ENERGY FUELS

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November 17, 2016

Sent VIA E-MAIL AND OVERNIGHT DELIVERY

Mr. Scott Anderson
Director of Waste Management and Radiation Control
Utah Department of Environmental Quality
195 North 1950 West
P.O. Box 144880
Salt Lake City, UT 84114-4880

Re: Transmittal of Revised Statistical analysis for Cadmium and Thallium in MW-24, White Mesa Mill Groundwater Discharge Permit UGW370004

Dear Mr. Anderson:

Pursuant to the Division of Waste Management and Radiation Control ("DWMRC") letter dated September 14, 2016, Energy Fuels Resource (USA) Inc.'s ("EFRI") is submitting this revised statistical analysis for cadmium and thallium in MW-24. This revised analysis supplements the Source Assessment Report ("SAR") for MW-24, at the White Mesa Mill, dated June 24, 2016.

If you should have any questions regarding this report please contact me.

Yours very truly,

Kathy Weinel

ENERGY FUELS RESOURCES (USA) INC.
Kathy Weinel
Quality Assurance Manager

CC: David C. Frydenlund
Harold R. Roberts
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INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

TECHNICAL MEMORANDUM

DATE: November 17, 2016

FROM: Angela Persico, INTERA, Incorporated

TO: Kathy Weinel, Energy Fuels Resources, Inc.

SUBJECT: Revised statistical analysis for cadmium and thallium in MW-24

1.0 INTRODUCTION

This Technical Memorandum supplements the June 24, 2016 Source Assessment Report (SAR) for MW-24 (INTERA, 2016) and has been prepared at the request of the State of Utah Division of Waste Management and Radiation Control (DWMRC). In a letter dated September 19, 2016 ("the Letter"), DWMRC requests additional information, specifically a separate analysis of the data sets for cadmium and thallium in MW-24 after a point of inflection in 2009 when concentrations of cadmium and thallium began increasing. DWMRC states that this comparison between the complete data set and the post-inflection data set is useful in that it may provide a normalized data set and a comparable and representative determination of mean + 2σ.

The Letter also states that the June 24, 2016 SAR supports the premise that increasing concentrations in MW-24 are not caused by tailings solution based on (1) a review of plots of indicator parameter concentration trends, (2) the University of Utah Study (2008) which included age dating of the water in tailings cell 1 and comparison with groundwater age dating of water in monitoring well MW-2 (near MW-24) which found that "stable isotope fingerprints do not suggest contamination of groundwater by tailings cell leakage, evidence that is corroborated by trace metal concentrations similar to historically observed concentrations," (3) potential geochemical influences from pyrite oxidation in the perched groundwater causing site-wide decreases in pH and dissolution of metals including cadmium and thallium, and (4) potential analytical influences caused by a change of analytical laboratories during the fourth quarter of 2012.

This technical memorandum provides the additional analyses for cadmium and thallium in MW-24, following the approach that was provided in the December 9, 2015 SAR (INTERA, 2015). The analyses are discussed here and results are included in the attachments.

2.0 CADMIUM AND THALLIUM IN MW-24

Samples from MW-24 were first collected in June of 2005. Groundwater samples from MW-24 are collected and analyzed quarterly for out-of-compliance constituents (sulfate, pH, fluoride, cadmium, and thallium), which are the constituents included in the June 2016 SAR. All other permit constituents are collected and analyzed semi-annually.

At the time of the background report, cadmium and thallium concentrations in MW-24 were mostly non-detected, and Groundwater Compliance Limits (GWCLs) were therefore determined by the fractional approach in accordance with the Groundwater Data Preparation and Statistical Process Flow for Calculating Groundwater Protection Standards, White Mesa Mill Site (INTERA, 2007) (the "Flowsheet"). Cadmium and thallium concentrations in MW-24 were regularly detected in groundwater samples beginning in 2009, and started exceeding their respective fractional GWCLs in 2010. Cadmium and thallium were included in the 2012 SAR (INTERA, 2012), and in the June 2016 SAR (INTERA, 2016). The conclusion of both SARs was that the increase in cadmium and thallium can be attributed to the site-wide decrease in pH.

2.1 Changes in Groundwater Conditions in MW-24

The June 2016 SAR includes a discussion about potential changes, events, and conditions that may be influencing the behavior of constituents in MW-24. Although many variables are considered when evaluating the source of increased concentrations, decreasing pH is the only variable that fits with the timing of the change in concentrations of cadmium and thallium.

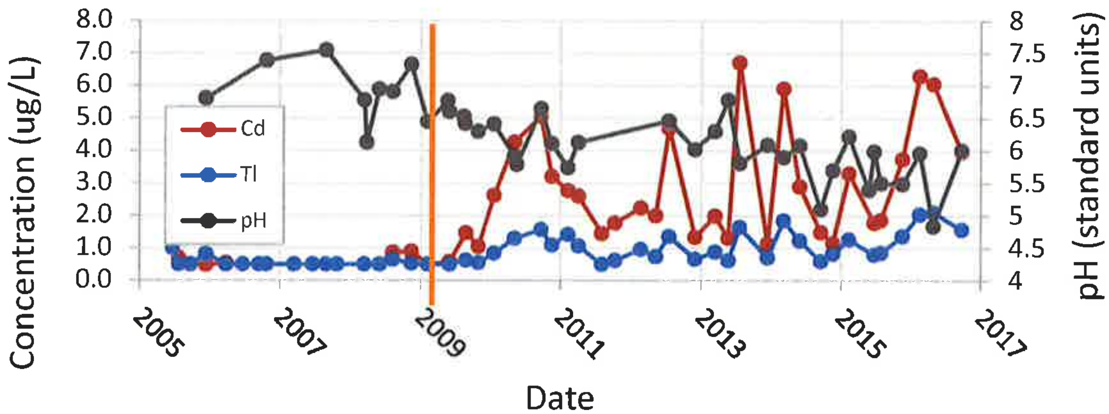


Figure 1: Cadmium, thallium, and pH concentrations in MW-24 over time. The orange vertical line indicates the shift in concentrations. Data included in this analysis were collected after the shift, from August 2009 to September 2016.

2.2 Post-Inflection Analysis

In the Letter, DWMRC states that a data inflection is noted at approximately 2009 for cadmium and thallium in MW-24. For the additional analysis presented in this memo, only data collected after second quarter of 2009 were included. The post-inflection data set was analyzed following the Flowsheet. A summary table of the flowsheet analysis is included in Attachment 1, equivalent to the DWMRC-requested revised Table B-1 of the June 2016 SAR. Attachment 2 is a descriptive statistics summary comparing the complete data set and the post-inflection data set. Attachment 3 lists the post-inflection data included in this analysis. Attachment 4 is box plots of the post-inflection and complete data sets. Attachment 5 is histograms of the post inflection and complete data sets.

The revised data sets do not contain any outliers (Attachment 4) and are normally or lognormally distributed (Attachment 5). Linear regression analysis shows increasing trends for both cadmium and thallium. The trend for cadmium is not significant and is far less pronounced after the 2009 shift in concentrations. The trend for thallium remains significant using the post-inflection data. (Attachment 6).

2.3 Modified Approach to Groundwater Compliance Limits

According to the DWMRC-approved Flowsheet, if an increasing trend is present, a modified approach should be considered for determining GWCLs. The complete data sets for cadmium and thallium in MW-24 are exhibiting significantly increasing trends that can be attributed to one or more of the following: (1) natural background conditions; (2) pyrite oxidation in the aquifer, which can decrease pH and increase mobility of metals and sulfate; (4) effects of recent events on groundwater in MW-24 such as well redevelopment, increased sampling frequency, change in water levels, and analytical method/laboratory change, as described in the June 2016 SAR. The historic lack of trends in these constituents have become significant trends due to a shift in concentrations that seem to correspond with the decreasing pH. The following modified approaches have been considered for calculating GWCLs in wells that have been thoroughly investigated and where the causes of increasing trends are not due to potential tailings system seepage or other Mill-related impacts that are not already addressed.

1. **Using 95% upper tolerance limit with 95% confidence and 95% coverage.**

This approach follows the DWMRC-approved Flowsheet until an increasing trend is identified. When a trend is identified, the data set can then be used to calculate the 95% upper tolerance limit (UTL). This value gives a 95% confidence that the UTL will contain at least 95% of the distribution of observations in background. The 95% UTL is typically a greater value than the mean+2σ, allowing for a longer and more successful compliance period.

2. **Using recent data to calculate GWCLs**

According to the Unified Guidance document, developed by the United States Environmental Protection Agency (EPA), "If a discrete shift in concentration level is evident, a confidence limit should be computed based on the most recent stable measurements." (EPA, 2009 p. 7-16). The Guidance also states "If a change is evident, it may be necessary to delete some of the earlier background values from the updated background sample, so as to ensure that compliance testing is based on current groundwater conditions and not on outdated measures of groundwater quality." (EPA, 2009 p. 5-15). This approach follows the DWMRC-approved Flowsheet by taking into account increasing trends and processing the data consistently with previously determined GWCLs. In this approach, the complete data set, which exhibits an increasing trend over the history of the well record, is divided into subset(s) of data based on identification of a point of inflection where the results appear more stable, even at higher concentrations. The data subset is then used to calculate GWCLs in accordance with the existing Flowsheet.

This approach allows for a more representative data set, but does not account for trends that may be present in the data subset. In this example, cadmium and thallium GWCLs are calculated using the mean +2σ of the data subset since both data subsets are normally or lognormally distributed.

3. Using 95% UTL with recent data to calculate GWCLs

This approach combines the previous two approaches, and is the preferred approach, following the DWMRC-approved Flowsheet until the increasing trend is identified. When a trend is identified, the data set is divided up into subset(s) of data based on identification of a point of inflection where the results appear more stable. The post-inflection data set can be used to perform the Flowsheet analysis. If a trend remains in the data subset, a GWCL can be calculated using the greater of the fractional approach, 95% UTL, mean + 2 σ, or the highest historical value. If no trend is present in the data subset, GWCLs can be calculated following the existing Flowsheet approach (mean + 2σ or equivalent). This approach is the preferred approach because it fits into the existing Flowsheet structure while utilizing methods suggested by the Unified Guidance including using a more recent data subset, and calculating 95% UTL, allowing for a GWCL that is more representative of current conditions in the well.

3.0 CALCULATION OF GROUNDWATER COMPLIANCE LIMITS

Existing GWCLs for cadmium and thallium and GWCLs calculated using the above approaches are summarized in Table 1. INTERA recommends using recent data which are representative of current conditions in groundwater to calculate a 95% UTL to be used as a GWCL. The 95% UTL is a higher value than other approaches, is supported by the Unified Guidance, and will allow for compliance for constituents that are variable and increasing in concentration.

Table 1
GWCL Alternatives

Cadmium (ug/L)	Thallium (ug/L)	Approach
2.5	1	[a] Original GWCL; Fractional
4.28	1.57	[b] DWMRC Approved GWCL; HHV
6.72	2.1	[c] All Data Flowsheet- Revised GWCL; HHV
3.61	2.04	[d] All Data 95% UTL
6.43	2.01	[e] Recent data Flowsheet GWCL; Mean + 2σ
9.06	2.55	[f] Recent Data 95% UTL

Notes:

HHV = highest historical value

SD = standard deviation

a = 2011 Groundwater Discharge Permit (GWDP)

b = DWMRC-Approved revised GWCLs presented in SAR (INTERA, 2012)

c = GWCL calculated using complete historic data set (June 2016 SAR)

d= Modified Approach 95% UTL using complete data set (Alternative 1)

e = Modified Approach GWCL calculated using representative data (8/2009-9/2016) as requested by DWMRC in the September 19, 2016 letter (Alternative 2)

f= Modified Approach 95% UTL using representative data (8/2009-9/2016), This is the preferred approach (Alternative 3)

4.0 REFERENCES

Division of Waste Management and Radiation Control (DWMRC), State of Utah. 2016. Letter from Scott T. Anderson of DWMRC to Kathy Weinel of Energy Fuels Resources (USA) Inc. Re: Energy Fuels Resources (USA) Inc. June 24, 2016, Transmittal of Source Assessment Report for Monitoring Well MW-18 and MW-24, White Mesa Uranium Mill Groundwater Discharge Permit No. UGW370004 (Permit). September 14.

Environmental Protection Agency (EPA), United States. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, EPA 530/R-09-007.

INTERA Incorporated. 2007. Revised Background Groundwater Quality Report: Existing Wells for Denison Mines (USA) Corp.'s White Mesa Mill Site, San Juan County, Utah. Prepared for Denison Mines (USA) Corp. October

———. 2012. Source Assessment Report White Mesa Uranium Mill, Blanding, Utah. Prepared for Energy Fuels Resources (USA) Inc. October 10.

______. 2015. Source Assessment Report for MW-31, White Mesa Uranium Mill, Blanding, Utah. Prepared for Energy Fuels Resources (USA) Inc. December 9.

______. 2016. Source Assessment Report for MW-18 And MW-24, White Mesa Uranium Mill, Blanding, Utah. Prepared for Energy Fuels Resources (USA) Inc. June 24.

University of Utah. 2008. Summary of Work Completed, Data Results, Interpretations and Recommendations for the July 2007 Sampling Event at the Denison Mines, USA, White Mesa Uranium Mill Near Blanding Utah. Prepared by T. Grant Hurst and D. Kip Solomon, Department of Geology and Geophysics, University of Utah. May 2008.

Attachment 1: Summary of Flowsheet Analysis for Cadmium and Thallium in MW-24 Using Modified Data Set

Well	Constituent	N	% Non-Detected Values	Mean	Standard Deviation	Shapiro-Wilk Test for Normality		Normally or Lognormally distributed?	Linear Regression Analysis		Significant Trend	Highest Historical Value (HHV)	Mean + 2σ	Current GWCL	Flowsheet GWCL	Flowsheet GWCL Rationale	Modified Approach; 95% UTL
						W	p		R2	p							
MW-24	Cadmium (ug/L)	29	0.00	2.98	1.72	0.95	0.17	Yes	0.07	0.17	No	6.720	6.430	4.280	6.430	Mean + 2σ	9.06
MW-24	Thallium (ug/L)	29	0.03	1.09	0.46	0.95	0.23	Yes	0.16	0.03	Yes	2.100	2.014	1.570	2.014	Mean + 2σ	2.55

Notes:

σ = sigma
%ND = percent of non-detected values
μg/L = micrograms per liter
mg/L = milligrams per liter
N = number of valid data points
p = probability
W = Shapiro Wilk test value
r^2 = The measure of how well the trendline fits the data where r^2=1 represents a perfect fit.

Analysis performed on data collected August 2009 through September 2016

Distribution = Distribution as determined by the Shapiro-Wilk distribution test for constituents with % Detect > 50% and N>8

Mean = The arithmatic mean as determined for normally or log-normally distributed constituents with % Detect > 50%

Standard Deviation = The standard deviation as determined for normally or log-normally distributed constituents with % Detect > 85%

Highest Historical Value = The highest observed value for constituents with % Detect < 50%

Attachment 2: Descriptive Statistics for Modified Data Set and All Data

Data Set	Post-Inflection	ALL Data		Post-Inflection	ALL Data
Analyte	Cadmium	Cadmium		Thallium	Thallium
Units	µg/L	µg/L		µg/L	µg/L
% Non-Detects	0	31		0.034	36
N	29	46		29	46
Normal or Lognormal?	Yes	No		Yes	No
Mean	2.98	2.02		1.09	0.871
Min. Conc.	1.06	0.5		0.5	0.5
Max. Conc.	6.72	6.72		2.1	2.1
Std. Dev.	1.72	1.79		0.46	0.447
Range	5.66	6.22		1.6	1.6
Geometric Mean	2.55	1.41		1.00	0.781
Skewness	0.87	1.30		0.68	1.27
Q25	1.50	0.51		0.70	0.5
Median	2.61	1.41		0.96	0.69
Q75	3.97	2.74		0.37	1.09

Post Inflection = Data collected August 2009 through September 2016

Attachment 3: MW-24 Data Used for Analysis

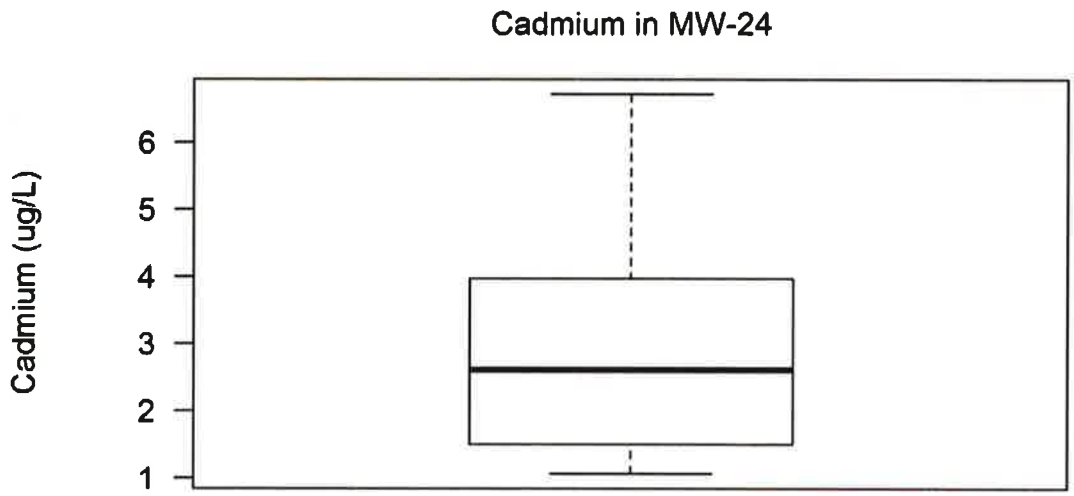
Field Sample ID	Location ID	Date Sampled	Parameter Name	Report Result	Report Units	Lab Qualifier	Detected	Sample Matrix	Sample Purpose	Sample Type
MW 24_08242009	MW-24	8/24/2009	Cadmium	1.48	ug/L		Y	WATER	REG	GW
MW 24_10282009	MW-24	10/28/2009	Cadmium	1.06	ug/L		Y	WATER	REG	GW
MW 24_01192010	MW-24	1/19/2010	Cadmium	2.63	ug/L		Y	WATER	REG	GW
MW 24_05062010	MW-24	5/6/2010	Cadmium	4.28	ug/L		Y	WATER	REG	GW
MW 24_09212010	MW-24	9/21/2010	Cadmium	5.06	ug/L		Y	WATER	REG	GW
MW 24_11172010	MW-24	11/17/2010	Cadmium	3.22	ug/L		Y	WATER	REG	GW
MW-24_02102011	MW-24	2/10/2011	Cadmium	2.78	ug/L		Y	WATER	REG	GW
MW-24_04052011	MW-24	4/5/2011	Cadmium	2.61	ug/L		Y	WATER	REG	GW
MW-24_08042011	MW-24	8/4/2011	Cadmium	1.46	ug/L		Y	WATER	REG	GW
MW-24_10112011	MW-24	10/11/2011	Cadmium	1.78	ug/L		Y	WATER	REG	GW
MW-24_02232012	MW-24	2/23/2012	Cadmium	2.25	ug/L		Y	Water	REG	GW
MW-24_05102012	MW-24	5/10/2012	Cadmium	2.01	ug/L		Y	WATER	REG	GW
MW-24_07182012	MW-24	7/18/2012	Cadmium	4.7	ug/L		Y	WATER	REG	GW
MW-24_11292012	MW-24	11/29/2012	Cadmium	1.35	ug/L		Y	WATER	REG	GW
MW-24_03142013	MW-24	3/14/2013	Cadmium	2	ug/L		Y	WATER	REG	GW
MW-24_05222013	MW-24	5/22/2013	Cadmium	1.32	ug/L		Y	WATER	REG	GW
MW-24_07192013	MW-24	7/19/2013	Cadmium	6.72	ug/L		Y	WATER	REG	GW
MW-24_12122013	MW-24	12/12/2013	Cadmium	1.15	ug/L		Y	WATER	REG	GW
MW-24_03062014	MW-24	3/6/2014	Cadmium	5.92	ug/L		Y	WATER	REG	GW
MW-24_05302014	MW-24	5/30/2014	Cadmium	2.91	ug/L		Y	WATER	REG	GW
MW-24_09172014	MW-24	9/17/2014	Cadmium	1.5	ug/L		Y	WATER	REG	GW
MW-24_11192014	MW-24	11/19/2014	Cadmium	1.17	ug/L		Y	WATER	REG	GW
MW-24_02122015	MW-24	2/12/2015	Cadmium	3.31	ug/L		Y	WATER	REG	GW
MW-24_06242015	MW-24	6/24/2015	Cadmium	1.79	ug/L		Y	WATER	REG	GW
MW-24_07292015	MW-24	7/29/2015	Cadmium	1.88	ug/L		Y	WATER	REG	GW
MW-24_11182015	MW-24	11/18/2015	Cadmium	3.75	ug/L		Y	WATER	REG	GW
MW-24_02172016	MW-24	2/17/2016	Cadmium	6.31	ug/L		Y	WATER	REG	GW
MW-24_04282016	MW-24	4/28/2016	Cadmium	6.07	ug/L		Y	WATER	REG	GW
MW-24_09222016	MW-24	9/22/2016	Cadmium	3.97	ug/L		Y	WATER	REG	GW
MW 24_08242009	MW-24	8/24/2009	Thallium	0.62	ug/L		Y	WATER	REG	GW
MW 24_10282009	MW-24	10/28/2009	Thallium	0.55	ug/L		Y	WATER	REG	GW
MW 24_01192010	MW-24	1/19/2010	Thallium	0.84	ug/L		Y	WATER	REG	GW
MW 24_05062010	MW-24	5/6/2010	Thallium	1.3	ug/L		Y	WATER	REG	GW
MW 24_09212010	MW-24	9/21/2010	Thallium	1.57	ug/L		Y	WATER	REG	GW

Attachment 3: MW-24 Data Used for Analysis

Field Sample ID	Location ID	Date Sampled	Parameter Name	Report Result	Report Units	Lab Qualifier	Detected	Sample Matrix	Sample Purpose	Sample Type
MW 24_11172010	MW-24	11/17/2010	Thallium	1.09	ug/L		Y	WATER	REG	GW
MW-24_02102011	MW-24	2/10/2011	Thallium	1.42	ug/L		Y	WATER	REG	GW
MW-24_04052011	MW-24	4/5/2011	Thallium	1.07	ug/L		Y	WATER	REG	GW
MW-24_08042011	MW-24	8/4/2011	Thallium	0.5	ug/L	U	N	WATER	REG	GW
MW-24_10112011	MW-24	10/11/2011	Thallium	0.62	ug/L		Y	WATER	REG	GW
MW-24_02232012	MW-24	2/23/2012	Thallium	0.96	ug/L		Y	Water	REG	GW
MW-24_05102012	MW-24	5/10/2012	Thallium	0.74	ug/L		Y	WATER	REG	GW
MW-24_07182012	MW-24	7/18/2012	Thallium	1.36	ug/L		Y	WATER	REG	GW
MW-24_11292012	MW-24	11/29/2012	Thallium	0.666	ug/L		Y	WATER	REG	GW
MW-24_03142013	MW-24	3/14/2013	Thallium	0.88	ug/L		Y	WATER	REG	GW
MW-24_05222013	MW-24	5/22/2013	Thallium	0.618	ug/L		Y	WATER	REG	GW
MW-24_07192013	MW-24	7/19/2013	Thallium	1.64	ug/L		Y	WATER	REG	GW
MW-24_12122013	MW-24	12/12/2013	Thallium	0.707	ug/L		Y	WATER	REG	GW
MW-24_03062014	MW-24	3/6/2014	Thallium	1.85	ug/L		Y	WATER	REG	GW
MW-24_05302014	MW-24	5/30/2014	Thallium	1.23	ug/L		Y	WATER	REG	GW
MW-24_09172014	MW-24	9/17/2014	Thallium	0.6	ug/L		Y	WATER	REG	GW
MW-24_11192014	MW-24	11/19/2014	Thallium	0.821	ug/L		Y	WATER	REG	GW
MW-24_02122015	MW-24	2/12/2015	Thallium	1.27	ug/L		Y	WATER	REG	GW
MW-24_06242015	MW-24	6/24/2015	Thallium	0.796	ug/L		Y	WATER	REG	GW
MW-24_07292015	MW-24	7/29/2015	Thallium	0.85	ug/L		Y	WATER	REG	GW
MW-24_11182015	MW-24	11/18/2015	Thallium	1.37	ug/L		Y	WATER	REG	GW
MW-24_02172016	MW-24	2/17/2016	Thallium	2.04	ug/L		Y	WATER	REG	GW
MW-24_04282016	MW-24	4/28/2016	Thallium	2.1	ug/L		Y	WATER	REG	GW
MW-24_09222016	MW-24	9/22/2016	Thallium	1.57	ug/L		Y	WATER	REG	GW

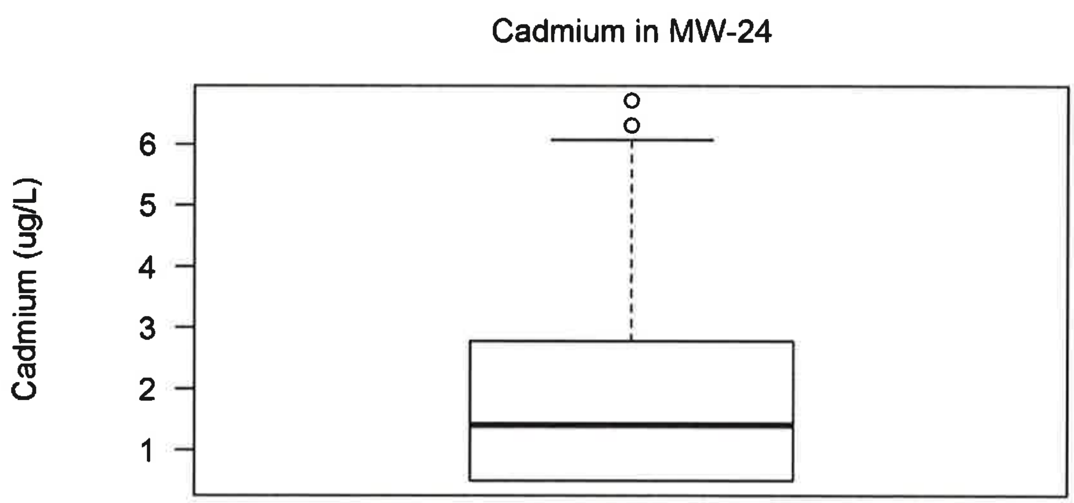
Attachment 4: Box Plots

Post-inflection



Percent nondetect: 0%
Min: 1.06, Mean: 2.98, Max: 6.72, Std Dev: 1.72
Upper extreme threshold (Q75 + 3xH): 11.38
Lower extreme threshold (Q25 - 3xH): -5.91

All data

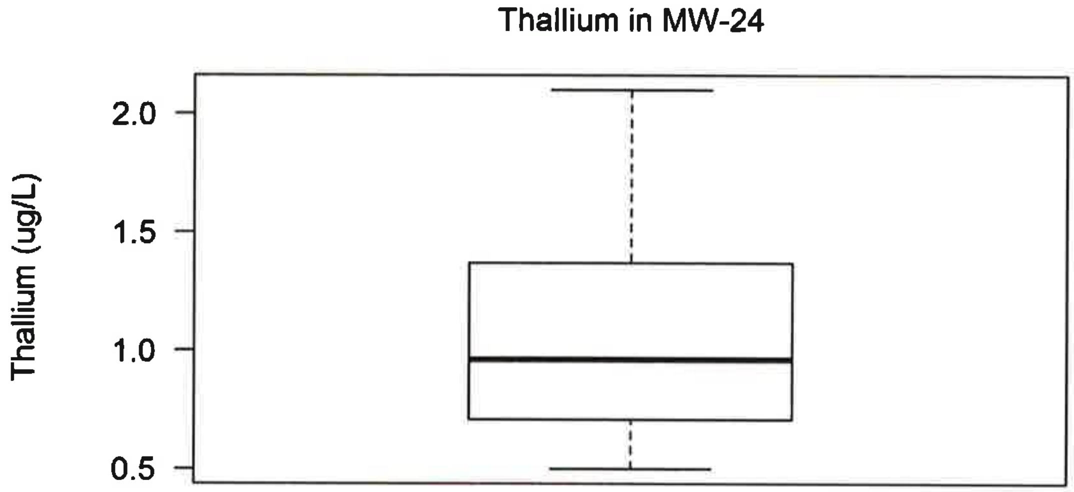


Percent nondetect: 30%
Min: 0.5, Mean: 2.02, Max: 6.72, Std Dev: 1.79
Upper extreme threshold (Q75 + 3xH): 9.4325
Lower extreme threshold (Q25 - 3xH): -6.1775

○ Outlier
✸ Extreme

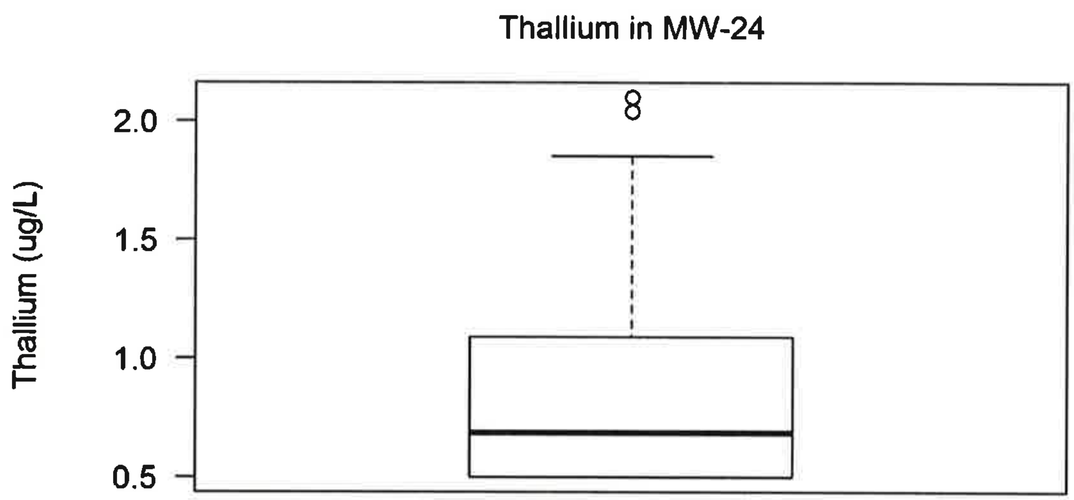
Attachment 4: Box Plots

Post-inflection



Percent nondetect: 3%
Min: 0.5, Mean: 1.09, Max: 2.1, Std Dev: 0.46
Upper extreme threshold (Q75 + 3xH): 3.359
Lower extreme threshold (Q25 - 3xH): -1.282

All data

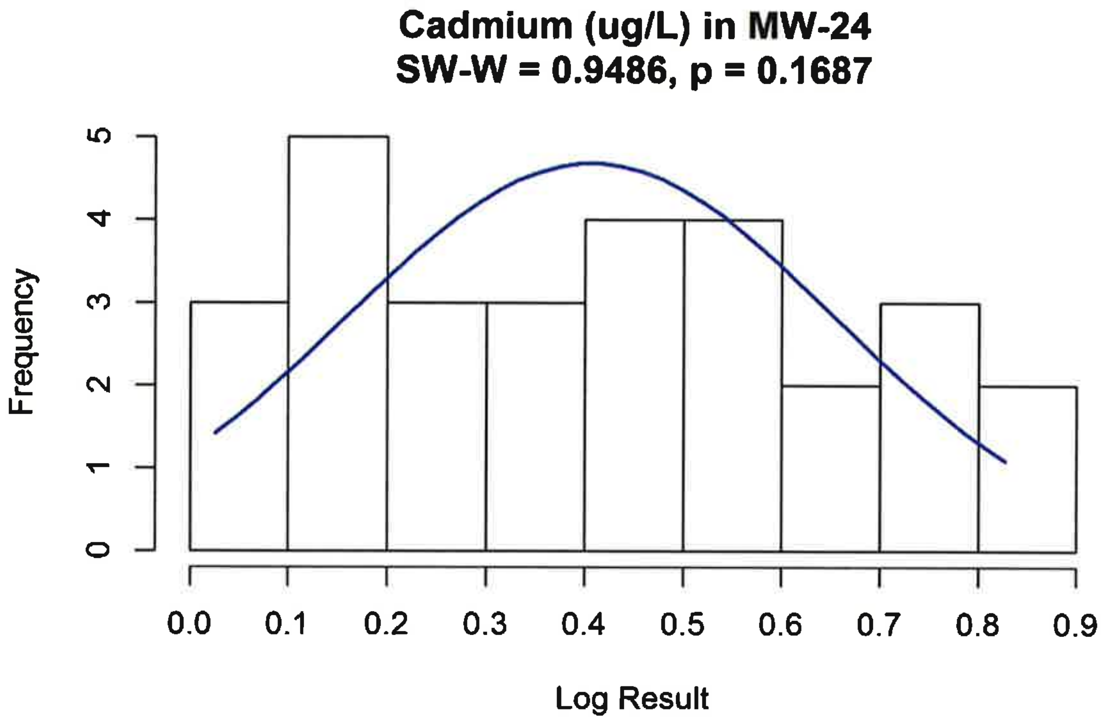


Percent nondetect: 35%
Min: 0.5, Mean: 0.87, Max: 2.1, Std Dev: 0.45
Upper extreme threshold (Q75 + 3xH): 2.84
Lower extreme threshold (Q25 - 3xH): -1.255

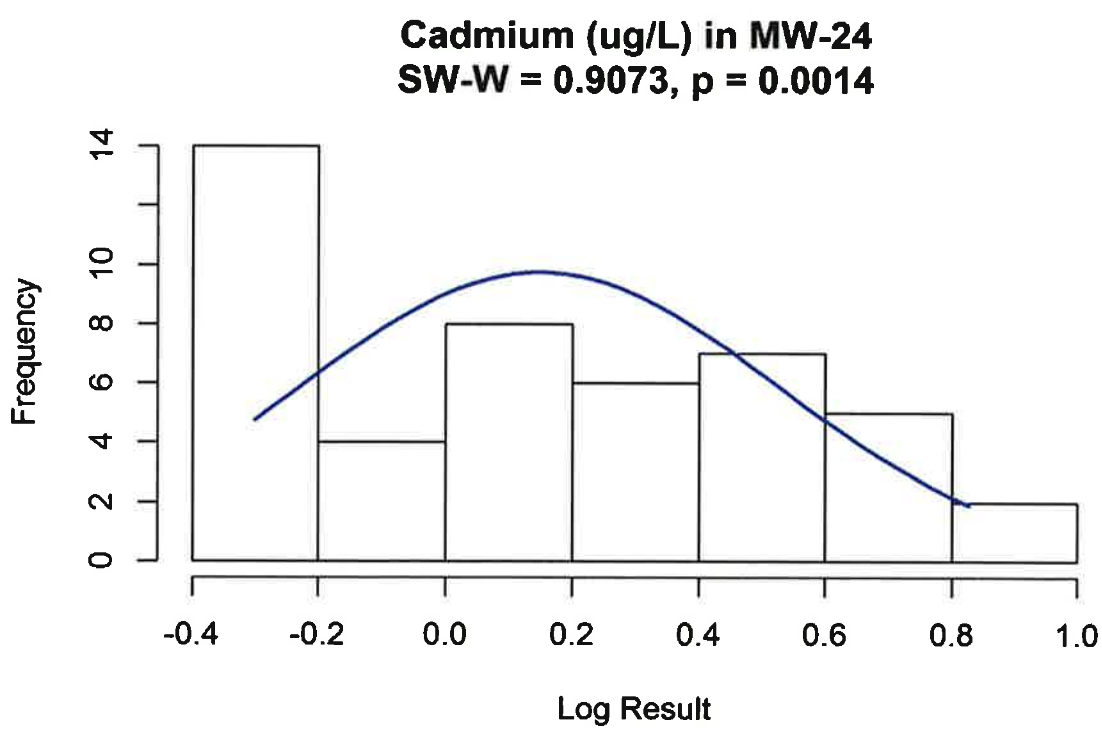
o Outlier
* Extreme

Attachment 5: Histograms

Post-Inflection Data

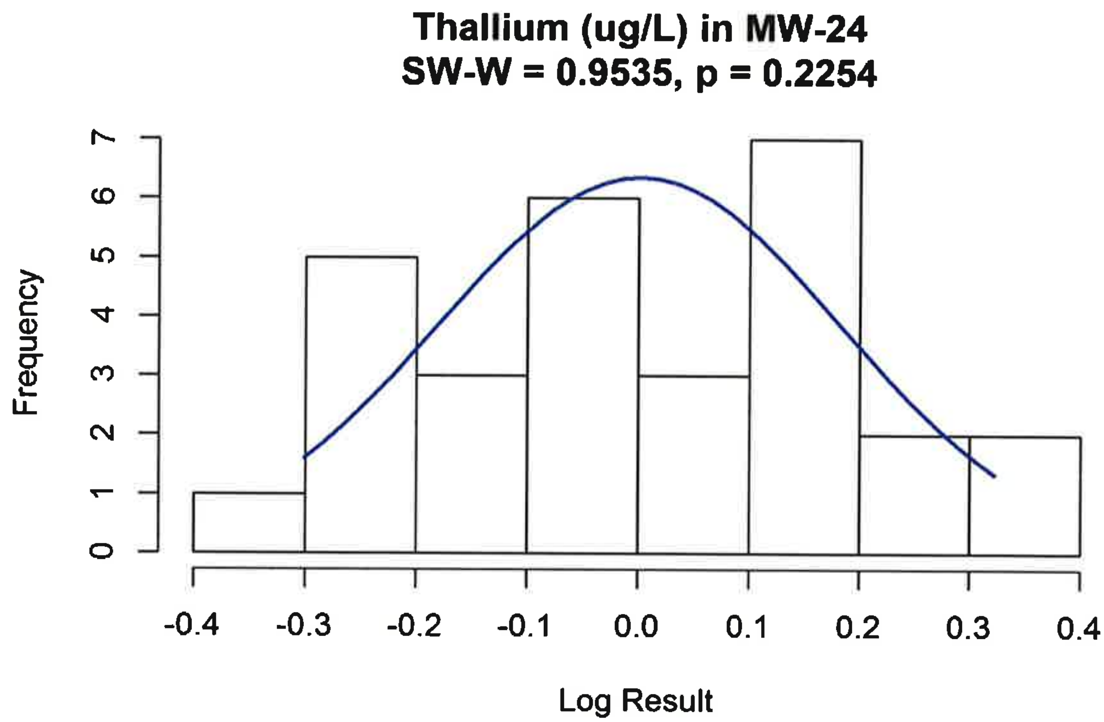


All Data

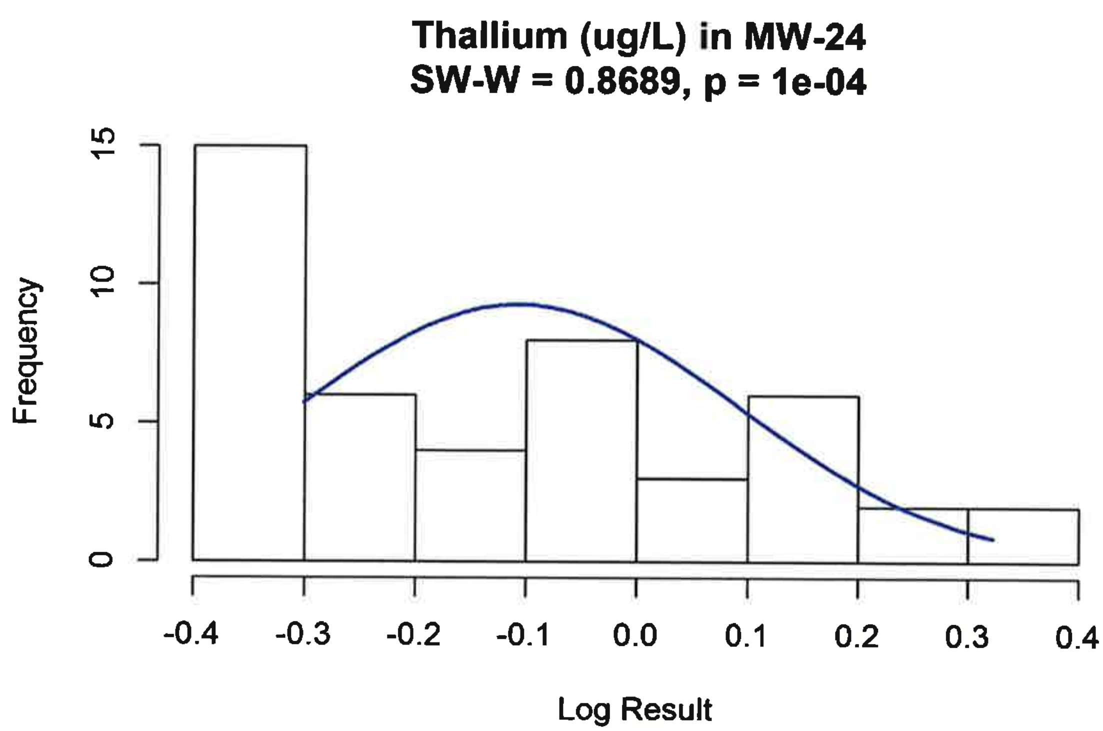


Attachment 5: Histograms

Post- Infection Data

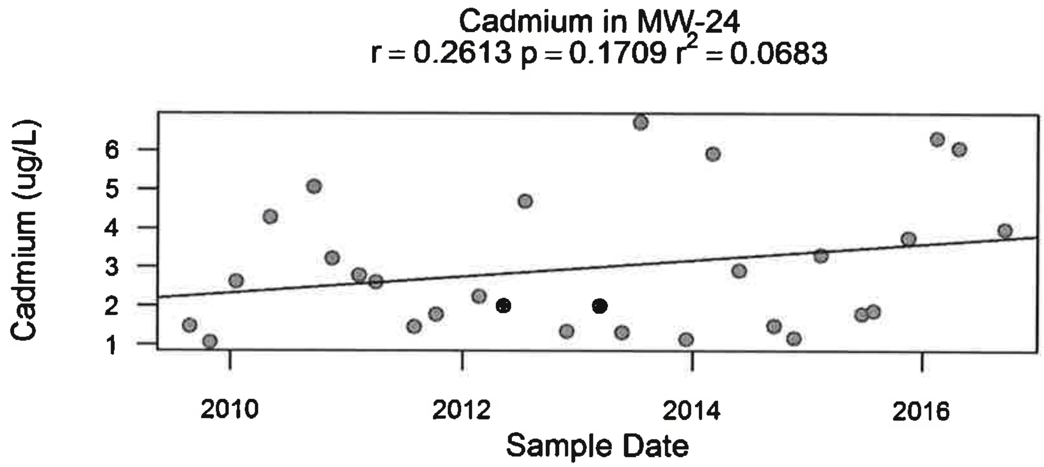


All Data

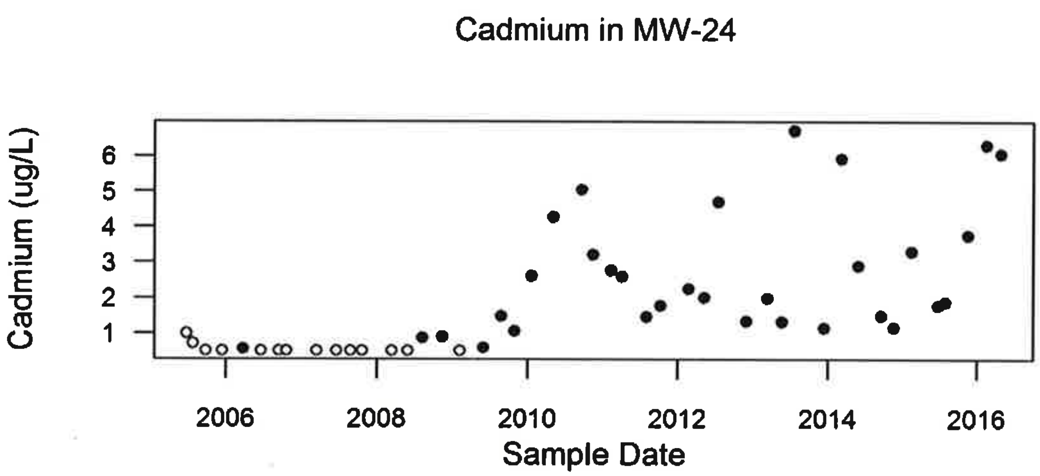


Attachment 6: Linear Regression Analysis

Post-Inflection Data

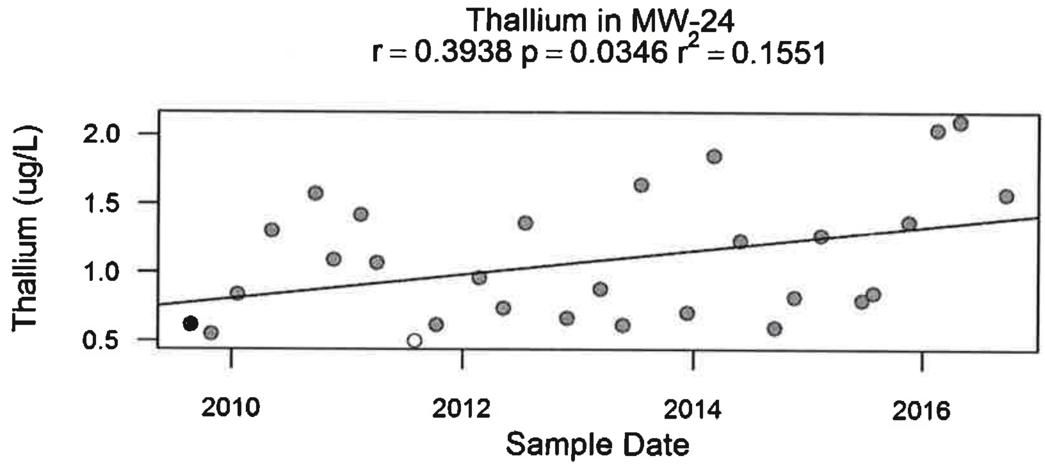


All Data



Attachment 6: Linear Regression Analysis

Post -Inflection Data



All Data