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August 28, 2014

Mr. Charles D. Williams
Program Manager
Response & Remediation Program
Land Protection Branch
Georgia Environmental Protection Division
2 Martin Luther King Jr. Drive, SE, Suite 1462
Atlanta, Georgia 30334

Re: Voluntary Remediation Program Third Semi-Annual Status Update
CSX Transportation, Inc.
DePriest Signal Shop (HSI #10611)
641 East Liberty Street
Savannah, Chatham County, Georgia
Tax Parcel ID#2-0033-12-001

Dear Mr. Williams:

Enclosed on behalf of CSX Transportation, Inc., is a hard copy and an electronic copy of the referenced report. The report is submitted in accordance with requirements of the Voluntary Remediation Program. This site was accepted into the program on March 15, 2013.

Please contact the undersigned if questions arise or further information is needed.

Sincerely,

Ronald E. Holley, P.E.

cc: Matt Adkins, CSXT

PORTABLE DOCUMENT FORMAT CERTIFICATION

The electronic document of the Third Semiannual Report, CSXT DePriest Signal Shop dated August 2014, as provided on this CD is, to the best of our knowledge, complete and identical to the paper copy and virus free.

Holley Consultants, Inc.

Ronald E. Holley

Ronald E. Holley

August 28, 2014

Voluntary Remediation Program
Third Semi-Annual Status Update

DePriest Signal Shop
641 East Liberty Street
Savannah, Chatham County, Georgia
Tax Parcel ID #2-0033-12-001

August 2014

Prepared for:

CSX Transportation, Inc.
Jacksonville, Florida

Prepared by:

Holley Consultants, Inc.
Roswell, Georgia

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1.0 Introduction

This report was prepared on behalf of CSX Transportation, Inc. (CSXT), to provide the third semi-annual status update for the DePriest Signal Shop Voluntary Remediation Program (VRP) Site. The site was accepted into the VRP program on March 15, 2013. Activities since the last semi-annual report are summarized below, and include development of exposure point concentrations, comparison of these concentrations to applicable risk reduction standards, and recommendations for limited soil remediation.

2.0 Soil Delineation

2.1 Actions Completed

2.1.1 Risk Reduction Standards Revision

Risk reduction standards (RRS) were re-evaluated in the second semi-annual report submitted in March 2014. Toxicity values were updated using the EPA Regional Screening Level tables. Updated values were available for mercury, barium, cadmium, chromium, and regulated polynuclear aromatic hydrocarbons. The revised values were used to calculate associated cancer and non-cancer risks for each regulated substance using appropriate RAGS equations.

Revised Type 3 Risk Reduction Standards (RRS) for soil were developed in accordance with Hazardous Site Response Act (HSRA) procedures, incorporating notification concentrations, drinking water standards, Type 1 soil criteria, and cancer and non-cancer risk levels using standard assumptions. Resulting Type 3 standards were developed for the 0-2 foot interval and for soil greater than two feet below ground surface.

The following regulated substances had at least one location at the site with an exceedance of Type 3 soil standards:

Antimony	Benzo(a)anthracene
Arsenic	Chrysene
Barium	Benzo(b) fluoranthene
Cadmium	Benzo(a)pyrene
Chromium	Benzo(k)fluoranthene
Lead	
Silver	

Type 4 RRS were developed for those regulated substances that exceeded Type 3 RRS. Type 4 RRS for soil address human health protection based on inhalation and ingestion of regulated substances, ground water protection and, for lead, application of the Georgia Adult Lead Model. The ground water protection limits apply to all soils above the ground water table. The other criteria apply to surface soils. These standards incorporate site-specific exposure factors appropriate to site usage patterns.

A single site domain was employed that includes both the fenced-in area of the active signal shop, as well as unfenced areas outside the active property. Three types of potential receptors were identified for the site – trespasser, commercial worker, and construction worker.

The approach described above resulted in development of Type 4 soil risk reduction standards for surface soils (0-2 foot below the surface), and subsurface soils (>2 foot below the surface). The values are summarized in **Table 2.1**. The following regulated substances did not meet Type 4 standards at all locations:

Arsenic
Barium
Chromium
Lead

The Type 3 RRS for barium (1,000 mg/kg) exceeds the Type 4 RRS. The Type 3 standard is therefore adopted for the site.

2.1.2 Exposure Point Concentrations

Exposure point concentrations (EPC's) were developed for the four regulated substances that exceeded applicable risk reduction standards. The VRP Act provides that "…compliance with site-specific cleanup standards shall be determined on the basis of representative concentrations of constituents of concern across each applicable soil exposure domain…". Determination of the representative concentrations (exposure point concentrations) were made using area averaging techniques across the single exposure domain identified previously.

Existing soil data for the site were used in the development of EPC's. The data were grouped into surface (0-2 feet) and subsurface (>2 feet) data sets. Multiple readings at the same location were averaged for that location. Arsenic and lead data are presented in **Table 2.2**. Barium and chromium data are presented in **Table 2.3**. Surface soil data points greatly exceeded subsurface sampling points because results were consistently higher in the surface soils and more points were needed to delineate RRS and background exceedances during CSR preparation.

Figure 2.1 shows soil sampling locations across the site. Although not all substances were sampled at all locations, the areal coverage for the regulated substances is representative of uncovered areas of the site. In most cases, site locations covered with buildings, pavement, or gravel were not sampled because exposure to soil in those areas is unlikely. The addition of surface sample results from those areas would be expected to lower the average concentration across the site.

EPA guidance in the form of Pro UCL software was employed to calculate the 95% upper confidence limit of the mean (UCL) for each of the regulated substances. Surface and subsurface soil data were entered into the program, which performed a statistical evaluation of the data. Results included arithmetic and logarithmic mean, and 95% UCL based on normal, lognormal, gamma, and nonparametric data distributions. The program recommended the most appropriate

UCL based on the statistical analysis. Results for surface soil are presented in **Attachment A**. Subsurface soil results are included as **Attachment B**.

The resulting 95% UCL concentrations for each of the four substances evaluated are presented in **Table 2.4**. Note that, although a 95% UCL was calculated for lead, the applicable EPC per EPA guidance is the mean concentration.

2.1.3 Comparison of EPC to RRS

Table 2.4 presents EPC's and RRS for each of the four regulated substances evaluated. The EPC's were developed as noted above. Risk reduction standards were calculated Type 4 values for arsenic, chromium, and lead, and Type 3 for barium. In all cases, area averaging of exposure resulted in compliance with RRS. An even lower average would be expected if samples had been taken from covered areas.

Even without area averaging, locations with exceedances of RRS were limited. Arsenic and lead exceedances are more widespread than those for barium (one exceedance) and chromium (three exceedances).

2.2 Work to be Performed

Although the site is in compliance with risk reduction standards, CSXT intends to remove a limited amount of soil in the vicinity of sample locations 602 and 702 where elevated lead levels were observed. Additional soil samples will be collected in this area for visual observation as well as limited laboratory analysis. The area to be excavated will be identified, and one or more composite samples will be analyzed for TCLP lead prior to excavation.

Based upon previous results, it is expected that the proposed excavation will be primarily limited to shallow soils. Confirmation sampling at the limits of the area will not be conducted given that

the removal is not required to meet standards. Clean soils will be placed and vegetated to restore previous grade. This will further lower the average concentration across the site.
Prior to conducting this work, CSXT proposes to meet with GAEPD to discuss this and previous submittals to ensure that both parties agree to conclusions and recommendations. After the work is completed, CSXT anticipates submittal of a final CSR for the site.

3.0 Professional Hours and Certification

Below is a summary of professional engineer hours expended on the project during the period:

March 2014	11.5 hours
April 2014	6.5 hours
May 2014	0 hours
June 2014	0 hours
July 2014	28.5 hours
Total	46.5 hours

Professional Engineer Certification

I certify under penalty of law that this report and all attachments were prepared by me or under my direct supervision in accordance with the Voluntary Remediation Program Act (O.C.G.A. Section 12-8-101, et. seq.). I am a professional engineer who is registered with the Georgia State Board of Registration for Professional Engineers and I have the necessary experience and am in charge of the investigation and remediation of this release of regulated substances.

Furthermore, to document my direct oversight of the Voluntary Remediation Plan development, implementation of corrective action, and long term monitoring, I have included a monthly summary of hours invoiced and a description of services provided by me to the Voluntary Remediation Program participant since the previous submittal to the Georgia Environmental Protection Division.

The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

August 28, 2014

Ronald E. Holley, P.E. Date

Georgia Registration 16507

Table 2.1 - Type 4 Soil Risk Reduction Standards

Regulated Substance	Max. Concentration	Construction Worker		Commercial Worker		Trespasser		Max. Value	Type 4 Soil RRS (0-2')	Type 4 Soil RRS (>2')
		NC-Type 4	C- Type 4	NC-Type 4	C- Type 4	NC-Type 4	C- Type 4			
Metals										
antimony	14	248		657		4,090		248	121[a]	121
lead	27,000							1,180	1,180[b]	4,942
mercury	8.6	186		493		3,070		186	186	192
arsenic	380	186	289	493	109	3,070	191	109	109	3,972
barium	2,900	124,000		329,000		2,040,000		124,000	448[a]	448
cadmium	46	310	5,260,000	821	805,000	5,110	526,000	310	114[a]	114
chromium	2,300	1,860	861	4,930	322	30,700	545	322	322[a]	38,655
selenium	3.1	3,100		8,210		51,100		3,100	285[a]	285
silver	14	3,100		8,210		51,100		3,100	240[a]	240
Semi-Volatile Compounds										
fluoranthene	44	24,800		65,700		409,000		24,800	[c]	
pyrene	49	18,600		49,300		307,000		18,600	[c]	
benzo(a)anthracene	18		594		225		392	225	225	332
chrysene	20		59,400		22,500		39,200	22,500	1,256[a]	1,256
benzo(b)fluoranthene	20		594		225		392	225	225	1,348
benzo(a)pyrene	10		59		23		39	23	23	1,004
indeno(1,2,3)pyrene	4.2		594		225		392	225	[c]	
benzo(g,h,i)perylene	0.98	18,600		49,300		307,000		18,600	[c]	
dibenzo(a,h)anthracene	0.49		59		39		39	39	[c]	
phenanthrene	0.56								[c]	
anthracene	0.44	186,000		493,000		3,070,000		186,000	[c]	
benzo(k)fluoranthene	18		5,940		2,250		3,920	2,250	2,250	6,072

All concentrations in mg/kg
a Ground water protection value governs
b Georgia Adult Lead Model governs
c Type 4 not applicable

TABLE 2.2
SOIL SAMPLES USED FOR EXPOSURE POINT CONCENTRATIONS-
ARSENIC AND LEAD

Sample Point	Arsenic	Type	Surface Value Used	Subsurface Value Used	Lead	Type	Surface Value Used	Subsurface Value Used
Risk Reduction Standard			**109**	**3,972**			**1,180**	**4,942**
001/0-1		S			230	S	230	
002(0-1.0)	18	S	18		140	S	140	
003(0-2.0)	**210**	S	**210**		310	S	310	
003(2-3.0)	51	SS		51	350	SS		350
004(0-1)	32	S	32		160	S	160	
005(0-1)	1.7	S	1.7					
006(0-1)	17	S	17					
007(0-1)	10	S	10					
101(0-1)	4.8	S	4.8					
101/0-1		S			330	S	330	
102/0-1		S			1000	S	1000	
103/0-1	7.1	S	7.1					
104/0-1		S						
105(0-2.5)	27	S	27		340	S	340	
106(0-2.0)	**120**	S	**120**		370	S	370	
107(0-1)	15	S	15					
201/0-1	13	S	13		**1800**	S	**1800**	
202/0-2	11	S	11		640	S	640	
203/0-2	**380**	S	**380**		300	S	300	
204(0-1)								
204/0-1	7.2	S	7.2					
205(0-1)	3.4	S	3.4					
205/0-1					140	S	140	
206(0-1.0)	20	S	20		280	S	280	
207(0-1)								
208(0-1)								
209(0-1)	36	S	36		210	S	210	
210(0-1)								
301/0-1	24	S	24		710	S	710	
302/0-1	11	S	11		25	S	25	
302/2-3	<1.1	SS		0.6	3.1	SS		3.1
303/0-1	14	S	14		1100	S	1100	
304/0-1	4.5	S	4.5		240	S	240	
312(0-1)	15	S	15		130	S	130	
401/0-1	73	S	73		880	S	880	
402/0-1	35	S	35		380	S	380	
403/0-1	30	S	30		**1300**	S	**1300**	
404/0-2	**260**	S	**260**		500	S	500	
405/0-1	1.6	S	1.6		150	S	150	
419(0-1)	15	S	15		**2500**	S	**2500**	
501/0-1	56	S	56		**1200**	S	**1200**	
502/0-2	35	S	35		**2000**	S	**2000**	
502/2-3	15	SS		15	2600	SS		2600
503/0-1	11	S	11		700	S	700	
504/0-2	61	S	61		370	S	370	
504/3-4	<1.0	SS		0.5	12	SS		12
505/0-1	19	S	19		**1200**	S	**1200**	
506/0-1	5.3	S	5.3		**2900**	S	**2900**	
522(0-1)	3.2	S	3.2		820	S	820	
523(0-1)					520	S	520	
524(0-1)					90	S	90	
525(0-1)					160	S	160	
526(0-1)					350	S	350	
527(0-1)					170	S	170	
601/0-1	<1.0	S	1		32	S	196	
601D/0-1	1.5	SD			360	SD		
602/0-1	**300**	S	**260**		**5100**	S	**8050**	

TABLE 2.2
SOIL SAMPLES USED FOR EXPOSURE POINT CONCENTRATIONS-
ARSENIC AND LEAD

Sample Point	Arsenic	Type	Surface Value Used	Subsurface Value Used	Lead	Type	Surface Value Used	Subsurface Value Used
Risk Reduction Standard			**109**	**3,972**			**1,180**	**4,942**
602R/0-1	**220**	SD			**11000**	SD		
603/0-1	10	S	10		44	S	44	
604/0-2	17	S	20		1000	S	820	
604D/0-2	23	SD			640	SD		
605/0-2	79	S	79		590	S	590	
606/0-1	3.1	S	2.5		560	S	520	
606R/0-1	1.9	SD			480	SD		
607/0-1					900	S	900	
624(0-1)	1.3	S	1.3		46	S	46	
625(0-1)					680	S	680	
701/0-1	**130**	S	**150**		600	S	615	
701D/0-1	**170**	SD			630	SD		
702/0-1	34	S	34		**27000**	S	**27000**	
702/2-3	<1.3	SS		0.6	3.3	SS		3.3
703/0-1	13	S	13		510	S	510	
704/0-2	13	S	13		**1700**	S	**1700**	
705/0-3	60	S	60		270	S	270	
719(0-1)	7.2	S	7.2		1000	S	1000	
720(0-1)								
721(0-1)					**1800**	S	**1800**	
722(0-1)					940	S	940	
801/0-1	11	S	11		**1400**	S	**1400**	
802/0-2	14	S	14		400	S	400	
803/0-1	5.3	S	5.3		120	S	120	
804/0-2	1.1	S	1.1		97	S	97	
805/0-3	74	S	74		470	S	470	
806(0-1)	1.5	S	1.5					
806/0-1					180	S	180	
821(2-3)	<1.1	SS		0.6	3.5	SS		3.5
822(0-1)	**160**	S	**160**		**5400**	S	**5400**	
823(0-1)	7.8	S	7.8					
824(0-1)	5.9	S	5.9					
901/0-1	5	S	5		440	S	440	
902/0-4	9.7	S	9.7		850	S	850	
903/0-1	9.4	S	9.4		**1600**	S	**1600**	
904/0-1	5.6	S	5.6		720	S	720	
905/0-2	15	S	15		280	S	280	
906/0-2	37	S	37		310	S	310	
921(0-3.5)	45	S	45		250	S	250	
922(0-1)	4.1	S	4.1		630	S	630	
923(0-1)	7.3	S	7.3		360	S	360	
1001/0-1	6.4	S	6.4		280	S	280	
1002/0-4	17	S	17		710	S	710	
1002/4-5	<1.0	SS	0.5		2.8	SS		2.8
1003/0-5	12	S	12		1000	S	1000	
1004/0-4	9.5	S	7.8		160	S	130	
1004D/0-4	6.1	SD			100	SD		
1005/0-3	9.9	S	9.9		300	S	300	
1006/0-2	17	S	13.5		190	S	160	
1006D/0-2	9.9	SD			130	SD	130	
1026(0-1.0)	71	S	71		110	S	110	
1101/0-1	7.6	S	7.6		560	S	560	
1102/0-2	4.1	S	4.1		61	S	61	
1103/0-1					860	S	860	
1104/0-1	**110**	S	**110**		470	S	470	
1104/1-2	2.4	S	2.4					
1105/0-1	37	S	37					

TABLE 2.2
SOIL SAMPLES USED FOR EXPOSURE POINT CONCENTRATIONS-
ARSENIC AND LEAD

Sample Point	Arsenic	Type	Surface Value Used	Subsurface Value Used	Lead	Type	Surface Value Used	Subsurface Value Used
Risk Reduction Standard			**109**	**3,972**			**1,180**	**4,942**
1142(0-1)	15	S	15					
1201/0-1	8.4	S	8.4		310	S	310	
1202/0-1								
1203/0-1	51	S	79		410	S	**3928**	
1203D/0-1	95	SD			**13000**	SD		
1203DR/0-1	**130**	SD			**1900**	SD		
1203R/0-1	40	SD			400	SD		
1204/0-1								
1301/0-2	13	S	13		360	S	360	
1302/0-1								
1303/0-1	24	S	24		250	S	250	
1304/0-1								
1332(0-1)	**160**	S	**160**		210	S	210	
1333(0-1)	56	S	56		3.7	S	3.7	
1334(0-1)	2.4	S	2.4			S		
1401/0-1	<1.1	S	0.6		18	S	18	
1402/0-1	23	S	23			S		
1403/0-1	41	S	41		350	S	350	
1444(0-1)	3.4	S	3.4		24	S	24	
1501/0-1	4.2	S	4.2		26	S	26	
1502/0-1	10	S	10		44	S	44	
1503/0-1	26	S	26		130	S	130	
1516(0-1)	27	S	27		98	S	98	
1601/0-1	2.4	S	2.4		140	S	140	
1602/0-1	19	S	19		35	S	35	
1603/0-1	10	S	10					
1724(0-1)	<1.1	S	0.6		26	S	26	
1830(0.1)	6.1	S	6.1		230	S	230	
1831(0-1)								
2215(0-1)	8.9	S	8.9		290	S	290	
2216(0-1)	2.2	S	2.2		90	S	90	

All concentrations in mg/kg
S = Surface Sample
SS = Subsurface Sample
SD = Duplicate Sample
Bold values exceed Risk Reduction Standard

TABLE 2.3
SOIL SAMPLES USED FOR EXPOSURE POINT CONCENTRATIONS-
BARIUM AND CHROMIUM

Sample Point	Barium	Type	Surface Value Used	Subsurface Value Used	Chromium	Type	Surface Value Used	Subsurface Value Used
Risk Reduction Standard			**1,000**	**1,000**			**322**	**38,655**
001/0-1		S				S		
002(0-1.0)		S			8.4	S	8.4	
003(0-2.0)		S			15	S	15	
003(2-3.0)		SS			9.1	SS		9.1
004(0-1)		S			7.2	S	7.2	
005(0-1)		S				S		
006(0-1)		S				S		
007(0-1)		S				S		
101(0-1)		S				S		
101/0-1	46	S	46			S		
102/0-1		S				S		
103/0-1		S			19	S	19	
104/0-1		S			12	S	12	
105(0-2.5)		S			8.6	S	8.6	
106(0-2.0)		S			14	S	14	
107(0-1)		S				S		
201/0-1	150	S	150		11	S	11	
202/0-2	84	S	84		7.3	S	7.3	
203/0-2	110	S	110		23	S	23	
204(0-1)								
204/0-1		S			11	S	11	
205(0-1)		S				S		
205/0-1	38	S	38					
206(0-1.0)		S			13	S	13	
207(0-1)								
208(0-1)								
209(0-1)		S			5.6	S	5.6	
210(0-1)								
301/0-1	130	S	130		11	S	11	
302/0-1	160	S	160		5	S	5	
302/2-3	3.7	SS		3.7	2	SS		2
303/0-1	110	S	110		10	S	10	
304/0-1	76	S	76			S		
312(0-1)		S			3.6	S	3.6	
401/0-1	86	S	86		8.8	S	8.8	
402/0-1	110	S	110		24	S	24	
403/0-1	170	S	170		17	S	17	
404/0-2	290	S	290		23	S	23	
405/0-1		S			5.1	S	5.1	
419(0-1)		S				S		
501/0-1	120	S	120		13	S	13	
502/0-2	170	S	170		**2300**	S	**2300**	
502/2-3	81	SS		81	250	SS		250
503/0-1	110	S	110		13	S	13	
504/0-2	170	S	170		15	S	15	
504/3-4	19	SS		19	1.9	SS		1.9
505/0-1	250	S	250		38	S	38	
506/0-1	66	S	66		8.1	S	8.1	
522(0-1)		S			8.6	S	8.6	
523(0-1)								
524(0-1)					28	S	28	
525(0-1)								
526(0-1)								
527(0-1)								
601/0-1	10	S	13		3.3	S	3.5	
601D/0-1	16	SD			3.7	SD		
602/0-1	820	S	690		**1500**	S	**1550**	

TABLE 2.3
SOIL SAMPLES USED FOR EXPOSURE POINT CONCENTRATIONS-
BARIUM AND CHROMIUM

Sample Point	Barium	Type	Surface Value Used	Subsurface Value Used	Chromium	Type	Surface Value Used	Subsurface Value Used
Risk Reduction Standard			**1,000**	**1,000**			**322**	**38,655**
602R/0-1	560	SD			1600	SD		
603/0-1	28	S	28		9.5	S	9.5	
604/0-2	230	S	215		13	S	13	
604D/0-2	200	SD			12	SD		
605/0-2	130	S	130		11	S	11	
606/0-1	52	S	51		9.8	S	9.6	
606R/0-1	49	SD			9.3	SD		
607/0-1								
624(0-1)		S			3.2	S	3.2	
625(0-1)					29	S	29	
701/0-1	110	S	125		16	S	18	
701D/0-1	140	SD			19	SD		
702/0-1	**2900**	S	**2900**		180	S	180	
702/2-3	16	SS		16	3.3	SS		3.3
703/0-1	49	S	49		53	S	53	
704/0-2	240	S	240		22	S	22	
705/0-3	150	S	150		7.1	S	7.1	
719(0-1)		S			9.3	S	9.3	
720(0-1)								
721(0-1)								
722(0-1)								
801/0-1	48	S	48		8.5	S	8.5	
802/0-2	57	S	57		27	S	27	
803/0-1	33	S	33		13	S	13	
804/0-2	35	S	35		6.8	S	6.8	
805/0-3	160	S	160		17	S	17	
806(0-1)		S			5.2	S	5.2	
806/0-1								
821(2-3)		SS			3.1	SS		3.1
822(0-1)		S			29	S	29	
823(0-1)		S				S		
824(0-1)		S			9.1	S	9.1	
901/0-1	57	S	57		7.6	S	7.6	
902/0-4	220	S	220		100	S	100	
903/0-1	480	S	480		25	S	25	
904/0-1	110	S	110		19	S	19	
905/0-2	160	S	160		7.5	S	7.5	
906/0-2	150	S	150		18	S	18	
921(0-3.5)		S			6.6	S	6.6	
922(0-1)		S			**360**	S	**360**	
923(0-1)		S			**330**	S	**330**	
1001/0-1	58	S	58		6.2	S	6.2	
1002/0-4	150	S	150		**1700**	S	**1700**	
1002/4-5	45	SS		45	2.4	SS		2.4
1003/0-5	190	S	190		30	S	30	
1004/0-4	53	S	47		22	S	20	
1004D/0-4	41	SD			18	SD		
1005/0-3	66	S	66		4.6	S	4.6	
1006/0-2	120	S	102		5.4	S	4.8	
1006D/0-2	84	SD			4.2	SD		
1026(0-1.0)		S			7.7	S	7.7	
1101/0-1	150	S	150		15	S	15	
1102/0-2	35	S	35		2.8	S	2.8	
1103/0-1	180	S	180		20		20	
1104/0-1	48	S	48		10	S	10	
1104/1-2		S				S		
1105/0-1		S				S		

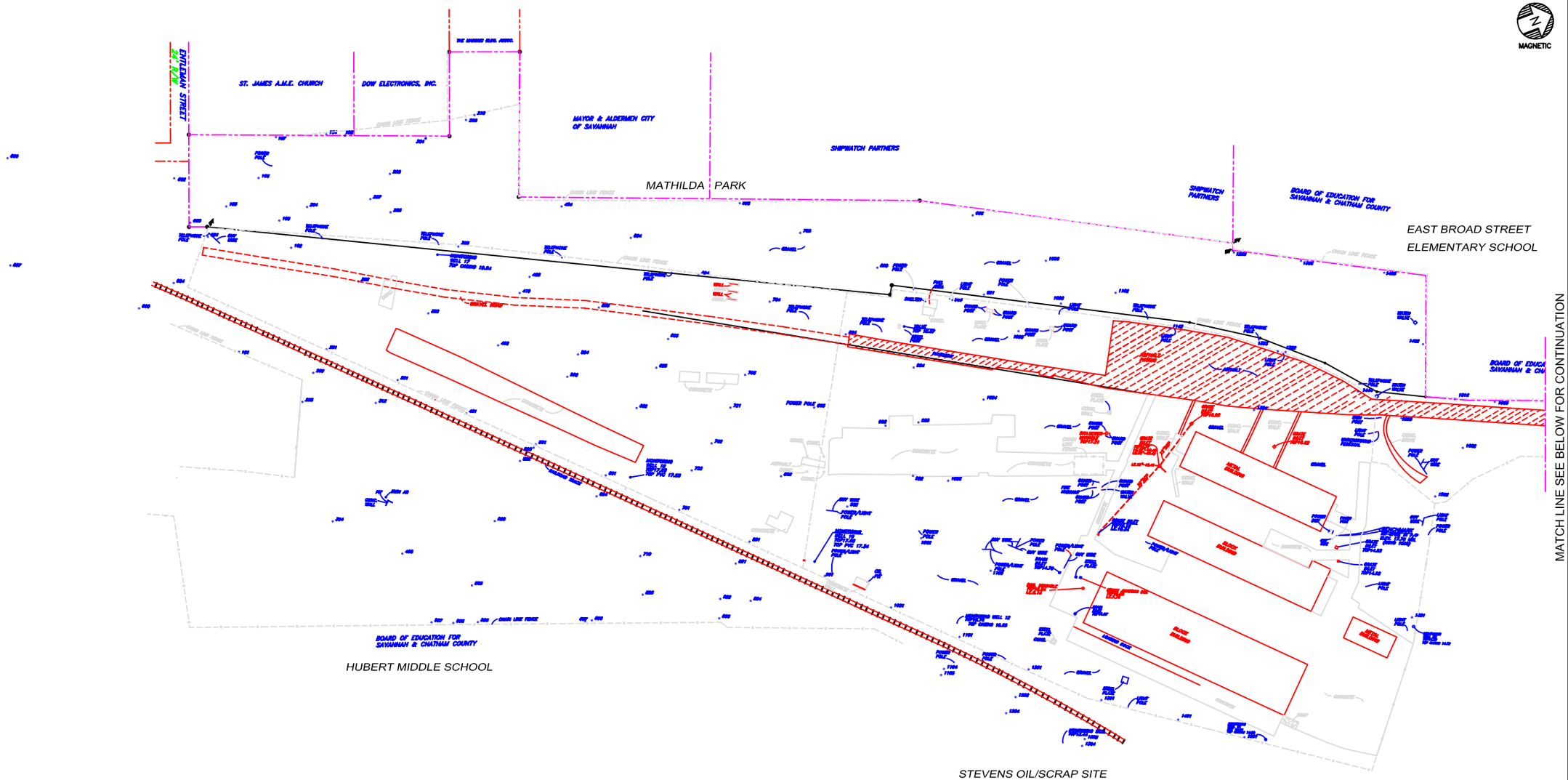
TABLE 2.3
SOIL SAMPLES USED FOR EXPOSURE POINT CONCENTRATIONS-
BARIUM AND CHROMIUM

Sample Point	Barium	Type	Surface Value Used	Subsurface Value Used	Chromium	Type	Surface Value Used	Subsurface Value Used
Risk Reduction Standard			**1,000**	**1,000**			**322**	**38,655**
1142(0-1)		S				S		
1201/0-1	52	S	52		15	S	15	
1202/0-1					11	S	11	
1203/0-1	160	S	182.5		18	S	28.5	
1203D/0-1	230	SD			58	SD		
1203DR/0-1	200	SD			26	SD		
1203R/0-1	140	SD			12	SD		
1204/0-1								
1301/0-2	93	S	93		15	S	15	
1302/0-1					11	S	11	
1303/0-1	53	S	53		5.5	S	5.5	
1304/0-1								
1332(0-1)		S			9.4	S	9.4	
1333(0-1)		S			3.1	S	3.1	
1334(0-1)		S				S		
1401/0-1	11	S	11		4.7	S	4.7	
1402/0-1		S				S		
1403/0-1	190	S	190		17	S	17	
1444(0-1)		S			4.4	S	4.4	
1501/0-1	23	S	23		4.2	S	4.2	
1502/0-1	30	S	30		5	S	5	
1503/0-1	40	S	40		6.2	S	6.2	
1516(0-1)		S			5.6	S	5.6	
1601/0-1	70	S	70		5.8	S	5.8	
1602/0-1	30	S	30		4.1	S	4.1	
1603/0-1		S				S		
1724(0-1)		S			5.8	S	5.8	
1830(0.1)		S			9	S	9	
1831(0-1)								
2215(0-1)		S			6.1	S	6.1	
2216(0-1)		S			4.6	S	4.6	

All concentrations in mg/kg
S = Surface Sample
SS = Subsurface Sample
SD = Duplicate Sample
Bold values exceed Risk Reduction Standard

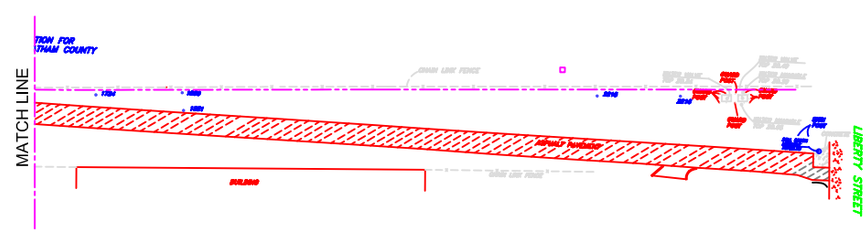
TABLE 2.4
EXPOSURE POINT CONCENTRATIONS AND
RISK REDUCTION STANDARDS FOR SOIL

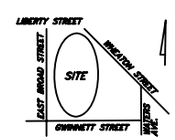
Regulated Substance	Number of Samples Used in Calculations	Exposure Point Concentration (EPC), mg/kg	Basis for EPC	Risk Reduction Standard (RRS), mg/kg	Type RRS
Surface Soil					
Arsenic	108	52	95% H-UCL	109	4
Barium	62	187	95% H-UCL	1,000	3
Chromium	93	232	95% Chebyshev (Mean, Sd) UCL	322	4
Lead	106	953	Mean	1,180	4
Subsurface Soil					
Arsenic	11	32	95% Approximate Gamma UCL	3,972	4
Barium	5	62	95% Student's-t UCL	1,000	3
Chromium	7	2,177	95% Halls' Bootstrap UCL	38,655	4
Lead	12	519	Mean	4,942	4



LEGEND

- Property Line
- RRS
- Background
- 30A — Sample Point
- 100/0-1 — Depth of Sample; Concentration in mg/Kg





VICINITY MAP
N.T.S.

GRAPHIC SCALE IN FEET
60 0 60 120 180 240

CSX TRANSPORTATION

HC HOLLEY CONSULTANTS

REVISIONS & DATE

FIGURE 2.1
SOIL SAMPLE LOCATIONS
CSXT DEPRIEST SIGNAL SHOP
SAVANNAH, GA

DESIGNED BY	CHECKED BY	SCALE	DATE
–	REH	INDICATED	AUG 2005

ATTACHMENT A

SURFACE SOIL EXPOSURE POINT CONCENTRATIONS

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2013 Activities\Table with Arsenic and Lead Soil Data wit
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic Surface

General Statistics

Number of Valid Observations	108	Number of Distinct Observations	75
Number of Missing Values	44		

Raw Statistics		Log-transformed Statistics	
Minimum	0.5	Minimum of Log Data	-0.693
Maximum	380	Maximum of Log Data	5.94
Mean	34.94	Mean of log Data	2.635
Median	13	SD of log Data	1.392
SD	59.27		
Coefficient of Variation	1.696		
Skewness	3.429		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.281	Lilliefors Test Statistic	0.0625
Lilliefors Critical Value	0.0853	Lilliefors Critical Value	0.0853
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	44.4	95% H-UCL	52.16
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	64.53
95% Adjusted-CLT UCL (Chen-1995)	46.33	97.5% Chebyshev (MVUE) UCL	76.83
95% Modified-t UCL (Johnson-1978)	44.72	99% Chebyshev (MVUE) UCL	101

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.651	**Data appear Lognormal at 5% Significance Level**	
Theta Star	53.68		
MLE of Mean	34.94		
MLE of Standard Deviation	43.31		
nu star	140.6		
Approximate Chi Square Value (.05)	114.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0478	95% CLT UCL	44.32
Adjusted Chi Square Value	113.9	95% Jackknife UCL	44.4
		95% Standard Bootstrap UCL	44.61
Anderson-Darling Test Statistic	2.772	95% Bootstrap-t UCL	48.43
Anderson-Darling 5% Critical Value	0.803	95% Hall's Bootstrap UCL	47.7
Kolmogorov-Smirnov Test Statistic	0.152	95% Percentile Bootstrap UCL	44.55
Kolmogorov-Smirnov 5% Critical Value	0.0914	95% BCA Bootstrap UCL	47.63
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	59.8
		97.5% Chebyshev(Mean, Sd) UCL	70.56
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	91.69

95% Approximate Gamma UCL	43.02
95% Adjusted Gamma UCL	43.14

Potential UCL to Use Use 95% H-UCL 52.16

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

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

General UCL Statistics for Full Data Sets

User Selected Options

From File	WorkSheet_a.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Barium Surface

General Statistics

Number of Valid Observations	62	Number of Distinct Observations	43
Number of Missing Values	79		

Raw Statistics		Log-transformed Statistics	
Minimum	11	Minimum of Log Data	2.398
Maximum	2900	Maximum of Log Data	7.972
Mean	166.9	Mean of log Data	4.549
Median	110	SD of log Data	0.922
SD	369.3		
Coefficient of Variation	2.213		
Skewness	6.909		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.346	Lilliefors Test Statistic	0.0956
Lilliefors Critical Value	0.113	Lilliefors Critical Value	0.113
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	245.2	95% H-UCL	187.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	228.2
95% Adjusted-CLT UCL (Chen-1995)	288	97.5% Chebyshev (MVUE) UCL	265
95% Modified-t UCL (Johnson-1978)	252.1	99% Chebyshev (MVUE) UCL	337.2

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.976	Data appear Lognormal at 5% Significance Level
Theta Star	171.1	
MLE of Mean	166.9	
MLE of Standard Deviation	169	
nu star	121	
Approximate Chi Square Value (.05)	96.56	**Nonparametric Statistics**
Adjusted Level of Significance	0.0461	95% CLT UCL 244
Adjusted Chi Square Value	96.05	95% Jackknife UCL 245.2
		95% Standard Bootstrap UCL 243.4
Anderson-Darling Test Statistic	2.956	95% Bootstrap-t UCL 430.8
Anderson-Darling 5% Critical Value	0.779	95% Hall's Bootstrap UCL 537
Kolmogorov-Smirnov Test Statistic	0.192	95% Percentile Bootstrap UCL 254.3
Kolmogorov-Smirnov 5% Critical Value	0.116	95% BCA Bootstrap UCL 304.3
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 371.3
		97.5% Chebyshev(Mean, Sd) UCL 459.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 633.5

95% Approximate Gamma UCL	209.1
95% Adjusted Gamma UCL	210.2

Potential UCL to Use Use 95% H-UCL 187.5

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

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

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2014 Activities\Barium and Chromium 042214.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium Surface

General Statistics

Number of Valid Observations	93	Number of Distinct Observations	66
Number of Missing Values	54		

Raw Statistics		Log-transformed Statistics	
Minimum	2.8	Minimum of Log Data	1.03
Maximum	2300	Maximum of Log Data	7.741
Mean	81.68	Mean of log Data	2.614
Median	11	SD of log Data	1.263
SD	334		
Coefficient of Variation	4.089		
Skewness	5.464		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.466	Lilliefors Test Statistic	0.17
Lilliefors Critical Value	0.0919	Lilliefors Critical Value	0.0919
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	139.2	95% H-UCL	42.25
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	51.91
95% Adjusted-CLT UCL (Chen-1995)	159.6	97.5% Chebyshev (MVUE) UCL	61.44
95% Modified-t UCL (Johnson-1978)	142.5	99% Chebyshev (MVUE) UCL	80.17

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.367	Data do not follow a Discernable Distribution (0.05)
Theta Star	222.3	
MLE of Mean	81.68	
MLE of Standard Deviation	134.7	
nu star	68.34	
Approximate Chi Square Value (.05)	50.31	**Nonparametric Statistics**
Adjusted Level of Significance	0.0474	95% CLT UCL 138.6
Adjusted Chi Square Value	50.07	95% Jackknife UCL 139.2
		95% Standard Bootstrap UCL 138.4
Anderson-Darling Test Statistic	18.65	95% Bootstrap-t UCL 192.5
Anderson-Darling 5% Critical Value	0.85	95% Hall's Bootstrap UCL 133
Kolmogorov-Smirnov Test Statistic	0.386	95% Percentile Bootstrap UCL 146.3
Kolmogorov-Smirnov 5% Critical Value	0.0998	95% BCA Bootstrap UCL 164.4
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 232.6
		97.5% Chebyshev(Mean, Sd) UCL 298
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 426.3

95% Approximate Gamma UCL	110.9
95% Adjusted Gamma UCL	111.5

Potential UCL to Use Use 95% Chebyshev (Mean, Sd) UCL 232.6

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

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2013 Activities\Table with Arsenic and Lead Soil Data wit
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead Surface

General Statistics

Number of Valid Observations	106	Number of Distinct Observations	77
Number of Missing Values	48		

Raw Statistics		Log-transformed Statistics	
Minimum	3.7	Minimum of Log Data	1.308
Maximum	27000	Maximum of Log Data	10.2
Mean	953.7	Mean of log Data	5.867
Median	355	SD of log Data	1.36
SD	2776		
Coefficient of Variation	2.91		
Skewness	8.23		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.366	Lilliefors Test Statistic	0.0615
Lilliefors Critical Value	0.0861	Lilliefors Critical Value	0.0861
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	1401	95% H-UCL	1252
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1549
95% Adjusted-CLT UCL (Chen-1995)	1627	97.5% Chebyshev (MVUE) UCL	1841
95% Modified-t UCL (Johnson-1978)	1437	99% Chebyshev (MVUE) UCL	2413

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.608	**Data appear Lognormal at 5% Significance Level**
Theta Star	1569	
MLE of Mean	953.7	
MLE of Standard Deviation	1223	
nu star	128.8	
Approximate Chi Square Value (.05)	103.6	**Nonparametric Statistics**
Adjusted Level of Significance	0.0477	95% CLT UCL 1397
Adjusted Chi Square Value	103.3	95% Jackknife UCL 1401
		95% Standard Bootstrap UCL 1395
Anderson-Darling Test Statistic	3.797	95% Bootstrap-t UCL 2243
Anderson-Darling 5% Critical Value	0.807	95% Hall's Bootstrap UCL 3036
Kolmogorov-Smirnov Test Statistic	0.151	95% Percentile Bootstrap UCL 1475
Kolmogorov-Smirnov 5% Critical Value	0.0922	95% BCA Bootstrap UCL 1808
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 2129
		97.5% Chebyshev(Mean, Sd) UCL 2637
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 3636

95% Approximate Gamma UCL 1186

95% Adjusted Gamma UCL 1189

Potential UCL to Use Use 95% H-UCL 1252

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

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

These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

ATTACHMENT B

SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2013 Activities\Table with Arsenic and Lead Soil Data wit
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic Subsurface

General Statistics

Number of Valid Observations	11	Number of Distinct Observations	9
Number of Missing Values	141		

Raw Statistics		Log-transformed Statistics	
Minimum	0.5	Minimum of Log Data	-0.693
Maximum	51	Maximum of Log Data	3.932
Mean	13.61	Mean of log Data	1.614
Median	11.38	SD of log Data	1.799
SD	15.45		
Coefficient of Variation	1.136		
Skewness	1.523		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.83	Shapiro Wilk Test Statistic	0.832
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
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	22.06	95% H-UCL	366
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	66.82
95% Adjusted-CLT UCL (Chen-1995)	23.56	97.5% Chebyshev (MVUE) UCL	87.53
95% Modified-t UCL (Johnson-1978)	22.41	99% Chebyshev (MVUE) UCL	128.2

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.509	**Data appear Gamma Distributed at 5% Significance Level**
Theta Star	26.72	
MLE of Mean	13.61	
MLE of Standard Deviation	19.07	
nu star	11.21	
Approximate Chi Square Value (.05)	4.708	**Nonparametric Statistics**
Adjusted Level of Significance	0.0278	95% CLT UCL 21.28
Adjusted Chi Square Value	4.044	95% Jackknife UCL 22.06
		95% Standard Bootstrap UCL 20.6
Anderson-Darling Test Statistic	0.604	95% Bootstrap-t UCL 26.24
Anderson-Darling 5% Critical Value	0.772	95% Hall's Bootstrap UCL 47.64
Kolmogorov-Smirnov Test Statistic	0.244	95% Percentile Bootstrap UCL 21.09
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL 22.75
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 33.92
		97.5% Chebyshev(Mean, Sd) UCL 42.71

Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	59.98
95% Approximate Gamma UCL	32.39		
95% Adjusted Gamma UCL	37.71		
Potential UCL to Use		Use 95% Approximate Gamma UCL	32.39

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

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2014 Activities\Barium and Chromium 042214.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Barium Subsurface

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5
Number of Missing Values	98		

Raw Statistics		**Log-transformed Statistics**	
Minimum	3.7	Minimum of Log Data	1.308
Maximum	81	Maximum of Log Data	4.394
Mean	32.94	Mean of log Data	3.045
Median	19	SD of log Data	1.173
SD	30.79		
Coefficient of Variation	0.935		
Skewness	1.145		

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	0.899	Shapiro Wilk Test Statistic	0.962
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	62.29	95% H-UCL	1154
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	110
95% Adjusted-CLT UCL (Chen-1995)	63.12	97.5% Chebyshev (MVUE) UCL	142.5
95% Modified-t UCL (Johnson-1978)	63.47	99% Chebyshev (MVUE) UCL	206.3

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	0.635	**Data appear Normal at 5% Significance Level**
Theta Star	51.91	
MLE of Mean	32.94	

MLE of Standard Deviation	41.35
nu star	6.345
Approximate Chi Square Value (.05)	1.819
Adjusted Level of Significance	0.0086
Adjusted Chi Square Value	0.952
Anderson-Darling Test Statistic	0.212
Anderson-Darling 5% Critical Value	0.689
Kolmogorov-Smirnov Test Statistic	0.2
Kolmogorov-Smirnov 5% Critical Value	0.363

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	114.9
95% Adjusted Gamma UCL	219.6

Nonparametric Statistics

95% CLT UCL	55.59
95% Jackknife UCL	62.29
95% Standard Bootstrap UCL	53.05
95% Bootstrap-t UCL	121.5
95% Hall's Bootstrap UCL	242.7
95% Percentile Bootstrap UCL	55
95% BCA Bootstrap UCL	56.2
95% Chebyshev(Mean, Sd) UCL	92.96
97.5% Chebyshev(Mean, Sd) UCL	118.9
99% Chebyshev(Mean, Sd) UCL	169.9

Potential UCL to Use

Use 95% Student's-t UCL 62.29

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

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2014 Activities\Barium and Chromium 042214.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium Subsurface

General Statistics

Number of Valid Observations	7	Number of Distinct Observations	7
Number of Missing Values	96		

Raw Statistics		**Log-transformed Statistics**	
Minimum	1.9	Minimum of Log Data	0.642
Maximum	250	Maximum of Log Data	5.521
Mean	38.83	Mean of log Data	1.752
Median	3.1	SD of log Data	1.743
SD	93.15		
Coefficient of Variation	2.399		
Skewness	2.642		

Warning: A sample size of 'n' = 7 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 7 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	0.473	Shapiro Wilk Test Statistic	0.689
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
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	107.2	95% H-UCL	1806
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	67.52
95% Adjusted-CLT UCL (Chen-1995)	134.3	97.5% Chebyshev (MVUE) UCL	88.92
95% Modified-t UCL (Johnson-1978)	113.1	99% Chebyshev (MVUE) UCL	130.9

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	0.297	Data do not follow a Discernable Distribution (0.05)
Theta Star	130.9	
MLE of Mean	38.83	

MLE of Standard Deviation	71.3
nu star	4.151
Approximate Chi Square Value (.05)	0.782
Adjusted Level of Significance	0.0158
Adjusted Chi Square Value	0.439
Anderson-Darling Test Statistic	1.5
Anderson-Darling 5% Critical Value	0.776
Kolmogorov-Smirnov Test Statistic	0.401
Kolmogorov-Smirnov 5% Critical Value	0.333

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	206
95% Adjusted Gamma UCL	367.5

Nonparametric Statistics

95% CLT UCL	96.74
95% Jackknife UCL	107.2
95% Standard Bootstrap UCL	91.83
95% Bootstrap-t UCL	5663
95% Hall's Bootstrap UCL	2177
95% Percentile Bootstrap UCL	109.3
95% BCA Bootstrap UCL	143.9
95% Chebyshev(Mean, Sd) UCL	192.3
97.5% Chebyshev(Mean, Sd) UCL	258.7
99% Chebyshev(Mean, Sd) UCL	389.1

Potential UCL to Use

Use 95% Hall's Bootstrap UCL 2177

Recommended UCL exceeds the maximum observation

In Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL

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

General UCL Statistics for Full Data Sets

User Selected Options

From File	C:\Users\Ron\Documents\A\DePriest 2011- Activities\2013 Activities\Table with Arsenic and Lead Soil Data wit
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead Subsurface

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12
Number of Missing Values	140		

Raw Statistics		Log-transformed Statistics	
Minimum	2.8	Minimum of Log Data	1.03
Maximum	2600	Maximum of Log Data	7.863
Mean	519.4	Mean of log Data	4.108
Median	181	SD of log Data	2.789
SD	773.4		
Coefficient of Variation	1.489		
Skewness	2.01		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.728	Shapiro Wilk Test Statistic	0.818
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% Student's-t UCL	920.4	95% H-UCL	843244
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5185
95% Adjusted-CLT UCL (Chen-1995)	1025	97.5% Chebyshev (MVUE) UCL	6931
95% Modified-t UCL (Johnson-1978)	942	99% Chebyshev (MVUE) UCL	10360

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.294	Data do not follow a Discernable Distribution (0.05)
Theta Star	1764	
MLE of Mean	519.4	
MLE of Standard Deviation	957.3	
nu star	7.066	
Approximate Chi Square Value (.05)	2.207	**Nonparametric Statistics**
Adjusted Level of Significance	0.029	95% CLT UCL 886.7
Adjusted Chi Square Value	1.816	95% Jackknife UCL 920.4
		95% Standard Bootstrap UCL 860.9
Anderson-Darling Test Statistic	0.843	95% Bootstrap-t UCL 1210
Anderson-Darling 5% Critical Value	0.82	95% Hall's Bootstrap UCL 2294
Kolmogorov-Smirnov Test Statistic	0.267	95% Percentile Bootstrap UCL 892.3
Kolmogorov-Smirnov 5% Critical Value	0.265	95% BCA Bootstrap UCL 1063
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 1493
		97.5% Chebyshev(Mean, Sd) UCL 1914
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 2741

95% Approximate Gamma UCL 1663

95% Adjusted Gamma UCL 2021

Potential UCL to Use Use 99% Chebyshev (Mean, Sd) UCL 2741

Recommended UCL exceeds the maximum observation

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