'	Elevation		

Test Pit Description and Sample Locations

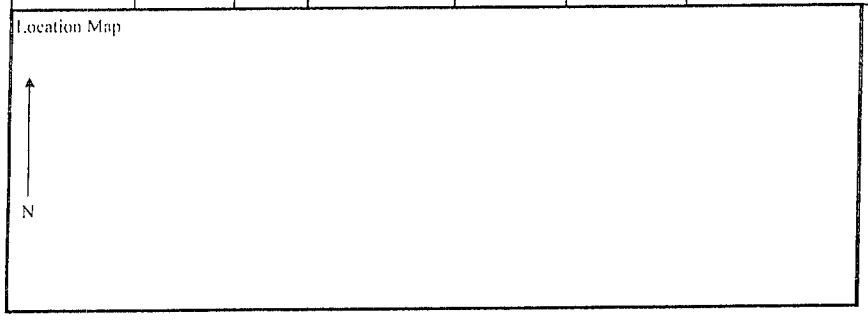
Note: Not to scale.

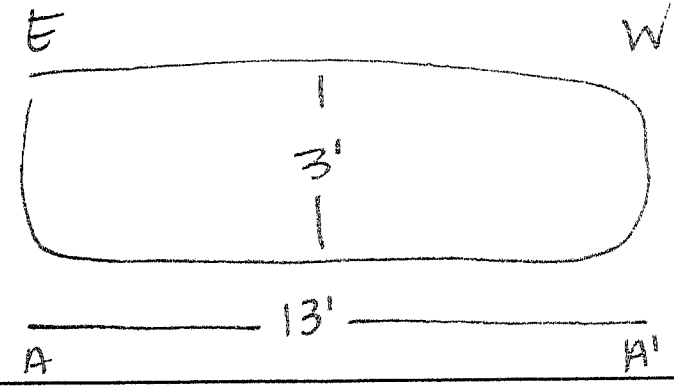


Depth	Lithology	Depth	Lithology
0-10	Silty sand & gravel (SM-GM), loose, gravel is pea-cobble angular-subrounded, increasing gravel w/depth, weak bedding, tan-lt brown, no visible staining		

Site ID	Field Sample #	Depth	Headspace	Sample Description	GC/MS (BNAs)	GC/MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA, EMPA	Thiodiglycol	DIMP	pH	Asbestos	Gross A & B	Total Phos	MT LAB
	141BG001-01-072810	0.2-0.7	—	SAA				X										
	141BG001-01-072810	9.5-10		SAA				X										

Location Map





178A

TEST PIT INFORMATION

					North Stake	South Stake
Site ID:	YPG178B4001	Depth:	8'	Northing		
Geol./Eng.	R. McDonald	Width:	3'	Easting		
Date:	20 Dec. 2010	Length:	18'	Elevation		

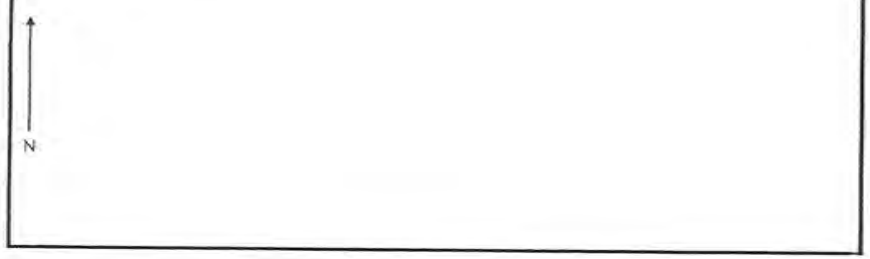
Test Pit Description and Sample Locations

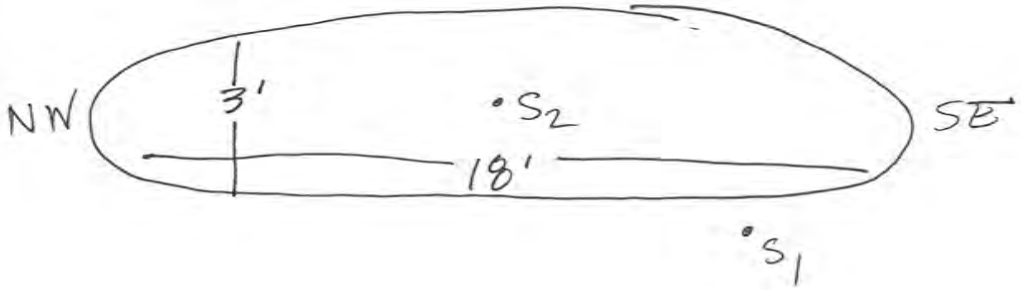
Note: Not to scale

Depth	Lithology	Depth	Lithology
0-6.5	Silty sand & gravel (GM) dry, loose, lt. reddish brn gravel is subround-subangular, pea-cobble size, weak bedding throughout. No visible staining		
6.5-7.5	sand (SW) lt tan, dry - sl. damp, no visible staining		
7.5-8	hard clay (caliche), reddish brn, inelastic, v.sl. damp, no visible staining		

Site ID		Field Sample #		Depth	Headspace	Sample Description	GC MS (BNAs)	GC MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	DMPA & EMPA	Thallium	DIMP	pH	Asbestos	Gross A & B	Total Phos	MT LAB
		178B	4001-01-122010	0.2-0.7	—	GM as above														
		178B	4001-02-122010	7.5-8	—	in clay as above														

Location Map





178B

TEST PIT INFORMATION

					North Stake	South Stake
Site ID:	YPG178B4002	Depth:	8.5'	Northing		
Geol./Eng.	R. McDonald	Width:	30"	Easting		
Date:	16 Dec. 2010	Length:	16'	Elevation		

Test Pit Description and Sample Locations

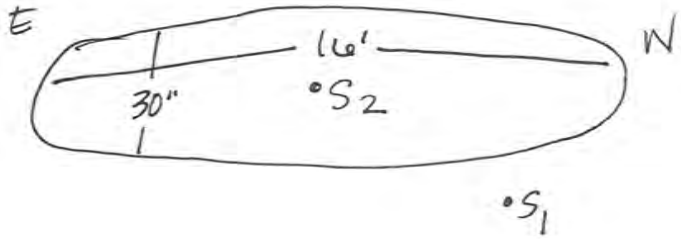
Note: Not to scale

Depth	Lithology	Depth	Lithology
0'-3'	silty sand & Gravel (SM-GM), cross-bedded, dry, loose, gravel is pea-size, no visible staining		
3-8.5'	silty sand w/ some gravel (SM), massive, dry, loose, gravel layer from approx. 5'-5.5', no visible staining		
@8.5'	silty sand (SW), lt. tan, sl. moist, fine-med, little (<10%) gravel, no visible staining		

Site ID		Field Sample #	Depth	Headspace	Sample Description	GC MS (BNAs)	GC MS (Vols)	Explosives	TCL (Metals)	TOC	TPHC	IMPA/ EMPA	Thodg/pest	DMP	pH	Asbestos	Gross A & B	Total Phos.	MT LAB
		178B4002-01-121610	0.2-0.7	—	SM-GM as above														
		178B4002-02-121610	8-8.5	—	SW as above														

Location Map

N



APPENDIX E

ECOLOGICAL RISK ASSESSMENT

APPENDIX E

ECOLOGICAL RISK ASSESSMENT

This ecological risk assessment (ERA) evaluates the potential for ecological impacts from potential exposure to chemicals of potential ecological concern (COPECs) in soils at YPG-028 at the U.S. Army Garrison Yuma Proving Ground (USAGYPG) in Yuma, Arizona. The results of this ERA provide a basis for decision in making regarding further action with respect to the COPECs in soils at the site.

Following USEPA (1997, 1998) guidance, the ERA process consists of four major components:

- Problem formulation
- Analysis
- Risk characterization
- Uncertainty analysis

Each step of the ERA process is discussed in detail below.

E.1 PROBLEM FORMULATION

Problem formulation is a systemic planning process that identifies the major factors to be considered in the ERA (USEPA 1997, 1998). This section includes the site descriptions, the approach for evaluation of available environmental data, selection of COPECs, exposure pathway characterization, development of a conceptual site model (CSM), and selection of assessment endpoints. Each is described below.

E.1.1 General Habitat Characterization

USAGYPG is a "U" shaped installation occupying approximately 1,300 square miles in located in southwestern Arizona just to the west of the Colorado River (Figure 1.1). The installation is 23 miles northeast of the City of Yuma along U.S. Highway 95, between Interstate Highways 8 and 10 (Figure 1.1). There are three wildlife refuges adjacent to USAYPG: 1) Cibola National Wildlife Refuge, 2) Imperial National Refuge, and 3) Kofa National Wildlife Refuge. The Cibola and Imperial National Refuge's are both located along the Colorado River to the west of USAGYPG, while the Kofa National Wildlife Refuge is located within and to the north of the "U" shaped boundary.

USAGYPG is located in the Sonoran Desert, a low elevation, hot, arid desert. It is characterized by high daytime temperatures with large daily temperature variations, low relative humidity, and very low average precipitation. The average monthly air temperature ranges from a low of 47.6 degrees Fahrenheit (°F) in January to a high of 106.8°F in July. The average annual

precipitation in Yuma and other areas along the lower Colorado River is very low, approximately 3.5 inches per year (National Weather Service, 2011).

No perennial lakes or streams occur within USAGYPG, however two major rivers flow through the adjacent desert. The Colorado River traverses a generally north-south direction west of USAGYPG with the mostly dry Gila River drainage traversing an east-west direction south of USAGYPG. Surface drainage on the northern and western part of USAGYPG flows into the Colorado River with the central and eastern parts of USAGYPG flowing into the Gila River (Figure 1.1).

E.1.2 Species at Yuma Proving Ground

More than 60 species of mammals have been observed at USAGYPG. Large mammal species that have been observed include the mule deer (*Odocoileus hemionus*), wild horse (*Equus caballus*), burro (*Equus asinus*), coyote (*Canis latrans*), mountain lion (*Puma concolor*), and kit fox (*Vulpes macrotis*). Small mammal species present at TEAD include mice (*Mus* spp. and *Peromyscus* spp.), pocket mice (*Chaetodipus* spp. and *Perognathus* spp.), kangaroo rats (*Dipodomys* spp.), bats (multiple genera), squirrels (*Ammospermophilus* spp. and *Spermophilus* spp.), and rabbits and hares (*Lepus* and *Sylvilagus* spp.) (Table E.1).

More than 141 species of birds have been observed at USAGYPG, including the red-tailed hawk (*Buteo jamaicencis*), rough-legged hawk (*Buteo lagopus*), bald eagle (*Haliaeetus leucocephalus*), turkey vulture (*Cathartes aura*), prairie falcon (*Falco mexicanus*), and six species of owls (Table E.1).

Thirty three species of reptiles have been observed on USAGYPG, including the Sonoran desert tortoise (*Gopherus morafkai*), Mohave fringe-toed lizard (*Uma scoparia*), collared lizard (*Crotaphytus collaris*), northern side blotched lizard (*Uta stansburiana*), western whiptail (*Aspidoscelis tigris*), gopher snake (*Pituophis catenifer*), and Mojave rattlesnake (*Crotalus scutulatus*) (Table E.1).

Three species of amphibians have been recorded at USAGYPG: Red-spotted toad (*Bufo punctatus*), Colorado River toad (*Bufo alvarius*), and Couch's spadefoot toad (*Scaphiopus couchii*) (Table E.1).

No fish have been recorded at USAGYPG.

Numerous plant species have been recorded at USAGYPG, including 7 Arizona special status species (Table E.1). The Nichol's turks' head cactus, a federally listed species, is listed in the current INRMP as occurring at YPG. The Nichol's turks' head cactus was reportedly photographed on the base in a 1994 plant survey; however, subsequent field surveys by the photographer, contract personnel, and USAGYPG staff have failed to find the plant (Command Technology Directorate et al., 2001). However, if the cactus is at USAGYPG, it is almost

certainly within the boundary of the proposed White Tanks Conservation Area (Laura Merrill, pers. comm.). Therefore, this species is assumed to not be present at YPG-028.

There are no federally listed threatened or endangered species known to occur on USAGYPG (Table E.1). However, 17 Arizona special status species have been observed at the facility. A list of amphibian, bird, mammal, and reptile species found at USAGYPG is presented in Table E.1.

E.1.3 Site Descriptions, Land Use, Wildlife, and Plants

The YPG-028 site is located on the southwestern base boundary, approximately ½ mile north of the Main Administrative Area and 1.2 miles southeast of Imperial Dam (Figure 2.1). Although a geophysical survey was performed at YPG-028 that covered approximately 1.61 acres, the extent of buried waste at the site is only approximately 0.06 acres (Figure 4.1).

Prior to a surface removal action in November, 2009, scattered pieces of broken glass and rusted metal were present at the site, along with a relatively large, shallow excavation and related soil piles near the northwest corner of the site (see Section 2.2.1). At present, the site consists of vacant unused land. Much of the site consists of disturbed soils without any vegetation (Figure 2.2). However, there are a few small undisturbed areas with small bushes and trees that include bursage, creosote, and paloverde.

While the Sonoran desert tortoise (*Gopherus morafkai*) is known to occur at USAGYPG (Grandmaison 2010), it has only been found in the northwestern corner of the base (Grandmaison 2010). The U.S. Geological Survey (USGS) (Nussear et al. 2009) has modeled the habitat preferences of desert tortoises and generated a map of the showing which areas are have suitable habitat in southern California and Arizona. Based on this habitat suitability map, YPG-028 does contain suitable desert tortoise habitat; i.e., on a scale of 0 to 1 (with 1 being the most suitable habitat), the suitability for YPG-028 was estimated at 0.

E.1.4 Selection of Representative Ecological Receptors

Ecological receptors (i.e., representative species) include non-domesticated plants and wildlife that may reasonably be expected to inhabit or regularly forage at the site, given current and anticipated future site conditions. As generally recognized by ERA guidance documents, it is impractical to evaluate all possible ecological receptors for a given site. Instead, a few species representative of the habitat functions and trophic structure present are selected for evaluation in the ERA.

The species present at USAGYPG are shown in Table E.1. Plants and terrestrial invertebrates were selected for evaluation. In addition, one mammal and one bird species were selected for evaluation from each of the major trophic guilds; i.e., herbivores, insectivores, and carnivores. Special status species, and those species with small home ranges, occurring on the

base were preferentially selected for evaluation. Species that are primarily associated with the rivers and the farmlands bordering the base were not selected for evaluation. Note that although there are several special status bat species that occur on the base, bats have larger home ranges than shrews and mice, which were selected for evaluation instead because evaluation of species with smaller home ranges will result in a more conservative risk estimates. The representative species selected for evaluation are as follows:

Plants:

- Terrestrial plants

Invertebrates:

- Terrestrial (soil dwelling) invertebrates

Mammals:

- Desert shrew (*Notiosorex crawfordi*)
- Little pocket mouse (*Perognathus longimembris*)
- Kit fox (*Vulpes macrotis*)

Birds:

- Gambel's quail (*Callipepla gambelii*)
- Verdin (*Auriparus flaviceps*)
- American kestrel (*Falco sparverius*)

Reptiles:

- Sonoran desert tortoise (*Gopherus morafkai*)

Although the Mohave fringe-toed lizard (*Uma scoparia*) occurs at YPG (AGFD 2008) and is an Arizona species of special concern, it is "restricted to sparsely vegetated areas that concentrate fine sands such as dunes and large washes in arid environments" (AGFD 2008). Since there are no dunes or fine sands at YPG-028, the Mohave fringe-toed lizard is unlikely to be present and was not selected for evaluation.

E.1.5 Selection of Chemicals of Potential Ecological Concern

Chemicals of potential ecological concern (COPECs) are those chemicals detected in environmental media at the site for which exposure may result in adverse ecological effects. The selection of COPECs consisted of a five step process, as follows:

- Data review
- Exclusion of essential nutrients
- Identification of metals elevated above background
- Comparison of maximum detects to ecological screening levels
- Comparison of upper confidence limits (UCL) to risk-based screening levels

E.1.5.1 Data Review

A total of 8 soil samples, including one field duplicate, were collected from 5 test pits at depths ranging between 0-4.5 ft bgs. These samples were variously analyzed for VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270C), metals (USEPA Method 6010B, Method 7471A for mercury), and explosives (USEPA Method 8330).

Data quality was evaluated in Appendix C. As part of the data quality assessment, the data was assigned qualifiers. Data without qualifiers were considered appropriate for risk assessment purposes; i.e., these data met the criteria prescribed in the applicable Quality Assurance Project Plan (Appendix A, Parsons, 2010). Following USEPA guidance (1989, 1992), data with J qualifiers were used for risk assessment purposes. U and UJ qualified data were considered to be below laboratory detection limits (i.e., nondetect) but usable for risk assessment purposes. NJ qualified data were treated as detects but are likely to be false positives (Appendix C). R qualified data were excluded from this risk assessment (USEPA 1989, 1992).

E.1.5.2 Exclusion of Essential Nutrients

Essential nutrients are toxic only at very high doses (i.e., much higher than those associated with exposure at the site) were not selected as COPECs. These include calcium, magnesium, potassium, iron, and sodium (USEPA 1989).

E.1.5.3 Background

Metals are naturally occurring in soils. To determine which metals are present at the site due to past releases, the maximum detected concentrations at the site were compared with statistically derived background threshold values (BTVs). Metals detected at concentrations less than the BTVs were assumed to be present at naturally occurring concentrations and were not evaluated further. Metals detected at concentrations exceeding the BTVs were evaluated further. The derivation of the BTVs is presented in Appendix D.

E.1.5.4 Comparison of Maximum Detect to Ecological Screening Levels

The maximum detected concentrations were compared to ecological screening levels derived from the following hierarchy of sources:

1. USEPA (2011) Ecological Soil Screening Levels
2. Los Alamos National Laboratory (2011) EcoRisk Database v3.0
3. USEPA Region 4 (2001) Ecological Screening Values
4. USEPA Region 5 (2003) Ecological Screening Levels

Chemicals with maximum detected concentrations less than the ecological screening levels were assumed not to be present at concentrations with the potential to cause adverse effects and were eliminated as COPECs.

For aluminum, USEPA (2003a) states that "potential ecological risks associated with aluminum in soils is [sic] identified based on the measured soil pH. Aluminum is identified as a COPC [chemical of potential concern] only for those soils with a soil pH less than 5.5. The technical basis for this procedure is that the soluble and toxic forms of aluminum are only present in soil under [sic] soil pH values of less than 5.5." The soils within USAGYPG and the YPG-028 site, are predominately slightly to moderately alkaline, with pH values between 7.4 to 8.4 (Table 2.1 and Section 2.1.3). Therefore, aluminum was eliminated as a COEPC and not evaluated further in this ERA.

E.1.5.5 Comparison of UCL to Risk-Based Screening Levels

In the last step, 95% upper confidence limits (UCLs) on the mean were calculated using USEPA's (2010) ProUCL v4.1.01 software and compared to the ecological screening levels derived in the previous step. Those chemicals with UCLs greater than ecological screening levels were selected as COPECs. The output from ProUCL for 0-0.7 and 0-4.5 ft bgs is presented as Attachments 1 and 2 to this Appendix.

Using the process outlined above, the following COPECs were selected for YPG-028:

- Antimony
- Bis(2-ethylhexyl) phthalate
- Cadmium
- Copper
- Lead
- Zinc

The maximum detected concentrations, UCLs, BTVs, ecological screening levels, and results of the comparisons are shown in Table E.2.

E.1.6 Exposure-Pathway Analysis and Conceptual Site Model

Ecological receptors may be at-risk from exposures to COPECs if there is a complete exposure pathway between the COPEC source and the receptor. Results of the soil sampling activities conducted during this RFI indicate that COPECs are present in site soils. In addition, the ingestion of plants and animals from these sites may expose animals to site-related chemicals via food-web transfers. There is no surface water or sediment USAGYPG and it is assumed that groundwater has not been affected. Thus, ecological receptors are assumed to be exposed to COPECs via the following pathways:

- Dermal contact with soils
- Incidental ingestion of soils
- Ingestion of site-associated biota
- Inhalation of contaminants emitted from soils

These exposure pathways form the basis for the assessment endpoints and the CSM, which is graphically illustrated in Figure E.1.

E.1.6.1 Soil Exposure Pathways

Wildlife can incidentally ingest soils while foraging or during other activities; e.g., during dust bathing, preening, grooming (USEPA 1993). Some animals (e.g., deer and cows) may also intentionally ingest soils to supplement their trace mineral intake (Beyer et al. 1994). Thus, soil ingestion was assumed to be a complete exposure pathway.

Plants present at the site may be exposed to contaminants in soils through root contact, and some contaminants may be taken up into the vegetation and then consumed by herbivorous organisms. Similarly, invertebrates potentially residing in contaminated soils would contact and potentially incorporate these contaminants.

Wildlife exposures to chemicals in soil via dermal contact will not be evaluated in this ERA. USEPA (2003b) states that "Although dermal exposure through direct contact with soil can be considered a complete exposure pathway for birds and mammals, this exposure pathway is usually considered to be incidental due to low frequency and/or duration of exposure and the relative contribution to risk compared to oral exposures... Feathers of birds, fur on mammals, and scales on reptiles are believed to reduce dermal exposure by limiting the contact of the skin surface with the contaminated media."

USEPA (2003b) also states that inhalation exposures are generally insignificant. Therefore, exposures via the inhalation of COPECs emitted from soils were assumed to be insignificant and were not evaluated here.

For most plants, most of the root mass and uptake process usually occurs in fairly shallow soils. Globally, 95% of all plants have rooting depths between 1.3 and 5 ft bgs. In particular, the maximum rooting depth of crops and pasture species is (on average) between 3 and 5 ft bgs (Breuer et al., 2003; Schenk and Jackson, 2002). Schenk and Jackson (2009) have also modeled ecosystem rooting depths in North America and their maps show that the mean 95% ecosystem rooting depth is approximately 5.5 to 6.2 ft bgs (1.7 to 1.9 meters) in the area surrounding YPG-028. Therefore, plants were assumed to be exposed to soils up to 6 ft bgs.

In general, terrestrial invertebrates are assumed to burrow up to 6 ft bgs. Non-burrowing animals are generally assumed to be exposed to soils from 0-2 inches bgs. Therefore, the non-burrowing animals evaluated in this HRA (i.e., desert shrew, Gambel's quail, verdin, and American kestrel), were assumed to be exposed to soils from 0-2 inches bgs. If suitable soils are present, the Sonoran desert tortoise will dig burrows up to 6 ft deep on the slopes of rocky foothills (USACE 2006). Therefore, the Sonoran desert tortoise was assumed to be exposed to soils up to 6 ft bgs. Kit fox dens extend approximately 1.3-3 meters bgs (Arjo et al. 2003). Therefore, it was assumed the kit foxes may be exposed to soils as deep as 10 ft bgs. Little

pocket mice typically have tunnels that reach up to approximately 2 ft bgs (Kenagy 1973). In contrast, desert shrews do not generally burrow and nest on the surface (Hoffmeister and Goodpaster 1962).

At YPG-028 field samples were taken at 0.7 ft bgs and 4.5 ft bgs. Based on this information, the following exposure intervals were used to estimate exposures:

- Terrestrial plants: 0-4.5 ft bgs
- Terrestrial invertebrates: 0-4.5 ft bgs
- Desert shrew: 0-0.7 ft bgs
- Kit fox: 0-4.5 ft bgs
- Little pocket mouse: 0-0.7 ft bgs
- Gambel's quail: 0-0.7 ft bgs
- Verdin: 0-0.7 ft bgs
- American kestrel: 0-0.7 ft bgs
- Sonoran desert tortoise: 0-4.5 ft bgs

E.1.6.2 Food Web Exposure Pathways

Wildlife may be exposed to the COPECs at the site via the consumption of food items (e.g., plants, and invertebrates). Wildlife exposures via the consumption of food items from the site were assumed to be a complete exposure pathway and were quantitatively evaluated.

E.1.6.3 Surface Water Exposure Pathways

There is no surface water or sediment at the site. Therefore, surface water and sediment exposure pathways are assumed to be incomplete.

E.1.6.4 Groundwater Exposure Pathways

It is expected that groundwater occurs at approximately 49 ft bgs at the site (Section 2.2.4.2). Since groundwater does not come to the surface at the site, and most plants do not have roots that extend to 49 ft bgs, groundwater exposure pathways were assumed to be incomplete.

E.1.6.5 Exposure Pathway Summary and Conceptual Site Model

The ecological receptors used in this ERA were assumed to be exposed to the COPECs at the site via the consumption of food items (e.g., plants and invertebrates) and the incidental ingestion of soil while foraging. These exposure pathways were quantitatively evaluated in the ERA and are illustrated in Figure E.1.

E.1.7 Selection of Assessment Endpoints

In accordance with USEPA (1997) guidance for ecological risk assessment, assessment endpoints are "explicit expressions of the actual environmental values (e.g., ecological resources) that are to be protected." USEPA (1998) further states that "once ecological values are selected as potential assessment endpoints, they need to be operationally defined. Two elements are required to define an assessment endpoint." The two elements are 1) an ecological entity: and 2) "the characteristic about the entity of concern that is important to protect and potentially at risk" (USEPA 1998). An "ecological entity" can be a species (e.g., the desert shrew), a functional group of species (e.g., plants), a community (e.g., soil invertebrates), an ecosystem (e.g., sediment benthos), or a specific valued habitat (e.g., high desert). Here, several different species and groups of species, representing a broad range of potential ecological receptors, were selected (see Section E.1.4) for evaluation in this ERA. The characteristics to be protected include survival, reproduction, and development.

The interpretation of available site-specific and biological information and an understanding of the structure and function of the terrestrial communities at the site were used to identify general assessment endpoints for the ERA. The following assessment endpoints were selected for this analysis: development (including growth), survivorship, and reproduction in populations of the selected ecological receptors (Section E.1.4).

These general assessment endpoints, and their measurable attributes, represent the basic complete exposure pathways relevant to addressing the potential for ecological hazards due to the presence of site-specific COPECs.

E.2 ANALYSIS

The purpose of the Analysis Phase is to 1) characterize the potential types of effects that might occur in receptors if exposed to site-related contaminants:, and 2) quantify the exposure for complete exposure pathways. This section presents the derivation of effects and exposure estimates.

E.2.1 Selection of Toxicity Reference Values

Toxicity reference values (TRVs) are used to evaluate the potential hazards from exposure to each COPEC. Numerical values chosen for a TRV are based on a specific, "assessment endpoint"- (i.e., unaffected development, survivorship, or reproduction of the representative species as described in Section E.1.4). Since adverse reproductive and developmental effects generally occur at lower exposures than mortality, TRVs protective of reproductive and developmental effects were assumed to be protective of mortality. Population persistence was assumed to be maintained if reproduction and growth were not affected.

The numerical values used as TRVs are called "measures of effect." From each toxicity study, there are multiple potential numerical values that can be used as measures of effect. The measures of effect used in this ERA were the no observable adverse effect levels (NOAELs) and lowest observable adverse effect levels (LOAELs) protective of reproductive and developmental (including growth) effects.

Toxicity reference values for mammals and birds were obtained from the following hierarchy of sources:

1. USEPA (2011) Ecological Soil Screening Levels (Eco-SSLs)
2. Los Alamos National Laboratory (2011) EcoRisk Database v3.0
3. US Army Center for Health Promotion & Preventive Medicine Wildlife Toxicity Assessment program
4. Navy/Biological Technical Assistance Group (BTAG) Toxicity Reference Values as updated by the California Department of Toxic Substances Control (DTSC 2009)
5. Peer-reviewed academic literature

In the Eco-SSLs, only NOAEL-based TRVs are derived. These were determined by USEPA as the lesser of the 1) geometric mean of all NOAELs for growth and reproduction and 2) the highest bounded NOAEL[1] lower than the lowest bounded LOAEL[2] for reproduction, growth, and survival. The NOAEL-based TRVs reported by USEPA were used here. Because the LOAELs for each study reviewed during the development of the EcoSSLs are also provided, LOAEL-based TRVs were calculated here as the geometric mean of the LOAELs from the acceptable studies with the same endpoint(s) that were used to derive the NOAEL-based TRVs. Since the data presented in the EcoSSLs are from multiple chronic oral exposure studies using animals of multiple body weights and LOAELs were not used to extrapolate to NOAELs (and vice versa), no uncertainty factors were applied to TRVs derived from the EcoSSLs.

For TRVs taken from the LANL (2011) EcoRisk Database, the uncertainty factors used by LANL (2011) were used here. For TRVs derived from the academic literature, the following uncertainty factors were used:

- Uncertainty Factors Used to Derive Toxicity Reference Values

Extrapolation Goal	Test-Study Result	Uncertainty Factor
NOAEL	NOAEL	1
	LOAEL	5

[1]A bounded NOAEL is a NOAEL from a study that also produced a LOAEL

[2]A bounded LOAEL is a LOAEL from a study that also produced a NOAEL

Extrapolation Goal	Test-Study Result	Uncertainty Factor
	Overt Effect-Level	10
	LD_{50} (median lethal dose)	15
LOAEL	NOAEL	0.2 (=1/5)
	LOAEL	1
	Overt Effect-Level or LD_{50}	5
Chronic Duration	Single dose or <5 days	15
	A few weeks	10
	A few months	5
	Chronic; lifetime	1

For plants and invertebrates, the following hierarchy of sources for TRVs (expressed as soil screening levels) was used:

1. USEPA (2011) Eco-SSLs
2. Los Alamos National Laboratory (2011) EcoRisk Database v3.0
3. Canadian Council of Ministers of the Environment (2011) Canadian Environmental Quality Guidelines
4. Efroymson. et al. (1997)
5. Peer-reviewed academic literature

For antimony, no soil screening level protective of plants is available from USEPA (2011). The screening values from LANL (2010) and Efroymson et al. (1997) were based on an unspecified plant species exposed to antimony for an unspecified duration and an unspecified effect. Therefore, the screening values from LANL (2010) and Efroymson et al. (1997) are not considered usable. The following screening levels for plants are available from the academic literature:

- He and Yang (1999): evaluated effects of antimony on rice but did not statistically analyze their data. However, RIVM (2005) reports an EC_{10} of 56 mg/kg from this study based on reduced biomass.
- Oorts et al. (2008): evaluated effects of antimony on barley and lettuce and derived an EC_{10} of 510 mg/kg.
- Pan et al. (2011) evaluated effects of antimony on corn and found a NOAEL and LOAEL of 0 and 10 mg/kg, respectively, for reduced root biomass and total root length.

Oorts et al. (2008) state that other studies on the toxicity of antimony to plants are confounded by the ions bound to the antimony added to soils (e.g., $SbCl_3$ or $KSb(OH)_6$) that may

affect soil pH and/or salinity. Only the experiment by Oorts et al. (2008) demonstrated that the toxic effects of antimony were not confounded by pH or salinity effects. Therefore, the EC_{10} derived by Oorts et al. (2008) of 510 mg/kg is used here.

The TRVs selected for use in this ERA for plant and invertebrate, avian, mammalian, and reptilian receptors are provided in Tables E.3 through E.6.

E.2.2 Exposure Characterization

For plants and invertebrates, measured soil concentrations may be used directly to assess exposures. However, the TRVs used to assess the potential toxic effects of chemical exposures to avian, mammalian, and reptilian receptors are expressed in terms of an average daily dose (ADD), which is defined as the average mass of the chemical ingested, in milligram $(mg)_{chemical}$/kilogram $(kg)_{Body\ Weight\ (BW)}$-day. Therefore, it is necessary to develop reasonable estimates of the doses to which the ecological receptors may be exposed at each site. The exposure dose is estimated as a function of the concentrations in environmental media (e.g., soil), biotransfer through the food web, and the manner in which receptors use the location (e.g., length of time a receptor is expected to forage at the location based on their home range size, seasonal behavior, dietary composition, and food ingestion rates). The equation used to estimate the ADD is as follows:

where:

ADD =	Average daily dose (mg chemical ingested per kg body weight per day [mg/kg-day])
IR_F =	Food ingestion rate (kg_{food}-dry weight [dw]/kg_{BW}-day)
C_p =	COPEC concentration in plants (mg/kg-dw)
df_p =	Dietary fraction consisting of terrestrial plants
C_i =	COPEC concentration in terrestrial invertebrates (mg/kg-dw)
df_i =	Dietary fraction consisting of terrestrial invertebrates
C_m =	COPEC concentration in small mammals/birds (mg/kg-dw)
df_m =	Dietary fraction consisting of small mammals/birds
C_s =	COPEC concentration in soil (mg/kg-dw)
df_s =	Dietary fraction consisting of soil
AUF =	Area Use Factor; ratio of the size of the site to the receptor-specific foraging area

Each of the variables used to estimate ADD is explained below and summarized in Table E.7.

E.2.2.1 Body Weight (BW)

Body weight is the average weight of each ecological receptor and is used to determine food ingestion rates and is negatively related to exposure and hazard estimates. Where available, the body weight of the smaller sex was used.

Mammals:

- Desert Shrew: Body weighs have been summarized in USACHPPM (2006). Adult body weights range from 3.5 to 4.5 grams (g), with an average of 4 g for adults. Therefore, the mean body weight of 4 g was used.
- Kit Fox: Average body weighs have been summarized in USACHPPM (2006) as follows:
  - Arizona
    - Females: 1.67 ± standard error of 0.04 kg
    - Females: 1.87 ± standard error of 0.06 kg
    - Males: 1.77 ± standard error of 0.06 kg
    - Males: 1.82 ± standard error of 0.06 kg
    - Both sexes: 1.76 ± standard error of 0.05 kg
  - California
    - Males: 2.4 ± standard error of 0.01 kg
    - Females: 2.1 ± standard error of 0.01 kg
  - Utah
    - Males: 2.06 kg (range 1.7-2.5 kg)
    - Females: 1.91 kg (range 1.6-2.1 kg)

To provide a protective risk assessment, the lowest reported mean body weight from Arizona of 1.67 kg was used.

- Little pocket mouse: The mean body weight for mice in the Owens valley of California is 7.1 g ± standard error of 0.11 g, with a range of 6.3 to 8.0 g (Kenagy 1973). Therefore, a mean body weight of 7.1 g was used.

Birds:

- American kestrel: Body weights have been summarized in USEPA (1993) and USACHPPM (2006). Average adult body weights range from 103 to 138 g. No body weight data from Arizona was presented. Therefore, to provide a protective risk assessment, the lowest reported mean body weight from of 103 g was used.
- Gambel's quail: Average body weights have been summarized by Brown et al. (1998), as follows:
  - Arizona
    - Females: 167.4 g (range 157–176 g)
    - Males: 171.1 g (range 164–180 g)
    - Both sexes: 169.3 g (range 157–180 g)
    - Both sexes: range 160-175 g
  - New Mexico
    - Females: 177.3 ± standard deviation of 10 g
    - Males: 181.8 ± standard deviation of 10 g

To provide a protective risk assessment, the lowest reported mean body weight from Arizona of 167.4 g was used.

- Verdin: Average body weights have been summarized by Webster (1999). Winter body weights in Riverside County California were 6.9 ± standard deviation of 0.2 g during the winter and 6.3 ± standard deviation of 0.6 g during the summer. To provide a protective risk assessment, the lowest reported mean body weight of 6.3 g was used.

Reptiles:

- Sonoran desert tortoise: The Cal/Ecotox Database[3] presents body weight data from a large number of studies, most of which are unpublished reports. Only one study in the Cal/Ecotox Database reported results for the Sonoran desert tortoise; i.e., desert tortoises collected east of the Colorado River. That study reported mean body weights for males and females of 3.28 kg (with a standard deviation of 0.56 kg) and 2.65 kg (with a standard deviation of 0.39), respectively. Specimens were collected from Washington County (UT) and Mohave County (AZ). To provide a protective risk assessment, the mean body weight for females of 2.65 kg was used.

E.2.2.2 Food Ingestion Rate (IR_F)

The food ingestion rate is the amount of food an ecological receptor consumes on a daily basis. Food ingestion rates vary with many factors, including metabolic rate, the energy devoted to growth and reproduction, and composition of the diet. The metabolic rate of free-ranging animals is a function of several factors, including ambient temperature, activity levels, and body weight (USEPA 1993). For most wild animals, experimentally derived dietary intake rates are not available. However, Nagy (2001) has provided equations that can be used to estimate the metabolically required dietary intake rate from the average body weight of a species. Since Nagy (2001) derived equations for several different groups of birds and mammals, the equations provided by Nagy (2001) that best fits the data (i.e., the Class with the highest correlation coefficient $[r]^2$, with an r^2 of one indicating the equation perfectly matches the data) was used to estimate the dietary intake rate for each receptor. The equations applicable to each receptor, and their respective r^2 values, are as follows:

Mammals:

Desert shrew - carnivores, $r^2 = 0.954$, equation:

$$\mathrm{IR_D}(kg\text{-}dw/day) = 0.153 \times (\mathrm{BW})^{0.834} \times \frac{1\ kg}{1{,}000\ g}$$

Kit fox – carnivores, $r^2 = 0.954$, equation:

[3] http://www.oehha.ca.gov/scripts/cal_ecotox/species.asp

$$\mathrm{IR_D}(kg\text{-}dw/day) = 0.153 \times (\mathrm{BW})^{0.834} \times \frac{1\ kg}{1{,}000\ g}$$

Little pocket mouse - mammals, $r^2 = 0.947$, equation:

$$\mathrm{IR_D}(kg\text{-}dw/day) = 0.323 \times (\mathrm{BW})^{0.744} \times \frac{1\ kg}{1{,}000\ g}$$

Birds:

American kestrel – birds, $r^2 = 0.940$

$$\mathrm{IR_D}(\text{kg-dw/day}) = 0.638 \times (\mathrm{BW})^{0.685} \times \frac{1\ kg}{1{,}000\ g}$$

Gambel's quail – Galliformes, $r^2 = 0.992$, equation:

$$\mathrm{IR_D}(\text{kg-dw/day}) = 0.088 \times (\mathrm{BW})^{0.891} \times \frac{1\ kg}{1{,}000\ g}$$

Verdin – desert birds, $r^2 = 0.961$, equation:

$$\mathrm{IR_D}(\text{kg-dw/day}) = 0.407 \times (\mathrm{BW})^{0.681} \times \frac{1\ kg}{1{,}000\ g}$$

Reptiles:

Sonoran desert tortoise – reptiles, $r^2 = 0.952$

$$\mathrm{IR_D}(\text{kg-dw/day}) = 0.0111 \times (\mathrm{BW})^{0.920} \times \frac{1\ kg}{1{,}000\ g}$$

where:

$\mathrm{IR_D}$ (kg-dw/day) = dietary intake rate, or the amount of food ingested per day in dry weight

BW = average body weight (g)

The estimated dietary intake rates ($\mathrm{IR_D}$) are presented in Table E.7. The dietary intake rates are then body weight normalized, as follows:

$$IR_F = \frac{IR_D}{BW}$$

where:

$\mathrm{IR_D}$ = dietary intake rate (kg-dw/day)

$\mathrm{IR_F}$ = body weight normalized amount of food ingested per day (kg-dw/kg-day)

BW = average body weight (g)

The estimated food ingestion rates based on the average body weight and dietary intake rate presented above are presented in Table E.7.

E.2.2.3 Dietary Fraction (df)

Most ecological receptors consume a variety of food items. However, for the purposes of an ecological risk assessment, it is necessary to know what fraction of the total amount of food consumed (on average) is composed of plant matter, small mammals, insects, etc. This is discussed below for each ecological receptor.

Mammals:

- Desert shrew: Dietary information is available from USACHPPM (2006), which states that their main source of food is insects but, "occasionally they will eat … carrion such as dead birds, mammals, and reptiles but will not eat live rodents." However, quantitative information on the consumption of birds, mammals, and reptiles was not available. Therefore, birds, mammals, and reptiles were assumed to represent 1% of the desert shrew's diet, with the remaining 99% assumed to be invertebrates.
- Kit fox: According to USACHPPM (2006), kit foxes are almost exclusively carnivorous. While kit foxes do consume insects, USACHPPM (2006) did not provide a quantitative estimate of insect consumption. Therefore, insects were assumed to represent 1% of the kit foxes diet, with the remaining 99% assumed to be small mammals and birds.
- Little pocket mouse: Quantitative dietary information for this species is available from two sources, as follows:
  - Bradley and Mauer (1973), Clark County, Nevada, by % volume of stomach contents
    - Plants: 99%
    - Insects: 1%
  - Lemen and Freeman (1986), Goldfield, Nevada by % coverage of stomach contents
    - Plants: 96.4%
    - Insects: 2.9%

Both of these estimates are very similar. However, % volume provides a more accurate estimate of the amount of material consumed. Therefore, the little pocket mouse was assumed to have a diet of 99% plant matter and 1% insects.

Birds:

- American kestrel: Dietary composition has been summarized by USEPA (1993) and USACHPPM (2006). Kestrels prey on a variety of small animals, including invertebrates (e.g., worms, spiders, scorpions, beetles, and grasshoppers), amphibians and reptiles (e.g., frogs, lizards, and snakes), and a wide variety of small-to medium-sized birds and mammals. USEPA (1993) and USACHPPM (2006) summarize the results of three dietary studies, as follows:
  - California-open areas, woods: 32.6% invertebrates, 63.9% small mammals/birds/herpetofauna, 3.5% other
  - Florida-woodlands: 51% invertebrates, 49% small mammals/birds/herpetofauna
  - California-hayfields, pasture: 25% invertebrates, 71.3% small mammals/birds/herpetofauna, 3.7% not specified

The average dietary intake[4] of these three studies was used assumed to be representative of the diets of American kestrels at the site and is as follows:

- Terrestrial invertebrates: 36.2%
- Small mammals/birds: 63.8%

- Gambel's quail: Dietary composition studies on the Gamble's quail have been summarized by Brown et al. (1998), who states that Gambel's quail consumes seeds, grass, leaves, fruit, berries, and insects. Quantitative information on the diet of Gambel's quail are available as follows:
  - Brown et al. (1998), southern Arizona, by frequency
    - Plants: 92%
    - Insects: 7%
  - Hungerford (1962), southern Arizona, by frequency
    - Plants: 95.2%
    - Insects: 4.8%
  - Campbell (1957), New Mexico, by %volume of stomach contents
    - Plants: 98.4%
    - Insects: 1.6%

Only one study (Campbell 1957) was available that quantified the diets of Gambel's quails by % volume, therefore, that study was selected as the basis for assuming that the diet of Gambel's quail is 98.4% plants and 1.6% insects.

- Verdin: Dietary composition has been summarized Webster (1999), who states that the verdin's diet consists of scale insects, caterpillars, jumping spiders, aphids, beetles, wasp larvae, leafhoppers, some berries, nectar, palm fruits, and seedpods of legumes. However, quantitative information was not available on the composition of the verdin's diet. Therefore, it was assumed that plants made up 1% of the verdin's diet, with the remaining 99% assumed to be invertebrates.

Reptiles:

- Sonoran desert tortoise: Dietary composition has been summarized van Devender (2002). Sonoran desert tortoises in Arizona have been documented to eat 199 species of plants including herbs (55.3%), grasses (17.6%), woody plants (22.1%), and succulents (5.0%), Therefore, it was assumed that plants made up 100% of the Sonoran desert tortoise's diet.

E.2.2.4 Soil Ingestion (df_s)

Soil ingestion rates are available for a handful of non-domesticated wildlife species from the academic literature. The relevant literature is surveyed below for each species.

Mammals:

- Desert shrew: The soil ingestion rate for this species has not been determined. Talmage and Walton (1980) are often cited as the source for a 13% soil ingestion rate for the short-

[4] with "other" or unspecified fractions assumed to be small mammals/birds/herpetofauna

tail shrew. However, Talmage and Walton (1980) state that they obtained that information from a study by Garten (1980). Unfortunately, Garten (1980) did not sample short-tail shrews (*Blarina brevicauda*), or any other species from the shrew family (Soricidae). Therefore, the 13% soil ingestion rate reported by Talmage and Walton (1980) cannot be used. However, based on unpublished data from Garten, USEPA (2007) estimated a mean soil ingestion rate of 1.1% for the short-tail shrew. Since that is the only available information available for any species of shrew, a soil ingestion rate of 1.1% was assumed for the desert shrew.

- Kit fox: The soil ingestion rate for this species has not been determined. Beyer et al. (1994) reported a mean soil ingestion rate of 2.8% in the red fox (*Vulpes vulpes*). Therefore, a soil ingestion rate of 2.8% was assumed for the kit fox.
- Little pocket mouse: the soil ingestion rate has not been determined for this species or for any other species in the same family (Heteromyidae). Soil ingestion rates are available for several other small mouse-like mammals from the family Cricetidae: white-footed mouse (<2%), meadow vole (2.4%) (Beyer et al. 1994), and the hispid cotton rat (2.8%) (Garten 1980). The only other rodents for which soil ingestion rates are available are the black-tailed prairie dog (7.7%) and the white-tailed prairie dog (2.7%) (Beyer et al.. 1994), which are both significantly larger the little pocket mouse. Therefore, it was assumed that that soil ingestion rate of the hispid cotton rat should be protective of the soil ingestion rate of the little pocket mouse and a soil ingestion rate of 2.8% was assumed.

Birds:

- American kestrel: USACHPPM (2006a) states that soil ingestion is likely to be negligible and consist only of that associated with prey that are consumed. However, USEPA (2007) estimated a mean soil ingestion rate for the red-tailed hawk (*Buteo jamaicensis*) of 2.6%. Assuming that the soil ingestion rate of the red-tailed hawk is representative of the American kestrel, a soil ingestion rate of 2.6% was assumed here.
- Gambel's quail: The soil ingestion rate has not been determined for this species. However, Beyer et al. (1994) provide a soil ingestion rate of 9.3% for the wild turkey. Since wild turkeys are in the same order as Gambel's quail (i.e., Galliformes), both species forage on the ground, and both species have a similar diet (i.e., mostly plant matter with some insects), it was assumed that the soil ingestion rate of wild turkeys would be representative of Gambel's quail. Therefore, a soil ingestion rate of 9.3% was used.
- Verdin: the soil ingestion rate has not been determined for this species. Johnson et al. (2007) measured the ingestion rates of several other species of Passeriformes, including the eastern bluebird (<2%), eastern phoebe (<2%), prairie warbler (<2%), and the brown thrasher (7%). These birds all eat insects, like the mountain verdin. The eastern phoebe and the prairie warbler catch insects either while flying or on tree limbs, as does the verdin. Therefore, the verdin was assumed to have a soil ingestion rate similar to that of the eastern phoebe (<2%) and the prairie warbler (<2%). To provide a protective risk assessment, a soil ingestion rate of 2% was assumed.

Reptiles:

- Sonoran desert tortoise: the soil ingestion rate has not been determined for this species. It has, however been documented that tortoises intentionally consume soil, probably for mineral supplementation (Esque and Peters 1992; Marlow and Tollestrup, 1982). Since there is no available information, but it is known that desert tortoises intentionally ingest soil, a soil ingestion rate of 5% was assumed.

Note that because the dietary intake rate presented above (Section E.2.2.2) is the metabolically required amount of food that must be ingested, and soils are not assumed to have any metabolic value, the amount of soil ingested is assumed to be in addition to the amount of food ingested. Therefore, the total dietary proportions, when soil is included will be greater than 100% (e.g., 105% for the Sonoran desert tortoise).

E.2.2.5 Foraging Area and Area Use Factor (AUF)

The AUF is the ratio of the size of the site to the receptor-specific foraging area/home range. When ecological receptors have foraging areas larger than a site, they are assumed to obtain only a portion of their total dietary intake from the site. That portion is assumed to be equal to the AUF. This section presents the foraging areas for each of the receptors and estimated AUFs.

Mammals:

- Desert shrew: The home range of this species has not been measured. However, USACHPPM (2006) estimated that the home range of adult desert shrews should be between 0.2 and 1.75 acres, based on body weight. To provide a health protective risk assessment, the smallest home range of 0.2 acres was used.
- Kit fox: Studies on the average home ranges for kit foxes have been summarized by USACHPPM (2006), as follows:
  - San Jaoquin Valley, California: 642-1,285 acres
  - Western Arizona
    - Males: 3,039 ± a standard error of 247 acres
    - Females: 2,422 ± 346 acres
    - Both sexes: 2,768 ± 232 acres
  - California : 2866 ± 222 acres

To provide a health protective risk assessment, the smallest average home range reported from Arizona (2,422 acres) was used.

- Little pocket mouse: Home range information is available from several sources, as follows:
  - Burge and Jorgensen (1973), Nevada (assuming 95% confidence and 99% coverage)
    - Males: 38.88 meter (m) radius
    - Females: 36.09 m radius
  - Jorgensen (1968), Nevada:
    - Males: 41.89 m radius
    - Females: 44.45 m radius
  - Maza et al. (1973), Nevada (assuming 99% coverage)

        - Male: 53.7 m radius
        - Female: 60.3 m radius
        - Both sexes: 57.0 m radius
    - Kenagy (1973), Owens Valley, California: maximum distance moved less than 50 m.

Since none of the available studies are from Arizona, the smallest home range radius (36.09 m radius) was converted to an area (i.e., area = πr^2) of 1.0 acres.

Birds:

- American kestrel: USACHPPM (2006) summarizes the available home range data for kestrels, as follows:
    - California (winter):
        - Female: 31.6 hectare (ha) ± 10.7 standard deviation (78 ± 26 acres)
        - Male: 13.1 ha ± 2.0 standard deviation (32 ± 4.9 acres)
        - Mean: 154 ha (range, <452 ha) (381 acres)
    - Wyoming (summer): 202 ha ± 131 standard deviation (499 acres)
    - Michigan: 131 ha ± 100 standard deviation (324 acres)

  To provide a protective assessment, the smallest reported home range of 32 acres was used.
- Gambel's quail: Gullion (1962) reported that home ranges of Gambel's quail ranged from of 19 to 95 acres, with an average of 35.7 acres. Therefore, a home range of 35.7 acres was used.
- Verdin: Home range information is available from several sources, as follows:
    - Taylor (1971), Maricopa County, Arizona.: 23.7 acres (8.9 and 31.2 acres) (breeding territory)
    - Webster (1999), Doña Ana County, New Mexico.
        - Breeding territory: 19.8 acres
        - Nonbreeding territory: 48.4 acres
    - Webster (1999), Riverside County, California.: 48.4 acres

The home range of 23.7 acres for the only study from Arizona (Taylor. 1971) was used.

Reptiles:

- Sonoran desert tortoise: Home range information is available from two sources, as follows:
    - Barrett (1990), Picacho Mountains, Arozina:
        - Males: 63.8 ± standard error of 20.4 acres
        - Females: 37.9 ± 13.6 acres
        - Range for both sexes: 7.0 to 132.0 acres
    - Riedle et al. (2008), Florence Military Reservation. Arizona
        - Males: 82.5 ± standard deviation of 71.6 acres
        - Females: 44.0 ± 42.6 acres
        - Range for both sexes: 7.7 to 230.1 acres
    - Averill-Murray (2002) summarizes several studies from Arizona, as follows:
        - Harcuvar Mountains
            - Males: 22.7 acres (range 2.5-55.1 acres)

    - Females: 11.6 acres (range 6.7-18.5 acres)
  - Little Shipp Wash
    - Males: 53.6 acres (range 37.6-77.8 acres)
    - Females: 57.6 acres (range 8.4-127.3 acres)
  - Mazatzal Mountains
    - Females: 31.6 acres (range 5.7-125.3 acres)
  - San Pedro Valley
    - Males: 27.2 acres (range 9.6-54.9 acres)
    - Females: 6.4 acres (range 2.7-14.8 acres)
  - Tortolita Mountains
    - Males: 40.3 acres (range 8.2-62.3 acres)
    - Females: 32.4 acres (20.0-53.4)

As all reported home ranges are from Arizona, the smallest reported home range of 6.4 acres was used.

For this site, either the acreage of the buried waste (0.06 acres) or the geophysical survey area (1.609 acres) could be used in the calculation of the AUF. Since a larger site acreage results in a more conservative risk estimate, the acreage of the geophysical survey area was used in the calculation of the AUF. Given an area of 1.609 acres for YPG-028, the area use factors are as follows:

- Desert shrew: 1.609 acres/0.2 acres ≥ 1, therefore, 1 was used
- Kit fox: 1.609 acres/2,422 acres = 0.0007
- Little pocket mouse: 1.609 acres/1.0 acres ≥ 1, therefore, 1 was used
- American kestrel: 1.609 acres/32 acres = 0.05
- Gambel's quail: 1.609 acres/35.7 acres = 0.05
- Verdin: 1.609 acres/23.7 acres = 0.07
- Sonoran desert tortoise: 1.609 acres/6.4 acres = 0.25

E.2.2.6 Exposure Point Concentrations (C_s, C_p, C_i)

An exposure point concentration (EPC) is the concentration of a particular chemical in an environmental medium (e.g., soil), at the point of contact with the receptor. An EPC was calculated for soils, invertebrates, small mammal/bird prey, and plants. EPCs for soil and food items (plants, invertebrates, and small mammal/bird prey) were estimated based on the corresponding soil intervals presented in Section E.1.6.1 above. Soil EPCs are provided in Table E.8.

EPCs were calculated as the lesser of the UCL or the maximum detected concentration within the respective soil interval. As discussed in Section E.1.5.5 UCLs were calculated using the most recent version of USEPA's ProUCL software. At the time the report was prepared, this was v4.1.01. ProUCL output is provided in Attachments 1 and 2.

Since plants, invertebrates, and small mammals were not sampled, bioaccumulation models were used to predict concentrations in these organisms. The models used were taken from the following hierarchy of sources:

1. USEPA (2011) Eco-SSLs
2. Los Alamos National Laboratory (2011) EcoRisk Database v3.0
3. Ecological risk assessment protocol for hazardous waste combustion facilities (USEPA 1999)
4. Bechtel Jacobs Company (1998)
5. Peer-reviewed academic literature

The bioaccumulation models may take several different forms. USEPA (2011) provides both bioaccumulation factors and regression models. The bioaccumulation models used and predicted EPCs are provided in Tables E.9 through E.11.

To provide a basis for comparison, EPCs were also estimated for background conditions.

E.3 RISK CHARACTERIZATION

Risk characterization involves two components:; hazard estimates and risk description. For vertebrates, hazard estimates are based on the comparison of average daily dose to the chemical- and receptor-specific TRVs and are expressed as a hazard quotient (HQ):

$$HQ = \frac{Average\ daily\ dose\ (ADD)}{Toxicity\ Reference\ Value\ (TRV)}$$

For invertebrates and plants, the HQ is calculated by dividing the soil EPC by the benchmark concentration, as follows:

$$HQ = \frac{Soil\ Exposure\ Point\ Concentration\ (EPC)}{Benchmark\ Concentration}$$

The HQ provides a mathematically derived index that expresses the relationship between the ADD and derived TRV. A NOAEL-based HQ of 1 is the threshold at or below which the contaminant is unlikely to cause adverse ecological effects: NOAEL-based HQs greater than 1 indicates that exposures exceeds a no-effect dose and does not necessarily indicate that adverse effects will occur. LOAEL-based HQs better indicate the potential for adverse effects to receptors because they are based on effect-based toxicological data. Thus, LOAEL-based HQs greater than 1 indicate that adverse effects may occur, but whether or not significant effects would actually occur cannot be judged with certainty. Menzie et al. (1993) recommended the following guidelines for interpreting HQs or HIs:

- Adverse effects are not expected for HQ or HI values less than one.
- A low potential for adverse effects may be indicated by HQ or HI values between one and 10.

- A significant potential for adverse effects on ecological receptors and communities may be indicated by HQ or HI values greater than 10, particularly if they exceed a value of 100.

The second component of the risk characterization step is the risk description. The risk description is an interpretation of the risks estimated for the assessment endpoints. It includes an "evaluation of the lines of evidence supporting or refuting the risk estimates and interpretation of the significance of the adverse effects on the assessment endpoints" (USEPA 1998).

To provide an estimate of the incremental hazards contributed by exposures at the site compared to background, ADDs and HQs were also estimated for background conditions. The plant and invertebrate screening levels and HQs are shown in Table E.12. Calculated ADDs, and the resulting HQs, are provided in Tables E.13 and E.14.

E.3.1 Hazard Estimates

Six COPECs were selected for the site: antimony, bis(2-ethylhexyl) phthalate, cadmium, copper, lead, and zinc (Section E.1.5.5). For both plants and invertebrates, the HQs for assumed exposures to antimony, cadmium, and lead were all less than one. However, the HQs for assumed plant and invertebrate exposures to copper were both approximately 2; and the HQs for assumed plant and invertebrate exposures to zinc were approximately 2 and 3, respectively (Table E.12).

For the vertebrate receptors, both the NOAEL and LOAEL-based HQs for all receptors were less than one for all COPECs, with the exception of the NOAEL-based HQs for assumed desert shrew exposures to cadmium and copper (Table E.13).

E.3.2 Risk Description

For plants and invertebrates, the HQs for assumed exposures to copper and zinc ranged from approximately 2 to 3. for both COPECs (Table E.12). This indicates that assumed exposure to copper and zinc in soils may result in adverse effects to plants and invertebrates.

For the vertebrate receptors, only the NOAEL-based HQs for assumed desert shrew exposures to cadmium and copper were greater than one (Table E.13). Since the LOAEL-based HQs and HIs did not exceed 1, assumed exposures to the COPECs at this site are unlikely to result in adverse effects to vertebrate receptors.

E.4 UNCERTAINTY ANALYSIS

All risk assessments involve the use of assumptions, professional judgment, and imperfect data to varying degrees, which results in uncertainty in the final hazard estimates. Uncertainties associated with the ecological risk assessment are qualitatively evaluated here.

The soil samples collected at part of this RFI used to calculate the soil EPCs were generally biased samples; i.e., sampling was biased toward areas of contamination. Thus, the soil EPCs presented here are likely to be representative of the most contaminated areas at the site and are unlikely to be representative of true site-wide average concentrations. Thus, the risks estimated here are likely to be over estimated.

Exposure estimates in this ERA incorporate an assumption of 100% bioavailability for all COPECs in soils. This is likely to result in an over-estimation of exposure, as it is unlikely that all of the COPECs are 100% bioavailable in soil. Actual ADDs are expected to be less than what was estimated in this ERA.

The bioaccumulation models used in this ERA are not site-specific. Therefore, the actual concentrations of EPCs in plants, terrestrial invertebrates, and small mammals/birds may differ from what was assumed here. Additionally, bioaccumulation is expected to differ among species of plants, terrestrial invertebrates, and small animals, as well as by site-specific soil properties. Therefore, the bioaccumulation models used here represent a degree of uncertainty in the assessments.

The exposure parameters used to estimate average daily intakes are generally the most conservative available; i.e., of the available data, the parameter values that would result in the highest exposure levels were used. Thus, it is anticipated that the exposures at the site are unlikely to be lower than what has been estimated here. However, it should also be noted that the exposure parameters used in this ERA are not taken from the populations at USAGYPG and the actual exposure parameters may differ somewhat from what was assumed in this ERA.

No TRVs were available to assess the potential effects of exposures of reptiles to vanadium and zinc. Thus, HQs could not be calculated for these metals and it is likely that the hazards to reptiles have been under estimated.

No TRVs were available that are specific to the species evaluated in this ERA. Thus, the degree to which the TRVs used here reflect the toxicity to the species evaluated is uncertain.

Actual annual average food ingestion rates for the species investigated in this ERA were not available. Therefore, the food ingestion rates were based on regression models of metabolic rates for mammals, birds, and reptiles (Nagy, 2001). Since the field measurements were not made at USAGYPG-028 for the species investigated here, there is some uncertainty regarding the accuracy of the estimated food ingestion rates.

For most of the species assessed in this ERA, soil ingestion rates have not been measured and it was necessary to extrapolate a soil ingestion rate based on similar species. This may have resulted in some uncertainty in the exposures estimated for soil ingestion.

For the desert shrew, the NOAEL-based HQs for cadmium and copper exceeded the threshold value of one while the LOAEL-based HQs were less than one for all COPECs.

Although adverse effects may occur at concentrations less than the LOAELs but greater than the NOAELs, this is expected to be a minor source of uncertainty when considered in the light of the accompanying estimated LOAEL-based HQs and hazard indexes.

Using the HQ method to assess hazards to ecological receptors includes intrinsic uncertainties. Limitations of this method (Tannenbaum et al., 2003) include:

- HQs are not measures of a potential hazard to ecological health, but only indicate if estimated exposure exceeds a particular toxicological value.
- HQs generally lack population-level relevance. The TRVs used in this ERA are based on responses of individuals. However, populations of ecological receptors are the focus of assessment-endpoint specifications for ERAs (in the absence of special-status species).
- HQ values in ERA seemingly indicate a linear relationship (e.g., an HQ=100 appears to be 100-fold worse than an HQ=1), whereas the underlying toxicological relationships may not be linear.
- Conservatism, assumptions, and uncertainties (particularly the use of "uncertainty factors" in deriving proxy values for no-effect TRVs) can combine to produce highly elevated HQ values that reflect toxicologically implausible conditions (e.g., extant conditions could be interpreted to be acutely lethal with respect to chemical concentrations, yet habitat is present and occupied by organisms).

It was also assumed in this ERA that the effects of exposures to multiple COPECs were additive. However, in some cases, the effects of exposures to multiple chemicals may result in synergistic (i.e., greater than additive) or antagonistic (i.e., less than additive) effects.

The sources of uncertainty discussed should be considered when evaluating this ERA as the basis for further action at the site. However, the generally conservative nature of the ERA process and the assumptions used in this ERA, should result in a generally health-protective assessment.

E.5 REFERENCES

Arizona Game and Fish Department (AGFD). 2008. Threatened, Endangered and Sensitive Species Surveys. Yuma Proving Ground. La Paz and Yuma Counties, Arizona.

Arjo WM, Bennett TJ, Kozlowski AJ. 2003. Characteristics of current and historical kit fox (*Vulpes macrotis*) dens in the Great Basin Desert. Canadian Journal of Zoology 81:96-102.

Averill-Murray RC, Martin BE, Bailey SC, Wirt EB. 2002. Activity and behavior of the Sonoran desert tortoise in Arizona. Pages 135-158 in The Sonoran Desert tortoise: natural history, biology and conservation. Tuscon: The University of Arizona Press. Edited by van Devender TR.

Barrett SL. 1990. Home range and habitat of the desert tortoise (*Xerobates agassizi*) in the Picacho Mountains of Arizona. Herpetologica, 46:202-206.

Bechtel Jacobs Company. 1998. Empirical models for the uptake of inorganic chemicals from soil by plants. BJC/OR-133, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Beyer WN, Connor EE, and Gerould S. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management. 58:375-382.

Bradley WG, Mauer RA. 1973. Rodents of a creosote-bush community in southern Nevada. Southwestern Naturalist 17:333-344.

Breuer L, Eckhardt K, and Frede H-G.- 2003. Plant parameter values for models in temperate climates. Ecological Modeling 169: 237–293.

Brown DE, Hagelin JC, Taylor M, and Galloway J. 1998. Gambel's quail (*Callipepla gambelii*), The Birds of North America Online. Ithaca: Cornell Lab of Ornithology; Available online at: http://bna.birds.cornell.edu/bna/species/321

Burge JR, Jorgensen CD. 1973. Home range of small mammals: a reliable estimate. Journal of Mammalogy 54:483-488.

Campbell H. 1957. Fall foods of Gambel's quail (*Lophortyx gambelii*) in New Mexico. Southwestern Naturalist 2:122-128.

Canadian Council of Ministers of the Environment. 2011. Canadian Environmental Quality Guidelines. Available online at: http://ceqg-rcqe.ccme.ca/

Command Technology Directorate, Gutierrez-Palmenberg, and Jason Associates. 2001. Range Wide Environmental Impact Statement. Yuma: U.S. Army Proving Ground Yuma and La Paz Counties, Arizona.

Department of Toxic Substances Control (DTSC). 2009. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) recommended toxicity reference values for mammals and birds.

Efroymson RA,Will ME, Suter GW, Wooten AC. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. ES/ER/TM-85/R3. Prepared for the U.S. Department of Energy, Office of Environmental Management. Prepared by Lockheed Martin Energy Systems, Inc., for the East Tennessee Technology Park, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Esque TC, Peters EL. 1992. Ingestion of bones, stones, and soil by desert tortoises. Fish and Wildlife Research 13:105-111.

Garten CT. 1980. Ingestion of soil by hispid cotton rats, white-footed mice, and eastern chipmunks. Journal of Mammalogy 61: 136-137.

Grandmaison-, DD.- 2010.- Landscape-level habitat associations and phylogenetics of desert tortoises on southwestern Arizona military ranges managed by the Army, Air Force, and Marines. Project 08-385.

Gullion GW. 1962. Organization and movements of coveys of a Gambel quail population. The Condor 64: 402-415.

He M, Yang J. 1999. Effects of different forms of antimony on rice during the period of germination and growth and antimony concentration in rice tissue. Science of the Total Environment 243/244: 149-155.

Hoffmeister DF, Goodpaster WW. 1962 Life history of the desert shrew, *Notiosorex crawfordi*. Southwestern Naturalist 7:236-252.

Hungerford CR. 1962. Adaptations shown in selection of food by Gambel quail. Condor 64:213-219.

Johnson MS, Wickwire WT, Quinn MJ Jr, Ziolkowski DJ Jr, Burmistrov D, Menzie CA, Geraghty C, Minnich M, Parsons PJ. 2007. Are songbirds at risk from lead at small arms ranges? An application of the spatially explicit exposure model. Environmental Toxicology and Chemistry 26: 2215–2225.

Jorgensen CD. 1968. Home range as a measure of probable interactions among populations of small mammals. Journal of Mammalogy 49:104-112.

Kenagy GJ. 1973. Daily and seasonal patterns of activity and energetics in a heteromyid rodent community. Ecology 54:1201-1219.

Lemen CA, Freeman PW. 1986. Interference competition in a heteromyid community in the Great Basin of Nevada, USA. Oikos 46:390–396.

Los Alamos National Laboratory (LANL). 2011. Ecorisk Database (Release 3.0): LA-UR-11-5650. Available online at: http://www.lanl.gov/environment/cleanup/ecorisk.shtml

Marlow RW, Tollestrup K. 1982. Mining and exploitation of natural mineral deposits by the desert tortoise, *Gopherus agassizii*. Animal Behavior 30:475-478.

Maza BG, French NR, Aschwanden AP. 1973. Home range dynamics in a population of heteromyid rodents. Journal of Mammalogy 54:405-425.

Menzie CA, Cura J, Freshman J, and Svirsky S. 1993. Evaluating ecological risks and developing remedial objectives at forested wetland systems in New England. In: Application of Ecological Risk Assessment to Hazardous Waste Site Remediation. Workshop Proceedings, USEPA Science Advisory Board.

Nagy KA. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. Nutrition Abstracts and Reviews, Series B: Livestock Feeds and Feeding 71:21R-32R.

National Weather Service (NWS). 2011. New 1981-2010 Climate Normals. http://www.wrh.noaa.gov/psr/pns/2011/July/newNormals.php

Nussear KE, Esque TC, Inman RD, Gass L, Thomas KA, Wallace CSA, Blainey, JB, Miller, DM, and Webb RH. 2009. Modeling habitat of the desert tortoise (*Gopherus agassizii*) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

Oorts K, Smolders E, Degryse F, Buekers J, Gascó G, Cornelis G, Mertens J. 2008. Solubility and toxicity of antimony trioxide (Sb_2O_3) in soil. Environmental Science and Technology 42: 4378–4383.

Pan X, Zhang D, Chen X, Bao A, Li L. 2011. Antimony accumulation, growth performance, antioxidant defense system and photosynthesis of *Zea mays* in response to antimony pollution in soil. Water, Air, & Soil Pollution 215:517–523.

Parsons. 2010. Final RCRA Facility Investigation Work Plan for Inactive Landfills and Muggins Mountain OB/OD Sites for U.S. Army Garrison Yuma Proving Ground. May.

Riedle JD, Averill-Murray RC, Lutz CL, Bolen DK. 2008. Habitat use by desert tortoises (*Gopherus agassizii*) on alluvial fans in the Sonoran desert, south-central Arizona. Copeia 2:414–420.

Rijksinstituut voor Volksgezondheid en Milieu (RIVM). 2005. Environmental risk limits for nine trace elements. RIVM report 601501029/2005.

Schenk HJ and, Jackson RB. 2002. The global biogeography of roots. Ecological Monographs 72:311-328.

Schenk HJ and Jackson RB. 2009. ISLSCP II ecosystem rooting depths. In Hall FG, Collatz G, Meeson B, Los S, Brown de Colstoun E, Landis D. (eds.). ISLSCP Initiative II Collection. Data set. Available on-line at http://daac.ornl.gov/. doi:10.3334/ORNLDAAC/929

Talmage SS, Walton BT. 1993. Food chain transfer and potential renal toxicity of mercury to small mammals at a contaminated terrestrial field site. Ecotoxicology 2:243-256.

Tannenbaum LV, Johnson MS, and Bazar M. 2003. Application of the hazard quotient method in remedial decisions: a comparison of human and ecological risk assessments. Human and Ecological Risk Assessment 9:387–401.

Taylor WK. 1971. A breeding biology study of the Verdin, *Auriparus flaviceps* (Sundevall) in Arizona. American Midland Naturalist 85: 289-328.

Tetra Tech EM Inc. 1998. *Final RCRA Facility Report*. U.S. Army Yuma Proving Ground, AZ. August.

United States Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2006. Development of terrestrial exposure and bioaccumulation information for ecological risk assessments.

United States Army Corps of Engineers (USACE). 2006. Screening level ecological risk assessments of some military munitions and obscurant-related compounds for selected threatened and endangered species. ERDC-TR-06-11.

United States Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund (RAGS). Human Health Evaluation Manual Part A. Interim Final. OSWER 9285.701A. EPA/540/1-89/002.

USEPA. 1992. Guidance for data usability in risk assessment (Part A) Final. Publication Number 9285.7-09A.

USEPA. 1993. Wildlife exposure factors handbook. EPA/600/R-93/187a.

USEPA. 1997. Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments, Interim Final. EPA 540-R-97-006.

USEPA. 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002F. Risk Assessment Forum.

USEPA. 1999. Screening level ecological risk assessment protocol for hazardous waste combustion facilities. EPA530-D-99-001A.

USEPA. 2003a. Ecological soil screening level for aluminum. Interim final. OSWER Directive 9285.7-60.

USEPA. 2003b. Guidance for developing ecological soil screening levels (Eco-SSLs). Evaluation of dermal contact and inhalation exposure pathways for the purpose of setting Eco-SSLs. OSWER Directive 92857-55.

USEPA. 2007. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs) Exposure factors and bioaccumulation models for derivation of wildlife Eco-SSLs. OSWER Directive 9285.7-55.

USEPA. 2010. ProUCL Version 4.1 User guide. statistical software for environmental applications for data sets with and without nondetect observations. EPA/600/R-07/041.

USEPA. 2011. Ecological Soil Screening Levels. Available online at: http://www.epa.gov/ecotox/ecossl/

USEPA. Region 4. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Available online at: http://www.epa.gov/region4/waste/ots/ecolbul.html

USEPA. Region 5. 2003. Ecological Screening Values. Available online at: http://www.epa.gov/reg5rcra/ca/edql.htm

van Devender TR. 2002. The Sonoran Desert tortoise: natural history, biology and conservation. Tuscon: The University of Arizona Press.

Webster MD. 1999. Verdin (*Auriparus flaviceps*). The Birds of North America Online. Ithaca: Cornell Lab of Ornithology; Available online at: http://bna.birds.cornell.edu/bna/species/470

TABLES

TABLE E.1
LIST OF SPECIES AT YUMA PROVING GROUND
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Class[1,2,3]	Common Name	Scientific Name	Trophic Level	Federal Status	Arizona Status	Migratory Bird Treaty Act	Associated with Colorado & Gila Rivers[4]	Associated with Farmlands[4]
Amphibia	Red-spotted toad	*Bufo punctatus*	Carnivore					
Amphibia	Colorado River toad	*Bufo alvarius*	Carnivore					
Amphibia	Couch's spadefoot toad	*Scaphiopus couchii*	Carnivore					
Aves	Cooper's hawk	*Accipiter cooperii*	Carnivore			X	X	
Aves	Sharp-shinned hawk	*Accipiter striatus*	Carnivore			X	X	X
Aves	Spotted sandpiper	*Actitis macularius*	Insectivore				X	
Aves	White-throated swift	*Aeronautes saxatalis*	Insectivore			X		
Aves	Red-winged blackbird	*Agelaius phoeniceus*	Herbivore				X	X
Aves	Black-throated sparrow	*Amphispiza bilineata*	Omnivore			X		
Aves	Northern pintail	*Anas acuta*	Omnivore			X	X	
Aves	American wigeon	*Anas americana*	Herbivore			X	X	X
Aves	Northern shoveler	*Anas clypeata*	Insectivore			X	X	
Aves	Green-winged teal	*Anas crecca*	Omnivore			X	X	
Aves	Cinnamon teal	*Anas cyanoptera*	Omnivore			X	X	
Aves	Blue-winged teal	*Anas discors*	Omnivore			X	X	
Aves	Mallard	*Anas platyrhynchos*	Omnivore			X	X	
Aves	Gadwall	*Anas strepera*	Omnivore			X	X	X
Aves	Golden eagle	*Aquila chrysaetos*	Carnivore			X		
Aves	Black-chinned hummingbird	*Archilochus alexandri*	Omnivore			X	X	X
Aves	Great blue heron	*Ardea herodias*	Carnivore			X	X	X
Aves	Long-earned owl	*Asio otus*	Carnivore			X		
Aves	Burrowing owl	*Athene cunicularia*	Carnivore			X		
Aves	Verdin	*Auriparus flaviceps*	Insectivore			X		
Aves	Cedar waxwing	*Bombycilla cedrorum*	Omnivore			X	X	X
Aves	Great horned owl	*Bubo virginianus*	Carnivore			X		
Aves	Cattle egret	*Bubulcus ibis*	Carnivore			X	X	X
Aves	Bufflehead	*Bucephala albeola*	Insectivore			X	X	

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Aves	Zone-tailed hawk	*Buteo albonotatus*	Carnivore			X		
Aves	Red-tailed hawk	*Buteo jamaicensis*	Carnivore			X		
Aves	Rough-legged hawk	*Buteo lagopus*	Carnivore			X		
Aves	Gambel's quail	*Callipepla gambelii*	Herbivore					
Aves	Costa's hummingbird	*Calypte costae*	Omnivore			X		
Aves	Cactus wren	*Campylorhynchus brunneicapillus*	Omnivore			X		
Aves	House finch	*Carpodacus mexicanus*	Herbivore			X		
Aves	Turkey vulture	*Cathartes aura*	Carnivore			X		
Aves	Hermit thrush	*Catharus guttatus*	Omnivore			X		
Aves	Swainson's thrush	*Catharus ustulatus*	Omnivore			X	X	
Aves	Canyon wren	*Catherpes mexicanus*	Insectivore			X		
Aves	Vaux's swift	*Chaetura vauxi*	Insectivore			X		
Aves	Killdeer	*Charadrius vociferus*	Insectivore			X		X
Aves	Lesser nighthawk	*Chordeiles acutipennis*	Insectivore			X		
Aves	Northern harrier	*Circus cyaneus*	Carnivore			X		
Aves	Northern flicker	*Colaptes auratus*	Insectivore			X		
Aves	Gilded flicker	*Colaptes chrysoides*	Insectivore			X		
Aves	Rock dove	*Columba livia*	Herbivore					
Aves	Inca dove	*Columbina inca*	Herbivore			X		
Aves	Common ground dove	*Columbina passerina*	Herbivore			X		
Aves	Olive-sided flycatcher	*Contopus cooperi*	Insectivore			X	X	
Aves	Western wood-peewee	*Contopus sordidulus*	Insectivore			X	X	
Aves	Common raven	*Corvus corax*	Omnivore			X		
Aves	Yellow-rumped warbler	*Dendroica coronata*	Omnivore			X		
Aves	Black-throated gray warbler	*Dendroica nigrescens*	Insectivore			X		
Aves	Hermit warbler	*Dendroica occidentalis*	Insectivore			X	X	X

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Aves	Yellow warbler	*Dendroica petechia*	Insectivore			X	X	X
Aves	Townsend's warbler	*Dendroica townsendi*	Insectivore			X	X	
Aves	Pacific-slope flycatcher	*Empidonax difficilis*	Insectivore			X		
Aves	Hammond's flycatcher	*Empidonax hammondii*	Insectivore			X		
Aves	Gray flycatcher	*Empidonax wrightii*	Insectivore			X		
Aves	Horned lark	*Eremophila alpestris*	Herbivore			X		
Aves	Merlin	*Falco columbarius*	Carnivore			X		
Aves	Prairie falcon	*Falco mexicanus*	Carnivore			X		
Aves	American peregrine falcon	*Falco peregrinus*	Carnivore	Delisted	WSC	X	X	
Aves	American kestrel	*Falco sparverius*	Carnivore			X		
Aves	Greater roadrunner	*Geococcyx californianus*	Omnivore			X		
Aves	Common yellowthroat	*Geothlypis trichas*	Insectivore			X	X	X
Aves	Sandhill crane	*Grus canadensis*	Omnivore			X	X	X
Aves	Bald eagle	*Haliaeetus leucocephalus*	Carnivore	Delisted	WSC	X	X	
Aves	Black-necked stilt	*Himantopus mexicanus*	Insectivore			X	X	X
Aves	Barn swallow	*Hirundo rustica*	Omnivore			X		
Aves	Baltimore oriole	*Icterus galbula*	Omnivore			X		
Aves	Scott's oriole	*Icterus parisorum*	Omnivore			X		
Aves	Loggerhead shrike	*Lanius ludovicianus*	Carnivore			X		
Aves	California gull	*Larus californicus*	Carnivore			X	X	X
Aves	Ring-billed gull	*Larus delawarensis*	Carnivore			X	X	X
Aves	Belted Kingfisher	*Megaceryle alcyon*	Carnivore		WSC	X	X	
Aves	Western Screech-Owl	*Megascops kennicottii*	Carnivore			X		
Aves	Gila woodpecker	*Melanerpes uropygialis*	Omnivore			X		
Aves	Elf owl	*Micrathene whitneyi*	Insectivore			X		
Aves	Northern mockingbird	*Mimus polyglottos*	Omnivore			X		
Aves	Brown-headed cowbird	*Molothrus ater*	Omnivore			X		

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Aves	Ash-throated flycatcher	*Myiarchus cinerascens*	Insectivore			X		
Aves	Brown-crested flycatcher	*Myiarchus tyrannulus*	Insectivore			X		
Aves	Long-billed curlew	*Numenius americanus*	Carnivore			X		
Aves	Black-crowned night-heron	*Nycticorax nycticorax*	Omnivore			X	X	X
Aves	MacGillivray's warbler	*Oporornis tolmiei*	Herbivore			X		
Aves	Sage thrasher	*Oreoscoptes montanus*	Omnivore			X		
Aves	Ruddy duck	*Oxyura jamaicensis*	Insectivore			X	X	
Aves	Osprey	*Pandion haliaetus*	Carnivore		WSC	X	X	
Aves	House sparrow	*Passer domesticus*	Herbivore					X
Aves	Lazuli bunting	*Passerina amoena*	Omnivore			X		
Aves	California brown pelican	*Pelecanus occidentalis*	Carnivore			X	X	
Aves	Cliff Swallow	*Petrochelidon pyrrhonota*	Insectivore			X		
Aves	Phainopepla	*Phainopepla nitens*	Omnivore			X		
Aves	Common poorwill	*Phalaenoptilus nuttallii*	Insectivore			X		
Aves	Wilson's phalarope	*Phalaropus tricolor*	Insectivore			X	X	X
Aves	Black-headed grosbeak	*Pheucticus melanocephalus*	Omnivore					
Aves	Ladder-backed woodpecker	*Picoides scalaris*	Insectivore			X		
Aves	Abert's towhee	*Pipilo aberti*	Omnivore			X	X	
Aves	Green-tailed towhee	*Pipilo chlorurus*	Omnivore			X		
Aves	Western tanager	*Piranga ludoviciana*	Insectivore			X		
Aves	Eared grebe	*Podiceps nigricollis*	Insectivore			X	X	
Aves	Blue-gray gnatcatcher	*Polioptila caerulea*	Insectivore			X		
Aves	Black-tailed gnatcatcher	*Polioptila melanura*	Insectivore			X		
Aves	Purple martin	*Progne subis*	Insectivore			X		
Aves	Vermilion flycatcher	*Pyrocephalus rubinus*	Insectivore			X		
Aves	Great-tailed grackle	*Quiscalus mexicanus*	Omnivore			X		X
Aves	American avocet	*Recurvirostra americana*	Omnivore			X	X	

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Aves	Ruby-crowned kinglet	*Regulus calendula*	Insectivore			X		
Aves	Rock wren	*Salpinctes obsoletus*	Insectivore			X		
Aves	Black phoebe	*Sayornis nigricans*	Insectivore			X	X	X
Aves	Say's phoebe	*Sayornis saya*	Insectivore			X		
Aves	Rufous hummingbird	*Selasphorus rufus*	Omnivore			X		
Aves	Lesser goldfinch	*Spinus psaltria*	Herbivore				X	X
Aves	Black-chinned sparrow	*Spizella atrogularis*	Omnivore			X		
Aves	Brewer's sparrow	*Spizella breweri*	Insectivore			X		
Aves	Chipping sparrow	*Spizella passerina*	Herbivore			X		X
Aves	Northern rough-winged swallow	*Stelgidopteryx serripennis*	Insectivore			X	X	
Aves	Eurasian Collared dove	*Streptopelia decaocto*	Herbivore					X
Aves	Western meadowlark	*Sturnella neglecta*	Omnivore			X		X
Aves	European starling	*Sturnus vulgaris*	Omnivore				X	X
Aves	Tree swallow	*Tachycineta bicolor*	Insectivore			X	X	
Aves	Violet-green swallow	*Tachycineta thalassina*	Insectivore			X		
Aves	Bendire's thrasher	*Toxostoma bendirei*	Omnivore			X		
Aves	Crissal thrasher	*Toxostoma crissale*	Insectivore			X		
Aves	Le Conte's thrasher	*Toxostoma lecontei*	Omnivore			X		
Aves	Brown thrasher	*Toxostoma rufum*	Omnivore			X		
Aves	Greater yellowlegs	*Tringa melanoleuca*	Carnivore			X	X	X
Aves	House wren	*Troglodytes aedon*	Insectivore			X		
Aves	American Robin	*Turdus migratorius*	Omnivore			X		
Aves	Western kingbird	*Tyrannus verticalis*	Insectivore			X		
Aves	Cassin's kingbird	*Tyrannus vociferans*	Insectivore			X		
Aves	Barn owl	*Tyto alba*	Carnivore			X		
Aves	Orange-crowned warbler	*Vermivora celata*	Insectivore			X		
Aves	Golden-winged warbler	*Vermivora chrysoptera*	Insectivore			X		

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Aves	Lucy's warbler	*Vermivora luciae*	Insectivore			X		
Aves	Nashville warbler	*Vermivora ruficapilla*	Insectivore			X		
Aves	Virginia's warbler	*Vermivora virginiae*	Insectivore			X		
Aves	Bell's vireo	*Vireo bellii arizonae*	Insectivore			X	X	
Aves	Cassin's vireo	*Vireo cassinii*	Insectivore			X	X	
Aves	Warbling vireo	*Vireo gilvus*	Insectivore			X		
Aves	Wilson's warbler	*Wilsonia pusilla*	Insectivore			X		
Aves	White-winged dove	*Zenaida asiatica*	Herbivore			X		
Aves	Mourning dove	*Zenaida macroura*	Herbivore			X		
Aves	White-crowned sparrow	*Zonotrichia leucophrys*	Omnivore			X		
Mammalia	Harris' antelope squirrel	*Ammospermophilus harrisii*	Herbivore					
Mammalia	White-tailed antelope squirrel	*Ammospermophilus leucurus*	Herbivore					
Mammalia	Pallid bat	*Antrozous pallidus*	Insectivore					
Mammalia	Ringtail	*Bassariscus astutus*	Omnivore					
Mammalia	Coyote	*Canis latrans*	Omnivore					
Mammalia	Bailey's pocket mouse	*Chaetodipus baileyi*	Herbivore					
Mammalia	Long-tailed pocket mouse	*Chaetodipus formosus*	Herbivore					
Mammalia	Rock pocket mouse	*Chaetodipus intermedius*	Herbivore					
Mammalia	Desert pocket mouse	*Chaetodipus penicillatus*	Herbivore					
Mammalia	Townsend's big-eared bat	*Corynorhinus townsendii*	Insectivore					
Mammalia	Desert kangaroo rat	*Dipodomys deserti*	Herbivore					
Mammalia	Merriam's kangaroo rat	*Dipodomys merriami*	Herbivore					
Mammalia	Big brown bat	*Eptesicus fuscus*	Insectivore					
Mammalia	Burro	*Equus asinus*	Herbivore					
Mammalia	Horse	*Equus caballus*	Herbivore					
Mammalia	Porcupine	*Erethizon dorsatum*	Herbivore					
Mammalia	Spotted bat	*Euderma maculatum*	Insectivore		WSC			

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Mammalia	Western mastiff bat	*Eumops perotis*	Insectivore					
Mammalia	Allen's big-eared bat	*Idionycteris phyllotis*	Insectivore					
Mammalia	Silver-haired bat	*Lasionycteris noctivagans*	Insectivore				X	
Mammalia	Western red bat	*Lasiurus blossevillii*	Insectivore		WSC		X	
Mammalia	Hoary bat	*Lasiurus cinereus*	Insectivore					
Mammalia	Southern yellow bat	*Lasiurus ega*	Insectivore					
Mammalia	Western yellow bat	*Lasiurus xanthinus*	Insectivore		WSC			
Mammalia	Black-tailed jack rabbit	*Lepus californicus*	Herbivore					
Mammalia	Bobcat	*Lynx rufus*	Carnivore					
Mammalia	California leaf-nosed bat	*Macrotus californicus*	Insectivore		WSC			
Mammalia	Striped skunk	*Mephitis mephitis*	Omnivore					
Mammalia	House mouse	*Mus musculus*	Omnivore				X	X
Mammalia	California myotis	*Myotis californicus*	Insectivore					
Mammalia	Western small-footed bat	*Myotis ciliolabrum*	Insectivore					
Mammalia	Arizona myotis	*Myotis occultus*	Insectivore				X	
Mammalia	Cave myotis	*Myotis velifer*	Insectivore					
Mammalia	Long-legged myotis	*Myotis volans*	Insectivore					
Mammalia	Yuma myotis	*Myotis yumanensis*	Insectivore				X	
Mammalia	White-throated woodrat	*Neotoma albigula*	Herbivore					
Mammalia	Desert woodrat	*Neotoma lepida*	Herbivore					
Mammalia	Desert shrew	*Notiosorex crawfordi*	Insectivore					
Mammalia	Pocketed free-tailed bat	*Nyctinomops femorosaccus*	Insectivore					
Mammalia	Big free-tailed bat	*Nyctinomops macrotis*	Insectivore					
Mammalia	Mule deer	*Odocoileus hemionus*	Herbivore					
Mammalia	Muskrat	*Ondatra zibethicus*	Herbivore				X	
Mammalia	Southern grasshopper mouse	*Onychomys torridus*	Omnivore					
Mammalia	Desert bighorn sheep	*Ovis canadensis mexicana*	Herbivore					

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Mammalia	Arizona pocket mouse	*Perognathus amplus*	Herbivore					
Mammalia	Little pocket mouse	*Perognathus longimembris*	Herbivore					
Mammalia	Brush mouse	*Peromyscus boylii*	Omnivore					
Mammalia	Canyon mouse	*Peromyscus crinitus*	Omnivore					
Mammalia	Cactus mouse	*Peromyscus eremicus*	Omnivore					
Mammalia	Deer mouse	*Peromyscus maniculatus*	Omnivore					
Mammalia	Western pipistrelle	*Pipistrellus hesperus*	Insectivore					
Mammalia	Racoon	*Procyon lotor*	Omnivore				X	X
Mammalia	Mountain lion	*Puma concolor*	Carnivore					
Mammalia	Round-tailed ground squirrel	*Spermophilus tereticaudus*	Herbivore					
Mammalia	Rock Squirrel	*Spermophilus variegatus*	Herbivore					
Mammalia	Spotted skunk	*Spilogale putorius*	Omnivore					
Mammalia	Desert cottontail	*Sylvilagus audubonii*	Herbivore					
Mammalia	Brazilian free-tailed bat	*Tadarida brasiliensis*	Insectivore					
Mammalia	American badger	*Taxidea taxus*	Carnivore					
Mammalia	Botta's pocket gopher	*Thomomys bottae*	Herbivore					
Mammalia	Gray fox	*Urocyon cinereoargenteus*	Carnivore				X	X
Mammalia	Kit fox	*Vulpes macrotis*	Carnivore					
Reptilia	Glossy snake	*Arizona elegans*	Carnivore					
Reptilia	Western whiptail	*Aspidoscelis tigris*	Carnivore					
Reptilia	Zebra-tailed lizard	*Callisaurus draconoides*	Insectivore					
Reptilia	Rosy boa	*Charina trivirgata gracia*	Carnivore					
Reptilia	Western shovel-nosed snake	*Chionactis occipitalis*	Carnivore					
Reptilia	Western banded gecko	*Coleonyx variegatus*	Insectivore					
Reptilia	Western diamondback rattlesnake	*Crotalus atrox*	Carnivore					
Reptilia	Sidewinder	*Crotalus cerastes*	Carnivore					

TABLE E.1
LIST OF SPECIES AT YUMA PROVING GROUND
RCRA FACILITY INVESTIGATION REPORT - YPG-028
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Class[1,2,3]	Common Name	Scientific Name	Trophic Level	Federal Status	Arizona Status	Migratory Bird Treaty Act	Associated with Colorado & Gila Rivers[4]	Associated with Farmlands[4]
Reptilia	Speckled rattlesnake	*Crotalus mitchellii*	Carnivore					
Reptilia	Mojave rattlesnake	*Crotalus scutulatus*	Carnivore					
Reptilia	Collared lizard	*Crotaphytus collaris*	Carnivore					
Reptilia	Great Basin collared lizard	*Crotaphytus bicintores*	Carnivore					
Reptilia	Desert iguana	*Dipsosaurus dorsalis*	Herbivore					
Reptilia	Long-nosed leopard lizard	*Gambelia wislizenii*	Carnivore					
Reptilia	Morafka's desert tortoise (aka Sonoran)	*Gopherus morafkai*	Herbivore		WSC			
Reptilia	Mediterranean house gecko	*Hemidactylus turcicus*	Insectivore					
Reptilia	Night snake	*Hypsiglena torquata*	Carnivore					
Reptilia	Common kingsnake	*Lampropeltis getula*	Carnivore					X
Reptilia	Western slender blind snake	*Leptotyphlops humilis*	Insectivore					
Reptilia	Coachwhip	*Masticophis flagellum*	Carnivore					
Reptilia	Western coral snake	*Micruroides euryxanthus*	Carnivore					
Reptilia	Desert horned lizard	*Phrynosoma platyrhinos*	Insectivore					
Reptilia	Spotted leaf-nosed snake	*Phyllorhynchus decurtatus*	Carnivore					
Reptilia	Gopher snake	*Pituophis catenifer*	Carnivore					
Reptilia	Long-nosed snake	*Rhinocheilus lecontei*	Carnivore					
Reptilia	Western patch-nosed snake	*Salvadora hexalepis*	Carnivore					
Reptilia	Common chuckwalla	*Sauromalus ater*	Herbivore					
Reptilia	Desert spiny lizard	*Sceloporus magister*	Insectivore					
Reptilia	Ground snake	*Sonora semiannulata*	Insectivore					
Reptilia	Mohave fringe-toed lizard	*Uma scoparia*	Insectivore		WSC			
Reptilia	Long-tailed brush lizard	*Urosaurus graciosus*	Insectivore					
Reptilia	Tree lizard	*Urosaurus ornatus*	Insectivore				X	
Reptilia	Side-blotched lizard	*Uta stansburiana*	Insectivore					

TABLE E.1
LIST OF SPECIES AT YUMA PROVING GROUND
RCRA FACILITY INVESTIGATION REPORT - YPG-028
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Class[1,2,3]	Common Name	Scientific Name	Trophic Level	Federal Status	Arizona Status	Migratory Bird Treaty Act	Associated with Colorado & Gila Rivers[4]	Associated with Farmlands[4]
Plants	Nichol's turkshead cactus	*Echinocactus horizonthalonius var. nicholii*	Plants	Endangered	HS			
Plants	Crucifixion thorn (Thorn of Christ)	*Castela emoryi*	Plants		HS			
Plants	Engelman's hedgehog cactus	*Echinocereus engelmannii*	Plants		SR			
Plants	Nichol's hedgehog cactus	*Echinocereus nicholii*	Plants		SR			
Plants	California barrel cactus	*Ferocactus cylindraceus*	Plants		SR			
Plants	Candy barrel cactus	*Ferocactus wislizeni*	Plants		SR			
Plants	Graham's nipple cactus	*Mammillaria grahamii*	Plants		SR			
Plants	Queen of the Night	*Peniocereus greggii*	Plants		SR			

Definitions:

WSC - Wildlife of Special Concern in Arizona.

HS- Highly Safeguarded

SR- Salvage Restricted

Notes:

1 - Includes only those species that have been observed at YPG

2 - For birds, the list presented here does not include "accidentals" (i.e., present as a result of weather events) or vagrants, unless the bird was also observed as breeding at YPG

3 - For plants, only special status species are shown

4 - Although these species may occasionally be found at Yuma Proving Ground (YPG), they are primarily associated with surface water and/or farmland and their presence at YPG is restricted to areas adjacent to surface water and/or farmland

TABLE E.2
CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	Max Detect[1] (mg/kg)	UCL[1] (mg/kg)	BTV (mg/kg)	ESL		MaxD Exceeds		UCL Exceeds	
					(mg/kg)	source	BTV	ESL	ESL	COPEC
Metals	Aluminum	10,900	-	12,000	NA[2]	Eco-SSL	No	NA	-	No
	Antimony	0.38	NA[3]	NA	0.27	Eco-SSL	NA	Yes	NA[3]	Yes
	Arsenic	6.12	-	6.6	18	Eco-SSL	No	No	-	No
	Barium	153	-	290	330	Eco-SSL	No	No	-	No
	Beryllium	0.46	-	0.92	21	Eco-SSL	No	No	-	No
	Cadmium	2.71	2.189	0.65	0.36	Eco-SSL	Yes	Yes	Yes	Yes
	Chromium, Total	12.3	-	14	26[4]	Eco-SSL	No	No	-	No
	Cobalt	4.5	-	7.9	13	Eco-SSL	No	No	-	No
	Copper	136	710.2	15	28	Eco-SSL	Yes	Yes	Yes	Yes
	Lead	18.8	14.02	14	11	Eco-SSL	Yes	Yes	Yes	Yes
	Manganese	290	-	920	220	Eco-SSL	No	Yes	-	No
	Mercury	0.019	0.0112	0.016	0.013	LANL ESL	Yes	Yes	No	No
	Molybdenum	0.27	-	0.49	17	LANL ESL	No	No	-	No
	Nickel	16	-	14	38	Eco-SSL	Yes	No	-	No
	Silver	0.88	-	0.062	4.2	Eco-SSL	Yes	No	-	No
	Vanadium	20.1	-	26	7.8	Eco-SSL	No	Yes	-	No
	Zinc	345	1,336	44	46	Eco-SSL	Yes	Yes	Yes	Yes
SVOCs	bis(2-Ethylhexyl) phthalate	0.0339	0.0242	NA	0.02	LANL ESL	NA	Yes	Yes	Yes
	Pentachlorophenol	0.0281	-	NA	2.1	Eco-SSL	NA	No	-	No
VOCs	Acetone	0.0958	-	NA	1.2	LANL ESL	NA	No	-	No
	Benzene	0.00117	-	NA	24	LANL ESL	NA	No	-	No
	Chlorobenzene	0.000506	-	NA	2.4	LANL ESL	NA	No	-	No
	Methyl ethyl ketone (2-Butanone)	0.0167	-	NA	360	LANL ESL	NA	No	-	No
	Methyl isobutyl ketone (4-Methyl-2-Pentanone)	0.00316	-	NA	9.8	LANL ESL	NA	No	-	No
	Methylene chloride	0.00825	-	NA	2.6	LANL ESL	NA	No	-	No
	Toluene	0.00291	-	NA	23	LANL ESL	NA	No	-	No
Explosives	1,3,5-Trinitrobenzene	0.058	-	NA	6.6	LANL ESL	NA	No	-	No
	2,4,6-Trinitrotoluene	0.023	-	NA	6.4	LANL ESL	NA	No	-	No
	2,4-Dinitrotoluene	0.0091	-	NA	2.5	LANL ESL	NA	No	-	No

TABLE E.2
CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	Max Detect[1] (mg/kg)	UCL[1] (mg/kg)	BTV (mg/kg)	ESL		MaxD Exceeds		UCL Exceeds	
					(mg/kg)	source	BTV	ESL	ESL	COPEC

Notes:

1 For 0-4.5 ft bgs
2 ESL is not applicable for alumnium because aluminum is identified as a COPC only for those soils with a soil pH less than 5.5 and the pH at the site is higher than 5.5.
3 No UCL could be calculations as there was only one detect.
4 as Chromium III

Definitions:

BTV - Background threshold value
COPEC - Chemicals of potential ecological concern
Eco-SSL - United States Environmnetal Protection Agency (USEPA) Ecological Soil Screening Level (http://www.epa.gov/ecotox/ecossl/)
ESL - Ecological Screening Level
LANL ESL - Los Alamos National Laboratory, EcoRisk Database v3.0 (http://www.lanl.gov/environment/cleanup/ecorisk.shtml)
Max - Maximum concentration
MaxD - Maximum detected value
NA - Not applicable
Shaded - Exceeded screenign levels.
SVOC - Semi-volatile organic compound
UCL - Upper confidence limit
VOC - Volatile organic compound

TABLE E.3
SOIL SCREENING LEVELS FOR PLANTS AND INVERTEBRATES - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Plant Screening-Benchmark		Invertebrate Screening-Benchmark	
	(mg/kg)	Source	(mg/kg)	Source
Antimony	510	Oorts et al. (2008)	78	USEPA (2011)
Bis(2-ethylhexyl) phthalate	-	-	-	-
Cadmium	32	USEPA (2011)	140	USEPA (2011)
Copper	70	USEPA (2011)	80	USEPA (2011)
Lead	120	USEPA (2011)	1,700	USEPA (2011)
Zinc	160	USEPA (2011)	120	USEPA (2011)

Definitions:

COPEC = chemical of potential ecological concern

kg = kilogram

mg = milligram

TABLE E.4
TOXICITY REFERENCE VALUES FOR BIRDS - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Test Species	Test Effect Dose (mg/kg-day)		Exposure Route	Effect	Source	Total Uncertainty Factors		TRV (mg/kg-day)	
		NOAEL[1]	LOAEL				NOAEL	LOAEL	NOAEL-based	LOAEL-based
Antimony	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl) phthalate	Dove, Ringed	1.1	-	Oral	Reproduction	LANL (2011)	1	10	1.1	11
Cadmium	Chicken, duck, quail	1.47	6.35	Oral	Reproduction, growth	USEPA (2011)	1	1	1.47	6.35
Copper	Chicken, duck, turkey, quail	4.05	34.87	Oral	Reproduction, growth	USEPA (2011)	1	1	4.05	34.87
Lead	Chicken, duck, pigeon, quail, American kestrel	1.63	44.63	Oral	Reproduction, growth	USEPA (2011)	1	1	1.63	44.63
Zinc	Chicken, duck, quail, turkey	66.1	171.44	Oral	Reproduction, growth	USEPA (2011)	1	1	66.1	171.44

Definitions:

COPEC = Chemical of potential ecological concern
kg = kilogram
LOAEL = Lowest observed adverse effect level
mg = milligram
NOAEL = No observed adverse effect level
TRV = Toxicity reference value

Notes:

1 - Value is the lesser of the 1) geometric mean of all NOAELs and 2) the highest bounded NOAEL for reproduction, growth or survival.

TABLE E.5
TOXICITY REFERENCE VALUES FOR MAMMALS - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Test Species	Test Effect Dose (mg/kg-day)		Exposure Route	Effect	Source	Total Uncertainty Factors		TRV (mg/kg-day)	
		NOAEL[1]	LOAEL				NOAEL	LOAEL	NOAEL-based	LOAEL-based
Antimony	Rat, mouse	0.059	2.76	Oral	Reproduction, growth	USEPA (2011)	1	1	0.06	2.76
Bis(2-ethylhexyl)phthalate	Mouse	18.3	183	Oral	Reproduction	LANL (2011)	1	1	18.3	183
Cadmium	Mouse, shrew, rat, dog, sheep, pig, vole, cattle	0.77	6.9	Oral	Reproduction, growth	USEPA (2011)	1	1	0.77	6.90
Copper	Rat, sheep, mouse, cattle, pig, shrw, guinea pig, rabbit, mink, goat	5.6	82.7	Oral	Reproduction, growth	USEPA (2011)	1	1	5.60	82.70
Lead	Rat, dog, sheep, mouse, cattle, pig, vole, shrew, guinea pig, hamster, horse, rabbit	4.7	186.4	Oral	Reproduction, growth	USEPA (2011)	1	1	4.70	186.40
Zinc	Cow, hamster, mink, mouse, pig, rabbit, rat, sheep, buffalo	75.4	297.58	Oral	Reproduction, growth	USEPA (2011)	1	1	75.40	297.58

Definitions:

COPEC = Chemical of potential ecological concern
LOAEL = Lowest observed adverse effect level
kg = kilogram
mg = milligram
NOAEL = No observed adverse effect level
TRV = Toxicity reference value

Notes:

1 - for NOAELs from USEPA (2001), value is the lesser of the 1) geometric mean of all NOAELs and 2) the highest bounded NOAEL for reproduction, growth or survival.

TABLE E.6
TOXICITY REFERENCE VALUES FOR REPTILES - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Test Species	Test Effect Dose (mg/kg-day)		Exposure Route	Effect	Source	Uncertainty Factors			TRV (mg/kg-day)	
		NOAEL	LOAEL				Study Duration	Endpoint	Total	NOAEL-based	LOAEL-based
Antimony	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalat	-	-	-	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	-	-	-	-	-
Lead	Western fence lizard	1	10	diet	Reduced testes, food consumption, and body fat, enlarged kidneys	Salice et al. (2009)	10	1	10	0.1	1
Zinc	-	-	-	-	-	-	-	-	-	-	-

Definitions:

COPEC = Chemical of potential ecological concern
kg = kilogram
LOAEL = Lowest observed adverse effect level
mg = milligram
NOAEL = No observed adverse effect level
TRV = Toxicity reference value

TABLE E.7
EXPOSURE PARAMETERS FOR WILDLIFE RECEPTORS - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Receptor	Average Body Weight (kg) BW	Dietary Intake Rate (kg-dw/day) IR_D	Food Ingestion Rate (kg-dw/kg-day) IR_F	Dietary Fraction: Soils df_s	Dietary Fraction: Terrestrial Plants df_P	Dietary Fraction: Terrestrial Invertebrates df_I	Dietary Fraction: Terrestrial Small Mammals/ Birds df_m	Foraging Area (acres)	Area Use Factor AUF (unitless)
Mammals									
Desert shrew	0.004	4.86E-04	0.12	0.011	0	0.99	0.01	0.2	1.0
Kit fox	1.67	7.45E-02	0.045	0.028	0	0.01	0.99	2,422	0.0007
Little pocket mouse	0.0071	1.39E-03	0.20	0.028	0.99	0.01	0	1.0	1.0
Birds									
American kestrel	0.103	1.53E-02	0.15	0.026	0	0.362	0.638	32	0.05
Gambel's quail	0.1674	8.43E-03	0.05	0.093	0.984	0.016	0	35.7	0.05
Verdin	0.0063	1.43E-03	0.23	0.02	0.01	0.99	0	23.7	0.07
Reptiles									
Sonoran desert tortoise	2.65	1.57E-02	0.0059	0.05	1	0	0	6.4	0.25

Definitions:

df_s = Dietary fraction consisting of soil
df_P = Dietary fraction consisting plants
df_I = Dietary fraction consisting invertebrates
df_m = Dietary fraction consisting small mammals/birds
kg = kilogram
mg = milligram

TABLE E.8
EXPOSURE POINT CONCENTRATION - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Number of Results		Percent Detections	Detected Results		ProUCL Distribution[1]	ProUCL UCL[2]	EPC[3]
	Total	Detects		Minimum	Maximum			
0-0.7 feet bgs								
Antimony	5	1	20%	0.38	0.38	-	-	0.38
Bis(2-ethylhexyl)phthalate	5	2	40%	0.0159	0.0201	95% KM (t) UCL	0.019	0.019
Cadmium	5	5	100%	0.074	2.71	95% Student's-t UCL	2.142	2.142
Copper	5	5	100%	6.66	16.2	95% Student's-t UCL	13.7	13.7
Lead	5	5	100%	6.67	12.4	95% Student's-t UCL	10.91	10.91
Zinc	5	5	100%	26.4	43.5	95% Student's-t UCL	38.82	38.82
0-4.5 feet bgs								
Antimony	8	1	13%	0.38	0.38	-	-	0.38
Bis(2-ethylhexyl)phthalate	8	4	50%	0.0159	0.0339	95% KM (t) UCL	0.0242	0.0242
Cadmium	8	8	100%	0.055	2.71	95% Approximate Gamma UCL	2.189	2.189
Copper	8	8	100%	6.66	136	95% Hall's Bootstrap UCL	710.20	136
Lead	8	8	100%	6.08	18.8	95% Student's-t UCL	14.02	14.02
Zinc	8	8	100%	25.5	345	95% Hall's Bootstrap UCL	1336.0	345
Background								
Antimony	12	0	0%	-	-	-	-	-
Cadmium	12	9	75%	0.013	0.75	95% KM (Chebyshev) UCL	0.37	0.37
Copper	12	12	100%	1.4	12.9	95% Student's -t UCL	7.13	7.13
Lead	12	12	100%	2.56	12.5	95% Approximate Gamma UCL	6.82	6.82
Zinc	12	12	100%	10.3	38.8	95% Student's-t UCL	24.8	24.8

Definitions:
COPEC - Chemical of potential ecological concern
EPC - exposure point concentration
UCL - 95% upper confidence limit

Notes:
1 - The method and distribution used by ProUCL version 4.1.01 to calculate the recommended UCL
2 - The 1st recommended UCL from ProUCL.
3 - The lesser of the maximum detected concentration and the UCL.

TABLE E.9
PREDICTED COPEC CONCENTRATIONS IN PLANTS YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Soil EPC (C_s) (mg/kg)	Uptake Parameters		Concentration in Plants (C_p) (mg/kg)
		PUF (kg soil dw / kg plant dw)	Source	
Site (0-4.5 ft bgs)				
Antimony	0.38	ln(Cp) = 0.938 * ln(Cs) - 3.233	USEPA (2007)	1.59E-02
Bis(2-ethylhexyl)phthalate	0.0242	$C_p = 0.05 * C_s$	LANL (2011)	1.21E-03
Cadmium	2.189	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	USEPA (2007)	9.54E-01
Copper	136	$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	USEPA (2007)	1.35E+01
Lead	14.02	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	USEPA (2007)	1.17E+00
Zinc	345	$\ln(C_p) = 0.554 * \ln(C_s) + 1.575$	USEPA (2007)	1.23E+02
Background				
Antimony	-	ln(Cp) = 0.938 * ln(Cs) - 3.233	USEPA (2007)	-
Cadmium	0.37	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	USEPA (2007)	3.62E-01
Copper	7.13	$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	USEPA (2007)	4.23E+00
Lead	6.82	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	USEPA (2007)	7.78E-01
Zinc	24.80	$\ln(C_p) = 0.554 * \ln(C_s) + 1.575$	USEPA (2007)	2.86E+01

Definitions:

C_p = concentration in terrestrial plants
C_s = concentration in soil
COPEC = Chemical of potential ecological concern
EPC = Exposure point concentration
dw = dry weight
kg = kilogram
mg = milligram
PUF = Plant uptake factor

TABLE E.10
PREDICTED COPEC CONCENTRATIONS IN INVERTEBRATES YPG-028
RCRA FACILITY INVESTIGATION REPORT

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Soil EPC (C_s) (mg/kg)	Uptake Parameters		Concentration in Invertebrates (C_i) (mg/kg)
		BAF (kg soil dw / kg invertebrate dw)	Source	
Site (0-4.5 ft bgs)				
Antimony	0.38	Ci = Cs	USEPA (2007)	3.80E-01
Bis(2-ethylhexyl)phthalate	0.0242	$C_i = 154 * C_s$	LANL (2011)	3.73E+00
Cadmium	2.19	$\ln(C_i) = 0.795 * \ln(C_s) + 2.114$	USEPA (2007)	1.54E+01
Copper	136	$C_i = 0.515 * C_s$	USEPA (2007)	7.00E+01
Lead	14.02	$\ln(C_i) = 0.807 * \ln(C_s) - 0.218$	USEPA (2007)	6.77E+00
Zinc	345	$\ln(C_i) = 0.328 * \ln(C_s) + 4.449$	USEPA (2007)	5.82E+02
Background				
Antimony	-	Ci = Cs	USEPA (2007)	-
Cadmium	0.37	$\ln(C_i) = 0.795 * \ln(C_s) + 2.114$	USEPA (2007)	3.77E+00
Copper	7.13	$C_i = 0.515 * C_s$	USEPA (2007)	3.67E+00
Lead	6.82	$\ln(C_i) = 0.807 * \ln(C_s) - 0.218$	USEPA (2007)	3.79E+00
Zinc	24.8	$\ln(C_i) = 0.328 * \ln(C_s) + 4.449$	USEPA (2007)	2.45E+02

Definitions:

BAF = earthworm bioaccumulation factor
C_i = concentration in terrestrial invertebrates
C_s = concentration in soil
COPEC = Chemical of potential ecological concern
dw = dry weight
EPC = Exposure point concentration
kg = kilogram
mg = milligram

TABLE E.11
PREDICATED COPEC CONCENTRATIONS IN SMALL MAMMALS/BIRDS - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Soil EPC (C_s) (mg/kg)	Uptake Parameters		Small Mammals/Birds (C_m) (mg/kg)
		BAF (kg soil dw / kg mammal dw)	Source	
Site (0-4.5 ft bgs)				
Antimony	0.38	Cm = 0.001*50*Cs	USEPA (2007)	1.90E-02
Bis(2-ethylhexyl)phthalate	0.0242	-	USEPA (2005)	-
Cadmium	2.19	$\ln(C_m) = 0.4723 * \ln(C_s) - 1.2571$	USEPA (2007)	4.12E-01
Copper	136	$\ln(C_m) = 0.1444 * \ln(C_s) + 2.042$	USEPA (2007)	1.57E+01
Lead	14	$\ln(C_m) = 0.4422 * \ln(C_s) + 0.0761$	USEPA (2007)	3.47E+00
Zinc	345	$\ln(C_m) = 0.0706 * \ln(C_s) + 4.3632$	USEPA (2007)	1.19E+02
Background				
Antimony	-	Cm = 0.001*50*Cs	USEPA (2007)	-
Cadmium	0.37	$\ln(C_m) = 0.4723 * \ln(C_s) - 1.2571$	USEPA (2007)	1.78E-01
Copper	7.13	$\ln(C_m) = 0.1444 * \ln(C_s) + 2.042$	USEPA (2007)	1.02E+01
Lead	6.82	$\ln(C_m) = 0.4422 * \ln(C_s) + 0.0761$	USEPA (2007)	2.52E+00
Zinc	24.80	$\ln(C_m) = 0.0706 * \ln(C_s) + 4.3632$	USEPA (2007)	9.85E+01

Definitions:

BAF = bioaccumulation factor
C_m = concentration in small mammals/birds
C_s = concentration in soil
COPEC = Chemical of potential ecological concern
dw = dry weight
EPC = Exposure point concentration
kg = kilogram
mg = milligram

TABLE E.12
HAZARD QUOTIENTS FOR PLANTS AND INVERTEBRATES - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Soil EPC (mg/kg)	Screening Benchmarks (mg/kg)		Hazard Quotients (unitless)	
		Plants	Invertebrates	Plants	Invertebrates
Site (0-4.5 ft bgs)					
Antimony	0.38	510	78	7.45E-04	4.87E-03
Bis(2-ethylhexyl)phthalate	0.0242	-	-	-	-
Cadmium	2.19	32	140	6.84E-02	1.56E-02
Copper	136	70	80	1.94E+00	1.70E+00
Lead	14.02	120	1,700	1.17E-01	8.25E-03
Zinc	345	160	120	2.16E+00	2.88E+00
Background					
Antimony	-	510	78	-	-
Cadmium	0.37	32	140	1.16E-02	2.66E-03
Copper	7.13	70	80	1.02E-01	8.92E-02
Lead	6.82	120	1,700	5.68E-02	4.01E-03
Zinc	24.80	160	120	1.55E-01	2.07E-01

Definitions:

COPEC = Chemical of potential ecological concern
EPC = Exposure point concentration
kg = kilogram
mg = milligram
Cells shaded blue indicate an HQ>1

TABLE E.13
AVERAGE DAILEY DOSES and HAZARD QUOTIENTS FOR WILDLIFE RECEPTORS - YPG-028
RCRA FACILITY INVESTIGATION REPORT
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Mammals			Birds			Reptiles
	Desert shrew (0-0.7 ft bgs)	Kit fox (0-4.5 ft bgs)	Little pocket mouse (0-0.7 ft bgs)	American kestrel (0-0.7 ft bgs)	Gambel's quail (0-0.7 ft bgs)	Verdin (0-0.7 ft bgs)	Sonoran desert tortoise (0-4.5 ft bgs)
Average Daily Dose (mg/kg-day)							
Antimony	4.63E-02	9.86E-07	5.90E-03	1.19E-03	1.30E-04	5.90E-03	5.19E-05
Bis(2-ethylhexyl)phthalate	4.48E-01	1.13E-06	7.63E-03	1.01E-02	1.42E-04	5.67E-02	3.59E-06
Cadmium	1.86E+00	1.85E-05	2.27E-01	4.40E-02	3.14E-03	2.36E-01	1.58E-03
Copper	8.47E+00	5.94E-04	2.83E+00	2.66E-01	3.56E-02	1.07E+00	3.02E-02
Lead	8.34E-01	1.15E-04	2.99E-01	3.69E-02	5.15E-03	1.07E-01	2.77E-03
Zinc	7.02E+01	3.94E-03	2.52E+01	2.14E+00	3.04E-01	8.87E+00	2.08E-01
NOAEL-based HQ (unitless)							
Antimony	7.84E-01	1.67E-05	1.00E-01	-	-	-	-
Bis(2-ethylhexyl)phthalate	2.45E-02	6.15E-08	4.17E-04	9.14E-03	1.29E-04	5.15E-02	-
Cadmium	2.42E+00	2.40E-05	2.94E-01	2.99E-02	2.14E-03	1.60E-01	-
Copper	1.51E+00	1.06E-04	5.05E-01	6.57E-02	8.79E-03	2.65E-01	-
Lead	1.77E-01	2.46E-05	6.35E-02	2.26E-02	3.16E-03	6.54E-02	2.77E-02
Zinc	9.31E-01	5.23E-05	3.34E-01	3.24E-02	4.60E-03	1.34E-01	-
Total	5	2E-04	1	0.2	0.02	0.6	0.03
LOAEL-based HQ (unitless)							
Antimony	1.68E-02	3.57E-07	2.14E-03	-	-	-	-
Bis(2-ethylhexyl)phthalate	2.45E-03	6.15E-09	4.17E-05	9.14E-04	1.29E-05	5.15E-03	-
Cadmium	2.70E-01	2.68E-06	3.28E-02	6.93E-03	4.95E-04	3.71E-02	-
Copper	1.02E-01	7.18E-06	3.42E-02	7.63E-03	1.02E-03	3.07E-02	-
Lead	4.47E-03	6.20E-07	1.60E-03	8.26E-04	1.15E-04	2.39E-03	2.77E-03
Zinc	2.36E-01	1.32E-05	8.46E-02	1.25E-02	1.77E-03	5.18E-02	-
Total	0.6	2E-05	0.2	0.03	0.003	0.1	0.003

Definitions:

COPEC = Chemical of potential ecological concern
EPC = Exposure point concentration
HQ = Hazard quotient
kg = kilogram
LOAEL = Lowest observed adverse effect level
mg = milligram
NOAEL = No observed adverse effect level
Cells shaded blue indicate an HQ>1

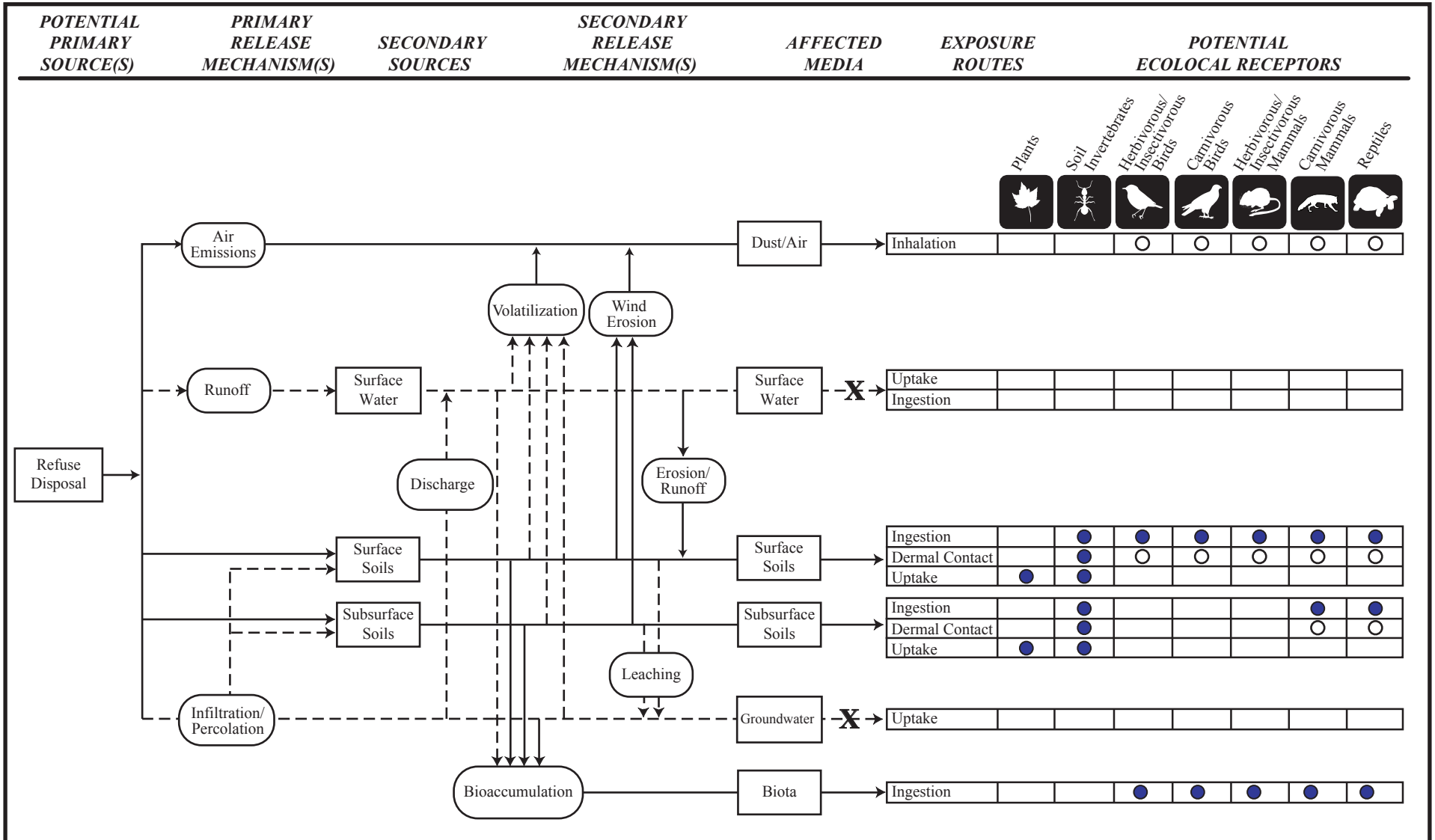
TABLE E.14
AVERAGE DAILEY DOSES and HAZARD QUOTIENTS FOR WILDLIFE RECEPTORS - BACKGROUND CONDITIONS
RCRA FACILITY INVESTIGATION REPORT - YPG-028
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

COPEC	Mammals			Birds			Reptiles
	Desert shrew (0-0.7 ft bgs)	Kit fox (0-4.5 ft bgs)	Little pocket mouse (0-0.7 ft bgs)	American kestrel (0-0.7 ft bgs)	Gambel's quail (0-0.7 ft bgs)	Verdin (0-0.7 ft bgs)	Sonoran desert tortoise (0-4.5 ft bgs)
Average Daily Dose (mg/kg-day)							
Antimony	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cadmium	4.55E-01	6.66E-06	7.96E-02	1.11E-02	1.03E-03	5.75E-02	5.66E-04
Copper	4.64E-01	3.07E-04	8.65E-01	5.99E-02	1.11E-02	5.87E-02	6.81E-03
Lead	4.68E-01	8.08E-05	1.95E-01	2.35E-02	3.32E-03	5.98E-02	1.66E-03
Zinc	2.97E+01	2.98E-03	6.15E+00	1.13E+00	7.80E-02	3.74E+00	4.43E-02
NOAEL-based HQ (unitless)							
Antimony	0.00E+00	0.00E+00	0.00E+00	-	-	-	-
Cadmium	5.91E-01	8.65E-06	1.03E-01	7.55E-03	6.97E-04	3.91E-02	-
Copper	8.29E-02	5.49E-05	1.54E-01	1.48E-02	2.74E-03	1.45E-02	-
Lead	9.95E-02	1.72E-05	4.16E-02	1.44E-02	2.03E-03	3.67E-02	1.66E-02
Zinc	3.93E-01	3.96E-05	8.16E-02	1.72E-02	1.18E-03	5.66E-02	-
Total	1	1E-04	0.4	0.05	0.007	0.1	0.017
LOAEL-based HQ (unitless)							
Antimony	0.00E+00	0.00E+00	0.00E+00	-	-	-	-
Cadmium	6.59E-02	9.66E-07	1.15E-02	1.75E-03	1.61E-04	9.06E-03	-
Copper	5.61E-03	3.72E-06	1.05E-02	1.72E-03	3.18E-04	1.68E-03	-
Lead	2.51E-03	4.34E-07	1.05E-03	5.27E-04	7.43E-05	1.34E-03	1.66E-03
Zinc	9.97E-02	1.00E-05	2.07E-02	6.62E-03	4.55E-04	2.18E-02	-
Total	0.2	2E-05	0.04	0.01	0.001	0.03	0.002

Definitions:

COPEC = Chemical of potential ecological concern
EPC = Exposure point concentration
HQ = Hazard quotient
kg = kilogram
LOAEL = Lowest observed adverse effect level
mg = milligram
NOAEL = No observed adverse effect level
Cells shaded blue indicate an HQ>1

FIGURES



Legend

- Potentially complete exposure pathway
- Potentially incomplete exposure pathway
- Incomplete exposure pathway
- Potentially complete exposure route
- Potentially complete (but insignificant) exposure route

Figure E.1
Conceptual Site Model for Ecological Receptors

YPG-028

U.S. Army Garrison Yuma Proving Ground

PARSONS

Salt Lake City, UT

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

ANTIMONY

General Statistics

Number of Valid Data	5	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	4
		Percent Non-Detects	80.00%

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 Antimony was not processed!

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

BIS (2-ETHYLHEXYL) PHTHALATE

General Statistics

Number of Valid Data	5	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	3
		Percent Non-Detects	60.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0159	Minimum Detected	-4.141
Maximum Detected	0.0201	Maximum Detected	-3.907
Mean of Detected	0.018	Mean of Detected	-4.024
SD of Detected	0.00297	SD of Detected	0.166
Minimum Non-Detect	0.0125	Minimum Non-Detect	-4.382
Maximum Non-Detect	0.0127	Maximum Non-Detect	-4.366

Note: Data have multiple DLs - Use of KM Method is recommende	Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	60.00%

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	0.011	Mean	-4.65
SD	0.00658	SD	0.577
95% DL/2 (t) UCL	0.0173	95% H-Stat (DL/2) UCL	0.0285
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)
Theta Star	N/A	
nu star	N/A	

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

BIS (2-ETHYLHEXYL) PHTHALATE (Continued)			
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	0.0167
5% K-S Critical Value	N/A	SD	0.00168
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.00106
		95% KM (t) UCL	0.019
Assuming Gamma Distribution		95% KM (z) UCL	0.0185
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0203
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	0.0201
Mean	N/A	95% KM (Percentile Bootstrap) UCL	0.0201
Median	N/A	95% KM (Chebyshev) UCL	0.0214
SD	N/A	97.5% KM (Chebyshev) UCL	0.0234
k star	N/A	99% KM (Chebyshev) UCL	0.0273
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	95% KM (t) UCL	0.019
% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (% Bootstrap) UCL	0.0201
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

CADMIUM

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	0.074	Minimum of Log Data	-2.604
Maximum	2.71	Maximum of Log Data	0.997
Mean	0.966	Mean of log Data	-1.107
Geometric Mean	0.33	SD of log Data	1.756
Median	0.11		
SD	1.234		
Std. Error of Mean	0.552		
Coefficient of Variation	1.277		
Skewness	0.882		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!
It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.
Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions
The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.775	Shapiro Wilk Test Statistic	0.781
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
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	2.142	95% H-UCL	2202
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3.733
95% Adjusted-CLT UCL (Chen-1995)	2.106	97.5% Chebyshev (MVUE) UCL	4.94
95% Modified-t UCL (Johnson-1978)	2.179	99% Chebyshev (MVUE) UCL	7.311

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.365	Data appear Normal at 5% Significance Level
Theta Star	2.648	
MLE of Mean	0.966	
MLE of Standard Deviation	1.6	
nu star	3.649	
Approximate Chi Square Value (.05)	0.588	**Nonparametric Statistics**
Adjusted Level of Significance	0.0086	95% CLT UCL 1.874
Adjusted Chi Square Value	0.232	95% Jackknife UCL 2.142
		95% Standard Bootstrap UCL 1.781
Anderson-Darling Test Statistic	0.691	95% Bootstrap-t UCL 68.99
Anderson-Darling 5% Critical Value	0.707	95% Hall's Bootstrap UCL 68.32
Kolmogorov-Smirnov Test Statistic	0.373	95% Percentile Bootstrap UCL 1.839
Kolmogorov-Smirnov 5% Critical Value	0.37	95% BCA Bootstrap UCL 1.842
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 3.371
		97.5% Chebyshev(Mean, Sd) UCL 4.412
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 6.456
% Approximate Gamma UCL (Use when n >= 40)	5.995	
95% Adjusted Gamma UCL (Use when n < 40)	15.2	
Potential UCL to Use		Use 95% Student's-t UCL 2.142

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

COPPER

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	6.66	Minimum of Log Data	1.896
Maximum	16.2	Maximum of Log Data	2.785
Mean	10.33	Mean of log Data	2.292
Geometric Mean	9.897	SD of log Data	0.319
Median	9.39		
SD	3.534		
Std. Error of Mean	1.581		
Coefficient of Variation	0.342		
Skewness	1.429		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!
It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.
Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions
The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.856	Shapiro Wilk Test Statistic	0.918
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
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	13.7	95% H-UCL	15.38
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.69
95% Adjusted-CLT UCL (Chen-1995)	14.01	97.5% Chebyshev (MVUE) UCL	19.45
95% Modified-t UCL (Johnson-1978)	13.86	99% Chebyshev (MVUE) UCL	24.88

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.913	Data appear Normal at 5% Significance Level
Theta Star	2.102	
MLE of Mean	10.33	
MLE of Standard Deviation	4.659	
nu star	49.13	
Approximate Chi Square Value (.05)	34.04	**Nonparametric Statistics**
Adjusted Level of Significance	0.0086	95% CLT UCL 12.93
Adjusted Chi Square Value	28.65	95% Jackknife UCL 13.7
		95% Standard Bootstrap UCL 12.61
Anderson-Darling Test Statistic	0.428	95% Bootstrap-t UCL 16.25
Anderson-Darling 5% Critical Value	0.679	95% Hall's Bootstrap UCL 26.87
Kolmogorov-Smirnov Test Statistic	0.292	95% Percentile Bootstrap UCL 12.93
Kolmogorov-Smirnov 5% Critical Value	0.358	95% BCA Bootstrap UCL 13.07
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 17.22
		97.5% Chebyshev(Mean, Sd) UCL 20.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 26.05
% Approximate Gamma UCL (Use when n >= 40)	14.9	
95% Adjusted Gamma UCL (Use when n < 40)	17.71	

Potential UCL to Use		Use 95% Student's-t UCL	13.7

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

LEAD

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	6.67	Minimum of Log Data	1.898
Maximum	12.4	Maximum of Log Data	2.518
Mean	8.854	Mean of log Data	2.159
Geometric Mean	8.664	SD of log Data	0.228
Median	8.49		
SD	2.153		
Std. Error of Mean	0.963		
Coefficient of Variation	0.243		
Skewness	1.378		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 5 Values in this data

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

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Test Statistic	0.941
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
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	10.91	95% H-UCL	11.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	12.78
95% Adjusted-CLT UCL (Chen-1995)	11.07	97.5% Chebyshev (MVUE) UCL	14.48
95% Modified-t UCL (Johnson-1978)	11.01	99% Chebyshev (MVUE) UCL	17.82

Gamma Distribution Test		Data Distribution
k star (bias corrected)	9.414	Data appear Normal at 5% Significance Level
Theta Star	0.941	
MLE of Mean	8.854	
MLE of Standard Deviation	2.886	
nu star	94.14	
Approximate Chi Square Value (.05)	72.76	**Nonparametric Statistics**
Adjusted Level of Significance	0.0086	95% CLT UCL 10.44
Adjusted Chi Square Value	64.58	95% Jackknife UCL 10.91
		95% Standard Bootstrap UCL 10.28
Anderson-Darling Test Statistic	0.332	95% Bootstrap-t UCL 12.11
Anderson-Darling 5% Critical Value	0.679	95% Hall's Bootstrap UCL 18.55
Kolmogorov-Smirnov Test Statistic	0.265	95% Percentile Bootstrap UCL 10.34
Kolmogorov-Smirnov 5% Critical Value	0.357	95% BCA Bootstrap UCL 10.55
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 13.05
		97.5% Chebyshev(Mean, Sd) UCL 14.87
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 18.44
% Approximate Gamma UCL (Use when n >= 40)	11.46	
95% Adjusted Gamma UCL (Use when n < 40)	12.91	

Potential UCL to Use		Use 95% Student's-t UCL	10.91

Attachment E.1
ProUCL Output for 0-0.7 feet bgs
YPG-028 Landfill

ZINC

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	26.4	Minimum of Log Data	3.273
Maximum	43.5	Maximum of Log Data	3.773
Mean	32.52	Mean of log Data	3.467
Geometric Mean	32.03	SD of log Data	0.19
Median	30.6		
SD	6.604		
Std. Error of Mean	2.953		
Coefficient of Variation	0.203		
Skewness	1.511		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!
It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.
Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions
The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
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	38.82	95% H-UCL	40.11
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	44.51
95% Adjusted-CLT UCL (Chen-1995)	39.51	97.5% Chebyshev (MVUE) UCL	49.7
95% Modified-t UCL (Johnson-1978)	39.15	99% Chebyshev (MVUE) UCL	59.91

Gamma Distribution Test		Data Distribution
k star (bias corrected)	13.48	Data appear Normal at 5% Significance Level
Theta Star	2.413	
MLE of Mean	32.52	
MLE of Standard Deviation	8.859	
nu star	134.8	
Approximate Chi Square Value (.05)	108.9	**Nonparametric Statistics**
Adjusted Level of Significance	0.0086	95% CLT UCL 37.38
Adjusted Chi Square Value	98.78	95% Jackknife UCL 38.82
		95% Standard Bootstrap UCL 36.75
Anderson-Darling Test Statistic	0.363	95% Bootstrap-t UCL 45.59
Anderson-Darling 5% Critical Value	0.678	95% Hall's Bootstrap UCL 63.61
Kolmogorov-Smirnov Test Statistic	0.236	95% Percentile Bootstrap UCL 37.18
Kolmogorov-Smirnov 5% Critical Value	0.357	95% BCA Bootstrap UCL 38.02
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 45.39
		97.5% Chebyshev(Mean, Sd) UCL 50.96
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 61.9
% Approximate Gamma UCL (Use when n >= 40)	40.23	
95% Adjusted Gamma UCL (Use when n < 40)	44.36	

Potential UCL to Use		Use 95% Student's-t UCL	38.82

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

BIS(2-ETHYLHEXYL) PHTHALATE

General Statistics

Number of Valid Data	8	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	4
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0159	Minimum Detected	-4.141
Maximum Detected	0.0339	Maximum Detected	-3.384
Mean of Detected	0.0233	Mean of Detected	-3.798
SD of Detected	0.00769	SD of Detected	0.318
Minimum Non-Detect	0.0125	Minimum Non-Detect	-4.382
Maximum Non-Detect	0.0127	Maximum Non-Detect	-4.366

Note: Data have multiple DLs - Use of KM Method is recomme	Number treated as Non-Detect	4
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	50.00%

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	0.939	Shapiro Wilk Test Statistic	0.982
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	0.0148	Mean	-4.432
SD	0.0104	SD	0.709
95% DL/2 (t) UCL	0.0218	95% H-Stat (DL/2) UCL	0.032
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0132	Mean in Log Scale	-4.302
SD	0.0123	SD in Log Scale	0.587
95% MLE (t) UCL	0.0214	Mean in Original Scale	0.0158
95% MLE (Tiku) UCL	0.0233	SD in Original Scale	0.00953
		95% t UCL	0.0222
		95% Percentile Bootstrap UCL	0.0211
		95% BCA Bootstrap UCL	0.022
		95% H UCL	0.0281

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	3.436	Data appear Normal at 5% Significance Level
Theta Star	0.00678	
nu star	27.48	
A-D Test Statistic	0.246	**Nonparametric Statistics**
5% A-D Critical Value	0.657	Kaplan-Meier (KM) Method
K-S Test Statistic	0.657	Mean 0.0196
5% K-S Critical Value	0.395	SD 0.00599
Data appear Gamma Distributed at 5% Significance Level		SE of Mean 0.00244

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

BIS(2-ETHYLHEXYL) PHTHALATE (Continued)			
		95% KM (t) UCL	0.0242
Assuming Gamma Distribution		95% KM (z) UCL	0.0236
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.024
Minimum	0.000001	95% KM (bootstrap t) UCL	0.0249
Maximum	0.0339	95% KM (BCA) UCL	0.0339
Mean	0.0117	95% KM (Percentile Bootstrap) UCL	0.026
Median	0.00795	95% KM (Chebyshev) UCL	0.0303
SD	0.0134	97.5% KM (Chebyshev) UCL	0.0349
k star	0.191	99% KM (Chebyshev) UCL	0.0439
Theta star	0.0609		
Nu star	3.062	**Potential UCLs to Use**	
AppChi2	0.391	95% KM (t) UCL	0.0242
% Gamma Approximate UCL (Use when n >= 40)	0.0912	95% KM (Percentile Bootstrap) UCL	0.026
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

CADMIUM

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	0.055	Minimum of Log Data	-2.9
Maximum	2.71	Maximum of Log Data	0.997
Mean	0.74	Mean of log Data	-1.236
Geometric Mean	0.291	SD of log Data	1.51
Median	0.225		
SD	0.998		
Std. Error of Mean	0.353		
Coefficient of Variation	1.35		
Skewness	1.491		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.746	Shapiro Wilk Test Statistic	0.896
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
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	1.408	95% H-UCL	13.79
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.404
95% Adjusted-CLT UCL (Chen-1995)	1.519	97.5% Chebyshev (MVUE) UCL	3.133
95% Modified-t UCL (Johnson-1978)	1.439	99% Chebyshev (MVUE) UCL	4.565

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.492	Data appear Gamma Distributed at 5% Significance Level
Theta Star	1.504	
MLE of Mean	0.74	
MLE of Standard Deviation	1.055	
nu star	7.866	
Approximate Chi Square Value (.05)	2.658	**Nonparametric Statistics**
Adjusted Level of Significance	0.0195	95% CLT UCL 1.32
Adjusted Chi Square Value	1.956	95% Jackknife UCL 1.408
		95% Standard Bootstrap UCL 1.279
Anderson-Darling Test Statistic	0.546	95% Bootstrap-t UCL 3.082
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL 4.386
Kolmogorov-Smirnov Test Statistic	0.267	95% Percentile Bootstrap UCL 1.32
Kolmogorov-Smirnov 5% Critical Value	0.306	95% BCA Bootstrap UCL 1.403
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 2.278
		97.5% Chebyshev(Mean, Sd) UCL 2.944
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 4.251
% Approximate Gamma UCL (Use when n >= 40)	2.189	
95% Adjusted Gamma UCL (Use when n < 40)	2.974	

Potential UCL to Use		Use 95% Approximate Gamma UCL	2.189

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

COPPER

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8
Raw Statistics		**Log-transformed Statistics**	
Minimum	6.66	Minimum of Log Data	1.896
Maximum	136	Maximum of Log Data	4.913
Mean	41.34	Mean of log Data	2.921
Geometric Mean	18.56	SD of log Data	1.253
Median	9.745		
SD	58.19		
Std. Error of Mean	20.57		
Coefficient of Variation	1.408		
Skewness	1.431		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.604	Shapiro Wilk Test Statistic	0.723
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
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	80.31	95% H-UCL	279.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	104.5
95% Adjusted-CLT UCL (Chen-1995)	86.29	97.5% Chebyshev (MVUE) UCL	134.4
95% Modified-t UCL (Johnson-1978)	82.05	99% Chebyshev (MVUE) UCL	193.3
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.551	Data do not follow a Discernable Distribution (0.05)	
Theta Star	75.06		
MLE of Mean	41.34		
MLE of Standard Deviation	55.7		
nu star	8.811		
Approximate Chi Square Value (.05)	3.213	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	75.17
Adjusted Chi Square Value	2.42	95% Jackknife UCL	80.31
		95% Standard Bootstrap UCL	73.12
Anderson-Darling Test Statistic	1.369	95% Bootstrap-t UCL	664.5
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL	710.2
Kolmogorov-Smirnov Test Statistic	0.365	95% Percentile Bootstrap UCL	73.17
Kolmogorov-Smirnov 5% Critical Value	0.304	95% BCA Bootstrap UCL	88.01
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	131
		97.5% Chebyshev(Mean, Sd) UCL	169.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	246
% Approximate Gamma UCL (Use when n >= 40)	113.4		
95% Adjusted Gamma UCL (Use when n < 40)	150.5		
Potential UCL to Use		Use 95% Hall's Bootstrap UCL	710.2

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

LEAD

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8
Raw Statistics		**Log-transformed Statistics**	
Minimum	6.08	Minimum of Log Data	1.805
Maximum	18.8	Maximum of Log Data	2.934
Mean	10.78	Mean of log Data	2.297
Geometric Mean	9.942	SD of log Data	0.422
Median	8.69		
SD	4.832		
Std. Error of Mean	1.708		
Coefficient of Variation	0.448		
Skewness	0.935		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.855	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
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	14.02	95% H-UCL	15.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	17.77
95% Adjusted-CLT UCL (Chen-1995)	14.19	97.5% Chebyshev (MVUE) UCL	20.81
95% Modified-t UCL (Johnson-1978)	14.11	99% Chebyshev (MVUE) UCL	26.79
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.038	Data appear Normal at 5% Significance Level	
Theta Star	2.67		
MLE of Mean	10.78		
MLE of Standard Deviation	5.365		
nu star	64.61		
Approximate Chi Square Value (.05)	47.12	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	13.59
Adjusted Chi Square Value	43.36	95% Jackknife UCL	14.02
		95% Standard Bootstrap UCL	13.42
Anderson-Darling Test Statistic	0.462	95% Bootstrap-t UCL	16.84
Anderson-Darling 5% Critical Value	0.718	95% Hall's Bootstrap UCL	14.99
Kolmogorov-Smirnov Test Statistic	0.256	95% Percentile Bootstrap UCL	13.59
Kolmogorov-Smirnov 5% Critical Value	0.295	95% BCA Bootstrap UCL	13.68
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	18.23
		97.5% Chebyshev(Mean, Sd) UCL	21.45
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	27.78
% Approximate Gamma UCL (Use when n >= 40)	14.78		
95% Adjusted Gamma UCL (Use when n < 40)	16.06		
Potential UCL to Use		Use 95% Student's-t UCL	14.02

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

MERCURY

General Statistics

Number of Valid Data	8	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	6
		Percent Non-Detects	75.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0051	Minimum Detected	-5.279
Maximum Detected	0.019	Maximum Detected	-3.963
Mean of Detected	0.0121	Mean of Detected	-4.621
SD of Detected	0.00983	SD of Detected	0.93
Minimum Non-Detect	0.0032	Minimum Non-Detect	-5.745
Maximum Non-Detect	0.0033	Maximum Non-Detect	-5.714

Note: Data have multiple DLs - Use of KM Method is recomme	Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	75.00%

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	0.00423	Mean	-5.976
SD	0.00609	SD	0.907
95% DL/2 (t) UCL	0.00831	95% H-Stat (DL/2) UCL	0.0115
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)
Theta Star	N/A	
nu star	N/A	

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

MERCURY (Continued)			
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	0.00684
5% K-S Critical Value	N/A	SD	0.0046
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0023
		95% KM (t) UCL	0.0112
Assuming Gamma Distribution		95% KM (z) UCL	0.0106
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0169
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	0.019
Mean	N/A	95% KM (Percentile Bootstrap) UCL	0.019
Median	N/A	95% KM (Chebyshev) UCL	0.0169
SD	N/A	97.5% KM (Chebyshev) UCL	0.0212
k star	N/A	99% KM (Chebyshev) UCL	0.0297
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	95% KM (t) UCL	0.0112
% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (% Bootstrap) UCL	0.019
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Attachment E.2
ProUCL Output for 0-4.5 feet bgs
YPG-028 Landfill

ZINC

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	25.5	Minimum of Log Data	3.239
Maximum	345	Maximum of Log Data	5.844
Mean	97.39	Mean of log Data	3.99
Geometric Mean	54.07	SD of log Data	1.056
Median	31.85		
SD	125.2		
Std. Error of Mean	44.28		
Coefficient of Variation	1.286		
Skewness	1.619		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.642	Shapiro Wilk Test Statistic	0.712
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
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	181.3	95% H-UCL	392.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	229
95% Adjusted-CLT UCL (Chen-1995)	197.3	97.5% Chebyshev (MVUE) UCL	290.8
95% Modified-t UCL (Johnson-1978)	185.5	99% Chebyshev (MVUE) UCL	412.4

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.698	Data do not follow a Discernable Distribution (0.05)
Theta Star	139.6	
MLE of Mean	97.39	
MLE of Standard Deviation	116.6	
nu star	11.16	
Approximate Chi Square Value (.05)	4.68	**Nonparametric Statistics**
Adjusted Level of Significance	0.0195	95% CLT UCL 170.2
Adjusted Chi Square Value	3.677	95% Jackknife UCL 181.3
		95% Standard Bootstrap UCL 164.1
Anderson-Darling Test Statistic	1.349	95% Bootstrap-t UCL 1513
Anderson-Darling 5% Critical Value	0.736	95% Hall's Bootstrap UCL 1336
Kolmogorov-Smirnov Test Statistic	0.386	95% Percentile Bootstrap UCL 166.9
Kolmogorov-Smirnov 5% Critical Value	0.302	95% BCA Bootstrap UCL 187.9
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 290.4
		97.5% Chebyshev(Mean, Sd) UCL 373.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 537.9
% Approximate Gamma UCL (Use when n >= 40)	232.3	
95% Adjusted Gamma UCL (Use when n < 40)	295.6	

Potential UCL to Use		Use 95% Hall's Bootstrap UCL	1336

APPENDIX F

REMOVAL ACTION PHOTOGRAPHS

APPENDIX F – REMOVAL ACTION PHOTOGRAPHS

Photograph F-1
SWMU 28 – Rusted metal fender found partially buried

Photograph F-2
SWMU 28 – Drilling gear found on surface