APPENDIX H

STATISTICAL ANALYSES

LEAD DATA USED IN STATISTICAL EVALUATION PRESENTED IN SECTION 6.1.1

Composite Area	Lithology	SampleID	Sample Interval	Total Lead (mg/kg)	Actual WET Pb (mg/L)	WET Lead (mg/L)	Area Type	AreaDepth	LithDepth
9	F	E059F-1.0	1	2.2		0.22	Cut	Cut 1'	F1
9	F	E060F-1.0	1	9.9		0.99	Cut	Cut 1'	F1
9	F	E061F-1.0	1	8.2		0.82	Cut	Cut 1'	F1
10	F	E063F-1.0	1	110	7.8	7.8	Cut	Cut 1'	F1
10	F	E065F-1.0	1	100	15	15	Cut	Cut 1'	F1
10	F	E067F-1.0	1	160	2.9	2.9	Cut	Cut 1'	F1
10	F	E069F-1.0	1	20		2	Cut	Cut 1'	F1
10	F	E071F-1.0	1	79	1.9	1.9	Cut	Cut 1'	F1
10	F	E071F-2.0	1	12		1.2	Cut	Cut 1'	F1
12	F	E073F-1.0	1	120	4.9	4.9	Cut	Cut 1'	F1
12	F	E074F-1.0	1	59	1.2	1.2	Cut	Cut 1'	F1
12	F	E075F-1.0	1	320	2.7	2.7	Cut	Cut 1'	F1
12	F	E076F-1.0	1	130	2	2	Cut	Cut 1'	F1
12	A	E077AA-1.0	1	20		2	Cut	Cut 1'	A1
12	F	E077F-1.0	1	14		1.4	Cut	Cut 1'	F1
12	A	E078AA-1.0	1	7.4		0.74	Cut	Cut 1'	A1
12	F	E078F-1.0	1	8.2		0.82	Cut	Cut 1'	F1
12	F	E079F-1.0	1	120	4.3	4.3	Cut	Cut 1'	F1
12	F	E080F-1.0	1	60	1.1	1.1	Cut	Cut 1'	F1
12	F	E081F-1.0	1	3.7		0.37	Cut	Cut 1'	F1
12	A	E082A-1.0	1	4.1		0.41	Cut	Cut 1'	A1
9	F	E059F-2.5	2.5	120	1.1	1.1	Cut	Cut 2.5'	F2.5
9	F	E060FS-2.5	2.5	21		2.1	Cut	Cut 2.5'	F2.5
9	F	E061C-2.5	2.5	2.5		0.25	Cut	Cut 2.5'	F2.5
10	F	E063F-2.5	2.5	160	1.9	1.9	Cut	Cut 2.5'	F2.5
10	F	E065F-2.5	2.5	23		2.3	Cut	Cut 2.5'	F2.5
10	F	E067F-2.5	2.5	13		1.3	Cut	Cut 2.5'	F2.5
10	F	E069F-2.5	2.5	4		0.4	Cut	Cut 2.5'	F2.5
12	F	E073F-2.5	2.5	3		0.3	Cut	Cut 2.5'	F2.5
12	F	E074F-2.5	2.5	4.6		0.46	Cut	Cut 2.5'	F2.5
12	F	E075F-2.5	2.5	30		3	Cut	Cut 2.5'	F2.5
12	F	E076F-2.5	2.5	2.4		0.24	Cut	Cut 2.5'	F2.5
12	A	E077A-2.5	2.5	1.8		0.18	Cut	Cut 2.5'	A2.5
12	A	E077AA-2.5	2.5	6.9		0.69	Cut	Cut 2.5'	A2.5
12	A	E078A-2.5	2.5	1.9		0.19	Cut	Cut 2.5'	A2.5
12	A	E078AA-2.5	2.5	2.8		0.28	Cut	Cut 2.5'	A2.5
12	F	E079F-2.5	2.5	49		4.9	Cut	Cut 2.5'	F2.5
12	A	E080A-2.5	2.5	1.6		0.16	Cut	Cut 2.5'	A2.5
12	F	E081F-2.5	2.5	13		1.3	Cut	Cut 2.5'	F2.5
12	A	E082A-2.5	2.5	5.1		0.51	Cut	Cut 2.5'	A2.5
11	F	E062F-1.0	1	34		3.4	Fill	Fill 1'	F1
11	F	E064F-1.0	1	570	5.1	5.1	Fill	Fill 1'	F1
11	F	E066F-1.0	1	140	7.9	7.9	Fill	Fill 1'	F1
11	F	E068F-1.0	1	47		4.7	Fill	Fill 1'	F1
11	F	E070F-1.0	1	8.6		0.86	Fill	Fill 1'	F1
11	F	E072F-1.0	1	17		1.7	Fill	Fill 1'	F1
11	F	E062F-2.5	2.5	27		2.7	Fill	Fill 2.5'	F2.5
11	F	E064F-2.5	2.5	1000	7.5	7.5	Fill	Fill 2.5'	F2.5
11	F	E066F-2.5	2.5	130	13	13	Fill	Fill 2.5'	F2.5
11	F	E068F-2.5	2.5	120	23	23	Fill	Fill 2.5'	F2.5
11	F	E070F-2.5	2.5	190	0.98	0.98	Fill	Fill 2.5'	F2.5
11	F	E072F-2.5	2.5	330	12	12	Fill	Fill 2.5'	F2.5

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median

Area of Concern Data: Total Lead(fill)
Background Data: Total Lead(cut)

Raw Statistics

	Site	Background
Number of Valid Observations	12	40
Number of Distinct Observations	12	34
Minimum	8.6	1.6
Maximum	1000	320
Mean	217.8	45.83
Median	125	13
SD	294.8	66.28
SE of Mean	85.1	10.48

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background

Site Rank Sum W-Stat	464
WMW Test U-Stat	3.182
WMW Critical Value (0.050)	-1.645
P-Value	0.999

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site >= Background
P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median

Area of Concern Data: Total Lead(cut)
Background Data: Total Lead(fill)

Raw Statistics

	Site	Background
Number of Valid Observations	40	12
Number of Distinct Observations	34	12
Minimum	1.6	8.6
Maximum	320	1000
Mean	45.83	217.8
Median	13	125
SD	66.28	294.8
SE of Mean	10.48	85.1

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background

Site Rank Sum W-Stat	914
WMW Test U-Stat	-3.16
WMW Critical Value (0.050)	-1.645
P-Value	0.000789

Conclusion with Alpha = 0.05
Reject H0, Conclude Site < Background
P-Value < alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Total Lead(fill 1')
Background Data: Total Lead(fill 2.5')

Raw Statistics

	Site	Background
Number of Valid Observations	6	6
Number of Distinct Observations	6	6
Minimum	8.6	27
Maximum	570	1000
Mean	136.1	299.5
Median	40.5	160
SD	217.8	357.4
SE of Mean	88.9	145.9

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	31
WMW Test U-Stat	10
WMW Critical Value (0.050)	28
Approximate P-Value	0.913

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site <= Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Total Lead(fill 2.5')
Background Data: Total Lead(fill 1')

Raw Statistics

	Site	Background
Number of Valid Observations	6	6
Number of Distinct Observations	6	6
Minimum	27	8.6
Maximum	1000	570
Mean	299.5	136.1
Median	160	40.5
SD	357.4	217.8
SE of Mean	145.9	88.9

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	47
WMW Test U-Stat	26
WMW Critical Value (0.050)	28
Approximate P-Value	0.115

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site <= Background

General UCL Statistics for Full Data Sets

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	90%
No. of Bootstrap Operations	2000

WET Lead (fill)

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12

Raw Statistics

Minimum	0.86
Maximum	23
Mean	6.903
Median	4.9
SD	6.469
Coefficient of Variation	0.937
Skewness	1.542

Log-transformed Statistics

Minimum of Log Data	-0.151
Maximum of Log Data	3.135
Mean of log Data	1.502
SD of log Data	1.031

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.847
Shapiro Wilk Critical Value	0.859

Data not Normal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	9.449

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	9.89
90% Modified-t UCL	9.588

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical Value	0.859

Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

90% H-UCL	14.72
90% Chebyshev (MVUE) UCL	14.06
95% Chebyshev (MVUE) UCL	17.18
97.5% Chebyshev (MVUE) UCL	21.5
99% Chebyshev (MVUE) UCL	30

Gamma Distribution Test

k star (bias corrected)	1.033
Theta Star	6.682
MLE of Mean	6.903
MLE of Standard Deviation	6.792
nu star	24.8
Approximate Chi Square Value (.05)	16.31
Adjusted Level of Significance	0.0752
Adjusted Chi Square Value	15.49
Anderson-Darling Test Statistic	0.169
Anderson-Darling 5% Critical Value	0.75
Kolmogorov-Smirnov Test Statistic	0.0944
Kolmogorov-Smirnov 5% Critical Value	0.251

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

90% Approximate Gamma UCL	10.5
90% Adjusted Gamma UCL	11.05

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

90% CLT UCL	9.297
90% Jackknife UCL	9.449
90% Standard Bootstrap UCL	9.207
90% Bootstrap-t UCL	10.66
90% Hall's Bootstrap UCL	11.03
90% Percentile Bootstrap UCL	9.228
90% BCA Bootstrap UCL	9.863
90% Chebyshev(Mean, Sd) UCL	12.51
95% Chebyshev(Mean, Sd) UCL	15.04
97.5% Chebyshev(Mean, Sd) UCL	18.57
99% Chebyshev(Mean, Sd) UCL	25.48

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median

Area of Concern Data: Total Lead(cut 1')
Background Data: Total Lead(cut 2.5')

Raw Statistics

	Site	Background
Number of Valid Observations	21	19
Number of Distinct Observations	18	18
Minimum	2.2	1.6
Maximum	320	160
Mean	65.13	24.51
Median	20	5.1
SD	77.94	43.04
SE of Mean	17.01	9.875

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background

Site Rank Sum W-Stat	518.5
WMW Test U-Stat	2.397
WMW Critical Value (0.050)	-1.645
P-Value	0.992

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Site >= Background
P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Full Data Sets without NDs

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Greater Than or Equal to Background Mean/Median (Form 2)
Alternative Hypothesis	Site or AOC Mean/Median Less Than Background Mean/Median

Area of Concern Data: Total Lead(cut 2.5')
Background Data: Total Lead(cut 1')

Raw Statistics

	Site	Background
Number of Valid Observations	19	21
Number of Distinct Observations	18	18
Minimum	1.6	2.2
Maximum	160	320
Mean	24.51	65.13
Median	5.1	20
SD	43.04	77.94
SE of Mean	9.875	17.01

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC >= Mean/Median of Background

Site Rank Sum W-Stat	301.5
WMW Test U-Stat	-2.37
WMW Critical Value (0.050)	-1.645
P-Value	0.0089

Conclusion with Alpha = 0.05
Reject H0, Conclude Site < Background
P-Value < alpha (0.05)

General UCL Statistics for Full Data Sets

User Selected Options

From File	D:\LHfiles\DoyleDrive\Explore EDDs\Contract 4 Data Eval\Pb Data for Final Check.xls.wst
Full Precision	OFF
Confidence Coefficient	90%
No. of Bootstrap Operations	2000

WET Lead (cut 1')

General Statistics

Number of Valid Observations	21	Number of Distinct Observations	17

Raw Statistics

Minimum	0.22
Maximum	15
Mean	2.608
Median	1.4
SD	3.362
Coefficient of Variation	1.289
Skewness	2.894

Log-transformed Statistics

Minimum of Log Data	-1.514
Maximum of Log Data	2.708
Mean of log Data	0.442
SD of log Data	1.013

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.638
Shapiro Wilk Critical Value	0.908

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.984
Shapiro Wilk Critical Value	0.908

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	3.58

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	3.879
90% Modified-t UCL	3.658

Assuming Lognormal Distribution

90% H-UCL	3.996
90% Chebyshev (MVUE) UCL	4.381
95% Chebyshev (MVUE) UCL	5.229
97.5% Chebyshev (MVUE) UCL	6.406
99% Chebyshev (MVUE) UCL	8.718

Gamma Distribution Test

k star (bias corrected)	0.978
Theta Star	2.666
MLE of Mean	2.608
MLE of Standard Deviation	2.637
nu star	41.09
Approximate Chi Square Value (.05)	29.98
Adjusted Level of Significance	0.0869
Adjusted Chi Square Value	29.41
Anderson-Darling Test Statistic	0.643
Anderson-Darling 5% Critical Value	0.767
Kolmogorov-Smirnov Test Statistic	0.191
Kolmogorov-Smirnov 5% Critical Value	0.194

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

90% CLT UCL	3.548
90% Jackknife UCL	3.58
90% Standard Bootstrap UCL	3.534
90% Bootstrap-t UCL	4.577
90% Hall's Bootstrap UCL	7.776
90% Percentile Bootstrap UCL	3.531
90% BCA Bootstrap UCL	4.031
90% Chebyshev(Mean, Sd) UCL	4.809
95% Chebyshev(Mean, Sd) UCL	5.806
97.5% Chebyshev(Mean, Sd) UCL	7.19
99% Chebyshev(Mean, Sd) UCL	9.908

Assuming Gamma Distribution

90% Approximate Gamma UCL	3.574
90% Adjusted Gamma UCL	3.643

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient