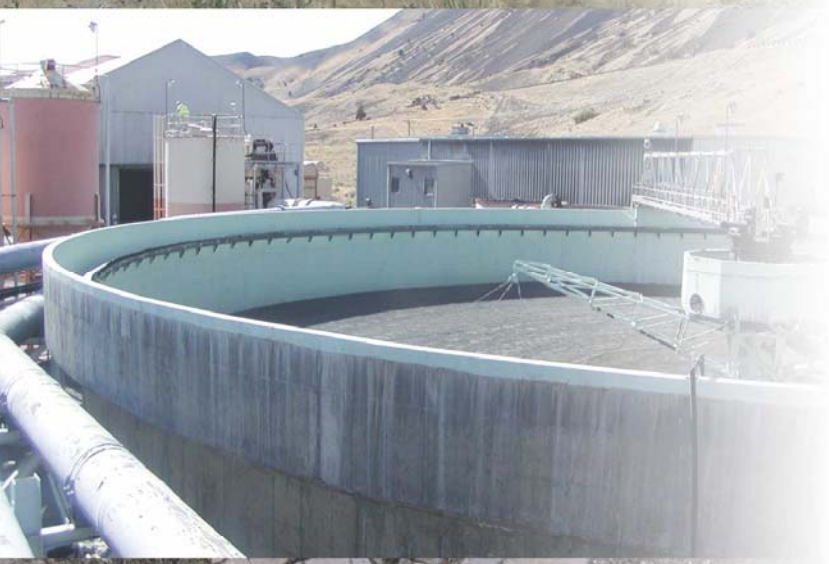

2020 ANNUAL GROUNDWATER MONITORING REPORT

WEST SURFACE IMPOUNDMENT

Columbia Gorge Aluminum Smelter Site

85 John Day Dam Road, Goldendale WA

Facility Site ID #95415874

July 10, 2020

On behalf of:

NSC Smelter LLC
3313 West Second Street
The Dalles OR 97058

In Cooperation With:

Blue Mountain Environmental Consulting Inc.
125 Main Street
Waitsburg WA 99361

Prepared by:

GeoPro LLC
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APPENDICES

1 INTRODUCTION

1.1 SCOPE AND PURPOSE

This report presents the results of the 2020 annual groundwater monitoring and evaluation following closure of the former Columbia Gorge Aluminum Smelter West Surface Impoundment (WSI). Statistical evaluation of the groundwater monitoring data was conducted to evaluate natural attenuation in the concentration of groundwater contaminates. This monitoring and statistical evaluation was conducted in accordance with the Groundwater Sampling Data Analysis and Evaluation Plan (GSDAEP) for the WSI facility (Parametrix 2004b). Groundwater sampling was performed on June 20, 2020 by GeoPro LLC, Battle Ground, Washington.

1.2 SITE DESCRIPTION

The approximately 10-acre WSI was constructed as an earthen impoundment with Hypalon liner in 1981. It was used through 2001 to dispose of various types of waste generated from plant pollution controls. A map of the location is shown in Figure 1.

The WSI contains approximately 89,000 cubic yards of sludge comprised primarily of alumina, dust, and particulates from wastewater and residual waste generated by plant emission control systems. The WSI managed waste through evaporation of wastewater and disposal of emission control sludge (DOE 2014). The WSI discontinued accepting waste and was closed in September 2004 (Parametrix 2004a). Closure of the WSI included placement of an engineered RCRA cap consisting of soil and geosynthetic materials and development of a post-closure maintenance and groundwater monitoring plan (Parametrix 2004b).

1.3 HYDROGEOLOGIC SETTING

The geologic materials present beneath the WSI consist of unconsolidated alluvial deposits of Quaternary age, underlain by a series of basalt flows and sedimentary interbeds of the Columbia River Basalt Group (CH2M Hill 1995; Golder 1989). The groundwater gradient flattens beneath the WSI; south of the WSI, groundwater flows southwestward toward the Columbia River. The following aquifer zones have been defined for the Smelter Site in the Remedial Investigation Report.

- Unconsolidated Aquifer (UA) – shallow water bearing zone in the colluvium, alluvium, and fill that overlies the basalt bedrock in most areas. The unit is thicker and more laterally extensive on the western side of the Site. Groundwater occurring locally within the upper 2-3 feet of weathered and fractured basalt bedrock is part of the UA.
- Basalt Aquifer Upper zone (BAU) – occurs within the basalt flow sequence commonly beneath a flow interior within a flow top.
- Basalt Aquifer Lower Zone (BAL) – includes saturated zones beneath BAU near the Columbia River elevation to the bottom elevation of the John Day Dam reservoir.

1.4 PREVIOUS GROUNDWATER MONITORING

The current monitoring network at the site consists of sixteen monitoring wells, including some shallow and deep well clusters. The initial monitoring wells were installed in 1984, and another set of wells were installed in 1989. An additional monitoring well, MW-18, was installed near the downgradient property boundary, about 2,500-feet from the WSI, in October 2004.

Sampling and analysis of groundwater has been conducted since 1984, and followed a quarterly schedule between 1991 and 2004. One additional pre-closure sampling event was conducted in September 2004 for the five wells included in the post- closure monitoring plan to establish groundwater quality before the wells could be affected by subsurface disturbances from WSI closure construction. Post-closure sampling and analysis was conducted quarterly from 2005-2007, semiannually from 2008-2010, and annually beginning in 2011. Previous samples were analyzed for pH, conductivity, total organic carbon, sulfate, fluoride, chloride, sodium, iron, manganese, free cyanide, total cyanide, and total phenols. Sulfate and fluoride were determined to be representative indicator parameters for the WSI wastes, since sulfate concentrations show direct response to periods of waste discharge into the pond. Pre-closure maximum sulfate concentrations were observed in 2000 and 2001 (Parametrix 2004a).

2 GROUNDWATER INVESTIGATION

The post-closure monitoring investigation was described in the GSDAEP (Parametrix 2004b) and is summarized in this section.

2.1 MONITORING WELL LOCATIONS

The post-closure monitoring well locations include the following upgradient and downgradient wells:

- Upgradient well: MW-8A
- Downgradient wells near WSI: MW-10A, MW-12A, and MW-14A
- Downgradient wells farther from WSI: MW-3B and MW-18

The aquifer in which each well is screened will be determined as part of implementing the Remedial Investigation work plan pursuant to the Agreed Order (DOE 2014). Monitoring well construction details are shown below in Table 1. Monitor well 12A has been dry except for the March 13, 2007 sampling event. Well locations are shown on Figure 2.

Table 1. Monitoring Well Construction Data

Well Number	Installed	Total Well Depth (ft bgs)	Well Screen Interval (ft bgs)	PVC Casing Diameter (inches)	Ground Surface Elevation (ft)	Top of PVC Elevation (ft)	Location
MW-8A	May 1989	41	22-32	4	490	492.97	Upgradient
MW-3B	April 1984	51	46-51	4	408	410.90	Downgradient
MW-10A	April 1989	26	13-25.5	4	425	427.95	Downgradient
MW-12A	May 1989	55	40-54	4	439	441.38	Downgradient
MW-14A	May 1989	30.5	8.5-29.5	4	429	431.65	Downgradient
MW-18	October 2004	51	35-50	4	346	348.40	Downgradient
Notes: bgs = below ground surface; elevations from Parametrix (2004b)							

2.2 SAMPLING PROCEDURES

Samples were collected on June 20, 2020 by GeoPro LLC using a submersible pump. Sampling collection procedures are summarized below.

- The static water level was measured prior to sampling.
- Each monitor well was purged of stagnant water in the casing and filter by slowly setting the pump within the approximate middle of the screened interval or slightly above the middle until the temperature, conductivity and pH stabilized.
- Samples were collected by setting the pump within the approximate middle of the screened interval with a low flow pumping rate.
- Water samples were placed in appropriate containers prepared by the laboratory. The containers were filled to prevent air-entrapment, sealed, labeled, and placed in an ice chest at approximately 4°C for transport to OnSite Laboratory. The samples were accompanied by a completed and signed chain-of-custody form. The samples were submitted by OnSite to AmTest laboratory for cyanide analysis.

2.3 SAMPLE ANALYSES

Laboratory reports from Onsite Environmental, Inc., Redmond, Washington for analysis of the groundwater samples were completed on June 26-30, 2020. The laboratory reports are included in Appendix A2.

2.4 MONITORING SCHEDULE

Groundwater sampling follows the schedule outlined in the post-closure plan (Parametric 2007c). Beginning in 2005, the plan specified quarterly sampling for the first two years, semiannually for years 3 through 7, and annual sampling thereafter until

concentrations drop below groundwater protection standards, or for a maximum of 30 years. One semiannual sampling event was not completed in 2011.

2.5 DATA EVALUATION

The statistical approach for evaluating the post-closure groundwater monitoring data collected at the WSI is described in the GSDAEP (Parametrix 2004b). The objectives of the post-closure data evaluation for the WSI are to demonstrate the effectiveness of the correction action, that is, evaluate whether groundwater quality is improving, deteriorating, or remaining unchanged relative to pre-closure conditions, and to determine compliance with the groundwater protection standards. The data evaluation schedule is summarized below in Table 2.

Table 2. Data Evaluation Schedule for WSI

Frequency of Evaluation	Statistical Procedure	Purpose
Quarterly or semiannually Years 1-7	Time-series plots	Visually identify increasing or decreasing trends in concentrations
Annually After Year 7	Trend analyses using Mann-Kendall test	Quantitatively identify increasing or decreasing trends in concentrations
	Upper Confidence Limit Evaluation	Compare concentrations to the groundwater protection standards
	Time-series plots	Visually identify increasing or decreasing trends in concentrations

Groundwater protection standards are MTCA[1] Method B cleanup standards and Maximum Contaminant Levels (MCLs). The groundwater protection standards for these parameters are presented in the following Table 3.

Table 3. Groundwater Protection Standards for WSI

Parameter	MTCA B Cleanup Level (mg/L)	MCL (mg/L)	
		Primary	Secondary
Fluoride	0.96	4	2
Chloride	-	-	250
Sulfate	-	-	250
Total Cyanide	0.32	0.2	-

The analysis for total cyanide is to be discontinued if not detected for four consecutive sampling events.

The GSDAEP (Parametrix 2004b) also recommended using Upper Prediction Limit (UPL) comparisons to evaluate post-closure data. However, EPA guidance (EPA 2004) does not recommend that UPL comparisons be used for sites such as WSI with pre-existing contamination.

[1] State of Washington Department of Ecology Model Toxics Control Act, Cleanup Regulations, Chapter 173-340 WAC, as revised.

Three years of quarterly data (2005-2007), three years of semiannual data (2008-2010), and ten years of annual data (2011-2020) from ground water sampling were used for analysis evaluation (see Appendix A1). The concentrations of fluoride, chloride, sulfate, and total cyanide in each well were evaluated and prepared to satisfy the quarterly and semiannual requirements. The time-series plots, Mann-Kendall test and UCL comparisons were conducted to satisfy the annual evaluation requirements. With approval from Paul Skyllingstad, DOE (personal communication, June 28, 2012) both the Washington Department of Ecology UCL calculator and the Environmental Protection Agency ProUCL calculator were used to calculate UCLs for the data.

Time-series plots were created using the Microsoft Excel graphing functions. The Mann-Kendall test was conducted using the EPA's ProUCL calculator. ProUCL did not directly create all the statistical outputs needed for the Mann-Kendall analysis. VAR(S) was computed using equation (1), Z was computed using equation (2), and probability was computed using Table A.21 (Hollander and Wolfe, 1973).

(1) Standard Deviation of S = $\sqrt{\text{VAR}(S)}$

(2) $$Z = \frac{|S|-1}{\sqrt{VAR(S)}}$$

The Washington DOE UCL (DOE, 2012) calculator was used to calculate the 95 percent UCL for normal and lognormal datasets as well as the mean, minimum value, and maximum value for each dataset. For datasets that were neither normal nor lognormal, the UCL was calculated using the EPA's ProUCL Calculator (ProUCL, 2012). The datasets evaluated using ProUCL were sulfate in MW-8A and MW-10A, chloride in MW-10A, and cyanide in MW-10A. Raw calculations for the DOE and EPA ProUCL calculators are presented in Appendix B.

3 RESULTS

3.1 SUMMARY

Post-closure data has been collected during 12 quarterly events between February 2005 and November 2007, 6 semiannual events between May 2008 and October 2010, and 10 annual events in July 2011, April 2012, June 2013, April 2014, July 2015, August 2016, August 2017, July 2018, July 2019, and June 2020. The post-closure data are summarized in Appendix A1 and individual results that exceed the groundwater protection level are highlighted.

3.2 STATISTICAL EVALUATION

3.2.1 Time-Series Plots

During the post-closure period beginning in February 2005 groundwater samples were analyzed for sulfate, fluoride, chloride, and total cyanide. Time-series plots of data collected since 2005 are presented in Appendix B1. For the time-series non-detected data, points were plotted using one half of the laboratory practical quantitative limit.

The time-series plots indicate the following trends since closing of the WSI in 2004 and compared to the prior year concentrations.

Sulfate

The sulfate concentrations are relatively steady in all wells except MW-10A. The sulfate concentrations slightly increased in all wells during this sampling event with concentrations in MW-10A showing the highest increasing trend. The sulfate concentrations remain above the groundwater protection standard of 250 mg/L except in upgradient well MW-8A which remains below the standard.

Fluoride

Fluoride concentrations are relatively steady in all wells except MW-10A and MW-14A in which the concentrations have been slightly increasing. The fluoride concentrations remain below the groundwater protection standard of 0.96 mg/L except in wells MW-10A and MW-14A in which fluoride concentrations continue to be above the standard.

Chloride

Chloride concentrations are relatively steady or decreasing in all wells during this sampling event. None of the chloride concentrations in any well have exceeded the groundwater protection standard of 250 mg/L.

Total Cyanide

Total cyanide continues to be detected in downgradient well MW-14A but below the standard of 0.2 mg/L.

3.2.2 Mann-Kendall Test

The Mann-Kendall test (Gilbert, 1987; Hollander and Wolfe, 1973) was used to evaluate temporal trends in the concentrations of analytes. The nonparametric Mann-Kendall test evaluates the direction and significance of trends in the data at the 95 percent UCL. The GWSDAEP specified that Sen's slope tests were to be used to evaluate trends in the data, but have not been used because they provide similar information to the Mann-Kendall test and are less conservative, since they evaluate the significance of the data at the 90 percent UCL.

The Mann-Kendall test was conducted using the post-closure data. Results of the Mann-Kendall tests are presented in Appendix B2 and summarized in Table 4.

Table 4. Post-Closure Significant Trends Using the Mann-Kendall Test

Well	Sulfate	Fluoride	Chloride	Total Cyanide
Upgradient				
MW-8A	-	↓	↓	-
Downgradient				
MW-3B	-	↓	↓	-
MW-10A	↑	+	↑	↓
MW-12A	n/a	n/a	n/a	n/a
MW-14A	↓	↓	↓	↓
MW-18	-	↓	↓	+

Table 4 Notes:

↑ Significant Increasing Trend

↓ Significant Decreasing Trend

\- Negative Trend

\+ Positive Trend

n/a Trend could not be calculated: only one data point available because the well is dry

The Mann-Kendall Trend test results indicate the following:

- Sulfate levels are significantly increasing in downgradient well MW-10A, and are significantly decreasing in downgradient well MW-14A.
- Fluoride levels are significantly decreasing in upgradient well MW-8A and downgradient wells MW-3B, MW-14A, and MW-18.
- Chloride levels are significantly increasing in downgradient well MW-10A and are significantly decreasing in upgradient well MW-8A and downgradient wells MW-3B, MW-14A, and MW-18.
- Total cyanide levels are significantly decreasing in the downgradient wells MW-10A and MW-14A.

3.2.3 Upper Confidence Limits

The primary tool cited in MTCA (WAC 173-340-720[9]) for assessing whether data exceeds established cleanup levels is by comparing data to UCLs calculated on the mean. The UCL for each parameter at each well was calculated using the post-closure data, and the calculated UCL was compared to the MTCA cleanup level and MCL for each analyte to assess whether groundwater protection standards are being met. The results of the UCL comparisons are presented in Appendix B and summarized in Table 5.

Table 5. Upper Confidence Limits of Post-Closure Groundwater Data

	Upper Confidence Limit (mg/L)			
	Sulfate	**Chloride**	**Fluoride**	**Total Cyanide**
Lowest Groundwater Protection Standard (mg/L)	250	250	0.96	0.2
Upgradient				
MW-8A	9.10	4.40	0.58	0.01
Downgradient				
MW-3B	**2205.04**	106.84	**2.07**	0.01
MW-10A	**2278.15**	68.04	**3.49**	0.03
MW-12A[1]	**1800**	150	**6.3**	0.01
MW-14A	**3709.62**	105.85	**18.4**	0.10
MW-18	**1478.15**	81.22	**2.54**	0.01

Table 5 Notes:
[1] No UCL calculated. Well was dry during most sampling events.
Bold indicates UCL exceeds lowest groundwater protection standard.

All the sampled wells downgradient of the WSI have post-closure UCL concentrations above the groundwater protection standards for sulfate and fluoride and below the groundwater protection standard for chloride and total cyanide. Upgradient well MW-8A has a UCL below the groundwater protection standard for sulfate, chloride fluoride and total cyanide.

3.3 GROUNDWATER FLOW

Groundwater elevations were measured once during 2004, quarterly between 2005 and 2007, semiannually between 2008 and 2010, and annually during 2011 through 2020 in the five sampled wells. The groundwater elevation data and a hydrograph showing changes in groundwater elevation during post-closure are presented in Appendix C. A groundwater elevation contour map was prepared using groundwater levels measured in July 2020 and is provided in Figure 3. Groundwater flow is consistent with historical data and the overall flow direction downgradient from the WSI is toward the southwest.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The following is concluded based on the July 2020 groundwater sampling results, trends, and statistical evaluation of historic data.

- Sulfate and fluoride concentrations in two downgradient wells, based on the calculated UCLs, are above groundwater protection standards. Sulfate and fluoride in the upgradient well are below groundwater protection standards.
- Sulfate concentration is significantly increasing in downgradient well MW-10A.
- Sulfate concentration is significantly decreasing in downgradient well MW-14A.
- Fluoride concentrations are significantly decreasing in all wells except downgradient well MW-10A.
- Chloride concentrations remain below groundwater protection standards, based on calculated UCLs, since the last reporting period. A significant increasing trend in chloride concentration continues in downgradient well MW-10A. There are significant decreasing trends for chloride concentration in upgradient well MW-8A and downgradient wells MW-3B, MW-14A, and MW-18.
- Total cyanide concentrations are below groundwater protection standards, based on calculated UCLs, since the last reporting period. A significant decreasing trend continues since the last reporting period for total cyanide in downgradient wells MW-10A and MW-14A.

4.2 RECOMMENDATIONS

Post-closure fluoride and sulfate concentrations are lower than pre-closure concentrations. However, the lack of significant reduction in their concentrations during the post-closure period may indicate that the WSI is continuing to contribute these contaminates to groundwater. Continued sampling and data evaluation will be required to determine whether the concentrations of fluoride and sulfate decrease below the lowest groundwater protection standards.

As specified in the GSDAEP, the WSI groundwater monitoring frequency is on an annual basis. Also specified, future annual reports will continue to include time-series plots, Mann-Kendall tests for trend and a comparison of the UCLs of the most recent sampling data to groundwater protection standards.

5 REFERENCES

CH2M Hill, 1995, West Surface Impoundment Closure and Postclosure Plan. Prepared for Goldendale Aluminum, February 1995.

DOE, 2012, State of Washington Department of Ecology 6/11/2012 http://www.ecy.wa.gov/programs/tcp/tools/SITE97.XLT.

DOE, 2014, Agreed Order No. DE 10483 Columbia Gorge Aluminum Smelter, Effective May 1, 2014.

GeoPro LLC, 2012, Semi-Annual Groundwater Monitoring Report, West Surface Impoundment, Former Goldendale Aluminum Smelter.

GeoPro LLC, 2013 Through 2019, Annual Groundwater Monitoring Reports, West Surface Impoundment, Former Goldendale Aluminum Smelter.

Gibbons, R.D., 1994, Statistical Methods for Ground Water Monitoring. John Wiley and Sons.

Gilbert, R.O., 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York.

Golder Associates, Inc., 1989, Groundwater Monitoring Well Installation, West Surface Impoundment, Golden Northwest Aluminum, Interim Report.

Hollander and Wolfe, 1973, Nonparametric Statistical Methods, John Wiley and Sons.

Parametrix, Inc., 2004a, Goldendale Aluminum West Surface Impoundment Closure.

Parametrix, Inc., 2004b, Groundwater Sampling Data Analysis and Evaluation Plan for Goldendale Aluminum West Surface Impoundment Facility.

Parametrix, Inc., 2004c, WSI Closure and Post Closure Plan.

Parametrix, Inc., 2005, Groundwater Sampling Data Analysis and Evaluation Plan for Goldendale Aluminum West Surface Impoundment Facility, February 2005 Revision to November 2004 Document.

Parametrix, Inc., 2007, Two-Year Post-Closure Groundwater Evaluation, Goldendale Aluminum West Surface Impoundment Facility, September 2007.

Paul Skyllingstad, WA DOE, Personal Communication, June 28, 2012.

ProUCL 7/12/11 U.S. Environmental Protection Agency 6/11/2012: http://www.epa.gov/osp/hstl/tsc/setup_v41.zip

6 LIMITATIONS

This report has been prepared for use by the landowner and is not intended for use by others except the landowner(s), landowner's agents and appropriate government agencies. All others should contact GeoPro LLC before applying or interpreting any information in this report. Each project and project site is unique and the information contained in this report is not applicable to other sites. This report has been prepared pursuant to a post-closure work plan prepared by others and the work plan approved by the State of Washington Department of Ecology.

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Conclusions and findings apply only to present conditions, and opinions expressed are subject to revision when additional or new information is presented and reviewed. This warranty is in lieu of all other warranties, either expressed or implied. It is possible that explorations failed to reveal the presence of hazardous materials at areas where hazardous materials were assumed, suspected or expected to exist (hazardous as used herein shall also mean contaminated and polluted). Through use of this report it is understand that failure to sample soil or water, or install groundwater monitor wells at locations through appropriate and mutually agreed-upon techniques does not guarantee that hazardous materials have, or will be, detected at such locations. Similarly, areas which in fact are unaffected by hazardous materials at the time of this report, may later, due to natural causes or human intervention, become contaminated. GeoPro LLC is not responsible for failing to locate hazardous materials which have not been discovered at the time of this report or in the future. In the event of changes in future development plans as understood at the time of this report, the conclusions and recommendations made herein shall be invalid until GeoPro LLC is given the opportunity to review and modify this report in writing. Portions of an Agreement to perform professional services may or may not be disclosed in this report.

Respectfully submitted,

Richard C. Kent, L.G.

GeoPro LLC

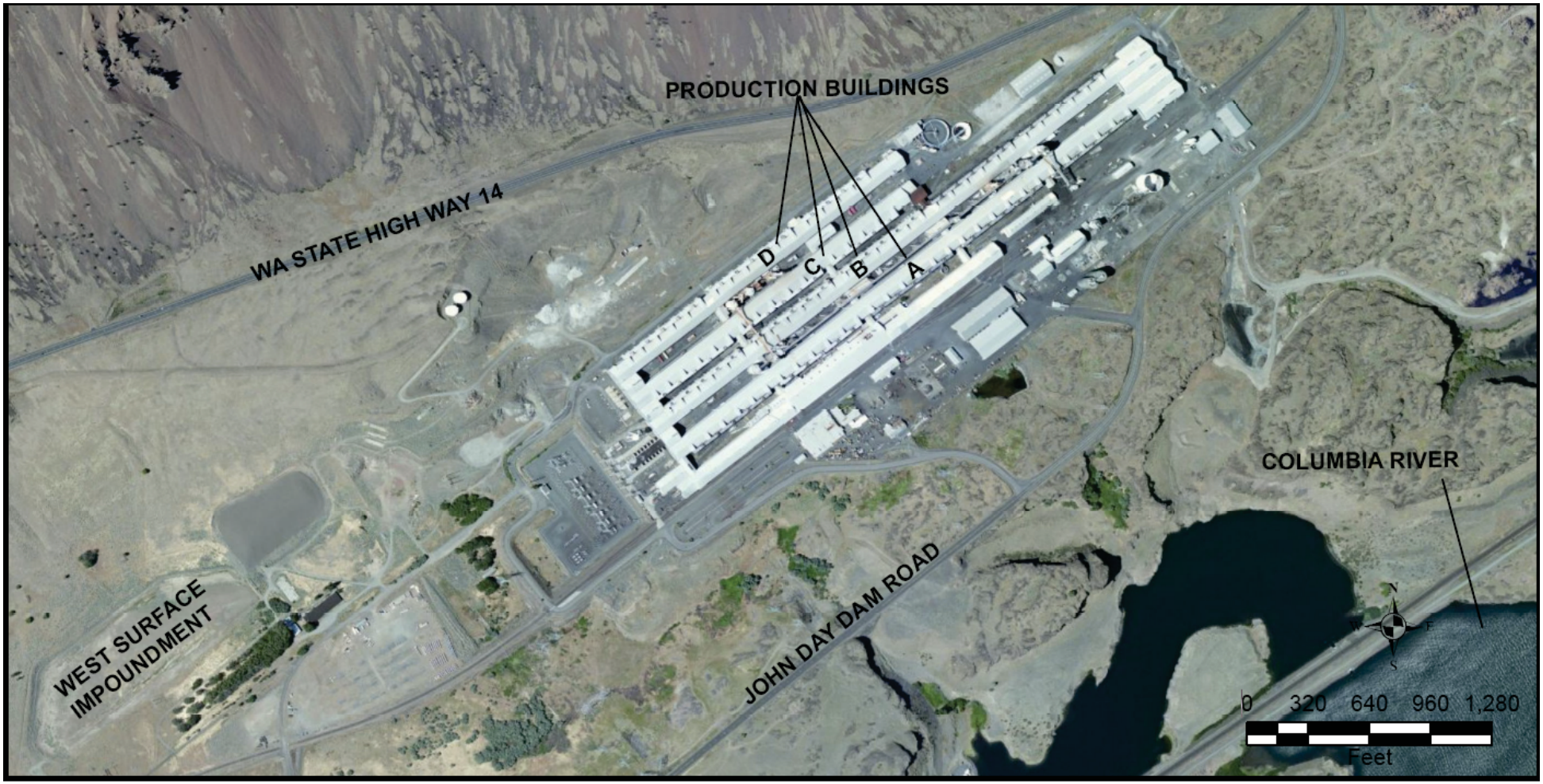


FIGURE 1

LOCATION MAP

Columbia Gorge Aluminum Corporation
Former Columbia Gorge Aluminum Smelter
Goldendale, Washington

GeoPro LLC
PO Box 26
Battle Ground, WA 98604

June 2020

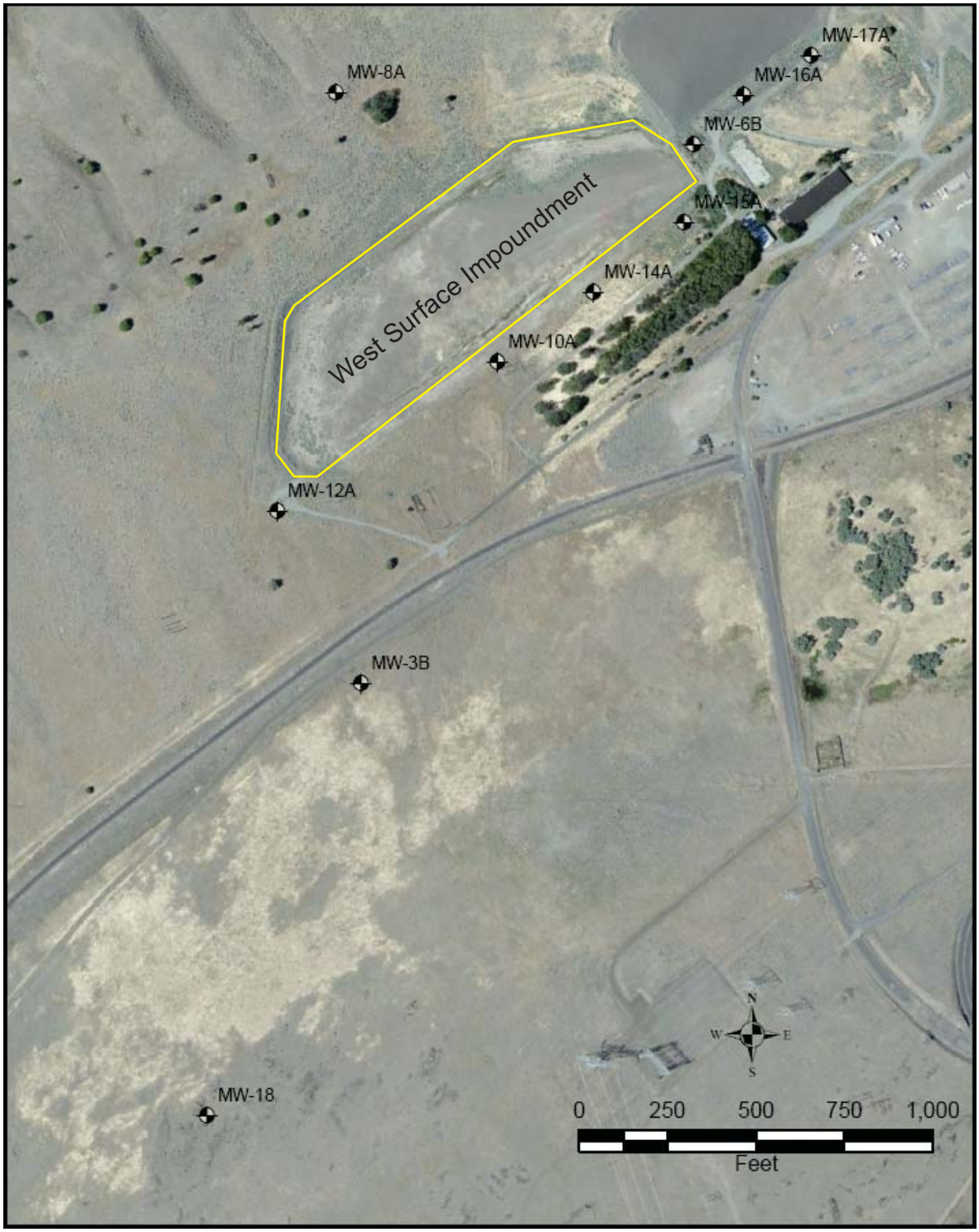


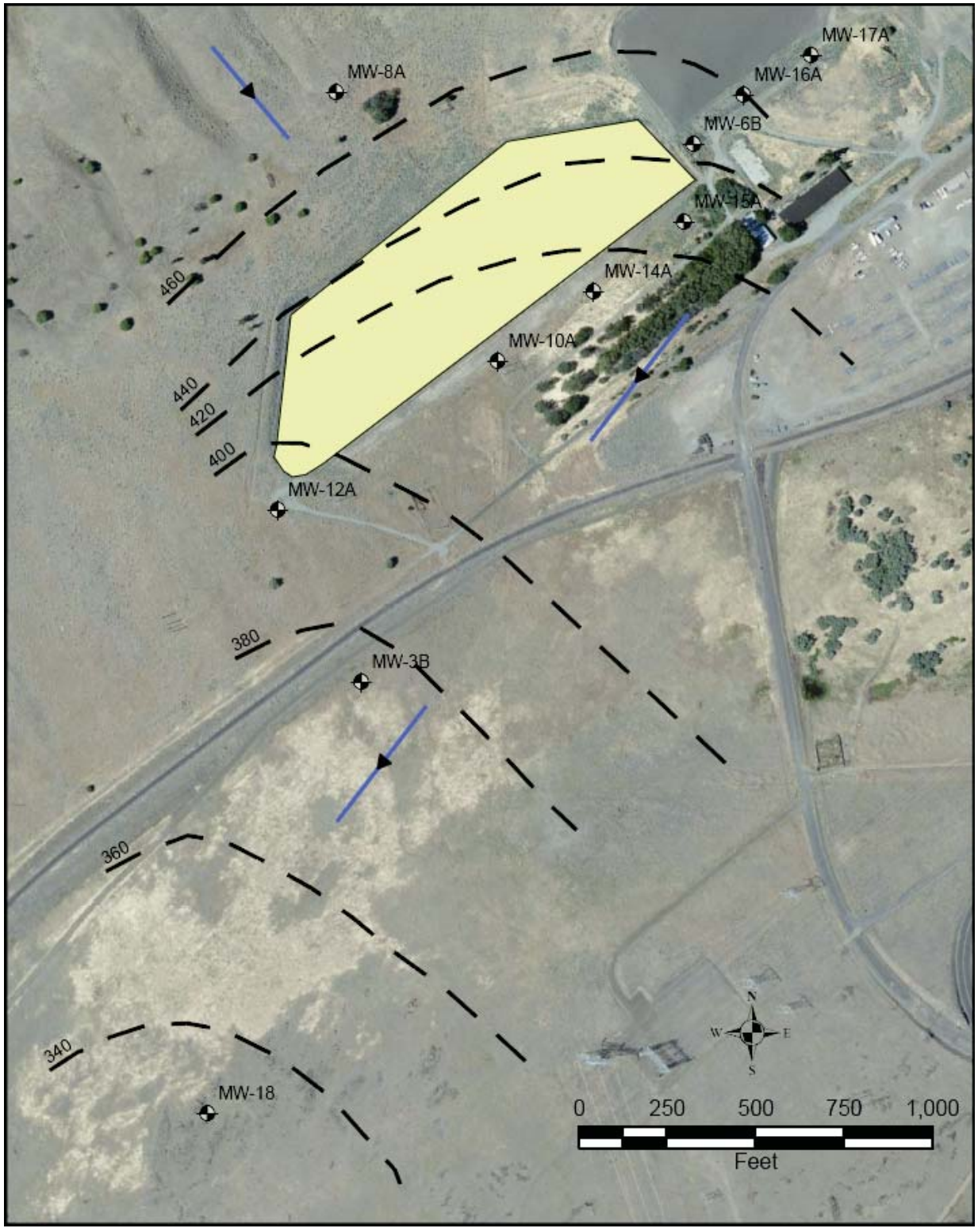
FIGURE 2

WEST SURFACE IMPOUNDMENT GROUNDWATER MONITOR WELLS LOCATION MAP

Columbia Gorge Aluminum Corporation
Former Columbia Gorge Aluminum Smelter
Goldendale, Washington

GeoPro LLC
PO Box 26
Battle Ground, WA 98604

June 2920



contour interval 20 feet
contours in feet MSL

flow direction

FIGURE 3

WEST SURFACE IMPOUNDMENT GROUNDWATER CONTOUR MAP

Columbia Gorge Aluminum Corporation
Former Columbia Gorge Aluminum Smelter
Goldendale, Washington

GeoPro LLC
PO Box 26
Battle Ground, WA 98604

June 2020

APPENDICES

Appendix A – Groundwater Analyses

Appendix A1
Analyses Summary Table

Analyses Summary Table (mg/L): page 1 of 2

	Upgradient Well MW-8A				**Downgradient Well MW-3B**				**Downgradient Well MW-10A**			
	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)
Lowest Groundwater Protection Standard	250	0.96	250	0.2	250	0.96	250	0.2	250	0.96	250	0.2
Sample Date												
2/16/2005	10	0.9	5.6	<0.01	2300	0.6	130	<0.01	940	1.8	29	0.04
5/11/2005	9.8	0.3	4.6	<0.01	2500	0.4	140	<0.01	910	1.5	31	0.05
8/29/2005	8.9	0.4	4.2	<0.01	2700	0.6	120	<0.01	670	1.2	28	0.04
11/1/2005	9.6	0.9	4.7	<0.01	2600	0.9	130	<0.01	670	2.7	28	0.03
2/27/2006	9.27	2.8	4.2	<0.01	2610	0.7	118	<0.01	1570	2.3	43	0.03
6/5/2006	9.8	0.2	4.9	<0.05	2220	0.2	113	<0.01	1650	3.2	48	0.03
7/31/2006	9.8	0.1	4.6	<0.01	2000	3.7	110	<0.01	860	2.3	35	0.08
10/9/2006	9.7	<0.2	4.5	<0.01	2500	3.8	110	<0.01	850	1.9	30	0.03
3/13/2007	10	<0.1	6.6	<0.01	2500	3.8	110	<0.01	1100	3.4	45	0.04
6/22/2007	1	<10	4.89	<0.01	2500	<10	97	<0.01	1100	<10	36	<0.01
9/24/2007	10	<1	4.2	<0.01	2200	<1	124.79	<0.01	760	1.2	30	0.04
11/14/2007	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.043
5/8/2008	10	<1	4	<0.01	2200	<50	100	<0.01	2700	<50	100	0.05
10/14/2008	10	0.1	4.5	<0.01	2600	<10	100	<0.01	860	<10	30	0.04
5/29/2009	9	<1	3	<0.02	2200	<1	96	<0.02	2000	2	68	0.03
10/27/2009	10	<1	5.5	<0.02	2606	<1	110	<0.02	760	<1	79	<0.02
5/26/2010	9.3	<1	4.4	<0.02	2300	2.3	120	<0.02	2200	4.4	83	0.032
10/6/2010	8.9	<1	3.6	<0.02	2400	<1	110	<0.02	710	1	23	0.022
7/26/2011	7.8	<1	3.6	<0.02	2000	<1	98	<0.02	1800	3.3	62	0.028
4/19/2012	10	0.18	3.8	<0.005	2200	0.16	90	<0.005	5800	1.9	180	0.007
6/20/2013	9.4	0.16	4.8	<0.005	1900	0.16	91	0.006	4700	3.1	99	0.008
4/25/2014	9.5	0.19	4.9	<0.005	2000	0.18	91	<0.006	6100	2	190	<0.005
7/20/2015	9.5	0.16	4.2	<0.005	1900	0.14	80	<0.005	1900	2	58	<0.005
8/2/2016	9.3	0.13	4.1	<0.005	1900	0.12	98	<0.005	3500	2.1	82	<0.005
8/9/2017	9.6	0.15	4.1	<0.005	1700	0.15	95	0.01	2900	3.2	170	<0.005
7/26/2018	9.5	0.15	3.2	<0.005	1800	0.16	95	<0.005	4800	4.1	71	<0.005
7/24/2019	5.4	0.14	4.1	<0.005	1500	0.15	93	<0.005	4000	3.7	82	<0.006
6/20/2020	11	0.16	3.9	<0.005	1700	0.14	88	<0.005	5700	4.4	77	<0.006

Analyses Summary Table (mg/L): page 2 of 2

	Downgradient Well MW-12A				Downgradient Well MW-14A				Downgradient Well MW-18			
	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)
Lowest Groundwater Protection Standard	250	0.96	250	0.2	250	0.96	250	0.2	250	0.96	250	0.2
Sample Date												
2/16/2005	Dry	Dry	Dry	Dry	4000	9.6	110	0.35	1500	0.6	86	<0.01
5/11/2005	Dry	Dry	Dry	Dry	3500	8.6	90	0.24	1300	0.4	91	<0.01
8/29/2005	Dry	Dry	Dry	Dry	3600	30	71	0.27	1500	0.4	75	<0.01
11/1/2005	Dry	Dry	Dry	Dry	2800	25	75	0.19	1300	1.8	84	<0.01
2/27/2006	Dry	Dry	Dry	Dry	2170	31	53	0.19	1520	0.9	83	<0.01
6/5/2006	Dry	Dry	Dry	Dry	2380	27	63	0.2	1490	0.2	91	<0.01
7/31/2006	Dry	Dry	Dry	Dry	3300	30	98	0.17	1500	2.6	89	<0.01
10/9/2006	Dry	Dry	Dry	Dry	3900	24	130	0.01	1600	2.4	80	<0.01
3/13/2007	1800	6.3	150	<0.01	4400	16	140	0.12	1600	2.6	93	<0.01
6/22/2007	Dry	Dry	Dry	Dry	7900	19	170	<0.01	1700	<1	77	<0.01
9/24/2007	Dry	Dry	Dry	Dry	6400	<50	200	0.03	1400	<50	100	<0.01
11/14/2007	Dry	Dry	Dry	Dry	-	-	-	<0.01	-	-	-	<0.01
5/8/2008	Dry	Dry	Dry	Dry	5500	<50	100	0.19	1300	<50	70	<0.01
10/14/2008	Dry	Dry	Dry	Dry	6500	20	180	0.12	1600	<1	80	<0.01
5/29/2009	Dry	Dry	Dry	Dry	7000	30	210	0.14	1500	1	81	<0.01
10/27/2009	Dry	Dry	Dry	Dry	5900	24	160	0.044	1200	<1	70	<0.01
5/26/2010	Dry	Dry	Dry	Dry	5200	32	170	0.14	1500	2	100	<0.02
10/6/2010	Dry	Dry	Dry	Dry	4000	18	120	0.086	1600	<1	84	<0.02
7/26/2011	Dry	Dry	Dry	Dry	3900	23	130	0.066	1600	<1	89	<0.02
4/19/2012	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	1700	0.2	79	<0.005
6/20/2013	Dry	Dry	Dry	Dry	2300	17	66	0.028	1500	0.13	84	<0.005
4/25/2014	Dry	Dry	Dry	Dry	2100	18	61	0.037	1700	0.12	79	<0.005
7/20/2015	Dry	Dry	Dry	Dry	1100	6.8	47	0.008	1300	0.11	86	<0.005
8/2/2016	Dry	Dry	Dry	Dry	1400	3.5	61	0.019	1700	0.12	79	<0.005
8/9/2017	Dry	Dry	Dry	Dry	1700	2.5	68	0.017	1300	0.11	59	0.086
7/26/2018	Dry	Dry	Dry	Dry	1800	3.6	66	<0.005	1400	0.11	69	<0.005
7/24/2019	Dry	Dry	Dry	Dry	1700	2.8	64	0.018	1200	0.12	68	<0.005
6/20/2020	Dry	Dry	Dry	Dry	2000	7	49	0.018	1400	0.13	67	<0.005

Appendix A2
Laboratory Report

OnSite Environmental Inc.
14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

July 2, 2020

Richard Kent
GeoPro, LLC
611 NW 5th Avenue
Battle Ground, WA 98604

Re: Analytical Data for Project 160802
Laboratory Reference No. 2006-256

Dear Richard:

Enclosed are the analytical results and associated quality control data for samples submitted on June 23, 2020.

The standard policy of OnSite Environmental, Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

Case Narrative

Samples were collected on June 20, 2020 and received by the laboratory on June 23, 2020. They were maintained at the laboratory at a temperature of 2^{o}C to 6^{o}C.

Please note that any and all soil sample results are reported on a dry-weight basis, unless otherwise noted below.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

FLUORIDE
SM 4500-F C

Matrix: Water
Units: mg F- /L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**MW-8A-2020**					
Laboratory ID:	06-256-01					
Fluoride	**0.16**	0.020	SM 4500-F C	6-30-20	6-30-20	
Client ID:	**MW-14A-2020**					
Laboratory ID:	06-256-02					
Fluoride	**7.0**	0.20	SM 4500-F C	6-30-20	6-30-20	
Client ID:	**MW-10A-2020**					
Laboratory ID:	06-256-03					
Fluoride	**4.4**	0.20	SM 4500-F C	6-30-20	6-30-20	
Client ID:	**MW-10A-D-2020**					
Laboratory ID:	06-256-04					
Fluoride	**4.6**	0.20	SM 4500-F C	6-30-20	6-30-20	
Client ID:	**MW-3B-2020**					
Laboratory ID:	06-256-05					
Fluoride	**0.14**	0.020	SM 4500-F C	6-30-20	6-30-20	
Client ID:	**MW-18-2020**					
Laboratory ID:	06-256-06					
Fluoride	**0.13**	0.020	SM 4500-F C	6-30-20	6-30-20	

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

FLUORIDE
SM 4500-F C
QUALITY CONTROL

Matrix: Water
Units: mg F- /L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0630W1					
Fluoride	**ND**	0.020	SM 4500-F C	6-30-20	6-30-20	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	06-256-05								
	ORIG	DUP							
Fluoride	**0.142**	**0.149**	NA	NA	NA	NA	5	15	
MATRIX SPIKE									
Laboratory ID:	06-256-05								
	MS		MS		MS				
Fluoride	**0.633**		0.500	0.142	98	55-143	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB0630W1								
	SB		SB		SB				
Fluoride	**0.446**		0.500	NA	89	77-110	NA	NA	

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

SULFATE
ASTM D516-11

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**MW-8A-2020**					
Laboratory ID:	06-256-01					
Sulfate	**11**	5.0	ASTM D516-11	6-26-20	6-26-20	
Client ID:	**MW-14A-2020**					
Laboratory ID:	06-256-02					
Sulfate	**2000**	1000	ASTM D516-11	6-26-20	6-26-20	
Client ID:	**MW-10A-2020**					
Laboratory ID:	06-256-03					
Sulfate	**5700**	2000	ASTM D516-11	6-26-20	6-26-20	
Client ID:	**MW-10A-D-2020**					
Laboratory ID:	06-256-04					
Sulfate	**5800**	2000	ASTM D516-11	6-26-20	6-26-20	
Client ID:	**MW-3B-2020**					
Laboratory ID:	06-256-05					
Sulfate	**1700**	1000	ASTM D516-11	6-26-20	6-26-20	
Client ID:	**MW-18-2020**					
Laboratory ID:	06-256-06					
Sulfate	**1400**	1000	ASTM D516-11	6-26-20	6-26-20	

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

SULFATE
ASTM D516-11
QUALITY CONTROL

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0626W1					
Sulfate	**ND**	5.0	ASTM D516-11	6-26-20	6-26-20	

Analyte	Result	Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE								
Laboratory ID:	06-256-01							
	ORIG DUP							
Sulfate	**10.5** **10.5**	NA	NA	NA	NA	0	11	
MATRIX SPIKE								
Laboratory ID:	06-256-01							
	MS	MS		MS				
Sulfate	**19.4**	10.0	10.5	89	61-148	NA	NA	
SPIKE BLANK								
Laboratory ID:	SB0626W1							
	SB	SB		SB				
Sulfate	**9.94**	10.0	NA	99	86-116	NA	NA	

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

CHLORIDE
SM 4500-Cl E

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**MW-8A-2020**					
Laboratory ID:	06-256-01					
Chloride	**3.9**	2.0	SM 4500-Cl E	6-29-20	6-29-20	
Client ID:	**MW-14A-2020**					
Laboratory ID:	06-256-02					
Chloride	**49**	2.0	SM 4500-Cl E	6-29-20	6-29-20	
Client ID:	**MW-10A-2020**					
Laboratory ID:	06-256-03					
Chloride	**77**	2.0	SM 4500-Cl E	6-29-20	6-29-20	
Client ID:	**MW-10A-D-2020**					
Laboratory ID:	06-256-04					
Chloride	**77**	2.0	SM 4500-Cl E	6-29-20	6-29-20	
Client ID:	**MW-3B-2020**					
Laboratory ID:	06-256-05					
Chloride	**88**	2.0	SM 4500-Cl E	6-29-20	6-29-20	
Client ID:	**MW-18-2020**					
Laboratory ID:	06-256-06					
Chloride	**67**	2.0	SM 4500-Cl E	6-29-20	6-29-20	

Date of Report: July 2, 2020
Samples Submitted: June 23, 2020
Laboratory Reference: 2006-256
Project: 160802

CHLORIDE
SM 4500-Cl E
QUALITY CONTROL

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB0629W1					
Chloride	**ND**	2.0	SM 4500-Cl E	6-29-20	6-29-20	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	06-256-01								
	ORIG	DUP							
Chloride	**3.94**	**3.62**	NA	NA	NA	NA	8	14	
MATRIX SPIKE									
Laboratory ID:	06-256-01								
	MS		MS		MS				
Chloride	**53.2**		50.0	3.94	99	86-110	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB0629W1								
	SB		SB		SB				
Chloride	**48.0**		50.0	NA	96	86-110	NA	NA	

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-naphthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

N1 - Hydrocarbons in diesel range are impacting lube oil range results.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

X1- Sample extract treated with a sulfuric acid/silica gel cleanup procedure.

Y - The calibration verification for this analyte exceeded the 20% drift specified in methods 8260 & 8270, and therefore the reported result should be considered an estimate. The overall performance of the calibration verification standard met the acceptance criteria of the method.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664

Professional Analytical Services

Jul 2 2020
On-Site Environmental
14648 NE 95th ST
Redmond, WA 98052
Attention: David Baumeister

Dear David Baumeister:

Enclosed please find the analytical data for your project.

The following is a cross correlation of client and laboratory identifications for your convenience.

CLIENT ID	MATRIX	AMTEST ID	TEST
MW-8A-2020	Water	20-A008840	CN- Shim
MW-14A-2020	Water	20-A008841	CN- Shim
MW-10A-2020	Water	20-A008842	CN- Shim
MW-10A-D-2020	Water	20-A008843	CN- Shim
MW-3B-2020	Water	20-A008844	CN- Shim
MW-18-2020	Water	20-A008845	CN- Shim

Your samples were received on Tuesday, June 23, 2020. At the time of receipt, the samples were logged in and properly maintained prior to the subsequent analysis.

The analytical procedures used at AmTest are well documented and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the Quality Control (QC) results.

Please note that the detection limits that are listed in the body of the report refer to the Practical Quantitation Limits (PQL's), as opposed to the Method Detection Limits (MDL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Aaron W. Young
Laboratory Manager

Project #: 160802
PO Number: 06-256

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics
NUT=Nutrients
DEM=Demand
MIN=Minerals

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

ANALYSIS REPORT

On-Site Environmental
14648 NE 95th ST
Redmond, WA 98052
Attention: David Baumeister
Project #: 160802
PO Number: 06-256
All results reported on an as received basis.

Date Received: 06/23/20
Date Reported: 7/ 2/20

AMTEST Identification Number **20-A008840**
Client Identification **MW-8A-2020**
Sampling Date **06/20/20, 11:30**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Total Cyanide	< 0.005	mg/l		0.005	SM 4500CN-E99	AW	06/27/20

AMTEST Identification Number **20-A008841**
Client Identification **MW-14A-2020**
Sampling Date **06/20/20, 13:00**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Total Cyanide	0.018	mg/l		0.005	SM 4500CN-E99	AW	06/27/20

AMTEST Identification Number **20-A008842**
Client Identification **MW-10A-2020**
Sampling Date **06/20/20, 13:55**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Total Cyanide	0.006	mg/l		0.005	SM 4500CN-E99	AW	06/27/20

AMTEST Identification Number **20-A008843**
Client Identification **MW-10A-D-2020**
Sampling Date **06/20/20, 13:55**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Total Cyanide	< 0.005	mg/l		0.005	SM 4500CN-E99	AW	06/27/20

AMTEST Identification Number **20-A008844**
Client Identification **MW-3B-2020**
Sampling Date **06/20/20, 15:15**

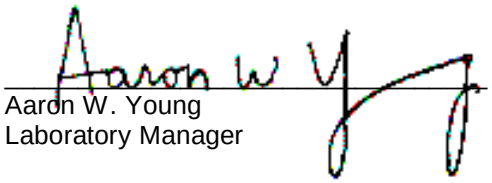
Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Total Cyanide	< 0.005	mg/l		0.005	SM 4500CN-E99	AW	06/27/20

AMTEST Identification Number **20-A008845**
Client Identification **MW-18-2020**
Sampling Date **06/20/20, 16:20**

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Total Cyanide	0.005	mg/l		0.005	SM 4500CN-E99	AW	06/27/20



Aaron W. Young
Laboratory Manager

Am Test Inc.
13600 NE 126th PL
Suite C
Kirkland, WA, 98034
(425) 885-1664
www.amtestlab.com

Professional Analytical Services

QC Summary for sample numbers: 20-A008840 to 20-A008845

MATRIX SPIKES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	SMPL+ SPK	SPK AMT	RECOVERY
20-A008986	Total Cyanide	mg/l	< 0.005	0.22	0.20	110.00 %
20-A008986	Total Cyanide	mg/l	< 0.005	0.21	0.20	105.00 %

MATRIX SPIKE DUPLICATES

SAMPLE #	ANALYTE	UNITS	SAMPLE + SPK	MSD VALUE	RPD
Spike	Total Cyanide	mg/l	0.22	0.21	4.7

STANDARD REFERENCE MATERIALS

ANALYTE	UNITS	TRUE VALUE	MEASURED VALUE	RECOVERY
Total Cyanide	mg/l	0.10	0.10	100. %

BLANKS

ANALYTE	UNITS	RESULT
Total Cyanide	mg/l	< 0.005

OnSite Environmental Inc.

14648 NE 95th Street, Redmond, WA 98052 · (425) 883-3881

Laboratory: AmTest Laboratories

Attention: Aaron Young

13600 NE 126th Pl Kirkland, WA 98034

Phone Number: (425) 885-1664

Turnaround Request

1 Day 2 Day 3 Day

Standard

Other: _____

Laboratory Reference #: 06-256

Project Manager: David Baumeister

email: dbaumeister@onsite-env.com

Project Number: 160802

Project Name: _____

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	# of Cont.	Requested Analyses
	MW-8A-2020 8840	6/20/20	11:30	W	1	Cyanide (Total)
	MW-14A-2020 41	6/20/20	13:00	W	1	Cyanide (Total)
	MW-10A-2020 42	6/20/20	13:55	W	1	Cyanide (Total)
	MW-10A-D-2020 43	6/20/20	13:55	W	1	Cyanide (Total)
	MW-3B-2020 44	6/20/20	15:15	W	1	Cyanide (Total)
	MW-18-2020 45	6/20/20	16:20	W	1	Cyanide (Total)

	Company	Date	Time	Comments/Special Instructions
Relinquished by: Michelle Bilyeu	OSE	6/23	12:22	
Received by:	Amtest	6/23/20	1222	
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Client TEGS

P.5

APPENDIX A2

Chain of Custody

OnSite Environmental Inc.
Analytical Laboratory Testing Services
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • www.onsite-env.com

Company: GeoPro LLC
Project Number: 160802
Project Name: CGA WS1
Project Manager: Richard Kent
Sampled by: Patrick Kent

Turnaround Request (in working days)

(Check One)

- ☐ Same Day
- ☐ 1 Day
- ☐ 2 Days
- ☐ 3 Days
- ☒ Standard (7 Days)
- ☐ _____ (other)

Laboratory Number: 06-256

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	Number of Containers
1	MW-8A-2020	6/20/20	1130	W	2
2	MW-14A-2020		1300		2
3	MW-10A-2020		1355		2
4	MW-10A-D-2020		1355		2
5	MW-3B-2020		1515		2
6	MW-18-2020		1620		2

Lab ID	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Gx	NWTPH-Dx (☐ Acid / SG Clean-up)	Volatiles 8260C	Halogenated Volatiles 8260C	EDB EPA 8011 (Waters Only)	Semivolatiles 8270D/SIM (with low-level PAHs)	PAHs 8270D/SIM (low-level)	PCBs 8082A	Organochlorine Pesticides 8081B	Organophosphorus Pesticides 8270D/SIM	Chlorinated Acid Herbicides 8151A	Total RCRA Metals	Total MTCA Metals	TCLP Metals	HEM (oil and grease) 1664A	Cyanide (Total)	Fluoride	Sulfate	Chloride	% Moisture
1																		X	X	X	X	
2																						
3																						
4																						
5																						
6																						

	Signature	Company	Date	Time
Relinquished		GeoPro LLC	6/22/20	1100
Received		CRE	6/23/20	1021
Relinquished				
Received				
Relinquished				
Received				
Reviewed/Date		Reviewed/Date		

Comments/Special Instructions

Invoice Blue Mountain Environmental Consulting LLC

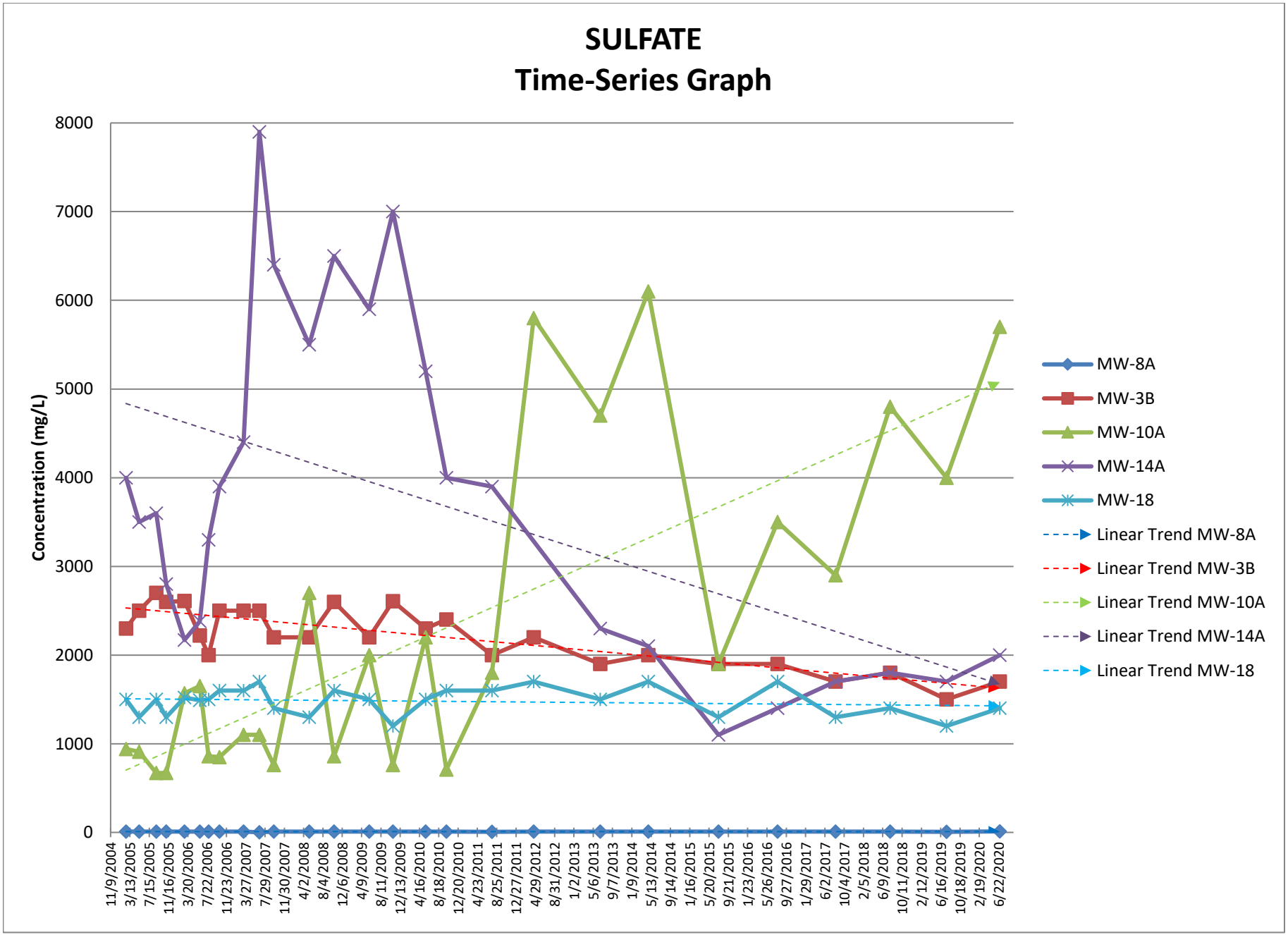
Data Package: Standard ☒ Level III ☐ Level IV ☐

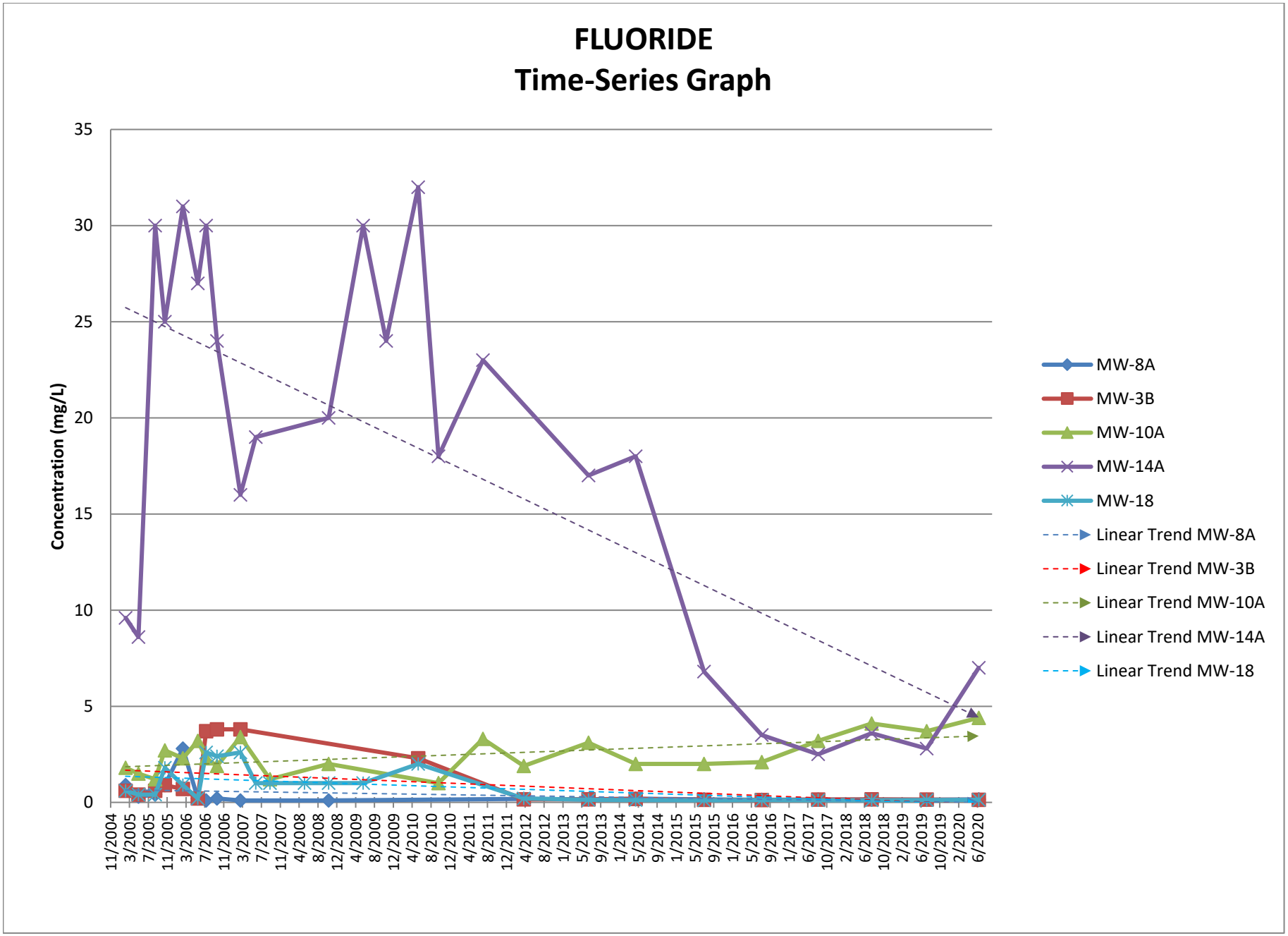
Chromatograms with final report ☐ Electronic Data Deliverables (EDDs) ☐

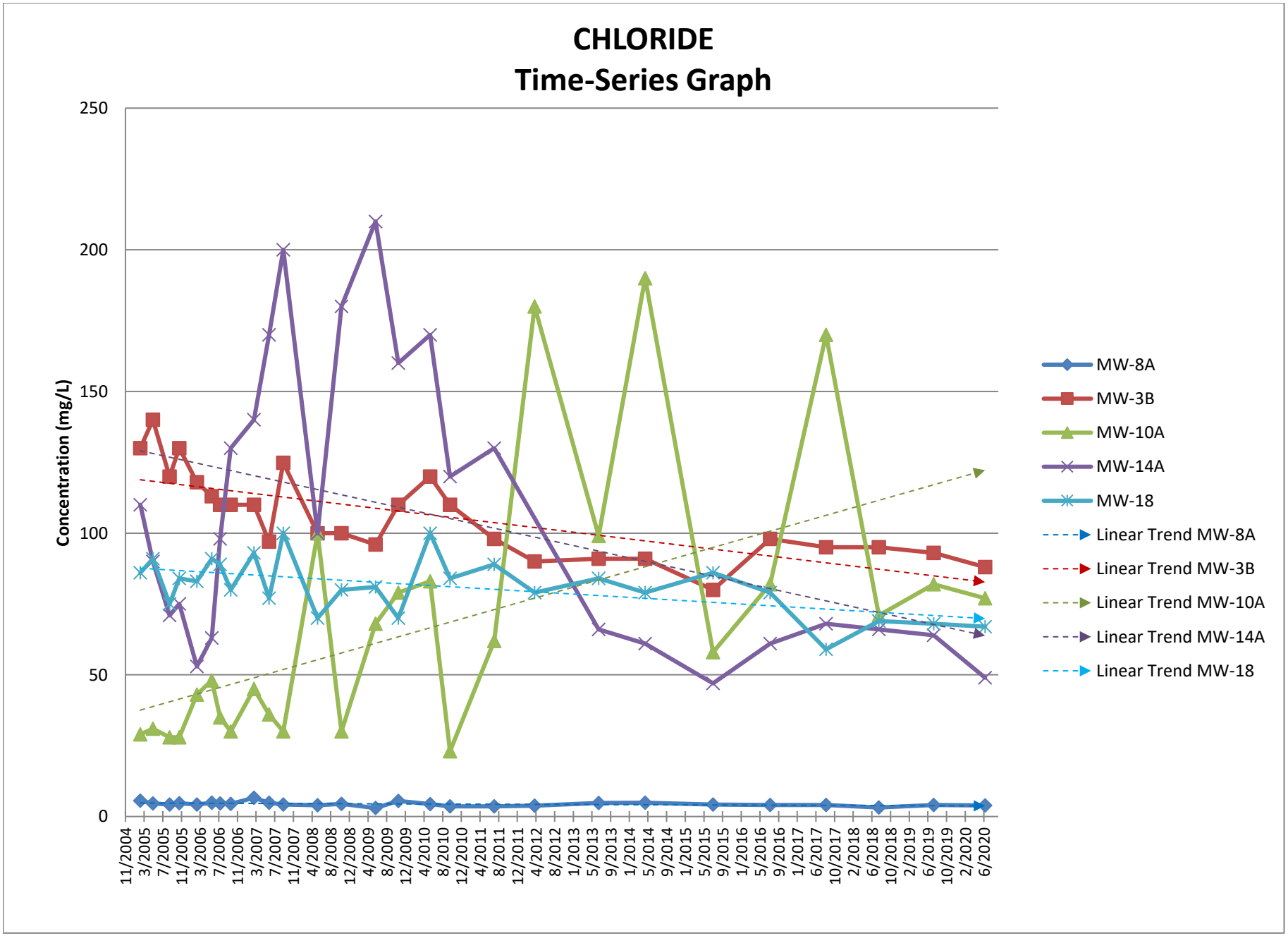
APPENDIX A2

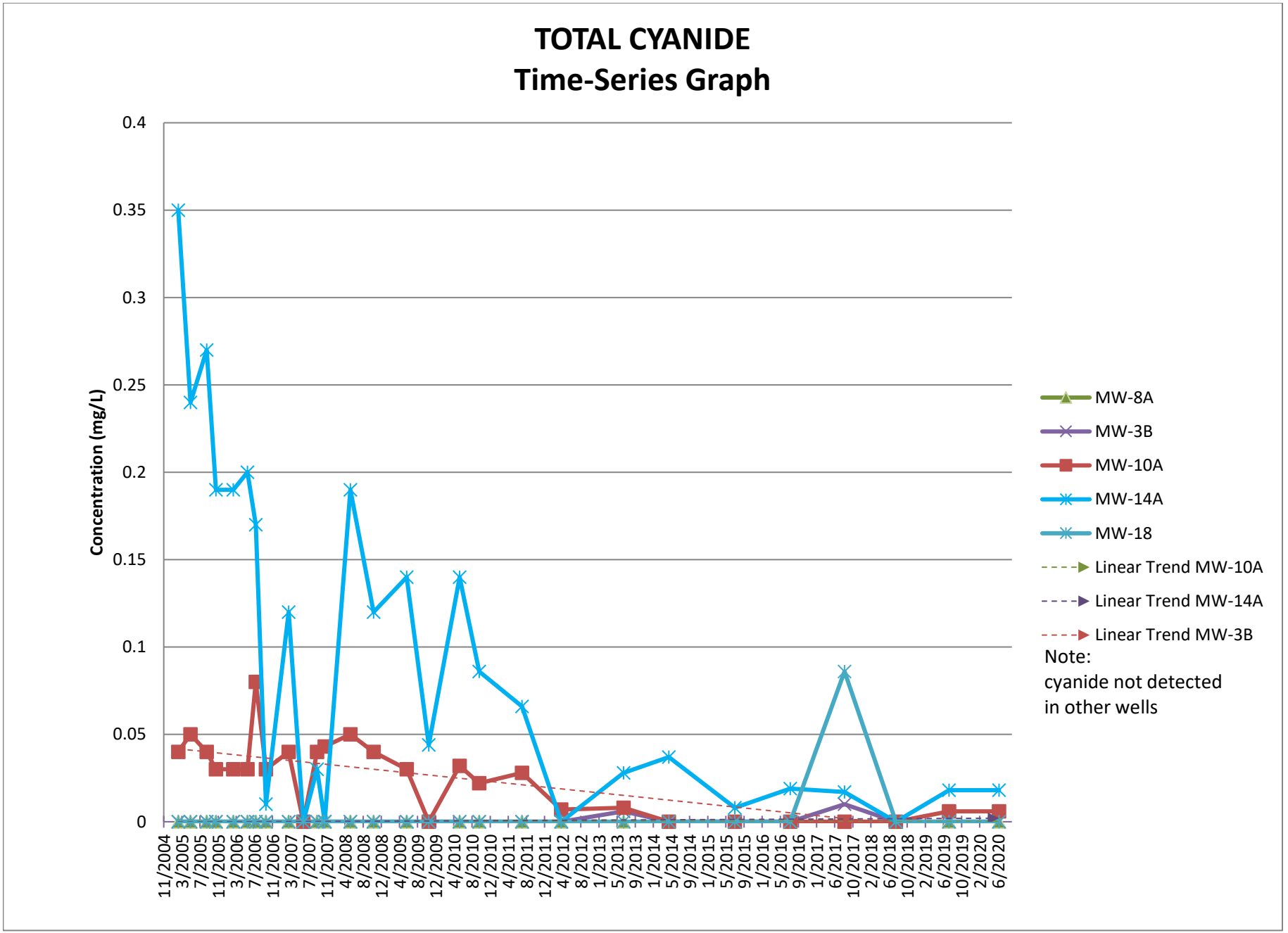
Appendix B - UCL and Trends

Appendix B1
Time-Series Graphs: Sulfate, Fluoride, Chloride, Cyanide


SULFATE
Time-Series Graph
Concentration (mg/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
11/9/2004
3/13/2005
7/15/2005
11/16/2005
3/20/2006
7/22/2006
11/23/2006
3/27/2007
7/29/2007
11/30/2007
4/2/2008
8/4/2008
12/6/2008
4/9/2009
8/11/2009
12/13/2009
4/16/2010
8/18/2010
12/20/2010
4/23/2011
8/25/2011
12/27/2011
4/29/2012
8/31/2012
1/2/2013
5/6/2013
9/7/2013
1/9/2014
5/13/2014
9/14/2014
1/16/2015
5/20/2015
9/21/2015
1/23/2016
5/26/2016
9/27/2016
1/29/2017
6/2/2017
10/4/2017
2/5/2018
6/9/2018
10/11/2018
2/12/2019
6/16/2019
10/18/2019
2/19/2020
6/22/2020
MW-8A
MW-3B
MW-10A
MW-14A
MW-18
Linear Trend MW-8A
Linear Trend MW-3B
Linear Trend MW-10A
Linear Trend MW-14A
Linear Trend MW-18


FLUORIDE
Time-Series Graph
Concentration (mg/L)
35
30
25
20
15
10
5
0
11/2004
3/2005
7/2005
11/2005
3/2006
7/2006
11/2006
3/2007
7/2007
11/2007
4/2008
8/2008
12/2008
4/2009
8/2009
12/2009
4/2010
8/2010
12/2010
4/2011
8/2011
12/2011
4/2012
8/2012
1/2013
5/2013
9/2013
1/2014
5/2014
9/2014
1/2015
5/2015
9/2015
1/2016
5/2016
9/2016
1/2017
6/2017
10/2017
2/2018
6/2018
10/2018
2/2019
6/2019
10/2019
2/2020
6/2020
MW-8A
MW-3B
MW-10A
MW-14A
MW-18
Linear Trend MW-8A
Linear Trend MW-3B
Linear Trend MW-10A
Linear Trend MW-14A
Linear Trend MW-18


CHLORIDE
Time-Series Graph
Concentration (mg/L)
250
200
150
100
50
0
11/2004
3/2005
7/2005
11/2005
3/2006
7/2006
11/2006
3/2007
7/2007
11/2007
4/2008
8/2008
12/2008
4/2009
8/2009
12/2009
4/2010
8/2010
12/2010
4/2011
8/2011
12/2011
4/2012
8/2012
1/2013
5/2013
9/2013
1/2014
5/2014
9/2014
1/2015
5/2015
9/2015
1/2016
5/2016
9/2016
1/2017
6/2017
10/2017
2/2018
6/2018
10/2018
2/2019
6/2019
10/2019
2/2020
6/2020
MW-8A
MW-3B
MW-10A
MW-14A
MW-18
Linear Trend MW-8A
Linear Trend MW-3B
Linear Trend MW-10A
Linear Trend MW-14A
Linear Trend MW-18


TOTAL CYANIDE
Time-Series Graph
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
11/2004
3/2005
7/2005
11/2005
3/2006
7/2006
11/2006
3/2007
7/2007
11/2007
4/2008
8/2008
12/2008
4/2009
8/2009
12/2009
4/2010
8/2010
12/2010
4/2011
8/2011
12/2011
4/2012
8/2012
1/2013
5/2013
9/2013
1/2014
5/2014
9/2014
1/2015
5/2015
9/2015
1/2016
5/2016
9/2016
1/2017
6/2017
10/2017
2/2018
6/2018
10/2018
2/2019
6/2019
10/2019
2/2020
6/2020
MW-8A
MW-3B
MW-10A
MW-14A
MW-18
Linear Trend MW-10A
Linear Trend MW-14A
Linear Trend MW-3B
Note:
cyanide not detected
in other wells

Appendix B2
Mann-Kendall Trend Test Results

SUMMARY MANN-KENDALL TEST FOR TREND RESULTS

Well ID	Analyte	n	s	variance	Z	Probability	Trend
MW-3B	Sulfate	16	-99	487.667	4.438	9.09E-06	Negative
	Fluoride	16	-78	486.667	3.490	0.000482	Significantly Negative
	Chloride	16	-69	490.333	3.071	0.00213	Significantly Negative
	Total Cyanide	10	-1	111.667	0	1	Negative
MW-8A	Sulfate	16	-19	481	0.821	0.412	Negative
	Fluoride	16	-64	477.333	2.884	0.00393	Significantly Negative
	Chloride	16	-46	488.667	2.036	0.0418	Significantly Negative
	Total Cyanide	16	-9	361	0.421	0.674	Negative
MW-10A	Sulfate	16	76	493.333	3.377	0.000734	Significantly Positive
	Fluoride	16	37	492.333	1.622	0.105	Positive
	Chloride	16	53	492.333	2.344	0.0191	Significantly Positive
	Total Cyanide	16	-68	482.667	3.050	0.00229	Significantly Negative
MW-12A	Sulfate	1	-	-	-	-	-
	Fluoride	1	-	-	-	-	-
	Chloride	1	-	-	-	-	-
	Total Cyanide	1	-	-	-	-	-
MW-14A	Sulfate	15	-54	2.626	407.333	0.00864	Significantly Negative
	Fluoride	15	-59	408.333	2.870	0.00410	Significantly Negative
	Chloride	15	-53	406.333	2.580	0.00989	Significantly Negative
	Total Cyanide	15	-66	407.333	3.221	0.00128	Significantly Negative
MW-18	Sulfate	16	-18	484	0.773	0.440	Negative
	Fluoride	16	-74	484	3.318	0.000906	Significantly Negative
	Chloride	16	-56	488.667	2.488	0.0128	Significantly Negative
	Total Cyanide	16	3	363.667	0.105	0.916	Positive

Notes:
n = sample size
S = Mann-Kendall test statistic; calculated based on S and the estimated variance when the sample size is greater than 10.
Variance = Standard deviation of S squared
Z = Approximate normal test statistic; calculated based on S and the estimated variance when the sample size is greater than 10.
Probability from Table A.21 [Hollander and Wolfe (1973)]
Trends significant at alpha = 0.05 or less are highlighted

Appendix B3
Mann-Kendall Test Output

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:35:25 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CH3B

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	80
Maximum	140
Mean	105.8
Geometric Mean	104.9
Median	100
Standard Deviation	14.97
Coefficient of Variation	0.141

Mann-Kendall Test

M-K Test Value (S)	-231
Critical Value (0.05)	-1.645
Standard Deviation of S	47.73
Standardized Value of S	-4.819
Approximate p-value	7.2291E-7

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:35:59 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CH8A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	3
Maximum	6.6
Mean	4.396
Geometric Mean	4.338
Median	4.2
Standard Deviation	0.746
Coefficient of Variation	0.17

Mann-Kendall Test

M-K Test Value (S)	-124
Critical Value (0.05)	-1.645
Standard Deviation of S	47.8
Standardized Value of S	-2.573
Approximate p-value	0.00504

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:36:39 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CH10A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	23
Maximum	190
Mean	68.04
Geometric Mean	56.19
Median	58
Standard Deviation	46.78
Coefficient of Variation	0.688

Mann-Kendall Test

M-K Test Value (S)	166
Critical Value (0.05)	1.645
Standard Deviation of S	47.91
Standardized Value of S	3.444
Approximate p-value	2.8661E-4

Statistically significant evidence of an increasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:37:12 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CH12A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	1
Number Values Reported (n)	9
Number Values Missing	8
Number Values Used	1
Minimum	150
Maximum	150
Mean	150
Geometric Mean	150
Median	150
Standard Deviation	N/A
Coefficient of Variation	N/A

Not enough reported values (n) to provide Mann-Kendall Statistics!

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:37:46 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CH14A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	26
Number Values Reported (n)	28
Number Values Missing	2
Number Values Used	26
Minimum	47
Maximum	210
Mean	105.8
Geometric Mean	95.2
Median	94
Standard Deviation	50.26
Coefficient of Variation	0.475

Mann-Kendall Test

M-K Test Value (S)	-59
Critical Value (0.05)	-1.645
Standard Deviation of S	45.32
Standardized Value of S	-1.28
Approximate p-value	0.1

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:38:16 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CH18

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	59
Maximum	100
Mean	81.22
Geometric Mean	80.62
Median	81
Standard Deviation	9.951
Coefficient of Variation	0.123

Mann-Kendall Test

M-K Test Value (S)	-121
Critical Value (0.05)	-1.645
Standard Deviation of S	47.83
Standardized Value of S	-2.509
Approximate p-value	0.00606

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:38:50 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CY3B

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	28
Number Values Reported (n)	28
Minimum	0.0025
Maximum	0.01
Mean	0.00593
Geometric Mean	0.00556
Median	0.005
Standard Deviation	0.00227
Coefficient of Variation	0.383

Mann-Kendall Test

M-K Test Value (S)	37
Critical Value (0.05)	1.645
Standard Deviation of S	41.42
Standardized Value of S	0.869
Approximate p-value	0.192

Insufficient evidence to identify a significant
trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:39:17 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CY8A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	28
Number Values Reported (n)	28
Minimum	0.0025
Maximum	0.025
Mean	0.00634
Geometric Mean	0.00556
Median	0.005
Standard Deviation	0.00428
Coefficient of Variation	0.674

Mann-Kendall Test

M-K Test Value (S)	-18
Critical Value (0.05)	-1.645
Standard Deviation of S	41.53
Standardized Value of S	-0.409
Approximate p-value	0.341

Insufficient evidence to identify a significant
trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:39:45 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CY10A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	28
Number Values Reported (n)	28
Minimum	0.0025
Maximum	0.08
Mean	0.0257
Geometric Mean	0.0175
Median	0.03
Standard Deviation	0.0192
Coefficient of Variation	0.748

Mann-Kendall Test

M-K Test Value (S)	-200
Critical Value (0.05)	-1.645
Standard Deviation of S	50.1
Standardized Value of S	-3.972
Approximate p-value	3.5626E-5

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:40:18 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CY12A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	1
Number Values Reported (n)	9
Number Values Missing	8
Number Values Used	1
Minimum	0.005
Maximum	0.005
Mean	0.005
Geometric Mean	0.005
Median	0.005
Standard Deviation	N/A
Coefficient of Variation	N/A

Not enough reported values (n) to provide Mann-Kendall Statistics!

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:40:51 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CY14A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	0.005
Maximum	0.35
Mean	0.101
Geometric Mean	0.0509
Median	0.066
Standard Deviation	0.0967
Coefficient of Variation	0.962

Mann-Kendall Test

M-K Test Value (S)	-196
Critical Value (0.05)	-1.645
Standard Deviation of S	47.86
Standardized Value of S	-4.074
Approximate p-value	2.3076E-5

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:41:21 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

CY18

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	28
Number Values Reported (n)	28
Minimum	0.0025
Maximum	0.086
Mean	0.00816
Geometric Mean	0.00553
Median	0.005
Standard Deviation	0.0154
Coefficient of Variation	1.883

Mann-Kendall Test

M-K Test Value (S)	12
Critical Value (0.05)	1.645
Standard Deviation of S	38.18
Standardized Value of S	0.288
Approximate p-value	0.387

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:32:27 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

F3B

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	0.12
Maximum	25
Mean	2.069
Geometric Mean	0.611
Median	0.5
Standard Deviation	4.848
Coefficient of Variation	2.343

Mann-Kendall Test

M-K Test Value (S)	-161
Critical Value (0.05)	-1.645
Standard Deviation of S	47.7
Standardized Value of S	-3.354
Approximate p-value	3.9823E-4

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:32:58 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

F8A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	0.05
Maximum	5
Mean	0.584
Geometric Mean	0.298
Median	0.2
Standard Deviation	1.029
Coefficient of Variation	1.762

Mann-Kendall Test

M-K Test Value (S)	-104
Critical Value (0.05)	-1.645
Standard Deviation of S	47.41
Standardized Value of S	-2.173
Approximate p-value	0.0149

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:33:28 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

F10A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	0.5
Maximum	25
Mean	3.489
Geometric Mean	2.564
Median	2.3
Standard Deviation	4.469
Coefficient of Variation	1.281

Mann-Kendall Test

M-K Test Value (S)	74
Critical Value (0.05)	1.645
Standard Deviation of S	47.87
Standardized Value of S	1.525
Approximate p-value	0.0636

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:33:55 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

F12A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	1
Number Values Reported (n)	9
Number Values Missing	8
Number Values Used	1
Minimum	6.3
Maximum	6.3
Mean	6.3
Geometric Mean	6.3
Median	6.3
Standard Deviation	N/A
Coefficient of Variation	N/A

Not enough reported values (n) to provide Mann-Kendall Statistics!

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:34:27 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

F14A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	26
Number Values Reported (n)	28
Number Values Missing	2
Number Values Used	26
Minimum	2.5
Maximum	32
Mean	18.4
Geometric Mean	14.56
Median	19.5
Standard Deviation	9.843
Coefficient of Variation	0.535

Mann-Kendall Test

M-K Test Value (S)	-137
Critical Value (0.05)	-1.645
Standard Deviation of S	45.27
Standardized Value of S	-3.004
Approximate p-value	0.00133

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:34:54 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

F18

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	0.11
Maximum	25
Mean	2.539
Geometric Mean	0.559
Median	0.5
Standard Deviation	6.523
Coefficient of Variation	2.569

Mann-Kendall Test

M-K Test Value (S)	-156
Critical Value (0.05)	-1.645
Standard Deviation of S	47.67
Standardized Value of S	-3.252
Approximate p-value	5.7333E-4

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:25:51 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

S3B

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	1500
Maximum	2700
Mean	2205
Geometric Mean	2180
Median	2200
Standard Deviation	331.8
Coefficient of Variation	0.15

Mann-Kendall Test

M-K Test Value (S)	-214
Critical Value (0.05)	-1.645
Standard Deviation of S	47.68
Standardized Value of S	-4.467
Approximate p-value	3.9601E-6

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:29:25 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

S8A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	0.5
Maximum	11
Mean	9.095
Geometric Mean	8.398
Median	9.6
Standard Deviation	1.978
Coefficient of Variation	0.217

Mann-Kendall Test

M-K Test Value (S)	-27
Critical Value (0.05)	-1.645
Standard Deviation of S	47.4
Standardized Value of S	-0.549
Approximate p-value	0.292

Insufficient evidence to identify a significant trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:29:57 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

S10A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	670
Maximum	6100
Mean	2278
Geometric Mean	1721
Median	1650
Standard Deviation	1777
Coefficient of Variation	0.78

Mann-Kendall Test

M-K Test Value (S)	177
Critical Value (0.05)	1.645
Standard Deviation of S	47.93
Standardized Value of S	3.672
Approximate p-value	1.2021E-4

Statistically significant evidence of an increasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:30:35 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

S12A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	1
Number Values Reported (n)	9
Number Values Missing	8
Number Values Used	1
Minimum	1800
Maximum	1800
Mean	1800
Geometric Mean	1800
Median	1800
Standard Deviation	N/A
Coefficient of Variation	N/A

Not enough reported values (n) to provide Mann-Kendall Statistics!

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:31:12 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

S14A

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	26
Number Values Reported (n)	28
Number Values Missing	2
Number Values Used	26
Minimum	1100
Maximum	7900
Mean	3710
Geometric Mean	3244
Median	3550
Standard Deviation	1907
Coefficient of Variation	0.514

Mann-Kendall Test

M-K Test Value (S)	-92
Critical Value (0.05)	-1.645
Standard Deviation of S	45.34
Standardized Value of S	-2.007
Approximate p-value	0.0224

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test Analysis

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 8:31:44 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	0.95
Level of Significance	0.05

S18

General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	27
Number Values Reported (n)	28
Number Values Missing	1
Number Values Used	27
Minimum	1200
Maximum	1700
Mean	1478
Geometric Mean	1470
Median	1500
Standard Deviation	152.9
Coefficient of Variation	0.103

Mann-Kendall Test

M-K Test Value (S)	2
Critical Value (0.05)	1.645
Standard Deviation of S	47.18
Standardized Value of S	0.0212
Approximate p-value	0.492

Insufficient evidence to identify a significant trend at the specified level of significance.

Appendix B4
UCL Calculations

SUMMARY OF UCL CALCULATIONS

	Sulfate						Fluoride					
	MW-3B	MW-8A	MW-10A	MW-12A	MW-14A	MW-18	MW-3B	MW-8A	MW-10A	MW-12A	MW-14A	MW-18
Num data pts	27	27	27	1	26	27	27	27	27	1	26	27
Num Non-Detect	0	1	0	0	0	0	8	8	4	0	2	8
Percent Non-Detect	0	3.703703704	0	0	0	0	29.62962963	29.62962963	14.81481481	0	7.692307692	29.62962963
Min.	1500	0.5	670	1800	1100	1200	0.12	0.05	0.5	6.3	2.5	0.11
Max.	2700	11	6100	1800	7900	1700	25	5	25	6.3	32	25
Mean	2205.037037	9.095185185	2278.148148	1800	3709.615385	1478.148148	2.068888889	0.584074074	3.488888889	6.3	18.4	2.538888889
Max Conc (>50% ND)				NA						NA		
Log Normal				NA						NA		
Normal	2206.682809			NA	3711.260401	1479.794996				NA		
Non-parametric		10.79671067	3806.425217	NA			6.239011185	1.469572036	7.33319057	NA	27.02873	8.150628321
Distribution	Normal	Neither	Neither	NA	Normal	Normal	Neither	Neither	Neither	NA	Neither	Neither
	Chloride						**Cyanide**					
	MW-3B	MW-8A	MW-10A	MW-12A	MW-14A	MW-18	MW-3B	MW-8A	MW-10A	MW-12A	MW-14A	MW-18
Num data pts	27	27	27	1	26	27	28	28	28	1	27	28
Num Non-Detect	0	0	0	0	0	0	26	28	6	1	2	27
Percent Non-Detect	0	0	0	0	0	0	92.85714286	100	21.42857143	100	7.407407407	96.42857143
Min.	80	3	23	150	47	59	0.0025	0.0025	0.0025	0.005	0.005	0.0025
Max.	140	6.6	190	150	210	100	0.01	0.025	0.08	0.005	0.35	0.086
Mean	105.8440741	4.395925926	68.03703704	150	105.8461538	81.22222222	0.005928571	0.006339286	0.025696429	0.005	0.100592593	0.008160714
Max Conc (>50% ND)				NA			0.01	0.025		0.005		0.086
Log Normal			70.36892839	NA	108.52534							
Normal	107.5095315	6.572619359		NA		82.89825899						
Non-parametric				NA					0.041928174		0.183803819	
Distribution	Normal	Normal	Log-Normal	NA	Log-Normal	Normal	Non-Detect (>50%)	Non-Detect (>50%)	Neither	Non-Detect (>50%)	Neither	Non-Detect (>50%)

Appendix B5
DOE Groundwater UCL Output

130	CH3B	Chloride MW-3B
140	CH3B	
120	CH3B	
130	CH3B	
118	CH3B	
113	CH3B	
110	CH3B	
110	CH3B	
110	CH3B	
97	CH3B	
124.79	CH3B	
100	CH3B	
100	CH3B	
96	CH3B	
110	CH3B	
120	CH3B	
110	CH3B	
98	CH3B	
90	CH3B	
91	CH3B	
91	CH3B	
80	CH3B	
98	CH3B	
95	CH3B	
95	CH3B	
93	CH3B	
88	CH3B	

Number of samples		Uncensored values	
Uncensored	27	Mean	105.84
Censored		Lognormal mean	105.87
Detection limit or PQL		Std. devn.	14.9658684
Method detection limit		Median	100
TOTAL	27	Min.	80
		Max.	140

Lognormal distribution?		Normal distribution?	
r-squared is:	0.970	r-squared is:	0.956

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 110.969319091673

B5_CH3B_2020.pdf

5.6	CH8A	Chloride MW-8A
4.6	CH8A	
4.2	CH8A	
4.7	CH8A	
4.2	CH8A	
4.9	CH8A	
4.6	CH8A	
4.5	CH8A	
6.6	CH8A	
4.89	CH8A	
4.2	CH8A	
4	CH8A	
4.5	CH8A	
3	CH8A	
5.5	CH8A	
4.4	CH8A	
3.6	CH8A	
3.6	CH8A	
3.8	CH8A	
4.8	CH8A	
4.9	CH8A	
4.2	CH8A	
4.1	CH8A	
4.1	CH8A	
3.2	CH8A	
4.1	CH8A	
3.9	CH8A	

Number of samples		Uncensored values	
Uncensored	27	Mean	4.40
Censored		Lognormal mean	4.40
Detection limit or PQL		Std. devn.	0.74574825
Method detection limit		Median	4.2
TOTAL	27	Min.	3
		Max.	6.6

Lognormal distribution?		Normal distribution?	
r-squared is:	0.964	r-squared is:	0.935

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 4.65323212614678

29	CH10A	Chloride MW-10A
31	CH10A	
28	CH10A	
28	CH10A	
43	CH10A	
48	CH10A	
35	CH10A	
30	CH10A	
45	CH10A	
36	CH10A	
30	CH10A	
100	CH10A	
30	CH10A	
68	CH10A	
79	CH10A	
83	CH10A	
23	CH10A	
62	CH10A	
180	CH10A	
99	CH10A	
190	CH10A	
58	CH10A	
82	CH10A	
170	CH10A	
71	CH10A	
82	CH10A	
77	CH10A	

Number of samples		Uncensored values	
Uncensored	27	Mean	68.04
Censored		Lognormal mean	67.82
Detection limit or PQL		Std. devn.	46.7789248
Method detection limit		Median	58
TOTAL	27	Min.	23
		Max.	190

Lognormal distribution?		Normal distribution?	
r-squared is:	0.939	r-squared is:	0.805

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 86.7490503250397

110	CH14A	Chloride MW-14A
90	CH14A	
71	CH14A	
75	CH14A	
53	CH14A	
63	CH14A	
98	CH14A	
130	CH14A	
140	CH14A	
170	CH14A	
200	CH14A	
100	CH14A	
180	CH14A	
210	CH14A	
160	CH14A	Lognormal distribution?
170	CH14A	r-squared is: 0.947
120	CH14A	Recommendations:
130	CH14A	Use lognormal distribution.
66	CH14A	
61	CH14A	
47	CH14A	
61	CH14A	
68	CH14A	
66	CH14A	
64	CH14A	UCL (Land's method) is 127.249470076681
49	CH14A	

Number of samples		Uncensored values	
Uncensored	26	Mean	105.85
Censored		Lognormal mean	106.22
Detection limit or PQL		Std. devn.	50.2566949
Method detection limit		Median	94
TOTAL	26	Min.	47
		Max.	210

Normal distribution? r-squared is: 0.907

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86	CH18	Chloride MW-18
91	CH18	
75	CH18	
84	CH18	
83	CH18	
91	CH18	
89	CH18	
80	CH18	
93	CH18	
77	CH18	
100	CH18	
70	CH18	
80	CH18	
81	CH18	
70	CH18	
100	CH18	
84	CH18	
89	CH18	
79	CH18	
84	CH18	
79	CH18	
86	CH18	
79	CH18	
59	CH18	
69	CH18	
68	CH18	
67	CH18	

Number of samples		Uncensored values	
Uncensored	27	Mean	81.22
Censored		Lognormal mean	81.26
Detection limit or PQL		Std. devn.	9.9511628
Method detection limit		Median	81
TOTAL	27	Min.	59
		Max.	100

Lognormal distribution?		Normal distribution?	
r-squared is:	0.968	r-squared is:	0.980

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 84.7702658156715

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0.005	CY3B	Cyanide MW-3B
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	
0.01	CY3B	
0.01	CY3B	
0.01	CY3B	
0.01	CY3B	
0.01	CY3B	
0.0025	CY3B	
0.006	CY3B	
0.0025	CY3B	
0.005	CY3B	
0.005	CY3B	
0.01	CY3B	
0.005	CY3B	
0.005	CY3B	
0.005	CY3B	

Number of samples		Uncensored values	
Uncensored	28	Mean	0.01
Censored		Lognormal mean	0.01
Detection limit or PQL		Std. devn.	0.00227187
Method detection limit		Median	0.005
TOTAL	28	Min.	0.0025
		Max.	0.01

Lognormal distribution?		Normal distribution?	
r-squared is:	0.718	r-squared is:	0.677

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 0.007

0.005	CY8A	Cyanide MW-8A
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.025	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.01	CY8A	
0.01	CY8A	
0.01	CY8A	
0.01	CY8A	
0.01	CY8A	
0.0025	CY8A	
0.0025	CY8A	
0.0025	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	
0.005	CY8A	

Number of samples		Uncensored values	
Uncensored	28	Mean	0.01
Censored		Lognormal mean	0.01
Detection limit or PQL		Std. devn.	0.00427537
Method detection limit		Median	0.005
TOTAL	28	Min.	0.0025
		Max.	0.025

Lognormal distribution?		Normal distribution?	
r-squared is:	0.735	r-squared is:	0.532

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 0.008

0.04	CY10A	Cyanide MW-10A
0.05	CY10A	
0.04	CY10A	
0.03	CY10A	
0.03	CY10A	
0.03	CY10A	
0.08	CY10A	
0.03	CY10A	
0.04	CY10A	
0.005	CY10A	
0.04	CY10A	
0.043	CY10A	
0.05	CY10A	
0.04	CY10A	
0.03	CY10A	
0.01	CY10A	
0.032	CY10A	
0.022	CY10A	
0.028	CY10A	
0.007	CY10A	
0.008	CY10A	
0.0025	CY10A	
0.005	CY10A	
0.005	CY10A	
0.005	CY10A	
0.005	CY10A	
0.006	CY10A	
0.006	CY10A	

Number of samples		Uncensored values	
Uncensored	28	Mean	0.03
Censored		Lognormal mean	0.03
Detection limit or PQL		Std. devn.	0.01921484
Method detection limit		Median	0.03
TOTAL	28	Min.	0.0025
		Max.	0.08

Lognormal distribution?		Normal distribution?	
r-squared is:	0.874	r-squared is:	0.884

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 0.032

0.35	CY14A	Cyanide MW-14A
0.24	CY14A	
0.27	CY14A	
0.19	CY14A	
0.19	CY14A	
0.2	CY14A	
0.17	CY14A	
0.01	CY14A	
0.12	CY14A	
0.005	CY14A	
0.03	CY14A	
0.005	CY14A	
0.19	CY14A	
0.12	CY14A	
0.14	CY14A	
0.044	CY14A	
0.14	CY14A	
0.086	CY14A	
0.066	CY14A	
0.028	CY14A	
0.037	CY14A	
0.008	CY14A	
0.019	CY14A	
0.017	CY14A	
0.005	CY14A	
0.018	CY14A	
0.018	CY14A	

Number of samples		Uncensored values	
Uncensored	27	Mean	0.10
Censored		Lognormal mean	0.13
Detection limit or PQL		Std. devn.	0.09672891
Method detection limit		Median	0.066
TOTAL	27	Min.	0.005
		Max.	0.35

Lognormal distribution?		Normal distribution?	
r-squared is:	0.930	r-squared is:	0.878

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.28705980728735

0.005	CY18	Cyanide MW-18
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	
0.01	CY18	
0.01	CY18	
0.01	CY18	
0.0025	CY18	
0.0025	CY18	
0.0025	CY18	
0.005	CY18	
0.005	CY18	
0.086	CY18	
0.005	CY18	
0.005	CY18	
0.005	CY18	

Number of samples		Uncensored values	
Uncensored	28	Mean	0.01
Censored		Lognormal mean	0.01
Detection limit or PQL		Std. devn.	0.01536594
Method detection limit		Median	0.005
TOTAL	28	Min.	0.0025
		Max.	0.086

Lognormal distribution?		Normal distribution?	
r-squared is:	0.522	r-squared is:	0.235

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 0.013

0.6	F3B	Fluoride MW-3B
0.4	F3B	
0.6	F3B	
0.9	F3B	
0.7	F3B	
0.2	F3B	
3.7	F3B	
3.8	F3B	
3.8	F3B	
5	F3B	
0.5	F3B	
25	F3B	
5	F3B	
0.5	F3B	
0.5	F3B	
2.3	F3B	
0.5	F3B	
0.5	F3B	
0.16	F3B	
0.16	F3B	
0.18	F3B	
0.14	F3B	
0.12	F3B	
0.15	F3B	
0.16	F3B	
0.15	F3B	
0.14	F3B	

Number of samples		Uncensored values	
Uncensored	27	Mean	2.07
Censored		Lognormal mean	1.72
Detection limit or PQL		Std. devn.	4.84755952
Method detection limit		Median	0.5
TOTAL	27	Min.	0.12
		Max.	25

Lognormal distribution?		Normal distribution?	
r-squared is:	0.885	r-squared is:	0.390

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 3.604

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0.9	F8A
0.3	F8A
0.4	F8A
0.9	F8A
2.8	F8A
0.2	F8A
0.1	F8A
0.1	F8A
0.05	F8A
5	F8A
0.5	F8A
0.5	F8A
0.1	F8A
0.5	F8A
0.5	F8A
0.5	F8A
0.5	F8A
0.5	F8A
0.18	F8A
0.16	F8A
0.19	F8A
0.16	F8A
0.13	F8A
0.15	F8A
0.15	F8A
0.14	F8A
0.16	F8A

Fluoride MW-8A

Number of samples		Uncensored values	
Uncensored	27	Mean	0.58
Censored		Lognormal mean	0.51
Detection limit or PQL		Std. devn.	1.02934729
Method detection limit		Median	0.2
TOTAL	27	Min.	0.05
		Max.	5

Lognormal distribution?		Normal distribution?	
r-squared is:	0.911	r-squared is:	0.457

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.854413560768238

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1.8	F10A	Fluoride MW-10A
1.5	F10A	
1.2	F10A	
2.7	F10A	
2.3	F10A	
3.2	F10A	
2.3	F10A	
1.9	F10A	
3.4	F10A	
5	F10A	
1.2	F10A	
25	F10A	
5	F10A	
2	F10A	
0.5	F10A	
4.4	F10A	
1	F10A	
3.3	F10A	
1.9	F10A	
3.1	F10A	
2	F10A	
2	F10A	
2.1	F10A	
3.2	F10A	
4.1	F10A	
3.7	F10A	
4.4	F10A	

Number of samples		Uncensored values	
Uncensored	27	Mean	3.49
Censored		Lognormal mean	3.28
Detection limit or PQL		Std. devn.	4.46880928
Method detection limit		Median	2.3
TOTAL	27	Min.	0.5
		Max.	25

Lognormal distribution?		Normal distribution?	
r-squared is:	0.893	r-squared is:	0.406

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 4.904

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9.6	F14A	Fluoride MW-14A
8.6	F14A	
30	F14A	
25	F14A	
31	F14A	
27	F14A	
30	F14A	
24	F14A	
16	F14A	
19	F14A	
25	F14A	
25	F14A	
20	F14A	
30	F14A	
24	F14A	
32	F14A	
18	F14A	
23	F14A	
17	F14A	
18	F14A	
6.8	F14A	
3.5	F14A	
2.5	F14A	
3.6	F14A	
2.8	F14A	
7	F14A	

Number of samples		Uncensored values	
Uncensored	26	Mean	18.40
Censored		Lognormal mean	20.21
Detection limit or PQL		Std. devn.	9.84296703
Method detection limit		Median	19.5
TOTAL	26	Min.	2.5
		Max.	32

Lognormal distribution?		Normal distribution?	
r-squared is:	0.834	r-squared is:	0.929

Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 21.6970628267736

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0.6	F18	Fluoride MW-18
0.4	F18	
0.4	F18	
1.8	F18	
0.9	F18	
0.2	F18	
2.6	F18	
2.4	F18	
2.6	F18	
0.5	F18	
25	F18	
25	F18	
0.5	F18	
1	F18	
0.5	F18	
2	F18	
0.5	F18	
0.5	F18	
0.2	F18	
0.13	F18	
0.12	F18	
0.11	F18	
0.12	F18	
0.11	F18	
0.11	F18	
0.12	F18	
0.13	F18	

Number of samples		Uncensored values	
Uncensored	27	Mean	2.54
Censored		Lognormal mean	1.81
Detection limit or PQL		Std. devn.	6.52336766
Method detection limit		Median	0.5
TOTAL	27	Min.	0.11
		Max.	25

Lognormal distribution?		Normal distribution?	
r-squared is:	0.880	r-squared is:	0.372

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 4.604

2300	S3B	Sulfate MW-3B
2500	S3B	
2700	S3B	
2600	S3B	
2610	S3B	
2220	S3B	
2000	S3B	
2500	S3B	
2500	S3B	
2500	S3B	
2200	S3B	
2200	S3B	
2600	S3B	
2200	S3B	
2606	S3B	
2300	S3B	
2400	S3B	
2000	S3B	
2200	S3B	
1900	S3B	
2000	S3B	
1900	S3B	
1900	S3B	
1700	S3B	
1800	S3B	
1500	S3B	
1700	S3B	

Number of samples		Uncensored values	
Uncensored	27	Mean	2205.04
Censored		Lognormal mean	2206.83
Detection limit or PQL		Std. devn.	331.816154
Method detection limit		Median	2200
TOTAL	27	Min.	1500
		Max.	2700

Lognormal distribution?		Normal distribution?	
r-squared is:	0.942	r-squared is:	0.957

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 2327.85992749149

10	S8A	Sulfate MW-8A
9.8	S8A	
8.9	S8A	
9.6	S8A	
9.27	S8A	
9.8	S8A	
9.8	S8A	
9.7	S8A	
10	S8A	
0.5	S8A	
10	S8A	
10	S8A	
10	S8A	
9	S8A	
10	S8A	
9.3	S8A	
8.9	S8A	
7.8	S8A	
10	S8A	
9.4	S8A	
9.5	S8A	
9.5	S8A	
9.3	S8A	
9.6	S8A	
9.5	S8A	
5.4	S8A	
11	S8A	

Number of samples		Uncensored values	
Uncensored	27	Mean	9.10
Censored		Lognormal mean	9.92
Detection limit or PQL		Std. devn.	1.97793865
Method detection limit		Median	9.6
TOTAL	27	Min.	0.5
		Max.	11

Lognormal distribution?		Normal distribution?	
r-squared is:	0.296	r-squared is:	0.507

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (based on Z-statistic) is 9.721

B5_S8A_2020.pdf

940	S10A	Sulfate MW-10A
910	S10A	
670	S10A	
670	S10A	
1570	S10A	
1650	S10A	
860	S10A	
850	S10A	
1100	S10A	
1100	S10A	
760	S10A	
2700	S10A	
860	S10A	
2000	S10A	
760	S10A	
2200	S10A	
710	S10A	
1800	S10A	
5800	S10A	
4700	S10A	
6100	S10A	
1900	S10A	
3500	S10A	
2900	S10A	
4800	S10A	
4000	S10A	
5700	S10A	

Number of samples		Uncensored values	
Uncensored	27	Mean	2278.15
Censored		Lognormal mean	2292.28
Detection limit or PQL		Std. devn.	1776.54599
Method detection limit		Median	1650
TOTAL	27	Min.	670
		Max.	6100

Lognormal distribution?		Normal distribution?	
r-squared is:	0.923	r-squared is:	0.834

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 3173.04647988373

B5_S10A_2020.pdf

4000	S14A	Sulfate MW-14A
3500	S14A	
3600	S14A	
2800	S14A	
2170	S14A	
2380	S14A	
3300	S14A	
3900	S14A	
4400	S14A	
7900	S14A	
6400	S14A	
5500	S14A	
6500	S14A	
7000	S14A	
5900	S14A	
5200	S14A	
4000	S14A	
3900	S14A	
2300	S14A	
2100	S14A	
1100	S14A	
1400	S14A	
1700	S14A	
1800	S14A	
1700	S14A	
2000	S14A	

Number of samples		Uncensored values	
Uncensored	26	Mean	3709.62
Censored		Lognormal mean	3755.76
Detection limit or PQL		Std. devn.	1906.94411
Method detection limit		Median	3550
TOTAL	26	Min.	1100
		Max.	7900

Lognormal distribution?		Normal distribution?	
r-squared is:	0.976	r-squared is:	0.943

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 4658.96453207407

B5_S14A_2020.pdf

1500	S18	Sulfate MW-18
1300	S18	
1500	S18	
1300	S18	
1520	S18	
1490	S18	
1500	S18	
1600	S18	
1600	S18	
1700	S18	
1400	S18	
1300	S18	
1600	S18	
1500	S18	
1200	S18	
1500	S18	
1600	S18	
1600	S18	
1700	S18	
1500	S18	
1700	S18	
1300	S18	
1700	S18	
1300	S18	
1400	S18	
1200	S18	
1400	S18	

Number of samples		Uncensored values	
Uncensored	27	Mean	1478.15
Censored		Lognormal mean	1478.56
Detection limit or PQL		Std. devn.	152.870912
Method detection limit		Median	1500
TOTAL	27	Min.	1200
		Max.	1700

Lognormal distribution?		Normal distribution?	
r-squared is:	0.935	r-squared is:	0.942

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 1531.79372807156

Appendix B6
EPA Groundwater UCL Output

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.17/8/2020 11:06:27 PM
From File	WSI2020.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

S3B

General Statistics

Total Number of Observations	27	Number of Distinct Observations	14
		Number of Missing Observations	1
Minimum	1500	Mean	2205
Maximum	2700	Median	2200
SD	331.8	Std. Error of Mean	63.86
Coefficient of Variation	0.15	Skewness	-0.339

Normal GOF Test

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.146	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2314	95% Adjusted-CLT UCL (Chen-1995)	2306
		95% Modified-t UCL (Johnson-1978)	2313

Gamma GOF Test

A-D Test Statistic	0.581	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.148	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	43.52	k star (bias corrected MLE)	38.71
Theta hat (MLE)	50.66	Theta star (bias corrected MLE)	56.96
nu hat (MLE)	2350	nu star (bias corrected)	2091
MLE Mean (bias corrected)	2205	MLE Sd (bias corrected)	354.4
		Approximate Chi Square Value (0.05)	1985
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	1979

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2322	95% Adjusted Gamma UCL (use when n<50)	2330

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.313	Mean of logged Data	7.687
Maximum of Logged Data	7.901	SD of logged Data	0.157

Assuming Lognormal Distribution

95% H-UCL	2328	90% Chebyshev (MVUE) UCL	2407
95% Chebyshev (MVUE) UCL	2498	97.5% Chebyshev (MVUE) UCL	2624
99% Chebyshev (MVUE) UCL	2872		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2310	95% Jackknife UCL	2314
95% Standard Bootstrap UCL	2311	95% Bootstrap-t UCL	2313
95% Hall's Bootstrap UCL	2305	95% Percentile Bootstrap UCL	2312
95% BCA Bootstrap UCL	2305		
90% Chebyshev(Mean, Sd) UCL	2397	95% Chebyshev(Mean, Sd) UCL	2483
97.5% Chebyshev(Mean, Sd) UCL	2604	99% Chebyshev(Mean, Sd) UCL	2840

Suggested UCL to Use

95% Student's-t UCL	2314

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

S8A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	14
		Number of Missing Observations	1
Number of Detects	26	Number of Non-Detects	1
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	5.4	Minimum Non-Detect	0.5
Maximum Detect	11	Maximum Non-Detect	0.5
Variance Detects	1	Percent Non-Detects	3.704%
Mean Detects	9.426	SD Detects	1
Median Detects	9.6	CV Detects	0.106

Skewness Detects	-2.795	Kurtosis Detects	10.68
Mean of Logged Detects	2.237	SD of Logged Detects	0.128

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.704	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.92	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.17	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	9.095	KM Standard Error of Mean	0.381
KM SD	1.941	95% KM (BCA) UCL	9.607
95% KM (t) UCL	9.745	95% KM (Percentile Bootstrap) UCL	9.615
95% KM (z) UCL	9.722	95% KM Bootstrap t UCL	9.573
90% KM Chebyshev UCL	10.24	95% KM Chebyshev UCL	10.76
97.5% KM Chebyshev UCL	11.47	99% KM Chebyshev UCL	12.89

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.941	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.743	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.267	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.171	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	72.55	k star (bias corrected MLE)	64.21
Theta hat (MLE)	0.13	Theta star (bias corrected MLE)	0.147
nu hat (MLE)	3773	nu star (bias corrected)	3339
Mean (detects)	9.426		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	5.4	Mean	9.359
Maximum	11	Median	9.6
SD	1.04	CV	0.111
k hat (MLE)	67.74	k star (bias corrected MLE)	60.24
Theta hat (MLE)	0.138	Theta star (bias corrected MLE)	0.155
nu hat (MLE)	3658	nu star (bias corrected)	3253
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (N/A, α)	3121	Adjusted Chi Square Value (N/A, β)	3113
95% Gamma Approximate UCL (use when n>=50)	9.754	95% Gamma Adjusted UCL (use when n<50)	9.779

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	9.095	SD (KM)	1.941
Variance (KM)	3.767	SE of Mean (KM)	0.381

k hat (KM)	21.96	k star (KM)	19.54
nu hat (KM)	1186	nu star (KM)	1055
theta hat (KM)	0.414	theta star (KM)	0.465
80% gamma percentile (KM)	10.77	90% gamma percentile (KM)	11.81
95% gamma percentile (KM)	12.72	99% gamma percentile (KM)	14.55

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	980.9	Adjusted Chi Square Value (N/A, β)	976.3
95% Gamma Approximate KM-UCL (use when n>=50)	9.785	95% Gamma Adjusted KM-UCL (use when n<50)	9.831

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.612	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.92	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.277	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.17	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.351	Mean in Log Scale	2.228
SD in Original Scale	1.054	SD in Log Scale	0.133
95% t UCL (assumes normality of ROS data)	9.697	95% Percentile Bootstrap UCL	9.656
95% BCA Bootstrap UCL	9.611	95% Bootstrap t UCL	9.632
95% H-UCL (Log ROS)	9.795		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.128	KM Geo Mean	8.398
KM SD (logged)	0.567	95% Critical H Value (KM-Log)	2.03
KM Standard Error of Mean (logged)	0.111	95% H-UCL (KM -Log)	12.36
KM SD (logged)	0.567	95% Critical H Value (KM-Log)	2.03
KM Standard Error of Mean (logged)	0.111		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	9.086	Mean in Log Scale	2.102
SD in Original Scale	2.02	SD in Log Scale	0.708
95% t UCL (Assumes normality)	9.749	95% H-Stat UCL	14.22

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	9.745	KM H-UCL	12.36
95% KM (BCA) UCL	9.607		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

S10A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	23
		Number of Missing Observations	1
Minimum	670	Mean	2278
Maximum	6100	Median	1650
SD	1777	Std. Error of Mean	341.9
Coefficient of Variation	0.78	Skewness	1.039

Normal GOF Test

Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	2861	95% Adjusted-CLT UCL (Chen-1995)	2914
		95% Modified-t UCL (Johnson-1978)	2873

Gamma GOF Test

A-D Test Statistic	1.078	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.187	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.171	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.933	k star (bias corrected MLE)	1.743
Theta hat (MLE)	1178	Theta star (bias corrected MLE)	1307
nu hat (MLE)	104.4	nu star (bias corrected)	94.14
MLE Mean (bias corrected)	2278	MLE Sd (bias corrected)	1725
		Approximate Chi Square Value (0.05)	72.76
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	71.56

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2947	95% Adjusted Gamma UCL (use when n<50)	2997

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.167	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.507	Mean of logged Data	7.451

Maximum of Logged Data	8.716	SD of logged Data	0.757

Assuming Lognormal Distribution

95% H-UCL	3189	90% Chebyshev (MVUE) UCL	3339
95% Chebyshev (MVUE) UCL	3827	97.5% Chebyshev (MVUE) UCL	4505
99% Chebyshev (MVUE) UCL	5835		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	2841	95% Jackknife UCL	2861
95% Standard Bootstrap UCL	2840	95% Bootstrap-t UCL	2994
95% Hall's Bootstrap UCL	2828	95% Percentile Bootstrap UCL	2865
95% BCA Bootstrap UCL	2951		
90% Chebyshev(Mean, Sd) UCL	3304	95% Chebyshev(Mean, Sd) UCL	3768
97.5% Chebyshev(Mean, Sd) UCL	4413	99% Chebyshev(Mean, Sd) UCL	5680

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	3768

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

S12A

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	8
Minimum	1800	Mean	1800
Maximum	1800	Median	1800

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable S12A was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

S14A

General Statistics

Total Number of Observations	26	Number of Distinct Observations	23
		Number of Missing Observations	2
Minimum	1100	Mean	3710

Maximum	7900	Median	3550
SD	1907	Std. Error of Mean	374
Coefficient of Variation	0.514	Skewness	0.614

Normal GOF Test

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4348	95% Adjusted-CLT UCL (Chen-1995)	4373
		95% Modified-t UCL (Johnson-1978)	4356

Gamma GOF Test

A-D Test Statistic	0.339	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.123	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.172	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.883	k star (bias corrected MLE)	3.46
Theta hat (MLE)	955.4	Theta star (bias corrected MLE)	1072
nu hat (MLE)	201.9	nu star (bias corrected)	179.9
MLE Mean (bias corrected)	3710	MLE Sd (bias corrected)	1994
		Approximate Chi Square Value (0.05)	149.9
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	148.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4453	95% Adjusted Gamma UCL (use when n<50)	4507

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.101	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.003	Mean of logged Data	8.084
Maximum of Logged Data	8.975	SD of logged Data	0.542

Assuming Lognormal Distribution

95% H-UCL	4665	90% Chebyshev (MVUE) UCL	4978
95% Chebyshev (MVUE) UCL	5543	97.5% Chebyshev (MVUE) UCL	6327
99% Chebyshev (MVUE) UCL	7866		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4325	95% Jackknife UCL	4348
95% Standard Bootstrap UCL	4328	95% Bootstrap-t UCL	4423
95% Hall's Bootstrap UCL	4390	95% Percentile Bootstrap UCL	4288
95% BCA Bootstrap UCL	4390		
90% Chebyshev(Mean, Sd) UCL	4832	95% Chebyshev(Mean, Sd) UCL	5340
97.5% Chebyshev(Mean, Sd) UCL	6045	99% Chebyshev(Mean, Sd) UCL	7431

Suggested UCL to Use

95% Student's-t UCL	4348

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

S18

General Statistics

Total Number of Observations	27	Number of Distinct Observations	8
		Number of Missing Observations	1
Minimum	1200	Mean	1478
Maximum	1700	Median	1500
SD	152.9	Std. Error of Mean	29.42
Coefficient of Variation	0.103	Skewness	-0.231

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.923	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.161	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.167	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1528	95% Adjusted-CLT UCL (Chen-1995)	1525
		95% Modified-t UCL (Johnson-1978)	1528

Gamma GOF Test

A-D Test Statistic	0.765	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.174	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.168	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	94.81	k star (bias corrected MLE)	84.3
Theta hat (MLE)	15.59	Theta star (bias corrected MLE)	17.53
nu hat (MLE)	5120	nu star (bias corrected)	4552
MLE Mean (bias corrected)	1478	MLE Sd (bias corrected)	161
		Approximate Chi Square Value (0.05)	4396
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	4387

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1531	95% Adjusted Gamma UCL (use when n<50)	1534

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.919	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.18	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.09	Mean of logged Data	7.293
Maximum of Logged Data	7.438	SD of logged Data	0.105

Assuming Lognormal Distribution

95% H-UCL	1532	90% Chebyshev (MVUE) UCL	1568
95% Chebyshev (MVUE) UCL	1609	97.5% Chebyshev (MVUE) UCL	1666
99% Chebyshev (MVUE) UCL	1777		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1527	95% Jackknife UCL	1528
95% Standard Bootstrap UCL	1525	95% Bootstrap-t UCL	1529
95% Hall's Bootstrap UCL	1524	95% Percentile Bootstrap UCL	1524
95% BCA Bootstrap UCL	1525		
90% Chebyshev(Mean, Sd) UCL	1566	95% Chebyshev(Mean, Sd) UCL	1606
97.5% Chebyshev(Mean, Sd) UCL	1662	99% Chebyshev(Mean, Sd) UCL	1771

Suggested UCL to Use

95% Student's-t UCL	1528

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

F3B

General Statistics

Total Number of Observations	27	Number of Distinct Observations	16
		Number of Missing Observations	1
Number of Detects	19	Number of Non-Detects	8
Number of Distinct Detects	13	Number of Distinct Non-Detects	3
Minimum Detect	0.12	Minimum Non-Detect	0.5
Maximum Detect	3.8	Maximum Non-Detect	25
Variance Detects	1.808	Percent Non-Detects	29.63%
Mean Detects	0.966	SD Detects	1.345
Median Detects	0.2	CV Detects	1.392
Skewness Detects	1.601	Kurtosis Detects	0.995
Mean of Logged Detects	-0.856	SD of Logged Detects	1.26

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.643	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.315	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.802	KM Standard Error of Mean	0.254
KM SD	1.208	95% KM (BCA) UCL	1.223
95% KM (t) UCL	1.235	95% KM (Percentile Bootstrap) UCL	1.238
95% KM (z) UCL	1.219	95% KM Bootstrap t UCL	1.443
90% KM Chebyshev UCL	1.563	95% KM Chebyshev UCL	1.907
97.5% KM Chebyshev UCL	2.385	99% KM Chebyshev UCL	3.325

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.833	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.781	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.268	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.206	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.731	k star (bias corrected MLE)	0.651
Theta hat (MLE)	1.321	Theta star (bias corrected MLE)	1.485
nu hat (MLE)	27.79	nu star (bias corrected)	24.74
Mean (detects)	0.966		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.762
Maximum	3.8	Median	0.2
SD	1.176	CV	1.544

k hat (MLE)	0.608	k star (bias corrected MLE)	0.565
Theta hat (MLE)	1.252	Theta star (bias corrected MLE)	1.347
nu hat (MLE)	32.84	nu star (bias corrected)	30.53
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (30.53, α)	18.91	Adjusted Chi Square Value (30.53, β)	18.32
95% Gamma Approximate UCL (use when n>=50)	1.23	95% Gamma Adjusted UCL (use when n<50)	1.269

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.802	SD (KM)	1.208
Variance (KM)	1.46	SE of Mean (KM)	0.254
k hat (KM)	0.441	k star (KM)	0.417
nu hat (KM)	23.8	nu star (KM)	22.49
theta hat (KM)	1.82	theta star (KM)	1.926
80% gamma percentile (KM)	1.3	90% gamma percentile (KM)	2.249
95% gamma percentile (KM)	3.286	99% gamma percentile (KM)	5.883

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (22.49, α)	12.71	Adjusted Chi Square Value (22.49, β)	12.24
95% Gamma Approximate KM-UCL (use when n>=50)	1.42	95% Gamma Adjusted KM-UCL (use when n<50)	1.474

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.251	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.766	Mean in Log Scale	-1.019
SD in Original Scale	1.166	SD in Log Scale	1.131
95% t UCL (assumes normality of ROS data)	1.148	95% Percentile Bootstrap UCL	1.149
95% BCA Bootstrap UCL	1.241	95% Bootstrap t UCL	1.341
95% H-UCL (Log ROS)	1.244		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.048	KM Geo Mean	0.351
KM SD (logged)	1.162	95% Critical H Value (KM-Log)	2.74
KM Standard Error of Mean (logged)	0.246	95% H-UCL (KM -Log)	1.286
KM SD (logged)	1.162	95% Critical H Value (KM-Log)	2.74
KM Standard Error of Mean (logged)	0.246		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.374	Mean in Log Scale	-0.697
SD in Original Scale	2.545	SD in Log Scale	1.345
95% t UCL (Assumes normality)	2.21	95% H-Stat UCL	2.716

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	1.907

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

F8A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	15
		Number of Missing Observations	1
Number of Detects	19	Number of Non-Detects	8
Number of Distinct Detects	13	Number of Distinct Non-Detects	2
Minimum Detect	0.05	Minimum Non-Detect	0.5
Maximum Detect	2.8	Maximum Non-Detect	5
Variance Detects	0.402	Percent Non-Detects	29.63%
Mean Detects	0.383	SD Detects	0.634
Median Detects	0.16	CV Detects	1.656
Skewness Detects	3.462	Kurtosis Detects	12.96
Mean of Logged Detects	-1.552	SD of Logged Detects	0.945

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.493	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.35	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.325	KM Standard Error of Mean	0.109
KM SD	0.537	95% KM (BCA) UCL	0.55
95% KM (t) UCL	0.51	95% KM (Percentile Bootstrap) UCL	0.524
95% KM (z) UCL	0.503	95% KM Bootstrap t UCL	0.845
90% KM Chebyshev UCL	0.651	95% KM Chebyshev UCL	0.799
97.5% KM Chebyshev UCL	1.004	99% KM Chebyshev UCL	1.407

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.133	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.326	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.204	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.979	k star (bias corrected MLE)	0.859
Theta hat (MLE)	0.391	Theta star (bias corrected MLE)	0.445
nu hat (MLE)	37.19	nu star (bias corrected)	32.65

Mean (detects)	0.383

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.329
Maximum	2.8	Median	0.16
SD	0.545	CV	1.655
k hat (MLE)	0.846	k star (bias corrected MLE)	0.777
Theta hat (MLE)	0.389	Theta star (bias corrected MLE)	0.424
nu hat (MLE)	45.7	nu star (bias corrected)	41.95
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (41.95, α)	28.11	Adjusted Chi Square Value (41.95, β)	27.38
95% Gamma Approximate UCL (use when n>=50)	0.492	95% Gamma Adjusted UCL (use when n<50)	0.505

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.325	SD (KM)	0.537
Variance (KM)	0.289	SE of Mean (KM)	0.109
k hat (KM)	0.365	k star (KM)	0.349
nu hat (KM)	19.69	nu star (KM)	18.83
theta hat (KM)	0.89	theta star (KM)	0.931
80% gamma percentile (KM)	0.514	90% gamma percentile (KM)	0.938
95% gamma percentile (KM)	1.413	99% gamma percentile (KM)	2.626

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (18.83, α)	9.996	Adjusted Chi Square Value (18.83, β)	9.585
95% Gamma Approximate KM-UCL (use when n>=50)	0.611	95% Gamma Adjusted KM-UCL (use when n<50)	0.638

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.856	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.261	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.327	Mean in Log Scale	-1.619
SD in Original Scale	0.537	SD in Log Scale	0.849
95% t UCL (assumes normality of ROS data)	0.503	95% Percentile Bootstrap UCL	0.52
95% BCA Bootstrap UCL	0.613	95% Bootstrap t UCL	0.81
95% H-UCL (Log ROS)	0.419		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.644	KM Geo Mean	0.193
KM SD (logged)	0.835	95% Critical H Value (KM-Log)	2.316
KM Standard Error of Mean (logged)	0.178	95% H-UCL (KM -Log)	0.4
KM SD (logged)	0.835	95% Critical H Value (KM-Log)	2.316

KM Standard Error of Mean (logged)	0.178

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.427	Mean in Log Scale	-1.418
SD in Original Scale	0.673	SD in Log Scale	0.917
95% t UCL (Assumes normality)	0.648	95% H-Stat UCL	0.57

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.799

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

F10A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	19
		Number of Missing Observations	1
Number of Detects	23	Number of Non-Detects	4
Number of Distinct Detects	16	Number of Distinct Non-Detects	3
Minimum Detect	1	Minimum Non-Detect	0.5
Maximum Detect	4.4	Maximum Non-Detect	25
Variance Detects	1.037	Percent Non-Detects	14.81%
Mean Detects	2.552	SD Detects	1.018
Median Detects	2.3	CV Detects	0.399
Skewness Detects	0.383	Kurtosis Detects	-0.858
Mean of Logged Detects	0.856	SD of Logged Detects	0.423

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.163	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.18	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	2.467	KM Standard Error of Mean	0.221
KM SD	1.058	95% KM (BCA) UCL	2.85
95% KM (t) UCL	2.843	95% KM (Percentile Bootstrap) UCL	2.821
95% KM (z) UCL	2.83	95% KM Bootstrap t UCL	2.872
90% KM Chebyshev UCL	3.129	95% KM Chebyshev UCL	3.429
97.5% KM Chebyshev UCL	3.845	99% KM Chebyshev UCL	4.663

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.378	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.129	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.312	k star (bias corrected MLE)	5.518
Theta hat (MLE)	0.404	Theta star (bias corrected MLE)	0.463
nu hat (MLE)	290.4	nu star (bias corrected)	253.8
Mean (detects)	2.552		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.636	Mean	2.462
Maximum	4.4	Median	2.3
SD	1.016	CV	0.413
k hat (MLE)	5.473	k star (bias corrected MLE)	4.889
Theta hat (MLE)	0.45	Theta star (bias corrected MLE)	0.503
nu hat (MLE)	295.5	nu star (bias corrected)	264
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (264.03, α)	227.4	Adjusted Chi Square Value (264.03, β)	225.2
95% Gamma Approximate UCL (use when n>=50)	2.858	95% Gamma Adjusted UCL (use when n<50)	2.886

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.467	SD (KM)	1.058
Variance (KM)	1.119	SE of Mean (KM)	0.221
k hat (KM)	5.438	k star (KM)	4.858
nu hat (KM)	293.6	nu star (KM)	262.4
theta hat (KM)	0.454	theta star (KM)	0.508
80% gamma percentile (KM)	3.326	90% gamma percentile (KM)	3.965
95% gamma percentile (KM)	4.548	99% gamma percentile (KM)	5.782

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (262.35, α)	225.8	Adjusted Chi Square Value (262.35, β)	223.7
95% Gamma Approximate KM-UCL (use when n>=50)	2.865	95% Gamma Adjusted KM-UCL (use when n<50)	2.893

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.134	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.18	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.46	Mean in Log Scale	0.813
SD in Original Scale	1.004	SD in Log Scale	0.441
95% t UCL (assumes normality of ROS data)	2.79	95% Percentile Bootstrap UCL	2.764
95% BCA Bootstrap UCL	2.805	95% Bootstrap t UCL	2.801
95% H-UCL (Log ROS)	2.934		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.791	KM Geo Mean	2.206
KM SD (logged)	0.509	95% Critical H Value (KM-Log)	1.978
KM Standard Error of Mean (logged)	0.106	95% H-UCL (KM -Log)	3.06
KM SD (logged)	0.509	95% Critical H Value (KM-Log)	1.978
KM Standard Error of Mean (logged)	0.106		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.831	Mean in Log Scale	0.839
SD in Original Scale	2.192	SD in Log Scale	0.672
95% t UCL (Assumes normality)	3.551	95% H-Stat UCL	3.841

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.843

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

F12A

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	8
Minimum	6.3	Mean	6.3
Maximum	6.3	Median	6.3

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable F12A was not processed!

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

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

F14A

General Statistics

Total Number of Observations	26	Number of Distinct Observations	20
		Number of Missing Observations	2
Number of Detects	24	Number of Non-Detects	2
Number of Distinct Detects	20	Number of Distinct Non-Detects	1
Minimum Detect	2.5	Minimum Non-Detect	25
Maximum Detect	32	Maximum Non-Detect	25
Variance Detects	101.2	Percent Non-Detects	7.692%
Mean Detects	17.85	SD Detects	10.06
Median Detects	18.5	CV Detects	0.564
Skewness Detects	-0.216	Kurtosis Detects	-1.341
Mean of Logged Detects	2.633	SD of Logged Detects	0.828

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.914	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.127	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.177	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	17.49	KM Standard Error of Mean	2.01
KM SD	9.779	95% KM (BCA) UCL	20.8
95% KM (t) UCL	20.92	95% KM (Percentile Bootstrap) UCL	20.76
95% KM (z) UCL	20.79	95% KM Bootstrap t UCL	20.71
90% KM Chebyshev UCL	23.52	95% KM Chebyshev UCL	26.25
97.5% KM Chebyshev UCL	30.04	99% KM Chebyshev UCL	37.49

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.127	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.18	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.16	k star (bias corrected MLE)	1.918
Theta hat (MLE)	8.264	Theta star (bias corrected MLE)	9.308
nu hat (MLE)	103.7	nu star (bias corrected)	92.05
Mean (detects)	17.85		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	2.5	Mean	17.46
Maximum	32	Median	18
SD	9.775	CV	0.56

k hat (MLE)	2.28	k star (bias corrected MLE)	2.043
Theta hat (MLE)	7.657	Theta star (bias corrected MLE)	8.547
nu hat (MLE)	118.6	nu star (bias corrected)	106.2
Adjusted Level of Significance (β)	0.0398		
Approximate Chi Square Value (106.21, α)	83.43	Adjusted Chi Square Value (106.21, β)	82.1
95% Gamma Approximate UCL (use when n>=50)	22.22	95% Gamma Adjusted UCL (use when n<50)	22.59

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	17.49	SD (KM)	9.779
Variance (KM)	95.63	SE of Mean (KM)	2.01
k hat (KM)	3.198	k star (KM)	2.855
nu hat (KM)	166.3	nu star (KM)	148.4
theta hat (KM)	5.468	theta star (KM)	6.126
80% gamma percentile (KM)	25.09	90% gamma percentile (KM)	31.36
95% gamma percentile (KM)	37.23	99% gamma percentile (KM)	49.98

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (148.45, α)	121.3	Adjusted Chi Square Value (148.45, β)	119.7
95% Gamma Approximate KM-UCL (use when n>=50)	21.4	95% Gamma Adjusted KM-UCL (use when n<50)	21.69

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.841	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.177	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	17.27	Mean in Log Scale	2.608
SD in Original Scale	9.892	SD in Log Scale	0.803
95% t UCL (assumes normality of ROS data)	20.59	95% Percentile Bootstrap UCL	20.4
95% BCA Bootstrap UCL	20.47	95% Bootstrap t UCL	20.72
95% H-UCL (Log ROS)	26.95		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.61	KM Geo Mean	13.59
KM SD (logged)	0.812	95% Critical H Value (KM-Log)	2.279
KM Standard Error of Mean (logged)	0.169	95% H-UCL (KM -Log)	27.37
KM SD (logged)	0.812	95% Critical H Value (KM-Log)	2.279
KM Standard Error of Mean (logged)	0.169		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	17.44	Mean in Log Scale	2.625
SD in Original Scale	9.758	SD in Log Scale	0.795
95% t UCL (Assumes normality)	20.71	95% H-Stat UCL	27.09

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 20.92

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

F18

General Statistics

Total Number of Observations	27	Number of Distinct Observations	14
		Number of Missing Observations	1
Number of Detects	19	Number of Non-Detects	8
Number of Distinct Detects	12	Number of Distinct Non-Detects	3
Minimum Detect	0.11	Minimum Non-Detect	0.2
Maximum Detect	2.6	Maximum Non-Detect	25
Variance Detects	0.886	Percent Non-Detects	29.63%
Mean Detects	0.834	SD Detects	0.941
Median Detects	0.4	CV Detects	1.128
Skewness Detects	1.041	Kurtosis Detects	-0.555
Mean of Logged Detects	-0.898	SD of Logged Detects	1.271

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.755	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.673	KM Standard Error of Mean	0.175
KM SD	0.85	95% KM (BCA) UCL	0.971
95% KM (t) UCL	0.972	95% KM (Percentile Bootstrap) UCL	0.964
95% KM (z) UCL	0.961	95% KM Bootstrap t UCL	1.071
90% KM Chebyshev UCL	1.198	95% KM Chebyshev UCL	1.436
97.5% KM Chebyshev UCL	1.766	99% KM Chebyshev UCL	2.414

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.325	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.776	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.236	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.206	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.825	k star (bias corrected MLE)	0.73
Theta hat (MLE)	1.011	Theta star (bias corrected MLE)	1.143
nu hat (MLE)	31.36	nu star (bias corrected)	27.74
Mean (detects)	0.834		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.661
Maximum	2.6	Median	0.2
SD	0.842	CV	1.274
k hat (MLE)	0.687	k star (bias corrected MLE)	0.635
Theta hat (MLE)	0.962	Theta star (bias corrected MLE)	1.04
nu hat (MLE)	37.08	nu star (bias corrected)	34.29
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (34.29, α)	21.9	Adjusted Chi Square Value (34.29, β)	21.27
95% Gamma Approximate UCL (use when n>=50)	1.035	95% Gamma Adjusted UCL (use when n<50)	1.065

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.673	SD (KM)	0.85
Variance (KM)	0.722	SE of Mean (KM)	0.175
k hat (KM)	0.628	k star (KM)	0.583
nu hat (KM)	33.9	nu star (KM)	31.47
theta hat (KM)	1.072	theta star (KM)	1.155
80% gamma percentile (KM)	1.11	90% gamma percentile (KM)	1.762
95% gamma percentile (KM)	2.448	99% gamma percentile (KM)	4.111

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (31.47, α)	19.65	Adjusted Chi Square Value (31.47, β)	19.05
95% Gamma Approximate KM-UCL (use when n>=50)	1.078	95% Gamma Adjusted KM-UCL (use when n<50)	1.112

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.833	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.197	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.66	Mean in Log Scale	-1.104
SD in Original Scale	0.834	SD in Log Scale	1.158
95% t UCL (assumes normality of ROS data)	0.933	95% Percentile Bootstrap UCL	0.934
95% BCA Bootstrap UCL	0.973	95% Bootstrap t UCL	1.021
95% H-UCL (Log ROS)	1.207		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.145	KM Geo Mean	0.318

KM SD (logged)	1.184	95% Critical H Value (KM-Log)	2.77
KM Standard Error of Mean (logged)	0.248	95% H-UCL (KM -Log)	1.22
KM SD (logged)	1.184	95% Critical H Value (KM-Log)	2.77
KM Standard Error of Mean (logged)	0.248		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.563	Mean in Log Scale	-0.787
SD in Original Scale	3.258	SD in Log Scale	1.459
95% t UCL (Assumes normality)	2.632	95% H-Stat UCL	3.276

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	1.436

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CH3B

General Statistics

Total Number of Observations	27	Number of Distinct Observations	17
		Number of Missing Observations	1
Minimum	80	Mean	105.8
Maximum	140	Median	100
SD	14.97	Std. Error of Mean	2.88
Coefficient of Variation	0.141	Skewness	0.519

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.17	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	110.8	95% Adjusted-CLT UCL (Chen-1995)	110.9
		95% Modified-t UCL (Johnson-1978)	110.8

Gamma GOF Test

A-D Test Statistic	0.495	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.161	**Kolmogorov-Smirnov Gamma GOF Test**

5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	53.37	k star (bias corrected MLE)	47.47
Theta hat (MLE)	1.983	Theta star (bias corrected MLE)	2.23
nu hat (MLE)	2882	nu star (bias corrected)	2563
MLE Mean (bias corrected)	105.8	MLE Sd (bias corrected)	15.36
		Approximate Chi Square Value (0.05)	2447
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	2439

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	110.9	95% Adjusted Gamma UCL (use when n<50)	111.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.382	Mean of logged Data	4.653
Maximum of Logged Data	4.942	SD of logged Data	0.139

Assuming Lognormal Distribution

95% H-UCL	111	90% Chebyshev (MVUE) UCL	114.4
95% Chebyshev (MVUE) UCL	118.2	97.5% Chebyshev (MVUE) UCL	123.6
99% Chebyshev (MVUE) UCL	134.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	110.6	95% Jackknife UCL	110.8
95% Standard Bootstrap UCL	110.4	95% Bootstrap-t UCL	110.9
95% Hall's Bootstrap UCL	110.8	95% Percentile Bootstrap UCL	110.5
95% BCA Bootstrap UCL	110.8		
90% Chebyshev(Mean, Sd) UCL	114.5	95% Chebyshev(Mean, Sd) UCL	118.4
97.5% Chebyshev(Mean, Sd) UCL	123.8	99% Chebyshev(Mean, Sd) UCL	134.5

Suggested UCL to Use

95% Student's-t UCL	110.8

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CH8A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	18
		Number of Missing Observations	1
Minimum	3	Mean	4.396
Maximum	6.6	Median	4.2
SD	0.746	Std. Error of Mean	0.144
Coefficient of Variation	0.17	Skewness	0.836

Normal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.138	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	4.641	95% Adjusted-CLT UCL (Chen-1995)	4.657
		95% Modified-t UCL (Johnson-1978)	4.645

Gamma GOF Test

A-D Test Statistic	0.356	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.121	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	37.58	k star (bias corrected MLE)	33.43
Theta hat (MLE)	0.117	Theta star (bias corrected MLE)	0.131
nu hat (MLE)	2029	nu star (bias corrected)	1805
MLE Mean (bias corrected)	4.396	MLE Sd (bias corrected)	0.76
		Approximate Chi Square Value (0.05)	1708
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	1702

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.647	95% Adjusted Gamma UCL (use when n<50)	4.664

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.12	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.099	Mean of logged Data	1.467
Maximum of Logged Data	1.887	SD of logged Data	0.166

Assuming Lognormal Distribution

95% H-UCL	4.654	90% Chebyshev (MVUE) UCL	4.818
95% Chebyshev (MVUE) UCL	5.01	97.5% Chebyshev (MVUE) UCL	5.276
99% Chebyshev (MVUE) UCL	5.798		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4.632	95% Jackknife UCL	4.641
95% Standard Bootstrap UCL	4.626	95% Bootstrap-t UCL	4.672
95% Hall's Bootstrap UCL	4.704	95% Percentile Bootstrap UCL	4.622
95% BCA Bootstrap UCL	4.647		
90% Chebyshev(Mean, Sd) UCL	4.826	95% Chebyshev(Mean, Sd) UCL	5.022
97.5% Chebyshev(Mean, Sd) UCL	5.292	99% Chebyshev(Mean, Sd) UCL	5.824

Suggested UCL to Use

95% Student's-t UCL	4.641

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CH10A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	23
		Number of Missing Observations	1
Minimum	23	Mean	68.04
Maximum	190	Median	58
SD	46.78	Std. Error of Mean	9.003
Coefficient of Variation	0.688	Skewness	1.522

Normal GOF Test

Shapiro Wilk Test Statistic	0.8	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.923	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.189	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.167	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	83.39	95% Adjusted-CLT UCL (Chen-1995)	85.66
		95% Modified-t UCL (Johnson-1978)	83.83

Gamma GOF Test

A-D Test Statistic	0.869	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.143	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.17	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.768	k star (bias corrected MLE)	2.485
Theta hat (MLE)	24.58	Theta star (bias corrected MLE)	27.38
nu hat (MLE)	149.5	nu star (bias corrected)	134.2
MLE Mean (bias corrected)	68.04	MLE Sd (bias corrected)	43.16
		Approximate Chi Square Value (0.05)	108.4
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	107

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	84.2	95% Adjusted Gamma UCL (use when n<50)	85.37

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.136	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.135	Mean of logged Data	4.029
Maximum of Logged Data	5.247	SD of logged Data	0.613

Assuming Lognormal Distribution

95% H-UCL	87.04	90% Chebyshev (MVUE) UCL	92.56
95% Chebyshev (MVUE) UCL	104	97.5% Chebyshev (MVUE) UCL	119.9
99% Chebyshev (MVUE) UCL	151.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	82.85	95% Jackknife UCL	83.39
95% Standard Bootstrap UCL	82.47	95% Bootstrap-t UCL	87.95
95% Hall's Bootstrap UCL	85.98	95% Percentile Bootstrap UCL	83.04
95% BCA Bootstrap UCL	85.52		
90% Chebyshev(Mean, Sd) UCL	95.04	95% Chebyshev(Mean, Sd) UCL	107.3
97.5% Chebyshev(Mean, Sd) UCL	124.3	99% Chebyshev(Mean, Sd) UCL	157.6

Suggested UCL to Use

95% Adjusted Gamma UCL	85.37

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CH12A

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	8
Minimum	150	Mean	150
Maximum	150	Median	150

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable CH12A was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

CH14A

General Statistics

Total Number of Observations	26	Number of Distinct Observations	22
		Number of Missing Observations	2
Minimum	47	Mean	105.8
Maximum	210	Median	94
SD	50.26	Std. Error of Mean	9.856
Coefficient of Variation	0.475	Skewness	0.685

Normal GOF Test

Shapiro Wilk Test Statistic	0.892	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.17	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	122.7	95% Adjusted-CLT UCL (Chen-1995)	123.5
		95% Modified-t UCL (Johnson-1978)	122.9

Gamma GOF Test

A-D Test Statistic	0.769	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.175	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.172	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.876	k star (bias corrected MLE)	4.339
Theta hat (MLE)	21.71	Theta star (bias corrected MLE)	24.39
nu hat (MLE)	253.6	nu star (bias corrected)	225.6
MLE Mean (bias corrected)	105.8	MLE Sd (bias corrected)	50.81
		Approximate Chi Square Value (0.05)	191.9
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	189.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	124.5	95% Adjusted Gamma UCL (use when n<50)	125.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.158	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.85	Mean of logged Data	4.556
Maximum of Logged Data	5.347	SD of logged Data	0.468

Assuming Lognormal Distribution

95% H-UCL	127.4	90% Chebyshev (MVUE) UCL	135.9
95% Chebyshev (MVUE) UCL	149.6	97.5% Chebyshev (MVUE) UCL	168.6
99% Chebyshev (MVUE) UCL	205.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	122.1	95% Jackknife UCL	122.7
95% Standard Bootstrap UCL	121.7	95% Bootstrap-t UCL	124.1
95% Hall's Bootstrap UCL	123.4	95% Percentile Bootstrap UCL	122.5
95% BCA Bootstrap UCL	123.2		
90% Chebyshev(Mean, Sd) UCL	135.4	95% Chebyshev(Mean, Sd) UCL	148.8
97.5% Chebyshev(Mean, Sd) UCL	167.4	99% Chebyshev(Mean, Sd) UCL	203.9

Suggested UCL to Use

95% Student's-t UCL	122.7	or 95% Modified-t UCL	122.9
or 95% H-UCL	127.4		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

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.

CH18

General Statistics

Total Number of Observations	27	Number of Distinct Observations	17
		Number of Missing Observations	1
Minimum	59	Mean	81.22
Maximum	100	Median	81
SD	9.951	Std. Error of Mean	1.915
Coefficient of Variation	0.123	Skewness	-0.135

Normal GOF Test

Shapiro Wilk Test Statistic	0.977	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.115	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.167	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	84.49	95% Adjusted-CLT UCL (Chen-1995)	84.32
		95% Modified-t UCL (Johnson-1978)	84.48

Gamma GOF Test

A-D Test Statistic	0.305	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.13	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	67.26	k star (bias corrected MLE)	59.81
Theta hat (MLE)	1.208	Theta star (bias corrected MLE)	1.358
nu hat (MLE)	3632	nu star (bias corrected)	3230
MLE Mean (bias corrected)	81.22	MLE Sd (bias corrected)	10.5
		Approximate Chi Square Value (0.05)	3099
Adjusted Level of Significance	0.0401	Adjusted Chi Square Value	3091

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	84.66	95% Adjusted Gamma UCL (use when n<50)	84.88

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.968	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.923	Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.14	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.167	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.078	Mean of logged Data	4.39
Maximum of Logged Data	4.605	SD of logged Data	0.126

Assuming Lognormal Distribution

95% H-UCL	84.78	90% Chebyshev (MVUE) UCL	87.14
95% Chebyshev (MVUE) UCL	89.81	97.5% Chebyshev (MVUE) UCL	93.53
99% Chebyshev (MVUE) UCL	100.8		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	84.37	95% Jackknife UCL	84.49
95% Standard Bootstrap UCL	84.4	95% Bootstrap-t UCL	84.36
95% Hall's Bootstrap UCL	84.32	95% Percentile Bootstrap UCL	84.33
95% BCA Bootstrap UCL	84.33		
90% Chebyshev(Mean, Sd) UCL	86.97	95% Chebyshev(Mean, Sd) UCL	89.57
97.5% Chebyshev(Mean, Sd) UCL	93.18	99% Chebyshev(Mean, Sd) UCL	100.3

Suggested UCL to Use

95% Student's-t UCL	84.49

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

CY3B

General Statistics

Total Number of Observations	28	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	26
Number of Distinct Detects	2	Number of Distinct Non-Detects	3
Minimum Detect	0.006	Minimum Non-Detect	0.0025
Maximum Detect	0.01	Maximum Non-Detect	0.01
Variance Detects	8.0000E-6	Percent Non-Detects	92.86%
Mean Detects	0.008	SD Detects	0.00283
Median Detects	0.008	CV Detects	0.354
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-4.861	SD of Logged Detects	0.361

Warning: Data set has only 2 Detected Values.

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

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00292	KM Standard Error of Mean	4.2130E-4
KM SD	0.00154	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00364	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00361	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00419	95% KM Chebyshev UCL	0.00476
97.5% KM Chebyshev UCL	0.00555	99% KM Chebyshev UCL	0.00711

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	15.66	k star (bias corrected MLE)	N/A
Theta hat (MLE)	5.1087E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	62.64	nu star (bias corrected)	N/A
Mean (detects)	0.008		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00292	SD (KM)	0.00154
Variance (KM)	2.3684E-6	SE of Mean (KM)	4.2130E-4
k hat (KM)	3.603	k star (KM)	3.241
nu hat (KM)	201.8	nu star (KM)	181.5
theta hat (KM)	8.1074E-4	theta star (KM)	9.0136E-4
80% gamma percentile (KM)	0.00413	90% gamma percentile (KM)	0.0051
95% gamma percentile (KM)	0.006	99% gamma percentile (KM)	0.00794

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0404
Approximate Chi Square Value (181.49, α)	151.3	Adjusted Chi Square Value (181.49, β)	149.6
95% Gamma Approximate KM-UCL (use when n>=50)	0.0035	95% Gamma Adjusted KM-UCL (use when n<50)	0.00354

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00192	Mean in Log Scale	-6.631
SD in Original Scale	0.00203	SD in Log Scale	0.855
95% t UCL (assumes normality of ROS data)	0.00257	95% Percentile Bootstrap UCL	0.00259
95% BCA Bootstrap UCL	0.00286	95% Bootstrap t UCL	0.00308
95% H-UCL (Log ROS)	0.00277		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.904	KM Geo Mean	0.00273
KM SD (logged)	0.307	95% Critical H Value (KM-Log)	1.806

KM Standard Error of Mean (logged)	0.0853	95% H-UCL (KM -Log)	0.00318
KM SD (logged)	0.307	95% Critical H Value (KM-Log)	1.806
KM Standard Error of Mean (logged)	0.0853		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00325	Mean in Log Scale	-5.836
SD in Original Scale	0.0018	SD in Log Scale	0.446
95% t UCL (Assumes normality)	0.00383	95% H-Stat UCL	0.0038

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.00364	KM H-UCL	0.00318
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CY8A

General Statistics

Total Number of Observations	28	Number of Distinct Observations	4
Number of Detects	0	Number of Non-Detects	28
Number of Distinct Detects	0	Number of Distinct Non-Detects	4

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable CY8A was not processed!

CY10A

General Statistics

Total Number of Observations	28	Number of Distinct Observations	14
Number of Detects	22	Number of Non-Detects	6
Number of Distinct Detects	12	Number of Distinct Non-Detects	3
Minimum Detect	0.005	Minimum Non-Detect	0.0025
Maximum Detect	0.08	Maximum Non-Detect	0.01
Variance Detects	3.2371E-4	Percent Non-Detects	21.43%
Mean Detects	0.0312	SD Detects	0.018
Median Detects	0.03	CV Detects	0.576
Skewness Detects	0.508	Kurtosis Detects	1.288

Mean of Logged Detects	-3.702	SD of Logged Detects	0.803

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.906	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.156	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.184	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0251	KM Standard Error of Mean	0.00377
KM SD	0.0195	95% KM (BCA) UCL	0.0316
95% KM (t) UCL	0.0316	95% KM (Percentile Bootstrap) UCL	0.0314
95% KM (z) UCL	0.0313	95% KM Bootstrap t UCL	0.0318
90% KM Chebyshev UCL	0.0364	95% KM Chebyshev UCL	0.0416
97.5% KM Chebyshev UCL	0.0487	99% KM Chebyshev UCL	0.0626

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.441	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.188	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.275	k star (bias corrected MLE)	1.995
Theta hat (MLE)	0.0137	Theta star (bias corrected MLE)	0.0157
nu hat (MLE)	100.1	nu star (bias corrected)	87.78
Mean (detects)	0.0312		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.005	Mean	0.0267
Maximum	0.08	Median	0.03
SD	0.0182	CV	0.681
k hat (MLE)	1.991	k star (bias corrected MLE)	1.801
Theta hat (MLE)	0.0134	Theta star (bias corrected MLE)	0.0148
nu hat (MLE)	111.5	nu star (bias corrected)	100.9
Adjusted Level of Significance (β)	0.0404		
Approximate Chi Square Value (100.87, α)	78.7	Adjusted Chi Square Value (100.87, β)	77.49
95% Gamma Approximate UCL (use when n>=50)	0.0342	95% Gamma Adjusted UCL (use when n<50)	0.0347

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0251	SD (KM)	0.0195
Variance (KM)	3.7887E-4	SE of Mean (KM)	0.00377
k hat (KM)	1.668	k star (KM)	1.513

nu hat (KM)	93.43	nu star (KM)	84.75
theta hat (KM)	0.0151	theta star (KM)	0.0166
80% gamma percentile (KM)	0.0389	90% gamma percentile (KM)	0.0523
95% gamma percentile (KM)	0.0653	99% gamma percentile (KM)	0.0947

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (84.75, α)	64.53	Adjusted Chi Square Value (84.75, β)	63.44
95% Gamma Approximate KM-UCL (use when n>=50)	0.033	95% Gamma Adjusted KM-UCL (use when n<50)	0.0336

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.819	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.29	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.184	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0257	Mean in Log Scale	-4.042
SD in Original Scale	0.0192	SD in Log Scale	0.98
95% t UCL (assumes normality of ROS data)	0.0319	95% Percentile Bootstrap UCL	0.0318
95% BCA Bootstrap UCL	0.0316	95% Bootstrap t UCL	0.0326
95% H-UCL (Log ROS)	0.0449		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.176	KM Geo Mean	0.0154
KM SD (logged)	1.15	95% Critical H Value (KM-Log)	2.645
KM Standard Error of Mean (logged)	0.223	95% H-UCL (KM -Log)	0.0534
KM SD (logged)	1.15	95% Critical H Value (KM-Log)	2.645
KM Standard Error of Mean (logged)	0.223		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0251	Mean in Log Scale	-4.193
SD in Original Scale	0.0199	SD in Log Scale	1.205
95% t UCL (Assumes normality)	0.0315	95% H-Stat UCL	0.0587

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0316

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CY12A

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	8
Number of Detects	0	Number of Non-Detects	1
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: This data set only has 1 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable CY12A was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

CY14A

General Statistics

Total Number of Observations	27	Number of Distinct Observations	20
		Number of Missing Observations	1
Number of Detects	25	Number of Non-Detects	2
Number of Distinct Detects	20	Number of Distinct Non-Detects	1
Minimum Detect	0.005	Minimum Non-Detect	0.005
Maximum Detect	0.35	Maximum Non-Detect	0.005
Variance Detects	0.00931	Percent Non-Detects	7.407%
Mean Detects	0.108	SD Detects	0.0965
Median Detects	0.086	CV Detects	0.892
Skewness Detects	0.789	Kurtosis Detects	-0.131
Mean of Logged Detects	-2.792	SD of Logged Detects	1.241

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.889	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.918	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.173	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.101	KM Standard Error of Mean	0.0186
KM SD	0.0949	95% KM (BCA) UCL	0.133
95% KM (t) UCL	0.132	95% KM (Percentile Bootstrap) UCL	0.131
95% KM (z) UCL	0.131	95% KM Bootstrap t UCL	0.137
90% KM Chebyshev UCL	0.157	95% KM Chebyshev UCL	0.182
97.5% KM Chebyshev UCL	0.217	99% KM Chebyshev UCL	0.286

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.642	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.773	Detected data appear Gamma Distributed at 5% Significance Level	

K-S Test Statistic	0.149	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.18	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.013	k star (bias corrected MLE)	0.919
Theta hat (MLE)	0.107	Theta star (bias corrected MLE)	0.118
nu hat (MLE)	50.67	nu star (bias corrected)	45.93
Mean (detects)	0.108		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.005	Mean	0.101
Maximum	0.35	Median	0.066
SD	0.0964	CV	0.954
k hat (MLE)	0.92	k star (bias corrected MLE)	0.843
Theta hat (MLE)	0.11	Theta star (bias corrected MLE)	0.12
nu hat (MLE)	49.71	nu star (bias corrected)	45.52
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (45.52, α)	31.04	Adjusted Chi Square Value (45.52, β)	30.27
95% Gamma Approximate UCL (use when n>=50)	0.148	95% Gamma Adjusted UCL (use when n<50)	0.152

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.101	SD (KM)	0.0949
Variance (KM)	0.00901	SE of Mean (KM)	0.0186
k hat (KM)	1.123	k star (KM)	1.023
nu hat (KM)	60.65	nu star (KM)	55.24
theta hat (KM)	0.0896	theta star (KM)	0.0983
80% gamma percentile (KM)	0.162	90% gamma percentile (KM)	0.23
95% gamma percentile (KM)	0.299	99% gamma percentile (KM)	0.458

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (55.24, α)	39.16	Adjusted Chi Square Value (55.24, β)	38.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.142	95% Gamma Adjusted KM-UCL (use when n<50)	0.145

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.918	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.186	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.173	Detected Data Not Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.1	Mean in Log Scale	-3.005
SD in Original Scale	0.0968	SD in Log Scale	1.419
95% t UCL (assumes normality of ROS data)	0.132	95% Percentile Bootstrap UCL	0.133

95% BCA Bootstrap UCL	0.135	95% Bootstrap t UCL	0.136
95% H-UCL (Log ROS)	0.323		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.978	KM Geo Mean	0.0509
KM SD (logged)	1.342	95% Critical H Value (KM-Log)	2.998
KM Standard Error of Mean (logged)	0.264	95% H-UCL (KM -Log)	0.276
KM SD (logged)	1.342	95% Critical H Value (KM-Log)	2.998
KM Standard Error of Mean (logged)	0.264		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.1	Mean in Log Scale	-3.029
SD in Original Scale	0.0969	SD in Log Scale	1.467
95% t UCL (Assumes normality)	0.132	95% H-Stat UCL	0.355

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	0.145

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

CY18

General Statistics

Total Number of Observations	28	Number of Distinct Observations	4
Number of Detects	1	Number of Non-Detects	27
Number of Distinct Detects	1	Number of Distinct Non-Detects	3

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).

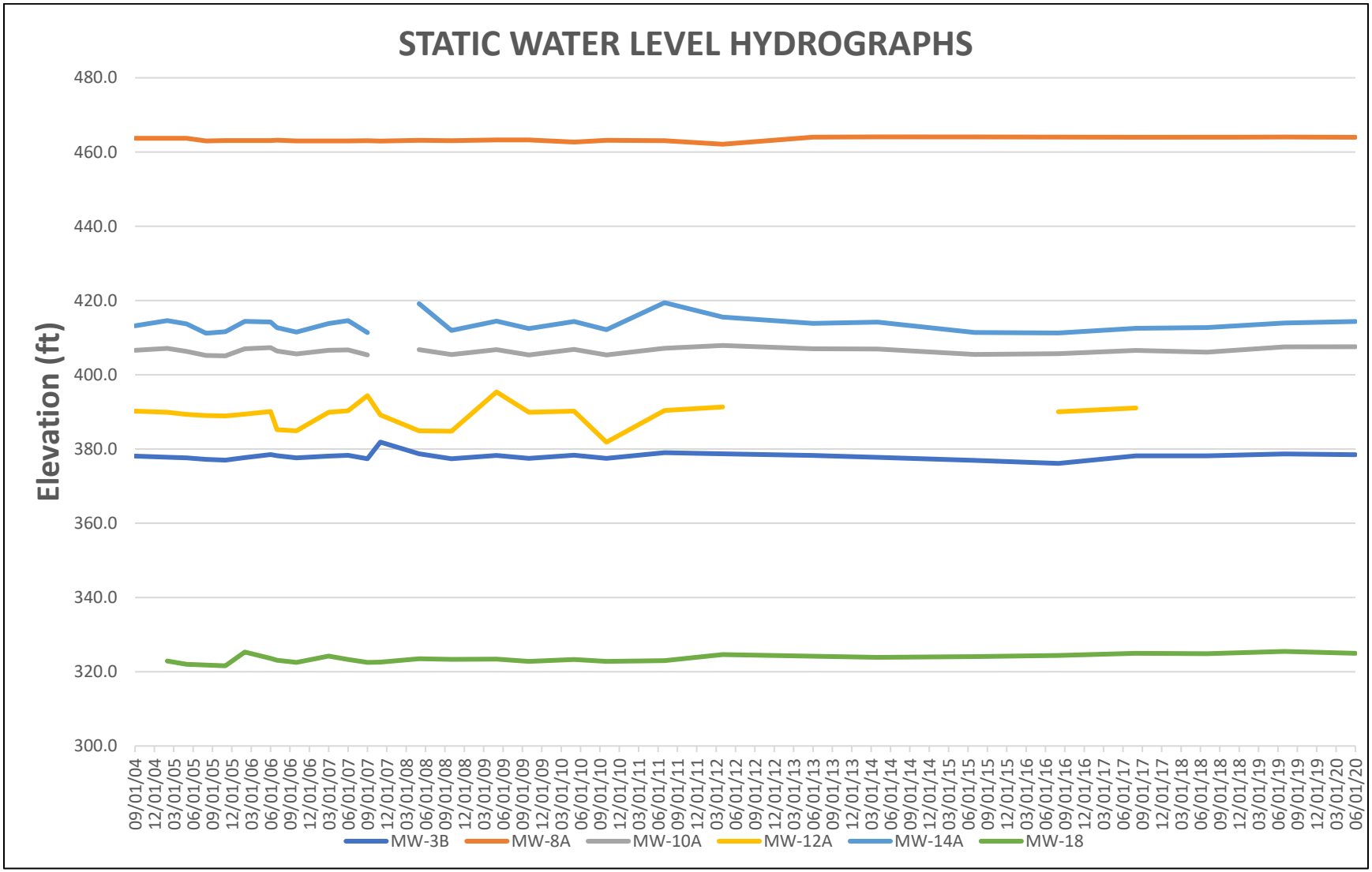
The data set for variable CY18 was not processed!

Appendix B7
Calculator Input Table

Date	S3B	D_S3B	S8A	D_S8A	S10A	D_S10A	S12A	D_S12A	S14A	D_S14A	S18	D_S18	F3B	D_F3B	F8A	D_F8A	F10A	D_F10A	F12A	D_F12A	F14A	D_F14A	F18	D_F18	CH3B	D_CH3B	CH8A	D_CH8A	CH10A	D_CH10A	CH12A	D_CH12A	CH14A	D_CH14A	CH18	D_CH18	CY3B	D_CY3B	CY8A	D_CY8A	CY10A	D_CY10A	CY12A	D_CY12A	CY14A	D_CY14A	CY18	D_CY18
2/16/2005	2300	1	10	1	940	1			4000	1	1500	1	0.6	1	0.9	1	1.8	1			9.6	1	0.6	1	130	1	5.6	1	29	1			110	1	86	1	0.005	0	0.005	0	0.04	1			0.35	1	0.005	0
5/11/2005	2500	1	9.8	1	910	1			3500	1	1300	1	0.4	1	0.3	1	1.5	1			8.6	1	0.4	1	140	1	4.6	1	31	1			90	1	91	1	0.005	0	0.005	0	0.05	1			0.24	1	0.005	0
8/29/2005	2700	1	8.9	1	670	1			3600	1	1500	1	0.6	1	0.4	1	1.2	1			30	1	0.4	1	120	1	4.2	1	28	1			71	1	75	1	0.005	0	0.005	0	0.04	1			0.27	1	0.005	0
11/1/2005	2600	1	9.6	1	670	1			2800	1	1300	1	0.9	1	0.9	1	2.7	1			25	1	1.8	1	130	1	4.7	1	28	1			75	1	84	1	0.005	0	0.005	0	0.03	1			0.19	1	0.005	0
2/27/2006	2610	1	9.27	1	1570	1			2170	1	1520	1	0.7	1	2.8	1	2.3	1			31	1	0.9	1	118	1	4.2	1	43	1			53	1	83	1	0.005	0	0.005	0	0.03	1			0.19	1	0.005	0
6/5/2006	2220	1	9.8	1	1650	1			2380	1	1490	1	0.2	1	0.2	1	3.2	1			27	1	0.2	0	113	1	4.9	1	48	1			63	1	91	1	0.005	0	0.025	0	0.03	1			0.2	1	0.005	0
7/31/2006	2000	1	9.8	1	860	1			3300	1	1500	1	3.7	1	0.1	1	2.3	1			30	1	2.6	1	110	1	4.6	1	35	1			98	1	89	1	0.005	0	0.005	0	0.08	1			0.17	1	0.005	0
10/9/2006	2500	1	9.7	1	850	1			3900	1	1600	1	3.8	1	0.1	1	1.9	1			24	1	2.4	1	110	1	4.5	1	30	1			130	1	80	1	0.005	0	0.005	0	0.03	1			0.01	1	0.005	0
3/13/2007	2500	1	10	1	1100	1	1800	1	4400	1	1600	1	3.8	1	0.05	1	3.4	1	6.3	1	16	1	2.6	1	110	1	6.6	1	45	1	150	1	140	1	93	1	0.005	0	0.005	0	0.04	1	0.005	0	0.12	1	0.005	0
6/22/2007	2500	1	0.5	0	1100	1			7900	1	1700	1	5	0	5	0	5	0			19	1	0.5	0	97	1	4.89	1	36	1			170	1	77	1	0.005	0	0.005	0	0.005	1			0.005	0	0.005	0
9/24/2007	2200	1	10	1	760	1			6400	1	1400	1	0.5	0	0.5	0	1.2	1			25	0	25	0	124.79	1	4.2	1	30	1			200	1	100	1	0.005	0	0.005	0	0.04	1			0.03	1	0.005	0
11/14/2007																																					0.005	0	0.005	0	0.043	1			0.005	1	0.005	0
5/8/2008	2200	1	10	1	2700	1			5500	1	1300	1	25	0	0.5	0	25	0			25	0	25	0	100	1	4	1	100	1			100	1	70	1	0.005	0	0.005	0	0.05	1			0.19	1	0.005	0
10/14/2008	2600	1	10	1	860	1			6500	1	1600	1	5	0	0.1	1	5	0			20	1	0.5	0	100	1	4.5	1	30	1			180	1	80	1	0.005	0	0.005	0	0.04	1			0.12	1	0.005	0
5/29/2009	2200	1	9	1	2000	1			7000	1	1500	1	0.5	0	0.5	0	2	1			30	1	1	1	96	1	3	1	68	1			210	1	81	1	0.01	0	0.01	0	0.03	1			0.14	1	0.005	0
10/27/2009	2606	1	10	1	760	1			5900	1	1200	1	0.5	0	0.5	0	0.5	0			24	1	0.5	0	110	1	5.5	1	79	1			160	1	70	1	0.01	0	0.01	0	0.01	0			0.044	1	0.005	0
5/26/2010	2300	1	9.3	1	2200	1			5200	1	1500	1	2.3	1	0.5	0	4.4	1			32	1	2	1	120	1	4.4	1	83	1			170	1	100	1	0.01	0	0.01	0	0.032	1			0.14	1	0.01	0
10/6/2010	2400	1	8.9	1	710	1			4000	1	1600	1	0.5	0	0.5	0	1	1			18	1	0.5	0	110	1	3.6	1	23	1			120	1	84	1	0.01	0	0.01	0	0.022	1			0.086	1	0.01	0
7/26/2011	2000	1	7.8	1	1800	1			3900	1	1600	1	0.5	0	0.5	0	3.3	1			23	1	0.5	0	98	1	3.6	1	62	1			130	1	89	1	0.01	0	0.01	0	0.028	1			0.066	1	0.01	0
4/19/2012	2200	1	10	1	5800	1					1700	1	0.16	1	0.18	1	1.9	1					0.2	1	90	1	3.8	1	180	1					79	1	0.0025	0	0.0025	0	0.007	1					0.0025	0
6/20/2013	1900	1	9.4	1	4700	1			2300	1	1500	1	0.16	1	0.16	1	3.1	1			17	1	0.13	1	91	1	4.8	1	99	1			66	1	84	1	0.006	1	0.0025	0	0.008	1			0.028	1	0.0025	0
4/25/2014	2000	1	9.5	1	6100	1			2100	1	1700	1	0.18	1	0.19	1	2	1			18	1	0.12	1	91	1	4.9	1	190	1			61	1	79	1	0.0025	0	0.0025	0	0.0025	0			0.037	1	0.0025	0
7/20/2015	1900	1	9.5	1	1900	1			1100	1	1300	1	0.14	1	0.16	1	2	1			6.8	1	0.11	1	80	1	4.2	1	58	1			47	1	86	1	0.005	0	0.005	0	0.005	0			0.008	1	0.005	0
8/2/2016	1900	1	9.3	1	3500	1			1400	1	1700	1	0.12	1	0.13	1	2.1	1			3.5	1	0.12	1	98	1	4.1	1	82	1			61	1	79	1	0.005	0	0.005	0	0.005	0			0.019	1	0.005	0
8/9/2017	1700	1	9.6	1	2900	1			1700	1	1300	1	0.15	1	0.15	1	3.2	1			2.5	1	0.11	1	95	1	4.1	1	170	1			68	1	59	1	0.01	1	0.005	0	0.005	0			0.017	1	0.086	1
7/26/2018	1800	1	9.5	1	4800	1			1800	1	1400	1	0.16	1	0.15	1	4.1	1			3.6	1	0.11	1	95	1	3.2	1	71	1			66	1	69	1	0.005	0	0.005	0	0.005	0			0.005	0	0.005	0
7/24/2019	1500	1	5.4	1	4000	1			1700	1	1200	1	0.15	1	0.14	1	3.7	1			2.8	1	0.12	1	93	1	4.1	1	82	1			64	1	68	1	0.005	0	0.005	0	0.006	1			0.018	1	0.005	0
6/30/2020	1700	1	11	1	5700	1			2000	1	1400	1	0.14	1	0.16	1	4.4	1			7	1	0.13	1	88	1	3.9	1	77	1			49	1	67	1	0.005	0	0.005	0	0.006	1			0.018	1	0.005	0

Appendix C – Groundwater Levels

Appendix C1
Monitoring Wells Hydrographs


STATIC WATER LEVEL HYDROGRAPHS
Elevation (ft)
480.0
460.0
440.0
420.0
400.0
380.0
360.0
340.0
320.0
300.0
09/01/04
12/01/04
03/01/05
06/01/05
09/01/05
12/01/05
03/01/06
06/01/06
09/01/06
12/01/06
03/01/07
06/01/07
09/01/07
12/01/07
03/01/08
06/01/08
09/01/08
12/01/08
03/01/09
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12/01/17
03/01/18
06/01/18
09/01/18
12/01/18
03/01/19
06/01/19
09/01/19
12/01/19
03/01/20
06/01/20
MW-3B
MW-8A
MW-10A
MW-12A
MW-14A
MW-18

Appendix C2
Static Water Levels

GROUNDWATER STATIC WATER LEVEL ELEVATIONS

		Well ID					
		MW-3B	MW-8A	MW-10A	MW-12A	MW-14A	MW-18
Elevation (ft.)	Ground	408	490	425	439	429	346
	PVC	410.97	492.97	427.95	441.38	431.65	348.40
Water Level Elevation from PVC (ft.)	09/08/04	378.1	463.7	406.6	390.2	413.2	NA [a]
	02/16/05	377.8	463.7	407.1	389.9	414.6	322.9
	05/11/05	377.6	463.7	406.3	389.3	413.7	322.0
	08/29/05	377.2	463.0	405.2	389.0	411.2	321.8
	11/01/05	377.0	463.1	405.1	388.9	411.6	321.6
	02/27/06	377.7	463.1	407.0	389.4	414.4	325.3
	06/05/06	378.5	463.1	407.3	390.1	414.2	323.6
	07/31/06	378.2	463.2	406.4	385.2	412.7	323.1
	10/09/06	377.6	463.0	405.6	384.9	411.5	322.5
	03/13/07	378.1	463.0	406.6	389.9	413.8	324.2
	06/22/07	378.3	463.0	406.7	390.3	414.6	323.3
	09/24/07	377.4	463.1	405.4	394.4	411.4	322.5
	11/14/07	381.9	463.0	NA [b]	389.2	NA [b]	322.6
	05/08/08	378.7	463.2	406.8	384.9	419.2	323.5
	10/14/08	377.4	463.1	405.5	384.8	412.0	323.3
	05/28/09	378.3	463.3	406.8	395.4	414.5	323.4
	10/27/09	377.5	463.3	405.4	389.9	412.5	322.8
	05/26/10	378.3	462.7	406.9	390.2	414.4	323.3
	10/06/10	377.5	463.2	405.4	381.9	412.2	322.8
	07/06/11	379.0	463.1	407.2	390.4	419.5	323.0
	04/17/12	378.7	462.1	407.9	391.3	415.5	324.6
	6/20/2013	378.27	464.02	407	dry	413.85	324.18
	4/25/2014	377.8	464.1	407.0	dry	414.2	323.9
	7/20/2015	376.9	464.1	405.5	dry	411.4	324.1
	8/2/2016	376.12	464.00	405.68	390.04	411.25	324.40
	8/8/2017	378.17	463.97	406.55	391.05	412.50	324.96
	7/26/2018	378.16	464.00	406.10	dry	412.72	324.85
	7/24/2019	378.68	464.05	407.5	dry	413.93	325.5
	6/20/2020	378.46	463.97	407.56	dry	414.35	324.98

Notes: [a] Well was not in operation at this time. [b] Field sheets for MW-10A and MW-14A are missing for 5/8/2008.