



# 2018 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

*Byproduct Storage Area B*

*St. Johns River Power Park*

*Jacksonville, Florida*

Submitted to:

**JEASJRPP**

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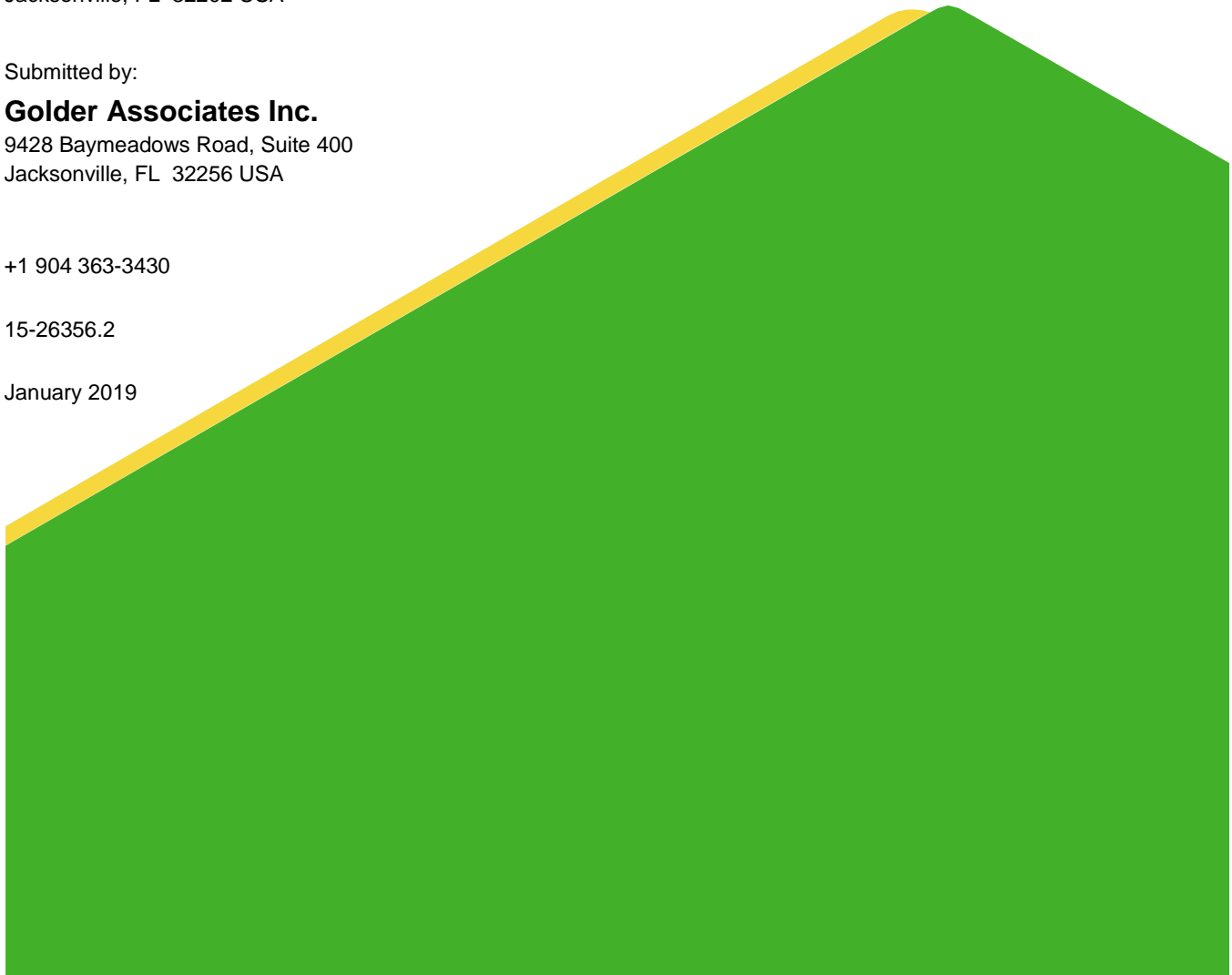
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January 2019



## Distribution List

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## 1.0 INTRODUCTION

Pursuant to the Coal Combustion Residual (CCR) Rule<sup>1</sup>, this Annual Groundwater Monitoring and Corrective Action report has been prepared for the Byproduct Storage Area B (Area B) at the St. Johns River Power Park (SJRPP) on behalf of JEA. This Annual Report has been prepared to meet the requirements of §257.90(e).

### 1.1 Site Information and Background

The SJRPP facility is located at 11201 New Berlin Road in Jacksonville, Florida. A site location map is provided as Figure 1. SJRPP consists of two coal fired steam-electric generation units and associated facilities, and decommissioning began in 2018. The primary CCRs generated at SJRPP include fly ash, bottom ash, and synthetic gypsum, a flue gas desulfurization product. Phase I of Area B encompasses approximately 30 acres in the northeast portion of the SJRPP. Area B Phase I is an active unlined landfill cell receiving residual CCR that are not sold for off-site beneficial use.

### 1.2 Site Hydrogeology

The main hydrogeologic units at Area B are an unconfined surficial aquifer system and the Floridan aquifer system (Golder, 2007 and Geosyntec, 2013). The surficial aquifer system, which is the uppermost water bearing unit at Area B, is subdivided into three zones: 1) upper, 2) intermediate, and 3) deep zones. The underlying Hawthorn Group (generally encountered at about 98 to 106 feet below ground surface at Area B) consists of low-permeability sediments (i.e., silty clays, clayey silts, and sandy clays) that are confining units for the deeper Floridan aquifer. The upper zone of the surficial aquifer is the most transmissive zone of the surficial aquifer (Golder, 2007). The prevailing directions of groundwater flow in the upper zone of the surficial aquifer are generally from the northwest to east with southeastern components of flow. The groundwater flow velocity is approximately 17 feet/year. The average hydraulic conductivity, of the upper zone of the surficial aquifer, determined from slug tests of monitoring wells, is approximately 5 feet/day.

### 1.3 CCR Groundwater Monitoring Well Network

The CCR groundwater monitoring network for BSA-B at SJRPP consists of three background monitoring wells (CCR-1, CCR-2 and CCR-3) and four downgradient monitoring wells (CCR-4, CCR-5, CCR-6 and CCR-7). Background and downgradient monitoring wells have been installed with screen intervals in the upper zone of the surficial aquifer (total depth of approximately 20 feet below ground surface). The background wells (CCR-1, CCR-2 and CCR-3) are located such that they represent background groundwater quality that has not been affected by a CCR unit and represent groundwater quality in the same zone as the downgradient monitoring wells. Downgradient monitoring wells (CCR-4 through CCR-7) have been installed as close as practical to the waste boundary to accurately represent the quality of groundwater passing the waste boundary. The monitoring wells have been encased in a manner that maintains the integrity of the monitoring well borehole. CCR groundwater monitoring well locations (CCR-1 through CCR-7) are shown on **Figure 1** and monitoring well construction data are provided in **Table 1**.

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<sup>1</sup> 40 Code of Federal Regulations Part 257 (40 CFR 257), Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, Published in Federal Register / Vol. 80, No. 74, April 17, 2015.

## 2.0 CCR GROUNDWATER MONITORING ACTIVITIES

A statistical significant increase (SSI) analysis of detection monitoring event performed October 11, 2017 indicated a number of SSIs of Appendix III constituents for downgradient wells above background concentrations. The SSI determination was made on January 15, 2018. Pursuant to §257.94(e)(1), an assessment monitoring program was established for Area B. The SSI evaluation is summarized in the table below:

Appendix III Constituent	Background Limit	Monitoring Wells with Verified SSIs
Boron	400 µg/L	CCR-4, CCR-5, CCR-6, CCR-7
Calcium	7681 µg/L	CCR-4, CCR-5, CCR-6, CCR-7
Chloride	34.7 mg/L	CCR-4, CCR-5, CCR-6, CCR-7
Fluoride	0.09 mg/L	CCR-4, CCR-5
pH	4.14 / 5.26 S.U.	None
Sulfate	65.6 mg/L	CCR-4, CCR-6, CCR-7
Total Dissolved Solids	195 mg/L	CCR-4, CCR-5, CCR-6, CCR-7

Pursuant to §257.90(e), the following sections describe the groundwater monitoring activities performed during the preceding calendar year.

### 2.1 Monitoring Well Installation and Decommissioning

The monitoring wells that comprise the CCR groundwater monitoring well network (CCR-1, CCR-2, CCR-3, CCR-4, CCR-5, CCR-6 and CCR-7) were installed in October 2015. No additional CCR network wells were installed or abandoned in 2018.

Additional wells have been/will be installed as part of the characterization required by §257.95(g)(1).

### 2.2 Groundwater Sampling Activities

The groundwater sampling activities related to the CCR groundwater monitoring program for Area B that occurred during 2018 are described in the sections below.

#### 2.2.1 Assessment Monitoring

The assessment monitoring program was established for Area B in March 2018. The initial annual assessment monitoring event was conducted on March 26, 2018, and subsequent semi-annual assessment monitoring events were conducted on June 27, 2018 and December 19, 2018. Assessment monitoring laboratory analytical data is summarized in Tables A-1 to A-3 in **Appendix A**.

During the initial annual assessment monitoring event, samples were collected from the CCR groundwater monitoring well network (CCR-1 through CCR-7) and analyzed for the all Appendix IV constituents in accordance with §257.95(a) (additional analysis of boron and calcium was also performed by the laboratory).

During the subsequent semi-annual assessment monitoring events in June and December 2018, samples were collected from the CCR groundwater monitoring well network (CCR-1 through CCR-7) and analyzed for all Appendix III constituents and detected Appendix IV constituents from the annual monitoring event (all Appendix IV constituents other than cadmium and mercury).

## 2.3 Groundwater Sampling Methodology

CCR groundwater sampling at Area B was performed in accordance with §257.93(a). The monitoring wells were purged and sampled using low-flow sampling techniques. Prior to purging, the depth to water level was measured for each well using an electronic water level indicator. The monitoring wells were purged and sampled using dedicated low-flow pneumatic bladder pumps. Calibrated water quality meters were used to monitor field stabilization parameters, including pH, specific conductance, temperature, dissolved oxygen, oxygen reduction potential and turbidity. After the water quality parameters stabilized, groundwater samples were collected and placed into iced coolers under chain-of-custody control pending delivery to the laboratory. Following sample collection, the samples were delivered to the JEA Springfield laboratory for analysis. The JEA laboratory sent select samples to Pace Analytical Services, LLC for analysis.

## 3.0 CCR GROUNDWATER DATA EVALUATION

### 3.1 Groundwater Flow Rate and Direction

Groundwater elevation measurements were recorded for the CCR groundwater monitoring network during each sampling event at Area B. A summary of the groundwater elevations recorded for the background and detection monitoring events is provided in Table 2. Groundwater elevation data was used to develop a potentiometric surface map for the initial detection monitoring event in October 2017 (Figure 3). The hydraulic gradient (direction and magnitude) for each sampling event was calculated using the least-squares method of fitting the data to a plane. The average hydraulic gradient was 0.0018 feet per feet with an average eastward direction. A summary of the hydraulic gradients for each sampling event is provided in **Table 2**.

### 3.2 Groundwater Protection Standards

The CCR Rule requires the establishment of groundwater protection standards (GWPS) for any Appendix IV constituent that is detected in downgradient monitoring wells (§257.95(d)(2) and §257.95(h)). Cadmium and mercury were not detected in the initial annual assessment event. The following GWPS have been established for BSA-B:

Parameter	BSA-B GWPS	Basis
Antimony	6 µg/L	MCL
Arsenic	10 µg/L	MCL
Barium	2000 µg/L	MCL
Beryllium	4 µg/L	MCL
Chromium	100 µg/L	MCL

Parameter	BSA-B GWPS	Basis
Cobalt	6 µg/L	CCR Rule GWPS
Fluoride	4 mg/L	MCL
Lead	15 µg/L	CCR Rule GWPS
Lithium	40 µg/L	CCR Rule GWPS
Molybdenum	100 µg/L	CCR Rule GWPS
Selenium	50 µg/L	MCL
Thallium	2 µg/L	MCL
Radium 226+228	5 pCi/L	MCL

### 3.3 Assessment Monitoring Statistical Analysis (June 2018)

The goal of the assessment monitoring program is to determine if downgradient monitoring well concentrations are at statistically significant levels (SSL) relative to the GWPS. The statistical analysis was performed in accordance with the Statistical Analysis Plan for CCR Groundwater Monitoring (Golder, 2017).

This assessment monitoring statistical analysis has been limited to those wells and parameters that had a maximum concentration above the GWPS. Given that BSA-B is an existing unlined facility and if there is no evidence of a shift in the constituent results from a well, then the Appendix IV data from the background period as well as assessment monitoring was used to calculate the LCL.

Assessment monitoring laboratory analytical data is summarized in Tables A-1 to A-3 in **Appendix A**. Appendix IV groundwater data collected during the background monitoring period was presented in the 2017 annual groundwater report (Golder, 2018). Statistical analysis worksheets are provided in **Appendix B**.

#### 3.3.1 Antimony

Antimony was detected above the GWPS in CCR-4 at a maximum concentration of 8.3 µg/L. Antimony was not detected above the GWPS in samples from CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for antimony at CCR-5, CCR-6 and CCR-7.

##### *Antimony at CCR-4*

Antimony was not detected in approximately 36% of the samples from CCR-4, therefore, the robust regression on order statistic (ROS) method (also referred to as lognormal ROS) was used to estimate the mean and standard deviation. The dataset had a lognormal distribution using ROS imputed data. There was one upper outlier (8.3 µg/L) identified in the CCR-4 antimony dataset. There was insufficient evidence of a trend in the CCR-4 antimony dataset. The LCL for antimony in CCR-4 is summarized below:



Well/Parameter: CCR-4 - Antimony	
Adjusted <sup>2</sup> Mean (log-mean):	2.167 (0.463) µg/L
Adjusted Standard Deviation (Log-Standard Deviation):	2.036 (0.8) µg/L
Distribution:	Lognormal (ROS)
95% LCL:	1.52 µg/L

There is no SSL above the GWPS of 6 µg/L for antimony at CCR-4 based on the calculated LCL.

### 3.3.2 Arsenic

Arsenic was detected above the GWPS in CCR-4 at a maximum concentration of 19.1 µg/L (estimated). Arsenic was not detected above the GWPS in samples from CCR-5, CCR-6 and CCR-7 therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for arsenic at CCR-5, CCR-6 and CCR-7.

#### Arsenic at CCR-4

Arsenic was detected in all the samples from CCR-4. The CCR-4 arsenic dataset has a normal distribution. There was one upper outlier (maximum concentration of 19.1 µg/L) identified in the CCR-4 arsenic dataset. There was no trend identified in the CCR-4 arsenic dataset. The LCL for arsenic in CCR-4 is summarized below:

Well/Parameter: CCR-4 - Arsenic	
Mean:	9.334 µg/L
Standard Deviation:	4.381 µg/L
Distribution:	Normal
95% LCL:	7.26 µg/L

There is no SSL above the GWPS of 10 µg/L for arsenic at CCR-4 based on the calculated LCL.

### 3.3.3 Barium

Barium was not detected above the GWPS in samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for barium at CCR-4, CCR-5, CCR-6 and CCR-7.

<sup>2</sup> Adjusted mean and standard deviation based on non-detect processing methods.

### 3.3.4 Beryllium

Beryllium was detected above the GWPS of 4 µg/L in CCR4 (maximum concentration 12 µg/L) and CCR-5 (maximum concentration 8.47 µg/L). Beryllium was not detected above the GWPS in CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for beryllium at CCR-6 and CCR-7.

#### *Beryllium at CCR-4*

Beryllium was not detected in approximately 7% of the samples from CCR-4, therefore, the simple substitution method (1/2 method detection limit [MDL]) was used in accordance with the Statistical Analysis Plan. The CCR-4 beryllium dataset has a lognormal distribution and no trend in the dataset was identified. The maximum estimated concentration of 12 µg/L was identified as an outlier, but no further justification was identified for removal. The LCL for beryllium in CCR-4 is summarized below:

Well/Parameter: CCR-4 - Beryllium	
Adjusted Mean (log-mean):	2.847 (0.311) µg/L
Adjusted Standard Deviation (log-standard deviation):	3.14 (1.539) µg/L
Distribution:	Lognormal
95% LCL:	1.996 µg/L

There is no SSL above the GWPS of 4 µg/L for beryllium at CCR-4 based on the calculated LCL.

#### *Beryllium at CCR-5*

Beryllium was not detected in approximately 14% of the samples from CCR-5, therefore, the simple substitution method (1/2 MDL) was used to process non-detect data. There was no statistically significant trend identified in the CCR-5 beryllium dataset. The maximum concentration of 8.47 µg/L was identified as an outlier. The beryllium dataset for CCR-5 did not have a normal or log-normal distribution, therefore, the non-parametric method is used to calculate the LCL. The LCL for beryllium in CCR-5 is summarized below:

Well/Parameter: CCR-5 - Beryllium	
Adjusted Mean:	1.399 µg/L
Adjusted Standard Deviation:	2.128 µg/L
Distribution:	Non-normal
Median:	0.92 µg/L
LCL (4th order statistic with 97% confidence):	0.691 µg/L

There is no SSL above the GWPS of 4 µg/L for beryllium at CCR-5 based on the calculated LCL.

### 3.3.5 Cadmium

Cadmium was not detected in the initial annual assessment monitoring sampling event in March 2018, therefore, no GWPS was established for cadmium and no statistical analysis was performed.

### 3.3.6 Chromium

Chromium has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for chromium at CCR-4, CCR-5, CCR-6 and CCR-7.

### 3.3.7 Cobalt

Cobalt has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for cobalt at CCR-4, CCR-5, CCR-6 and CCR-7.

### 3.3.8 Fluoride

Fluoride has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for fluoride at CCR-4, CCR-5, CCR-6 and CCR-7.

### 3.3.9 Lead

Lead has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for lead at CCR-4, CCR-5, CCR-6 and CCR-7.

### 3.3.10 Lithium

Lithium has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for lithium at CCR-4, CCR-5, CCR-6 and CCR-7.

### 3.3.11 Mercury

Mercury was not detected in the initial annual assessment monitoring sampling event in March 2018, therefore, no GWPS was established for mercury and no statistical analysis was performed.

### 3.3.12 Molybdenum

Molybdenum has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for molybdenum at CCR-4, CCR-5, CCR-6 and CCR-7.

### 3.3.13 Radium 226+228

Maximum combined radium 226+228 concentrations in samples from CCR-6 and CCR-7 exceeded the GWPS of 5 pCi/L. Radium 226+228 was not detected above the GWPS in samples from CCR-4 and CCR-5, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for radium 226+228 at CCR-4 and CCR-5.

### **Radium 226+228 at CCR-6**

Radium 226+228 was below the MDL in less than 8% of the samples from CCR-6, therefore, the simple substitution method was used to process non-detect data. There were no outliers and no trends identified in the CCR-6 radium dataset and the dataset has a normal distribution. The LCL for radium 226+228 at CCR-6 is summarized below:

<b>Well/Parameter: CCR-6 – Radium 226+228</b>	
Adjusted Mean:	9.568 pCi/L
Adjusted Standard Deviation:	3.144 pCi/L
Distribution:	Normal
95% LCL:	8.01 pCi/L

Radium 226+228 is at an SSL above the GWPS of 5 pCi/L at CCR-6 based on the calculated LCL.

### **Radium 226+228 at CCR-7**

Radium 226+228 was below the MDL in less than 8% of the samples from CCR-7, therefore, the simple substitution method (1/2 MDL) was used to process non-detect data. There were no outliers and no trends identified in the CCR-7 radium dataset, and the dataset has a normal distribution. The LCL for radium 226+228 at CCR-7 is summarized below:

<b>Well/Parameter: CCR-7– Radium 226+228</b>	
Adjusted Mean:	4.362 pCi/L
Adjusted Standard Deviation:	2.011 pCi/L
Distribution:	Normal
LCL (normal):	3.37 pCi/L

There is no SSL above the GWPS of 5 pCi/L for radium 226+228 at CCR-7 based on the calculated LCL.

## **3.3.14 Selenium**

The maximum selenium from CCR-4 samples was above the GWPS of 50 µg/L. Selenium was not detected above the GWPS in samples from CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for selenium at CCR-5, CCR-6 and CCR-7.

### **Selenium at CCR-4**

Selenium was not detected in approximately 7% of the samples from CCR-4, therefore, the simple substitution method (1/2 MDL) was used to process the non-detect data. There was one upper outlier (264.23 µg/L) identified in the selenium dataset for CCR-4, however, the data fit a log-normal distribution. There were no trends identified in the CCR-4 selenium dataset. The LCL for selenium at CCR-4 is summarized below:

Well/Parameter: CCR-4– Selenium	
Adjusted Mean (Log-Mean):	26.31 (1.901) µg/L
Adjusted Standard Deviation (Log- Standard Deviation):	68.76 (1.551) µg/L
Distribution:	Lognormal
95% LCL:	9.91 µg/L

There is no SSL above the GWPS of 50 µg/L for selenium at CCR-4 based on the calculated LCL.

### 3.3.15 Thallium

Thallium has not been detected above the GWPS in any samples from CCR-4, CCR-5, CCR-6 and CCR-7, therefore, a statistical evaluation of the assessment monitoring data is unwarranted at those wells. There is no SSL above the GWPS for lithium at CCR-4, CCR-5, CCR-6 and CCR-7.

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the October 15, 2018 SSL evaluation (summarized in Section 3.3, above), assessment of corrective measures was initiated January 13, 2019 in accordance with §257.96. Pursuant to §257.95(g)(1), a characterization of the nature and extent of the release is required and will be performed in 2019. Assessment of corrective measures will be completed by April 13, 2019 unless an extension up to 60 days is warranted in accordance with §257.96(a).

Assessment monitoring will continue during assessment of corrective measures in accordance with §257.96(b). The second annual assessment monitoring event will be performed in March 2019. The subsequent semi-annual assessment monitoring events will be performed in June 2019 and December 2019.

## 5.0 REFERENCES

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- Golder. 2018c. Statistically Significant Level Evaluation, Byproduct Storage Area B, St. Johns River Power Park, Jacksonville, Florida, dated October 15.
- JEA. 2007. JEA SJRPP Byproduct Storage Area B, dated April 19, 2007. [This document includes as an attachment a report prepared by Golder in April 2007, Hydrogeologic and Geotechnical Site Evaluation, St. Johns River Power Park Area B By-product Storage Area, Duval County, Florida (Golder 2007)]
- USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. EPA 350/R-09-007, dated March 2009.

## Signature Page

This Annual Report has been prepared to meet the requirements of §257.90(e).

Golder appreciates the opportunity to assist JEA with this project. Should you have any questions or need any additional information, please do not hesitate to contact us.

**Golder Associates Inc.**



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## TABLES



**Table 1: Summary of CCR Monitoring Well Construction Details**

Well ID	Date Installed	Northing (ft NAD83)	Easting (ft NAD83)	Ground Surface Elevation (ft NAVD83)	Top of Casing Elevation (ft NAVD83)	Stick-up Height (ft)	Well Depth (ft bgs)	Screen Interval Depth (ft bgs)
CCR-1	10/20/2015	2221016.34	485450.08	13.37	16.58	3.21	19.79	9.79-19.79
CCR-2	10/20/2015	2222219.71	485292.98	14.45	18.06	3.61	19.49	9.49-19.49
CCR-3	10/20/2015	2222897.83	485087.81	14.22	17.74	3.52	19.78	9.78-19.78
CCR-4	10/21/2015	2221065.31	486365.39	17.87	20.73	2.86	20.84	10.84-20.84
CCR-5	10/21/2015	2221064.27	486865.44	15.44	18.29	2.85	20.35	10.35-20.35
CCR-6	10/21/2015	2221455.96	487055.81	13.07	16.07	3	20.1	10.1-20.1
CCR-7	10/22/2015	2221887.42	487053.83	12.44	15.72	3.28	20.12	10.12-20.12

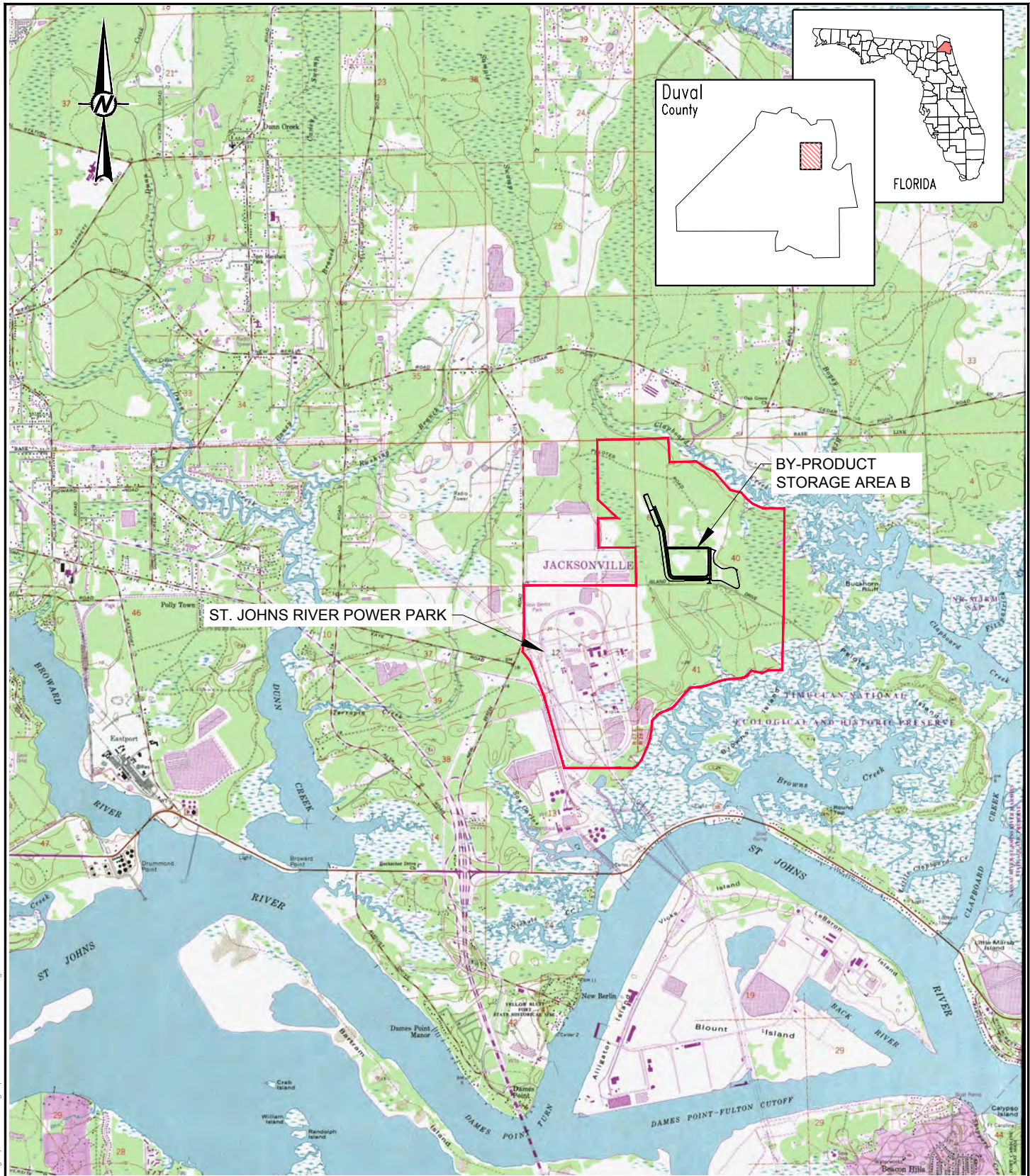
Notes:  
ft bgs - feet below ground surface  
ft TOC - feet below top of casing  
NAD83 - Horizontal Control: North American Datum, State Plan Coordinate System Florida, East Zone  
NAVD88 - Vertical Control: North American Vertical Datum of 1988

**Table 2: Summary of Groundwater Elevation Measurements**

Well ID	26-Mar-18		27-Jun-18		19-Dec-18	
	Depth to Water (ft-TOC)	Groundwater Elevation (ft-NAVD88)	Depth to Water (ft-TOC)	Groundwater Elevation (ft-NAVD88)	Depth to Water (ft-TOC)	Groundwater Elevation (ft-NAVD88)
CCR-1	4.53	12.05	4.48	12.10	5.02	11.56
CCR-2	6.04	12.02	5.31	12.75	6.19	11.87
CCR-3	5.23	12.51	4.30	13.44	5.20	12.54
CCR-4	9.49	11.24	8.81	11.92	9.28	11.45
CCR-5	9.43	8.86	8.55	9.74	8.93	9.36
CCR-6	7.66	8.41	6.91	9.16	7.63	8.44
CCR-7	6.72	9.00	6.45	9.27	6.95	8.77
<b>Hydraulic Gradient (ft/ft)</b>	<b>2.08E-03</b>		<b>1.97E-03</b>		<b>1.92E-03</b>	
<b>Flow Direction (degrees from N)</b>	<b>81.9</b>		<b>87.9</b>		<b>82.0</b>	
<b>Coefficient of Determination</b>	<b>0.93</b>		<b>0.91</b>		<b>0.89</b>	
<p>Notes:</p> <p>Hydraulic Gradient calculated using the least squares method of fitting data to a plane</p> <p>ft/ft - feet per foot</p> <p>degrees from N - degrees from north in clockwise direction</p> <p>ft TOC - feet below top of casing</p>						

## FIGURES





**REFERENCE(S)**

- 1.) USGS TOPOGRAPHIC MAP, 7.5 MIN. QUADRANGLE MAP SERIES: EASTPORT QUADRANGLE, DUVAL COUNTY, FLORIDA.



**CLIENT**

HOPPING GREEN & SAMS

**PROJECT**

ST. JOHNS RIVER POWER PARK - CCR SUPPORT  
JACKSONVILLE, DUVAL COUNTY, FLORIDA

**CONSULTANT**

YYYY-MM-DD 2019-01-16

DESIGNED SFS  
PREPARED BCL  
REVIEWED SFS  
APPROVED GMP

**TITLE**

**SITE LOCATION MAP**

PROJECT NO. 15-26356.0010 Phase 1526356-U001

REV.

FIGURE

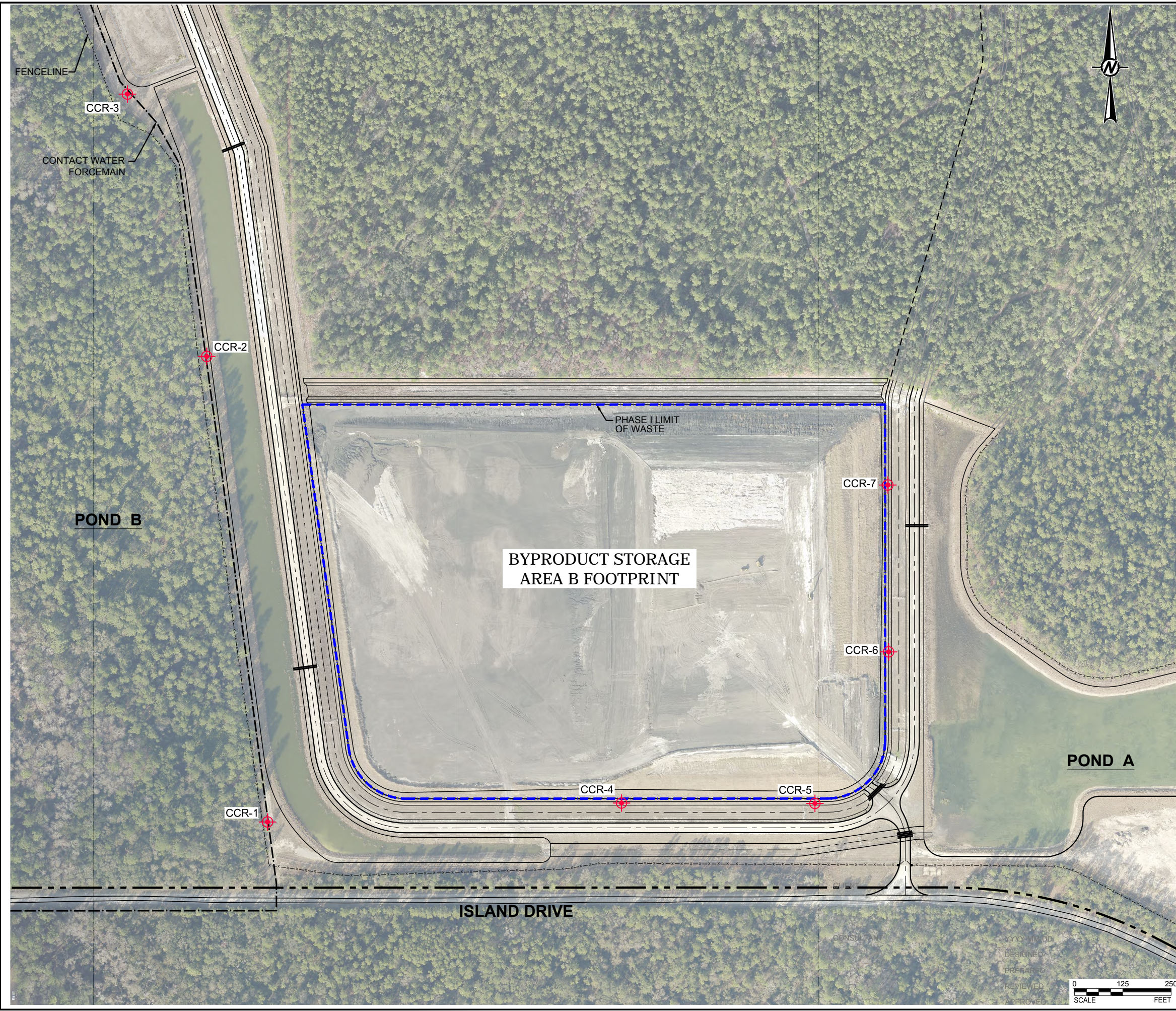
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSIA





**LEGEND**

	PROPERTY BOUNDARY
	CHAIN LINK FENCELINE
	PHASE I LIMIT OF WASTE
	CCR-1 CCR GROUNDWATER MONITORING WELL LOCATIONS

- NOTE(S)**
1. CCR-SERIES MONITORING WELL AS-BUILT SURVEY PERFORMED BY B.V. & ASSOCIATES, INC. ON NOVEMBER 17, 2015.
  2. AERIAL IMAGE TAKEN FROM FDEP BUREAU OF SURVEY AND MAPPING (LAND BOUNDARY INFORMATION SYSTEM), YEAR 2013.

HOPPING GREEN & SAMS

	2019-01-16
	SFS
	BCL
	SFS
	GMP

PROJECT  
**ST. JOHNS RIVER POWER PARK - CCR SUPPORT**  
 JACKSONVILLE, DUVAL COUNTY, FLORIDA

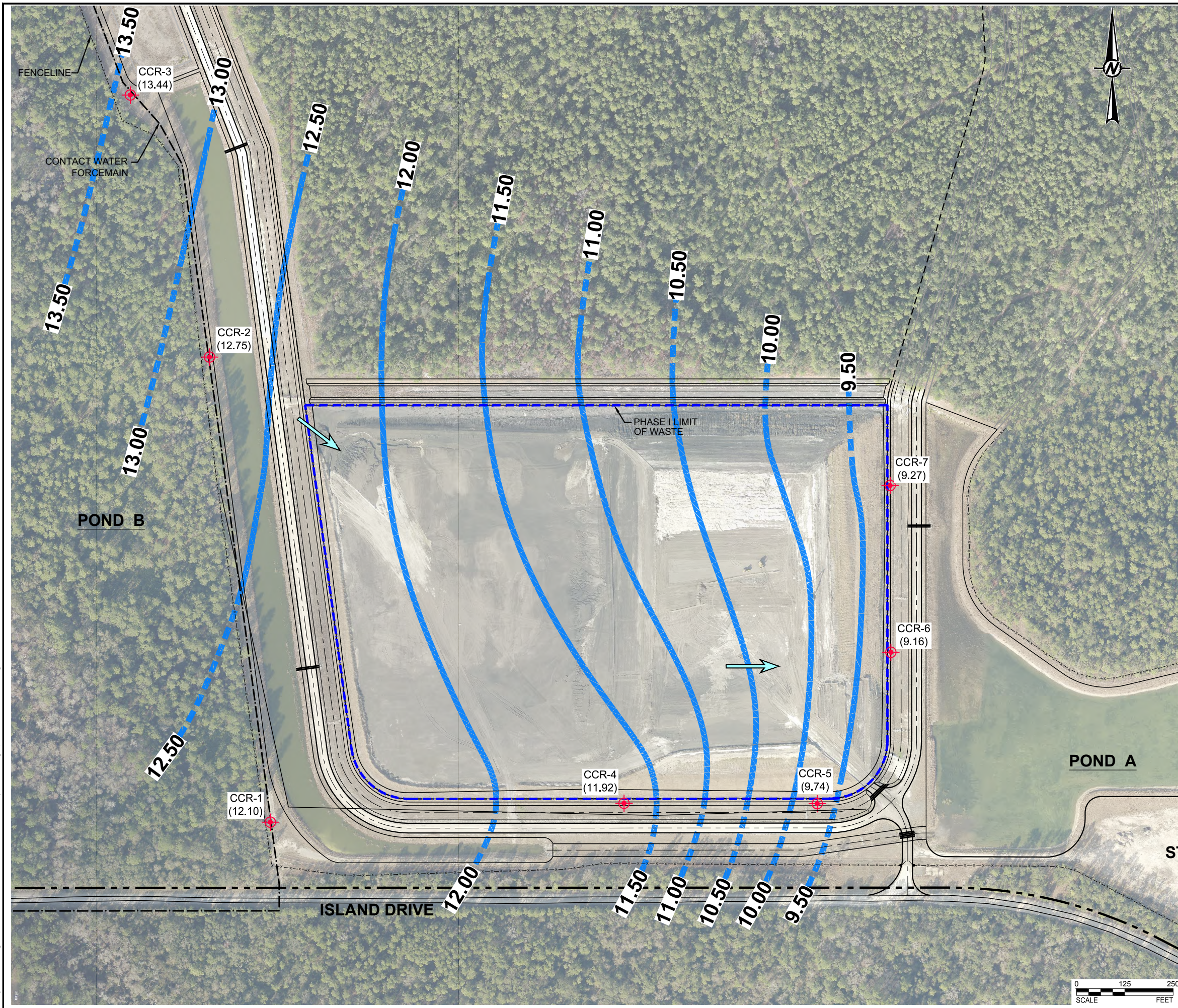
TITLE  
**CCR GROUNDWATER MONITORING WELLS**

PROJECT NO.	Phase	REV.	FIGURE
15-26356.0010	1526356-U002		2

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B





**LEGEND**

---	PROPERTY BOUNDARY
- X - X - X - X -	CHAIN LINK FENCELINE
- - - - -	PHASE I LIMIT OF WASTE
⊕	CCR GROUNDWATER MONITORING WELL LOCATIONS
(9.27)	GROUNDWATER ELEVATION
11.00	GROUNDWATER CONTOUR INTERVAL (DASHED WHERE INFERRED)
→	ESTIMATED GROUNDWATER FLOW DIRECTION

- NOTE(S)**
- CCR-SERIES MONITORING WELL AS-BUILT SURVEY PERFORMED BY B.V. & ASSOCIATES, INC. ON NOVEMBER 17, 2015.
  - AERIAL IMAGE TAKEN FROM FDEP BUREAU OF SURVEY AND MAPPING (LAND BOUNDARY INFORMATION SYSTEM), YEAR 2013.

CLIENT  
HOPPING GREEN & SAMS

CONSULTANT	YYYY-MM-DD	2019-01-16
	DESIGNED	SFS
	PREPARED	BCL
	REVIEWED	SFS
	APPROVED	GMP

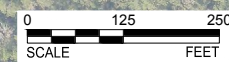
PROJECT  
ST. JOHNS RIVER POWER PARK - CCR SUPPORT  
JACKSONVILLE, DUVAL COUNTY, FLORIDA

TITLE  
**POTENTIOMETRIC MAP**  
(JUNE 27, 2018)

PROJECT NO.	Phase	REV.	FIGURE
15-26356.0010	1526356-U003		<b>3</b>

Path: \\jacksonriver\powerpark\GIS\SRPP\CCRU - 2018 Annual GW Rpt\Active Drawings\ - File Name: 1526356-U003.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSIB





APPENDIX A  
Laboratory Analytical Results

TABLE A-1 - FIRST ANNUAL ASSESSMENT MONITORING EVENT - MARCH 2018

Sample ID	Sample Date	APPENDIX IV																	FIELD PARAMETERS						APPENDIX III	
		Antimony (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Beryllium (ug/L)	Cadmium (ug/L)	Chromium (ug/L)	Cobalt (ug/L)	Fluoride (ug/L)	Lead (ug/L)	Lithium (ug/L)	Mercury (ug/L)	Molybdenum (ug/L)	Selenium (ug/L)	Thallium (ug/L)	Radium-226 (pCi/L)	Radium-228 (pCi/L)	Total Radium (pCi/L)	DO (Field) Concentration (mg/L)	Field Turb (NTU)	Redox Potential (Field) (mV)	Specific Conductance (Field) (umhos/cm)	Temp (Field) (deg C)	pH (Field) (SU)	Boron (ug/L)	Calcium (ug/L)
CCR 1	3/26/2018	0.12 U	0.37	236.85	0.337	0.224 U	0.342 U	1.10 U	0.085	0.096	1.3	0.0170 U	1.27 U	0.19	0.028 U	3.65 ± 1.08	0.955U ± 0.518	4.56 ± 1.60	0.7	2.72	10.6	386.9	17.8	4.96	417.57	13244
CCR 2	3/26/2018	0.12 U	0.99	153.38	0.685	0.224 U	2.70	1.10 U	0.10	1.1	2.9	0.0170 U	1.27 U	0.33	0.042	0.807U ± 0.513	0.878U ± 0.408	1.68U ± 0.921	0.8	16.1	-18.3	410.5	18.1	4.57	542.90	10785
CCR 3	3/26/2018	0.12 U	0.22	108.07	0.124	0.224 U	0.342 U	1.10 U	0.064	0.10	0.17	0.0170 U	1.27 U	0.17 U	0.028 U	2.13 ± 0.916	1.55 ± 0.617	3.68 ± 1.53	0.8	12.4	298.6	196.2	17.3	3.93	158.50	7575.7
CCR 4	3/26/2018	2.1	7.1	117.78	1.40	0.224 U	1.77	1.10 U	0.12	0.50	0.24	0.0170 U	8.14	1.1	0.028 U	2.98 ± 1.07	0.825 ± 0.397	3.81 ± 1.47	0.3	7100 0	-281.0	2980	17.8	6.19	25751	415570
CCR 5	3/26/2018	0.12 U	0.65	266.41	0.691	0.224 U	1.02	1.10 U	0.11	0.12	1.3	0.0170 U	1.27 U	0.18	0.028 U	0.825 ± 0.442	0.727U ± 0.378	1.36 ± 0.821	0.5	5.18	43.8	838	19.0	9.52	2329.9	17311
CCR 6	3/26/2018	0.12 U	0.69	37.1	0.0627 U	0.224 U	0.590	1.10 U	0.17 U	0.064	0.14 U	0.0170 U	31.3	1.6	0.028 U	2.09 ± 0.868	3.39 ± 0.848%	5.47 ± 1.72	0.7	14.5	477.7	3651	16.4	5.51	20423	277570
CCR 7	3/26/2018	0.12 U	0.70	31.6	0.0627 U	0.224 U	2.61	1.26	0.068 U	0.039	0.48	0.0170 U	1.27 U	0.61	0.028 U	2.31 ± 0.942	1.28 ± 0.489	3.59 ± 1.43	0.3	16.3	-172.4	2430	17.9	4.70	11634	103190
CCR 5 Well DUP	3/26/2018	0.12 U	0.67	263.70	0.721	0.224 U	0.908	1.10 U	0.088	0.19	1.3	0.0170 U	1.27 U	0.17	0.028 U	0.987 ± 0.603	0.748U ± 0.397	1.62 ± 1.00	0.5	5.18	43.8	838	19.0	9.52	2375.9	17593
Field Blank	3/26/2018	0.12 U	0.21 U	0.140 U	0.0627 U	0.224 U	0.342 U	1.10 U	--	0.028 U	--	0.0170 U	1.27 U	0.17 U	0.028 U	--	--	--	--	--	--	--	--	--	15.4 U	36.5



TABLE A-2 - FIRST SEMI-ANNUAL ASSESSMENT MONITORING EVENT (YEAR 1) - JUNE 2018

Sample ID	Sample Date	APPENDIX IV																	APPENDIX III							FIELD PARAMETERS						
		Antimony (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Beryllium (ug/L)	Cadmium (ug/L)	Chromium (ug/L)	Cobalt (ug/L)	Fluoride (ug/L)	Lead (ug/L)	Lithium (ug/L)	Mercury (ug/L)	Molybdenum (ug/L)	Selenium (ug/L)	Thallium (ug/L)	Radium-226 (pCi/L)	Radium-228 (pCi/L)	Total Radium (pCi/L)	Boron (ug/L)	Calcium (ug/L)	Chloride (ug/L)	Fluoride (ug/L)	pH (Field) (SU)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Redox Potential (mV)	Specific Conductance (umhos/cm)	Temperature (deg C)	pH (Field) (SU)	
CCR 1	6/27/2018	0.50 U	0.50 U	163	0.50 U	--	2.5 U	5.0 U	0.062	0.50 U	1.1	--	5.0 U	1.4	0.50 U	1.34	1.02	2.36	209	8140	18.0	0.062	4.65	91.8	193	0.2	1.5	17.8	317.9	23.3	4.65	
CCR 2	6/27/2018	0.50 U	0.50 U	92.4	1.6 U	--	1.7 U	2.3 U	0.12	0.50 U	2.9	--	4.0 U	1.1	0.50 U	0.904U	0.957	1.74U	559	12800	18.0	0.12	4.40	170	315	0.2	6.10	-63.1	459.3	23.5	4.40	
CCR 3	6/27/2018	0.50 U	0.50 U	44.0	1.6 U	--	1.7 U	2.3 U	0.043	0.50 U	0.14 U	--	4.0 U	0.50 U	0.50 U	1.17	1.41	2.58	41.4	4220	9.8	0.043	4.32	17.2	67	0.3	0.99	71.2	105.8	23.8	4.32	
CCR 4	6/27/2018	1.9	8.7	98.2	3.3	--	2.7	5.0 U	0.090	0.90	0.32	--	8.9	4.4	0.50 U	1.90	1.97	3.87	20400	529000	68.0	0.090	5.99	1650	2595	0.6	370	-252.6	3015	24.1	5.99	
CCR 5	6/27/2018	0.50 U	0.90	331	0.96	--	2.5 U	5.0 U	0.11	0.50 U	1.5	--	5.0 U	0.92	0.50 U	1.86	1.35	3.21	2430	17300	195	0.11	4.71	63.7	478	0.5	6.09	-42.6	922	23.1	4.71	
CCR 6	6/27/2018	0.50 U	1.2	37.2	0.50 U	--	2.5 U	5.0 U	0.068 U	0.50 U	0.14 U	--	36.8	1.7	0.50 U	2.78	4.72	7.50	22500	373000	95.5	0.068 U	5.82	1740	2817	0.2	9.37	-177.7	3514	24.3	5.82	
CCR 7	6/27/2018	0.50 U	1.2	40.2	0.50 U	--	3.0	5.0 U	0.063	0.50 U	0.061	--	5.0 U	1.2	0.50 U	2.68	3.24	5.92	14300	119000	122	0.063	4.09	1220	1882	0.3	6.87	-140.8	2794	24.9	4.09	
CCR 6 WELL DUP	6/27/2018	0.50 U	0.55	39.4	1.6 U	--	1.7 U	2.3 U	0.17 U	0.50 U	0.14 U	--	33.8	1.2	0.50 U	2.92	5.22	8.14	22800	361000	91.3	0.17 U	5.82	1880	2777	0.2	9.37	-177.7	3514	24.3	5.82	
Field Blank	6/27/2018	0.50 U	0.50 U	5.0 U	0.50 U	--	2.5 U	5.0 U	0.034 U	0.50 U	0.14 U	--	5.0 U	0.50 U	0.50 U	0.733U	0.871U	1.60U	45.2	250 U	2.5 U	0.034 U	--	2.5 U	16	--	--	--	--	--	--	

TABLE A-3 - SECOND SEMI-ANNUAL ASSESSMENT MONITORING EVENT (YEAR 1) - DECEMBER 2018

Sample ID	Sample Date	APPENDIX IV															APPENDIX III							FIELD PARAMETERS							
		Antimony (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Beryllium (ug/L)	Cadmium (ug/L)	Chromium (ug/L)	Cobalt (ug/L)	Fluoride (ug/L)	Lead (ug/L)	Lithium (ug/L)	Mercury (ug/L)	Molybdenum (ug/L)	Selenium (ug/L)	Thallium (ug/L)	Radium-226 (pCi/L)	Radium-228 (pCi/L)	Total Radium (pCi/L)	Boron (ug/L)	Calcium (ug/L)	Chloride (ug/L)	Fluoride (ug/L)	pH (Field) (SU)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Redox Potential (mV)	Specific Conductance (umhos/cm)	Temperature (deg C)	pH (Field) (SU)
CCR 1	12/19/2018	0.0946 U	0.514	195.23	0.837	NA	0.342 U	1.10 U	0.10	0.460 U	1.8	NA	1.27 U	1.35 U	0.428 U	3.42	1.48	4.90	1118.0	30705	16.8	0.10	4.83	234	411	0.40	2.50	-36.9	597	22.3	4.83
CCR 2	12/19/2018	0.0946 U	0.391	56.1	1.13	NA	1.39	1.10 U	0.14	0.460 U	3.1	NA	1.27 U	1.35 U	0.428 U	0.778U	0.728U	1.51U	746.92	21087	18.4	0.14	4.62	212	386	0.43	3.94	-51.6	563	21.9	4.62
CCR 3	12/19/2018	0.0946 U	0.913	116.82	0.656	NA	0.846	1.10 U	0.17	0.460 U	0.24	NA	1.27 U	1.35 U	0.428 U	4.04	3.79	7.83	7038.0	221990	31.9	0.17	4.48	786	1137	0.44	4.48	-22.4	1400	20.7	4.48
CCR 4	12/19/2018	3.95	14.3	101.16	1.85	NA	3.18	1.10 U	0.045	1.26	0.19 U	NA	14.0	6.17	0.428 U	1.74	1.17	2.90	28878	500540	80.8	0.045	6.28	1490	2863	0.23	>1000	-285.7	3047	22.3	6.28
CCR 5	12/19/2018	0.0946 U	0.770	433.00	1.14	NA	1.48	1.10 U	0.068 U	0.460 U	1.4	NA	1.27 U	26.5	0.428 U	2.01	2.44	4.44	4890.9	22229	286	0.068 U	4.78	164	746	0.30	3.34	-76.6	1339	22.4	4.78
CCR 6	12/19/2018	0.0946 U	0.595	37.7	0.0627 U	NA	0.502	1.10 U	0.034 U	0.460 U	0.19 U	NA	25.2	11.2	0.428 U	2.77	5.57	8.34	24974	342760	103	0.034 U	6.02	1740	2718	0.27	13.8	-183.5	3299	21.4	6.02
CCR 7	12/19/2018	0.0946 U	1.12	59.9	0.0627 U	NA	3.91	2.13	0.045	0.460 U	0.59	NA	1.27 U	23.9	0.428 U	3.97	5.99	9.96	25338	185080	95.6	0.045	4.72	809	2660	0.45	11.2	-98.1	3301	21.3	4.72
CCR 7 Well DUP	12/19/2018	0.0946 U	1.04	59.5	0.0627 U	NA	3.98	1.93	0.17 U	0.460 U	0.57	NA	1.27 U	8.56	0.580	3.63	5.18	8.81	25349	186450	188	0.17 U	4.72	1620	2658	0.45	11.2	-98.1	3301	21.3	4.72
Field Blank	12/19/2018	0.0946 U	0.0499 U	0.140 U	0.0627 U	NA	0.342 U	1.10 U	0.034 U	0.460 U	0.22	NA	1.27 U	1.35 U	0.428 U	0.753U	1.01U	1.76U	15.4 U	822.18	2.5 U	0.034 U	NA	2.5 U	11	NA	NA	NA	NA	NA	NA

APPENDIX B  
Statistical Worksheets

**Table B1: Antimony Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	0.813 U	0.813 U	0.813 U	0.813 U
Background	1/21/2016	0.813 U	0.65 U	0.813 U	0.813 U
Background	2/23/2016	0.813 U	0.813 U	0.813 U	0.813 U
Background	3/23/2016	0.813 U	0.813 U	0.813 U	0.813 U
Background	5/25/2016	1.97	0.813 U	0.813 U	0.813 U
Background	7/27/2016	4.06	0.175 U	0.175 U	0.175 U
Background	9/20/2016	1.9	0.5 U	0.5 U	0.5 U
Background	11/8/2016	8.3	0.175 U	0.175 U	0.175 U
Background	2/21/2017	3.2	0.175 U	0.175 U	0.175 U
Background	4/18/2017	1.91	0.262 I	0.214 I	0.206 I
Background	6/22/2017	1.23 U	1.23 U	1.23 U	1.23 U
Detection	10/11/2017	1.5	1.23 U	1.23 U	1.23 U
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	2.1	0.12 U	0.12 U	0.12 U
Assessment	6/27/2018	1.9	0.5 U	0.5 U	0.5 U
	Minimum	<0.813	<0.12	<0.12	<0.12
	Maximum	8.3	0.262	0.214	0.206
	n	14	14	14	14
	Count Detects	9	1	1	1
	Count Non-Detects	5	13	13	13
	Percent Non-Detects	36%	93%	93%	93%
	Mean of Detects	2.982	--	--	--
	Standard Deviation of Detects	2.15	--	--	--

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B2: Arsenic - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	11.9 I	4.11 I	2.51 I	1.91 I
Background	1/21/2016	6.37 I	1.11 U	2.21 I	2.95 U
Background	2/23/2016	11.1 I	1.39 U	1.39 U	1.4 I
Background	3/23/2016	10.3 I	1.39 U	1.39 U	1.39 U
Background	5/25/2016	8.56 I	1.39 U	1.39 U	1.39 U
Background	7/27/2016	17.3	0.615 U	0.615 U	0.615 U
Background	9/20/2016	7.5	1.1	0.8 I	0.5 U
Background	11/8/2016	19.1 I	1.67 I	0.651 I	0.793 I
Background	2/21/2017	7.49 I	3.46 I	1.81 I	0.615 U
Background	4/18/2017	4.66 I	2.65 I	2.17 I	1.93 I
Background	6/22/2017	3.87 I	5.26 I	4.48 I	5.44 I
Detection	10/11/2017	6.72 I	4.97 I	2.35 I	4.99 I
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	7.1	0.65	0.69	0.7
Assessment	6/27/2018	8.7	0.9 I	1.2	1.2
Minimum		3.87	<0.615	<0.615	<0.5
Maximum		19.1	5.26	4.48	5.44
n		14	14	14	14
Count Detects		14	9	10	8
Count Non-Detects		0	5	4	6
Percent Non-Detects		0%	36%	29%	43%
Mean of Detects		9.334	2.752	1.887	2.295
Standard Deviation of Detects		4.381	1.779	1.161	1.861

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B3: Barium - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	56.2	62.9	47	37.1
Background	1/21/2016	65.2	61.1	39.5	29.3 U
Background	2/23/2016	71.3	97.2	41.4	30.4
Background	3/23/2016	72.2	113.07	36	29.4
Background	5/25/2016	77.7	203.82	47.2	25.5
Background	7/27/2016	79.1	204	47.4	29.9
Background	9/20/2016	92.2	254	56.2	36.7
Background	11/8/2016	66.1	223.59	52.9	46.6
Background	2/21/2017	89	230.39	42.4	25.6
Background	4/18/2017	79.6	252.87	48.3	46
Background	6/22/2017	73.8	278.48	40.3	51.5
Detection	10/11/2017	99.8	311.216	37.6	53
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	117.78	266.41	37.1	31.6
Assessment	6/27/2018	98.2	331	37.2	40.2
	Minimum	56.2	61.1	36	<29.3
	Maximum	117.8	331	56.2	53
	n	14	14	14	14
	Count Detects	14	14	14	13
	Count Non-Detects	0	0	0	1
	Percent Non-Detects	0%	0%	0%	7%
	Mean of Detects	81.3	206.4	43.61	37.19
	Standard Deviation of Detects	16.45	88.99	6.308	9.541

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B4: Beryllium - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	0.0777 U	0.0777 U	0.0777 U	0.0777 U
Background	1/21/2016	0.916 I	0.0777 U	0.0777 U	0.0777 U
Background	2/23/2016	0.314 I	2.63	0.364 I	0.138 I
Background	3/23/2016	0.176 I	0.216 I	0.0901 I	0.0848 I
Background	5/25/2016	2.27 I	8.47	1.86 I	1.37 I
Background	7/27/2016	5.2	0.99 I	0.62 I	0.5 U
Background	9/20/2016	3.3	1	0.5 U	0.5 U
Background	11/8/2016	12 I	0.974 I	0.028 U	0.028 U
Background	2/21/2017	3.24 I	0.869 I	0.028 U	0.028 U
Background	4/18/2017	5.45 I	0.805 I	0.028 U	0.028 U
Background	6/22/2017	0.64 I	0.92 I	0.028 U	0.028 U
Detection	10/11/2017	1.61 I	0.977 I	0.028 U	0.028 U
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	1.4 I	0.691 I	0.0627 U	0.0627 U
Assessment	6/27/2018	3.3	0.96 I	0.5 U	0.5 U
Minimum		<0.0777	<0.0777	<0.028	<0.028
Maximum		12	8.47	1.86	1.37
n		14	14	14	14
Count Detects		13	12	4	3
Count Non-Detects		1	2	10	11
Percent Non-Detects		7%	14%	71%	79%
Mean of Detects		3.063	1.625	0.734	0.531
Standard Deviation of Detects		3.191	2.227	0.782	0.727

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B5: Chromium - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	2.95	3.01	0.539 U	1.88 I
Background	1/21/2016	2.11 I	0.991 I	0.539 U	1.06 U
Background	2/23/2016	0.539 U	0.539 U	0.539 U	1.22 I
Background	3/23/2016	0.539 U	1.96 I	0.539 U	2.35 I
Background	5/25/2016	0.539 U	0.539 U	0.539 U	1.39 I
Background	7/27/2016	4.6 I	2.5 U	2.5 U	2.9 I
Background	9/20/2016	3.6 I	2.5 U	2.5 U	4.6 I
Background	11/8/2016	19 I	3.01 I	0.501 I	2.81 I
Background	2/21/2017	3.56 I	1.77 I	0.785 I	2.42 I
Background	4/18/2017	4.31 I	1.42 I	0.528 I	2.55 I
Background	6/22/2017	2.46 I	1.27 I	0.82 I	3.63 I
Detection	10/11/2017	2.75 I	1.32 I	0.766 I	3.9 I
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	1.77 I	1.02 I	0.59 I	2.61 I
Assessment	6/27/2018	2.7 I	2.5 U	2.5 U	3 I
Minimum		<0.539	<0.539	<0.539	<1.06
Maximum		19	3.01	0.82	4.6
n		14	14	14	14
Count Detects		11	9	6	13
Count Non-Detects		3	5	8	1
Percent Non-Detects		21%	36%	57%	7%
Mean of Detects		4.528	1.752	0.665	2.712
Standard Deviation of Detects		4.879	0.779	0.141	0.952

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit



**Table B6: Cobat - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	1.5 I	0.5 U	0.5 U	0.975 I
Background	1/21/2016	0.864 I	0.5 U	0.5 U	0.684 U
Background	2/23/2016	0.5 U	0.5 U	0.5 U	0.761 I
Background	3/23/2016	0.5 U	0.5 U	0.5 U	0.938 I
Background	5/25/2016	0.509 I	0.5 U	0.5 U	1.26 I
Background	7/27/2016	5 U	5 U	5 U	5 U
Background	9/20/2016	5 U	5 U	5 U	5 U
Background	11/8/2016	3.15 I	2.73 U	2.73 U	2.73 U
Background	2/21/2017	2.73 U	2.73 U	2.73 U	2.73 U
Background	4/18/2017	2.73 U	2.73 U	2.73 U	2.73 U
Background	6/22/2017	2.73 U	2.73 U	2.73 U	2.73 U
Detection	10/11/2017	2.73 U	2.73 U	2.73 U	2.73 U
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	1.1 U	1.1 U	1.1 U	1.26 I
Assessment	6/27/2018	5 U	5 U	5 U	5 U
Minimum		<0.5	<0.5	<0.5	<0.684
Maximum		3.15	--	--	1.26
n		14	14	14	14
Count Detects		4	0	0	5
Count Non-Detects		10	14	14	9
Percent Non-Detects		71%	100%	100%	64%
Mean of Detects		1.506	--	--	1.039
Standard Deviation of Detects		1.17	--	--	0.218

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B7: Fluoride - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	0.57	0.38	0.17 U	0.1
Background	1/21/2016	0.56	0.32	0.68 U	0.092 I
Background	2/23/2016	0.2	0.25	0.068 U	0.079
Background	3/23/2016	0.21	0.23	0.068 U	0.093
Background	5/25/2016	0.36	0.2	0.068 U	0.07
Background	7/27/2016	0.5	0.16	0.17 U	0.073
Background	9/20/2016	0.8	0.19	0.17 U	0.076
Background	11/8/2016	0.52	0.15	0.17 U	0.11
Background	2/21/2017	0.52	0.11	0.17 U	0.088 I
Background	4/18/2017	0.35	0.12	0.05	0.11
Background	6/22/2017	0.5	0.12	0.17 U	0.17 U
Detection	10/11/2017	0.51	0.11	0.17 U	0.1
Detection	12/13/2017	0.4	0.12	NA	0.17 U
Assessment	3/26/2018	0.12	0.11	0.17 U	0.068 U
Assessment	6/27/2018	0.09 I	0.11	0.068 U	0.063
Minimum		0.09	0.11	<0.068	<0.068
Maximum		0.8	0.38	0.05	0.11
n		15	15	14	15
Count Detects		15	15	1	12
Count Non-Detects		0	0	13	3
Percent Non-Detects		0%	0%	93%	20%
Mean of Detects		0.414	0.179	--	0.0878
Standard Deviation of Detects		0.194	0.0842	--	0.0157

## Notes:

All concentrations reported in milligrams per liter (mg/L)

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B8: Lead - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	1.02 I	2.12	0.813 U	0.813 U
Background	1/21/2016	0.813 U	0.65 U	0.813 U	0.813 U
Background	2/23/2016	0.813 U	0.813 U	0.813 U	0.813 U
Background	3/23/2016	0.813 U	0.813 U	0.813 U	0.813 U
Background	5/25/2016	0.813 U	0.813 U	0.813 U	0.813 U
Background	7/27/2016	0.491 U	0.491 U	0.491 U	0.491 U
Background	9/20/2016	5 U	13.1	5.9 I	5 U
Background	11/8/2016	11.7	1.5	0.491 U	0.491 U
Background	2/21/2017	0.852 I	0.491 U	0.491 U	0.491 U
Background	4/18/2017	1.08 I	0.491 U	0.491 U	0.491 U
Background	6/22/2017	0.412 U	0.412 U	0.412 U	0.412 U
Detection	10/11/2017	0.412 U	0.412 U	0.412 U	0.412 U
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	0.5	0.12	0.064 I	0.039 I
Assessment	6/27/2018	0.9 I	0.5 U	0.5 U	0.5 U
Minimum		<0.412	<0.412	<0.412	<0.412
Maximum		11.7	13.1	5.9	0.039
n		14	14	14	14
Count Detects		6	4	2	1
Count Non-Detects		8	10	12	13
Percent Non-Detects		57%	71%	86%	93%
Mean of Detects		2.675	4.21	--	--
Standard Deviation of Detects		4.426	5.985	--	--

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B9: Lithium - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	6.7 I	6.1 I	4.8 I	3 I
Background	1/21/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	2/23/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	3/23/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	5/25/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	7/27/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	9/20/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	11/8/2016	12.5 U	12.5 U	12.5 U	12.5 U
Background	2/21/2017	12.5 U	12.5 U	12.5 U	12.5 U
Background	4/18/2017	12.5 U	12.5 U	12.5 U	12.5 U
Background	6/22/2017	12.5 U	12.5 U	12.5 U	12.5 U
Detection	10/11/2017	NA	NA	NA	NA
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	0.24 I	1.3	0.14 U	0.48 I
Assessment	6/27/2018	0.32 I	1.5	0.14 U	0.61 I
Minimum		<12.5	<12.5	<0.14	<12.5
Maximum		6.7	6.1	4.8	3
n		13	13	13	13
Count Detects		3	3	1	3
Count Non-Detects		10	10	12	10
Percent Non-Detects		77%	77%	92%	77%
Mean of Detects		2.42	2.967	--	1.363
Standard Deviation of Detects		3.707	2.715	--	1.419

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B10: Molybdenum - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	1.67 I	0.944 U	69	0.944 U
Background	1/21/2016	1.94 I	0.944 U	72.4	0.944 U
Background	2/23/2016	2.09 I	0.944 U	65.6	0.944 U
Background	3/23/2016	2.13 I	0.944 U	64.2	0.944 U
Background	5/25/2016	5.79 I	0.944 U	46.8	0.944 U
Background	7/27/2016	16.9	5 U	77.8	5 U
Background	9/20/2016	11.4	5 U	23.9	5 U
Background	11/8/2016	21.2	0.475 U	36.2	0.475 U
Background	2/21/2017	14.6 I	0.475 U	39.7	0.475 U
Background	4/18/2017	11.3 I	0.475 U	38.1	0.475 U
Background	6/22/2017	3.56 I	0.475 U	35	0.475 U
Detection	10/11/2017	10.3 I	0.475 U	41.6	0.475 U
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	8.14 I	1.27 U	31.3	1.27 U
Assessment	6/27/2018	8.9 I	5 U	36.8	5 U
Minimum		1.67	<0.475	23.9	<0.475
Maximum		21.2	--	77.8	--
n		14	14	14	14
Count Detects		14	0	14	0
Count Non-Detects		0	14	0	14
Percent Non-Detects		0%	100%	0%	100%
Mean of Detects		8.566	--	48.46	--
Standard Deviation of Detects		6.151	--	17.53	--

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B11: Radium 226+228 - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	3.22	3.05	9.16	3.32
Background	1/21/2016	1.55	3.005	11.74	3.6
Background	2/23/2016	0.835 U	1.285	8.58	3.07
Background	3/23/2016	2.065	1.33	9.78	5.36
Background	5/25/2016	3.06	1.395	11.54	2.7
Background	7/27/2016	2.56	2.055	11.36	4.54
Background	9/20/2016	2.085	2.59	12.82	5.12
Background	11/8/2016	2.38	1.42	13.73	6.58
Background	2/21/2017	2.95	0.87 U	9.72	2.265
Background	4/18/2017	1.87	1.93	10.83	8.97
Background	6/22/2017	1.575 U	1.125 U	4.29 U	3.34 U
Detection	10/11/2017	NA	NA	NA	NA
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	3.8	1.18	5.48	3.59
Assessment	6/27/2018	3.87	3.21	7.5	5.92
Minimum		<0.835	<0.87	<4.29	<3.34
Maximum		3.87	3.21	13.73	8.97
n		13	13	13	13
Count Detects		11	11	12	12
Count Non-Detects		2	2	1	1
Percent Non-Detects		15%	15%	8%	8%
Mean of Detects		2.674	2.041	10.19	4.586
Standard Deviation of Detects		0.771	0.791	2.314	1.923

## Notes:

All concentrations reported in picocuries per liter (pCi/L)

NA = not analyzed

U = Result less than the method detection limit for both Radium 226 and 228

I = Reported value between method detection limit and practical quantification limit

**Table B12: Selenium - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	7.05 I	21.9	9.94 I	12.1 I
Background	1/21/2016	10.5 I	15.8	7.91 I	8.18 U
Background	2/23/2016	9 I	19.4	9.71 I	7.96 I
Background	3/23/2016	0.846 U	3.54 I	2.75 I	7.77 I
Background	5/25/2016	16.1	31.1	34.9	21.9
Background	7/27/2016	5.81 I	13.8	14.7	10.1 I
Background	9/20/2016	2.9	0.9 I	1.9	0.5 U
Background	11/8/2016	264.23	11.2 I	6.57 I	9.43 I
Background	2/21/2017	9.48 I	12.5	12 I	2.07 I
Background	4/18/2017	1.25 I	6.5 I	5.05 I	6.27 I
Background	6/22/2017	21.6	10.8 I	8.76 I	11.8 I
Detection	10/11/2017	14.5	25.8	18.3	26.8
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	1.1	0.18 I	1.6	0.61
Assessment	6/27/2018	4.4	0.92 I	1.7	1.2
Minimum		<0.846	0.18	1.6	<0.5
Maximum		264.2	31.1	34.9	26.8
n		14	14	14	14
Count Detects		13	14	14	12
Count Non-Detects		1	0	0	2
Percent Non-Detects		7%	0%	0%	14%
Mean of Detects		28.3	12.45	9.699	9.834
Standard Deviation of Detects		71.14	9.658	8.83	7.88

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

**Table B13: Thallium - Downgradient Well Summary**

Event	Date	CCR-4	CCR-5	CCR-6	CCR-7
Background	11/30/2015	0.113 U	0.113 U	0.113 U	0.113 U
Background	1/21/2016	0.113 U	0.09 U	0.113 U	0.113 U
Background	2/23/2016	0.113 U	0.113 U	0.113 U	0.113 U
Background	3/23/2016	0.113 U	0.113 U	0.113 U	0.113 U
Background	5/25/2016	0.113 U	0.113 U	0.113 U	0.113 U
Background	7/27/2016	0.261 U	0.261 U	0.261 U	0.261 U
Background	9/20/2016	0.5 U	0.5 U	0.5 U	0.5 U
Background	11/8/2016	0.316 I	0.261 U	0.261 U	0.261 U
Background	2/21/2017	0.261 U	0.261 U	0.261 U	0.261 U
Background	4/18/2017	0.365 I	0.261 U	0.261 U	0.261 U
Background	6/22/2017	0.942 U	0.942 U	0.942 U	0.942 U
Detection	10/11/2017	0.942 U	0.942 U	0.942 U	0.942 U
Detection	12/13/2017	NA	NA	NA	NA
Assessment	3/26/2018	0.028 U	0.028 U	0.028 U	0.028 U
Assessment	6/27/2018	0.5 U	0.5 U	0.5 U	0.5 U
Minimum		<0.028	<0.028	<0.028	<0.028
Maximum		0.365	--	--	--
n		14	14	14	14
Count Detects		2	0	0	0
Count Non-Detects		12	14	14	14
Percent Non-Detects		86%	100%	100%	100%
Mean of Detects		--	--	--	--
Standard Deviation of Detects		--	--	--	--

## Notes:

All concentrations reported in micrograms per liter ( $\mu\text{g/L}$ )

NA = not analyzed

U = Result less than the method detection limit

I = Reported value between method detection limit and practical quantification limit

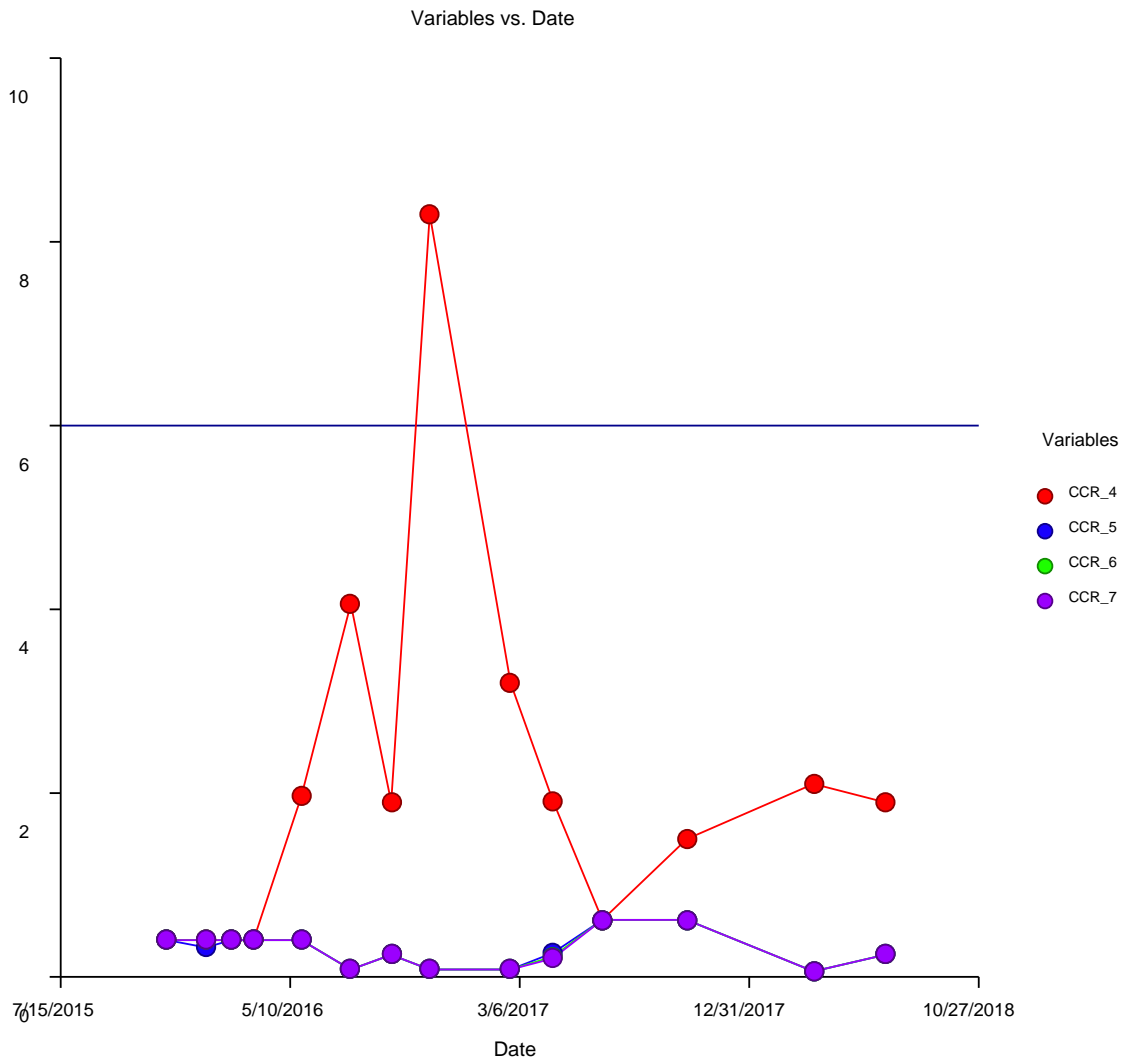




### Scatter Plots

Dataset C:\...\sstafford\Documents\NCSS 11\Data\SJRPP\Antimony.NCSS

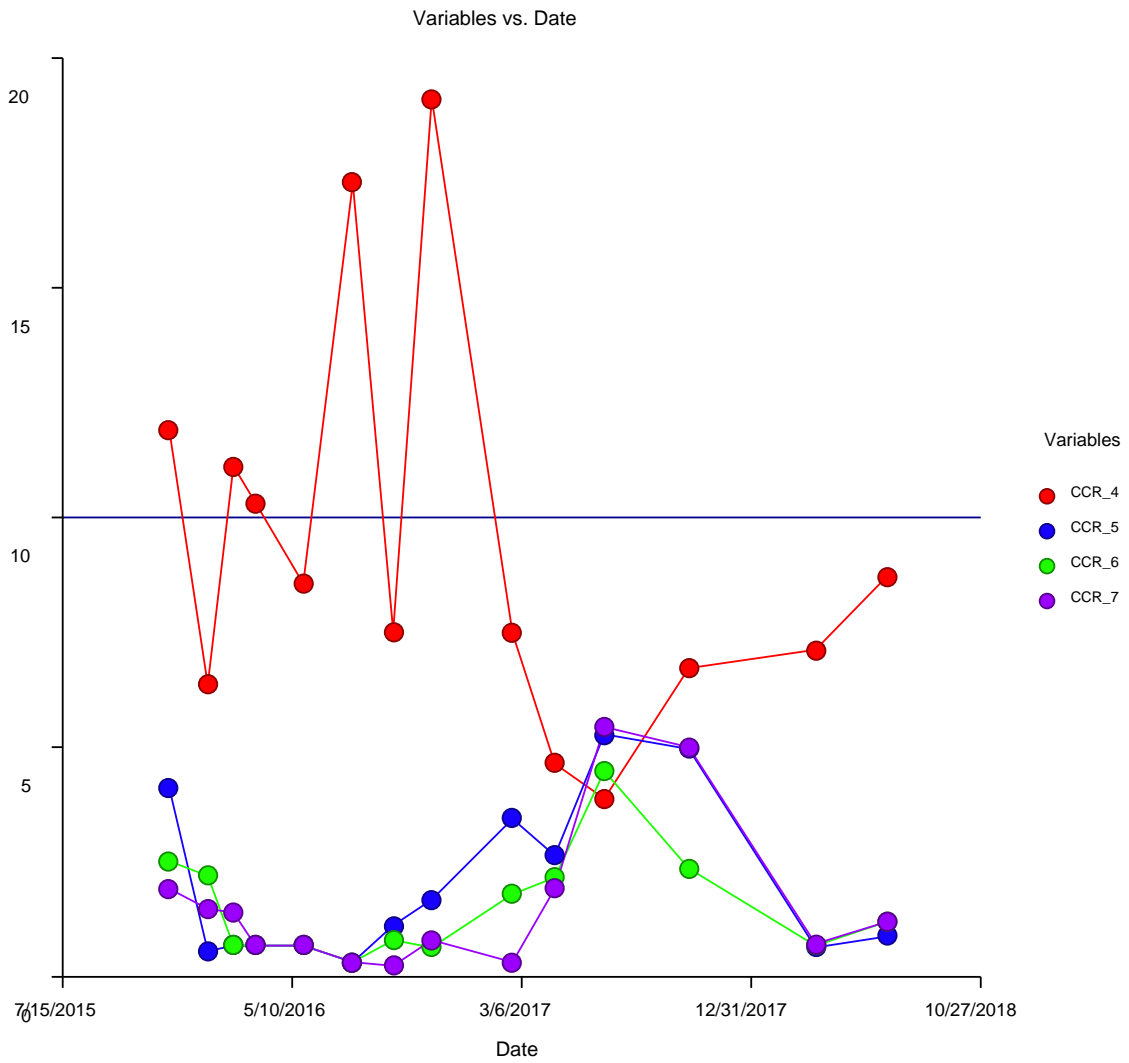
#### Scatter Plot Section



### Scatter Plots

Dataset C:\Users\sstafford\Documents\NCSS 11\Data\SJRPP\Arsenic.NCSS

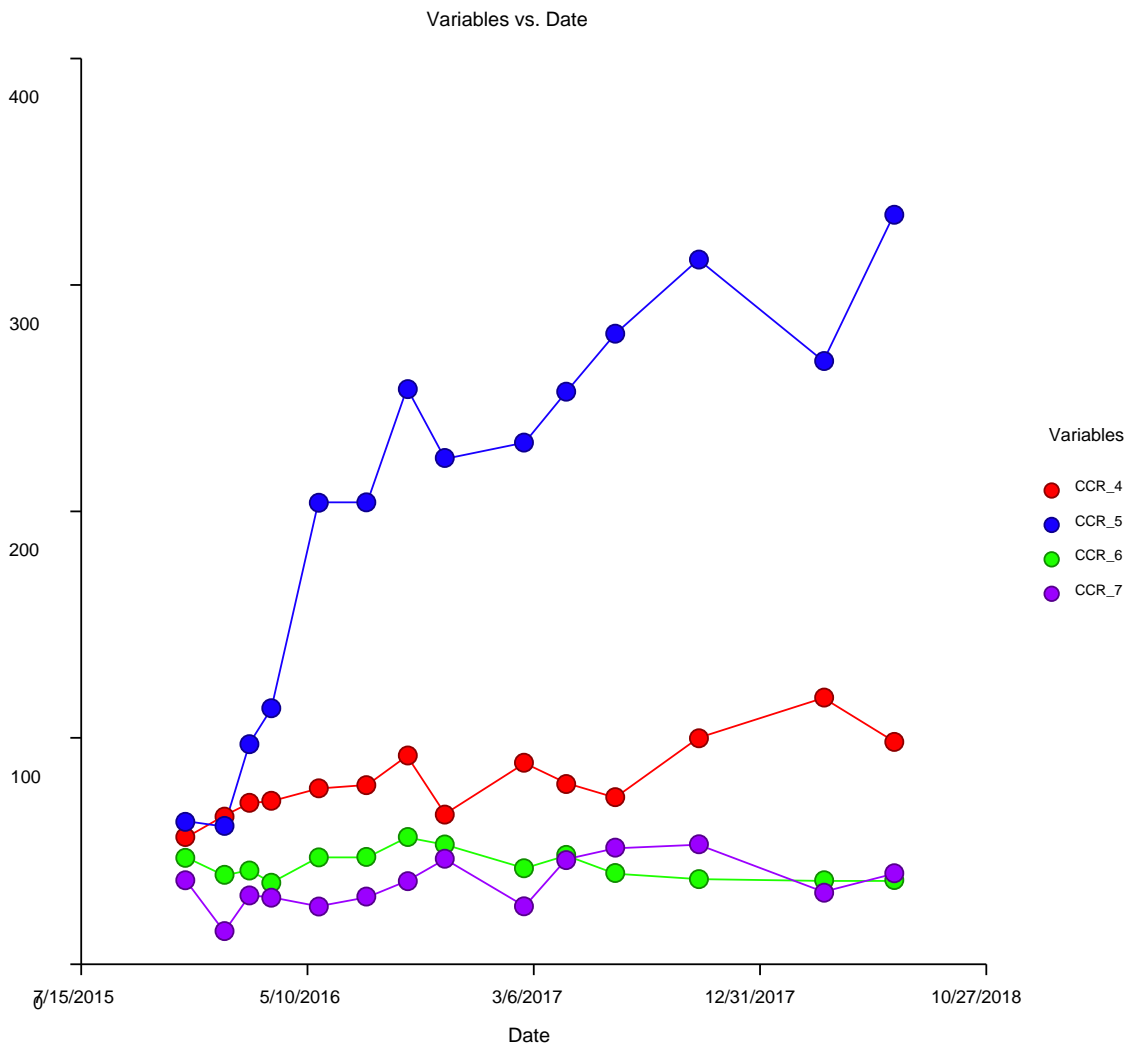
#### Scatter Plot Section



### Scatter Plots

Dataset C:\Users\sstafford\Documents\NCSS 11\Data\SJRPP\Barium.NCSS

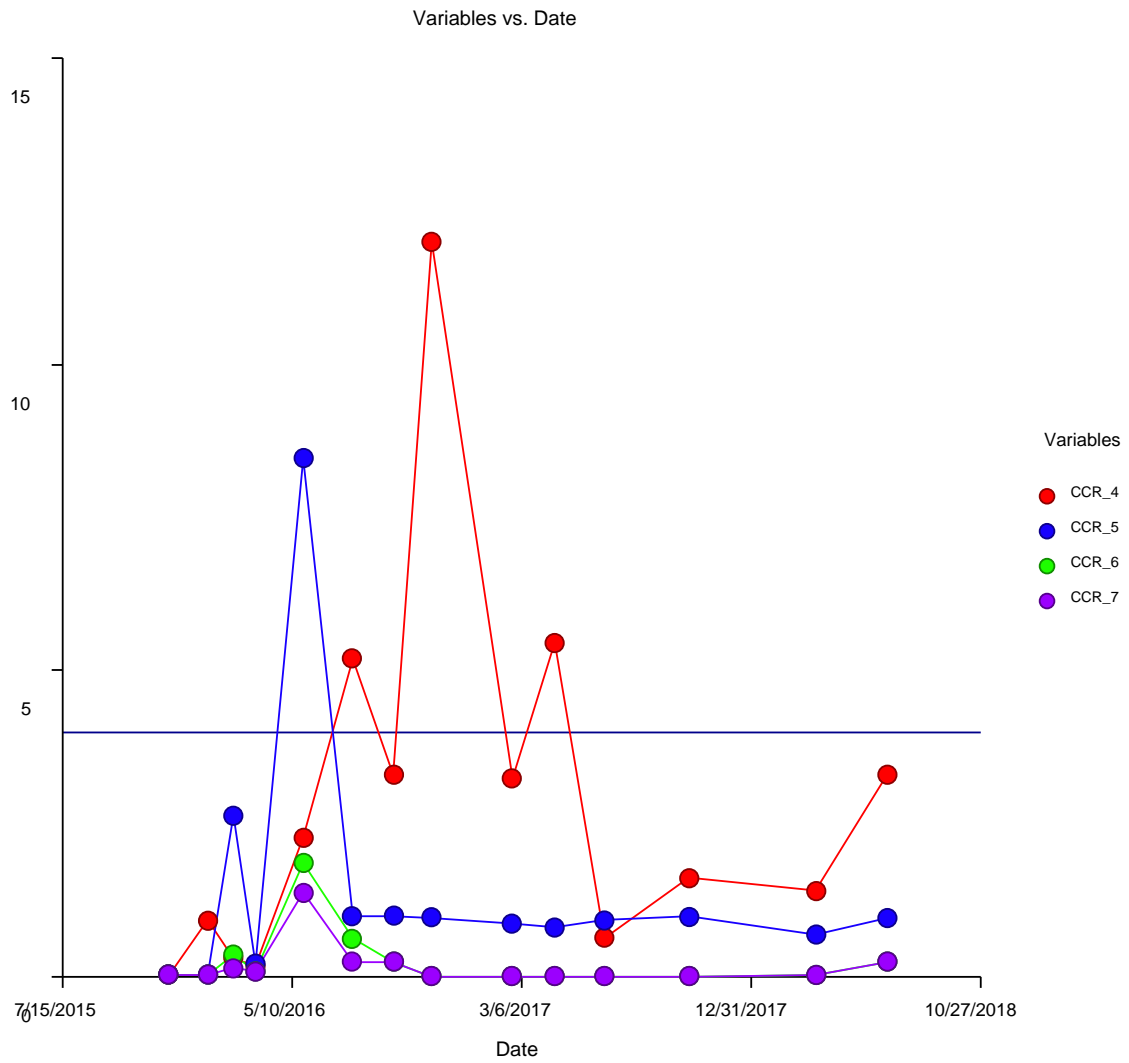
#### Scatter Plot Section



### Scatter Plots

Dataset C:\...\sstafford\Documents\NCSS 11\Data\SJRPP\Beryllium.NCSS

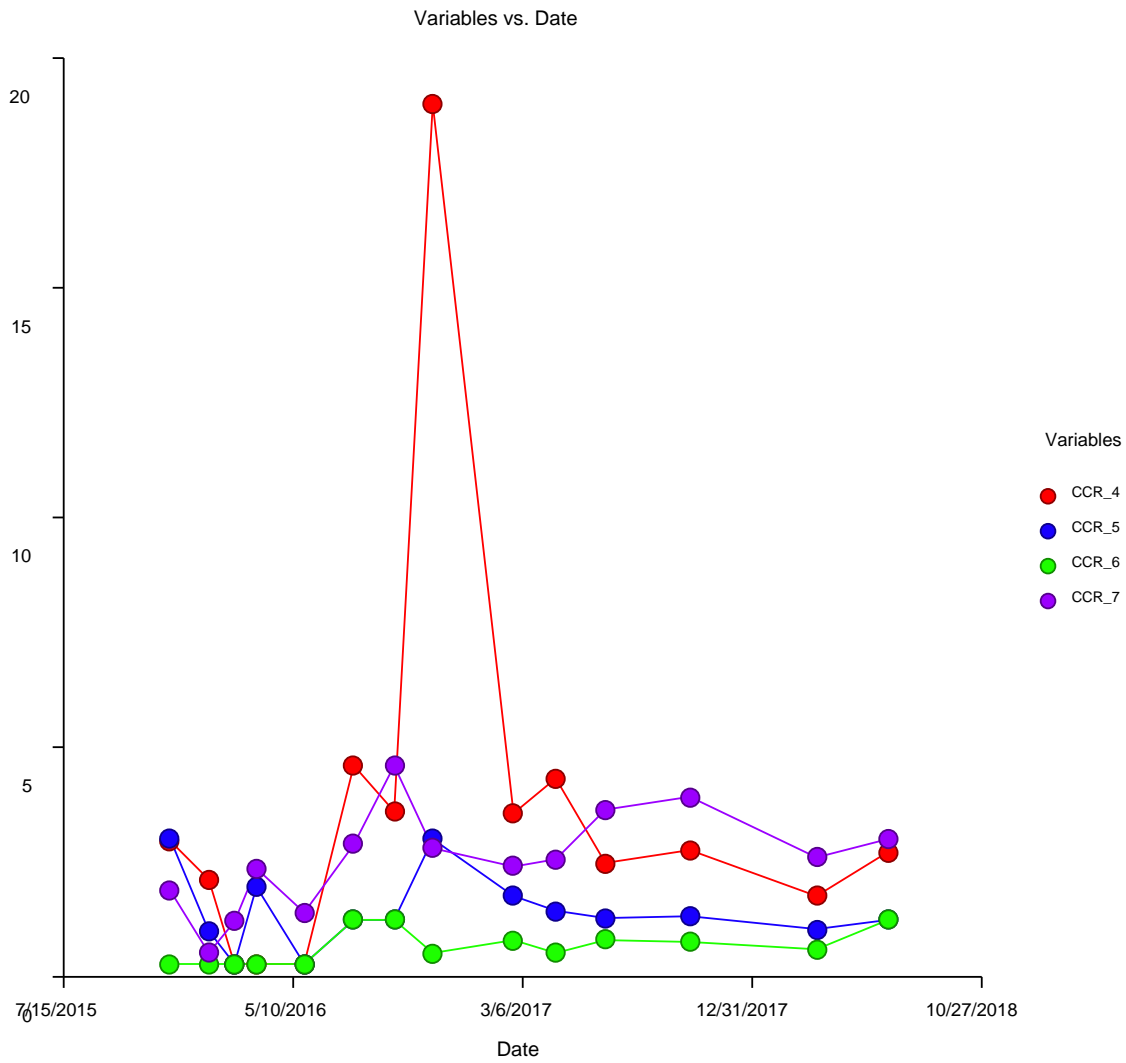
#### Scatter Plot Section



### Scatter Plots

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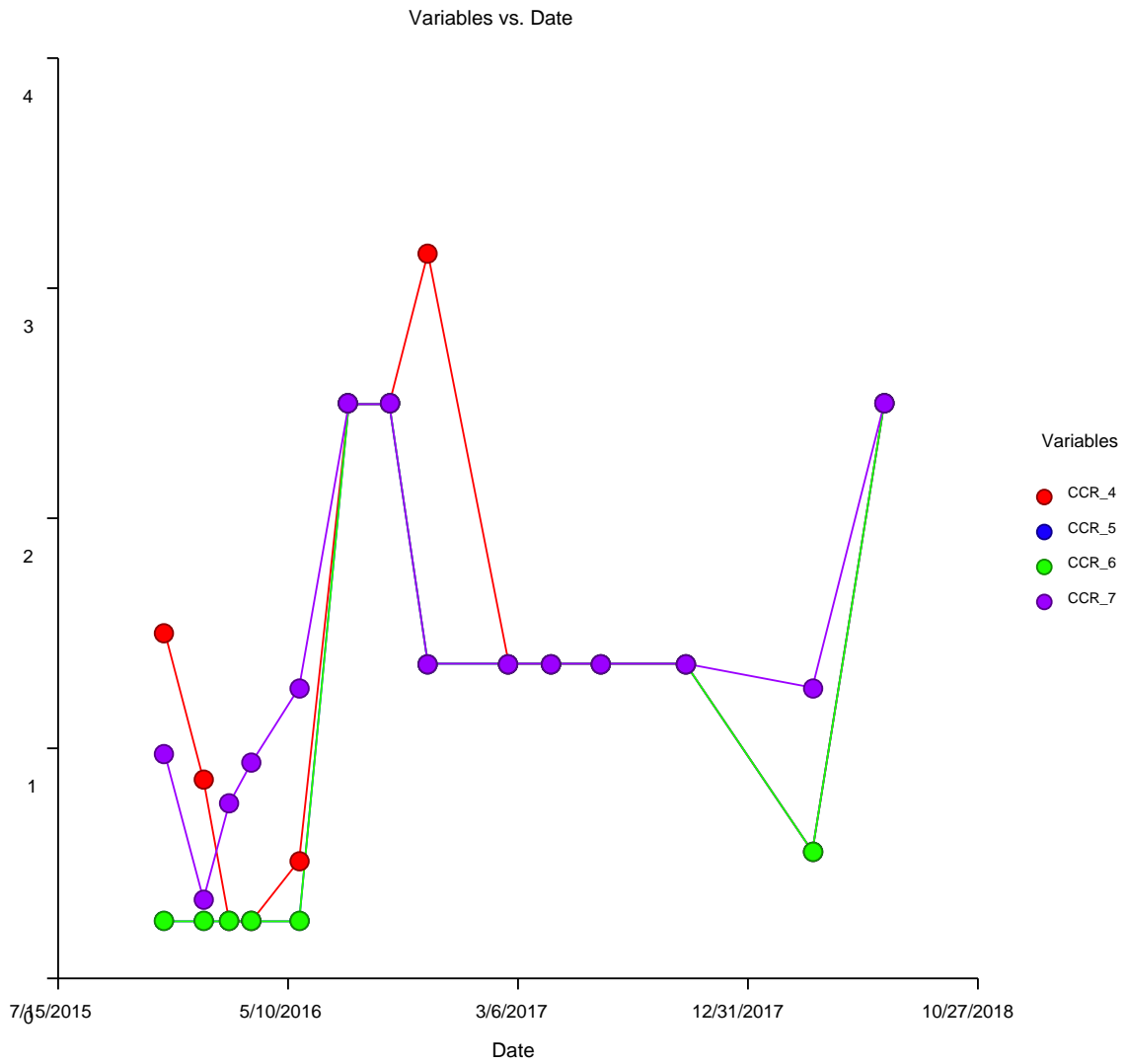
#### Scatter Plot Section



### Scatter Plots

Dataset C:\Users\sstafford\Documents\NCSS 11\Data\SJRPP\Cobalt.NCSS

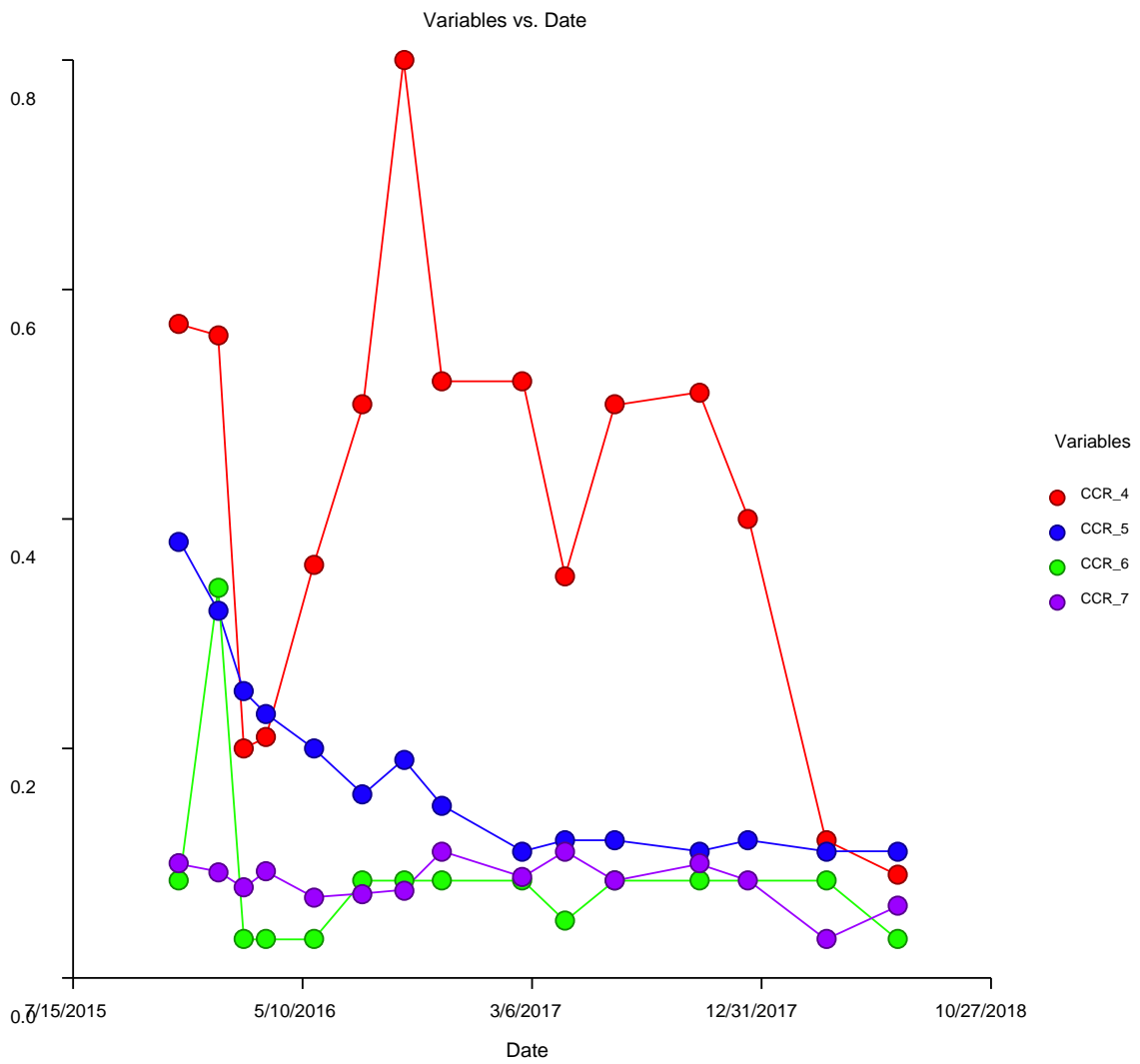
#### Scatter Plot Section



### Scatter Plots

Dataset C:\...\sstafford\Documents\NCSS 11\Data\SJRPP\Fluoride.NCSS

### Scatter Plot Section

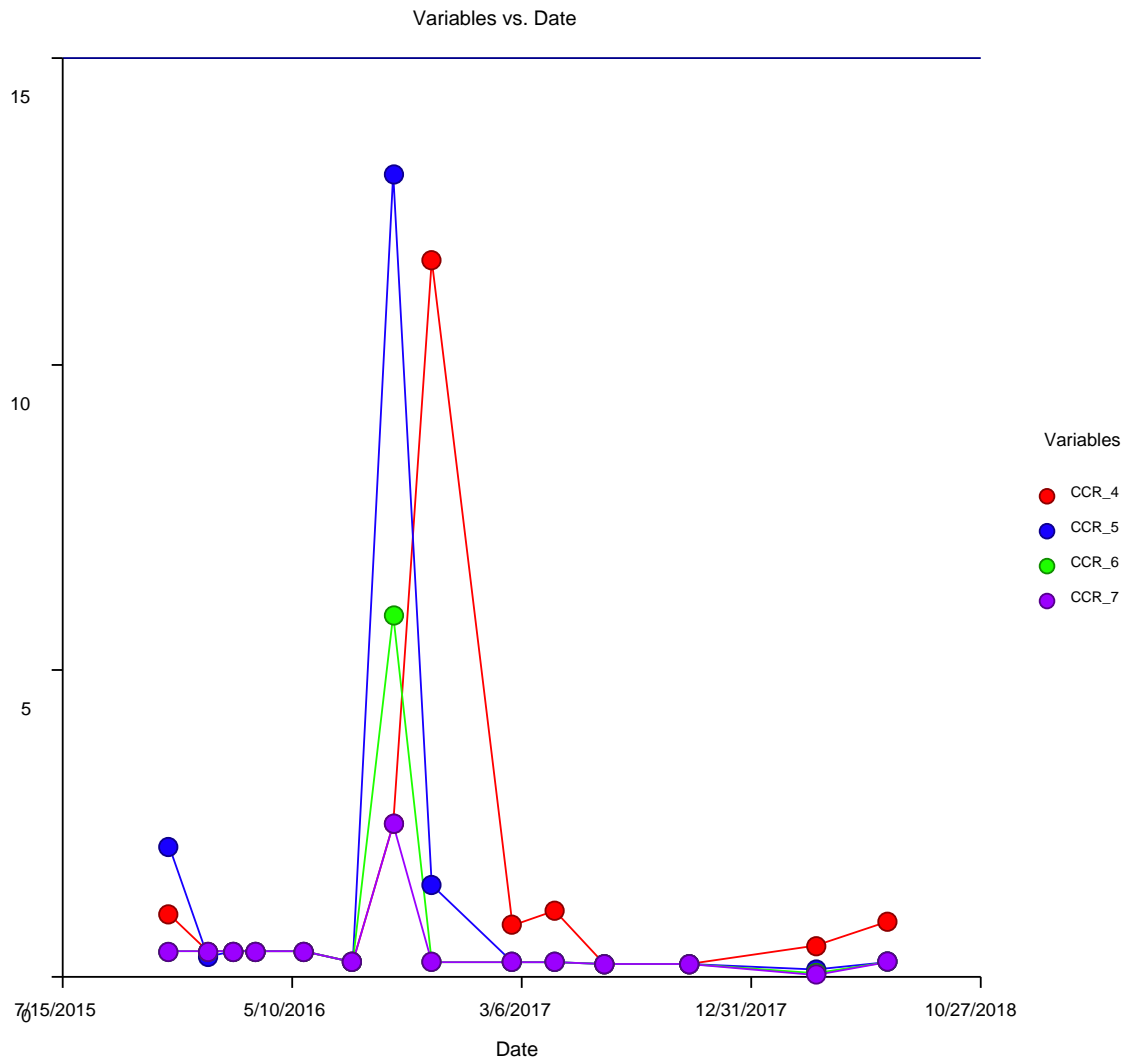




### Scatter Plots

Dataset C:\Users\sstafford\Documents\NCSS 11\Data\SJRPP\Lead.NCSS

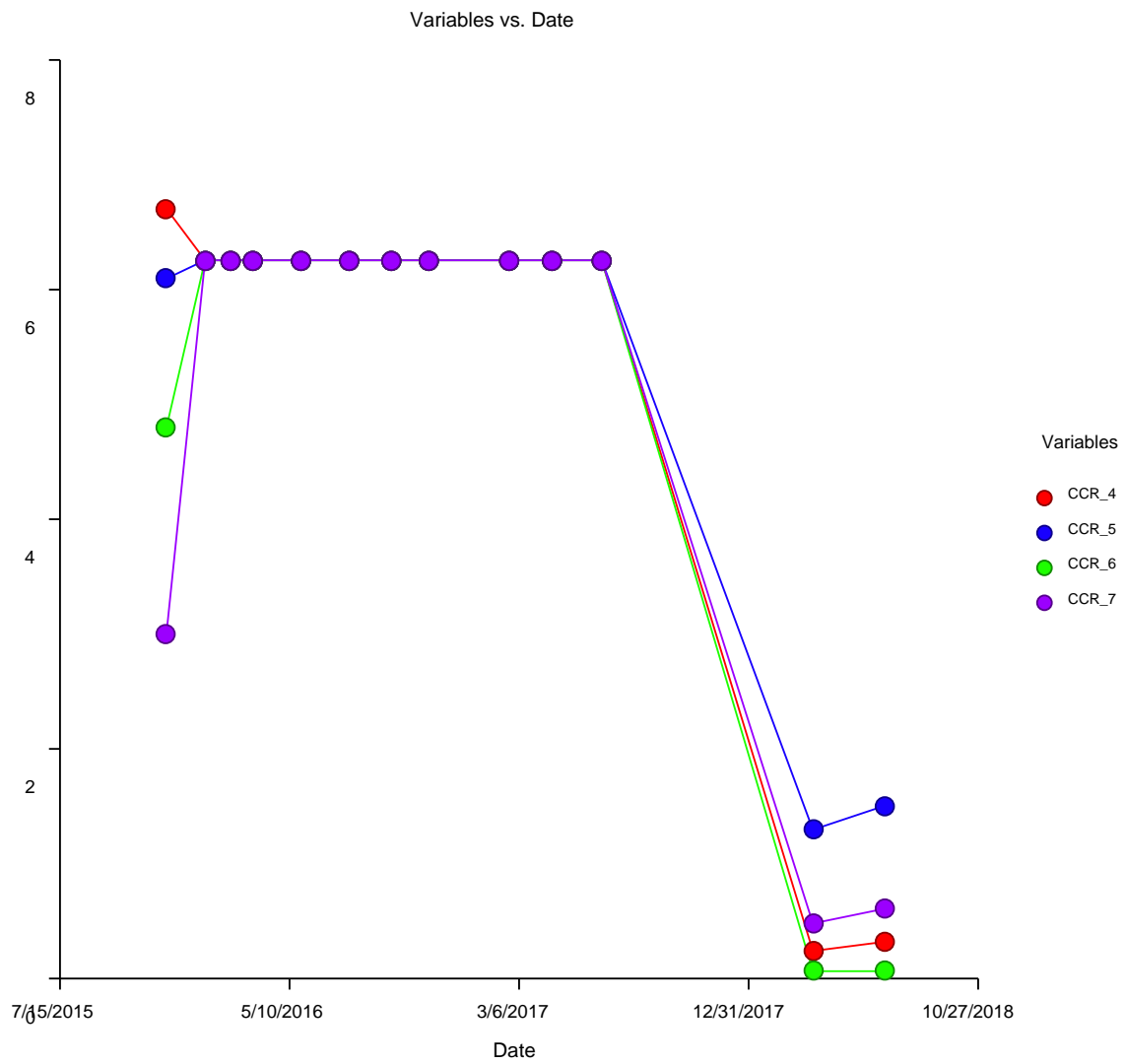
### Scatter Plot Section



### Scatter Plots

Dataset C:\Users\sstafford\Documents\NCSS 11\Data\SJRPP\Lithium.NCSS

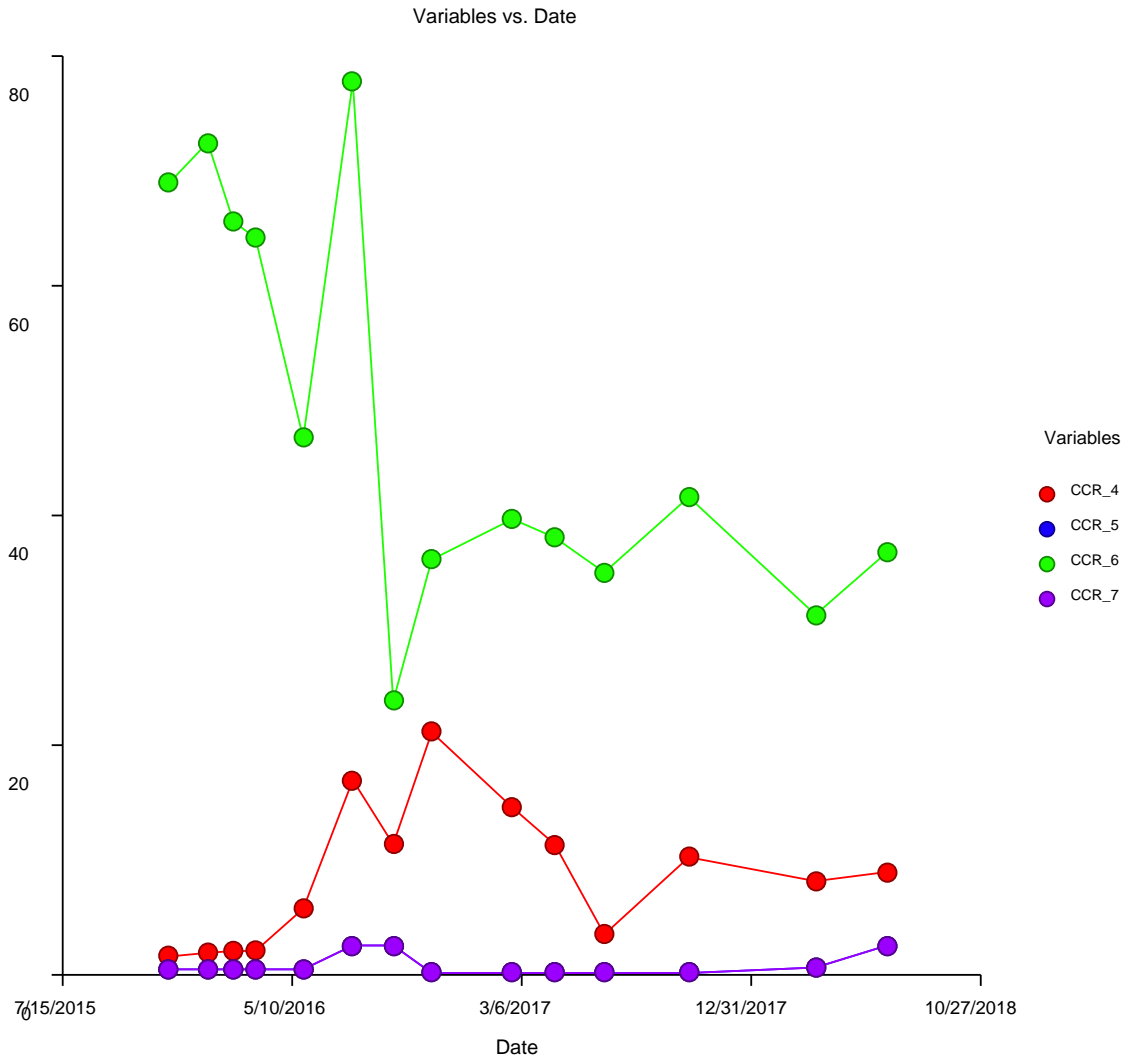
#### Scatter Plot Section



### Scatter Plots

Dataset C:\...\Documents\NCSS 11\Data\SJRPP\Molybdenum.NCSS

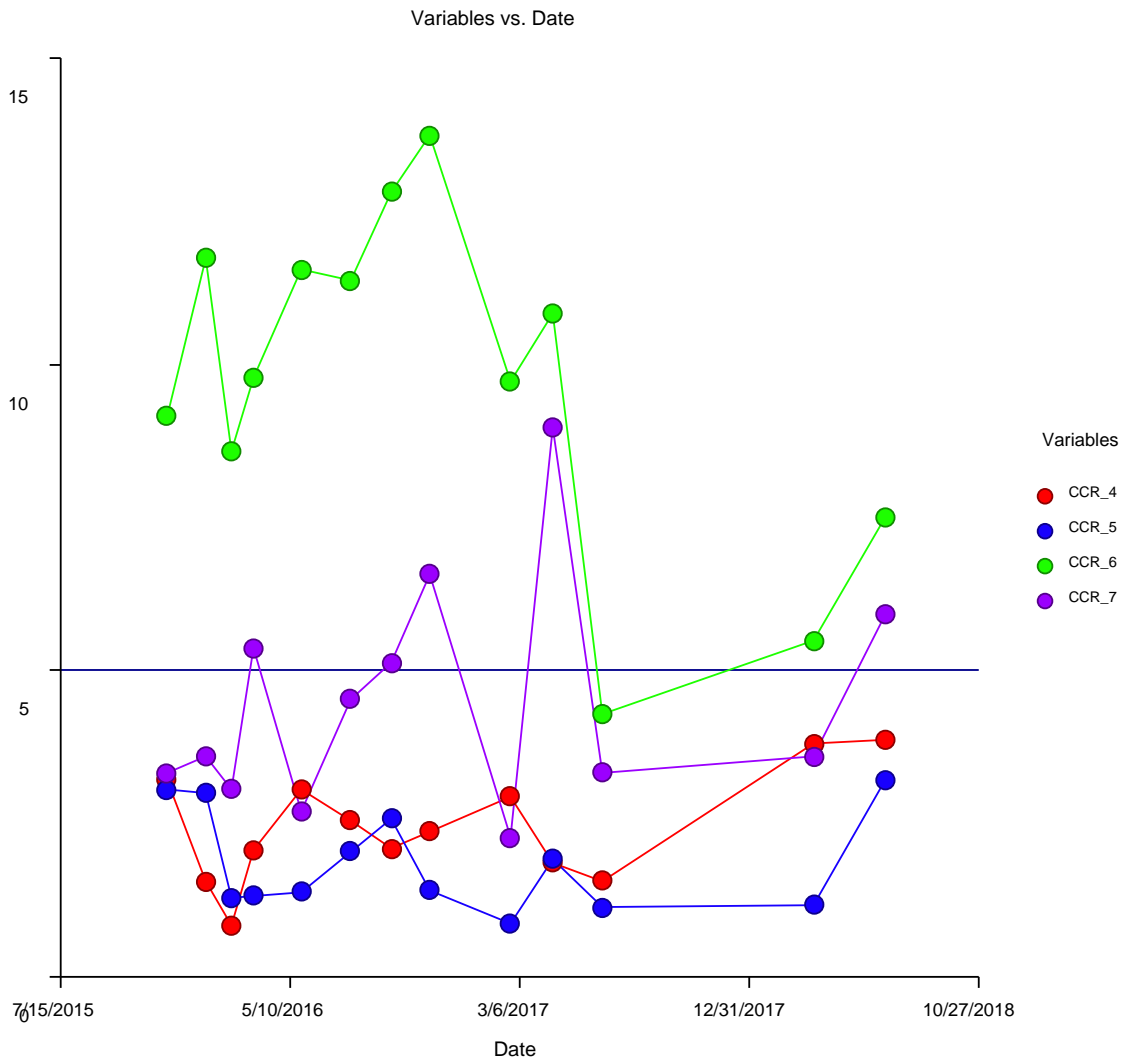
#### Scatter Plot Section



### Scatter Plots

Dataset C:\Users\sstafford\Documents\NCSS 11\Data\SJRPP\Radium.NCSS

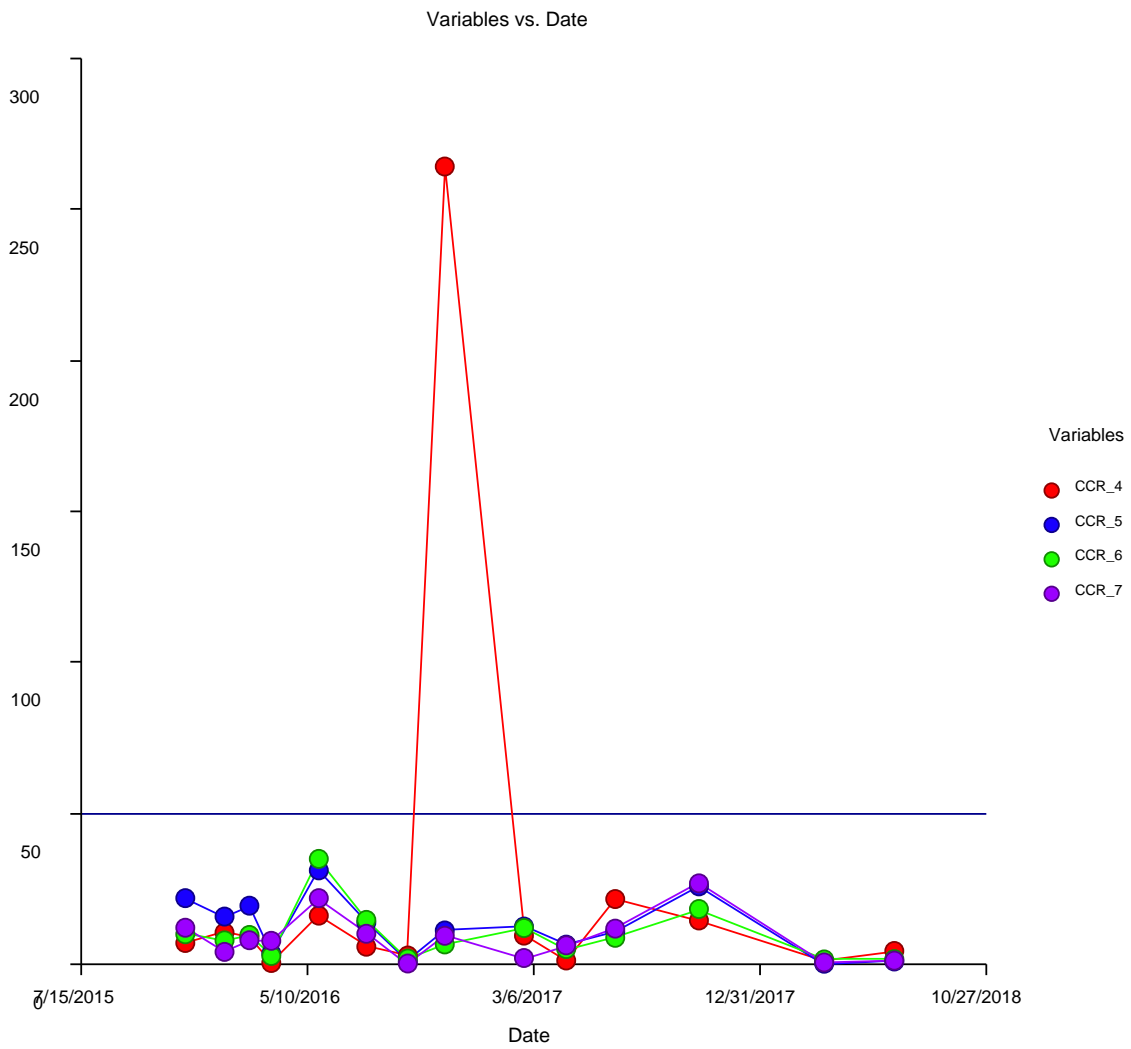
#### Scatter Plot Section



### Scatter Plots

Dataset C:\...\sstafford\Documents\NCSS 11\Data\SJRPP\Selenium.NCSS

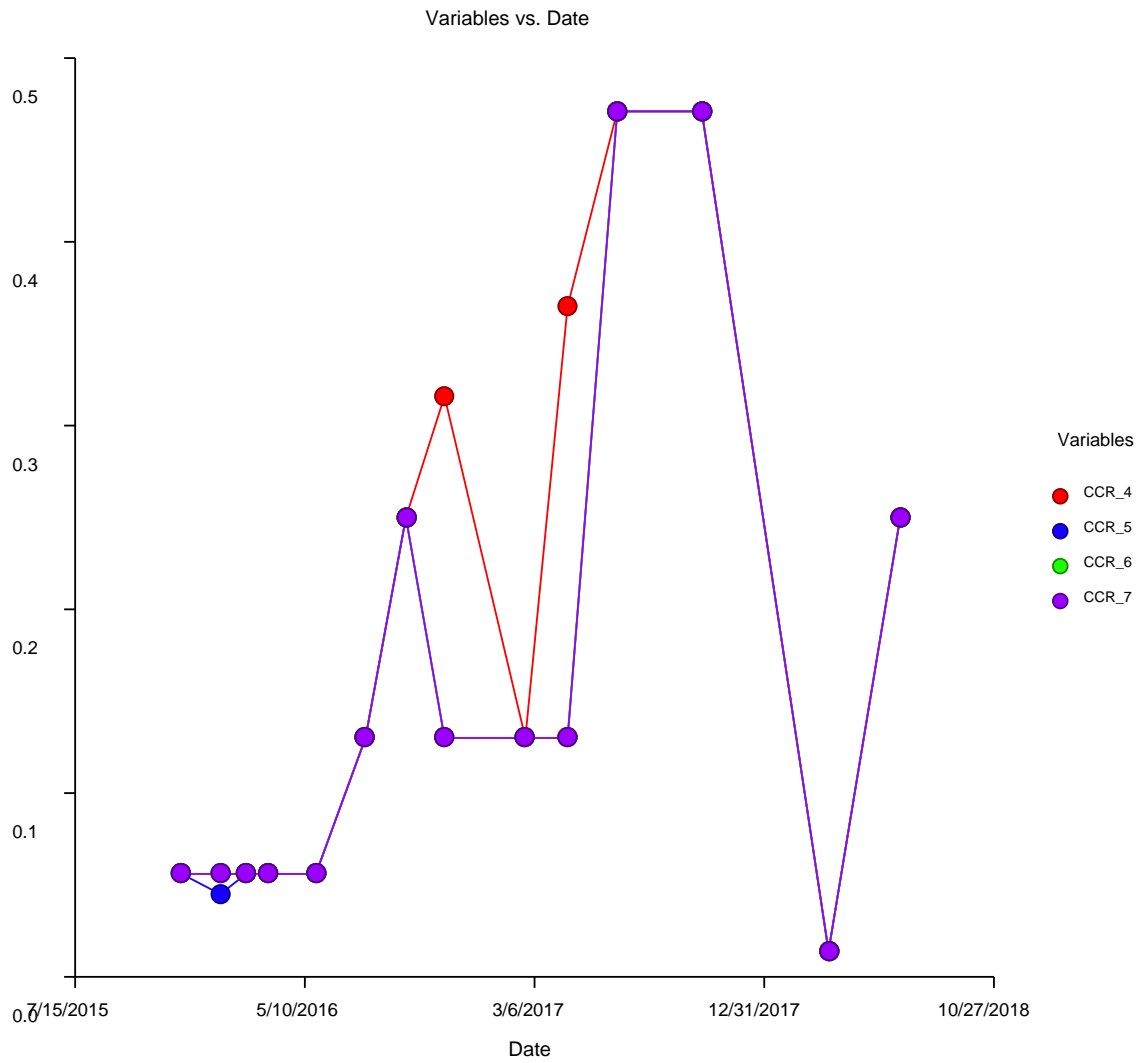
#### Scatter Plot Section



### Scatter Plots

Dataset C:\...\sstafford\Documents\NCSS 11\Data\SJRPP\Thallium.NCSS

#### Scatter Plot Section



**Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit**

Date/Time of Computation ProUCL 5.110/3/2018 12:08:15 PM

From File AppIV\_list.xls

**Dixon's Outlier Test for Antimony-CCR4**

Total N = 14

Number NDs = 5

Number Detects = 9

Number Data (n) = 14

10% critical value: 0.492

5% critical value: 0.546

1% critical value: 0.641

Note: NDs replaced by DL/2 in Outlier Test

**1. Data Value 8.3 is a Potential Outlier (Upper Tail)?**

Test Statistic: 0.646

For 5% significance level, 8.3 is an outlier.

**2. Data Value 0.4065 is a Potential Outlier (Lower Tail)?**

Test Statistic: 0.000

For 5% significance level, 0.4065 is not an outlier.

**Dixon's Outlier Test for Arsenic-CCR4**

Total N = 14

Number NDs = 0

Number Detects = 14

Number Data (n) = 14

10% critical value: 0.492

5% critical value: 0.546

1% critical value: 0.641

Note: NDs replaced by DL/2 in Outlier Test

**1. Data Value 19.1 is a Potential Outlier (Upper Tail)?**

Test Statistic: 0.566

For 5% significance level, 19.1 is an outlier.

**2. Data Value 3.87 is a Potential Outlier (Lower Tail)?**

Test Statistic: 0.311

For 5% significance level, 3.87 is not an outlier.

### Dixon's Outlier Test for Beryllium-CCR4

Total N = 14

Number NDs = 1

Number Detects = 13

Number Data (n) = 14

10% critical value: 0.492

5% critical value: 0.546

1% critical value: 0.641

Note: NDs replaced by DL/2 in Outlier Test

#### 1. Data Value 12 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.582

For 5% significance level, 12 is an outlier.

#### 2. Data Value 0.03885 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.053

For 5% significance level, 0.03885 is not an outlier.

### Dixon's Outlier Test for Beryllium-CCR5

Total N = 14

Number NDs = 2

Number Detects = 12

Number Data (n) = 14

10% critical value: 0.492

5% critical value: 0.546

1% critical value: 0.641

Note: NDs replaced by DL/2 in Outlier Test

#### 1. Data Value 8.47 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.905

For 5% significance level, 8.47 is an outlier.

#### 2. Data Value 0.03885 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.184

For 5% significance level, 0.03885 is not an outlier.



#### Dixon's Outlier Test for Selenium-CCR4

Total N = 14

Number NDs = 1

Number Detects = 13

Number Data (n) = 14

10% critical value: 0.492

5% critical value: 0.546

1% critical value: 0.641

Note: NDs replaced by DL/2 in Outlier Test

##### 1. Data Value 264.23 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.944

For 5% significance level, 264.23 is an outlier.

##### 2. Data Value 0.423 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.053

For 5% significance level, 0.423 is not an outlier.

#### Dixon's Outlier Test for Radium-CCR6

Total N = 13

Number NDs = 1

Number Detects = 12

Number Data (n) = 13

10% critical value: 0.467

5% critical value: 0.521

1% critical value: 0.615

Note: NDs replaced by DL/2 in Outlier Test

##### 1. Data Value 13.73 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.241

For 5% significance level, 13.73 is not an outlier.

##### 2. Data Value 2.145 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.502

For 5% significance level, 2.145 is not an outlier.

## Dixon's Outlier Test for Radium-CCR7

Total N = 13

Number NDs = 1

Number Detects = 12

Number Data (n) = 13

10% critical value: 0.467

5% critical value: 0.521

1% critical value: 0.615

Note: NDs replaced by DL/2 in Outlier Test

### 1. Data Value 8.97 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.455

For 5% significance level, 8.97 is not an outlier.

### 2. Data Value 1.67 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.210

For 5% significance level, 1.67 is not an outlier.

### Mann-Kendall Trend Test Analysis

Date/Time of Computation ProUCL 5.110/3/2018 12:20:11 PM  
From File AppIV\_list.xls  
Full Precision OFF  
Confidence Coefficient 0.95  
Level of Significance 0.05

#### Antimony-CCR4

##### General Statistics

Number of Reported Events Not Used	0
Number of Generated Events	14
Number Values Reported (n)	14
Minimum	0.813
Maximum	8.3
Mean	2.237
Geometric Mean	1.748
Median	1.9
Standard Deviation	1.983
Coefficient of Variation	0.886

##### Mann-Kendall Test

M-K Test Value (S)	26
Tabulated p-value	0.079
Standard Deviation of S	18
Standardized Value of S	1.389
Approximate p-value	0.0824

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

### Arsenic-CCR4

#### General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	14
Number Values Reported (n)	14
Minimum	3.87
Maximum	19.1
Mean	9.334
Geometric Mean	8.502
Median	8.03
Standard Deviation	4.381
Coefficient of Variation	0.469

#### Mann-Kendall Test

M-K Test Value (S)	-27
Tabulated p-value	0.079
Standard Deviation of S	18.27
Standardized Value of S	-1.423
Approximate p-value	0.0773

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

### Beryllium-CCR4

#### General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	14
Number Values Reported (n)	14
Minimum	0.0777
Maximum	12
Mean	2.85
Geometric Mean	1.433
Median	1.94
Standard Deviation	3.168
Coefficient of Variation	1.112

#### Mann-Kendall Test

M-K Test Value (S)	28
Tabulated p-value	0.063
Standard Deviation of S	18.24
Standardized Value of S	1.48
Approximate p-value	0.0694

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

### Beryllium-CCR5

#### General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	14
Number Values Reported (n)	14
Minimum	0.0777
Maximum	8.47
Mean	1.404
Geometric Mean	0.728
Median	0.94
Standard Deviation	2.124
Coefficient of Variation	1.513

#### Mann-Kendall Test

M-K Test Value (S)	2
Tabulated p-value	0.457
Standard Deviation of S	18.24
Standardized Value of S	0.0548
Approximate p-value	0.478

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

### Radium-CCR6

#### General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	13
Number Values Reported (n)	14
Number Values Missing	1
Number Values Used	13
Minimum	4.29
Maximum	13.73
Mean	9.733
Geometric Mean	9.295
Median	9.78
Standard Deviation	2.754
Coefficient of Variation	0.283

#### Mann-Kendall Test

M-K Test Value (S)	-16
Tabulated p-value	0.184
Standard Deviation of S	16.39
Standardized Value of S	-0.915
Approximate p-value	0.18

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

### Radium-CCR7

#### General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	13
Number Values Reported (n)	14
Number Values Missing	1
Number Values Used	13
Minimum	2.265
Maximum	8.97
Mean	4.49
Geometric Mean	4.175
Median	3.6
Standard Deviation	1.873
Coefficient of Variation	0.417

#### Mann-Kendall Test

M-K Test Value (S)	18
Tabulated p-value	0.153
Standard Deviation of S	16.39
Standardized Value of S	1.037
Approximate p-value	0.15

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

#### Selenium-CCR4

##### General Statistics

Number or Reported Events Not Used	0
Number of Generated Events	14
Number Values Reported (n)	14
Minimum	0.846
Maximum	264.2
Mean	26.34
Geometric Mean	7.034
Median	8.025
Standard Deviation	68.74
Coefficient of Variation	2.61

##### Mann-Kendall Test

M-K Test Value (S)	-5
Tabulated p-value	0.415
Standard Deviation of S	18.27
Standardized Value of S	-0.219
Approximate p-value	0.413

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

**Goodness-of-Fit Test Statistics for Data Sets with Non-Detects**

Date/Time of Computation ProUCL 5.110/3/2018 12:10:13 PM

From File AppIV\_list.xls

Full Precision OFF

Confidence Coefficient 0.95

**Antimony-CCR4**

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	14	0	14	9	5	35.71%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	5	0.813	1.23	0.896	0.813	0.186
Statistics (Non-Detects Only)	9	1.5	8.3	2.982	1.97	2.15
Statistics (All: NDs treated as DL value)	14	0.813	8.3	2.237	1.9	1.983
Statistics (All: NDs treated as DL/2 value)	14	0.407	8.3	2.077	1.9	2.106
Statistics (Normal ROS Imputed Data)	14	-3.561	8.3	1.233	1.9	3.025
Statistics (Gamma ROS Imputed Data)	14	0.01	8.3	1.921	1.9	2.243
Statistics (Lognormal ROS Imputed Data)	14	0.433	8.3	2.167	1.9	2.036
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Non-Detects Only)	3.378	2.326	0.883	0.937	0.537	0.572
Statistics (NDs = DL)	2.176	1.758	1.028	0.558	0.683	1.223
Statistics (NDs = DL/2)	1.332	1.094	1.56	0.311	0.974	3.135
Statistics (Gamma ROS Estimates)	0.39	0.354	4.926	-1.042	2.788	-2.675
Statistics (Lognormal ROS Estimates)	--	--	--	0.463	0.8	1.729

**Lognormal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.893	0.951	0.95	0.98
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.81	0.829	Data Not Lognormal	
Shapiro-Wilk (NDs = DL)	0.901	0.874	Data Appear Lognormal	
Shapiro-Wilk (NDs = DL/2)	0.89	0.874	Data Appear Lognormal	
Shapiro-Wilk (Lognormal ROS Estimates)	0.964	0.874	Data Appear Lognormal	
Lilliefors (Detects Only)	0.309	0.274	Data Not Lognormal	
Lilliefors (NDs = DL)	0.18	0.226	Data Appear Lognormal	
Lilliefors (NDs = DL/2)	0.204	0.226	Data Appear Lognormal	
Lilliefors (Lognormal ROS Estimates)	0.16	0.226	Data Appear Lognormal	

**Raw Statistics**

Number of Valid Observations	14
Number of Distinct Observations	14
Minimum	3.87
Maximum	19.1
Mean of Raw Data	9.334
Standard Deviation of Raw Data	4.381
Khat	5.518
Theta hat	1.691
Kstar	4.383
Theta star	2.129
Mean of Log Transformed Data	2.14
Standard Deviation of Log Transformed Data	0.444

**Normal GOF Test Results**

Correlation Coefficient R	0.939
Shapiro Wilk Test Statistic	0.884
Shapiro Wilk Critical (0.05) Value	0.874
Approximate Shapiro Wilk P Value	0.0651
Lilliefors Test Statistic	0.2
Lilliefors Critical (0.05) Value	0.226

Data appear Normal at (0.05) Significance Level



	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	14	0	14	13	1	7.14%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	1	0.0777	0.0777	0.0777	0.0777	N/A
Statistics (Non-Detects Only)	13	0.176	12	3.063	2.27	3.191
Statistics (All: NDs treated as DL value)	14	0.0777	12	2.85	1.94	3.168
Statistics (All: NDs treated as DL/2 value)	14	0.0389	12	2.847	1.94	3.17
Statistics (Normal ROS Imputed Data)	14	-4.046	12	2.555	1.94	3.606
Statistics (Gamma ROS Imputed Data)	14	0.01	12	2.845	1.94	3.172
Statistics (Lognormal ROS Imputed Data)	14	0.0992	12	2.851	1.94	3.166
	K hat	K Star	Theta hat	Log Mean	Log Stdev	Log CV
Statistics (Non-Detects Only)	1.07	0.875	2.861	0.584	1.195	2.046
Statistics (NDs = DL)	0.856	0.72	3.328	0.36	1.422	3.95
Statistics (NDs = DL/2)	0.806	0.681	3.532	0.311	1.539	4.955
Statistics (Gamma ROS Estimates)	0.723	0.616	3.933	0.214	1.801	8.43
Statistics (Lognormal ROS Estimates)	--	--	--	0.378	1.385	3.668

**Lognormal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.983	0.976	0.964	0.978
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.965	0.866	Data Appear Lognormal	
Shapiro-Wilk (NDs = DL)	0.951	0.874	Data Appear Lognormal	
Shapiro-Wilk (NDs = DL/2)	0.935	0.874	Data Appear Lognormal	
Shapiro-Wilk (Lognormal ROS Estimates)	0.952	0.874	Data Appear Lognormal	
Lilliefors (Detects Only)	0.151	0.234	Data Appear Lognormal	
Lilliefors (NDs = DL)	0.145	0.226	Data Appear Lognormal	
Lilliefors (NDs = DL/2)	0.15	0.226	Data Appear Lognormal	
Lilliefors (Lognormal ROS Estimates)	0.146	0.226	Data Appear Lognormal	

**Note: Substitution methods such as DL or DL/2 are not recommended.**

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	14	0	14	12	2	14.29%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	2	0.0777	0.0777	0.0777	0.0777	0
Statistics (Non-Detects Only)	12	0.216	8.47	1.625	0.967	2.227
Statistics (All: NDs treated as DL value)	14	0.0777	8.47	1.404	0.94	2.124
Statistics (All: NDs treated as DL/2 value)	14	0.0389	8.47	1.399	0.94	2.128
Statistics (Normal ROS Imputed Data)	14	-2.596	8.47	1.079	0.94	2.479
Statistics (Gamma ROS Imputed Data)	14	0.01	8.47	1.394	0.94	2.131
Statistics (Lognormal ROS Imputed Data)	14	0.148	8.47	1.419	0.94	2.114
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Non-Detects Only)	1.303	1.033	1.248	0.055	0.854	15.52
Statistics (NDs = DL)	0.891	0.747	1.576	-0.318	1.231	-3.873
Statistics (NDs = DL/2)	0.79	0.668	1.77	-0.417	1.434	-3.44
Statistics (Gamma ROS Estimates)	0.648	0.557	2.153	-0.611	1.866	-3.055
Statistics (Lognormal ROS Estimates)	--	--	--	-0.2	1.021	-5.113

**Normal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.685	0.7	0.703	0.822
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.502	0.859	Data Not Normal	
Shapiro-Wilk (NDs = DL)	0.521	0.874	Data Not Normal	
Shapiro-Wilk (NDs = DL/2)	0.526	0.874	Data Not Normal	
Shapiro-Wilk (Normal ROS Estimates)	0.715	0.874	Data Not Normal	
Lilliefors (Detects Only)	0.444	0.243	Data Not Normal	
Lilliefors (NDs = DL)	0.433	0.226	Data Not Normal	
Lilliefors (NDs = DL/2)	0.431	0.226	Data Not Normal	
Lilliefors (Normal ROS Estimates)	0.37	0.226	Data Not Normal	

**Lognormal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.871	0.918	0.902	0.924
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.798	0.859	Data Not Lognormal	
Shapiro-Wilk (NDs = DL)	0.856	0.874	Data Not Lognormal	
Shapiro-Wilk (NDs = DL/2)	0.827	0.874	Data Not Lognormal	
Shapiro-Wilk (Lognormal ROS Estimates)	0.871	0.874	Data Not Lognormal	
Lilliefors (Detects Only)	0.359	0.243	Data Not Lognormal	
Lilliefors (NDs = DL)	0.269	0.226	Data Not Lognormal	
Lilliefors (NDs = DL/2)	0.299	0.226	Data Not Lognormal	
Lilliefors (Lognormal ROS Estimates)	0.28	0.226	Data Not Lognormal	

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	14	0	14	13	1	7.14%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	1	0.846	0.846	0.846	0.846	N/A
Statistics (Non-Detects Only)	13	1.1	264.2	28.3	9	71.14
Statistics (All: NDs treated as DL value)	14	0.846	264.2	26.34	8.025	68.74
Statistics (All: NDs treated as DL/2 value)	14	0.423	264.2	26.31	8.025	68.76
Statistics (Normal ROS Imputed Data)	14	-78.84	264.2	20.65	8.025	74.11
Statistics (Gamma ROS Imputed Data)	14	0.01	264.2	26.28	8.025	68.77
Statistics (Lognormal ROS Imputed Data)	14	0.32	264.2	26.3	8.025	68.76
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Non-Detects Only)	0.514	0.447	55.01	2.114	1.386	0.656
Statistics (NDs = DL)	0.484	0.428	54.47	1.951	1.464	0.751
Statistics (NDs = DL/2)	0.469	0.416	56.13	1.901	1.551	0.816
Statistics (Gamma ROS Estimates)	0.402	0.364	65.36	1.634	2.236	1.368
Statistics (Lognormal ROS Estimates)	--	--	--	1.881	1.59	0.845

**Lognormal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Log ROS
Correlation Coefficient R	0.945	0.954	0.963	0.963
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.911	0.866	Data Appear Lognormal	
Shapiro-Wilk (NDs = DL)	0.923	0.874	Data Appear Lognormal	
Shapiro-Wilk (NDs = DL/2)	0.945	0.874	Data Appear Lognormal	
Shapiro-Wilk (Lognormal ROS Estimates)	0.948	0.874	Data Appear Lognormal	
Lilliefors (Detects Only)	0.168	0.234	Data Appear Lognormal	
Lilliefors (NDs = DL)	0.15	0.226	Data Appear Lognormal	
Lilliefors (NDs = DL/2)	0.154	0.226	Data Appear Lognormal	
Lilliefors (Lognormal ROS Estimates)	0.155	0.226	Data Appear Lognormal	

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	14	1	13	12	1	7.69%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	1	4.29	4.29	4.29	4.29	N/A
Statistics (Non-Detects Only)	12	5.48	13.73	10.19	10.31	2.314
Statistics (All: NDs treated as DL value)	13	4.29	13.73	9.733	9.78	2.754
Statistics (All: NDs treated as DL/2 value)	13	2.145	13.73	9.568	9.78	3.144
Statistics (Normal ROS Imputed Data)	13	4.559	13.73	9.754	9.78	2.71
Statistics (Gamma ROS Imputed Data)	13	5.346	13.73	9.814	9.78	2.591
Statistics (Lognormal ROS Imputed Data)	13	5.48	13.73	9.825	9.78	2.571
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Non-Detects Only)	18.55	13.97	0.549	2.294	0.254	0.111
Statistics (NDs = DL)	11.02	8.525	0.884	2.229	0.336	0.151
Statistics (NDs = DL/2)	6.238	4.849	1.534	2.176	0.489	0.225
Statistics (Gamma ROS Estimates)	13.51	10.45	0.726	2.246	0.297	0.132
Statistics (Lognormal ROS Estimates)	--	--	--	2.248	0.293	0.13

**Normal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.987	0.98	0.958	0.981
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.977	0.859	Data Appear Normal	
Shapiro-Wilk (NDs = DL)	0.956	0.866	Data Appear Normal	
Shapiro-Wilk (NDs = DL/2)	0.926	0.866	Data Appear Normal	
Shapiro-Wilk (Normal ROS Estimates)	0.957	0.866	Data Appear Normal	
Lilliefors (Detects Only)	0.111	0.243	Data Appear Normal	
Lilliefors (NDs = DL)	0.116	0.234	Data Appear Normal	
Lilliefors (NDs = DL/2)	0.146	0.234	Data Appear Normal	
Lilliefors (Normal ROS Estimates)	0.116	0.234	Data Appear Normal	

	Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs
Raw Statistics	14	1	13	12	1	7.69%
	Number	Minimum	Maximum	Mean	Median	SD
Statistics (Non-Detects Only)	1	3.34	3.34	3.34	3.34	N/A
Statistics (Non-Detects Only)	12	2.265	8.97	4.586	4.07	1.923
Statistics (All: NDs treated as DL value)	13	2.265	8.97	4.49	3.6	1.873
Statistics (All: NDs treated as DL/2 value)	13	1.67	8.97	4.362	3.6	2.011
Statistics (Normal ROS Imputed Data)	13	2.265	8.97	4.436	3.6	1.919
Statistics (Gamma ROS Imputed Data)	13	2.265	8.97	4.435	3.6	1.92
Statistics (Lognormal ROS Imputed Data)	13	2.265	8.97	4.447	3.6	1.908
	K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV
Statistics (Non-Detects Only)	6.8	5.156	0.674	1.448	0.402	0.278
Statistics (NDs = DL)	7.031	5.46	0.639	1.429	0.391	0.273
Statistics (NDs = DL/2)	5.311	4.137	0.821	1.376	0.464	0.337
Statistics (Gamma ROS Estimates)	6.487	5.041	0.684	1.41	0.408	0.289
Statistics (Lognormal ROS Estimates)	--	--	--	1.415	0.402	0.284

**Normal GOF Test Results**

	No NDs	NDs = DL	NDs = DL/2	Normal ROS
Correlation Coefficient R	0.959	0.948	0.969	0.95
	Test value	Crit. (0.05)	Conclusion with Alpha(0.05)	
Shapiro-Wilk (Detects Only)	0.922	0.859	Data Appear Normal	
Shapiro-Wilk (NDs = DL)	0.903	0.866	Data Appear Normal	
Shapiro-Wilk (NDs = DL/2)	0.943	0.866	Data Appear Normal	
Shapiro-Wilk (Normal ROS Estimates)	0.904	0.866	Data Appear Normal	
Lilliefors (Detects Only)	0.196	0.243	Data Appear Normal	
Lilliefors (NDs = DL)	0.221	0.234	Data Appear Normal	
Lilliefors (NDs = DL/2)	0.186	0.234	Data Appear Normal	
Lilliefors (Normal ROS Estimates)	0.207	0.234	Data Appear Normal	



**[golder.com](http://golder.com)**