PREPARED FOR CLIENT:

UNITED STATES FOREST SERVICE
CUSTER-GALLATIN NATIONAL FOREST
10 EAST BABCOCK AVE
BOZEMAN, MONTANA 59715

2016 Riley Pass Abandoned Uranium Mine Verification Sampling Report

Bluff F, Bluff G, and Bluff I

TETRA TECH PROJECT NO. 114-560543

FEBRUARY 15, 2017

TETRA TECH

3801 Automation Way Suite #100, Fort Collins, Colorado 80525
Phone: 970-223-9600

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Cleanup Criteria 4
1.3 Purpose and Scope of Work 4
1.4 Report Organization 5
2.0 METHODS 6
2.1 Survey Unit Classification 6
2.2 In situ XRF Field Survey 10
2.2.1 Overview 10
2.2.2 Methods 11
2.2.3 Quality Assurance/Quality Control Protocol 11
2.3 Gamma Exposure Rate Survey 12
2.3.1 Objective 12
2.3.2 Methods 13
2.3.3 Quality Assurance and Quality Control Protocol 14
2.4 Soil Confirmation Sampling 15
2.4.1 Objectives 15
2.4.2 Methods 16
2.4.3 Quality Assurance/Quality Control Protocol 17
3.0 VERIFICATION SAMPLING RESULTS 18
3.1 Bluff F Results 18
3.1.1 Bluff F In situ XRF Field and Soil Sampling Information 18
3.1.2 Bluff F In situ XRF Field Survey Results 20
3.1.3 Bluff F Gamma Survey Results 22
3.1.4 Bluff F Radium-226 Soil Confirmation Sampling Information 24
3.2 Bluff G Results 24
3.2.1 Bluff G In situ XRF Field and Soil Sampling Information 24
3.2.2 Bluff G In situ XRF Field Survey Results 27
3.2.3 Bluff G Gamma Survey Results 29
3.2.4 Bluff G Radium-226 Soil Confirmation Sampling Information 31
3.3 Bluff I Results 31
3.3.1 Bluff I In situ XRF Field and Soil Sampling Information 31
3.3.2 Bluff I In situ XRF Field Survey Results 34
3.3.3 Bluff I Gamma Survey Results 36
3.3.4 Bluff I Radium-226 Soil Confirmation Sampling Information 38
4.0 EVALUATION OF REGRESSION MODELS 39
4.1 Evaluation of XRF Regression Model 39
4.2 Evaluation of Gamma/Ra-226 Regression Model 42

5.0 STATISICAL EVALUATION OF ARSENIC DATA 48
5.1 STATISTICAL EVALUATION OF IN SITU MEASUREMENTS (ARSENIC) 48
5.1.1 SAMPLE SIZE DETERMINATION 48
5.1.2 SIGN TEST FOR IN SITU XRF ARSENIC MEASUREMENTS 49
5.2 STATISTICAL EVALUATION OF SOIL SAMPLE RESULTS (ARSENIC) 50
5.2.1 SAMPLE SIZE DETERMINATION OF ARSENIC SOIL CONFIRMATION SAMPLES 50
5.2.2 DETERMINATION OF 95 PERCENT UCL OF MEAN ARSENIC SOIL CONFIRMATION SAMPLES 51
6.0 STATISICAL EVALUATION OF RADIUM-226 DATA 52
6.1 STATISTICAL EVALUATION OF IN SITU RESULTS (RADIUM-226) 52
6.2 STATISTICAL EVALUATION OF RA-226 SOIL SAMPLE RESULTS 60
6.2.1 SAMPLE SIZE DETERMINATION OF RA-226 SOIL CONFIRMATION SAMPLES 60
6.2.2 DETERMINATION OF 95 PERCENT UCL OF RA-226 SOIL CONFIRMATION SAMPLES 60
7.0 CONCLUSIONS 62
8.0 REFERENCES 65

LIST OF TABLES

Table 1 Summary of Survey Unit Classification for Survey Areas 6
Table 2 Summary of Laboratory Analytical Methods for Soil Samples 16
Table 3 Summary of Bluff F In situ XRF Sampling and Arsenic Soil Sampling Information 18
Table 4 Summary Statistics of Arsenic Concentrations at Survey Unit F1 20
Table 5 Summary Statistics of Individual Gamma Exposure Rates at Bluff F 22
Table 6 Summary of Bluff F Gamma Radiation Survey Grids and Ra-226 Soil Sampling Information 24
Table 7 Summary of Bluff G In situ XRF Sampling and Arsenic Soil Sampling Information 25
Table 8 Summary Statistics of Arsenic Concentrations at Bluff G 27
Table 9 Summary Statistics of Individual Gamma Exposure Rates at Bluff G 29
Table 10 Summary of Bluff G Gamma Radiation Survey Grids and Ra-226 Soil Sampling Information 31
Table 11 Summary of Bluff I In situ XRF Sampling and Arsenic Soil Sampling Information 32
Table 12 Summary Statistics of Arsenic Concentrations at Bluff I 34
Table 13 Summary Statistics of Individual Gamma Exposure Rates at Bluff I 36
Table 14 Summary of Bluff I Gamma Radiation Survey Grids and Ra-226 Soil Sampling Information 38
Table 15 Summary of Soil Confirmation Reported Laboratory Arsenic Concentrations at Bluff F 40
Table 16 Summary of Soil Confirmation Reported Laboratory Arsenic Concentrations at Bluff G 40
Table 17 Summary of Soil Confirmation Reported Laboratory Arsenic Concentrations at Bluff I 41
Table 18 Summary of Soil Confirmation Reported Laboratory Ra-226 Concentrations at Bluff F 45
Table 19 Summary of Soil Confirmation Reported Laboratory Ra-226 Concentrations at Bluff G 46
Table 20 Summary of Soil Confirmation Reported Laboratory Ra-226 Concentrations at Bluff I 47
Table 21 Sample Size Determination Result Table for XRF Samples for Single Sample Sign Test 49
Table 22 Single Sample Hypothesis Sign Test ProUCL Output for In situ Arsenic Measurements 50
Table 23 Summary of ProUCL Output for Arsenic Soil Confirmation Sample Size for Mean Estimation 51
Table 24 Summary of ProUCL Output for Determination of 95% UCL of Arsenic 51
Table 25 Single Sample Hypothesis Sign Test ProUCL Output for Grid Averaged Radium-226 Measurements 53
Table 26 Summary of ProUCL Output for Soil Sample Size Estimation of the Mean (Radium-226) 60
Table 27 Summary of ProUCL Output for Determination of 95% UCL of Radium-226 61
Table 28 Summary of Statistical Procedures for Arsenic Soil Cleanup Criteria 62
Table 29 Summary of Statistical Procedures for Ra-226 Soil Cleanup Criteria 63

LIST OF FIGURES

Figure 1 Riley Pass Site Location and Major Drainages 2
Figure 2 Bluff F, Bluff G, and Bluff I Location Map 3
Figure 3 Survey Area Bluff F Survey Unit Classification Map 7
Figure 4 Survey Area Bluff G Survey Unit Classification Map 8
Figure 5 Survey Area Bluff I Survey Unit Classification Map 9
Figure 6 In Situ XRF Total Arsenic Concentration versus Laboratory-Reported Total Arsenic Concentration 10
Figure 7 Gamma Exposure Rate versus Soil Ra-226 Mass Activity Concentration 12
Figure 8 Energy Response for Ludlum Model 44-10 with Cs-137 Source 14
Figure 9 Bluff F Verification Sampling In situ XRF Location Map 19
Figure 10 Bluff F Verification Sampling Arsenic Concentration Map (Point) 21
Figure 11 Bluff F Verification Sampling Gamma Exposure Rate Map 23
Figure 12 Bluff G Verification Sampling In situ XRF Location Map 26
Figure 13 Bluff G Verification Sampling Arsenic Concentration Map (Point) 28
Figure 14 Bluff G Verification Sampling Gamma Exposure Rate Map 30
Figure 15 Bluff I Verification Sampling In situ XRF Location 33
Figure 16 Bluff I Verification Sampling Arsenic Concentration Map (Point) 35
Figure 17 Bluff I Verification Sampling Gamma Exposure Rate Map 37
Figure 18 Regression Evaluation of In Situ XRF and Laboratory Soil Confirmation Samples (Arsenic) 39
Figure 19 Regression Evaluation of Gamma/Ra-226 Model (Ra-226) 42
Figure 20 Regression Model of Gamma/Ra-226 (2016 Data Only) 44
Figure 21 Bluff F Verification Sampling Radium-226 Levels 54
Figure 22 Bluff F Verification Sampling Grid Average Radium-226 Levels 55
Figure 23 Bluff G Verification Sampling Radium-226 Levels 56
Figure 24 Bluff G Verification Sampling Grid Average Radium-226 Levels 57
Figure 25 Bluff I Verification Sampling Radium-226 Levels 58
Figure 26 Bluff I Verification Sampling Grid Average Radium-226 Levels 59

LIST OF APPENDICES

Appendix A Data Validation and QC Review Summary
Appendix B Soil Confirmation and Laboratory Sampling Information
Appendix C Laboratory Analytical Reports
Appendix D Scanned Copy of the Field Logbook and Field Sheets
Appendix E Field Sampling Photographic Log
Appendix F ProUCL Statistical Software Output Results

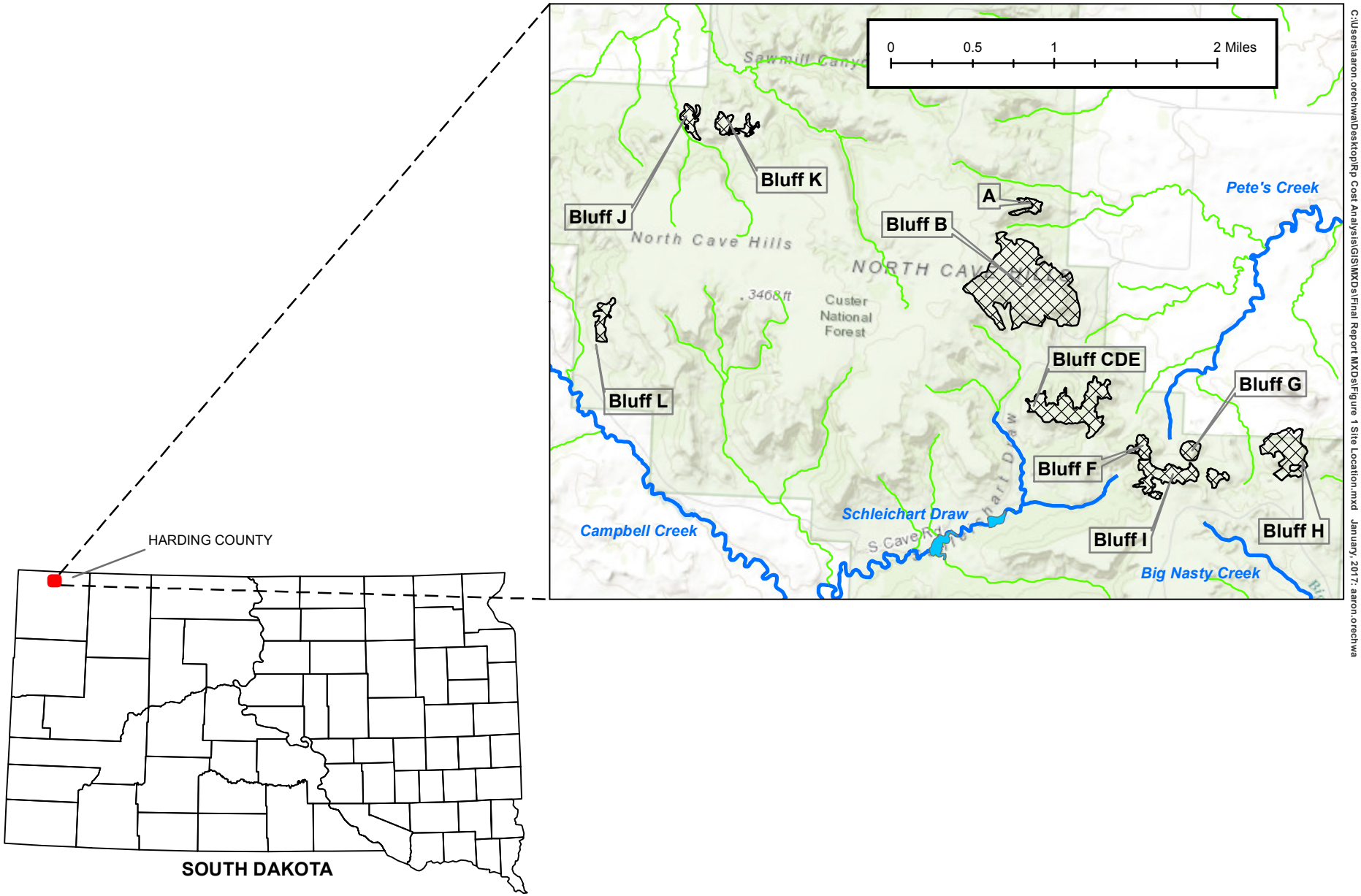
1.0 INTRODUCTION

1.1 BACKGROUND

Tetra Tech, Inc. prepared this verification sampling report (VSR) for the United States Forest Service (USFS) to document and present the findings of the cleanup verification surveys of the surface soils and solid media at the Riley Pass Abandoned Uranium Mine Site (Riley Pass) at Bluff F, Bluff G, and Bluff I in 2016. Since 2006, the Riley Pass site has been under the regulatory jurisdiction of the USFS, which is authorized under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as the primary federal land manager responsible for site cleanup. This document was developed in accordance with the *2016 Action Memorandum [2016 Action Memo]* (USFS 2016). Numerous documented studies at the site, located in northwestern South Dakota, have shown heavy metals and radionuclide concentrations present in soil at levels posing a potential threat to human health and the environment. The primary contaminants of concern identified in the 2016 Action Memo include arsenic and radium-226 (Ra-226); both contaminants are driving risk factors for human health and the environment. Removal action with on-site disposal and stabilization of soils and solid media is the selected remedy for this non time-critical CERCLA site.

Tetra Tech prepared a VSP for the USFS in November 2015 (Tetra Tech 2015b). The purpose of the VSP was to provide clear and detailed, cost-effective, defensible, and statistically valid guidance to the USFS and the contractor deemed responsible for conducting the cleanup verification surveys at Riley Pass. The VSP presented the cleanup verification survey methodology that should be performed after removal action has been completed, with the goal of assessing whether the risk-based cleanup standards for soil have been attained for the Riley Pass uranium sites. The methodology presented in the VSP allowed for a phased approach in the likely event that the removal action itself is carried out in a phased approach. In addition to assessing whether cleanup standards have been attained, a secondary goal of the surveys is to provide detailed information on the spatial extent of contaminant concentrations in soil that remain at each study area after remedial actions have been conducted. The simultaneous characterization of concentrations in soil will provide useful data in the event cleanup objectives are not attained and additional remedial action is necessary. The cleanup verification surveys presented in this report consist of X-ray fluorescence (XRF) field surveys, gamma radiation surveys, and soil confirmation sampling.

This VSR summarizes the methods and results of the verification surveys Tetra Tech performed in support of the soil cleanup at the Riley Pass Abandoned Uranium mines. A site vicinity map is provided in Figure 1. A location map of Bluff F, Bluff G, and Bluff I is provided in Figure 2.



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure 1 Site Location.mxd January, 2017, aaron.orechwa

NAD_1983_STATEPLANE
SOUTH_DAKOTA
NORTH_FIPS_4001_FEET

Riley Pass Site Location
Study Area Boundaries
Major Drainage
Minor Drainage

Prepared for:

Prepared by:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970)223-9600 (970)223-7171 fax

Title: RILEY PASS SITE LOCATION & MAJOR DRAINAGES

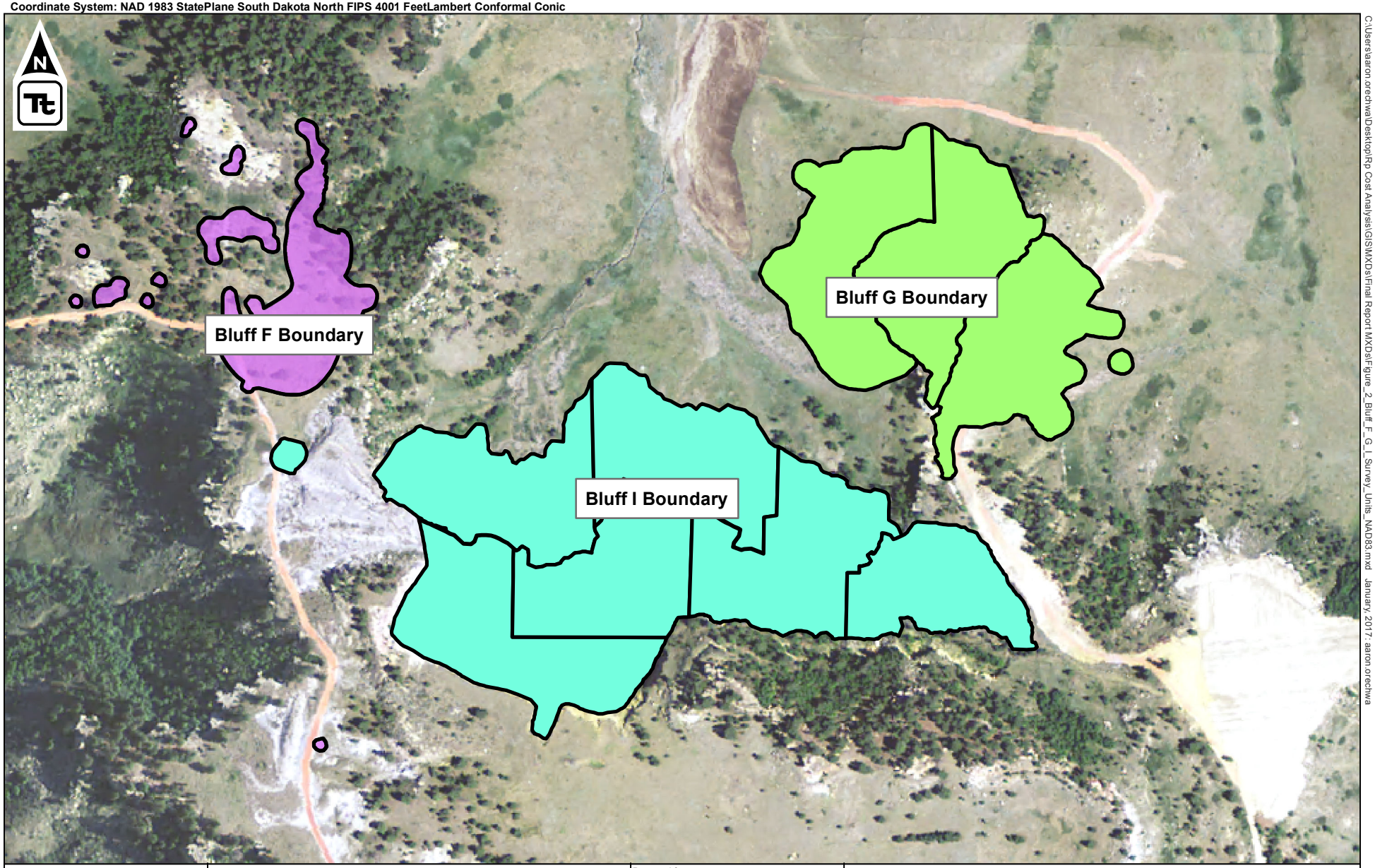
Location: HARDING COUNTY, SD

Project no.: 114-560543

Date: JAN 2017

Figure: Figure 1

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_2_Bluff_F_G_I_Survey_Units_NAD83.mxd January 2017 aaron.orechwa

FEET
0 100 200

RILEY PASS BLUFFS

Bluff F
Bluff G
Bluff I

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F, BLUFF G, BLUFF I LOCATION MAP

Project:	Project no.:	
RILEY PASS	114-560543	Figure 2
Location: HARDING COUNTY, SD	Date: 1/2017	

1.2 CLEANUP CRITERIA

As described in the VSP, the study areas shown in Figure 2 were geographically subdivided into "survey units" based on their potential for contamination. Survey units are the fundamental compliance units being assessed for attainment of risk-based cleanup criteria. The spatial extent of areas with contaminant concentrations above the risk-based soil cleanup criteria was established from the characterization surveys and documented in previous submittals (MSE 2009; Tetra Tech 2013, 2015d); the affected areas underwent removal action and reclamation in the summer and fall of 2016. Cleanup verification surveys were performed in all areas where land disturbance occurred. Risk-based concentration criteria for arsenic and Ra-226 were established for Riley Pass (USFS 2016) and identified in the 2016 Action Memo, The VSP refers to the risk-based soil cleanup criteria as derived concentration guideline levels (DCGL). As defined in Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC 2000), the DCGLs are intended for designation of radioisotopes; however, a DCGL is also assigned for this project for arsenic, a stable element. A detailed analysis showed the contaminants of concern identified in the engineering evaluation and cost analysis (EE/CA) and risk assessment (USFS 2006) can be assessed by verifying the presence or absence of arsenic and Ra-226 in soil media. The 2016 Action Memo requirements are as follows:

1. Soils exceeding the DCGL guideline of 30 picocuries per gram (pCi/g) Ra-226 will be excavated and stabilized.

2. Soils exceeding the DCGL of 142 milligrams per kilogram (mg/kg) arsenic will be excavated and stabilized.

Information on arsenic and Ra-226 concentrations in soil was obtained from surface soils for the verification sampling (USFS 2016). Two techniques were used in the field to generate information pertinent to the verification sampling plan requirements for arsenic: (1) in situ XRF field surveys, and (2) surface soil confirmation sampling. Similarly, two techniques were used in the field to generate information pertinent to the verification sampling plan requirements for Ra-226: (1) gamma exposure rate surveys, and (2) surface soil confirmation sampling. A systematic grid based sampling approach was followed for both the in situ XRF field survey and the gamma exposure rate survey following the methods outlined in Section 2.0 and in the VSP. A simple random sampling approach was followed for the soil confirmation sampling.

1.3 PURPOSE AND SCOPE OF WORK

The primary scope of work for Tetra Tech included the following items in general accordance with the VSP:

- Subdivide all areas impacted by disturbance from cleanup operations of survey areas of Bluff F, Bluff G, and Bluff I into survey units based on the criteria set forth in the Action Memo.

- After clearing and grubbing, removal action, and placement of final cover soils, conduct a detailed characterization gamma exposure rate survey at a 100 percent density (where achievable) across all survey units identified for survey areas Bluff F, Bluff G, and Bluff I following methods outlined in the VSP.

- Develop a systematic grid-based system, consisting of 100 square meter (m^2) square grids across all individual survey units within survey areas Bluff F, Bluff G, and Bluff I. Conduct an in situ XRF field measurement at the center of each grid following methods outlined in the VSP.

- Conduct soil confirmation sampling using a simple random sampling approach at a frequency of 1 sample per 20 grids as identified in the VSP.

- Conduct statistical evaluations of grid averaged gamma exposure rate measurements and in situ XRF field measurements using the cutoff values established for the site.

- Conduct statistical evaluations of laboratory reported analytical soil results for arsenic and Ra-226.

1.4 Report Organization

This report is organized as follows:

- Section 1.0 provides background, cleanup criteria, and the purpose and scope of work.

- Section 2.0 presents the methods for survey unit classification, gamma exposure rate surveys, in situ XRF field surveys, and soil confirmation sampling, including quality assurance/quality control protocols.

- Section 3.0 provides the results of the in situ XRF field surveys, gamma exposure rate surveys, and soil confirmation sampling for Bluff F, Bluff G, and Bluff I.

- Section 4.0 provides an evaluation of the regression models for the XRF and gamma survey methods based on data collected in the field.

- Section 5.0 presents a statistical evaluation of arsenic data across all survey areas based on the data collected in the field and the evaluation of the regression models.

- Section 6.0 presents a statistical evaluation of Ra-226 data across all survey areas based on the data collected in the field and the evaluation of the regression models.

- Section 7.0 presents the summary and conclusions.

- Section 8.0 presents the references and work cited.

2.0 METHODS

This section describes the methods and quality assurance (QA) and quality control (QC) procedures for the gamma exposure rate surveys, in situ XRF field surveys, and soil sampling conducted at the Riley Pass Uranium Mines in 2016. While the sampling methods and QA/QC protocol are briefly described in these sections, more detailed Standard Operating Procedures (SOPs) for each sampling method are provided as appendices in the VSP.

2.1 SURVEY UNIT CLASSIFICATION

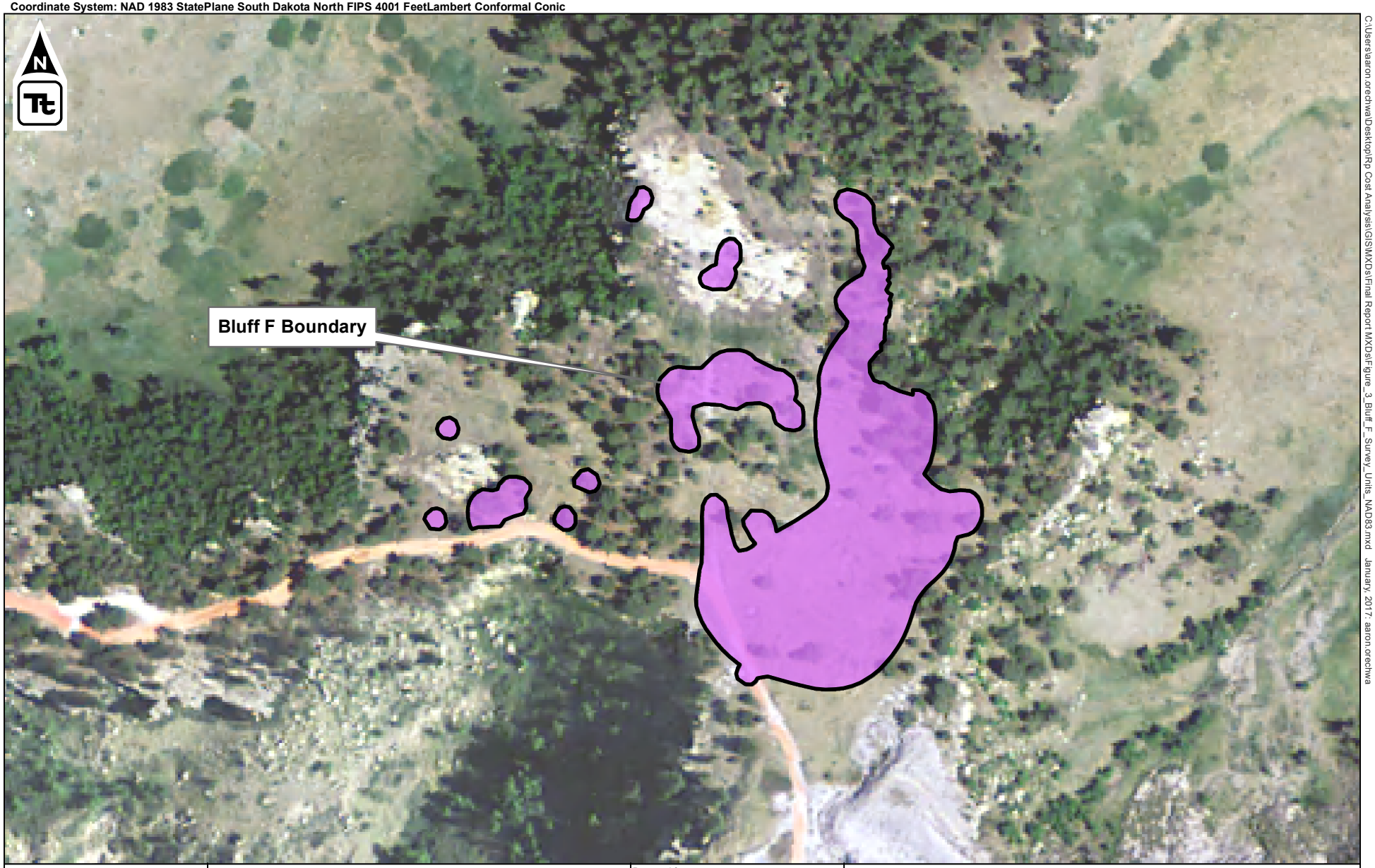
The study areas shown in Figure 2 were geographically divided into "survey units" based on their potential for contamination. Using the approach stated in the VSP, survey areas Bluff F, Bluff G, and Bluff I — which have undergone removal and reclamation activities — are released survey unit by survey unit. A detailed discussion on survey unit classification and procedures for selecting survey unit locations and size is provided in Section 7.3 of the VSP. A maximum survey unit size of 12,000 m^2 was selected for Riley Pass. The survey unit design is a subjective process and was completed before the sampling efforts were initiated in the field. There are a total of 10 survey units subdivided across the four survey areas, totaling 26.4 acres (106,872 m^2). Table 1 provides a summary of the survey unit classification and identification for survey areas Bluff F, Bluff G, and Bluff I.

Table 1 Summary of Survey Unit Classification for Survey Areas

Survey Area	Survey Unit	Surface Area	
		Acres	Square Meters
Bluff F	F1	2.67	10,785
Bluff G	G1	2.76	11,185
	G2	2.96	11,969
	G3	2.73	11,275
Bluff I	I1	2.72	11,022
	I2	2.92	11,833
	I3	2.42	9,780
	I4	2.45	9,924
	I5	2.80	11,337
	I6	1.92	7,760
Total		**26.4**	**106,872**

Survey area Bluff F is 2.67 acres (10,785 m^2) and was not subdivided into multiple survey units. Figure 3 shows the survey unit for Bluff F. Survey area Bluff G was subdivided into three survey units G1, G2, and G3, as shown in Figure 4. Survey area Bluff I was subdivided into six survey units I1, I2, I3, I4, I5, and I6, as shown in Figure 5. All of the survey units were below the maximum survey unit size of 12,000 m^2. The following subsection presents the methods for the in situ XRF survey.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_3_Bluff_F_Survey_Units_NAD83.mxd January 2017 aaron.orechwa

FEET
0 50 100

SURVEY UNIT CLASSIFICATION

Survey Unit F1

Prepared for:

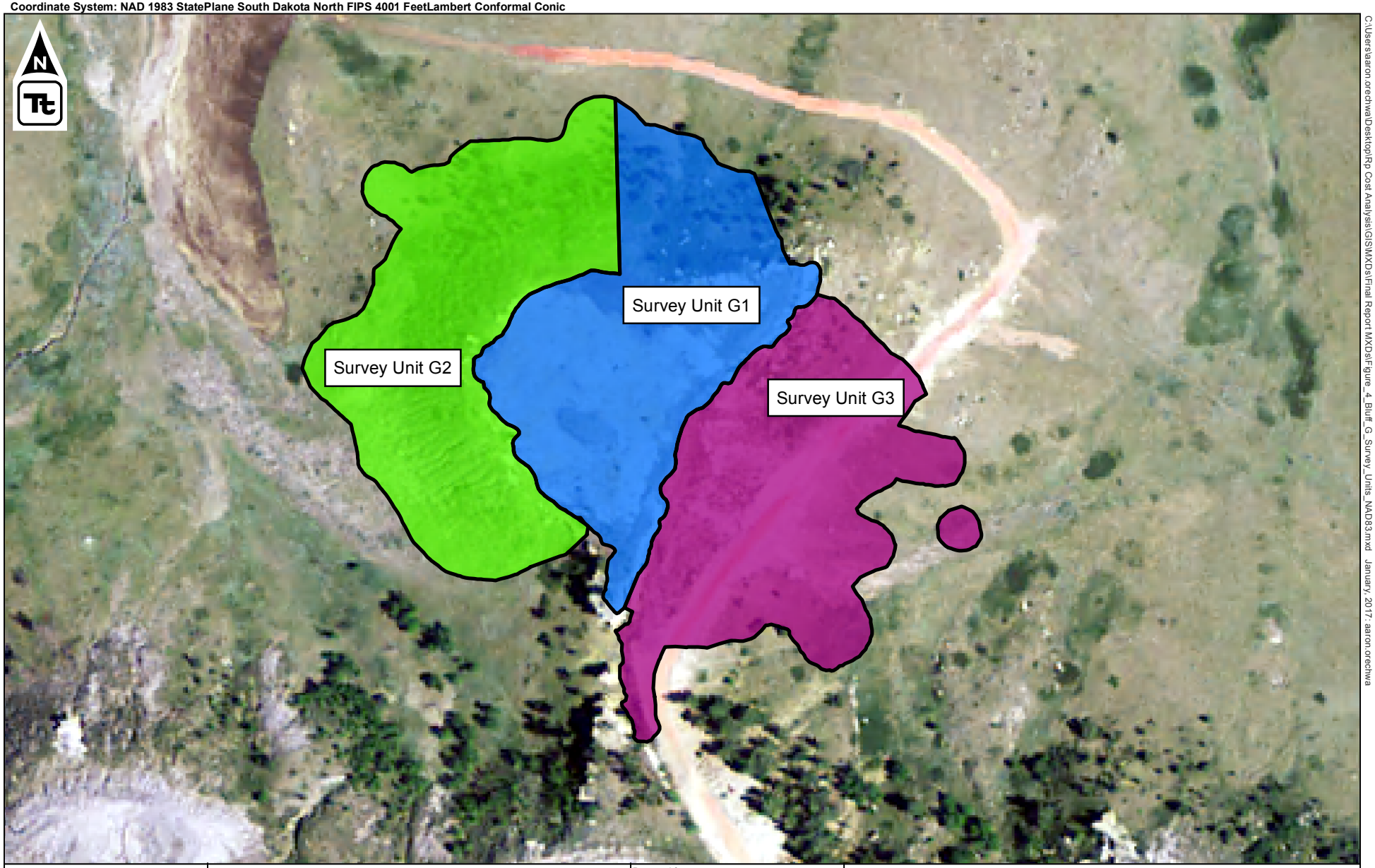
Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

SURVEY AREA BLUFF F
SURVEY UNIT CLASSIFICATION MAP

Project:	Project no.:	
RILEY PASS	114-560543	Figure 3
Location: HARDING COUNTY, SD	Date: 1/2017	

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 50 100

SURVEY UNIT CLASSIFICATION
Survey Unit G1
Survey Unit G2
Survey Unit G3

Prepared for:

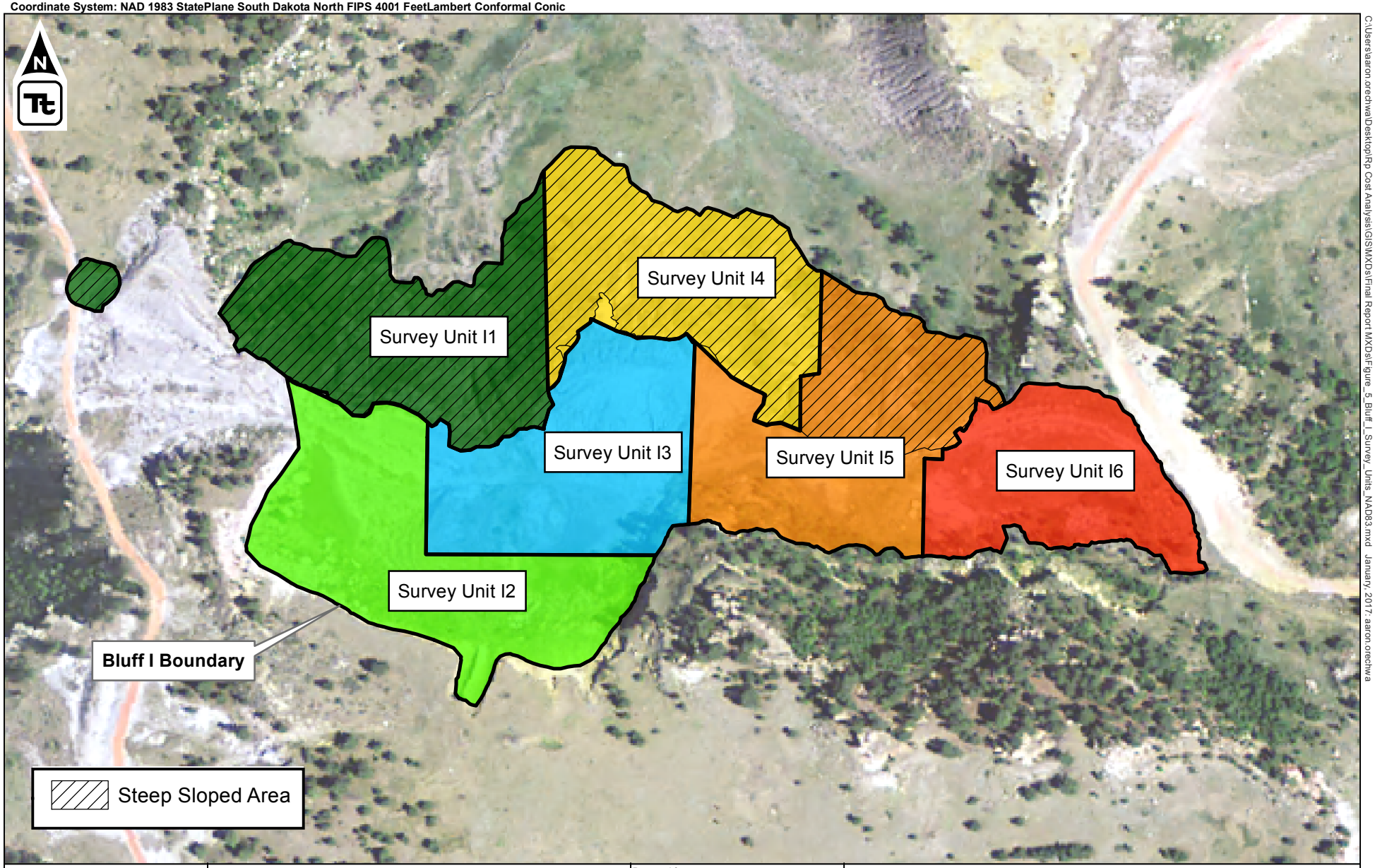
Prepared By:
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

SURVEY AREA BLUFF G
SURVEY UNIT CLASSIFICATION MAP

Project:	Project no.:	
RILEY PASS	114-560543	Figure 4
Location:	Date:	
HARDING COUNTY, SD	1/2017	

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_4_Bluff_G_Survey_Units_NAD83.mxd January, 2017: aaron.orechwa

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_5_Bluff_I_Survey_Units_NAD83.mxd January, 2017, aaron.orechwa

FEET
0 50 100

SURVEY UNIT CLASSIFICATION

- Survey Unit I1
- Survey Unit I2
- Survey Unit I3
- Survey Unit I4
- Survey Unit I5
- Survey Unit I6

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

SURVEY AREA BLUFF I
SURVEY UNIT CLASSIFICATION MAP

Project:	Project no.:	
RILEY PASS	114-560543	**Figure 5**
Location: HARDING COUNTY, SD	Date: 1/2017	

2.2 IN SITU XRF FIELD SURVEY

2.2.1 Overview

In situ XRF field surveys (XRF field surveys) were shown to be effective tools to measure concentrations of arsenic in soil at a definitive level at Riley Pass (Tetra Tech 2013). XRF field surveys were performed in accordance with the sampling methods presented in this section using a portable Niton XRF spectrum analyzer (or equivalent) to meet the data quality objectives (DQOs) presented in the VSP. A correlation between in situ XRF arsenic concentrations and arsenic concentrations reported by the analytical laboratory (EPA Method 6020A) was developed for the site (Tetra Tech 2015b). This correlation will be the primary method for estimating arsenic concentrations in the field.

A strong correlation (R^2= 0.897; r = 0.947) was calculated between the in situ XRF arsenic measurements and the laboratory-reported total arsenic concentrations. The following equation was used to convert the in situ XRF measurements to laboratory equivalent arsenic concentrations at the site (Figure 6):

Equation 1 $$Lab\ Arsenic\ = 10^{0.352+0.891log_{10}(\text{XRF Arsenic})}$$

Where:

Lab arsenic = laboratory reported arsenic concentration in surface soil (mg/kg)

XRF Arsenic = XRF measured arsenic concentration in surface soil (mg/kg)

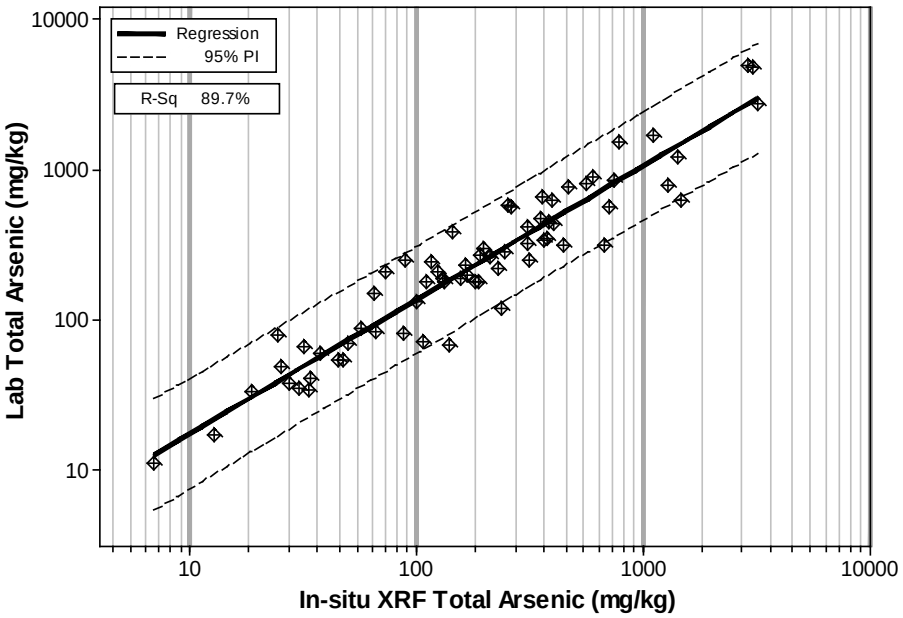


Figure 6 In Situ XRF Total Arsenic Concentration versus Laboratory-Reported Total Arsenic Concentration

2.2.2 Methods

In situ XRF field surveys were performed in accordance with the methods outlined in Appendix A of the VSP. The XRF field survey was performed at sampling locations spaced over a 10-meter by 10-meter systematic square grid within in all of the survey units at all of the study areas. Global positioning system (GPS) locations and XRF measurement results were logged in the field as specified in Appendix A of the VSP. If an elevated measurement was recorded, additional measurements were collected to characterize the extent of this area to guide potential additional removal action; however, these additional measurements were not used for the statistical test— instead, they were used only for characterization purposes when further remedial action was deemed warranted by the lead field engineer. Statistical tests presented in the VSP were utilized to determine whether each survey unit has met the release criterion for concentrations of arsenic in soil. The results of the in situ XRF field surveys, including measurement locations and sampling results, are provided in Section 3.0 through Section 3.3 for Bluff F, Bluff G, and Bluff I. To ensure the correlation provided in Equation 1 is still valid, an exercise was performed to evaluate how well the laboratory-reported arsenic concentrations align with the existing correlation between XRF/laboratory arsenic values, and adjustments were made if justified and necessary. A statistical analysis to evaluate the in situ XRF field survey results is presented in Section 5.0.

2.2.3 Quality Assurance/Quality Control Protocol

The primary QA/QC methods for the in situ XRF field surveys are presented in Appendix A of the VSP. The primary QA methods for the XRF include manufacturer recommend calibration and daily energy calibration checks. The primary QC methods for the XRF include the use of calibration checks, field duplicates, and precision measurements. All of these tools are critical for a good QC program for the XRF data to be used beyond a screening designation to more definitive uses, as is the case with this project. Calibration checks are performed by field engineers on a daily basis for a number of purposes (EPA 2008):

- They are used to identify whether the XRF unit is properly calibrated to provide unbiased measurements for the elements of concern in the range of concern.
- They are used over time to make sure the calibration stays constant.
- They can be used to identify and quantify potential interference effects.

Other QC methods include field duplicates and precision measurements that were performed by engineers in the field. The following operational and QC requirements also applied to operation of the XRF instrument and were followed and documented in the field logbook maintained by the analyst. Results of the data QA/QC results and evaluation of these data for determination if project acceptance criteria met per the in situ XRF field survey requirements outlined in the VSP are provided in the Data Validation and QC Review Summary (Appendix A). Sampling information of the in situ XRF field measurements is provided in Appendix B. Copies of the laboratory analytical reports are provided in Appendix C. Scanned copies of field logbooks and field sheets are provided in Appendix D.

2.3 GAMMA EXPOSURE RATE SURVEY

2.3.1 Objective

Gamma exposure rate surveys have been shown to be effective at identifying the spatial extent and predicting the concentration of Ra-226 in surface soils at Riley Pass. Previous site-specific studies (MSE 2009; Tetra Tech 2013) have shown there is a direct correlation between gamma exposure rate (microroengtens per hour [µR/hr-) and Ra-226 (pCi/g) activity concentration for all of the study areas at Riley Pass. Gamma exposure rate surveys were performed through systematic walkovers with a detector height of 1 meter above the ground surface within the Class 1 areas after remedial action has been completed in accordance with the methods outlined in in the VSP. Tetra Tech developed a site-specific gamma/Ra-226 correlation as described in Tetra Tech (2015b). The correlation is presented in Equation 2 and Figure 7. Figure 7 presents the log-log correlation between gamma exposure rate and Ra-226 soil concentrations across the Riley Pass mine waste areas; the black line represents the main regression line provided in Equation 2 and the dashed lines show the 95 percent prediction intervals. A strong correlation ($R = 0.96$; $R^2 = 0.92$) was established between gamma exposure rate and the activity concentration of Ra-226 in soil. A gamma exposure rate cutoff of 76.5 µR/hr was used for cleanup verification purposes. The following equation was used to convert the gamma exposure rate measurements collected at the site to laboratory-equivalent Ra-226 activity concentrations in soil:

Equation 2 $$\text{Lab Ra} - 226 = 10^{-1.979+1.835\ log_{10}(Gamma)}$$

Where:

Lab Ra-226 = laboratory equivalent soil radium-226 concentration (pCi/g)

Gamma = gamma exposure rate measurement (µR/hr)

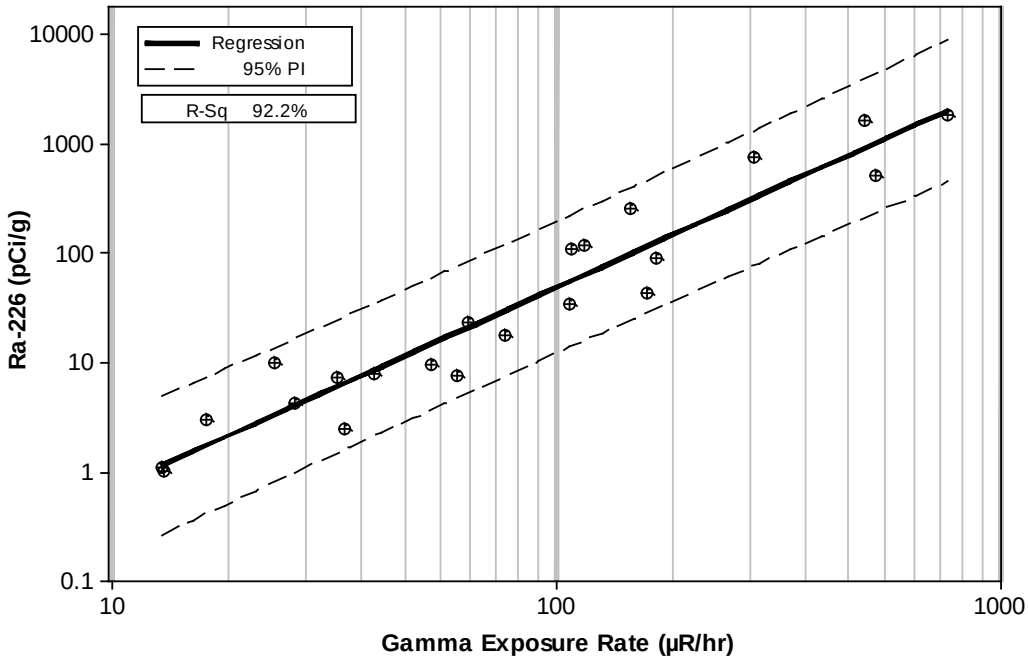


Figure 7 Gamma Exposure Rate versus Soil Ra-226 Mass Activity Concentration

2.3.2 Methods

Gamma radiation surveys were performed in accordance with the methods outlined in Appendix B of the VSP. The DQO process presented in the VSP identified gamma exposure rate surveys were to be used to provide information on the Ra-226 activity concentrations in surface soils within surveys units and to determine whether these values meet the project cleanup objectives. Ra-226 soil activity concentrations can be directly estimated using site-specific gamma/Ra-226 correlations that have been developed for the site during the characterization study (Tetra Tech 2013, 2015a, 2015b). The objective of the gamma exposure rate surveys was to scan the surface soils to measure and identify the presence of elevated radiation emanating from the ground that would indicate residual soil activity and hot spots associated with Ra-226 above risk-based levels identified in the Action Memo (USFS 2016). Scanning refers to a portable mobile radiation detection system moved across the surface of an area of interest at a specified density with the intent of identifying radionuclide concentrations (NRC 2000). *The scanning used for this project was a screening level tool primarily — soil sampling is the final verification tool to assess attainment of cleanup standards.* The purpose of the gamma exposure rate survey is to collect gamma exposure rate measurements within each survey unit after the removal action is completed. The gamma radiation survey methods are outlined in more detail in Appendix B of VSP.

Tetra Tech utilized mobile backpack scanning systems consisting of a 2-inch-by-2-inch Ludlum 44-10 thallium-doped sodium iodide [NaI(Tl)] scintillation detectors and Ludlum 2350-1 data loggers coupled to wide area augmentation system (WAAS) enabled GPS connected to a field laptop. NaI(Tl) survey meters are used for scanning areas for gamma emitters because they are sensitive to gamma radiation and are easily portable. A scanning rate of 0.5 meter per second (m/s) (about equal to 1 mph) was used for distributed gamma emitting constituents as recommended in Nuclear Regulatory Commission (NRC) (1992) and NRC (2000). The gamma exposure rate data were transmitted once per second to a portable computer and logged using proprietary logging and mapping software (Tetra Tech 2006). A detector height of 1 meter above ground surface is recommended in NUREG-5849 (NRC 1992) and is typically used for baseline radiological studies (OSD 2012; EPA 1999) among other projects (ERG 2009a, 2009b; Tetra Tech 2010). All measurement data were automatically stored and processed, with the measurement location information mapped and analyzed in real time. Real-time mapping allowed the field engineer to maintain position on pre-determined scan transect lines and to help identify any problems arising during the scanning efforts. Tetra Tech's experience at similar sites indicates that NaI(Tl) detector response to significant above-background gamma radiation sources near the ground surface ranges horizontally to about 1.5 meters, giving the detector an estimated ground surface field of view about 3 meters in diameter (1.5 meter radius is about 5 feet). Scan density of 100 percent was achieved for all of the gamma exposure rate surveys conducted for this project, with scan transects spaced approximately 2 meters apart in width. The Ludlum NaI(Tl) detector systems exhibit energy-dependent response characteristics as shown in Figure 8; the radiation energy spectrum associated with background radiation from soils found at sites with uranium or Ra-226 contamination can be adequately characterized using these systems.

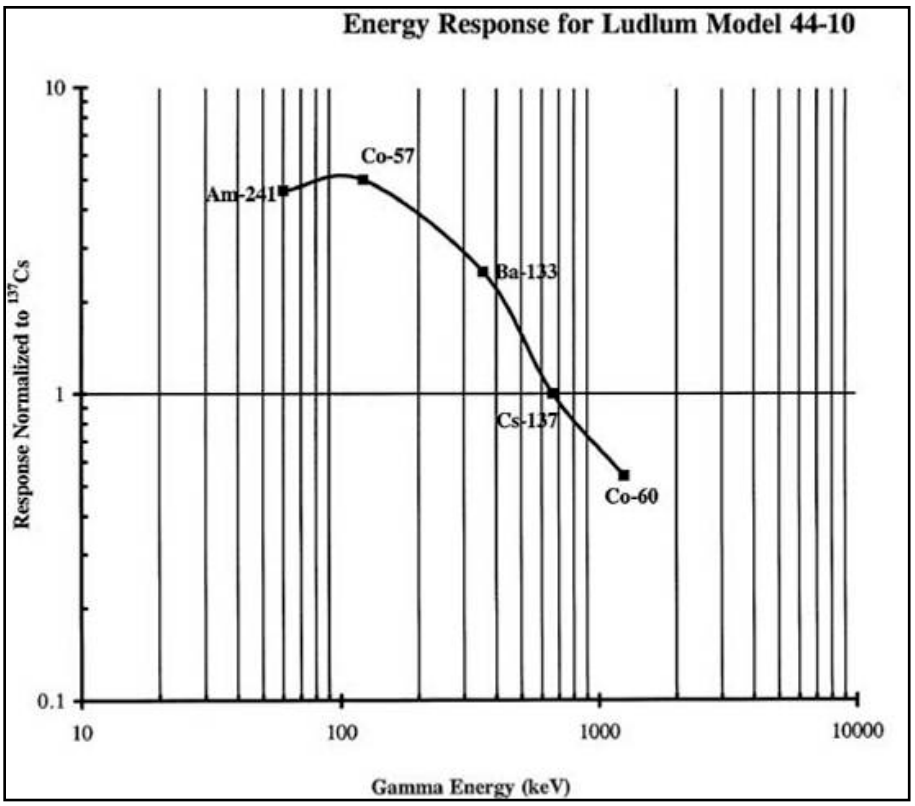


Figure 8 Energy Response for Ludlum Model 44-10 with Cs-137 Source

The Ludlum 2350-1 data logger system employs a calibration factor to internally convert detector counts per minute (cpm) to a gamma exposure rate in µR/hr. The calculated exposure rate, which is directly proportional to the measured count rate, is transmitted by the data logger to the scanning system portable PC. No record of count rate is retained by the system, but count rate can be calculated using the instrument-specific calibration factor. The following subsection describes the QA/QC protocol for radiation instrumentation performed during the project.

2.3.3 Quality Assurance and Quality Control Protocol

All radiological projects conducted by Tetra Tech incorporate data QA/QC protocols established both internally and to achieve guidelines established by MARSSIM (NRC 2000). In general, QA includes qualitative factors that provide confidence in the results, while QC involves quantitative, field evidence that supports the validity of results. Data quality indicators as recommended in MARRSIM (NRC 2000) and the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) (NRC 2004) were used to ensure the data collected were reliable and of the highest quality. Tetra Tech utilized GPS-based gamma scanning systems with automated electronic data acquisition software to perform the gamma exposure rate surveys. The QA/QC survey procedures are widely used and represent accepted techniques for characterization of gamma radiation in the uranium industry. This type of technology allows for a large amount of radiological data to be collected during the survey.

Under the QC program, factory-calibrated instruments met on-site field-test criteria (such as calibration checks). Tetra Tech field personnel collected quantitative measurements as part of the QC program including:

1. Pre-survey field instrument calibration checks.
2. Daily field instrument calibration checks.
3. Post-survey field instrument calibration checks.

An important QA protocol includes instrument calibration. All of the radiation detection instruments employed during the field work were calibrated by an accredited laboratory within the previous 12 months as recommended by the manufacturer, Ludlum Measurements, Inc. (Ludlum). Data developed with the field-qualified instruments are then interchangeable, allowing instrument substitution as needed.

A detailed explanation of the QA/QC methods for the radiation instrumentation, including data validation testing, QC acceptance limits, and results of the calibration checks, is provided in Appendix A. Results of the data QA/QC and evaluation of these data for determination if project acceptance criteria met per the VSP are provided in the Riley Pass Data Validation and QC Review Summary (Appendix A). Copies of factory calibration documentation for the detectors used during the surveys are provided in Appendix A. Information relating to the field conditions and gamma radiation survey QC calibration checks were recorded in the daily field logbook; a scanned copy is provided in Appendix D. A photographic log including photos of scanning and excavation activities is provided in Appendix E.

2.4 Soil Confirmation Sampling

2.4.1 Objectives

The in situ XRF field surveys and the gamma radiation surveys are effective means of conducting verification sampling to determine cleanup objectives have been attained within each survey unit across the three survey areas, as described in the previous subsections. However, the soil confirmation sampling is the primary tool to assess whether cleanup objectives have been attained in soils for both arsenic and Ra-226. The two goals of the soil confirmation sampling are:

1. Confirm the efficacy of the XRF field surveys and gamma radiation surveys.
2. Verify that the arsenic and Ra-226 concentrations in soil meet the cleanup criteria within each study area.

There are two primary soil confirmation sample types: (1) XRF confirmation samples and (2) soil Ra-226 correlation samples. These two types have unique sampling methods that were followed. Detailed methods for both sample types including QA/QC procedures are presented in the VSP. The VSP describes the procedures that should be used at the Riley Pass site to perform both the XRF confirmation soil sampling and the Ra-226 soil confirmation/correlation sampling. The VSP also addresses sample handling, labeling, documentation, preservation, shipping, and laboratory analysis.

2.4.2 Methods

Soil confirmation sampling was performed in accordance with the methods outlined in Appendix C of the VSP. Soil samples were collected at a frequency of 5 percent (1 in 20) of the in situ XRF measurements within each survey unit or as required by the minimum number of samples of a study area for the statistical test (Section 6.2 of VSP). If not enough samples were collected using the 5 percent frequency to satisfy the minimum number of samples for the statistical test, then additional samples were collected as necessary to meet the statistical testing requirements. Results of the sample size analysis are provided in Section 5.0 and Section 6.0. Soil sampling locations were selected using a random number generator assuming a normal distribution. They were selected prior to field deployment and after survey unit classification by identifying all of the proposed in situ XRF sample locations with a numeric identifier and selecting the random locations from a random number generator. If additional samples were required to meet the statistical testing requirements, this process was repeated as necessary and further field sampling was conducted; however, additional samples must be collected at different locations than locations previously sampled. **As described in Section 5.0 and Section 6.0, there were enough soil confirmation samples collected for both arsenic and Ra-226 that additional samples were not required.**

Before soil sampling, the coordinates of each sample location plot were identified. The XRF confirmation sampling and the soil Ra-226 correlation sampling was performed following the methods presented in Appendix C of the VSP. The XRF soil confirmation sampling locations were located in the center of the 10-meter by 10-meter soil correlation plot location. Sampling plot locations were initially located using a handheld GPS device. Sampling locations were adjusted as necessary in the field for access and to accommodate field conditions. The GPS coordinates of the actual (adjusted) sampling locations were recorded in the field logbook at the time of sampling.

Tetra Tech conducted post-excavation verification grab sampling of soil samples within the systematic square 100-m^2 grid alignment overlain across the affected areas of the survey units at Bluff F, Bluff G, and Bluff I. The soil samples were submitted for laboratory analysis to a U.S. Environmental Protection Agency (EPA)-accredited laboratory for analysis of arsenic and Ra-226, after drying, homogenization and, for the Ra-226 measurement, radon daughter equilibration as described in Appendix B of the VSP. Table 2 presents a summary of the laboratory analytical methods for soil samples.

Table 2 Summary of Laboratory Analytical Methods for Soil Samples

Analyte	Laboratory Method	CAS No.	Units
Radium-226	Modified E901.1	7440-14-4	pCi/g
Arsenic	Method 6020A	7440-38-2	mg/kg

CAS = Chemical Abstract Service
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram

A Trimble GEO7X GPS with sub-meter accuracy was used to map the soil sample locations and grid locations. The data were post processed using Trimble Pathfinder software. A differential correction was performed using GPS Pathfinder Office on all geospatial points collected during the project.

2.4.3 Quality Assurance/Quality Control Protocol

Blind field duplicate samples were sent to the laboratory along with the primary field samples at a minimum frequency of 1 in 20 samples. The data validation for this project was conducted by Tetra Tech following the procedures outlined in the VSP. The results of the data validation for soil confirmation samples are presented in Appendix A of this report. As described earlier, an evaluation on the regression models to meet project acceptance criteria is provided in Section 4.0.

3.0 VERIFICATION SAMPLING RESULTS

3.1 BLUFF F RESULTS

This subsection presents the verification sampling locations and results for the in situ XRF field surveys, gamma exposure rate surveys, and soil confirmation sampling for Bluff F. The field work was conducted in September 2016.

3.1.1 Bluff F In situ XRF Field and Soil Sampling Information

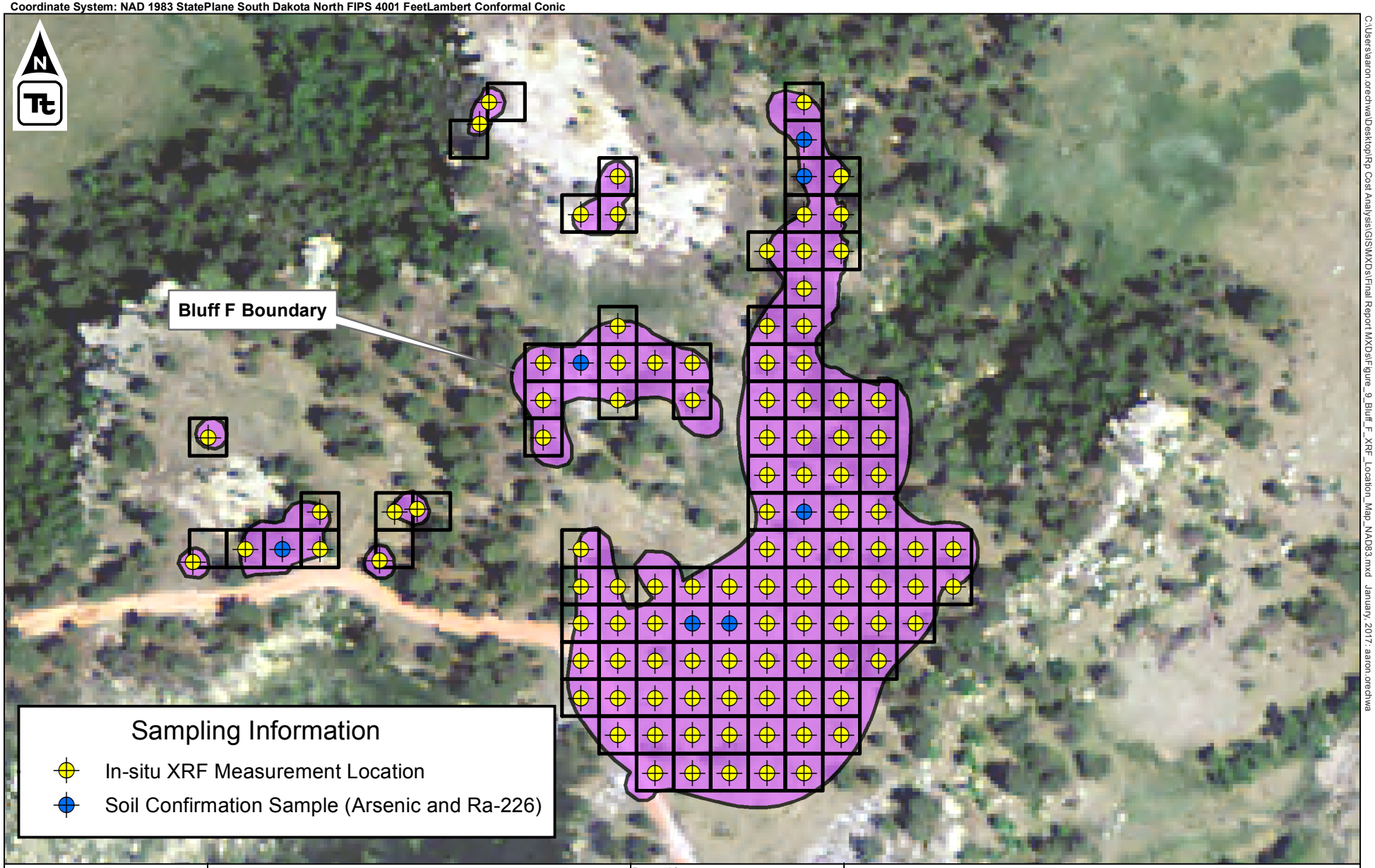
Survey area Bluff F consists of one survey unit because of the limited size of the reclaimed area, as described in Section 2.1. Table 3 provides a summary of Bluff F in situ XRF measurement and confirmation sampling data for arsenic in soil collected within the survey unit. A systematic grid sampling approach was conducted for determination of arsenic at Bluff F, as described in Section 2.2 of this report and Section 4.2 of the VSP. The grid used for the verification sampling was based on a 10-meter by 10-meter grid overlay system that was used for both the analysis of arsenic and Ra-226. The grid overlay identification map for Bluff F is provided in Figure B1 of Appendix B of this report. The laboratory sample identification information for the arsenic soil confirmation samples collected at Bluff F is provided in Appendix B of this report.

Table 3 Summary of Bluff F In situ XRF Sampling and Arsenic Soil Sampling Information

Survey Area	Survey Unit	Number of XRF Measurements	Number of Arsenic Soil Confirmation Samples (Primary)
Bluff F	F1	111	6
Total		111	6

A map showing the in situ XRF measurements and soil confirmation sample locations is provided on Figure 9. **Note: the soil confirmation samples shown on Figure 9 represent the locations of both arsenic and Ra-226 soil confirmation samples.** A total of 111 in situ XRF field measurements were collected across Bluff F. A total of six soil confirmation samples were collected across the survey unit. The sampling frequency of 1 in 20 soil samples per in situ XRF measurements was achieved within the primary survey unit. Samples were submitted to ALS laboratory in Fort Collins, Colorado for analysis.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechtwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_9_Bluff_F_XRF_Location_Map_NAD83.mxd January, 2017, aaron.orechtwa

FEET
0 50 100

SURVEY UNIT CLASSIFICATION

Survey Unit F1

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F VERIFICATION SAMPLING
IN-SITU XRF LOCATION MAP

Project:	Project no.:	
RILEY PASS	114-560543	Figure 9
Location: HARDING COUNTY, SD	Date: 1/2017	

3.1.2 Bluff F In situ XRF Field Survey Results

The locations of in situ XRF arsenic measurements collected at Bluff F are provided on Figure 9. The geospatial coordinates of each in situ XRF measurement and soil confirmation sample locations shown on Figure 9 are provided in tabular format in Appendix B of this report. In situ XRF field measurements were collected following the procedures outlined in the VSP and Section 2.2. **After evaluation of the XRF/lab regression model (Section 4.1), it was determined that Equation 1 represents the arsenic soil concentrations from in situ XRF measurements accurately.** Using Equation 1, all in situ XRF measurements were converted to laboratory equivalent arsenic concentrations. The arsenic concentration ranged between 15.9 mg/kg and 104 mg/kg, all below the risk based cleanup level of 142 mg/kg. Table 4 provides summary statistics for the 111 estimated arsenic measurements collected across the survey unit F1.

Table 4 Summary Statistics of Arsenic Concentrations at Survey Unit F1

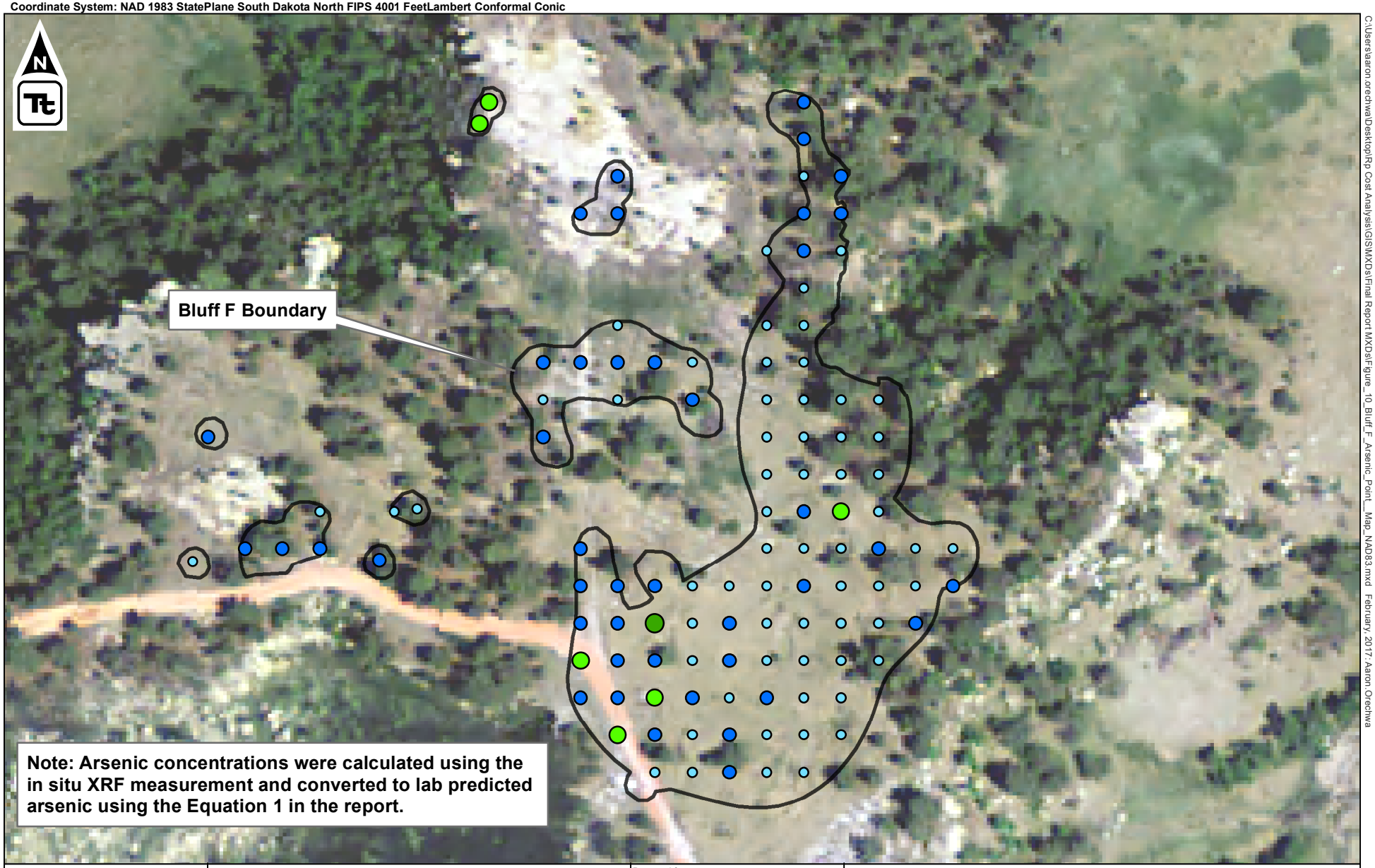
Summary Statistic	Units	Bluff F Survey Unit
Number of Measurements	*#*	111
Minimum	*mg/kg*	15.9
Maximum	*mg/kg*	104
Standard Deviation	*mg/kg*	14.7
Average	*mg/kg*	36.2
Median	*mg/kg*	33.0
90th Percentile	*mg/kg*	51.0
95th Percentile	*mg/kg*	66.5
99th Percentile	*mg/kg*	86.0

mg/kg = Milligrams per kilogram

Figure 10 provides the arsenic soil concentration maps for each individual XRF measurement location after conversion to laboratory equivalent arsenic concentrations using Equation 1. As shown in Table 4, all measured arsenic soil concentrations were below the cutoff of 142 mg/kg. Since all of the laboratory equivalent arsenic levels for Bluff F were below the cutoff levels no further statistical analysis is required. **The cleanup objectives for arsenic were attained at survey unit F1 of survey area Bluff F because all arsenic values are below the soil cleanup criteria.**

Tetra Tech field engineers followed the established QA/QC protocol outlined in Appendix A of the VSP. The QA/QC results are provided in the data validation report for field sampling data, provided in Appendix A of this report. Appendix B provides the field sampling information. Appendix C provides the laboratory reports. Scanned copies of field log sheets and field logbooks are provided in Appendix D. A photographic log of the field sampling efforts is provided in Appendix E.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 50 100

Arsenic Concentration (mg/kg)

- < 35
- 35 - 65
- 65 -100
- 100 -142
- 142 - 200
- > 200

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F VERIFICATION SAMPLING ARSENIC CONCENTRATION MAP (POINT)

Project:	Project no.:	
RILEY PASS	114-560543	**Figure 10**
Location: HARDING COUNTY, SD	Date: 1/2017	

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_10_Bluff_F_Arsenic_Point_Map_NAD83.mxd February 2017 Aaron.Orechwa

3.1.3 Bluff F Gamma Survey Results

A gamma exposure rate survey was conducted at Bluff F per methods outlined in Section 2.3 of this report and Appendix B of the VSP. All of the gamma exposure rate survey QA/QC project acceptance criteria for this project were achieved, as presented in Appendix A. A total of 6,452 individual gamma exposure rate measurements were collected within the single survey unit of survey area Bluff F. The summary statistics of both individual and grid averaged gamma exposure rate measurements collected within the survey unit are provided in Table 5. The individual gamma exposure rates collected at Bluff F ranged between 19.2 µR/hr and 114 µR/hr. The average and median gamma exposure rates within the survey unit were 31.5 µR/hr and 28.2 µR/hr. There were 83 measurements above the gamma cutoff of 76.5 µR/hr (less than 1.3 percent of all points) concentrated in a small, isolated area within the southern portion of survey unit F1. A raw gamma exposure rate map is provided in Figure 11.

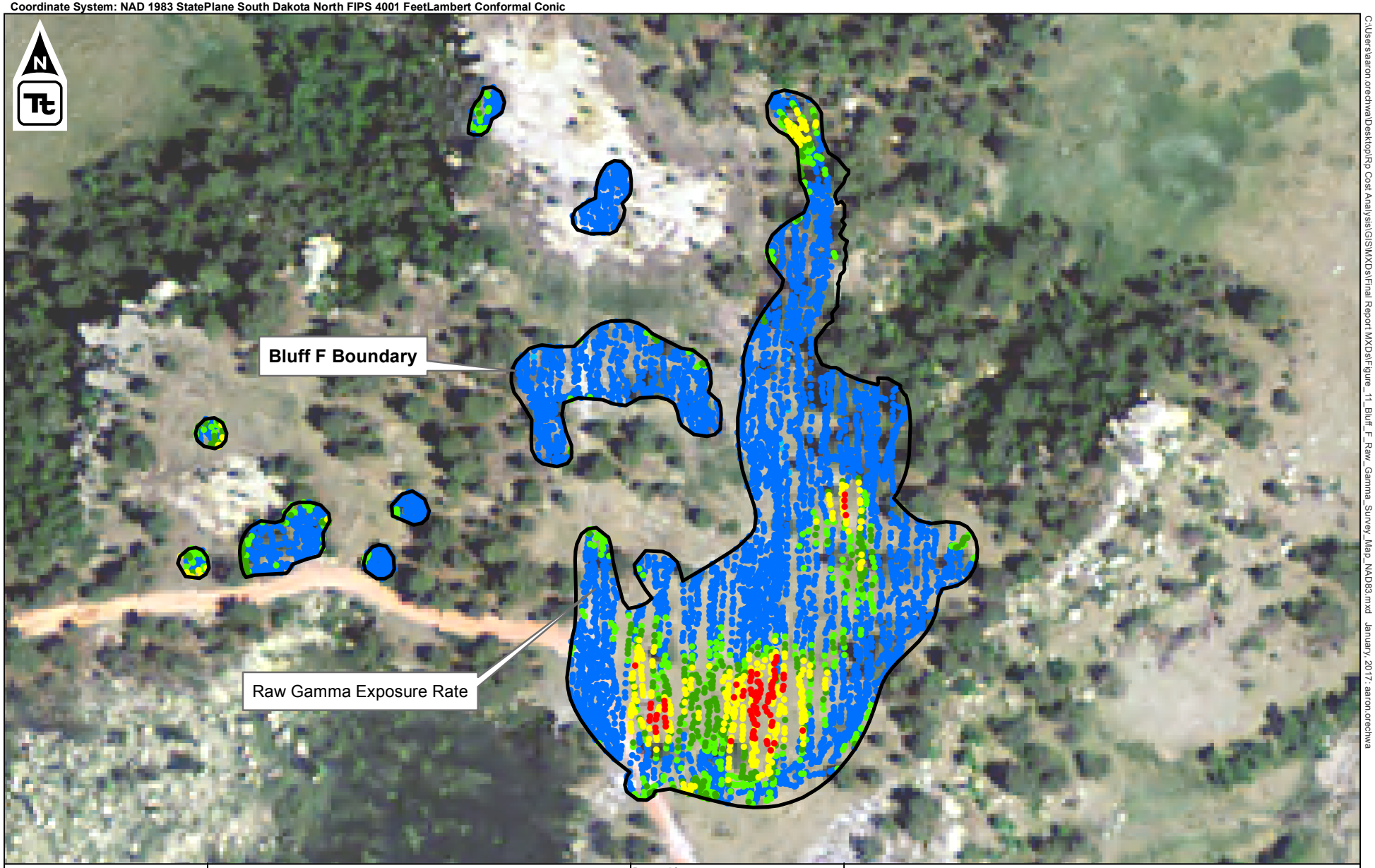
Table 5 Summary Statistics of Individual Gamma Exposure Rates at Bluff F

Summary Statistic	Units	Survey Unit F1
Number of Measurements	#	6,452
Survey Unit Area	m^2	10,785
Minimum	µR/hr	19.2
Maximum	µR/hr	114
Standard Deviation	µR/hr	11.2
Average	µR/hr	31.5
Median	µR/hr	28.2
90th Percentile	µR/hr	44.2
95th Percentile	µR/hr	54.0
99th Percentile	µR/hr	80.0

µR/hr = Microroentgens per hour
m^2 = Square meters

Section 3.5 of the VSP specifies that all gamma exposure rate measurements be converted into Ra-226 soil concentrations as part of the data post-processing. However, further analysis is required to determine if the existing regression model (Equation 2) is still appropriate. Section 4.0 provides the results of an evaluation of the existing gamma/Ra-226 regression model using the 2016 Ra-226 soil confirmation sampling and gamma exposure rate data pairs. After the data are converted into individual Ra-226 soil concentrations, the VSP states that an optimal geospatial technique is selected to conduct data post-processing analysis to determine if the survey unit meets the soil cleanup criteria for Ra-226. Section 6.0 describes the procedures used to evaluate the soil cleanup criteria and provides conclusions on whether or not soil cleanup criteria for Ra-226 was achieved.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_11_Bluff_F_Raw_Gamma_Survey_Map_NAD83.mxd January 2017, aaron.orechwa

FEET
0 50 100

Gamma Exposure Rate (µR/hr)

< 20	35 - 42	50 - 76.5
20 - 35	42 - 50	≥ 76.5

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F VERIFICATION SAMPLING GAMMA EXPOSURE RATE MAP

Project: RILEY PASS		Project no.: 114-560543	**Figure 11**
Location: HARDING COUNTY, SD		Date: 1/2017	

3.1.4 Bluff F Radium-226 Soil Confirmation Sampling Information

The gamma exposure rate survey was used to guide cleanup as well as provide a tool to estimate continuous Ra-226 concentrations across the site. A number of Ra-226 soil confirmation samples were collected using the same method used to develop the soil correlation to determine if the gamma/Ra-226 correlation (Equation 2) used in the characterization survey is still valid. The statistical evaluation of Ra-226 soil confirmation samples collected across the survey units at survey area Bluff F is the primary factor used to determine if cleanup objectives are achieved. Table 6 presents the sample type and quantities collected across survey unit F1 within survey area Bluff F. The grid overlay identification map for Bluff F is provided in Figure B1 of Appendix B of this report. The laboratory sample identification information for the Ra-226 soil confirmation samples collected at Bluff F is provided in Appendix B of this report.

Table 6 Summary of Bluff F Gamma Radiation Survey Grids and Ra-226 Soil Sampling Information

Survey Area	Survey Unit	Number of Gamma Exposure Rate 100 m^2 Grids	Number of Ra-226 Soil Confirmation Samples (Primary)
Bluff F	F1	111	6
Total		**111**	**6**

Section 4.0 presents the results of the Ra-226 soil confirmation samples and provides an evaluation of the existing gamma/Ra-226 correlation model. **Note: After further analysis it was determined that the soil correlation provided in Equation 2 underestimated the Ra-226 soil concentrations from gamma exposure rate measurements. Equation 3, presented in Section 4.0, was developed to better estimate the post-reclamation Ra-226 soil concentrations from the gamma radiation survey data.** Further statistical analysis of the Ra-226 soil concentrations across the survey area Bluff F is provided in Section 6.0. The following subsection presents the verification sampling results for Bluff G.

3.2 BLUFF G RESULTS

This subsection presents the verification sampling locations and results for the in situ XRF field surveys, gamma exposure rate surveys, and soil confirmation sampling for Bluff G. The field work was conducted as part of a phased approach in September, October, and November of 2016.

3.2.1 Bluff G In situ XRF Field and Soil Sampling Information

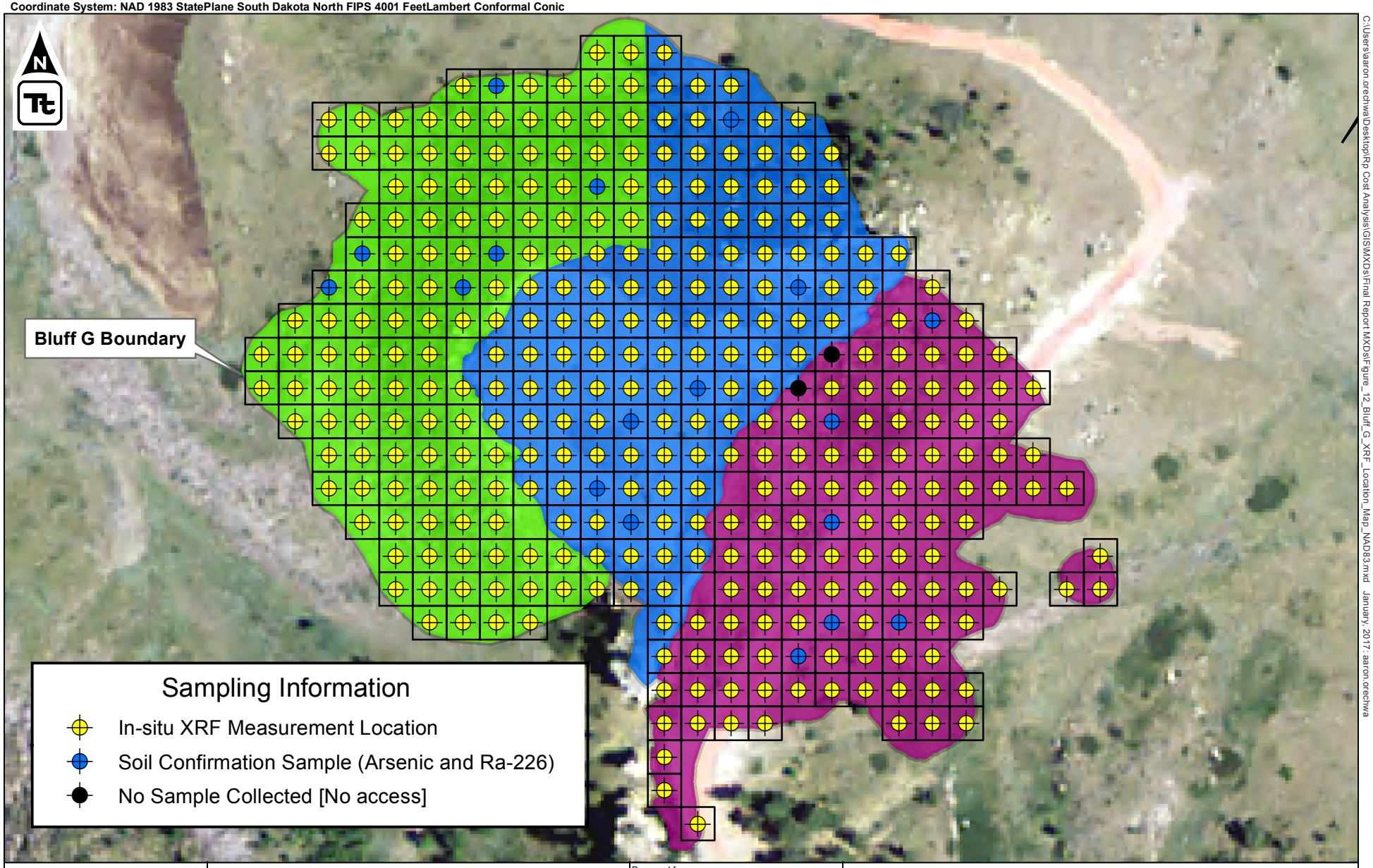
Survey area Bluff G consists of three primary survey units G1, G2, and G3 identified in Figure 4 of Section 2.1. Table 7 provides a summary of Bluff G in situ XRF measurement and confirmation sampling quantities for arsenic in soil collected per survey unit (G1, G2, and G3). A systematic grid sampling approach was conducted for determination of arsenic at Bluff G as described in Section 2.2 of this report and Section 4.2 of the VSP. The grid used for the verification sampling was based on a 10-meter by 10-meter grid overlay system that was used for both the analysis of arsenic and Ra-226. The grid overlay identification map for Bluff G is provided in Figure B2 of Appendix B of this report. The laboratory sample identification information for the arsenic soil confirmation samples collected at Bluff G is provided in Appendix B of this report.

Table 7 Summary of Bluff G In situ XRF Sampling and Arsenic Soil Sampling Information

Survey Area	Survey Unit	Number of XRF Measurements	Number of Arsenic Soil Confirmation Samples (Primary)
Bluff G	G1	110	6
	G2	118	6
	G3	108	6
Total		**336**	**18**

A map showing the in situ XRF measurements and soil confirmation samples locations is provided on Figure 12. **Note: the soil confirmation samples shown on Figure 12 represent the locations of both arsenic and Ra-226 soil confirmation samples.** A total of 336 in situ XRF field measurements were collected spatially uniform across the three survey units discretized for survey area Bluff G. A total of 338 measurements were proposed, but because of access restriction two of these locations fell on the cliff edge and no measurements were collected. A total of 18 soil confirmation soil samples were collected across the three survey units. The sampling frequency of 1 in 20 soil samples per in situ XRF measurements was achieved within each survey unit. Samples were submitted to ALS laboratory in Fort Collins, Colorado, for analysis.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_12_Bluff_G_XRF_Location_Map_NAD83.mxd January 2017, aaron.orechwa

FEET
0 50 100

SURVEY UNIT CLASSIFICATION
Survey Unit G1
Survey Unit G2
Survey Unit G3

Prepared for:

Prepared By:
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF G VERIFICATION SAMPLING
IN-SITU XRF LOCATION MAP

Project:	RILEY PASS	Project no.:	114-560543	Figure 12
Location:	HARDING COUNTY, SD	Date:	1/2017	

3.2.2 Bluff G In situ XRF Field Survey Results

The locations of in situ XRF arsenic measurements collected at Bluff G are provided on Figure 12. The geospatial coordinates of each in situ XRF measurement and soil confirmation sample locations shown on Figure 12 are provided in tabular format in Appendix B of this report. In situ XRF field measurements were collected following the procedures outlined in the VSP and Section 2.2 of this report. **After evaluation of the XRF/lab regression model (Section 4.1), it was determined that Equation 1 represents the arsenic soil concentrations from in situ XRF measurements accurately.** Using Equation 1, all in situ XRF measurements were converted to laboratory equivalent arsenic concentrations. The arsenic concentration ranged between 7.5 mg/kg and 225 mg/kg; two samples were above the cutoff for arsenic of 142 mg/kg. Both of these samples were located at sandstone outcrops on cliff edges located in survey units G2 and G3. All measurements within survey G1 fell below the risk based cleanup level. Table 8 provides summary statistics for the 336 estimated arsenic measurements collected across the survey units G1, G2, and G3.

Table 8 Summary Statistics of Arsenic Concentrations at Bluff G

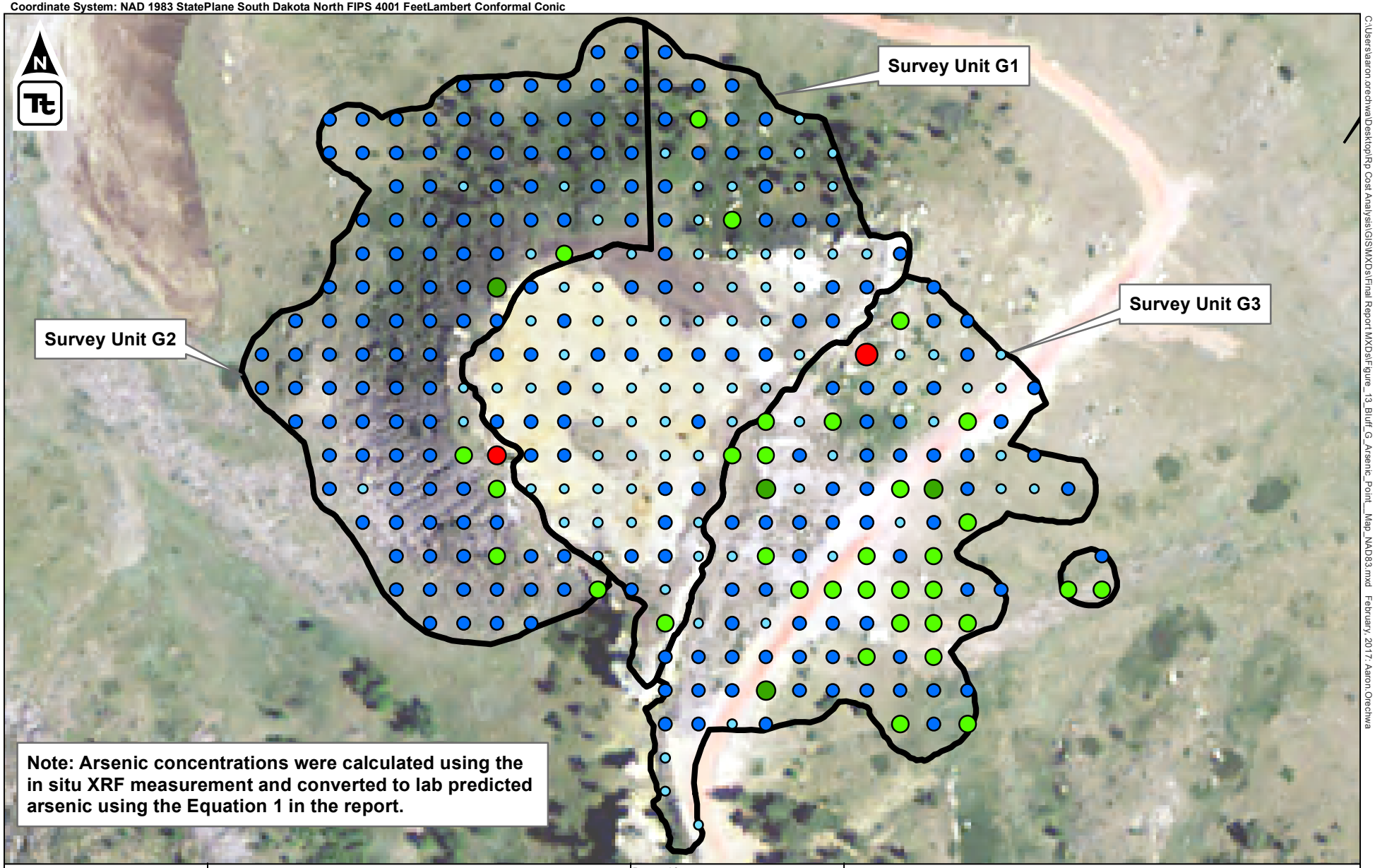
Summary Statistic	Units	Bluff G Survey Unit			All Survey Units
		G1	G2	G3	
# of Measurements	*#*	110	118	108	336
Minimum	*mg/kg*	7.5	25.2	19.6	7.5
Maximum	*mg/kg*	90.0	145	225	225
Standard Deviation	*mg/kg*	14.0	13.6	27.9	21.3
Average	*mg/kg*	34.8	47.9	56.5	46.4
Median	*mg/kg*	33.8	46.6	50.6	43.5
90th Percentile	*mg/kg*	52.0	55.1	85.1	67.8
95th Percentile	*mg/kg*	56.9	67.7	95.3	82.8
99th Percentile	*mg/kg*	69.9	105	138	121

mg/kg = Milligrams per kilogram

Figure 13 provides the arsenic soil concentration map for each individual XRF measurement location after conversion to laboratory equivalent arsenic concentrations using Equation 1. As shown in Table 8, all measured arsenic soil concentrations at survey unit G1 were below the cutoff of 142 mg/kg. Since all of the laboratory equivalent arsenic levels at survey unit G1 were below the cutoff levels no further statistical analysis is required. **The cleanup objectives for arsenic were attained at survey unit G1 of survey area Bluff G because all arsenic values are below the soil cleanup criteria.** As described earlier, there was one arsenic exceedance each within survey units G2 and G3; therefore, further analysis was warranted per Section 3.5 of the VSP. The results of the statistical analysis are presented in Section 5.0.

Tetra Tech field engineers followed the established QA/QC protocol outlined in Appendix A of the VSP. The QA/QC results are provided in the data validation report for field sampling data, provided in Appendix A of this report. Appendix B provides the field sampling information. Appendix C provides the laboratory reports. Scanned copies of field log sheets and field logbooks are provided in Appendix D. A photographic log of the field sampling efforts is provided in Appendix E.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 50 100

Arsenic Concentration (mg/kg)

< 35	100 -142
35 - 65	142 - 200
65 -100	> 200

Prepared for:

Prepared By:
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF G VERIFICATION SAMPLING
ARSENIC CONCENTRATION MAP (POINT)

Project:	RILEY PASS	Project no.:	114-560543
Location:	HARDING COUNTY, SD	Date:	1/2017

Figure 13

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_13_Bluff_G_Arsenic_Point__Map_NAD83.mxd February, 2017 Aaron Orechwa

3.2.3 Bluff G Gamma Survey Results

A gamma exposure rate survey was conducted at Bluff G using the methods outlined in Section 2.3 of this report and Appendix B of the VSP. All of the QA/QC project acceptance criteria for this project were achieved, as presented in Appendix A. A total of 19,797 individual gamma exposure rate measurements were collected within the three survey units (G1, G2, and G3) of survey area Bluff G. The summary statistics of the raw gamma exposure rate measurements collected within all of the survey units are provided in Table 9. The gamma exposure rates ranged between 14.3 µR/hr and 95.7 µR/hr. The average and median gamma exposure rates across all of the survey units was 25.7 µR/hr and 25.6 µR/hr. Six measurements were above the gamma cutoff of 76.5 µR/hr located at a sandstone outcrop within the boundary of survey unit G3. (Less than 0.001 percent of all measurements in survey unit G3 were above the cutoff.) All of the individual gamma exposure rates within survey units G1 and G2 were below the cutoff values. A raw gamma exposure rate map is provided in Figure 14.

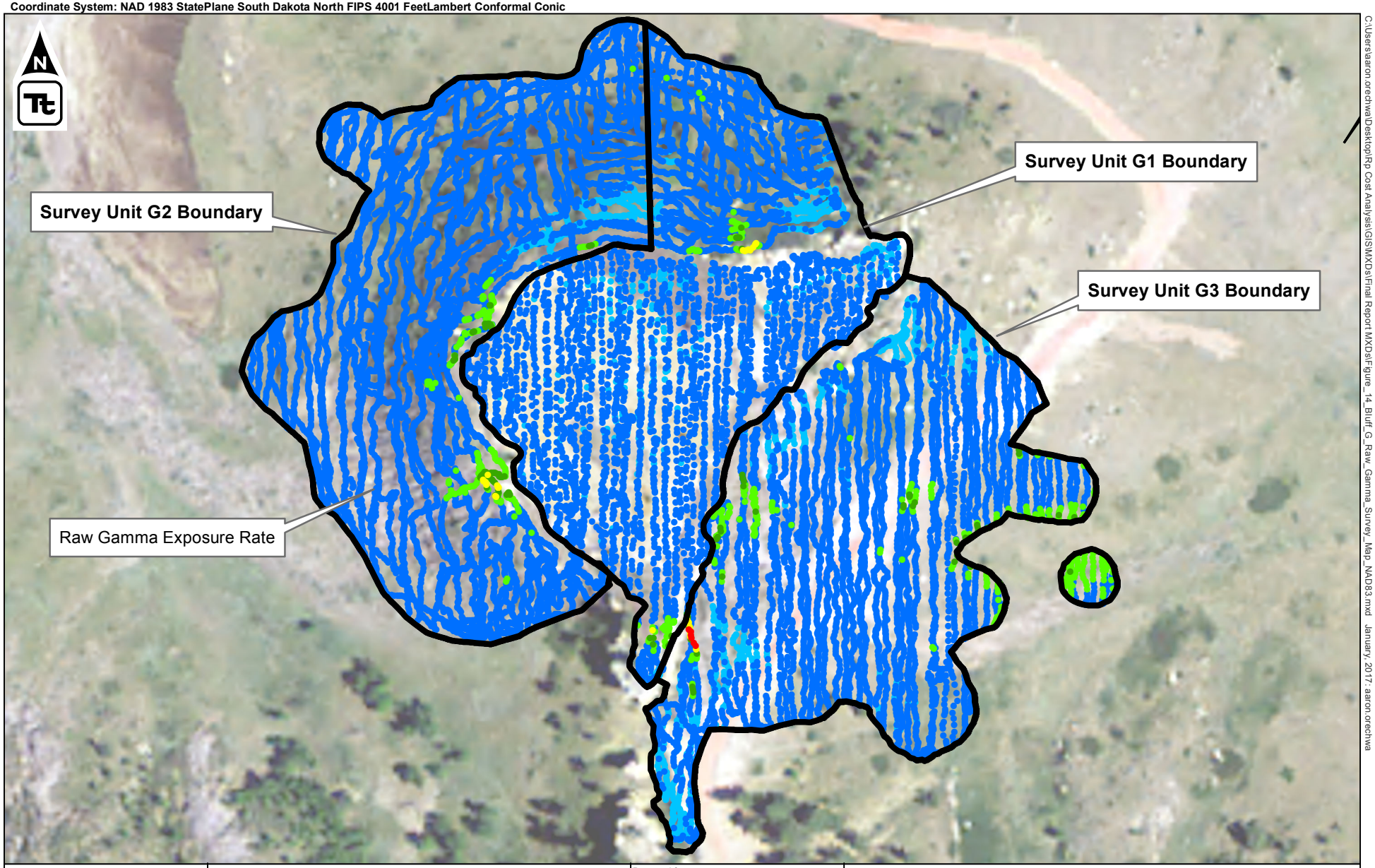
Table 9 Summary Statistics of Individual Gamma Exposure Rates at Bluff G

Raw Gamma Exposure Rate Measurement Summary Statistic	Units	Survey Unit			All Bluff G Survey Units
		G1	G2	G3	
Number of Measurements	#	5,453	8,303	6,041	19,797
Survey Unit Area	m^2	11,185	11,969	11,275	34,430
Minimum	µR/hr	14.3	15.2	15.3	14.3
Maximum	µR/hr	67.1	60.9	95.7	95.7
Standard Deviation	µR/hr	3.89	3.77	5.70	4.75
Average	µR/hr	23.4	27.4	25.6	25.7
Median	µR/hr	22.5	27.4	24.5	25.6
90^{th} Percentile	µR/hr	27.8	30.7	32.3	30.8
95^{th} Percentile	µR/hr	29.9	32.4	35.1	32.9
99^{th} Percentile	µR/hr	38.4	40.9	41.8	40.8

µR/hr = Microroentgen per hour
m^2 = Square meters

Section 3.5 of the VSP specifies that all gamma exposure rate measurements be converted into Ra-226 soil concentrations as part of the data post-processing. However, further analysis is required to determine if the existing regression model (Equation 2) is still appropriate. Section 4.0 provides the results of an evaluation of the existing gamma/Ra-226 regression model using the 2016 Ra-226 soil confirmation sampling and gamma exposure rate data pairs. After the data are converted into individual Ra-226 soil concentrations, the VSP states that an optimal geospatial technique is selected to conduct data post-processing analysis to determine if the survey unit meets the soil cleanup criteria for Ra-226. Section 6.0 describes the procedures used to evaluate the soil cleanup criteria and provides conclusions on whether or not soil cleanup criteria for Ra-226 was achieved.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_14_Bluff_G_Raw_Gamma_Survey_Map_NAD83.mxd January 2017 aaron.orechwa

FEET
0 50 100

Gamma Exposure Rate (µR/hr)

< 20	35 - 42	50 - 76.5
20 - 35	42 - 50	≥ 76.5

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF G VERIFICATION SAMPLING
GAMMA EXPOSURE RATE MAP

Project: RILEY PASS		Project no.: 114-560543	**Figure 14**
Location: HARDING COUNTY, SD		Date: 1/2017	

3.2.4 Bluff G Radium-226 Soil Confirmation Sampling Information

The gamma exposure rate survey was used to guide cleanup as well as provide a tool to estimate continuous Ra-226 concentrations across the site. A number of Ra-226 soil confirmation samples were collected using the same method used in to develop the soil correlation to determine if the gamma/Ra-226 correlation (Equation 2) used in the characterization survey is still valid. Furthermore, the statistical evaluation of Ra-226 soil confirmation samples collected across the survey units at survey area Bluff G was the primary factor used to determine if cleanup objectives are achieved. Table 10 presents the sample type and quantities collected across survey units G1, G2, and G3 within survey area Bluff G. The grid overlay identification map for Bluff G is provided in Figure B2 of Appendix B of this report. The laboratory sample identification information for the Ra-226 soil confirmation samples collected at Bluff G is provided in Appendix B of this report.

Table 10 Summary of Bluff G Gamma Radiation Survey Grids and Ra-226 Soil Sampling Information

Survey Area	Survey Unit	Number of Gamma Exposure Rate 100 m^2 Grids	Number of Ra-226 Soil Confirmation Samples (Primary)
Bluff G	G1	110	6
	G2	118	6
	G3	110	6
Total		**338**	**18**

Section 4.0 presents the results of the Ra-226 soil confirmation samples and provides an evaluation of the existing gamma/Ra-226 correlation model. **Note: After further analysis it was determined that the soil correlation provided in Equation 2 underestimated the Ra-226 soil concentrations from gamma exposure rate measurements. Equation 3, presented in Section 4.0, was developed to better estimate the post-reclamation Ra-226 soil concentrations from the gamma radiation survey data.** Further statistical analysis of the Ra-226 soil concentrations across the survey area Bluff G is provided in Section 6.0. The following subsection presents the verification sampling results for Bluff I.

3.3 Bluff I Results

This section presents the verification sampling locations and results for the in situ XRF field surveys, gamma radiation surveys, and soil confirmation sampling for Bluff I. The field work was conducted in three separate phases of work in October and November of 2016.

3.3.1 Bluff I In situ XRF Field and Soil Sampling Information

Survey area Bluff I consists of six primary survey units, I1, I2, I3, I4, I5, and I6 identified in Figure 5. Table 11 provides a summary of Bluff I in situ XRF measurement and arsenic soil confirmation sampling quantities collected per survey unit (I1, I2, I3, I4, I5, and I6). A systematic grid sampling approach was conducted for determination of arsenic at Bluff I as described in Section 2.2 of this report and Section 4.2 of the VSP. The grid used for the verification sampling was based on a 10-meter by 10-meter grid overlay system that was used for both the analysis of arsenic and Ra-226. The grid overlay identification map for Bluff I is provided

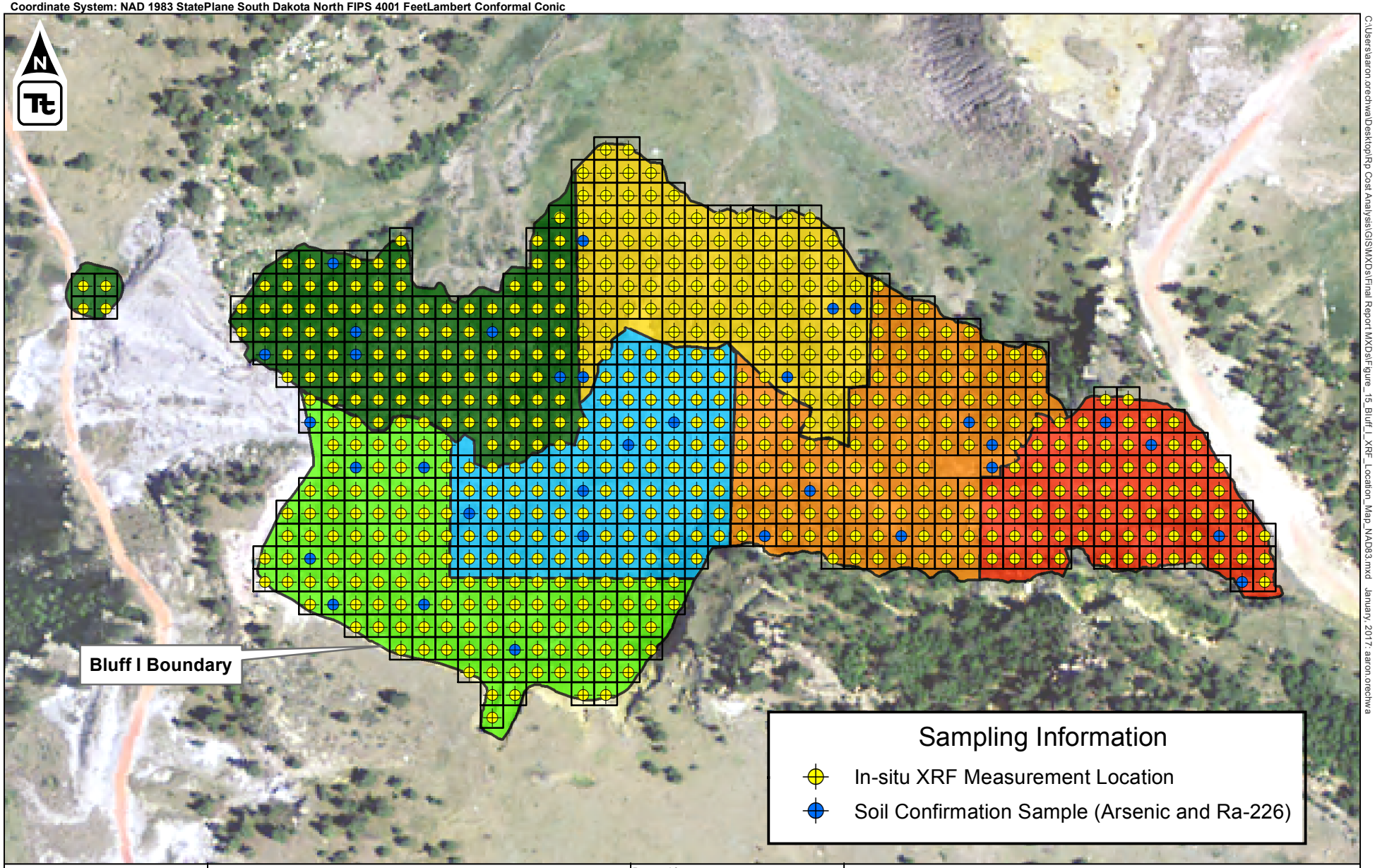
in Figure B3 of Appendix B of this report. The laboratory sample identification information for the arsenic soil confirmation samples collected at Bluff I is provided in Appendix B of this report.

Table 11 Summary of Bluff I In situ XRF Sampling and Arsenic Soil Sampling Information

Survey Area	Survey Unit	Number of XRF Measurements	Number of Arsenic Soil Confirmation Samples (Primary)
Bluff I	I1	104	6
	I2	125	7
	I3	91	5
	I4	100	5
	I5	112	6
	I6	77	4
Total		**609**	**33**

A map showing the in situ XRF measurements and soil confirmation sample locations is provided on Figure 15. **Note: the soil confirmation samples shown on Figure 15 represent the locations of both arsenic and Ra-226 soil confirmation samples.** A total of 609 in situ XRF field measurements were collected spatially uniform across the six survey units discretized for survey area Bluff I. A total of 33 soil confirmation soil samples were collected across the six survey units. The sampling frequency of 1 in 20 soil samples per in situ XRF measurements was achieved within each survey unit. Samples were submitted to ALS laboratory in Fort Collins, Colorado.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_15_Bluff_I_XRF_Location_Map_NAD83.mxd January 2017 aaron.orechwa

FEET
0 125 250

SURVEY UNIT CLASSIFICATION

- Survey Unit I1
- Survey Unit I2
- Survey Unit I3
- Survey Unit I4
- Survey Unit I5
- Survey Unit I6

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF I VERIFICATION SAMPLING
IN SITU XRF LOCATION MAP

Project:	Project no.:	
RILEY PASS	114-560543	Figure 15
Location: HARDING COUNTY, SD	Date: 1/2017	

3.3.2 Bluff I In situ XRF Field Survey Results

The locations of in situ XRF arsenic measurements collected within the six survey units I1, I2, I3, I4, I5, and I6 within survey area Bluff I are provided on Figure 15. The geospatial coordinates of each in situ XRF measurement and respective soil confirmation sample locations shown on Figure 15 are provided in tabular format in Appendix B of this report. In situ XRF field measurements were collected following the procedures outlined in the VSP and Section 2.2 of this report. **After evaluation of the XRF/lab regression model (Section 4.1), it was determined that Equation 1 represents the arsenic soil concentrations from in situ XRF measurements accurately.** Using Equation 1, all in situ XRF measurements were converted to laboratory equivalent arsenic concentrations. The arsenic concentrations ranged between 6.0 mg/kg to 120 mg/kg, all below the risk-based cleanup level of 142 mg/kg. Table 12 provides summary statistics for the 609 estimated arsenic measurements collected across the survey units of survey area Bluff I.

Table 12 Summary Statistics of Arsenic Concentrations at Bluff I

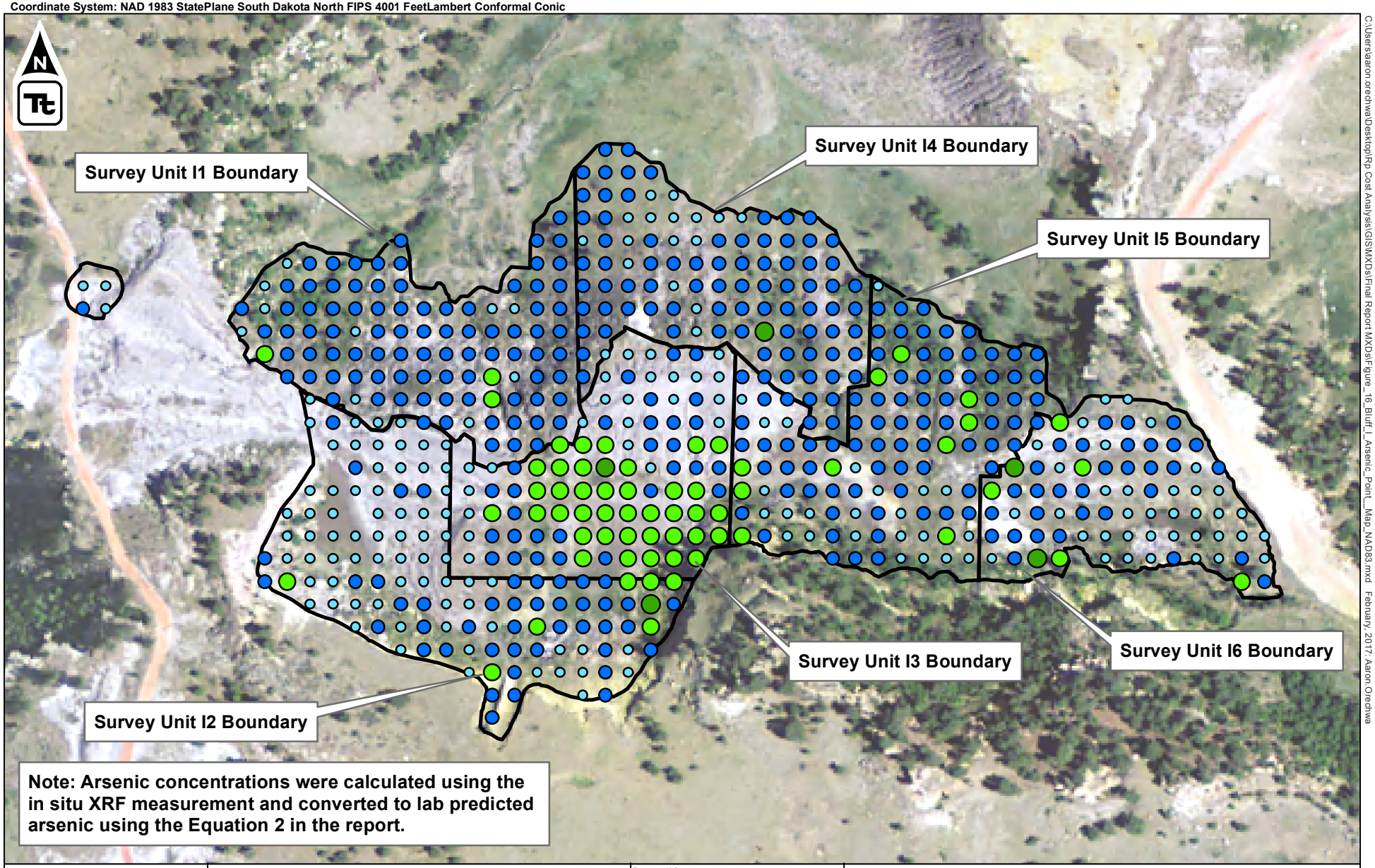
Summary Statistic	Units	Bluff I Survey Unit						All Survey Units
		I1	I2	I3	I4	I5	I6	
Number of Measurements	#	104	125	91	100	112	77	609
Minimum	mg/kg	9.6	6.0	13.9	16.9	13.2	13.3	6.0
Maximum	mg/kg	76.2	101	106	109	92	120	120
Standard Deviation	mg/kg	11.2	19.2	23.0	11.4	14.7	20.0	17.9
Average	mg/kg	46.6	36.3	55.5	45.1	46.7	40.8	44.9
Median	mg/kg	46.2	30.4	59.2	46.4	49.5	35.8	44.5
90th Percentile	mg/kg	59.8	59.5	88.5	55.1	63.8	62.3	66.5
95th Percentile	mg/kg	63.8	66.8	92.1	58.1	67.9	78.1	75.5
99th Percentile	mg/kg	73.1	97.6	98	64.0	79.3	109	97.4

mg/kg = Milligrams per kilogram

Figure 16 provides the arsenic soil concentration maps for each individual XRF measurement location after conversion to laboratory equivalent arsenic concentrations using Equation 1. As shown in Table 12, all measured arsenic soil concentrations across all survey units were below the cutoff of 142 mg/kg. Since all of the laboratory equivalent arsenic levels for Bluff I were below the cutoff levels no further statistical analysis is required. **The cleanup objectives for arsenic were attained at survey units I1, I2, I3, I4, I5, and I6 of survey area Bluff I because all arsenic values are below the soil cleanup criteria**

Tetra Tech field engineers followed the established QA/QC protocol outlined in Appendix A of the VSP. The QA/QC results are provided in the data validation report for field sampling data, provided in Appendix A of this report. Appendix B provides the field sampling information. Appendix C provides the laboratory reports. Scanned copies of field log sheets and field logbooks are provided in Appendix D. A photographic log of the field sampling efforts is provided in Appendix E.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 125 250

Arsenic Concentration (mg/kg)

< 35	100 -142
35 - 65	142 - 200
65 -100	> 200

Prepared for:

Prepared By:
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF I VERIFICATION SAMPLING ARSENIC CONCENTRATION MAP (POINT)

Project: RILEY PASS	Project no.: 114-560543	**Figure 16**
Location: HARDING COUNTY, SD	Date: 1/2017	

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_16_Bluff_I_Arsenic_Point_Map_NAD83.mxd February, 2017 Aaron Orechwa

3.3.3 Bluff I Gamma Survey Results

A gamma exposure rate survey was conducted at Bluff I in accordance with the methods outlined in Section 2.3 of this report and Appendix B of the VSP. All of the QA/QC project acceptance criteria for this project were achieved, as presented in Appendix A. A total of 32,510 individual gamma exposure rate measurements were collected within the six survey units (I1, I2, I3, I4, I5, and I6) of survey area Bluff I. The summary statistics of the individual gamma exposure rate measurements collected within all of the survey units are provided in Table 13. The gamma exposure rates ranged between 13.4 µR/hr and 121 µR/hr. The average and median gamma exposure rates across all of the survey units was 26.6 µR/hr and 27.0 µR/hr, both below the gamma cutoff level of 76.5 µR/hr. Six individual gamma measurements within survey unit I1 exceeded the gamma cutoff; this number of measurements was equal to less than 0.001 percent of the total number of gamma exposure measurements collected within survey unit I1. These measurements were an isolated area emanating from exposed sandstone layer on the cliff edge on the western edge of the survey unit I1 main boundary. Figure 17 presents a map showing the individual gamma exposure rates at Bluff I.

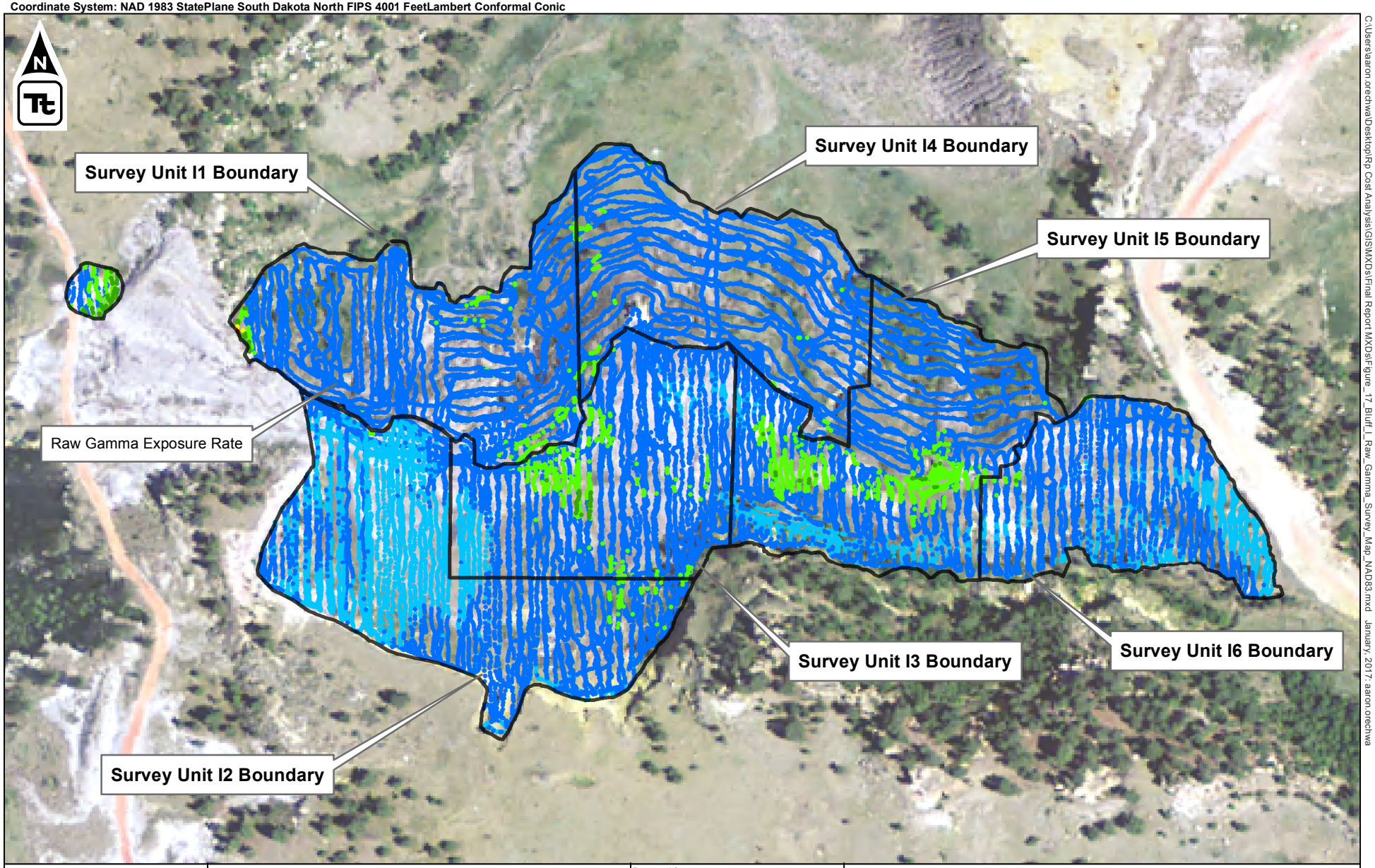
Table 13 Summary Statistics of Individual Gamma Exposure Rates at Bluff I

Raw Gamma Exposure Rate Measurement Summary Statistic	Units	Survey Unit						All Bluff I Survey Units
		I1	I2	I3	I4	I5	I6	
Number of Measurements	#	6,698	6,089	5,829	4,480	5,717	3,697	32,510
Survey Unit Area	m^2	11,022	11,833	9,780	9,924	11,337	7,760	61,657
Minimum	µR/hr	20.1	14.1	15.1	19.0	16.1	13.4	13.4
Maximum	µR/hr	121	39.7	67.8	54.3	59.6	52.7	121
Standard Deviation	µR/hr	4.57	4.69	5.85	2.82	6.14	4.50	5.68
Average	µR/hr	29.1	22.2	27.2	28.4	28.8	23.2	26.6
Median	µR/hr	28.4	21.0	26.9	28.2	29.0	23.3	27.0
90^{th} Percentile	µR/hr	32.7	29.3	34.1	31.6	36.0	28.5	32.7
95^{th} Percentile	µR/hr	34.6	31.7	36.1	32.8	39.3	29.6	34.9
99^{th} Percentile	µR/hr	50.2	34.7	44.6	36.5	47.2	33.7	43.6

µR/hr = Microroentgen per hour
m^2 = Square meters

Section 3.5 of the VSP specifies that all gamma exposure rate measurements be converted into Ra-226 soil concentrations as part of the data post-processing. However, further analysis is required to determine if the existing regression model (Equation 2) is still appropriate. Section 4.0 provides the results of an evaluation of the existing gamma/Ra-226 regression model using the 2016 Ra-226 soil confirmation sampling and gamma exposure rate data pairs. After the data are converted into individual Ra-226 soil concentrations, the VSP states that an optimal geospatial technique is selected to conduct data post-processing analysis to determine if the survey unit meets the soil cleanup criteria for Ra-226. Section 6.0 describes the procedures used to evaluate the soil cleanup criteria and provides conclusions on whether or not soil cleanup criteria for Ra-226 was achieved.

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_17_Bluff_I_Raw_Gamma_Survey_Map_NAD83.mxd January, 2017 aaron.orechwa

FEET
0 125 250

Gamma Exposure Rate (µR/hr)

< 20	35 - 42	50 - 76.5
20 - 35	42 - 50	≥ 76.5

Prepared for:

Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF I VERIFICATION SAMPLING GAMMA EXPOSURE RATE MAP

Project: RILEY PASS		Project no.: 114-560543	**Figure 17**
Location: HARDING COUNTY, SD		Date: 1/2017	

3.3.4 Bluff I Radium-226 Soil Confirmation Sampling Information

The gamma exposure rate survey was used to guide cleanup as well as provide a tool to estimate continuous Ra-226 concentrations across the site. In order to determine if the gamma/Ra-226 correlation (Equation 2) used in the characterization survey is still valid, a number of Ra-226 soil confirmation samples were collected using the same method used to develop the soil correlation. Furthermore, the statistical evaluation of Ra-226 soil confirmation samples collected across the survey units at survey area Bluff I is the primary factor used to determine if cleanup objectives are achieved. Table 14 presents the sample type and quantities collected across survey units I1, I2, I3, I4, I5, and I6. The grid overlay identification map for Bluff I is provided in Figure B3 of Appendix B of this report. The laboratory sample identification information for the Ra-226 soil confirmation samples collected at Bluff I is provided in Appendix B of this report.

Table 14 Summary of Bluff I Gamma Radiation Survey Grids and Ra-226 Soil Sampling Information

Survey Area	Survey Unit	Number of Gamma Exposure Rate 100 m^2 Grids	Number of Ra-226 Soil Confirmation Samples (Primary)
Bluff I	I1	105	6
	I2	125	7
	I3	90	5
	I4	100	5
	I5	112	6
	I6	77	4
Total		**609**	**33**

Section 4.0 presents the results of the Ra-226 soil confirmation samples and provides an evaluation of the existing gamma/Ra-226 correlation model. **Note: After further analysis it was determined that the soil correlation provided in Equation 2 underestimated the Ra-226 soil concentrations from gamma exposure rate measurements. Equation 3, presented in Section 4.0, was developed to better estimate the post-reclamation Ra-226 soil concentrations from the gamma radiation survey data.** Further statistical analysis of the Ra-226 soil concentrations across the survey area Bluff I is provided in Section 6.0. The following section presents an analysis of the regression models for both in situ XRF and gamma radiation surveys.

4.0 EVALUATION OF REGRESSION MODELS

4.1 EVALUATION OF XRF REGRESSION MODEL

The regression model presented in Equation 1 is the primary method for determination of arsenic levels across all of the survey areas and must be validated to ensure the relationship previously established between in situ XRF and laboratory reported arsenic concentrations is still valid. Section 3.2.2.1 of Appendix C of the VSP provides guidance for the evaluation of the existing regression model to provide definitive-level measurement. Once the arsenic laboratory reported concentrations were made available, the in situ XRF measurement and the laboratory arsenic concentrations were plotted on the existing regression model with 95 percent prediction limits, shown as red and blue lines on Figure 18. The project QC criteria specifies that 95 percent of the data must fall within these limits. Table 15 through Table 17 provide the laboratory reported arsenic concentrations for all 57 primary arsenic soil confirmation samples along with the corresponding in situ XRF arsenic measurement. These data pairs are plotted on the existing regression model as described in Appendix C of the VSP.

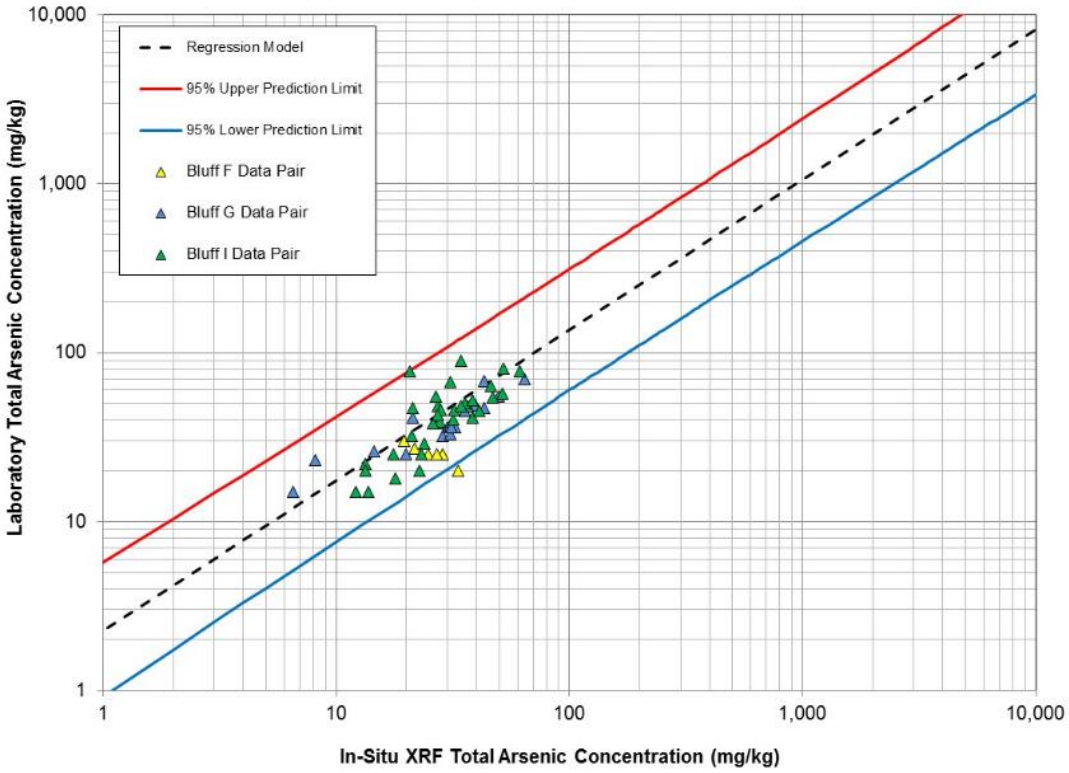


Figure 18 Regression Evaluation of In Situ XRF and Laboratory Soil Confirmation Samples (Arsenic)

Out of the 57 data pairs, 56 of the data pairs fell within the acceptable limits, at a frequency of 98.2 percent. This frequency exceeds the 95 percent criterion; therefore, the existing regression model (Equation 1) can be used to predict the arsenic concentrations using the XRF field surveys as described earlier in this report. **No further changes to the existing regression for estimation of arsenic soil concentrations are recommended.**

Table 15 Summary of Soil Confirmation Reported Laboratory Arsenic Concentrations at Bluff F

Field Soil Sample ID	Grid Overlay Position	XRF Reported Arsenic Concentration (mg/kg)	Lab Reported Arsenic Concentration (mg/kg)	RL (mg/kg)
AS-F64-01	F64	24.76	25	0.22
AS-F21-01	F21	21.73	27	0.19
AS-F27-01	F27	28.5	25	0.21
AS-F103-01	F103	19.58	30	0.22
AS-F44-01	F44	33.42	20	0.22
AS-F71-01	F71	27.13	25	0.21
AS-G104-01	F104	14.45	26	0.21

mg/kg = Milligram per kilogram
RL = Reporting limit

Table 16 Summary of Soil Confirmation Reported Laboratory Arsenic Concentrations at Bluff G

Field Soil Sample ID	Grid Overlay Position	XRF Reported Arsenic Concentration (mg/kg)	Lab Reported Arsenic (mg/kg)	RL (mg/kg)
AS-G5-01	G5	27.3	38	0.20
AS-G25-01	G25	29.9	36	0.19
AS-G50-01	G50	28.5	32	0.20
AS-G73-01	G73	32.3	36	0.21
AS-G77-01	G77	30.9	33	0.20
AS-G90-01	G90	30.9	37	0.19
AS-G94-01	G94	31.1	36	0.20
AS-G104-01	G104	14.5	26	0.21
AS-G126-01	G126	43.1	47	0.19
AS-G163-01	G163	21.4	41	0.22
AS-G184-01	G184	6.54	15	0.22
AS-G190-01	G190	64.4	70	0.21
AS-G226-01	G226	8.15	23	0.22
AS-G247-01	G247	19.9	25	0.19
AS-G253-01	G253	43.0	68	0.22
AS-G305-01	G305	39.7	49	0.21
AS-G307-01	G307	49.6	55	0.22
AS-G314-01	G314	35.7	45	0.20

mg/kg = Milligram per kilogram
RL = Reporting limit

Table 17 Summary of Soil Confirmation Reported Laboratory Arsenic Concentrations at Bluff I

Field Soil Sample ID	Grid Overlay Position	XRF Reported Arsenic Concentration (mg/kg)	XRF Precision (ppm)	Lab Reported Arsenic Concentration (mg/kg)	RL[2] (mg/kg)
AS-I27-01	I27	38.5	2.9	41	0.23
AS-I41-01	I41	23.9	2.8	29	0.22
AS-I113-01	I113	36.8	2.9	48	0.20
AS-I114-01	I114	31.7	2.9	40	0.19
AS-I123-01	I123	21.2	2.8	32	0.22
AS-I129-01	I129	27.2	2.6	48	0.22
AS-I149-01	I149	46.0	3.1	64	0.22
AS-I153-01	I153	27.9	2.7	39	0.20
AS-I195-01	I195	28.1	3.2	46	0.21
AS-I196-01	I196	32.0	2.7	46	0.22
AS-I205-01	I205	26.9	2.7	55	0.20
AS-I251-01	I251	12.1	2.2	15	0.19
AS-I267-01	I267	26.1	2.5	38	0.21
AS-I280-01	I280	47.1	3.4	54	0.20
AS-I286-01	I286	35.5	3.0	50	0.22
AS-I302-01	I302	21.4	2.7	47	0.21
AS-I318-01	I318	38.5	2.9	52	0.21
AS-I325-01	I325	27.4	2.8	43	0.22
AS-I329-01	I329	22.8	2.4	20	0.22
AS-I332-01	I332	17.9	2.3	18	0.23
AS-I355-01	I355	34.3	3.1	48	0.20
AS-I378-01	I378	61.6	4.0	77	0.21
AS-I388-01	I388	34.2	2.7	89	0.24
AS-I415-01	I415	13.7	2.2	15	0.19
AS-I463-01	I463	51.5	3.0	57	0.18
AS-I471-01	I471	31.0	2.8	67	0.22
AS-I477-01	I477	13.4	2.1	22	0.24
AS-I491-01	I491	20.8	2.4	77	0.22
AS-I496-01	I496	17.6	2.6	25	0.21
AS-I552-01	I552	52.3	3.4	81	0.24
AS-I555-01	I555	13.4	2.6	20	0.21
AS-I559-01	I559	23.2	2.7	25	0.20
AS-I590-01	I590	41.2	2.9	45	0.21

mg/kg = Milligram per kilogram
RL = Reporting limit

4.2 Evaluation of Gamma/Ra-226 Regression Model

The regression model presented in Equation 2 is the primary method for determination of Ra-226 levels across all of the survey areas and must be validated to ensure the relationship previously established between gamma exposure rates and laboratory reported Ra-226 concentration is still valid. Section 3.2.2.2 of Appendix C of the VSP provides guidance for the evaluation of the existing regression model to provide definitive-level measurement. Appendix C of the VSP specifies that the regression model between gamma/Ra-226 be evaluated using the Ra-226 soil confirmation samples and the gamma plots that were conducted during the 2016 verification sampling. The Ra-226 laboratory reported concentrations and gamma exposure rates shown on Table 18 through Table 20 are plotted on the existing regression model (Equation 2) with 95 percent upper and lower prediction limits, shown as red and blue lines on Figure 19. The project QC criteria specifies that 95 percent of the data must fall within these limits.

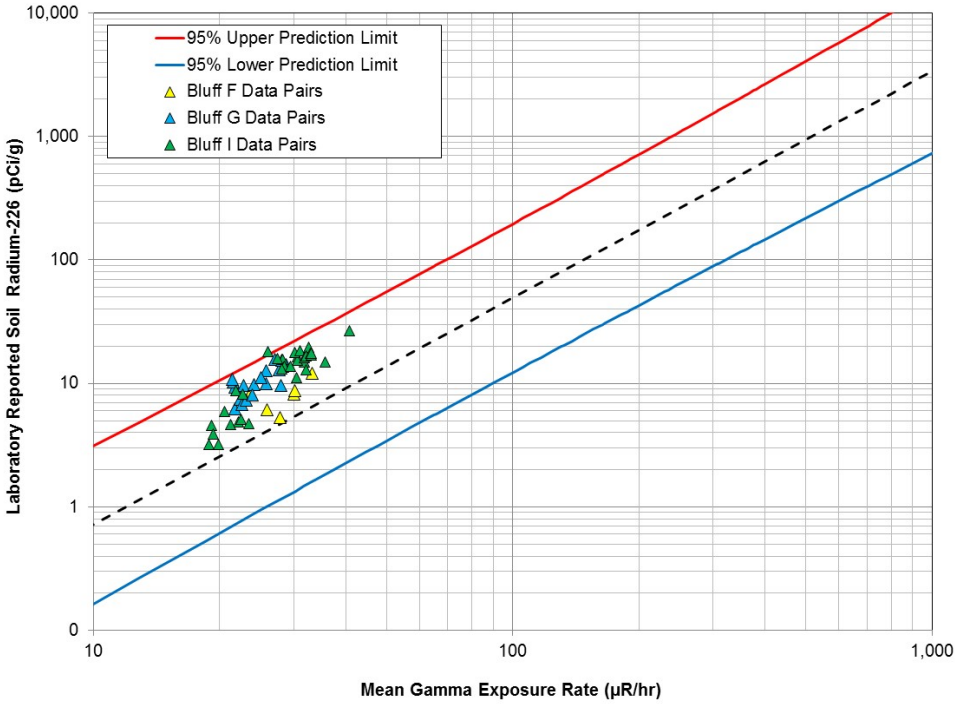


Figure 19 Regression Evaluation of Gamma/Ra-226 Model (Ra-226)

Out of the 57 data pairs, 56 of the data pairs fell within the acceptable limits, at a frequency of 98.2 percent. This frequency exceeds the 95 percent criterion; therefore, the existing regression model can technically be used to predict the Ra-226 concentrations using the gamma radiation surveys as described earlier in this report. **However, Tetra Tech determined the current model being used under predicts the Ra-226 concentrations for the observed laboratory reported values of Ra-226 and gamma exposure rates observed in the post-reclamation in soil conditions.** This was determined by comparing the predicted Ra-226 soil concentrations from the gamma exposure rates using Equation 2. In general, using Equation 2, the Ra-226 soil concentrations were lower compared to the observed laboratory reported concentrations for the corresponding gamma exposure rates. There are a number of factors that can be attributed to this and further analysis was warranted.

Tetra Tech determined it was necessary to evaluate only the 2016 verification data because (1) there were a large number of data pairs available for comparative analysis; (2) the soil samples and gamma exposure rates collected during the 2016 verification gamma radiation surveys were collected on reclaimed surfaces that were covered with a uniform soil type; (3) a new model was needed to more accurately represent (e.g. reduction of error between predicted and observed Ra-226 soil concentrations) the Ra-226 soil concentrations by taking into account the soil cover that was used for reclamation purposes.

The correlation presented in Equation 2 was used to characterize the spatial extent of Ra-226 concentrations in waste material across the bluffs by converting the gamma exposure rates collected in the characterization studies (Tetra Tech 2013) and was used for removal action design purposes. In general, the regression model presented in Equation 2 represents the radiological characteristics of mine waste material very well based on verification sampling from previous years. However, the soil cover used for the 2016 reclamation events has different radiological characteristics (e.g. uranium, thorium, potassium radionuclide makeup) than the mine waste that was evaluated to develop Equation 2.

For the purposes of developing a more accurate model for prediction of Ra-226 soil concentrations of the 2016 post-reclamation conditions, Tetra Tech solely evaluated the 2016 verification data. The 2016 verification included data pairs consisting of: (1) Ra-226 soil samples collected in 100 m^2 plots; (2) gamma exposure rate measurements collected in the same 100 m^2 plots. A regression analysis was performed on the data pairs. The regression model for these data pairs is shown in Figure 20. Equation 3, provided below, was developed as an optimal solution for predicting the 2016 post-reclamation Ra-226 soil concentrations using gamma exposure rates. Using the same approach as described above for Equation 2, Equation 3 was used to predict Ra-226 soil concentrations from the gamma exposure rates collected during the 2016 verification sampling events. The predicted Ra-226 soil concentrations were compared to the observed laboratory reported Ra-226 soil concentrations; this analysis showed a reduction in percent difference between predicted versus observed Ra-226 soil concentrations. Therefore, Equation 3 was selected as the model to predict Ra-226 soil concentrations and was used for the statistical analysis presented in Section 6.1. Equation 3 is the optimal model for prediction of Ra-226 soil concentrations for the 2016 verification sampling, and is presented as follows:

Equation 3 $$\text{Lab Ra} - 226 = -11.94 + .8699\left(Mean\ Gamma\ Exposure\ [\frac{\mu R}{hr}]\right)$$

Where:

Lab Ra-226 = laboratory equivalent soil radium-226 concentration (pCi/g).

Mean Gamma Exposure = gamma exposure rate measurement (µR/hr)

A cutoff value of 76.5 µR/hr corresponds to a Ra-226 soil concentration of 30 pCi/g using Equation 2. The cutoff value of 48.2 µR/hr corresponds to a Ra-226 soil concentration of 30 pCi/g using Equation 3. Equation 2 is used for prediction and characterization of Ra-226 soil concentrations for mine waste and Equation 3 is used for prediction of Ra-226 soil concentrations for the post-reclamation conditions.

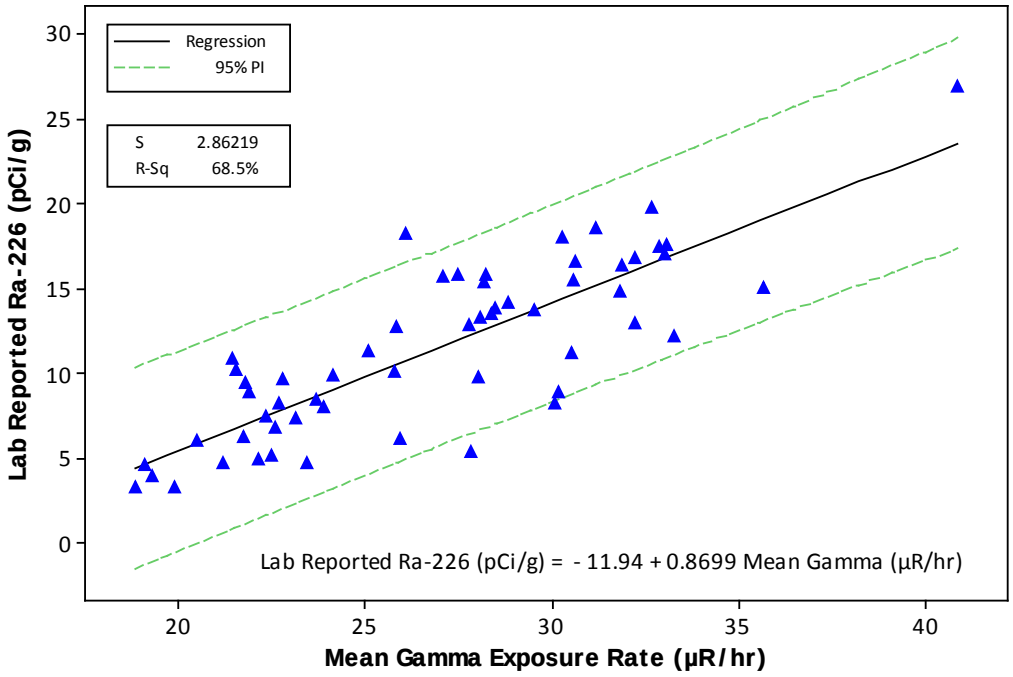


Figure 20 Regression Model of Gamma/Ra-226 (2016 Data Only)

Equation 3 and the model shown in Figure 20 shows there is a statistically significant relationship between Ra-226 and mean gamma exposure rate (p-value < 0.05). A p-value less than 0.05 is a metric used for determining if a regression model is statistically significant and the rejection of the null hypothesis is warranted. The Pearson's correlation coefficient (r) is a statistic for measuring the linear interdependence between two variables. A positive correlation (r = 0.83) indicates that when gamma increases so does the Ra-226 concentration in soil.

Developing a correlation between soil radionuclide concentrations and gamma exposure rates requires careful attention to sample and gamma data collection (Meyer, Shields, and Green 2005). Results of such a correlation analysis can vary significantly from site to site. Variances of soil correlations can be attributed to primordial radionuclide concentrations such as potassium-40 (K-40), thorium-232 (Th-232), and uranium-238 (U-238) gamma emitting decay progeny. There was a clear difference between the soil correlation analysis conducted on the 2016 data and the 2009/2012 data sets. One key consideration is that the soil borrow material radionuclide makeup has not been characterized in detail (i.e. laboratory analysis of gamma emitting radionuclides); therefore, it is difficult to determine what the primary cause is for the differences in the soil regression models. In general, the regression model presented in Equation 2 represents the mine waste material very well. The previous soil correlation studies conducted in 2009 and 2012 involved sampling mine waste areas at a number of different bluffs within the Riley Pass uranium mine complex. The correlation samples were only collected on bluffs that had been mined and not within the region where the soil borrow material was excavated. MARSSIM (NRC 2000) does not require the same regression model be used for characterization as is used for final status survey (e.g. verification sampling). **Equation 3 may be used in future verification work where the same soil cover material is used; however, Equation 2 is still useful for prediction of Ra-226 soil concentrations within non-reclaimed study areas where mine waste materials are still present.**

For the purposes of evaluating the Ra-226 soil concentrations based on the data collected in the gamma radiation survey, Tetra Tech utilized Equation 3 to convert gamma exposure rate measurements into individual Ra-226 soil concentrations across all of the survey units. A geospatial approach was then applied to estimate grid-averaged Ra-226 soil concentrations that can be evaluated according to the statistical tests outlined in the VSP. Section 6.1 provides Ra-226 soil concentration maps using Equation 3.

Table 18 Summary of Soil Confirmation Reported Laboratory Ra-226 Concentrations at Bluff F

Field Soil Sample ID	Grid Overlay Position	Mean Gamma Exposure Rate (µR/hr)	Standard Deviation of Gamma Exposure Rate (µR/hr)	Lab Reported Ra-226 (pCi/g)	Precision +/- (pCi/g)	MDC (pCi/g)
RA-F21-01	F21	30.2	4.05	8.8	1.2	0.7
RA-F27-01	F27	30.1	2.70	8.2	1.1	0.7
RA-F44-01	F44	27.8	3.62	5.31	0.75	0.52
RA-F64-01	F64	25.9	2.08	6.11	0.84	0.57
RA-F71-01	F71	23.7	1.43	8.4	1.1	0.7
RA-F103-01	F103	33.3	4.77	12.1	1.6	0.7

µR/hr = Microroentgen per hour
MDC = Minimum detectable concentration
pCi/g = Picocuries per gram

Table 19 Summary of Soil Confirmation Reported Laboratory Ra-226 Concentrations at Bluff G

Field Soil Sample ID	Grid Overlay Position	Mean Gamma Exposure Rate (µR/hr)	Standard Deviation of Gamma Exposure Rate (µR/hr)	Lab Reported Ra-226 (pCi/g)	Precision +/- (pCi/g)	MDC (pCi/g)
RA-G5-01	G5	25.8	1.13	12.7	1.6	0.6
RA-G25-01	G25	27.1	1.28	15.6	1.9	0.6
RA-G50-01	G50	22.8	1.20	9.6	1.3	0.8
RA-G73-01	G73	27.8	0.91	12.8	1.6	0.7
RA-G77-01	G77	21.4	2.27	10.8	1.4	0.6
RA-G90-01	G90	28.8	1.14	14.1	1.8	0.9
RA-G94-01	G94	28.2	2.66	15.3	2	0.9
RA-G104-01	G104	21.8	1.00	9.4	1.2	0.6
RA-G126-01	G126	21.5	1.99	10.2	1.3	0.6
RA-G163-01	G163	22.4	1.07	7.4	1	0.8
RA-G184-01	G184	21.7	0.99	6.24	0.95	0.83
RA-G190-01	G190	25.1	2.28	11.2	1.4	0.6
RA-G226-01	G226	23.2	1.77	7.3	1.1	0.9
RA-G247-01	G247	22.6	1.17	6.71	0.95	0.75
RA-G253-01	G253	25.8	1.76	10	1.3	0.6
RA-G305-01	G305	24.1	1.31	9.8	1.3	0.8
RA-G307-01	G307	28.0	2.36	9.7	1.3	0.6
RA-G314-01	G314	23.9	2.29	8	1	0.5

µR/hr = Microroentgen per hour
MDC = Minimum detectable concentration
pCi/g = Picocuries per gram

Table 20 Summary of Soil Confirmation Reported Laboratory Ra-226 Concentrations at Bluff I

Field Soil Sample ID	Grid Overlay Position	Mean Gamma Exposure Rate (µR/hr)	Standard Deviation of Gamma Exposure Rate (µR/hr)	Lab Reported Ra-226 (pCi/g)	Precision +/- (pCi/g)	MDC (pCi/g)
RA-I27-01	I27	33.0	3.34	17	2.1	0.7
RA-I41-01	I41	30.5	1.61	11.1	1.4	0.6
RA-I113-01	I113	31.8	1.87	16.3	2.1	0.9
RA-I114-01	I114	30.6	1.49	15.4	1.9	0.7
RA-I123-01	I123	28.5	1.48	13.8	1.8	0.7
RA-I129-01	I129	32.2	2.05	16.7	2.1	0.7
RA-I149-01	I149	29.5	1.98	13.7	1.8	0.7
RA-I153-01	I153	32.2	2.05	12.9	1.7	0.7
RA-I195-01	I195	31.8	1.19	14.8	1.9	0.7
RA-I196-01	I196	35.6	3.94	15	1.9	0.8
RA-I205-01	I205	28.4	1.45	13.5	1.8	0.7
RA-I251-01	I251	19.9	1.58	3.22	0.54	0.68
RA-I267-01	I267	21.9	1.18	8.8	1.2	0.7
RA-I280-01	I280	32.6	1.81	19.7	2.5	0.9
RA-I296-01	I296	28.2	0.99	15.7	1.9	0.6
RA-I302-01	I302	31.2	1.74	18.5	2.3	0.7
RA-I318-01	I318	30.3	1.51	17.9	2.2	0.7
RA-I325-01	I325	27.5	1.35	15.8	2	0.6
RA-I329-01	I329	18.8	1.26	3.2	0.51	0.41
RA-I332-01	I332	19.1	1.20	4.59	0.68	0.49
RA-I355-01	I355	32.8	2.54	17.4	2.2	0.9
RA-I378-01	I378	40.9	3.90	26.8	3.3	0.9
RA-I388-01	I388	33.1	4.80	17.5	2.2	0.7
RA-I415-01	I415	19.3	1.42	3.89	0.59	0.5
RA-I463-01	I463	30.6	1.46	16.5	2.1	0.8
RA-I471-01	I471	22.5	2.54	5.11	0.74	0.59
RA-I477-01	I477	23.4	3.38	4.7	0.71	0.63
RA-I491-01	I491	21.2	4.76	4.64	0.69	0.54
RA-I496-01	I496	22.2	1.25	4.87	0.68	0.45
RA-I552-01	I552	28.1	2.49	13.2	1.7	0.8
RA-I555-01	I555	20.5	1.09	5.93	0.81	0.49
RA-I559-01	I559	22.7	2.51	8.2	1.1	0.6
RA-I590-01	I590	26.1	1.52	18.2	2.3	0.6

µR/hr = Microroentgen per hour
MDC = Minimum detectable concentration
pCi/g = Picocuries per gram

5.0 STATISICAL EVALUATION OF ARSENIC DATA

5.1 STATISTICAL EVALUATION OF IN SITU MEASUREMENTS (ARSENIC)

In situ XRF surveys have been shown to be an effective tool to measure concentrations of arsenic at a definitive level at the Riley Pass site. Section 4.1 provides the results of the evaluation of the existing regression model (Equation 1) used to convert in situ XRF arsenic measurements into definitive level arsenic soil concentrations that can be evaluated to determine if cleanup standards are attained for each survey unit. The VSP specifies a number of steps (Figure 3 and Figure 4 of the VSP) to be used to evaluate if arsenic soil cleanup criteria has been achieved. This subsection presents the two metrics used for determining if the soil cleanup criteria for arsenic was achieved for the in situ XRF field survey: (1) sample size determination for number of in situ XRF arsenic measurements; (2) evaluation of arsenic data from the in situ XRF surveys collected within the survey units.

5.1.1 Sample Size Determination

The VSP specifies a 1 in 20 sampling frequency be followed for collection of arsenic soil confirmation samples per in situ XRF measurement that is collected. However, a further check is required to evaluate whether the total number of in situ measurements is statistically adequate for estimation of the mean for each survey unit. After the verification sampling was completed, a statistical evaluation of the median and standard deviation of the estimated arsenic concentrations within each survey unit was conducted as presented in Section 3.0 for each study area. The statistical software package ProUCL was used to evaluate the sample size requirements for the single sample Sign test with a Type I and Type II error rates of 95 percent (false rejection rate of 5 percent). The width of the gray region is calculated by subtracting the median of the collected data from the arsenic cleanup criterion (142 mg/kg). This evaluation used the highest median from all of the survey units within each survey areas for conservative purposes. The other necessary parameter was the standard deviation of the arsenic data. Similarly, the highest standard deviation from all of the survey units within each survey areas was used for conservative purposes. Table 21 provides the ProUCL statistical results including input and output parameters for the sample size determination for in situ XRF measurements within each survey unit across all of the survey areas and a comparison of actual number of samples collected.

Table 21 Sample Size Determination Result Table for XRF Samples for Single Sample Sign Test

Survey Area	Survey Unit	Estimation of Population Standard Deviation (SD)	Width of Grey Region (Δ)	Required Number of Samples (n)	Number of Samples Collected
Bluff F	F1	14.7	109	13	111
Bluff G	G1	27.9	91.4	14	110
	G2			14	118
	G3			14	108
Bluff I	I1	23.0	82.8	14	104
	I2			14	125
	I3			14	91
	I4			14	100
	I5			14	112
	I6			14	77

Based on the analysis described above, a sufficient number of in situ XRF measurements were collected to adequately estimate the mean to evaluate the attainment of cleanup standards for arsenic soil concentrations within each survey unit, described in the following subsection. The ProUCL output is provided in Appendix F.

5.1.2 Sign Test for In situ XRF Arsenic Measurements

The one sample Sign test for uncensored full data sets without nondetects using ProUCL was the primary statistical test used to evaluate the laboratory estimated soil arsenic concentrations. The in situ XRF arsenic measurements were converted into an equivalent total arsenic concentrations using regression model (Equation 1). These data sets were input into the statistical software ProUCL and run through the Sign test. The result of the test at a 95 percent significant level determines if the median of the data set is lower than the action level (soil cleanup criteria). The Sign test was run for all of the survey units within each survey area, unless there were no arsenic measurements exceeding the arsenic cutoff level. Table 22 provides the results of the Sign test results and conclusions.

Table 22 Single Sample Hypothesis Sign Test ProUCL Output for In situ Arsenic Measurements

Survey Area	Survey Unit	No. of Valid Observations	No. Above Action Level	Median (mg/kg)	Sign Test Result
Bluff F	F1	111	0	33.0	**No Grids Exceed Action Level**
Bluff G	G1	110	0	33.8	**No Grids Exceed Action Level**
	G2	118	1	46.6	**Conclude Median < Action Level**
	G3	108	1	50.6	**Conclude Median < Action Level**
Bluff I	I1	104	0	46.2	**No Grids Exceed Action Level**
	I2	125	0	30.4	**No Grids Exceed Action Level**
	I3	91	0	59.2	**No Grids Exceed Action Level**
	I4	100	0	46.4	**No Grids Exceed Action Level**
	I5	112	0	49.5	**No Grids Exceed Action Level**
	I6	77	0	35.8	**No Grids Exceed Action Level**

All of the converted arsenic soil concentrations fell below the action level except one sample within G2 and one sample within G3. These two samples were located on an area of cliff with exposed bedrock where soil cover placement was not possible. **Following the statistical procedures in the VSP all of the median arsenic concentrations were below the action level and met the criteria for attainment of cleanup standards well below the risk based cleanup level of 142 mg/kg.** The ProUCL output results are provided in Appendix F.

5.2 Statistical Evaluation of Soil Sample Results (Arsenic)

In addition to collection of in situ XRF survey arsenic measurements within each survey unit, soil confirmation samples were also collected across the entire survey area as part of the cleanup verification survey process (Section 6.2 of the VSP). The evaluation of the mean 95 percent upper confidence limit (UCL) of the arsenic soil confirmation sample results is the final check to verify that cleanup objectives have been attained at each survey area. This subsection presents the two metrics used for determining if the soil cleanup criteria for arsenic was achieved for the soil confirmation sampling: (1) sample size determination for number of arsenic soil samples; (2) evaluation of the mean 95 percent UCL of arsenic soil confirmation data collected across each the survey area.

5.2.1 Sample Size Determination of Arsenic Soil Confirmation Samples

The number of soil samples required to statistically estimate the mean arsenic concentration of the entire survey area using the simple random sampling scheme proposed in the VSP was determined using ProUCL. The approximate minimum number of soil samples was calculated from the confidence coefficient, the allowable error margin, and the estimate of the standard deviation from the laboratory results. The results of the laboratory arsenic sampling are provided in Table 15 through Table 17. The minimum sample size required computations from ProUCL is provided in Table 23. A comparison was done to determine if enough samples were collected to achieve the DQOs. For all survey areas, the number of arsenic confirmation soil samples collected met the minimum number of samples required; therefore, the DQOs for sample size determination of confirmation arsenic samples was achieved for all survey areas.

Table 23 Summary of ProUCL Output for Arsenic Soil Confirmation Sample Size for Mean Estimation

Survey Area	Confidence Coefficient	Allowable Error Margin	Estimate of Standard Deviation	Approximate Minimum Sample Size for Arsenic (ProUCL)	No. of Arsenic Samples Collected
Bluff F	95%	14.2	3.26	3	6
Bluff G		14.2	14.5	6	18
Bluff I		14.2	19.2	9	33

After it was determined the appropriate number of arsenic soil confirmation samples were collected to appropriately determine the mean, it was then necessary to evaluate the 95 percent UCL of the mean arsenic concentration for each survey area.

5.2.2 Determination of 95 Percent UCL of Mean Arsenic Soil Confirmation Samples

Section 5.1 presented an analysis to evaluate if the attainment of arsenic cleanup objectives for each survey unit was achieved for arsenic. The final check involves an analysis of the mean arsenic soil concentrations across each survey area individually. There were 57 arsenic soil confirmation samples collected, which was determined to be enough to statistically justify the calculation of the 95 percent UCL for each survey area. ProUCL was used to calculate the 95 percent UCL for each survey area as shown in Table 24. The 95 percent UCL of arsenic for each area ranged between 10.1 pCi/g and 17.1 pCi/g. **The soil cleanup objectives for arsenic soil confirmation samples was attained for all of the survey areas Bluff F, Bluff G, and Bluff I.**

Table 24 Summary of ProUCL Output for Determination of 95% UCL of Arsenic

Survey Area	Confidence Coefficient	No. of Samples Collected	95% UCL of Mean Arsenic Per Survey Area	Suggested UCL to Use (ProUCL)	Action Level (mg/kg)	Determination
Bluff F	95%	6	27.6	95% Student's-t UCL	142	UCL < Action Level
Bluff G		18	45.5	95% Student's-t UCL	142	UCL < Action Level
Bluff I		33	50.4	95% Chebyshev UCL	142	UCL < Action Level

mg/kg = Milligram per kilogram

6.0 STATISICAL EVALUATION OF RADIUM-226 DATA

6.1 STATISTICAL EVALUATION OF IN SITU RESULTS (RADIUM-226)

Equation 2 was the primary tool used to characterize the mine waste, which typically had higher gamma exposure rates and corresponding radionuclide conditions. A reanalysis was performed (Section 4.2) on the 57 new correlation plots to determine a more appropriate correlation to accurately predict Ra-226 at the post-cleanup levels observed across the site. MARSSIM (NRC 2000) does not require the same correlation used for characterization be used for final status survey. A more appropriate model was selected and presented on Figure 20 and Equation 3 was developed using only the 2016 data that are used to estimate Ra-226 concentrations in soil for statistical analysis. Following the methods outlined in the VSP, the individual gamma exposure rate measurements were converted to predict Ra-226 concentrations at each measurement location across all survey units within each survey area. The VSP states that an optimal geostatistical or grid averaged approach be used to estimate an average Ra-226 concentration in soil over 100 m^2 grids. The assessment of cleanup objectives is not based on individual measurements, but rather a grid average within each survey unit using the Sign test.

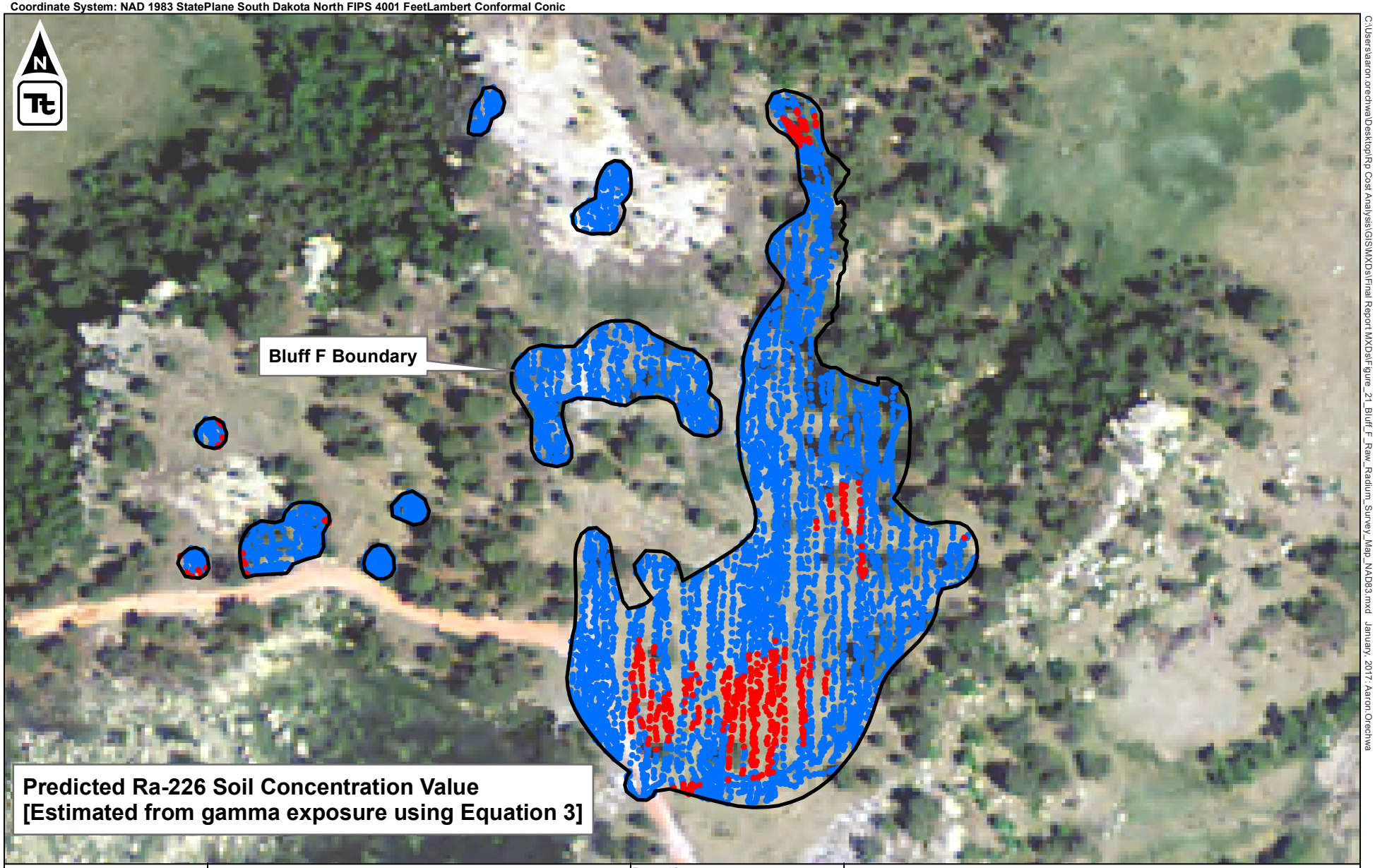
The one sample Sign test for uncensored full data sets without nondetects using ProUCL was the primary statistical test used to evaluate the laboratory estimated Ra-226 concentrations in soil. Equation 3 was used to convert each gamma exposure rate measurement into an estimate of Ra-226 concentration in soil. These data sets were input into the statistical software ProUCL and run through the Sign test. The result of the test at a 95 percent significant level determines if the median of the data set is lower than the action level (soil cleanup criteria). *Note: The Sign test was run for all of the survey units within each survey area only if any of the grid averaged measurements exceeded the action level criteria.*

Maps showing both the individual and grid averaged spatial distributions of estimated Ra-226 soil concentrations for all survey areas were developed. Figure 21 provides the individual predicted Ra-226 concentrations in soil for survey unit F1 at survey area Bluff F. Figure 22 provides the grid averaged Ra-226 concentrations in soil for survey unit F1 at survey area Bluff F. Figure 23 provides the individual predicted Ra-226 concentrations in soil for survey units G1, G2, and G3 at survey area Bluff G. Figure 24 provides the grid averaged Ra-226 concentrations in soil for survey units G1, G2, and G3 at survey area Bluff G. Figure 25 provides the individual predicted Ra-226 soil concentrations for survey units I1, I2, I3, I4, I5, and I6 at survey area Bluff I. Figure 26 provides the grid averaged Ra-226 soil concentrations for survey units I1, I2, I3, I4, I5, and I6 at survey area Bluff I. Table 25 provides the results of the single sample hypothesis Sign test ProUCL output for estimated Ra-226 concentrations in soil across 100 m^2 grids of each survey unit. Survey unit F1 was the only survey unit where an elevated grid was observed; there were six grids where Ra-226 concentrations were over the cutoff level. Therefore, this survey unit was evaluated following the statistical procedures presented in the VSP. A statistical analysis was performed, as specified in Section 6.1 and Figure 3 of the VSP, to evaluate the 111 valid Ra-226 grid-averaged values within Ra-226 and ProUCL was used to verify the median (13.7 pCi/g) was less than the Ra-226 soil criteria (30 pCi/g). Based on this analysis, it was determined survey unit F1 met the soil Ra-226 cleanup objectives established in the VSP. All other survey units also met the soil Ra-226 cleanup objectives because no grids exceeded the cleanup level. **All survey units at survey areas Bluff F, Bluff G, and Bluff I met the objectives of soil cleanup for Ra-226 based on the gamma radiation survey requirements in the VSP.**

Table 25 Single Sample Hypothesis Sign Test ProUCL Output for Grid Averaged Radium-226 Measurements

Survey Area	Survey Unit	No. of Valid Observations	No. Above Action Level	Median	Sign Test Result
Bluff F	F1	111	**9**	13.7	**Conclude Median < Action Level**
Bluff G	G1	110	0	-	**No Grids Exceed Action Level**
	G2	118	0	-	**No Grids Exceed Action Level**
	G3	110	0	-	**No Grids Exceed Action Level**
Bluff I	I1	105	0	-	**No Grids Exceed Action Level**
	I2	125	0	-	**No Grids Exceed Action Level**
	I3	90	0	-	**No Grids Exceed Action Level**
	I4	100	0	-	**No Grids Exceed Action Level**
	I5	112	0	-	**No Grids Exceed Action Level**
	I6	77	0	-	**No Grids Exceed Action Level**

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechtwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_21_Bluff_F_Raw_Radium_Survey_Map_NAD83.mxd January, 2017 Aaron.Orechtwa

FEET
0 50 100

Radium-226 Concentration (pCi/g)

< 30 ≥ 30

Prepared for:

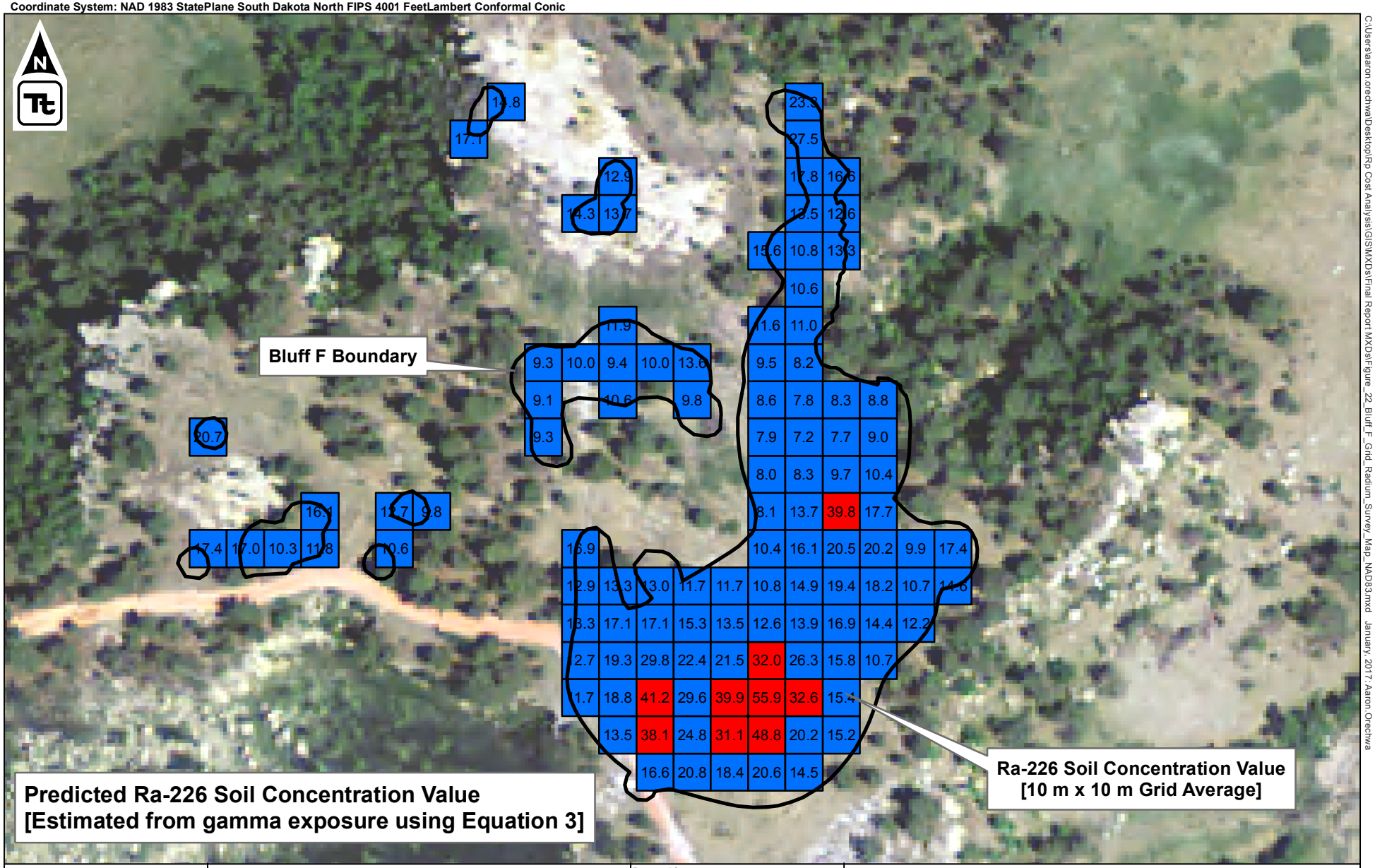
Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F VERIFICATION SAMPLING RADIUM-226 LEVELS

Project:	Project no.:	
RILEY PASS	114-560543	**Figure 21**
Location: HARDING COUNTY, SD	Date: 1/2017	

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



Prepared for:

Prepared By:

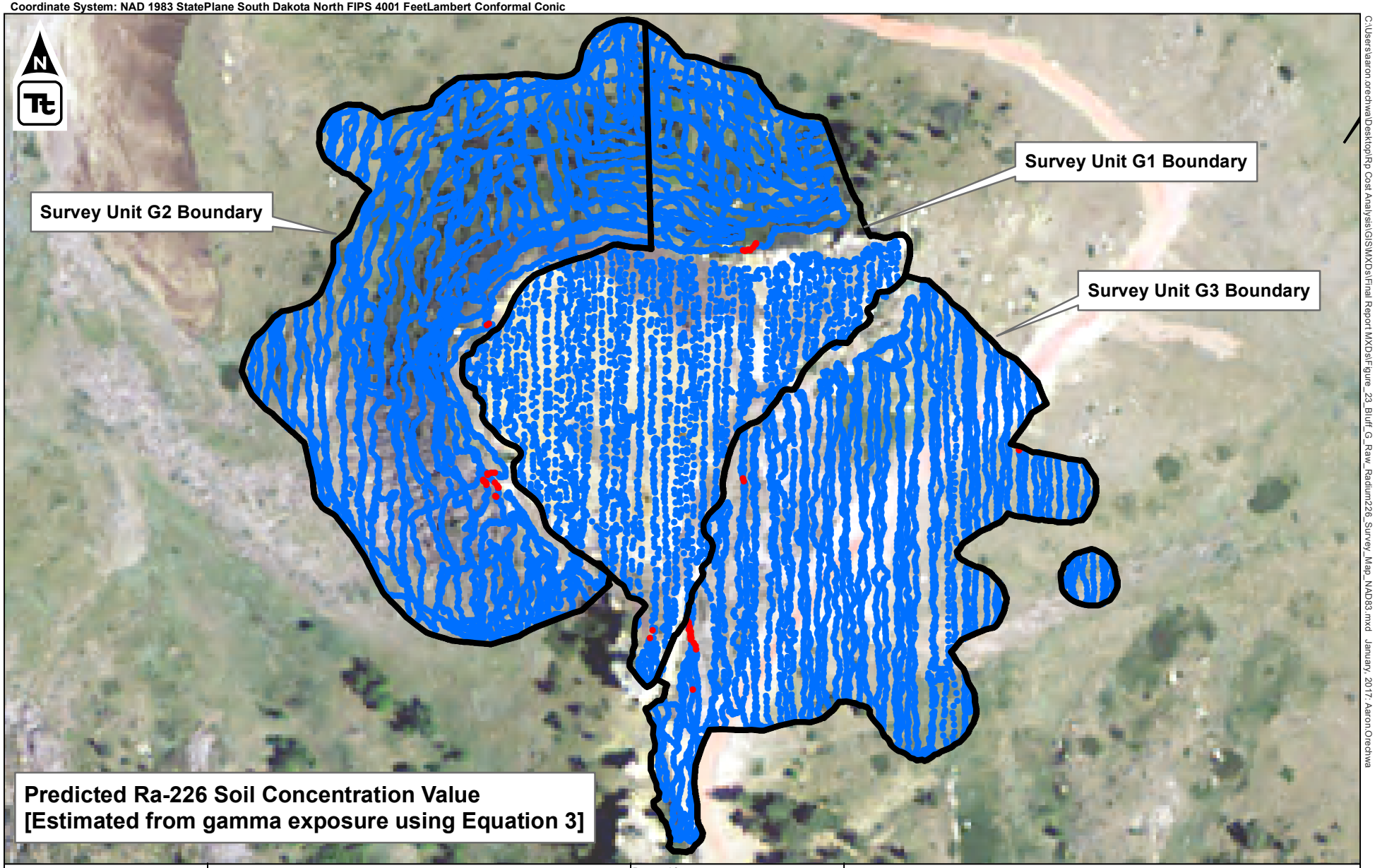
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F VERIFICATION SAMPLING
GRID AVERAGE RADIUM-226 LEVELS

Project:	Project no.:	
RILEY PASS	114-560543	Figure 22
Location: HARDING COUNTY, SD	Date: 1/2017	

C:\Users\aaron.orechwa\Desktop\RpCostAnalysis\GIS\MXDs\Final Report MXDs\Figure_22_Bluff_F_Grid_Radium_Survey_Map_NAD83.mxd January 2017 Aaron Orechwa

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_23_Bluff_G_Raw_Radium226_Survey_Map_NAD83.mxd January, 2017 Aaron Orechwa

FEET
0 50 100

Radium-226 Concentration (pCi/g)

< 30 ≥ 30

Prepared for:

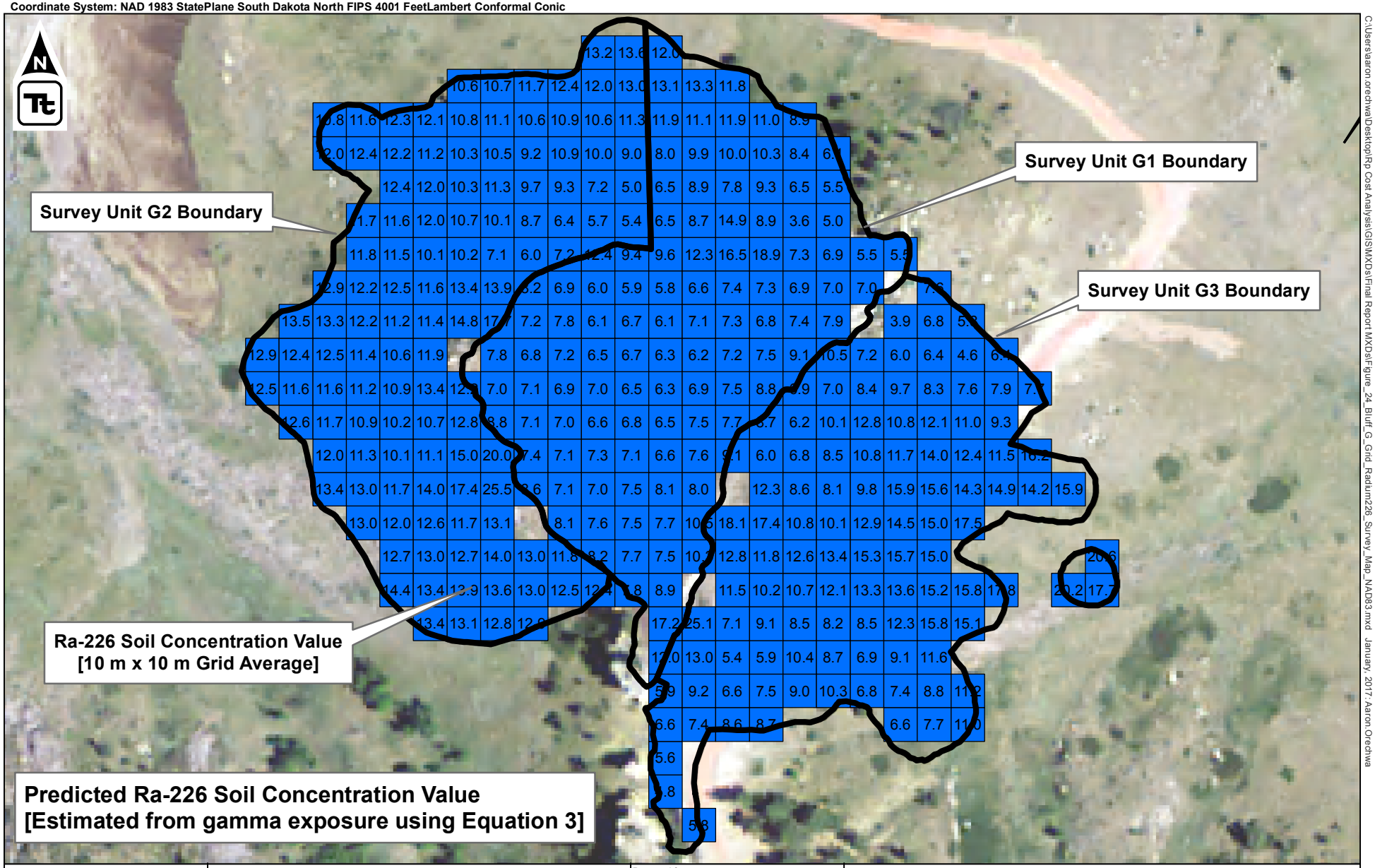
Prepared By:

TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF G VERIFICATION SAMPLING RADIUM-226 LEVELS

Project: RILEY PASS		Project no.: 114-560543	**Figure 23**
Location: HARDING COUNTY, SD		Date: 1/2017	

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 50 100

Radium-226 Concentration (pCi/g)

< 30 ≥ 30

Prepared for:

Prepared By:

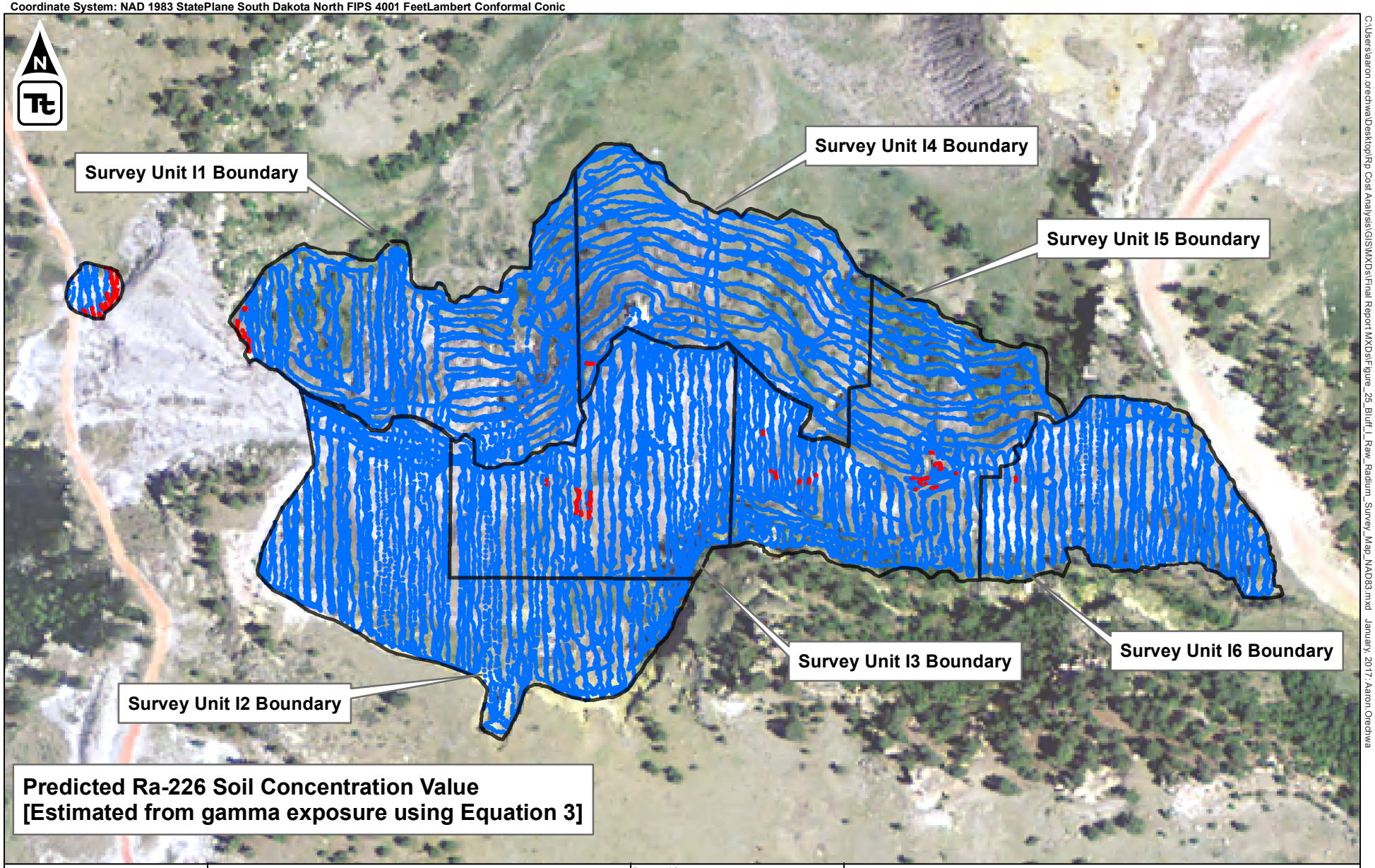
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF G VERIFICATION SAMPLING GRID AVERAGE RADIUM-226 LEVELS

Project:	RILEY PASS	Project no.:	114-560543	**Figure 24**
Location:	HARDING COUNTY, SD	Date:	1/2017	

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_24_Bluff_G_Grid_Radium226_Survey_Map_NAD83.mxd January 2017 Aaron.Orechwa

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_25_Bluff_I_Raw_Radium_Survey_Map_NAD83.mxd January 2017 Aaron Orechwa

FEET
0 125 250

Radium-226 Concentration (pCi/g)

< 30 ≥ 30

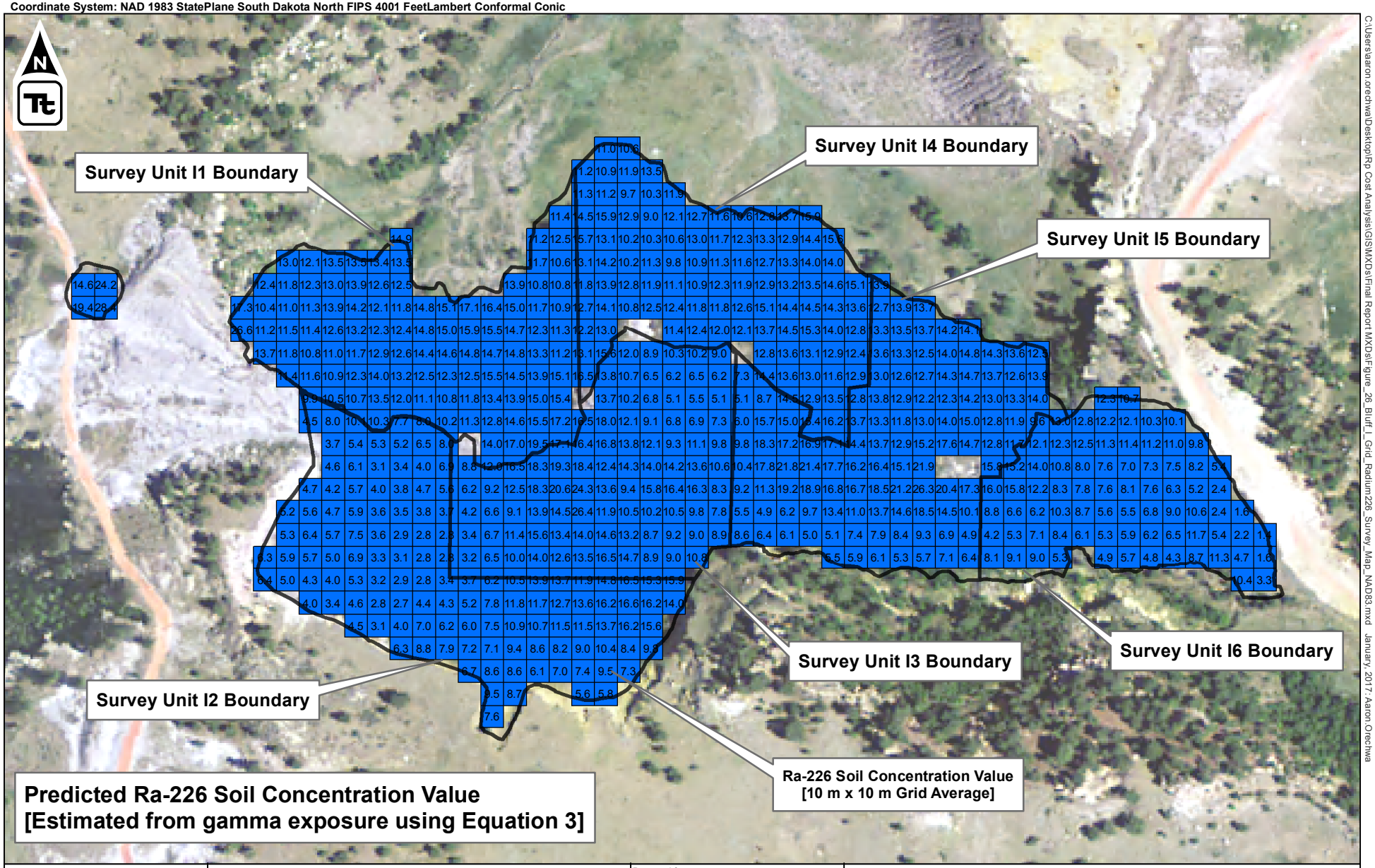
Prepared for: USDA Forest Service

Prepared By: TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF I VERIFICATION SAMPLING RADIUM-226 LEVELS

Project:	Project no.:	
RILEY PASS	114-560543	**Figure 25**
Location: HARDING COUNTY, SD	Date: 1/2017	

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



C:\Users\aaron.orechwa\Desktop\RpCostAnalysis\GIS\MXDs\Final Report MXDs\Figure_26_Bluff_I_Grid_Radium226_Survey_Map_NAD83.mxd January, 2017 Aaron.Orechwa

FEET
0 125 250

Radium-226 Concentration (pCi/g)

< 30 ≥ 30

Prepared for: USFS

Prepared By: TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF I VERIFICATION SAMPLING GRID AVERAGE RADIUM-226 LEVELS

Project:	Project no.:	
RILEY PASS	114-560543	**Figure 26**
Location: HARDING COUNTY, SD	Date: 1/2017	

6.2 STATISTICAL EVALUATION OF RA-226 SOIL SAMPLE RESULTS

In addition to collection of gamma exposure rate measurements within each survey unit, soil confirmation samples were also collected across the entire survey area as part of the cleanup verification survey process (Section 6.2 of the VSP). The evaluation of the mean 95 percent UCL of the Ra-226 soil confirmation sample results is the final check to verify that cleanup objectives have been attained at each survey area. This subsection presents the two metrics used for determining if the soil cleanup criteria for Ra-226 was achieved for the soil confirmation sampling: (1) sample size determination for number of Ra-226 soil samples; (2) evaluation of the mean 95 percent UCL of Ra-226 soil confirmation data collected across each the survey area.

6.2.1 Sample Size Determination of Ra-226 Soil Confirmation Samples

The number of soil samples required to statistically estimate the mean Ra-226 concentration of the entire survey area using the simple random sampling scheme proposed in the VSP was determined using ProUCL. The approximate minimum number of soil samples was determined from the confidence coefficient, the allowable error margin, and the estimate of the standard deviation from the laboratory results. The results of the laboratory Ra-226 soil sampling are provided in

The minimum sample size required computations from ProUCL is provided in Table 26. A comparison was done to determine if enough samples were collected to achieve the DQOs. For all survey areas, the number of Ra-226 soil confirmation samples collected met the minimum number of samples required; therefore, **the DQOs for sample size determination of Ra-226 soil confirmation samples was achieved for all survey areas.**

Table 26 Summary of ProUCL Output for Soil Sample Size Estimation of the Mean (Radium-226)

Survey Area	Confidence Coefficient	Allowable Error Margin	Estimate of Standard Deviation	Approximate Minimum Sample Size for Ra-226 (ProUCL)	No. of Ra-226 Samples Collected
Bluff F	95%	3.0	2.17	4	6
Bluff G		3.0	2.73	6	18
Bluff I		3.0	5.88	17	33

6.2.2 Determination of 95 percent UCL of Ra-226 Soil Confirmation Samples

Section 6.1 presented an analysis to evaluate the attainment of Ra-226 soil cleanup objectives for each survey unit and showed that all survey units met the cleanup requirements for Ra-226. The final check involves an analysis of the mean Ra-226 concentrations in soil across each survey area individually. There were 57 Ra-226 soil confirmation samples collected, which was determined to be enough to statistically justify the calculation of the 95 percent UCL for each survey area. ProUCL was used to calculate the 95 percent UCL for each survey area, as shown on Table 27. The 95 percent UCL of Ra-226 for each area ranged between 10.1 pCi/g to 17.1 pCi/g. **The soil cleanup objectives for Ra-226 soil confirmation samples was attained for all of the survey areas Bluff F, Bluff G, and Bluff I.**

Table 27 Summary of ProUCL Output for Determination of 95% UCL of Radium-226

Survey Area	Confidence Coefficient	No. of Samples Collected	95% UCL of Ra-226 Per Survey Area	Suggested UCL to Use (ProUCL)	Action Level (pCi/g)	Determination
Bluff F	95%	6	10.1	**95% Student's-t UCL**	30	**UCL < Action Level**
Bluff G		18	11.5	**95% Student's-t UCL**	30	**UCL < Action Level**
Bluff I		33	17.1	**95% Chebyshev UCL**	30	**UCL < Action Level**

pCi/g = Picocurie per gram

7.0 CONCLUSIONS

The purpose of this verification sampling effort at Riley Pass was to evaluate the attainment of risk based cleanup objectives of arsenic and Ra-226 at individual survey units as well as the entire survey areas reclaimed during the 2016 field season. Verification sampling was performed during different phases of the 2016 cleanup and reclamation activities at survey areas Bluff F, Bluff G, and Bluff I. A removal action and innovative landform engineering design approach was followed to adequately address known contamination established from previously conducted mine waste characterization studies at these bluffs. Some level of reclamation had been conducted at all of these survey areas in the past. The 2016 Action Memo, officially published by the USFS on April 26, 2016, meets the criteria for initiating Removal Action under 40 Code of Federal Regulations (CFR) Section 300.415 (b)(2) of the National Contingency Plan. This Action Memo considered many factors and provided risk-based cleanup levels and criteria to be followed. The VSP submitted by Tetra Tech in 2015 is the current document to be followed for the evaluation and determination of whether cleanup objectives were attained across the survey areas.

A comprehensive verification sampling strategy was performed to evaluate the post-reclamation/post-cleanup conditions of arsenic concentrations in soil within the survey areas Bluff F, Bluff G, and Bluff I. In situ XRF field surveys were performed to evaluate the post-reclamation arsenic soil concentrations within the individual survey units of survey areas Bluff F, Bluff G, and Bluff I. Statistical testing was performed in accordance with the VSP to determine if a statistically representative number of in situ XRF measurements were collected at each survey unit and to determine if the arsenic values measured met the statistical requirements required in the VSP. Additionally, arsenic soil confirmation samples were collected across each survey area at Bluff F, Bluff G, and Bluff I. Statistical tests were also conducted in accordance with the VSP to evaluate if a statistically representative number of arsenic soil confirmation samples were collected at each survey area and to determine the if the 95 percent UCL of the mean met the soil cleanup criteria for arsenic. The following table summarizes the results of these statistical procedures.

Table 28 Summary of Statistical Procedures for Arsenic Soil Cleanup Criteria

Survey Area	Survey Unit	Evaluation of Arsenic Soil Cleanup Criteria			
		In-Situ XRF Field Surveys		Arsenic Soil Confirmation Sampling	
		In-Situ Sample Size Requirement Met?	Is median arsenic level for survey unit below soil cleanup criteria?	Were minimum sample size requirements met for survey area?	Does the 95% UCL of the sample mean fall below soil cleanup criteria?
Bluff F	F1	YES	YES	YES	YES
Bluff G	G1	YES	YES	YES	YES
	G2	YES	YES		
	G3	YES	YES		
Bluff I	I1	YES	YES	YES	YES
	I2	YES	YES		
	I3	YES	YES		
	I4	YES	YES		
	I5	YES	YES		
	I6	YES	YES		

The table above summarizes the statistical tests presented in Section 5.0 for determination of attainment of soil cleanup criteria for arsenic. A total of 1,056 in situ XRF measurements and 57 arsenic soil confirmation samples were collected across the 26 acres of survey areas. The site-specific risk-based cleanup level for arsenic is 142 mg/kg as identified in the Action Memo. The evaluations from this study indicate the following: **(1)** ***The cleanup objectives for arsenic were achieved at survey unit F1 of survey area Bluff F;*** **(2)** ***The cleanup objectives for arsenic were achieved at survey units G1, G2, and G3 of survey area Bluff G3; and*** **(3)** ***The cleanup objectives for arsenic were achieved at survey units I1, I2, I3, I4, I5, and I6 of survey area Bluff I.***

A comprehensive verification sampling strategy was implemented to evaluate the post-reclamation/post-cleanup Ra-226 soil activity concentrations within the survey areas Bluff F, Bluff G, and Bluff I. Gamma radiation surveys were performed to evaluate the post-reclamation Ra-226 soil concentrations within the individual survey units of survey areas Bluff F, Bluff G, and Bluff I. Statistical testing was performed in accordance with the VSP to determine if the grid based Ra-226 values measured using Equation 3 met the statistical requirements required in the VSP. Additionally, Ra-226 soil confirmation samples were collected across each survey area at Bluff F, Bluff G, and Bluff I. Statistical tests were also conducted in accordance with the VSP to evaluate if a statistically representative number of Ra-226 soil confirmation samples were collected at each survey area and to determine the if the 95 percent UCL of the mean met the soil cleanup criteria for Ra-226. The following table summarizes the results of these statistical procedures.

Table 29 Summary of Statistical Procedures for Ra-226 Soil Cleanup Criteria

Survey Area	Survey Unit	Evaluation of Ra-226 Soil Cleanup Criteria			
		Gamma Radiation Surveys		Ra-226 Soil Confirmation Sampling	
		Sample Size Requirement Met?	Is median Ra-226 level for survey unit below soil cleanup criteria?	Were minimum sample size requirements met for survey area?	Does the 95% UCL of the sample mean fall below soil cleanup criteria?
Bluff F	F1	N/A	YES	YES	YES
Bluff G	G1	N/A	YES	YES	YES
	G2	N/A	YES		
	G3	N/A	YES		
Bluff I	I1	N/A	YES	YES	YES
	I2	N/A	YES		
	I3	N/A	YES		
	I4	N/A	YES		
	I5	N/A	YES		
	I6	N/A	YES		

N/A = Not applicable; gamma radiation surveys were conducted at 100 % density.

The table above summarizes the statistical tests presented in Section 6.0 for determination of attainment of soil cleanup criteria for Ra-226. A total of 58,759 gamma exposure rate measurements were collected across all the survey areas, and a grid analysis was performed to discretize and compute the average gamma and Ra-226 measurements within 1,058 grids each 100 m^2 in size across all the survey units within each survey area. Additionally, a total of 57 soil confirmation samples were collected across the survey areas and analyzed for Ra-226. The site-specific, risk-based cleanup level for Ra-226 is 30 pCi/g as

identified in the Action Memo. Stringent statistical procedures as recommended in MARSSIM and other guidance documents were followed to ensure that an adequate number of measurements and samples were collected, including evaluation of the existing gamma/Ra-226 correlation for determination of Ra-226. The evaluations from this study indicate the following: **(1)** ***The cleanup objectives for Ra-226 were achieved at survey unit F1 of survey area Bluff F;*** **(2)** ***The cleanup objectives for Ra-226 were achieved at survey units G1, G2, and G3 of survey area Bluff G3; and*** **(3)** ***The cleanup objectives for Ra-226 were achieved at survey units I1, I2, I3, I4, I5, and I6 of survey area Bluff I.***

Note: While attainment of cleanup objectives based on risk-based levels and statistical procedures at survey unit F1 were achieved based on the VSP; there is an isolated area (~ 0.22 acres) of residual gamma radiation levels exceeding the cutoff levels remaining on Bluff F. The USFS may decide to conduct further reclamation activities at this location in the future to reduce all gamma levels below cutoff values.

8.0 REFERENCES

Environmental Restoration Group, Inc. (ERG). 2009a. Baseline Radiological Investigation Report; Prepared for Knight Piesold, Inc. Dewey-Burdock ISR Licensing Support. January 29, 2009

ERG. 2009b. Baseline Radiological Investigation Report, Pinon Ridge Uranium Mill; Prepared for Energy Fuels Resource. Montrose County, CO. October 5, 2009.

Meyer, R., M. Shields, and S. Green. 2005. A GPS-based system for preliminary or remedial action gamma scanning. In: Proceedings of the American Nuclear Society Topical Meeting on Decommissioning, Decontamination, & Reutilization, Denver, Colorado, 7-11 August 2005. La Grange Park, IL; ANS; 2005; 131-134.

Millennium Science and Engineering (MSE). 2009. Riley Pass Uranium Mines Site X-Ray Fluorescence (XRF) and Gamma Surveys Report, USDA Forest Service, Custer National Forest (North Cave Hills), Riley Pass Uranium Mines Site (Mine Bluffs I, F, J, K, L & A), Harding County, South Dakota. MSE. 32p.

Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense Programs/Nuclear Matters. (OSD). 2012. Nuclear Weapon Accident Response Procedures (NARP) Internet Supplement. DoD3150.08 M.

Tetra Tech, Inc. (Tetra Tech). 2006. Gamma Data Map Viewer. Software. Fort Collins, Colorado.

Tetra Tech. 2010. Baseline Gamma Radiation and Soil Radium-226 Correlation Report for the Ross Proposed In-Situ Uranium Recovery Site. Fort Collins, CO. November 17, 2010.

Tetra Tech. 2013. Tronox Bluff Waste Characterization Report, Riley Pass Abandoned Uranium Mines Site North Cave Hills, Harding County, South Dakota. June 27, 2013. Tetra Tech. 187p.

Tetra Tech. 2015a. Final Waste Characterization Evaluation Report. Riley Pass Uranium Mines Site (North Cave Hills), Harding County, South Dakota. November 18, 2015.

Tetra Tech. 2015b. Final Verification Sampling Plan. Riley Pass Uranium Mines Site (North Cave Hills), Harding County, South Dakota. November 18, 2015.

U.S. Environmental Protection Agency (EPA). 1999. United States Environmental Protection Agency, Luftig SD. 1999 Dec 17. Distribution of OSWER Radiation Risk Assessment Q&A's Final Guidance [Memorandum]

EPA. 2008. XRF and Appropriate Quality Control. CLU-IN Studios Webinar. Presented by Stephen Dyment. U.S. EPA Technology Innovation Field Services Division.

U.S. Forest Service (USFS). 2006. Riley Pass Uranium Mines Site, Final Engineering Evaluation/Cost Analysis, U.S. Department of Agriculture/Forest Service Region 1, Custer National Forest, Sioux Ranger District, Harding County, South Dakota. November.

USFS. 2016. Riley Pass Uranium Mines Site Removal Action, Action Memorandum, Custer National Forest, Sioux Ranger District, Harding County, South Dakota. April.

U.S. Nuclear Regulatory Commission (NRC). 1992. Manual for Conducting Radiological Surveys in Support for License Termination. NUREG-5849. June 1992.

NRC. 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), (NUREG 1575, Revision 1). NRC. 360p.

NRC. 2004. Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP), (NUREG 1576,). EPA 402-B-04-001A. NTIS PB2004-105421. July.

APPENDIX A

DATA VALIDATION AND QC REVIEW SUMMARY

TETRA TECH

2016 Riley Pass Verification Sampling
Appendix A – Data Validation and QC Review Summary

1.0 OVERVIEW

The Riley Pass cleanup verification sampling plan [VSP] (Tetra Tech 2015) presented the results of the Data Quality Objectives (DQO) process, which identified three main field activities to be conducted at the site once the removal actions have been completed. These field activities include X-ray fluorescence (XRF) field surveys, gamma radiation surveys, and soil confirmation sampling. The data validation process for the 2016 Verification Sampling involved a review of quality assurance (QA) and quality control (QC) data related to the in situ XRF field surveys, gamma radiation surveys, and soil confirmation sampling performed at Riley Pass during the verification sampling phases conducted in 2016 to determine if project acceptance criteria was achieved in accordance with the standard operating procedures (SOPs) contained in the Verification Sampling Plan [VSP] (Tetra Tech 2015). The data validation and QA/QC review process is intended to assess the technical reliability and the degree of confidence in the reported analytical data. This appendix summarizes the QA/QC analysis results that are used in the data validation process for the 2016 Verification Sampling at Riley Pass.

2.0 DATA VALIDATION METHODS

2.1 DATA VALIDATION TESTING

An evaluation of the precision data validation testing between primary and duplicate measurements was performed. The primary data validation methods included the relative percent difference (RPD), duplicate error ratio (DER), percent difference (%D), and the relative standard deviation (RSD). The RPD was used for in situ XRF field survey QC measurements, pre-survey and post-survey gamma exposure rate measurements, and for analytical soil sampling data. The DER was used only for radium soil confirmation sampling where an individual precision was reported for the analytes. The %D was used to evaluate NIST calibration check measurements for the in situ XRF. The RSD was used only for evaluation of precision measurements of in situ XRF field survey data. The environmental media evaluated in this report included in situ XRF field survey measurements, gamma exposure rate measurements, and soil samples. The following subsections present the methods used for calculating RPD and DER which are used throughout this Appendix.

2.1.1 RPD Evaluation

The RPD equation is given by:

$$RPD(\%) = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

where:

RPD = relative percent difference, non-detects are excluded
S = concentration of primary sample
D = concentration of duplicate sample

2.1.2 DER Evaluation

The DER is calculated between duplicates for all radium samples which precision estimates were provided and the equation for DER is given by:

$$DER = \frac{|S - D|}{\sqrt{{\sigma_s}^2 + {\sigma_d}^2}}$$

where:

S = primary sample result
D = duplicate sample result measured field sample concentration;
σ_s = primary sample uncertainty
σ_d = duplicate sample uncertainty

2.1.3 Relative Standard Deviation

The RSD of the sample mean is used to assess method precision. The equation for calculating RSD is as follows:

$$RSD = \frac{\sigma}{\mu} \times 100$$

where:

RSD = relative standard deviation for the precision measurement for the analyte (arsenic)
σ = standard deviation of the concentration for the analyte (arsenic)
μ = mean concentration for the analyte (arsenic)

2.1.4 Percent Difference

The following equation will be used to evaluate the %D:

$$\%D = \frac{|C_s - C_k|}{C_k} \times 100$$

where:

%D = percent difference
C_k = known arsenic concentration
C_s = XRF determined arsenic concentration (mean of 10 measurements)

2.2 QC ACCEPTANCE LIMITS

The QC acceptance limits are based on the type of media being analyzed and are described in the following sections.

3.0 IN SITU XRF FIELD SURVEY

3.1 QUALITY ASSURANCE

The primary QA methods for the XRF include manufacturer recommended calibration and daily energy calibration checks are described in Appendix A of the VSP (Tetra Tech 2015).

3.1.1 Calibration by Manufacturer

All XRF instruments used at the project were be calibrated by the manufacturer at certified facility per manufacturer recommendations. The calibration documentation for each instrument was reviewed by Tetra Tech and was determined to have met the recommended calibration requirements as described in the VSP. The second primary QA method involved energy calibration checks throughout the field sampling phases of the project. The instrument calibration requirements used for this project in the field met the QA project acceptance criteria.

3.1.2 Energy Calibration Checks

The Niton analyzer performs an internal re-calibration before any analysis is initiated following the methods outlined in the Niton User's Manual. The analyzer calibration screen was displayed until calibration was completed. After the calibration finished, the calibration results were displayed for the engineer to view. During operations, the ambient air temperature was recorded for each measurement. If the ambient temperature changes by more than 10°F, the instrument was recalibrated. Once the calibration was been completed, the calibration results were recorded in the field logbook. A copy of the field logbook will be included in Appendix E of the final verification sampling report. All energy calibration checks conducted in the field met the QA project acceptance criteria.

3.2 QUALITY CONTROL

The primary QC methods for the XRF include the use of calibration checks, field duplicates, and precision measurements. All of these tools are critical for a good QC program for the XRF data to be used beyond a screening designation to more definitive uses, as is the case with this project. Calibration checks are performed by field engineers on a daily basis for a number of purposes (EPA 2008):

- They are used to identify whether the XRF unit is properly calibrated to measure unbiased measurements for the elements of concern in the range of concern.
- They are used over time to make sure the calibration stays constant.
- They can be used to identify and quantify potential interference effects.

Other QC methods include field duplicates and precision measurements that will be performed by field engineers in the field. The following operational and QC requirements also apply to operation of the XRF instrument and must be followed and documented in the field logbook maintained by the analyst.

3.2.1 XRF Field Duplicate

One replicate sample was collected for every 20 in situ XRF measurements collected in the field. In general, replicate samples were collected at the same locations where soil confirmation samples were be collected. The same method for measuring the primary XRF measurement was used to measure the XRF replicate measurement. The project QC acceptance criterion for XRF duplicate analysis is 50 percent RPD for this project. The method for calculating the RPD is presented in Section 2.1.1. The primary and replicate arsenic measurements were stored in the XRF and were downloaded daily and were also be recorded in the field sheets. A copy of the field logbook and field sheets are provided in the Appendix E. An analysis showing the data validation results of XRF field results is provided in Attachment A1 of this Appendix. A total of 68 XRF duplicate measurements were collected. The RPD ranged between < 1 percent to 40 percent for all XRF field duplicate samples. The frequency of XRF field duplicates collected met the frequency of samples collected and all RPD values were below the project acceptance criteria. **The project acceptance criteria for XRF field duplicates was achieved.**

3.2.2 XRF Daily Calibration Checks

Calibration checks were performed by field engineers before the XRF field survey was used in the field each day. Soil standards from NIST-certified standard reference materials (SRMs) were measured on a daily basis by field personnel and results compared with the provided arsenic reference values. A minimum of 10 measurements were recorded by field engineers prior to field use and the results were

recorded on field sheets provided in Appendix D. The SRM arsenic concentration or range of concentrations was also manually recorded on each field sheet. The project QC acceptance criterion is that the %D between the average of the XRF measurements and the reported arsenic value in the SRM should be less than 20 percent. A method for calculating the %D is provided in Section 2.1.3. All of the average XRF calibration check measurements were within the range of %D of the SRM reported values. **The project acceptance criteria for XRF daily calibration checks was achieved.**

3.2.3 Precision Measurements

A precision measurement was performed at a minimum of once per day for each XRF instrument in use, this involves measurement of one sample location a minimum of seven times in replicate. The project QC acceptance criterion for precision measurement is that the RSD must be less than 20 percent. The method for calculating the RSD is presented in Section 2.1.3. The precision measurements collected in the field were recorded by the field engineer on the field sheets provided in Appendix D. An analysis showing the data validation results of XRF precision results is provided in Attachment A2 of this Appendix. A total of 18 XRF precision measurements were collected. The RSD ranged between 2.4 percent to 17.8 percent for all XRF field precision measurements. The frequency of XRF precision measurements collected met the frequency required and all RSD values were below the project acceptance criteria. **The project acceptance criteria for XRF precision was achieved.**

4.0 GAMMA RADIATION SURVEY

Tetra Tech adhered to QA/QC protocol for gamma radiation surveys as specified in Appendix B of the VSP (Tetra Tech 2015). QA includes qualitative factors that provide confidence in the results, while QC involves quantitative, field evidence that supports the validity of results. Tetra Tech uses data quality indicators as recommended in MARRSIM (NRC 2000) and MARLAP (NRC 2006) to ensure the data being collected is reliable. This section summarizes the methods and results of the QC analyses performed for those detectors that were actually used during the survey. The QC protocol involved pre-survey and post-survey calibration checks and daily instrument calibration field checks. Before and after performing the gamma radiation survey at Riley Pass, Tetra Tech performed QC analyses for the radiation instruments that were to be used during the survey. The purpose of the QC analyses is to quantify the consistency of gamma exposure readings between detectors. The QC data measurements were recorded only for the detectors that were planned to be utilized during the survey.

One detector, identified as MFG-12 was utilized during the gamma radiation surveys for verification sampling. Detector MFG-15 was brought into the field and analyzed but only data from MFG-12 was utilized for this project. The QC analysis involved calibration checks of these instruments under a controlled indoor environment for pre-survey and post-survey calibration checks at the Tetra Tech office in Fort Collins, Colorado. The pre-survey was performed in in early 2016 and the post-survey was performed in December 2016 following the field activities. The pre-survey and post-survey calibration checks involved the collection of 1,000 background measurements and 1,000 cesium-137 (Cs-137) source checks under a controlled environment.

Additionally, field engineers performed daily QC checks during the field work at a designated are within the parking lot of the North Winds Lodge located in Bowman, North Dakota located not far from the site. The daily checks included background and field strip calibration checks. Under these circumstances, all data from any given set of properly calibrated and correctly functioning radiation instruments should follow a normal distribution.

4.1 GAMMA RADIATION SURVEY QA/QC METHODS

4.1.1 Gamma Radiation Survey Data Quality Assurance Procedures

An important QA protocol includes instrument calibration. All of the radiation detection equipment employed during the field work must have been factory calibrated within the previous 12 months. Data developed using any of the field-qualified instruments are then interchangeable, allowing instrument substitution as needed. Copies of factory calibration documentation for the three detectors used during the survey are provided in Attachment A3 of this Appendix.

4.1.2 Gamma Radiation Survey Data Quality Control Procedures

Under the QC program, factory-calibrated instruments must also meet on-site field test criteria. Calibration checks are measurements performed to verify instrument performance each time an instrument is used (NRC 2000). Tetra Tech field personnel collected quantitative measurements as part of the QC program including:

1.) *Daily field instrument calibration checks,*

2.) *Pre-survey and post-survey instrument calibration checks.*

A control chart is a graphical plot of measurement results with respect to time and helps monitor performance of the radiation detection instrumentation (NRC 2000).

Daily Field Instrument Calibration Field Check:

The instrument calibration field checks consist of collecting measurements using the scan systems from a static background area, a field strip area approximately 10 meters in length, and a Cs-137 source check performed at the same location as the static background area. These checks were performed at a pre-determined background reference area that is typically un-impacted by site activities. For this particular project, the field checks were performed within at Bowman, North Dakota. The following criteria are used to assess the daily field calibration checks:

- For normally distributed data, 99 percent of all measurements are expected to fall within ±3 standard deviations from the mean. Background, field strip, and check source standard deviation values were recalculated twice daily throughout the project. Any instrument with a QC measurement result falling outside ±3 standard deviations from the mean of all QC measurements on the field check control chart would require investigation. A detector exceeding control limits on any QC check (background or field strip) would be replaced with a pre-qualified spare detector and sent back to the manufacturer for evaluation, repair, and recalibration.
- QC measurements, including a background check, field strip check, and source check were performed twice daily during the work for each scanning system in use. These checks were performed outdoors at the same time and location. The daily field strip check provides an indication of total measurement uncertainty from turbulent movement for each mobile system being used in the field.

Pre-Survey and Post-Survey Instrument Calibration Check:

In addition to daily QC checks, pre-survey and post-survey QC instrument measurements were collected at an indoor location for each NaI(Tl) detector that would be potentially used during the gamma radiation survey. The purpose of these measurements was to quantify the consistency of readings among the detectors, under controlled conditions before (pre-survey) and after (post-survey) the field survey. A minimum of 1,000 background and Cs-137 source measurements were collected both pre-survey and post-survey for each detector under the same counting conditions. The pre-survey and post-survey QC checks were performed at the Tetra Tech office in Fort Collins, Colorado, prior to and after the field work.

4.2 PRE-SURVEY AND POST-SURVEY CALIBRATION CHECK QC RESULTS

This section summarizes the QC results for the background and Cs-137 source response measurements for the pre-survey and post-survey. The QC acceptance criteria for the pre-survey and post-survey mean background and Cs-137 source response gamma exposure rate are less than 10 percent RPD. Additionally, the distributions of the pre-survey and post-survey QC measurements must be normally distributed. Table A-1 provides the pre-survey and post-survey background QC results for detector MFG-12. Figure A-1 and Figure A-2 show the background indoor survey results as frequency histograms and normal probability plots. Table A-2 provides the pre-survey and post-survey Cs-137 source QC results for detector MFG-12. Figure A-3 and Figure A-4 show the background indoor survey results as frequency histograms and normal probability plots. **The gamma radiation survey QC data met the project acceptance criteria for pre-survey and post-survey calibration checks.**

Table A-1 Instrument MFG-12 Pre-Survey and Post-Survey Background QC Results

Survey:	Pre-Survey	Post-Survey	Relative Percent Difference
Date:	May-16	December-16	
Detector ID:	MFG-12	MFG-12	
# of Readings (µR/hr)	1,000	1,000	-
Mean (µR/hr)	16.7	16.9	1.37%
Median (µR/hr)	16.7	17.0	1.58%
Standard Deviation (µR/hr)	0.85	0.86	0.95%
95th Percentile (µR/hr)	18.1	18.3	1.25%
99th Percentile (µR/hr)	18.7	18.9	0.88%

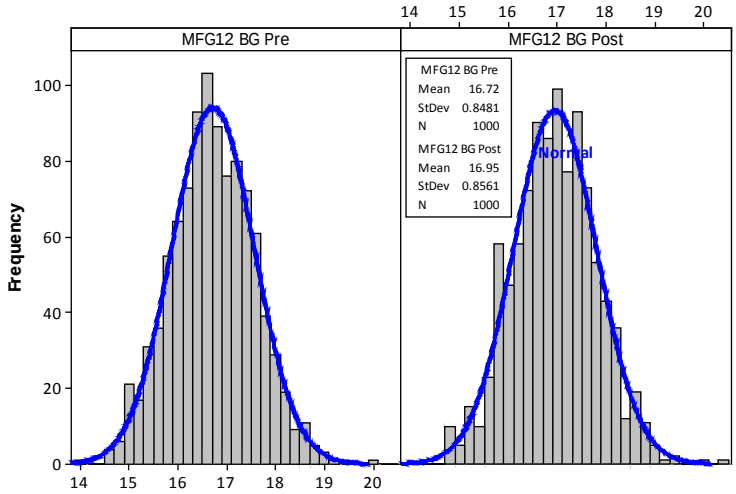


Figure A-1 Histogram for Pre- and Post-Survey Measurements (Background)

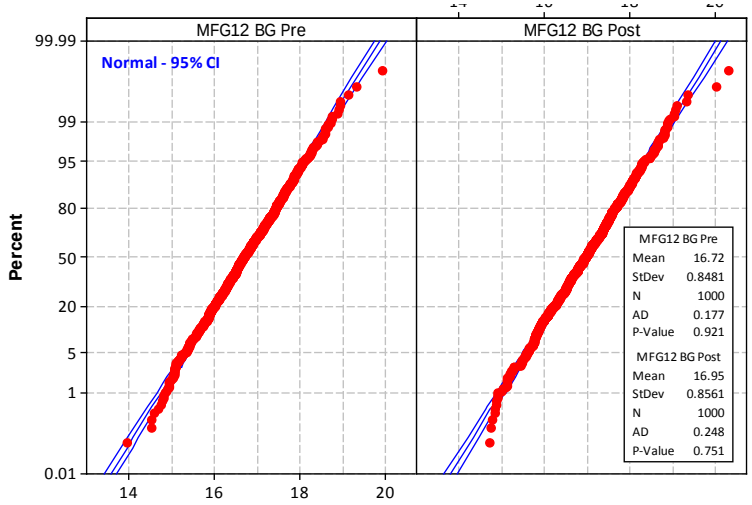


Figure A-2 Normal Probability Plots for Pre- and Post-Survey (Background)

Table A-2 Instrument MFG-12 Pre-Survey and Post-Survey Cs-137 Source QC Results

Survey:	Pre-Survey	Post-Survey	Relative Percent Difference
Date:	May-16	December-16	
Detector ID:	MFG-12	MFG-12	
# of Readings (µR/hr)	1,000	1,000	n/a
Mean (µR/hr)	214	210	2.26%
Median (µR/hr)	214	210	2.27%
Standard Deviation (µR/hr)	3.05	3.04	0.43%
95th Percentile (µR/hr)	219	215	2.10%
99th Percentile (µR/hr)	222	217	2.26%

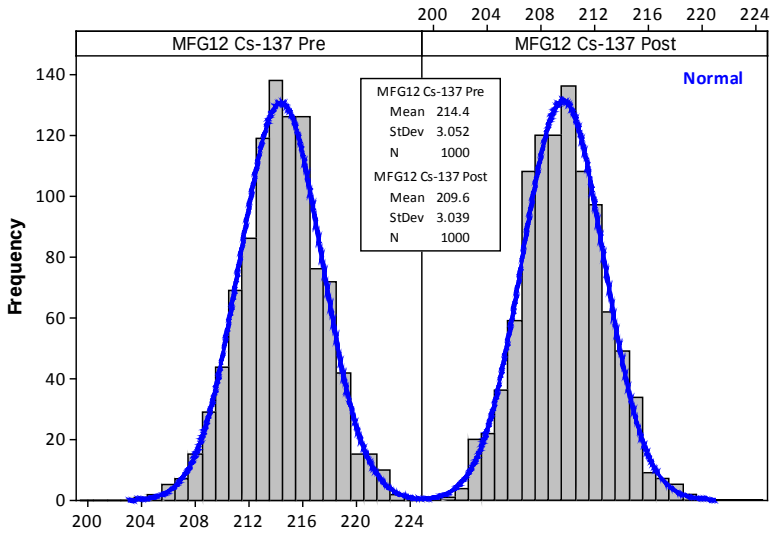


Figure A-3 Histogram for Pre- and Post-Survey Measurements (Cs-137)

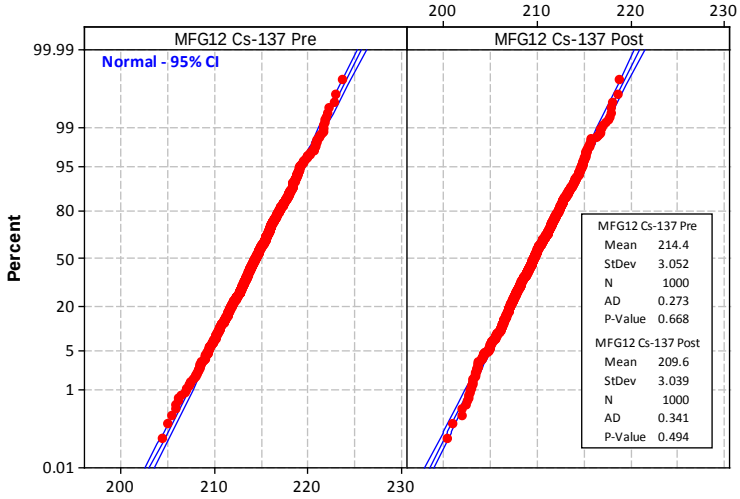


Figure A-4 Normal Probability Plots for Pre- and Post-Survey (Cs-137)

4.3 DAILY FIELD CALIBRATION CHECK QC RESULTS

The QC charts showing the results of the daily field calibration checks for background, field strip and Cs-137 source check are shown on Figures A-5 through Figure A-7. The respective QC acceptance limits are shown as red lines on these control charts. **The gamma radiation survey QC data met the project acceptance criteria for daily calibration checks.**

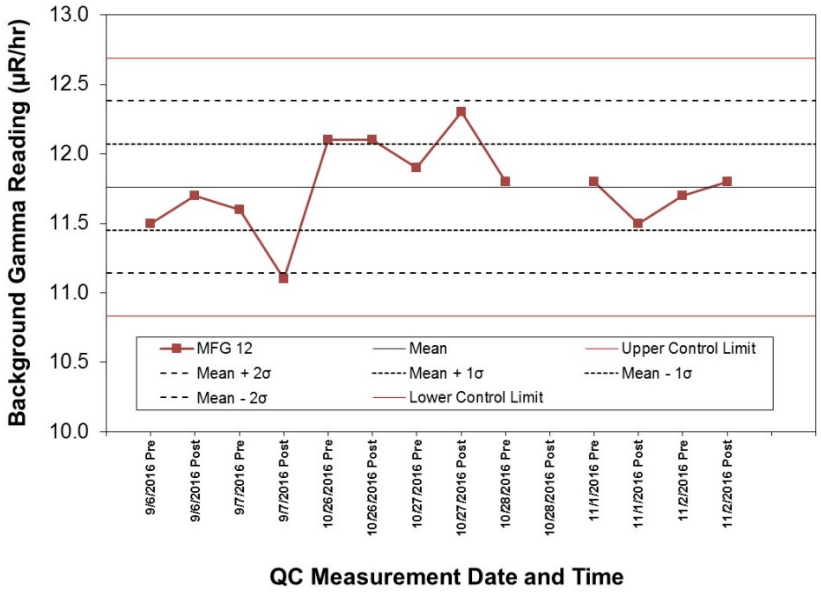


Figure A-5 Daily Field Calibration Check Results (Background)

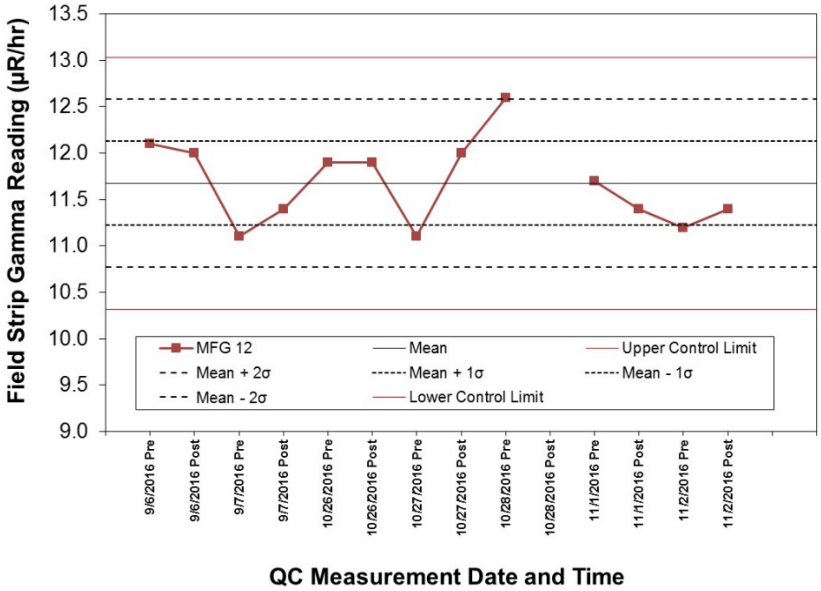


Figure A-6 Daily Field Calibration Check Results (Field Strip)

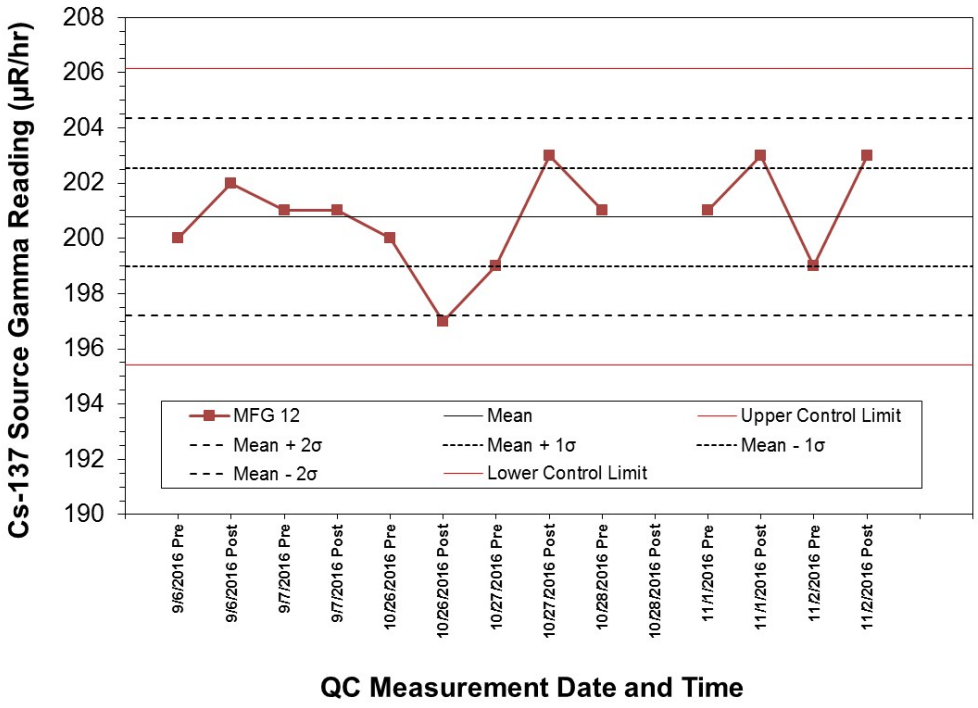


Figure A-7 Daily Field Calibration Check Results (Cs-137)

5.0 SOIL CONFIRMATION SAMPLING

5.1 QUALITY ASSURANCE/QUALITY CONTROL

Soil confirmation QA/QC protocol was followed in accordance with SOP3 of the VSP (Tetra Tech 2015). To measure the precision of the laboratory analysis methods, field duplicate QC samples were collected and submitted for analysis to the laboratory. Field duplicates are samples obtained from one location, homogenized and divided into separate containers and treated as separate samples throughout the sample handling and analytical process. Field duplicates were collected and submitted to the analytical laboratory at a minimum frequency of one duplicate sample for every 20 soil confirmation samples. Field duplicate samples were sent blindly to the laboratory along with primary soil samples.

5.1.1 QC Acceptance for Soil Sampling Data

The project QC acceptance limits are based on the RPD and DER testing results for all applicable samples. The DER was only performed on the radium soil confirmation samples, and was not be applied to the XRF confirmation sample field duplicates. Tetra Tech evaluated the analyte results for the field duplicate soil samples by calculating the RPD and DER between the two samples when both values of the primary/field duplicate sample pair are greater than five times the reporting limit (RL) for a given analyte. The QC acceptance limits are an RPD of less than 30 percent and a DER less than 1.96. Data validation flags or data qualifiers are given to the analytical data which exceed the project QC acceptance limits. The data qualifiers shown in Table A-3 are applied to the data that do not meet the performance acceptance criteria discussed above. The QC acceptance goal is that 85 percent of the samples shall meet the project QC acceptance criteria.

Table A-3 Summary of Data QC Qualifiers

Data Qualifier	Description of Data Qualifier
K	RPD > 30% and the average concentration is greater than five times the LOR
J	RPD > 30% and the average concentration is less than five times the LOR
G	DER > or = 1.96 and the average concentration is greater than five times the LOR
H	DER > or = 1.96 and the average concentration is less than five times the LOR

DER = duplicate error ratio
LOR = limit of reporting or reporting limit or minimum detectable concentration
RPD = relative percent difference

5.2 SOIL SAMPLING DATA VALIDATION AND QC REVIEW

A total of 8 duplicate sets were collected (4 for radium and 4 for arsenic). The frequency of one duplicate set per 20 primary samples was achieved. A data validation analysis was performed on each of the duplicate samples. One arsenic sample was qualified as “K”. Overall, 7 of the 8 duplicate data pairs met the acceptance criteria, at a rate of 87.5 percent. Attachment A-4 provides data tables summarizing the soil confirmation data validation analysis. **The project acceptance criteria is 85 percent. The soil confirmation sampling QC acceptance criteria was achieved.**

6.0 REFERENCES

Tetra Tech, Inc. 2015. Final Verification Sampling Plan. Riley Pass Uranium Mines Site (North Cave Hills), Harding County, South Dakota. November 18.

U.S. Environmental Protection Agency (EPA). 2008. XRF and Appropriate Quality Control. CLU-IN Studios Webinar. Presented by Stephen Dyment. U.S. EPA Technology Innovation Field Services Division.

U.S. Nuclear Regulatory Commission (NRC). 2000. Multi-Agency Radiological Site Survey and Investigation Manual. NUREG-1575, Rev. 1. August (with 2001 addendum).

NRC. 2004. Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP). NUREG-1576, EPA 402-N-04-001A, NTIS PB2004-105421. July.

ATTACHMENT A1

XRF FIELD DUPLICATE DATA VALIDATION ANALYSIS

QC Set	Time	Units	XRF Arsenic (mg/kg)	Bluff	Number	QC	Relative Percent Difference
1	9/6/2016 14:54	ppm	21.43	Bluff G	163	Primary	21%
	9/6/2016 14:55	ppm	26.54	Bluff G		Duplicate	
2	9/6/2016 20:19	ppm	32.56	Bluff F	5	Primary	3%
	9/6/2016 20:22	ppm	31.57	Bluff F		Duplicate	
3	9/7/2016 16:27	ppm	28.43	Bluff F	96	Primary	7%
	9/7/2016 16:30	ppm	26.49	Bluff F		Duplicate	
4	10/10/2016 13:37	ppm	27.01	Bluff I	87	Primary	41%
	10/10/2016 13:40	ppm	17.75	Bluff I		Duplicate	
5	10/10/2016 14:28	ppm	18.52	Bluff I	39	Primary	4%
	10/10/2016 14:30	ppm	17.8	Bluff I		Duplicate	
6	10/10/2016 15:24	ppm	21.43	Bluff I	118	Primary	2%
	10/10/2016 15:25	ppm	21.09	Bluff I		Duplicate	
7	10/10/2016 18:10	ppm	39.82	Bluff I	184	Primary	8%
	10/10/2016 18:11	ppm	36.83	Bluff I		Duplicate	
8	10/10/2016 18:18	ppm	36.77	Bluff I	219	Primary	2%
	10/10/2016 18:19	ppm	37.68	Bluff I		Duplicate	
9	10/11/2016 15:12	ppm	38.92	Bluff I	297	Primary	22%
	10/11/2016 15:15	ppm	31.26	Bluff I		Duplicate	
10	10/11/2016 15:20	ppm	28.65	Bluff I	262	Primary	5%
	10/11/2016 15:21	ppm	27.38	Bluff I		Duplicate	
11	10/11/2016 16:33	ppm	20.17	Bluff I	15	Primary	5%
	10/11/2016 16:36	ppm	21.3	Bluff I		Duplicate	
12	10/11/2016 16:39	ppm	31.97	Bluff I	7	Primary	13%
	10/11/2016 16:41	ppm	36.3	Bluff I		Duplicate	
13	10/11/2016 17:58	ppm	34.31	Bluff I	4	Primary	5%
	10/11/2016 18:02	ppm	32.54	Bluff I		Duplicate	
14	10/12/2016 17:11	ppm	37.69	Bluff I	71	Primary	32%
	10/12/2016 17:13	ppm	27.27	Bluff I		Duplicate	
15	10/12/2016 17:55	ppm	28.06	Bluff I	25	Primary	8%
	10/12/2016 17:56	ppm	30.28	Bluff I		Duplicate	
16	10/14/2016 10:49	ppm	22.46	Bluff I	21	Primary	8%
	10/14/2016 10:51	ppm	20.64	Bluff I		Duplicate	
17	10/14/2016 11:27	ppm	30.33	Bluff I	81	Primary	11%
	10/14/2016 11:29	ppm	27.08	Bluff I		Duplicate	
18	10/14/2016 11:47	ppm	32.07	Bluff I	112	Primary	2%
	10/14/2016 11:49	ppm	31.36	Bluff I		Duplicate	
19	10/14/2016 13:42	ppm	32.78	Bluff I	178	Primary	8%
	10/14/2016 13:44	ppm	35.54	Bluff I		Duplicate	
20	10/14/2016 18:03	ppm	45.83	Bluff I	245	Primary	1%
	10/14/2016 18:05	ppm	46.48	Bluff I		Duplicate	

QC Set	Time	Units	XRF Arsenic (mg/kg)	Bluff	Number	QC	Relative Percent Difference
21	10/17/2016 10:45	ppm	47.05	Bluff I	280	Primary	11%
	10/17/2016 10:46	ppm	42.29	Bluff I		Duplicate	
22	10/17/2016 16:34	ppm	21.53	Bluff I	75	Primary	14%
	10/17/2016 16:36	ppm	24.83	Bluff I		Duplicate	
23	10/17/2016 17:29	ppm	21.41	Bluff I	86	Primary	3%
	10/17/2016 17:31	ppm	20.76	Bluff I		Duplicate	
24	10/18/2016 15:34	ppm	5.07	Bluff I	98	Primary	19%
	10/18/2016 15:35	ppm	6.16	Bluff I		Duplicate	
25	10/18/2016 17:01	ppm	26.99	Bluff G	28	Primary	2%
	10/18/2016 17:04	ppm	27.57	Bluff G		Duplicate	
26	10/19/2016 14:58	ppm	32.39	Bluff G	276	Primary	6%
	10/19/2016 15:01	ppm	30.38	Bluff G		Duplicate	
27	10/20/2016 13:54	ppm	29.73	Bluff G	244	Primary	2%
	10/20/2016 13:56	ppm	29.22	Bluff G		Duplicate	
28	10/20/2016 17:50	ppm	29.14	Bluff G	108	Primary	2%
	10/20/2016 17:51	ppm	29.68	Bluff G		Duplicate	
29	10/24/2016 16:13	ppm	30.94	Bluff G	90	Primary	18%
	10/24/2016 16:15	ppm	36.89	Bluff G		Duplicate	
30	10/24/2016 16:43	ppm	30.89	Bluff G	77	Primary	5%
	10/24/2016 16:44	ppm	29.26	Bluff G		Duplicate	
31	10/24/2016 16:56	ppm	32.3	Bluff G	73	Primary	8%
	10/24/2016 16:57	ppm	29.88	Bluff G		Duplicate	
32	10/24/2016 17:26	ppm	28.47	Bluff G	50	Primary	4%
	10/24/2016 17:28	ppm	29.67	Bluff G		Duplicate	
33	10/25/2016 16:26	ppm	27.29	Bluff G	5	Primary	4%
	10/25/2016 16:27	ppm	26.28	Bluff G		Duplicate	
34	10/25/2016 16:52	ppm	29.86	Bluff G	25	Primary	5%
	10/25/2016 16:53	ppm	28.5	Bluff G		Duplicate	
35	10/25/2016 17:23	ppm	24.4	Bluff G	39	Primary	4%
	10/25/2016 17:25	ppm	25.43	Bluff G		Duplicate	
36	10/25/2016 17:55	ppm	23.18	Bluff G	52	Primary	16%
	10/25/2016 17:56	ppm	19.66	Bluff G		Duplicate	
37	10/26/2016 14:22	ppm	30.5	Bluff G	67	Primary	10%
	10/26/2016 14:24	ppm	33.57	Bluff G		Duplicate	
38	10/27/2016 15:40	ppm	23.21	Bluff I	559	Primary	5%
	10/27/2016 15:42	ppm	24.37	Bluff I		Duplicate	
39	10/27/2016 15:53	ppm	13.41	Bluff I	555	Primary	20%
	10/27/2016 15:55	ppm	16.42	Bluff I		Duplicate	
40	10/27/2016 16:13	ppm	18.02	Bluff I	575	Primary	5%
	10/27/2016 16:14	ppm	17.11	Bluff I		Duplicate	
41	10/27/2016 17:04	ppm	17.55	Bluff I	496	Primary	1%
	10/27/2016 17:05	ppm	17.43	Bluff I		Duplicate	
42	11/1/2016 17:20	ppm	19.67	Bluff I	254	Primary	5%
	11/1/2016 17:21	ppm	18.66	Bluff I		Duplicate	
43	11/1/2016 17:45	ppm	22.8	Bluff I	329	Primary	27%
	11/1/2016 17:46	ppm	17.34	Bluff I		Duplicate	

QC Set	Time	Units	XRF Arsenic (mg/kg)	Bluff	Number	QC	Relative Percent Difference
44	11/2/2016 15:19	ppm	17.88	Bluff I	332	Primary	16%
	11/2/2016 15:22	ppm	15.22	Bluff I		Duplicate	
45	11/2/2016 16:15	ppm	41.2	Bluff I	590	Primary	8%
	11/2/2016 16:18	ppm	44.44	Bluff I		Duplicate	
46	11/3/2016 12:36	ppm	31.96	Bluff I	304	Primary	0%
	11/3/2016 12:38	ppm	31.86	Bluff I		Duplicate	
47	11/3/2016 13:17	ppm	27.99	Bluff I	374	Primary	3%
	11/3/2016 13:18	ppm	28.88	Bluff I		Duplicate	
48	11/4/2016 12:55	ppm	7.05	Bluff I	411	Primary	1%
	11/4/2016 12:56	ppm	7.13	Bluff I		Duplicate	
49	11/4/2016 13:29	ppm	54.01	Bluff I	424	Primary	1%
	11/4/2016 13:30	ppm	53.62	Bluff I		Duplicate	
50	11/4/2016 13:50	ppm	51.98	Bluff I	465	Primary	1%
	11/4/2016 13:51	ppm	51.51	Bluff I		Duplicate	
51	11/4/2016 16:25	ppm	39.99	Bluff I	509	Primary	11%
	11/4/2016 16:26	ppm	44.78	Bluff I		Duplicate	
52	11/4/2016 17:01	ppm	27.71	Bluff I	562	Primary	1%
	11/4/2016 17:02	ppm	27.46	Bluff I		Duplicate	
53	11/7/2016 13:40	ppm	31.77	Bluff I	596	Primary	1%
	11/7/2016 13:41	ppm	31.41	Bluff I		Duplicate	
54	11/7/2016 14:36	ppm	24.59	Bluff I	233	Primary	5%
	11/7/2016 14:37	ppm	23.39	Bluff I		Duplicate	
55	11/7/2016 15:24	ppm	16.8	Bluff I	137	Primary	21%
	11/7/2016 15:25	ppm	13.67	Bluff I		Duplicate	
56	11/7/2016 17:58	ppm	31.42	Bluff I	289	Primary	12%
	11/7/2016 18:00	ppm	27.81	Bluff I		Duplicate	
57	11/7/2016 18:26	ppm	22.35	Bluff I	360	Primary	1%
	11/7/2016 18:27	ppm	22.05	Bluff I		Duplicate	
58	11/8/2016 13:55	ppm	15.84	Bluff I	473	Primary	5%
	11/8/2016 13:57	ppm	16.67	Bluff I		Duplicate	
59	11/8/2016 16:23	ppm	12.6	Bluff I	386	Primary	27%
	11/8/2016 16:24	ppm	16.45	Bluff I		Duplicate	
60	11/9/2016 11:40	ppm	31.79	Bluff I	347	Primary	3%
	11/9/2016 11:41	ppm	30.87	Bluff I		Duplicate	
61	11/9/2016 11:47	ppm	41.87	Bluff I	309	Primary	9%
	11/9/2016 11:48	ppm	38.13	Bluff I		Duplicate	
62	11/9/2016 16:35	ppm	23.09	Bluff G	329	Primary	9%
	11/9/2016 16:37	ppm	25.26	Bluff G		Duplicate	
63	11/9/2016 16:58	ppm	33.19	Bluff G	321	Primary	4%
	11/9/2016 16:59	ppm	31.73	Bluff G		Duplicate	
64	11/9/2016 17:36	ppm	27.37	Bluff G	302	Primary	15%
	11/9/2016 17:38	ppm	23.55	Bluff G		Duplicate	
65	11/10/2016 14:51	ppm	67.11	Bluff G	269	Primary	1%
	11/10/2016 14:53	ppm	67.77	Bluff G		Duplicate	
66	11/10/2016 16:52	ppm	40.94	Bluff G	233	Primary	2%
	11/10/2016 16:54	ppm	41.77	Bluff G		Duplicate	
67	11/10/2016 17:20	ppm	27.01	Bluff G	214	Primary	14%
	11/10/2016 17:21	ppm	23.55	Bluff G		Duplicate	
68	11/10/2016 17:58	ppm	14.61	Bluff G	193	Primary	6%
	11/10/2016 17:59	ppm	13.72	Bluff G		Duplicate	

ATTACHMENT A2

XRF PRECISION DATA VALIDATION ANALYSIS

Sample ID	F5	F96	F4	F98	I219	-	I25	I575	I329	
Date	9/6/2016	9/7/2016	9/6/2016	9/7/2016	10/10/2016	10/11/2016	10/12/2016	10/27/2016	10/18/2016	11/1/2016
XRF	571181	571181	47412	47412	571181	571181	571181	571181	571181	571181
Measurment #										
1	33	28	30	29	37	33	28	18	27	23
2	32	26	34	28	38	33	30	17	28	17
3	29	26	33	28	38	34	32	17	30	16
4	27	25	33	29	37	35	31	20	28	15
5	28	28	34	30	35	33	31	23	29	15
6	28	26	31	29	37	36	30	21	30	16
7	30	26	35	28	37	36	33	19	29	13
Standard Deviation	**2.1**	**1.0**	**1.6**	**0.7**	**0.9**	**1.3**	**1.5**	**2.1**	**1.0**	**2.9**
Average	**29.6**	**26.4**	**32.9**	**28.7**	**37.0**	**34.3**	**30.7**	**19.3**	**28.7**	**16.4**
RSD	**7.0%**	**4.0%**	**5.0%**	**2.4%**	**2.5%**	**3.7%**	**4.8%**	**10.6%**	**3.6%**	**17.8%**

Sample ID	G108	G39	G67		I562	I360		I309		
Date	10/20/2016	10/25/2016	10/26/2016	11/3/2016	11/4/2016	11/7/2016	11/10/2016	11/9/2016	-	-
XRF	571181	571181	571181	571181	571181	571181	571181	571181	-	-
Measurment #										
1	29	24	31	7	28	22	27	42		
2	30	25	34	7	27	22	24	38		
3	29	27	30	9	27	26	25	38		
4	27	28	33	6	28	25	27	39		
5	31	28	32	8	25	24	22	40		
6	29	27	30	7	25	24	27	40		
7	28	26	35	10	28	25	24	39		
Standard Deviation	**1.2**	**1.4**	**1.8**	**1.3**	**1.2**	**1.4**	**1.8**	**1.3**		
Average	**29.0**	**26.4**	**32.1**	**7.7**	**26.9**	**24.0**	**25.1**	**39.4**		
RSD	**4.1%**	**5.3%**	**5.6%**	**16.6%**	**4.6%**	**5.9%**	**7.2%**	**3.3%**		

ATTACHMENT A3

RADIATION INSTRUMENTATION CALIBRATION DOCUMENTS

Designer and Manufacturer of Scientific and Industrial Instruments

MFG-12

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER TETRA TECH MFG, INC. ORDER NO. 20285871/433017

Mfg. Ludlum Measurements, Inc. Model 2350-1 Serial No. 134764

Cal. Date 14-Mar-16 Cal Due Date 14-Mar-17 Cal. Interval 1 Year Meterface N/A

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 31 % Alt 701.0 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical check ☐ Input Sens. Linearity

☑ F/S Resp. check ☑ Reset check ☐ Window Operation

☑ Audio check ☑ Alarm Setting check ☑ Battery check (Min. Volt) 4.4 VDC

☑ Ratemeter Linearity check ☑ Integrated Dose check ☑ Recycle Mode check

☑ Data Log check ☑ Overload check ☑ Scaler Readout check Threshold Dial Ratio 100 = 10 mV

☑ Calibrated in accordance with LMI SOP 14.8 ☑ Calibrated in accordance with LMI SOP 14.9

☑ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 1999 V

COMMENTS:

Firmware: 37122N21

I/O Firmware: 37123N05 Calibrated with 39" cable.

Resolution for Cs137≈9.37%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

	Probe Model	Serial #	High Voltage	Threshold	Units/ Time Base	Dead Time Correction Factor	Calibration Constant	Linearity ±10%*
Detector # 1	LMI44-10	PR139484	900	100	4 / 2	1.382029E-05	5.535037E+10	✓
Detector # 2	LMI44-10	PR139484	900	100	7 / 1	1.382029E-05	1.000000E+00	
Detector # 3	CS137PK	662KEV	601	642	7 / 1	0.000000E+00	1.000000E+00	
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								
Detector #								

Units: 0 -- rad, 1 -- Gray, 2 -- rem, 3 -- Sv, 4 -- R, 5 -- C/Kg, 6 -- Disintegrations, 7 -- Counts, 8 -- Ci/cm sq., 9 -- Bq/cm sq.

Time Base: 0 -- Seconds, 1 -- Minutes, 2 -- Hours

* See attached detector documentation, if applica

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400kcpm	400 10 (0)	400 10 (0)	400cpm	40 (0)	40 (0)
	40kcpm	402 (	402 (	40cpm	4 1	4 1
	4kcpm	400	400			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N: ☐ 059 ☐ 2171CP ☐ 2261CP ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 5105 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T10081 ☐ T10082 Neutron Am-241 Be S/N: ☐ T-304 Ra-226 S/N: ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 289158 ☐ Ra-226 S/N Y982 ☑ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 14-Mar-16

Reviewed By: Donnie Mickos Date 14-Mar-16

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Model 2350 Bench Test Data

Customer TETRA TECH MFG, INC. Date 14-Mar-16 Order #. 20285871/433017

Model 2350-1 Serial No. 134764 Detector 44-10 Serial No. PR139484

Source Cs137 1.5mCi

High Voltage 900 V As Found 900 V. Input 10.00 mV As Found 10 mV.

Cal. Constant 5.535037E+10 as found 5.535037 E+10

Dead Time 1.382029E-05 as found 1.382029 E-05

Alarm Setting: Ratemeter 1000000000.000000 as found 1.0 E+09

Scaler 1000000.000000 as found 1.0 E+06

Integrated dose 1000000000.0000 as found 1.0 E+09

Overload ☐ On ☑ Off as found ☐ On ☑ Off Window 1000 as found 1000

Detector Received: ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

Reference Point	"As Found" Readings: Meter Reading	After Adjustment Readings: Meter Reading
2000 mR/hr	1.91 mR/hr	1.91 mR/hr
1500	1.48	1.48
1000	1.02	1.02
500	497 mR/hr	497 mR/hr
200	198	198
150	145	145
100	98.1	98.1

Other

Signature Jeremy Thompson Date 14-Mar-16

• *Serving The Nuclear Industry Since 1962* •

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. PR139484

Customer TETRA TECH MFG, INC. Order #. 20285871/433017

Counter 2350-1 Serial No. 134764 Counter Input Sensitivity 10.00 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other Cal Constant = 1.000000E+00 Dead Time = 1.382029E-05

High Voltage	Background	Isotope Am241 Size ~0.7 µCi	Isotope ____ Size	Isotope ____ Size	Isotope ____ Size
800	736	12151			
850	744	12243			
*900	754	12231			
950	771	12417			
1000	761	12373			
1050	756	12287			
1100	894	12439			
1150	1387	13611			

Signature Jeremy Thompson Date 14-Mar-16

• *Serving The Nuclear Industry Since 1962* •

Detector Setup Barcodes GENERATED: 3/14/2016 11:45:16 AM
Model 2350-1 Serial Number: 134764
Detector Setup Number: 1


H900$M
Set High Voltage: 900


W1000$WOFF$P
Set Window: 1000,OFF


F6$H
Set Scaler Count Time: 6


SB2$.
Set Readout Time Base: hours


SL1.382029E-05$X
Set Dead Time: 1.382029E-05


SC5.535037E+10$S
Set Calibration Constant: 5.535037E+10


*MLMI44-10$ *
Set High Detector Model: LMI44-10


NPR139484$E
Set High Detector Serial #: PR139484


J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09


K1000000$H
Set High Scaler Alarm: 1000000


P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09


SP1$7

Save Parameters as: D1



T100$Q

Set Threshold: 100



O40.0$OOFF$6

Set Overload: 40.0,OFF



SU4$F

Set Readout Units: R



SM0$3

Set Readout Range Multiplier: Auto



SVD0$P

Set Display Mode: Normal



SVD1$Q

Set Display Mode: Parameters



SVD2$R

Set Display Mode: Detector



D1$A

Set Active Detector Setup: 1

Detector Setup Barcodes GENERATED: 3/14/2016 11:45:17 AM
Model 2350-1 Serial Number: 134764
Detector Setup Number: 2



H900$M
Set High Voltage: 900



W1000$WOFF$P
Set Window: 1000,OFF



F6$H
Set Scaler Count Time: 6



SB1$-
Set Readout Time Base: minutes



SL1.382029E-05$X
Set Dead Time: 1.382029E-05



SC1.000000E+00$0
Set Calibration Constant: 1.000000E+00



*MLMI44-10$ *
Set High Detector Model: LMI44-10



NPR139484$E
Set High Detector Serial #: PR139484



J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09



K1000000$H
Set High Scaler Alarm: 1000000



P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09



SP2$8

Save Parameters as: D2



T100$Q

Set Threshold: 100



O40.0$OOFF$6

Set Overload: 40.0,OFF



SU7$I

Set Readout Units: c



SM0$3

Set Readout Range Multiplier: Auto



SVD0$P

Set Display Mode: Normal



SVD1$Q

Set Display Mode: Parameters



SVD2$R

Set Display Mode: Detector



D2$B

Set Active Detector Setup: 2

Detector Setup Barcodes GENERATED: 3/14/2016 11:45:18 AM
Model 2350-1 Serial Number: 134764
Detector Setup Number: 3


H601$K
Set High Voltage: 601


W40WONL
Set Window: 40,ON


F6$H
Set Scaler Count Time: 6


SB1$-
Set Readout Time Base: minutes


SL0.000000E+00$8
Set Dead Time: 0.000000E+00


SC1.000000E+00$0
Set Calibration Constant: 1.000000E+00


MCS137PK$S
Set High Detector Model: CS137PK


N662KEV$C
Set High Detector Serial #: 662KEV


J1.000000E+09$V
Set High Ratemeter Alarm: 1.000000E+09


K1000000$H
Set High Scaler Alarm: 1000000


P1.000000E+09$.
Set High Dose Alarm: 1.000000E+09


SP3$9

Save Parameters as: D3



T642$.

Set Threshold: 642



O40.0$OOFF$6

Set Overload: 40.0,OFF



SU7$I

Set Readout Units: c



SM0$3

Set Readout Range Multiplier: Auto



SVD0$P

Set Display Mode: Normal



SVD1$Q

Set Display Mode: Parameters



SVD2$R

Set Display Mode: Detector



D3$C

Set Active Detector Setup: 3

Detector Setup Checklist GENERATED: 3/14/2016 11:45:23 AM
Model 2350-1 Serial Number: 134764
Detector Setup Number: 1

The following list is stored as detector setup D1 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: JT

Comments:

User ID	=
High Voltage	= 900 volts
Threshold	= 100
Window	= 1000,OFF
Overload Current	= 40.0 micro amperes
Scaler Count Time	= 6 seconds
Readout Units	= R
Readout Time Base	= hours
Readout Range Multiplier	= Auto
Detector Dead Time	= 1.382029E-05
Detector Calibration Constant	= 5.535037E+10
Detector Model Number	= LMI44-10
Detector Serial Number	= PR139484
Ratemeter Alarm Setting	= 1.000000E+09
Scaler Alarm Setting	= 1000000
Integrated Dose Alarm Setting	= 1.000000E+09
Low Count Alarm Setting	= 0.000000E+00
Operating Batter Voltage	= 6.5 volts

Detector Setup Checklist GENERATED: 3/14/2016 11:45:23 AM
Model 2350-1 Serial Number: 134764
Detector Setup Number: 2

The following list is stored as detector setup D2 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: DT

Comments:

User ID	=
High Voltage	= 900 volts
Threshold	= 100
Window	= 1000,OFF
Overload Current	= 40.0 micro amperes
Scaler Count Time	= 6 seconds
Readout Units	= c
Readout Time Base	= minutes
Readout Range Multiplier	= Auto
Detector Dead Time	= 1.382029E-05
Detector Calibration Constant	= 1.000000E+00
Detector Model Number	= LMI44-10
Detector Serial Number	= PR139484
Ratemeter Alarm Setting	= 1.000000E+09
Scaler Alarm Setting	= 1000000
Integrated Dose Alarm Setting	= 1.000000E+09
Low Count Alarm Setting	= 0.000000E+00
Operating Batter Voltage	= 6.5 volts

Detector Setup Checklist GENERATED: 3/14/2016 11:45:23 AM
Model 2350-1 Serial Number: 134764
Detector Setup Number: 3

The following list is stored as detector setup D3 in the Model 2350.

I have verified the list below has no discrepancies with the detector settings table: JT

Comments:

User ID	=
High Voltage	= 601 volts
Threshold	= 642
Window	= 40,ON
Overload Current	= 40.0 micro amperes
Scaler Count Time	= 6 seconds
Readout Units	= c
Readout Time Base	= minutes
Readout Range Multiplier	= Auto
Detector Dead Time	= 0.000000E+00
Detector Calibration Constant	= 1.000000E+00
Detector Model Number	= CS137PK
Detector Serial Number	= 662KEV
Ratemeter Alarm Setting	= 1.000000E+09
Scaler Alarm Setting	= 1000000
Integrated Dose Alarm Setting	= 1.000000E+09
Low Count Alarm Setting	= 0.000000E+00
Operating Batter Voltage	= 6.5 volts

ATTACHMENT A4

SOIL CONFIRMATION DATA VALIDATION ANALYSIS

QC	FieldID	Quality Control	LabID	Lab Reported Arsenic Concentration (mg/kg)	RPD	Flag
1	AS-F71-01	Primary	1609139-9	25	21%	None
	AS-F71-02	Duplicate	1609139-10	31		
2	AS-G184-01	Primary	1609139-3	15	13%	None
	AS-G184-02	Duplicate	1609139-4	17		
3	AS-I332-01	Primary	1611081-11	18	6%	None
	AS-I332-02	Duplicate	1611081-12	17		
4	AS-I590-01	Primary	1611081-9	45	41%	**K**
	AS-I590-02	Duplicate	1611081-10	68		

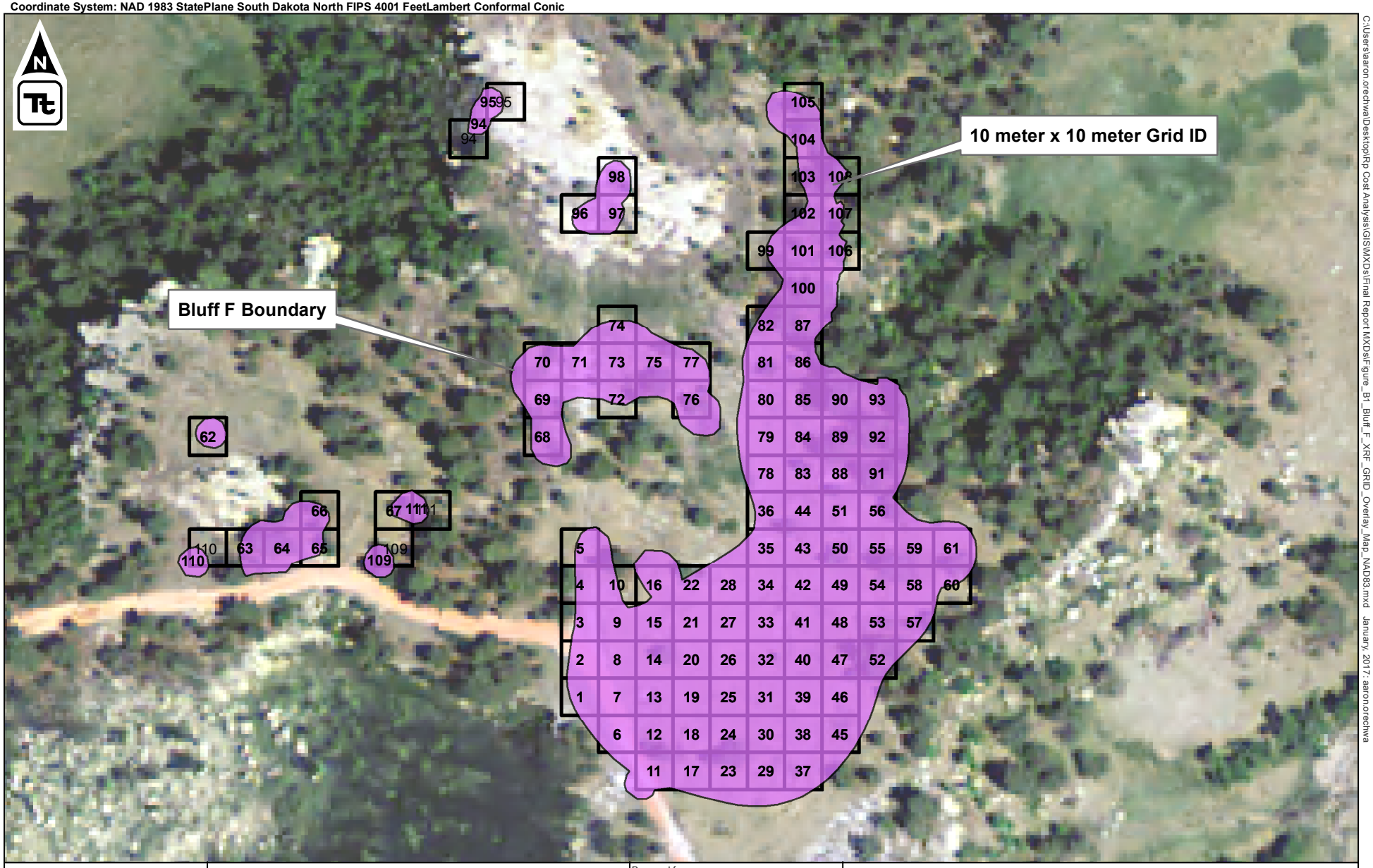
QC	FieldID	Bluff	Grid	QC	LabID	Lab Reported Radium-226 (pCi/g)	TPU	RPD	DER	Flag
1	RA-F71-02	F	71	Duplicate	1609140-10	8.2	1.1	2%	0.13	None
	RA-F71-01	F	71	Primary	1609140-9	8.4	1.1			
2	RA-G104-01	G	104	Primary	1609140-1	9.4	1.2	7%	0.35	None
	RA-G104-02	G	104	Duplicate	1609140-2	8.8	1.2			
3	RA-I590-01	I	590	Primary	1611084-16	18.2	2.3	6%	0.31	None
	RA-I590-02	I	590	Duplicate	1611084-17	17.2	2.2			
4	RA-I332-01	I	332	Primary	1611084-18	4.59	0.68	11%	0.54	None
	RA-I332-02	I	332	Duplicate	1611084-19	4.1	0.59			

APPENDIX B

SOIL CONFIRMATION AND LABORATORY SAMPLING INFORMATION

SAMPLING GRID OVERLAY MAPS

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 50 100

SURVEY UNIT CLASSIFICATION

Survey Unit F1

Prepared for:

Prepared By:

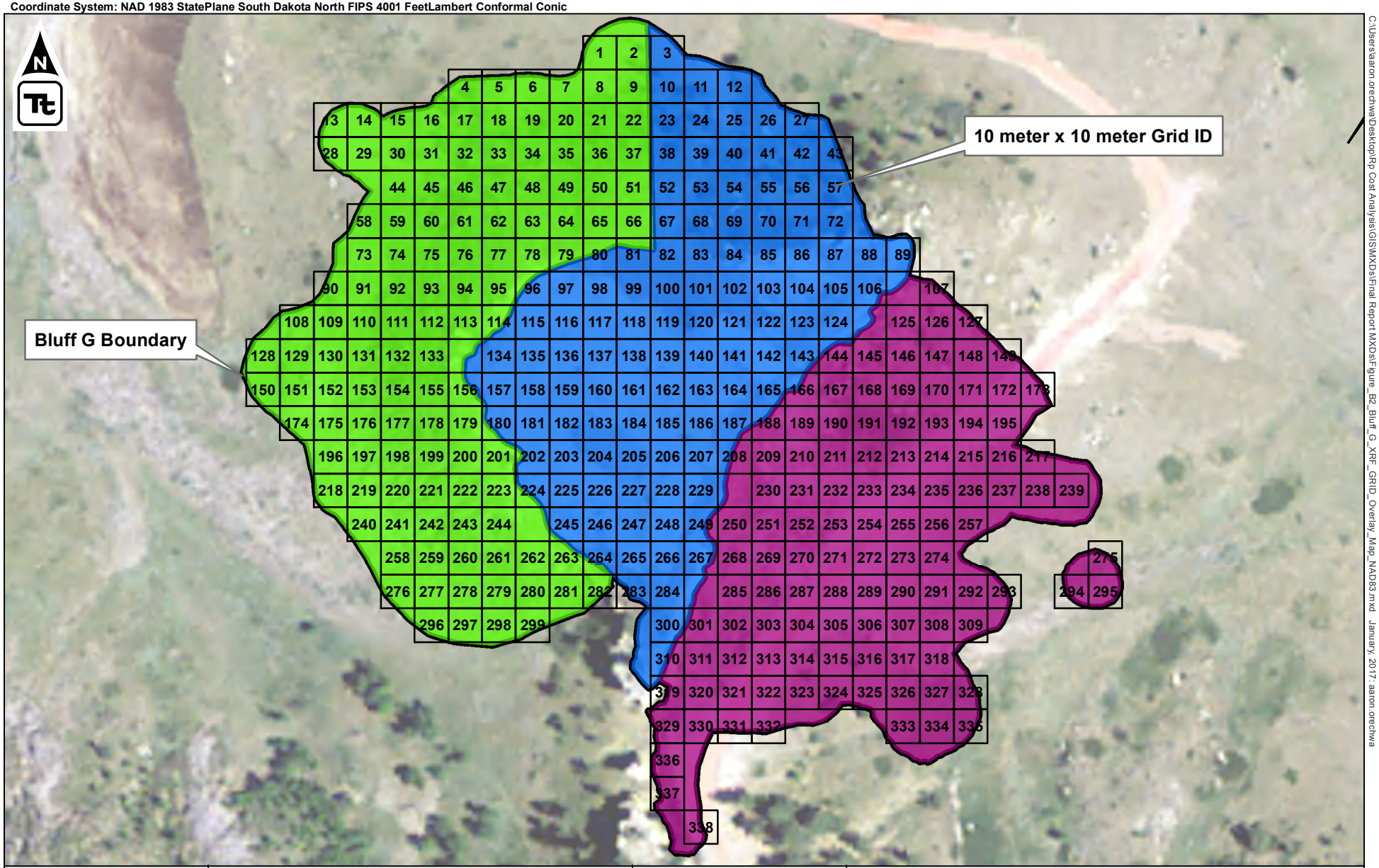
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF F VERIFICATION SAMPLING GRID OVERLAY MAP

Project:	Project no.:	
RILEY PASS	114-560543	Figure B1
Location: HARDING COUNTY, SD	Date: 1/2017	

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_B1_Bluff_F_XRF_GRID_Overlay_Map_NAD83.mxd January 2017 aaron.orechwa

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 50 100

SURVEY UNIT CLASSIFICATION
Survey Unit G1
Survey Unit G2
Survey Unit G3

Prepared for:

Prepared By:
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

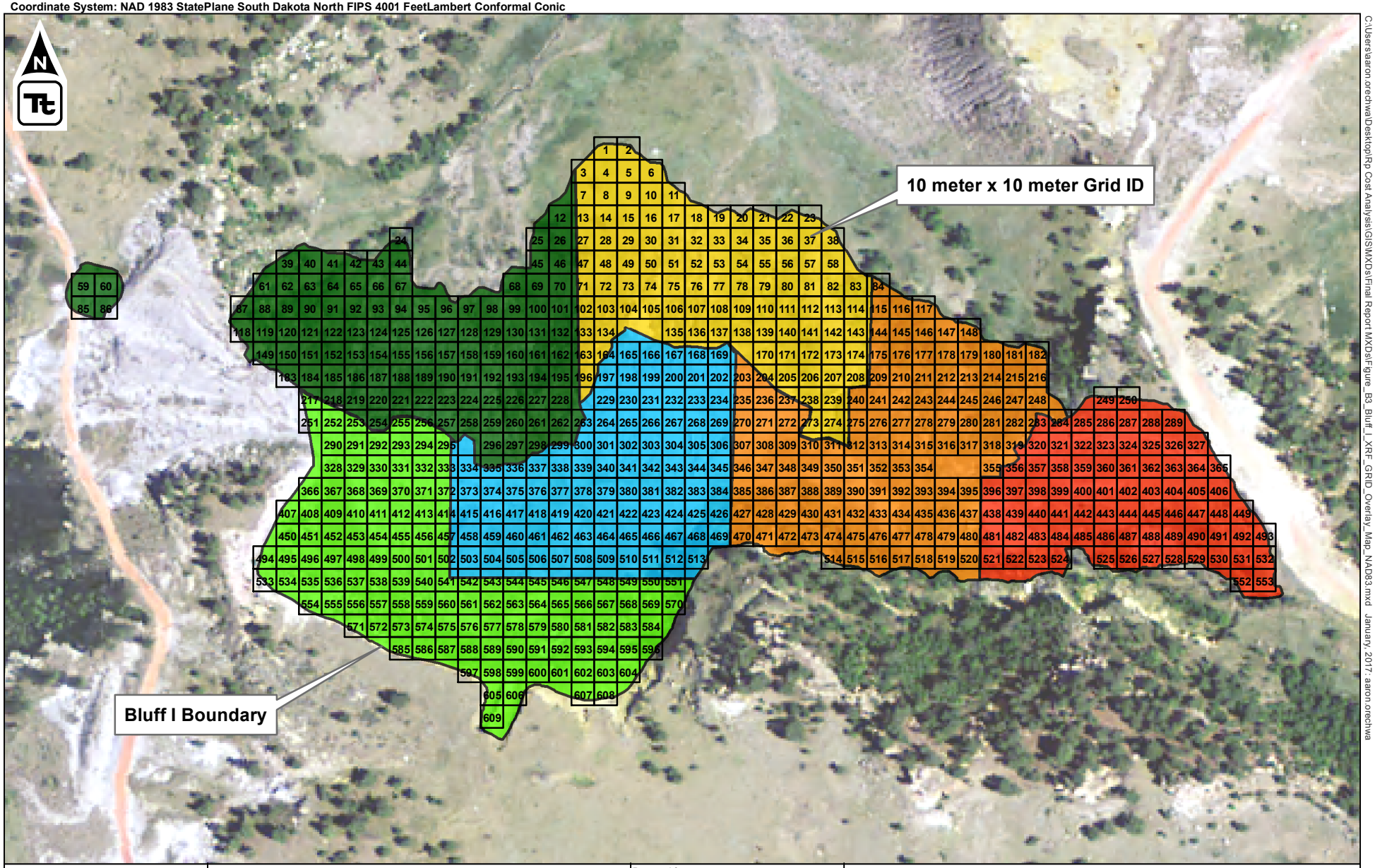
BLUFF G VERIFICATION SAMPLING
GRID OVERLAY MAP

Project: RILEY PASS
Project no.: 114-560543
Location: HARDING COUNTY, SD
Date: 1/2017

Figure B2

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_B2_Bluff_G_XRF_GRID_Overlay_Map_NAD83.mxd January 2017: aaron.orechwa

Coordinate System: NAD 1983 StatePlane South Dakota North FIPS 4001 FeetLambert Conformal Conic



FEET
0 125 250

SURVEY UNIT CLASSIFICATION

- Survey Unit I1
- Survey Unit I2
- Survey Unit I3
- Survey Unit I4
- Survey Unit I5
- Survey Unit I6

Prepared for: USDA Forest Service

Prepared By:
TETRA TECH
3801 Automation Way Suite 100
Fort Collins, Colorado 80525
(970) 223-9600 (970) 223-7171 fax

BLUFF I VERIFICATION SAMPLING GRID OVERLAY MAP

Project: RILEY PASS	Project no.: 114-560543	Figure B3
Location: HARDING COUNTY, SD	Date: 1/2017	

C:\Users\aaron.orechwa\Desktop\Rp Cost Analysis\GIS\MXDs\Final Report MXDs\Figure_B3_Bluff_I_XRF_GRID_Overlay_Map_NAD83.mxd January, 2017, aaron.orechwa

Arsenic and Radium-226 Soil Confirmation Sample Information

Table B1 Summary of Laboratory Information for Bluff F Arsenic Soil Confirmation Samples

Field Soil Sample ID	Grid Overlay Position	Quality Control	Laboratory ID	Date Collected	Time Collected
AS-F64-01	F64	Primary	1609139-11	9/7/2016	4:15 PM
AS-F21-01	F21	Primary	1609139-12	9/7/2016	4:30 PM
AS-F27-01	F27	Primary	1609139-13	9/7/2016	4:40 PM
AS-F103-01	F103	Primary	1609139-7	9/7/2016	3:35 PM
AS-F44-01	F44	Primary	1609139-8	9/7/2016	3:45 PM
AS-F71-01	F71	Primary	1609139-9	9/7/2016	3:52 PM
AS-F71-02	F71	Duplicate	1609139-10	9/7/2016	3:52 PM

Table B2 Summary of Laboratory Information Bluff G Arsenic Soil Confirmation Samples

Field Soil Sample ID	Grid Overlay Position	Quality Control	Laboratory ID	Date Collected	Time Collected
AS-G5-01	G5	Primary	1610590-1	10/25/2016	2:18 PM
AS-G25-01	G25	Primary	1610590-2	10/25/2016	2:45 PM
AS-G50-01	G50	Primary	1610590-3	10/24/2016	3:18 PM
AS-G73-01	G73	Primary	1610590-4	10/24/2016	2:48 PM
AS-G77-01	G77	Primary	1610590-5	10/24/2016	2:34 PM
AS-G90-01	G90	Primary	1610590-6	10/24/2016	2:06 PM
AS-G94-01	G94	Primary	1610590-7	10/24/2016	2:19 PM
AS-G104-01	G104	Primary	1609139-1	9/6/2016	10:56 AM
AS-G126-01	G126	Primary	1611081-1	11/1/2016	11:45 AM
AS-G163-01	G163	Primary	1609139-2	9/6/2016	12:45 PM
AS-G184-01	G184	Primary	1609139-3	9/6/2016	2:30 PM
AS-G184-02	G184	Duplicate	1609139-4	9/6/2016	2:30 PM
AS-G190-01	G190	Primary	1611081-2	11/1/2016	11:30 AM
AS-G226-01	G226	Primary	1609139-5	9/6/2016	3:00 PM
AS-G247-01	G247	Primary	1609139-6	9/6/2016	3:22 PM
AS-G253-01	G253	Primary	1611081-3	11/1/2016	11:10 AM
AS-G305-01	G305	Primary	1611081-4	11/1/2016	10:40 AM
AS-G307-01	G307	Primary	1611081-5	11/1/2016	10:50 AM
AS-G314-01	G314	Primary	1611081-6	11/1/2016	10:25 AM

Table B3 Summary of Laboratory Information Bluff I Arsenic Soil Confirmation Samples

Field Soil Sample ID	Grid Overlay Position	Quality Control	Laboratory ID	Date Collected	Time Collected
AS-I27-01	I27	Primary	1610590-8	10/18/2016	1:40 PM
AS-I41-01	I41	Primary	1610590-9	10/10/2016	12:28 PM
AS-I113-01	I113	Primary	1610590-10	10/14/2016	9:45 AM
AS-I114-01	I114	Primary	1610590-11	10/14/2016	9:49 AM
AS-I123-01	I123	Primary	1610590-12	10/10/2016	1:00 PM
AS-I129-01	I129	Primary	1610590-13	10/18/2016	1:33 PM
AS-I149-01	I149	Primary	1610590-14	10/10/2016	3:11 PM
AS-I153-01	I153	Primary	1610590-15	10/10/2016	3:25 PM
AS-I195-01	I195	Primary	1610590-16	10/11/2016	1:46 PM
AS-I196-01	I196	Primary	1610590-17	10/11/2016	1:40 PM
AS-I205-01	I205	Primary	1611081-18	11/2/2016	11:15 AM
AS-I251-01	I251	Primary	1611081-7	11/1/2016	3:01 PM
AS-I267-01	I267	Primary	1611081-14	11/2/2016	2:50 PM
AS-I280-01	I280	Primary	1610590-18	10/17/2016	8:37 AM
AS-I286-01	I286	Primary	1611081-23	11/2/2016	9:30 AM
AS-I302-01	I302	Primary	1611081-15	11/2/2016	2:35 PM
AS-I318-01	I318	Primary	1610590-19	10/17/2016	9:15 AM
AS-I325-01	I325	Primary	1611081-24	11/2/2016	9:45 AM
AS-I329-01	I329	Primary	1611081-8	11/1/2016	3:45 PM
AS-I332-01	I332	Primary	1611081-11	11/2/2016	1:10 PM
AS-I332-02	I332	Duplicate	1611081-12	11/2/2016	1:10 PM
AS-I355-01	I355	Primary	1611081-20	11/2/2016	10:35 AM
AS-I378-01	I378	Primary	1611081-16	11/2/2016	1:45 PM
AS-I388-01	I388	Primary	1611081-21	11/2/2016	11:00 AM
AS-I415-01	I415	Primary	1611081-13	11/2/2016	1:30 PM
AS-I463-01	I463	Primary	1611081-17	11/2/2016	3:20 PM
AS-I471-01	I471	Primary	1611081-19	11/2/2016	3:05 PM
AS-I477-01	I477	Primary	1611081-22	11/2/2016	10:50 AM
AS-I491-01	I491	Primary	1611081-25	11/2/2016	9:55 AM
AS-I496-01	I496	Primary	1610590-20	10/27/2016	2:56 PM
AS-I552-01	I552	Primary	1611081-26	11/2/2016	10:10 AM
AS-I555-01	I555	Primary	1610590-21	10/27/2016	1:46 PM
AS-I559-01	I559	Primary	1610590-22	10/27/2016	1:33 PM
AS-I590-02	I590	Duplicate	1611081-10	11/2/2016	2:05 PM
AS-I590-01	I590	Primary	1611081-9	11/2/2016	2:05 PM

Table B4 Summary of Laboratory Information for Bluff F Ra-226 Soil Confirmation Samples

Field Soil Sample ID	Grid Overlay Position	Quality Control	Laboratory ID	Date Collected	Time Collected
RA-F21-01	F21	Primary	1609140-12	9/7/2016	4:30 PM
RA-F27-01	F27	Primary	1609140-13	9/7/2016	4:40 PM
RA-F44-01	F44	Primary	1609140-8	9/7/2016	3:45 PM
RA-F64-01	F64	Primary	1609140-11	9/7/2016	4:15 PM
RA-F71-02	F71	Primary	1609140-10	9/7/2016	3:52 PM
RA-F71-01	F71	Duplicate	1609140-9	9/7/2016	3:52 PM
RA-F103-01	F103	Primary	1609140-7	9/7/2016	3:35 PM

Table B5 Summary of Laboratory Information for Bluff G Ra-226 Soil Confirmation Samples

Field Soil Sample ID	Grid Overlay Position	Quality Control	Laboratory ID	Date Collected	Time Collected
RA-G5-01	G5	Primary	1611084-7	11/1/2016	1:10 PM
RA-G25-01	G25	Primary	1611084-13	11/1/2016	2:00 PM
RA-G50-01	G50	Primary	1611084-8	11/1/2016	1:50 PM
RA-G73-01	G73	Primary	1611084-9	11/1/2016	1:20 PM
RA-G77-01	G77	Primary	1611084-10	11/1/2016	1:40 PM
RA-G90-01	G90	Primary	1611084-11	11/1/2016	1:30 PM
RA-G94-01	G94	Primary	1611084-12	11/1/2016	1:35 PM
RA-G104-01	G104	Primary	1609140-1	9/6/2016	10:56 AM
RA-G126-01	G126	Primary	1609140-2	9/6/2016	10:56 AM
RA-G163-01	G163	Primary	1611084-1	11/1/2016	11:45 AM
RA-G184-01	G184	Primary	1609140-3	9/6/2016	12:45 PM
RA-G184-02	G184	Duplicate	1609140-4	9/6/2016	2:30 PM
RA-G190-01	G190	Primary	1611084-2	11/1/2016	11:30 AM
RA-G226-01	G226	Primary	1609140-5	9/6/2016	3:00 PM
RA-G247-01	G247	Primary	1609140-6	9/6/2016	3:22 PM
RA-G253-01	G253	Primary	1611084-3	11/1/2016	11:10 AM
RA-G305-01	G305	Primary	1611084-4	11/1/2016	10:40 AM
RA-G307-01	G307	Primary	1611084-5	11/1/2016	10:50 AM
RA-G314-01	G314	Primary	1611084-6	11/1/2016	10:25 AM

Table B6 Summary of Laboratory Information for Bluff I Ra-226 Soil Confirmation Samples

Field Soil Sample ID	Grid Overlay Position	Quality Control	Laboratory ID	Date Collected	Time Collected
RA-I27-01	I27	Primary	1610597-1	10/28/2016	9:35 AM
RA-I41-01	I41	Primary	1610597-2	10/28/2016	9:15 AM
RA-I113-01	I113	Primary	1610597-3	10/28/2016	9:45 AM
RA-I114-01	I114	Primary	1610597-4	10/28/2016	9:50 AM
RA-I123-01	I123	Primary	1610597-5	10/28/2016	8:50 AM
RA-I129-01	I129	Primary	1610597-6	10/28/2016	9:25 AM
RA-I149-01	I149	Primary	1610597-7	10/28/2016	8:40 AM
RA-I153-01	I153	Primary	1610597-8	10/28/2016	8:45 AM
RA-I195-01	I195	Primary	1610597-9	10/28/2016	10:40 AM
RA-I196-01	I196	Primary	1610597-10	10/28/2016	10:45 AM
RA-I205-01	I205	Primary	1611084-25	11/2/2016	11:15 AM
RA-I251-01	I251	Primary	1611084-14	11/1/2016	2:40 PM
RA-I267-01	I267	Primary	1611084-21	11/2/2016	2:50 PM
RA-I280-01	I280	Primary	1610597-11	10/28/2016	10:05 AM
RA-I296-01	I286	Primary	1611084-30	11/2/2016	9:30 AM
RA-I302-01	I302	Primary	1611084-22	11/2/2016	2:35 PM
RA-I318-01	I318	Primary	1610597-12	10/28/2016	10:15 AM
RA-I325-01	I325	Primary	1611084-31	11/2/2016	9:45 AM
RA-I329-01	I329	Primary	1611084-15	11/1/2016	2:50 PM
RA-I332-01	I332	Primary	1611084-18	11/2/2016	1:10 PM
RA-I332-02	I332	Duplicate	1611084-19	11/2/2016	1:10 PM
RA-I355-01	I355	Primary	1611084-27	11/2/2016	10:35 AM
RA-I378-01	I378	Primary	1611084-23	11/2/2016	1:45 PM
RA-I388-01	I388	Primary	1611084-28	11/2/2016	11:00 AM
RA-I415-01	I415	Primary	1611084-20	11/2/2016	1:30 PM
RA-I463-01	I463	Primary	1611084-24	11/2/2016	3:20 PM
RA-I471-01	I471	Primary	1611084-26	11/2/2016	3:05 PM
RA-I477-01	I477	Primary	1611084-29	11/2/2016	10:50 AM
RA-I491-01	I491	Primary	1611084-32	11/2/2016	9:55 AM
RA-I496-01	I496	Primary	1610597-13	10/28/2016	8:25 AM
RA-I552-01	I552	Primary	1611084-33	11/2/2016	10:10 AM
RA-I555-01	I555	Primary	1610597-14	10/28/2016	8:11 AM
RA-I559-01	I559	Primary	1610597-15	10/28/2016	8:16 AM
RA-I590-01	I590	Primary	1611084-16	11/2/2016	2:05 PM
RA-I590-02	I590	Duplicate	1611084-17	11/2/2016	2:05 PM

SURVEY AREA BLUFF F

IN-SITU XRF MEASUREMENTS

GEOSPATIAL COORDINATES AND SAMPLING INFORMATION

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
1	F1	167	9/7/2016 18:42	1085645.88	747686.25	F1	NO	33	2.95
2	F2	160	9/7/2016 18:27	1085645.88	747719.06	F1	NO	48	3.4
3	F3	93	9/7/2016 19:26	1085645.88	747751.87	F1	NO	37	2.85
4	F4	98	9/6/2016 19:32	1085645.88	747784.68	F1	NO	30	4.31
5	F5	33	9/6/2016 20:19	1085645.88	747817.48	F1	NO	33	4.2
6	F6	103	9/7/2016 19:44	1085678.69	747653.44	F1	NO	55	3.42
7	F7	102	9/7/2016 19:42	1085678.69	747686.25	F1	NO	30	2.83
8	F8	94	9/7/2016 19:27	1085678.69	747719.06	F1	NO	23	2.52
9	F9	92	9/7/2016 19:24	1085678.69	747751.87	F1	NO	31	2.84
10	F10	153	9/7/2016 18:09	1085678.69	747784.68	F1	NO	33	2.93
11	F11	173	9/7/2016 18:55	1085711.49	747620.63	F1	NO	20	2.6
12	F12	168	9/7/2016 18:45	1085711.49	747653.44	F1	NO	27	2.76
13	F13	101	9/7/2016 19:40	1085711.49	747686.25	F1	NO	48	2.99
14	F14	161	9/7/2016 18:29	1085711.49	747719.06	F1	NO	30	2.82
15	F15	159	9/7/2016 18:24	1085711.49	747751.87	F1	NO	74	3.68
16	F16	83	9/7/2016 19:08	1085711.49	747784.68	F1	NO	25	2.54
17	F17	108	9/7/2016 19:54	1085744.30	747620.63	F1	NO	19	2.3
18	F18	104	9/7/2016 19:46	1085744.30	747653.44	F1	NO	9	1.7
19	F19	166	9/7/2016 18:40	1085744.30	747686.25	F1	NO	27	2.93
20	F20	95	9/7/2016 19:29	1085744.30	747719.06	F1	NO	18	2.29
21	F21	145	9/7/2016 17:36	1085744.30	747751.87	F1	YES	22	2.61
22	F22	84	9/7/2016 19:10	1085744.30	747784.68	F1	NO	15	2.48
23	F23	172	9/7/2016 18:53	1085777.11	747620.63	F1	NO	25	2.79
24	F24	169	9/7/2016 18:47	1085777.11	747653.44	F1	NO	27	2.91
25	F25	100	9/7/2016 19:38	1085777.11	747686.25	F1	NO	15	2.32
26	F26	162	9/7/2016 18:31	1085777.11	747719.06	F1	NO	26	2.9
27	F27	148	9/7/2016 17:44	1085777.11	747751.87	F1	YES	29	2.84
28	F28	154	9/7/2016 18:11	1085777.11	747784.68	F1	NO	18	2.51
29	F29	107	9/7/2016 19:51	1085809.92	747620.63	F1	NO	17	2.22
30	F30	105	9/7/2016 19:47	1085809.92	747653.44	F1	NO	20	2.59
31	F31	165	9/7/2016 18:38	1085809.92	747686.25	F1	NO	29	2.96
32	F32	96	9/7/2016 19:31	1085809.92	747719.06	F1	NO	18	2.42
33	F33	91	9/7/2016 19:22	1085809.92	747751.87	F1	NO	21	2.54
34	F34	85	9/7/2016 19:12	1085809.92	747784.68	F1	NO	18	2.46
35	F35	109	9/7/2016 19:57	1085809.92	747817.48	F1	NO	15	2.21
36	F36	132	9/7/2016 16:10	1085809.92	747850.29	F1	NO	15	2.28
37	F37	171	9/7/2016 18:51	1085842.73	747620.63	F1	NO	15	2.34
38	F38	170	9/7/2016 18:49	1085842.73	747653.44	F1	NO	17	2.52
39	F39	99	9/7/2016 19:36	1085842.73	747686.25	F1	NO	13	2.23
40	F40	163	9/7/2016 18:33	1085842.73	747719.06	F1	NO	21	2.51
41	F41	90	9/7/2016 19:20	1085842.73	747751.87	F1	NO	18	2.55
42	F42	155	9/7/2016 18:13	1085842.73	747784.68	F1	NO	23	2.57
43	F43	174	9/7/2016 18:59	1085842.73	747817.48	F1	NO	13	2.29
44	F44	139	9/7/2016 16:53	1085842.73	747850.29	F1	YES	33	3.13
45	F45	106	9/7/2016 19:49	1085875.54	747653.44	F1	NO	13	2.22
46	F46	164	9/7/2016 18:35	1085875.54	747686.25	F1	NO	16	2.62
47	F47	97	9/7/2016 19:33	1085875.54	747719.06	F1	NO	17	2.32
48	F48	158	9/7/2016 18:21	1085875.54	747751.87	F1	NO	16	2.38
49	F49	86	9/7/2016 19:13	1085875.54	747784.68	F1	NO	11	2.15
50	F50	110	9/7/2016 20:00	1085875.54	747817.48	F1	NO	14	2.19
51	F51	72	9/7/2016 17:07	1085875.54	747850.29	F1	NO	44	3.1
52	F52	98	9/7/2016 19:34	1085908.34	747719.06	F1	NO	13	2.3
53	F53	89	9/7/2016 19:19	1085908.34	747751.87	F1	NO	19	2.48
54	F54	156	9/7/2016 18:15	1085908.34	747784.68	F1	NO	14	2.35
55	F55	175	9/7/2016 19:01	1085908.34	747817.48	F1	NO	24	2.69
56	F56	131	9/7/2016 16:07	1085908.34	747850.29	F1	NO	19	2.58

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
57	F57	157	9/7/2016 18:18	1085941.15	747751.87	F1	NO	24	2.77
58	F58	87	9/7/2016 19:15	1085941.15	747784.68	F1	NO	11	2.16
59	F59	111	9/7/2016 20:02	1085941.15	747817.48	F1	NO	14	2.32
60	F60	88	9/7/2016 19:17	1085973.96	747784.68	F1	NO	23	2.83
61	F61	176	9/7/2016 19:03	1085973.96	747817.48	F1	NO	15	2.29
62	F62	82	9/7/2016 19:05	1085317.79	747915.91	F1	NO	22	2.57
63	F63	150	9/7/2016 17:56	1085350.60	747817.48	F1	NO	23	2.62
64	F64	143	9/7/2016 17:26	1085383.41	747817.48	F1	YES	25	2.98
65	F65	151	9/7/2016 17:59	1085416.22	747817.48	F1	NO	27	2.76
66	F66	79	9/7/2016 18:59	1085416.22	747850.29	F1	NO	20	2.6
67	F67	80	9/7/2016 19:01	1085481.83	747850.29	F1	NO	20	2.63
68	F68	136	9/7/2016 16:19	1085613.07	747915.91	F1	NO	22	2.56
69	F69	77	9/7/2016 17:18	1085613.07	747948.72	F1	NO	18	2.29
70	F70	76	9/7/2016 17:16	1085613.07	747981.53	F1	NO	24	2.42
71	F71	141	9/7/2016 17:03	1085645.88	747981.53	F1	YES	27	2.64
72	F72	135	9/7/2016 16:17	1085678.69	747948.72	F1	NO	20	2.55
73	F73	134	9/7/2016 16:15	1085678.69	747981.53	F1	NO	30	2.8
74	F74	75	9/7/2016 17:14	1085678.69	748014.34	F1	NO	20	2.54
75	F75	133	9/7/2016 16:12	1085711.49	747981.53	F1	NO	29	2.91
76	F76	73	9/7/2016 17:11	1085744.30	747948.72	F1	NO	23	2.67
77	F77	74	9/7/2016 17:12	1085744.30	747981.53	F1	NO	21	2.34
78	F78	69	9/7/2016 17:01	1085809.92	747883.10	F1	NO	13	2.24
79	F79	129	9/7/2016 16:01	1085809.92	747915.91	F1	NO	16	2.52
80	F80	65	9/7/2016 16:54	1085809.92	747948.72	F1	NO	10	2.17
81	F81	64	9/7/2016 16:52	1085809.92	747981.53	F1	NO	10	2.29
82	F82	63	9/7/2016 16:50	1085809.92	748014.34	F1	NO	17	2.21
83	F83	70	9/7/2016 17:03	1085842.73	747883.10	F1	NO	11	2.04
84	F84	68	9/7/2016 16:59	1085842.73	747915.91	F1	NO	10	2
85	F85	126	9/7/2016 15:54	1085842.73	747948.72	F1	NO	19	2.59
86	F86	125	9/7/2016 15:52	1085842.73	747981.53	F1	NO	14	2.43
87	F87	124	9/7/2016 15:50	1085842.73	748014.34	F1	NO	19	2.39
88	F88	130	9/7/2016 16:04	1085875.54	747883.10	F1	NO	13	2.3
89	F89	67	9/7/2016 16:58	1085875.54	747915.91	F1	NO	12	2.56
90	F90	66	9/7/2016 16:56	1085875.54	747948.72	F1	NO	15	2.42
91	F91	71	9/7/2016 17:05	1085908.34	747883.10	F1	NO	11	2.13
92	F92	128	9/7/2016 15:59	1085908.34	747915.91	F1	NO	16	2.43
93	F93	127	9/7/2016 15:56	1085908.34	747948.72	F1	NO	18	2.59
94	F94	48	9/7/2016 16:25	1085556.81	748191.90	F1	NO	60	3.38
95	F95	111	9/7/2016 15:22	1085565.14	748211.19	F1	NO	45	3.22
96	F96	49	9/7/2016 16:27	1085645.88	748112.76	F1	NO	28	2.68
97	F97	57	9/7/2016 16:36	1085678.69	748112.76	F1	NO	24	2.48
98	F98	113	9/7/2016 15:28	1085678.69	748145.57	F1	NO	29	2.86
99	F99	61	9/7/2016 16:46	1085809.92	748079.95	F1	NO	21	2.66
100	F100	62	9/7/2016 16:48	1085842.73	748047.14	F1	NO	16	2.39
101	F101	123	9/7/2016 15:48	1085842.73	748079.95	F1	NO	22	2.53
102	F102	60	9/7/2016 16:44	1085842.73	748112.76	F1	NO	23	2.48
103	F103	137	9/7/2016 16:43	1085842.73	748145.57	F1	YES	20	2.73
104	F104	120	9/7/2016 15:40	1085842.73	748178.38	F1	YES	26	2.84
105	F105	58	9/7/2016 16:39	1085842.73	748211.19	F1	NO	38	2.75
106	F106	122	9/7/2016 15:45	1085875.54	748079.95	F1	NO	21	2.55
107	F107	121	9/7/2016 15:43	1085875.54	748112.76	F1	NO	22	2.71
108	F108	59	9/7/2016 16:42	1085875.54	748145.57	F1	NO	38	2.7
109	F109	152	9/7/2016 18:02	1085468.88	747807.15	F1	NO	24	2.8
110	F110	78	9/7/2016 18:58	1085304.51	747806.11	F1	NO	19	2.51
111	F111	81	9/7/2016 19:02	1085502.05	747852.59	F1	NO	19	2.35

SURVEY AREA BLUFF G

IN-SITU XRF MEASUREMENTS

GEOSPATIAL COORDINATES AND SAMPLING INFORMATION

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Access Restriction?	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
1	G1	670	10/25/2016 16:03	1087220.68	748178.38	SU-2	NO	NO	23.73	2.65
2	G2	671	10/25/2016 16:05	1087253.49	748178.38	SU-2	NO	NO	34.43	2.81
3	G3	672	10/25/2016 16:07	1087286.30	748178.38	SU-1	NO	NO	38.19	2.87
4	G4	673	10/25/2016 16:24	1087089.45	748145.57	SU-2	NO	NO	32.81	2.73
5	G5	674	10/25/2016 16:26	1087122.25	748145.57	SU-2	NO	YES	27.29	2.54
6	G6	676	10/25/2016 16:32	1087155.06	748145.57	SU-2	NO	NO	29.48	2.69
7	G7	677	10/25/2016 16:33	1087187.87	748145.57	SU-2	NO	NO	35.57	2.97
8	G8	678	10/25/2016 16:36	1087220.68	748145.57	SU-2	NO	NO	37.19	2.91
9	G9	679	10/25/2016 16:38	1087253.49	748145.57	SU-2	NO	NO	29.47	2.74
10	G10	680	10/25/2016 16:40	1087286.30	748145.57	SU-1	NO	NO	34.84	2.71
11	G11	681	10/25/2016 16:42	1087319.11	748145.57	SU-1	NO	NO	36.56	3.01
12	G12	682	10/25/2016 16:44	1087351.91	748145.57	SU-1	NO	NO	36.78	2.82
13	G13	508	10/18/2016 16:51	1086958.21	748112.76	SU-2	NO	NO	22.45	2.35
14	G14	509	10/18/2016 16:53	1086991.02	748112.76	SU-2	NO	NO	26.14	2.7
15	G15	510	10/18/2016 16:55	1087023.83	748112.76	SU-2	NO	NO	27.79	2.74
16	G16	511	10/18/2016 16:58	1087056.64	748112.76	SU-2	NO	NO	24.65	2.5
17	G17	694	10/25/2016 17:13	1087089.45	748112.76	SU-2	NO	NO	30.93	2.73
18	G18	693	10/25/2016 17:10	1087122.25	748112.76	SU-2	NO	NO	26.51	2.71
19	G19	692	10/25/2016 17:08	1087155.06	748112.76	SU-2	NO	NO	32.8	2.94
20	G20	691	10/25/2016 17:06	1087187.87	748112.76	SU-2	NO	NO	22.28	2.58
21	G21	690	10/25/2016 17:03	1087220.68	748112.76	SU-2	NO	NO	24.22	2.65
22	G22	689	10/25/2016 17:01	1087253.49	748112.76	SU-2	NO	NO	26.01	2.51
23	G23	688	10/25/2016 16:59	1087286.30	748112.76	SU-1	NO	NO	33.57	2.95
24	G24	687	10/25/2016 16:56	1087319.11	748112.76	SU-1	NO	NO	47.6	3.24
25	G25	685	10/25/2016 16:52	1087351.91	748112.76	SU-1	NO	YES	29.86	2.81
26	G26	684	10/25/2016 16:49	1087384.72	748112.76	SU-1	NO	NO	34.25	2.94
27	G27	683	10/25/2016 16:47	1087417.53	748112.76	SU-1	NO	NO	17.71	2.33
28	G28	512	10/18/2016 17:01	1086958.21	748079.95	SU-2	NO	NO	26.99	2.71
29	G29	521	10/18/2016 17:13	1086991.02	748079.95	SU-2	NO	NO	26.62	2.55
30	G30	522	10/18/2016 17:15	1087023.83	748079.95	SU-2	NO	NO	25.18	2.52
31	G31	523	10/18/2016 17:17	1087056.64	748079.95	SU-2	NO	NO	24.21	2.44
32	G32	524	10/18/2016 17:20	1087089.45	748079.95	SU-2	NO	NO	23.69	2.43
33	G33	659	10/24/2016 17:44	1087122.25	748079.95	SU-2	NO	NO	30.24	2.71
34	G34	658	10/24/2016 17:41	1087155.06	748079.95	SU-2	NO	NO	30.34	2.76
35	G35	657	10/24/2016 17:39	1087187.87	748079.95	SU-2	NO	NO	29.68	2.68
36	G36	656	10/24/2016 17:36	1087220.68	748079.95	SU-2	NO	NO	23.62	2.51
37	G37	655	10/24/2016 17:34	1087253.49	748079.95	SU-2	NO	NO	32.31	2.82
38	G38	695	10/25/2016 17:17	1087286.30	748079.95	SU-1	NO	NO	14.5	2.39
39	G39	696	10/25/2016 17:23	1087319.11	748079.95	SU-1	NO	NO	24.4	2.67
40	G40	703	10/25/2016 17:34	1087351.91	748079.95	SU-1	NO	NO	26.14	2.59
41	G41	704	10/25/2016 17:36	1087384.72	748079.95	SU-1	NO	NO	33.72	2.93
42	G42	705	10/25/2016 17:38	1087417.53	748079.95	SU-1	NO	NO	15.58	2.34
43	G43	706	10/25/2016 17:40	1087450.34	748079.95	SU-1	NO	NO	16.16	2.34
44	G44	647	10/24/2016 17:04	1087023.83	748047.14	SU-2	NO	NO	30.85	2.9
45	G45	525	10/18/2016 17:25	1087056.64	748047.14	SU-2	NO	NO	34.22	2.74
46	G46	526	10/18/2016 17:28	1087089.45	748047.14	SU-2	NO	NO	21.5	2.26
47	G47	648	10/24/2016 17:07	1087122.25	748047.14	SU-2	NO	NO	35.8	2.94
48	G48	649	10/24/2016 17:21	1087155.06	748047.14	SU-2	NO	NO	34.87	2.82
49	G49	650	10/24/2016 17:24	1087187.87	748047.14	SU-2	NO	NO	18	2.43
50	G50	652	10/24/2016 17:26	1087220.68	748047.14	SU-2	NO	YES	28.47	2.79
51	G51	654	10/24/2016 17:31	1087253.49	748047.14	SU-2	NO	NO	26.57	2.6
52	G52	712	10/25/2016 17:55	1087286.30	748047.14	SU-1	NO	NO	23.18	2.47
53	G53	711	10/25/2016 17:52	1087319.11	748047.14	SU-1	NO	NO	20.98	2.45
54	G54	710	10/25/2016 17:50	1087351.91	748047.14	SU-1	NO	NO	15.82	2.26
55	G55	709	10/25/2016 17:48	1087384.72	748047.14	SU-1	NO	NO	30.79	2.8
56	G56	708	10/25/2016 17:45	1087417.53	748047.14	SU-1	NO	NO	15.24	2.26
57	G57	707	10/25/2016 17:43	1087450.34	748047.14	SU-1	NO	NO	15.89	2.32
58	G58	531	10/18/2016 17:40	1086991.02	748014.34	SU-2	NO	NO	25.59	2.67
59	G59	530	10/18/2016 17:38	1087023.83	748014.34	SU-2	NO	NO	26.89	2.58
60	G60	529	10/18/2016 17:35	1087056.64	748014.34	SU-2	NO	NO	27.75	2.67
61	G61	528	10/18/2016 17:33	1087089.45	748014.34	SU-2	NO	NO	26.05	2.58
62	G62	527	10/18/2016 17:30	1087122.25	748014.34	SU-2	NO	NO	27.81	2.66
63	G63	726	10/26/2016 14:10	1087155.06	748014.34	SU-2	NO	NO	32.38	2.85
64	G64	727	10/26/2016 14:12	1087187.87	748014.34	SU-2	NO	NO	35.4	2.98
65	G65	728	10/26/2016 14:15	1087220.68	748014.34	SU-2	NO	NO	19.82	2.48
66	G66	729	10/26/2016 14:17	1087253.49	748014.34	SU-2	NO	NO	38.21	3.09
67	G67	730	10/26/2016 14:22	1087286.30	748014.34	SU-1	NO	NO	30.5	2.71
68	G68	737	10/26/2016 14:37	1087319.11	748014.34	SU-1	NO	NO	18.61	2.4
69	G69	738	10/26/2016 14:40	1087351.91	748014.34	SU-1	NO	NO	44.41	3.09
70	G70	739	10/26/2016 14:42	1087384.72	748014.34	SU-1	NO	NO	41.19	3.21

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Access Restriction?	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
71	G71	740	10/26/2016 14:45	1087417.53	748014.34	SU-1	NO	NO	30.97	2.67
72	G72	741	10/26/2016 14:48	1087450.34	748014.34	SU-1	NO	NO	23.91	2.48
73	G73	645	10/24/2016 16:56	1086991.02	747981.53	SU-2	NO	YES	32.3	2.71
74	G74	644	10/24/2016 16:53	1087023.83	747981.53	SU-2	NO	NO	30.5	2.82
75	G75	643	10/24/2016 16:51	1087056.64	747981.53	SU-2	NO	NO	32.49	2.81
76	G76	641	10/24/2016 16:48	1087089.45	747981.53	SU-2	NO	NO	28.47	2.73
77	G77	639	10/24/2016 16:43	1087122.25	747981.53	SU-2	NO	YES	30.89	2.63
78	G78	638	10/24/2016 16:40	1087155.06	747981.53	SU-2	NO	NO	15.05	2.31
79	G79	637	10/24/2016 16:37	1087187.87	747981.53	SU-2	NO	NO	45.98	3.55
80	G80	37	9/6/2016 11:16	1087220.68	747981.53	SU-1	NO	NO	18.54	3.68
81	G81	36	9/6/2016 11:12	1087253.49	747981.53	SU-1	NO	NO	14.46	3.52
82	G82	35	9/6/2016 11:08	1087286.30	747981.53	SU-1	NO	NO	22.37	3.52
83	G83	34	9/6/2016 11:06	1087319.11	747981.53	SU-1	NO	NO	9.88	2.81
84	G84	33	9/6/2016 11:04	1087351.91	747981.53	SU-1	NO	NO	5.96	2.81
85	G85	32	9/6/2016 11:01	1087384.72	747981.53	SU-1	NO	NO	13.46	3.21
86	G86	31	9/6/2016 10:58	1087417.53	747981.53	SU-1	NO	NO	4.8	2.48
87	G87	30	9/6/2016 10:56	1087450.34	747981.53	SU-1	NO	NO	13.69	3.29
88	G88	28	9/6/2016 10:53	1087483.15	747981.53	SU-1	NO	NO	16.49	3.24
89	G89	27	9/6/2016 10:49	1087515.96	747981.53	SU-1	NO	NO	26.54	3.61
90	G90	630	10/24/2016 16:13	1086958.21	747948.72	SU-2	NO	YES	30.94	2.69
91	G91	632	10/24/2016 16:20	1086991.02	747948.72	SU-2	NO	NO	30.8	2.79
92	G92	633	10/24/2016 16:23	1087023.83	747948.72	SU-2	NO	NO	25.94	2.78
93	G93	634	10/24/2016 16:25	1087056.64	747948.72	SU-2	NO	NO	33.61	3
94	G94	635	10/24/2016 16:28	1087089.45	747948.72	SU-2	NO	YES	31.12	2.8
95	G95	636	10/24/2016 16:32	1087122.25	747948.72	SU-2	NO	NO	78.46	3.91
96	G96	39	9/6/2016 11:24	1087155.06	747948.72	SU-1	NO	NO	22.5	3.64
97	G97	40	9/6/2016 11:28	1087187.87	747948.72	SU-1	NO	NO	21.8	3.97
98	G98	41	9/6/2016 11:31	1087220.68	747948.72	SU-1	NO	NO	20.24	4.06
99	G99	42	9/6/2016 11:35	1087253.49	747948.72	SU-1	NO	NO	25.69	3.77
100	G100	43	9/6/2016 11:39	1087286.30	747948.72	SU-1	NO	NO	38.22	4.37
101	G101	44	9/6/2016 11:42	1087319.11	747948.72	SU-1	NO	NO	10.66	3.24
102	G102	45	9/6/2016 11:45	1087351.91	747948.72	SU-1	NO	NO	16.86	3.4
103	G103	46	9/6/2016 11:48	1087384.72	747948.72	SU-1	NO	NO	17.98	3.03
104	G104	47	9/6/2016 12:04	1087417.53	747948.72	SU-1	NO	YES	14.45	3.06
105	G105	49	9/6/2016 12:12	1087450.34	747948.72	SU-1	NO	NO	29.98	3.87
106	G106	50	9/6/2016 12:15	1087483.15	747948.72	SU-1	NO	NO	23.02	3.76
107	G107	821	11/1/2016 14:06	1087548.76	747948.72	SU-3	NO	NO	31.68	2.67
108	G108	602	10/20/2016 17:50	1086925.40	747915.91	SU-2	NO	NO	29.14	2.62
109	G109	619	10/24/2016 15:43	1086958.21	747915.91	SU-2	NO	NO	26.13	2.64
110	G110	620	10/24/2016 15:46	1086991.02	747915.91	SU-2	NO	NO	28.77	2.78
111	G111	621	10/24/2016 15:48	1087023.83	747915.91	SU-2	NO	NO	27.53	2.79
112	G112	622	10/24/2016 15:51	1087056.64	747915.91	SU-2	NO	NO	39.9	2.94
113	G113	623	10/24/2016 15:54	1087089.45	747915.91	SU-2	NO	NO	34.12	2.86
114	G114	62	9/6/2016 12:54	1087122.25	747915.91	SU-2	NO	NO	35.13	4.28
115	G115	60	9/6/2016 12:50	1087155.06	747915.91	SU-1	NO	NO	14.47	3.13
116	G116	59	9/6/2016 12:48	1087187.87	747915.91	SU-1	NO	NO	26.83	3.85
117	G117	58	9/6/2016 12:45	1087220.68	747915.91	SU-1	NO	NO	17.15	3.45
118	G118	57	9/6/2016 12:41	1087253.49	747915.91	SU-1	NO	NO	20.06	3.49
119	G119	56	9/6/2016 12:38	1087286.30	747915.91	SU-1	NO	NO	18.8	3.46
120	G120	55	9/6/2016 12:34	1087319.11	747915.91	SU-1	NO	NO	18.16	3.62
121	G121	54	9/6/2016 12:30	1087351.91	747915.91	SU-1	NO	NO	19.24	3.4
122	G122	53	9/6/2016 12:27	1087384.72	747915.91	SU-1	NO	NO	6.98	2.77
123	G123	52	9/6/2016 12:25	1087417.53	747915.91	SU-1	NO	NO	28.51	3.91
124	G124	51	9/6/2016 12:21	1087450.34	747915.91	SU-1	NO	NO	26.7	4.19
125	G125	822	11/1/2016 14:09	1087515.96	747915.91	SU-3	NO	NO	45.77	3.19
126	G126	819	11/1/2016 13:54	1087548.76	747915.91	SU-3	NO	YES	43.12	2.82
127	G127	820	11/1/2016 14:03	1087581.57	747915.91	SU-3	NO	NO	41.11	3.01
128	G128	629	10/24/2016 16:09	1086892.60	747883.10	SU-2	NO	NO	31.13	2.68
129	G129	628	10/24/2016 16:07	1086925.40	747883.10	SU-2	NO	NO	23.61	2.79
130	G130	627	10/24/2016 16:05	1086958.21	747883.10	SU-2	NO	NO	31.06	2.67
131	G131	626	10/24/2016 16:02	1086991.02	747883.10	SU-2	NO	NO	32.7	2.91
132	G132	625	10/24/2016 16:00	1087023.83	747883.10	SU-2	NO	NO	25.98	2.63
133	G133	624	10/24/2016 15:58	1087056.64	747883.10	SU-2	NO	NO	29.14	2.78
134	G134	63	9/6/2016 13:19	1087122.25	747883.10	SU-1	NO	NO	31.03	4.06
135	G135	64	9/6/2016 13:22	1087155.06	747883.10	SU-1	NO	NO	33.98	3.75
136	G136	65	9/6/2016 13:25	1087187.87	747883.10	SU-1	NO	NO	18.44	3.34
137	G137	66	9/6/2016 13:27	1087220.68	747883.10	SU-1	NO	NO	27.39	3.7
138	G138	67	9/6/2016 13:30	1087253.49	747883.10	SU-1	NO	NO	28.43	3.9
139	G139	68	9/6/2016 13:35	1087286.30	747883.10	SU-1	NO	NO	22.9	3.19
140	G140	69	9/6/2016 13:38	1087319.11	747883.10	SU-1	NO	NO	24.53	3.64

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Access Restriction?	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
141	G141	70	9/6/2016 13:41	1087351.91	747883.10	SU-1	NO	NO	29.62	3.95
142	G142	71	9/6/2016 13:45	1087384.72	747883.10	SU-1	NO	NO	31.53	4.16
143	G143	72	9/6/2016 13:47	1087417.53	747883.10	SU-1	NO	NO	19.61	3.21
144	G144	n/a	n/a	1087450.34	747883.10	SU-3	NO	NO		
145	G145	1379	11/10/2016 18:22	1087483.15	747883.10	SU-3	NO	NO	175.74	5.34
146	G146	1380	11/10/2016 18:25	1087515.96	747883.10	SU-3	NO	NO	21.47	2.4
147	G147	1381	11/10/2016 18:27	1087548.76	747883.10	SU-3	NO	NO	21.25	2.55
148	G148	1382	11/10/2016 18:29	1087581.57	747883.10	SU-3	NO	NO	31.89	2.79
149	G149	1383	11/10/2016 18:31	1087614.38	747883.10	SU-3	NO	NO	21.63	2.57
150	G150	588	10/20/2016 17:10	1086892.60	747850.29	SU-2	NO	NO	31.28	2.81
151	G151	589	10/20/2016 17:12	1086925.40	747850.29	SU-2	NO	NO	30.5	2.71
152	G152	590	10/20/2016 17:14	1086958.21	747850.29	SU-2	NO	NO	25.33	2.87
153	G153	591	10/20/2016 17:17	1086991.02	747850.29	SU-2	NO	NO	29.13	2.63
154	G154	592	10/20/2016 17:20	1087023.83	747850.29	SU-2	NO	NO	32.88	2.8
155	G155	593	10/20/2016 17:23	1087056.64	747850.29	SU-2	NO	NO	32.05	3.08
156	G156	3	9/6/2016 14:18	1087089.45	747850.29	SU-2	NO	NO	21.42	3.59
157	G157	4	9/6/2016 14:20	1087122.25	747850.29	SU-1	NO	NO	18.5	3.32
158	G158	5	9/6/2016 14:21	1087155.06	747850.29	SU-1	NO	NO	20.99	3.49
159	G159	6	9/6/2016 14:23	1087187.87	747850.29	SU-1	NO	NO	22.14	3.68
160	G160	7	9/6/2016 14:25	1087220.68	747850.29	SU-1	NO	NO	19.58	3.42
161	G161	8	9/6/2016 14:27	1087253.49	747850.29	SU-1	NO	NO	8.27	2.54
162	G162	9	9/6/2016 14:30	1087286.30	747850.29	SU-1	NO	NO	3.86	3.86
163	G163	12	9/6/2016 14:54	1087319.11	747850.29	SU-1	NO	YES	21.43	3.51
164	G164	10	9/6/2016 14:33	1087351.91	747850.29	SU-1	NO	NO	8.88	2.78
165	G165	11	9/6/2016 14:39	1087384.72	747850.29	SU-1	NO	NO	13.85	3.67
166	G166	n/a	n/a	1087417.53	747850.29	SU-3	NO	NO		
167	G167	1378	11/10/2016 18:18	1087450.34	747850.29	SU-3	NO	NO	24.75	2.51
168	G168	1377	11/10/2016 18:16	1087483.15	747850.29	SU-3	NO	NO	25.52	2.57
169	G169	1376	11/10/2016 18:14	1087515.96	747850.29	SU-3	NO	NO	23.08	2.69
170	G170	1375	11/10/2016 18:12	1087548.76	747850.29	SU-3	NO	NO	32.86	2.65
171	G171	1374	11/10/2016 18:10	1087581.57	747850.29	SU-3	NO	NO	18.26	2.57
172	G172	1373	11/10/2016 18:08	1087614.38	747850.29	SU-3	NO	NO	18.71	2.14
173	G173	1372	11/10/2016 18:06	1087647.19	747850.29	SU-3	NO	NO	21.84	2.52
174	G174	600	10/20/2016 17:43	1086925.40	747817.48	SU-2	NO	NO	23.78	2.48
175	G175	599	10/20/2016 17:41	1086958.21	747817.48	SU-2	NO	NO	24.5	2.86
176	G176	598	10/20/2016 17:39	1086991.02	747817.48	SU-2	NO	NO	38.81	3.38
177	G177	597	10/20/2016 17:37	1087023.83	747817.48	SU-2	NO	NO	27.69	2.68
178	G178	596	10/20/2016 17:34	1087056.64	747817.48	SU-2	NO	NO	25.42	2.48
179	G179	595	10/20/2016 17:31	1087089.45	747817.48	SU-2	NO	NO	21.48	2.47
180	G180	80	9/6/2016 14:28	1087122.25	747817.48	SU-1	NO	NO	26.82	4.07
181	G181	79	9/6/2016 14:25	1087155.06	747817.48	SU-1	NO	NO	22.42	3.61
182	G182	78	9/6/2016 14:23	1087187.87	747817.48	SU-1	NO	NO	23	3.65
183	G183	77	9/6/2016 14:17	1087220.68	747817.48	SU-1	NO	NO	14.59	3.47
184	G184	90	9/6/2016 15:33	1087253.49	747817.48	SU-1	NO	YES	6.54	3.26
185	G185	76	9/6/2016 14:14	1087286.30	747817.48	SU-1	NO	NO	6.05	3.06
186	G186	75	9/6/2016 14:11	1087319.11	747817.48	SU-1	NO	NO	21.91	3.63
187	G187	74	9/6/2016 14:07	1087351.91	747817.48	SU-1	NO	NO	15.68	3.34
188	G188	1364	11/10/2016 17:47	1087384.72	747817.48	SU-3	NO	NO	57.43	3.37
189	G189	1365	11/10/2016 17:51	1087417.53	747817.48	SU-3	NO	NO	15.82	2.63
190	G190	818	11/1/2016 13:38	1087450.34	747817.48	SU-3	NO	YES	64.35	3.5
191	G191	1366	11/10/2016 17:54	1087483.15	747817.48	SU-3	NO	NO	28.25	2.56
192	G192	1367	11/10/2016 17:56	1087515.96	747817.48	SU-3	NO	NO	22.65	2.37
193	G193	1368	11/10/2016 17:58	1087548.76	747817.48	SU-3	NO	NO	14.61	1.96
194	G194	1370	11/10/2016 18:01	1087581.57	747817.48	SU-3	NO	NO	44.95	3.05
195	G195	1371	11/10/2016 18:03	1087614.38	747817.48	SU-3	NO	NO	23.97	2.55
196	G196	587	10/20/2016 14:48	1086958.21	747784.68	SU-2	NO	NO	31.4	2.85
197	G197	586	10/20/2016 14:46	1086991.02	747784.68	SU-2	NO	NO	29.22	2.71
198	G198	585	10/20/2016 14:44	1087023.83	747784.68	SU-2	NO	NO	26.3	2.8
199	G199	584	10/20/2016 14:41	1087056.64	747784.68	SU-2	NO	NO	27.57	2.64
200	G200	583	10/20/2016 14:38	1087089.45	747784.68	SU-2	NO	NO	56.93	3.63
201	G201	582	10/20/2016 14:35	1087122.25	747784.68	SU-2	NO	NO	107.27	4.8
202	G202	22	9/6/2016 15:48	1087155.06	747784.68	SU-1	NO	NO	23.57	3.69
203	G203	21	9/6/2016 15:45	1087187.87	747784.68	SU-1	NO	NO	25.74	3.85
204	G204	19	9/6/2016 15:42	1087220.68	747784.68	SU-1	NO	NO	9.53	2.62
205	G205	17	9/6/2016 15:34	1087253.49	747784.68	SU-1	NO	NO	12.98	3.29
206	G206	15	9/6/2016 15:18	1087286.30	747784.68	SU-1	NO	NO	4.8	2.46
207	G207	14	9/6/2016 15:14	1087319.11	747784.68	SU-1	NO	NO	20.88	3.79
208	G208	1363	11/10/2016 17:40	1087351.91	747784.68	SU-3	NO	NO	57.04	3.52
209	G209	1362	11/10/2016 17:38	1087384.72	747784.68	SU-3	NO	NO	66.78	3.62
210	G210	1361	11/10/2016 17:36	1087417.53	747784.68	SU-3	NO	NO	26.07	2.68

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Access Restriction?	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
211	G211	1360	11/10/2016 17:34	1087450.34	747784.68	SU-3	NO	NO	21.47	2.34
212	G212	1359	11/10/2016 17:32	1087483.15	747784.68	SU-3	NO	NO	39.95	2.98
213	G213	1358	11/10/2016 17:29	1087515.96	747784.68	SU-3	NO	NO	30.4	2.69
214	G214	1351	11/10/2016 17:20	1087548.76	747784.68	SU-3	NO	NO	27.01	3.16
215	G215	1350	11/10/2016 17:16	1087581.57	747784.68	SU-3	NO	NO	27.12	2.85
216	G216	1349	11/10/2016 17:14	1087614.38	747784.68	SU-3	NO	NO	18.05	2.34
217	G217	1348	11/10/2016 17:11	1087647.19	747784.68	SU-3	NO	NO	25.2	2.47
218	G218	576	10/20/2016 14:18	1086958.21	747751.87	SU-2	NO	NO	32.49	2.72
219	G219	577	10/20/2016 14:20	1086991.02	747751.87	SU-2	NO	NO	19.35	2.53
220	G220	578	10/20/2016 14:23	1087023.83	747751.87	SU-2	NO	NO	31.45	2.69
221	G221	579	10/20/2016 14:25	1087056.64	747751.87	SU-2	NO	NO	34.53	2.97
222	G222	580	10/20/2016 14:28	1087089.45	747751.87	SU-2	NO	NO	33.87	2.85
223	G223	581	10/20/2016 14:31	1087122.25	747751.87	SU-2	NO	NO	45.63	2.95
224	G224	81	9/6/2016 14:37	1087155.06	747751.87	SU-1	NO	NO	18.43	3.25
225	G225	82	9/6/2016 14:42	1087187.87	747751.87	SU-1	NO	NO	19.57	3.28
226	G226	92	9/6/2016 16:05	1087220.68	747751.87	SU-1	NO	YES	8.15	2.53
227	G227	83	9/6/2016 14:45	1087253.49	747751.87	SU-1	NO	NO	10.63	3.09
228	G228	84	9/6/2016 14:47	1087286.30	747751.87	SU-1	NO	NO	22.87	3.72
229	G229	85	9/6/2016 14:50	1087319.11	747751.87	SU-1	NO	NO	28.51	4.1
230	G230	1337	11/10/2016 16:45	1087384.72	747751.87	SU-3	NO	NO	89.81	4.02
231	G231	1338	11/10/2016 16:48	1087417.53	747751.87	SU-3	NO	NO	19.03	2.46
232	G232	1339	11/10/2016 16:50	1087450.34	747751.87	SU-3	NO	NO	41.66	2.98
233	G233	1340	11/10/2016 16:52	1087483.15	747751.87	SU-3	NO	NO	40.94	2.74
234	G234	1342	11/10/2016 16:56	1087515.96	747751.87	SU-3	NO	NO	50.13	3.25
235	G235	1343	11/10/2016 16:58	1087548.76	747751.87	SU-3	NO	NO	82.61	3.84
236	G236	1344	11/10/2016 17:00	1087581.57	747751.87	SU-3	NO	NO	32.05	2.83
237	G237	1345	11/10/2016 17:02	1087614.38	747751.87	SU-3	NO	NO	17.27	2.47
238	G238	1346	11/10/2016 17:04	1087647.19	747751.87	SU-3	NO	NO	12.31	1.99
239	G239	1347	11/10/2016 17:06	1087680.00	747751.87	SU-3	NO	NO	37.51	2.95
240	G240	564	10/20/2016 13:44	1086991.02	747719.06	SU-2	NO	NO	30.85	2.88
241	G241	565	10/20/2016 13:47	1087023.83	747719.06	SU-2	NO	NO	28.75	2.73
242	G242	566	10/20/2016 13:49	1087056.64	747719.06	SU-2	NO	NO	25.44	2.66
243	G243	567	10/20/2016 13:51	1087089.45	747719.06	SU-2	NO	NO	31.53	2.8
244	G244	568	10/20/2016 13:54	1087122.25	747719.06	SU-2	NO	NO	29.73	2.73
245	G245	24	9/6/2016 15:52	1087187.87	747719.06	SU-1	NO	NO	9.16	3.11
246	G246	25	9/6/2016 15:57	1087220.68	747719.06	SU-1	NO	NO	19.31	4.15
247	G247	94	9/6/2016 16:28	1087253.49	747719.06	SU-1	NO	YES	19.92	3.44
248	G248	26	9/6/2016 16:00	1087286.30	747719.06	SU-1	NO	NO	27.59	4.41
249	G249	27	9/6/2016 16:02	1087319.11	747719.06	SU-1	NO	NO	20.9	3.16
250	G250	1336	11/10/2016 16:42	1087351.91	747719.06	SU-3	NO	NO	34.78	2.81
251	G251	1335	11/10/2016 16:40	1087384.72	747719.06	SU-3	NO	NO	34.73	2.71
252	G252		11/10/2016 13:28	1087417.53	747719.06	SU-3	NO	NO	30	0
253	G253	1333	11/10/2016 16:35	1087450.34	747719.06	SU-3	NO	YES	42.98	3.05
254	G254	1332	11/10/2016 16:33	1087483.15	747719.06	SU-3	NO	NO	38.47	2.84
255	G255	1331	11/10/2016 16:31	1087515.96	747719.06	SU-3	NO	NO	16.82	2.29
256	G256	1330	11/10/2016 16:29	1087548.76	747719.06	SU-3	NO	NO	34.42	2.75
257	G257	1329	11/10/2016 16:27	1087581.57	747719.06	SU-3	NO	NO	45	3.35
258	G258	575	10/20/2016 14:14	1087023.83	747686.25	SU-2	NO	NO	31.37	2.91
259	G259	574	10/20/2016 14:11	1087056.64	747686.25	SU-2	NO	NO	31.93	2.68
260	G260	573	10/20/2016 14:08	1087089.45	747686.25	SU-2	NO	NO	30.68	2.72
261	G261	572	10/20/2016 14:06	1087122.25	747686.25	SU-2	NO	NO	50.29	3.28
262	G262	571	10/20/2016 14:03	1087155.06	747686.25	SU-2	NO	NO	38.78	2.92
263	G263	570	10/20/2016 14:00	1087187.87	747686.25	SU-2	NO	NO	33.72	2.81
264	G264	89	9/6/2016 15:08	1087220.68	747686.25	SU-1	NO	NO	10.25	3.18
265	G265	88	9/6/2016 15:05	1087253.49	747686.25	SU-1	NO	NO	33.91	3.97
266	G266	87	9/6/2016 15:03	1087286.30	747686.25	SU-1	NO	NO	22.75	3.78
267	G267	86	9/6/2016 15:00	1087319.11	747686.25	SU-1	NO	NO	14.7	3.19
268	G268	1320	11/10/2016 14:49	1087351.91	747686.25	SU-3	NO	NO	19.24	2.54
269	G269	1321	11/10/2016 14:51	1087384.72	747686.25	SU-3	NO	NO	67.11	3.8
270	G270	1323	11/10/2016 14:56	1087417.53	747686.25	SU-3	NO	NO	26.49	2.47
271	G271	1324	11/10/2016 14:58	1087450.34	747686.25	SU-3	NO	NO	17.68	2.24
272	G272	1325	11/10/2016 15:00	1087483.15	747686.25	SU-3	NO	NO	52.94	4.01
273	G273	1326	11/10/2016 15:02	1087515.96	747686.25	SU-3	NO	NO	33.03	2.61
274	G274	1327	11/10/2016 15:04	1087548.76	747686.25	SU-3	NO	NO	57.12	3.24
275	G275	1328	11/10/2016 15:07	1087712.81	747686.25	SU-3	NO	NO	22.3	2.44
276	G276	552	10/19/2016 14:58	1087023.83	747653.44	SU-2	NO	NO	32.39	2.68
277	G277	551	10/19/2016 14:56	1087056.64	747653.44	SU-2	NO	NO	33.32	2.77
278	G278	550	10/19/2016 14:53	1087089.45	747653.44	SU-2	NO	NO	32.74	2.72
279	G279	549	10/19/2016 14:51	1087122.25	747653.44	SU-2	NO	NO	35.81	2.94
280	G280	548	10/19/2016 14:49	1087155.06	747653.44	SU-2	NO	NO	27.86	2.52

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Access Restriction?	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
281	G281	547	10/19/2016 14:46	1087187.87	747653.44	SU-2	NO	NO	24.53	2.61
282	G282	546	10/19/2016 14:43	1087220.68	747653.44	SU-2	NO	NO	48.77	3.48
283	G283	29	9/6/2016 16:10	1087253.49	747653.44	SU-1	NO	NO	29.67	3.82
284	G284	28	9/6/2016 16:07	1087286.30	747653.44	SU-1	NO	NO	19.15	3.31
285	G285	1318	11/10/2016 14:42	1087351.91	747653.44	SU-3	NO	NO	23.4	2.62
286	G286	1317	11/10/2016 14:40	1087384.72	747653.44	SU-3	NO	NO	27.86	2.71
287	G287	1316	11/10/2016 14:38	1087417.53	747653.44	SU-3	NO	NO	50.95	2.94
288	G288	1315	11/10/2016 14:36	1087450.34	747653.44	SU-3	NO	NO	45.47	3.17
289	G289	1314	11/10/2016 14:34	1087483.15	747653.44	SU-3	NO	NO	63.68	3.41
290	G290	1313	11/10/2016 14:32	1087515.96	747653.44	SU-3	NO	NO	53.33	3.31
291	G291	1312	11/10/2016 14:29	1087548.76	747653.44	SU-3	NO	NO	57.51	3.53
292	G292	1311	11/10/2016 14:27	1087581.57	747653.44	SU-3	NO	NO	32.8	2.68
293	G293	1310	11/10/2016 14:25	1087614.38	747653.44	SU-3	NO	NO	41.99	3.8
294	G294	1309	11/10/2016 14:23	1087680.00	747653.44	SU-3	NO	NO	57.2	3.27
295	G295	1308	11/10/2016 14:21	1087712.81	747653.44	SU-3	NO	NO	69.03	3.5
296	G296	542	10/19/2016 14:28	1087056.64	747620.63	SU-2	NO	NO	29.18	2.7
297	G297	543	10/19/2016 14:32	1087089.45	747620.63	SU-2	NO	NO	30.78	2.74
298	G298	544	10/19/2016 14:35	1087122.25	747620.63	SU-2	NO	NO	27.89	2.68
299	G299	545	10/19/2016 14:37	1087155.06	747620.63	SU-2	NO	NO	24.62	2.52
300	G300	30	9/6/2016 16:16	1087286.30	747620.63	SU-1	NO	NO	62.83	5
301	G301	1290	11/9/2016 17:34	1087319.11	747620.63	SU-3	NO	NO	19.91	2.47
302	G302	1291	11/9/2016 17:36	1087351.91	747620.63	SU-3	NO	NO	27.37	2.55
303	G303	1293	11/9/2016 17:40	1087384.72	747620.63	SU-3	NO	NO	20.54	2.56
304	G304	1294	11/9/2016 17:42	1087417.53	747620.63	SU-3	NO	NO	26.26	2.56
305	G305	815	11/1/2016 12:47	1087450.34	747620.63	SU-3	NO	YES	39.73	2.94
306	G306	1295	11/9/2016 17:45	1087483.15	747620.63	SU-3	NO	NO	28.31	2.64
307	G307	816	11/1/2016 13:00	1087515.96	747620.63	SU-3	NO	YES	49.6	3.12
308	G308	1296	11/9/2016 17:47	1087548.76	747620.63	SU-3	NO	NO	59.05	3.17
309	G309	1297	11/9/2016 17:49	1087581.57	747620.63	SU-3	NO	NO	59.67	3.23
310	G310	1289	11/9/2016 17:31	1087286.30	747587.83	SU-1	NO	NO	33.46	2.72
311	G311	1288	11/9/2016 17:29	1087319.11	747587.83	SU-3	NO	NO	29.73	2.64
312	G312	1287	11/9/2016 17:26	1087351.91	747587.83	SU-3	NO	NO	22.6	2.44
313	G313	1286	11/9/2016 17:24	1087384.72	747587.83	SU-3	NO	NO	27.09	2.85
314	G314	814	11/1/2016 12:35	1087417.53	747587.83	SU-3	NO	YES	35.65	2.89
315	G315	1285	11/9/2016 17:22	1087450.34	747587.83	SU-3	NO	NO	33.79	2.84
316	G316	1284	11/9/2016 17:20	1087483.15	747587.83	SU-3	NO	NO	59.02	3.33
317	G317	1283	11/9/2016 17:18	1087515.96	747587.83	SU-3	NO	NO	41.66	2.85
318	G318	1282	11/9/2016 17:16	1087548.76	747587.83	SU-3	NO	NO	51.58	3
319	G319	1271	11/9/2016 16:47	1087286.30	747555.02	SU-3	NO	NO	25.63	2.45
320	G320	1272	11/9/2016 16:55	1087319.11	747555.02	SU-3	NO	NO	27.27	2.66
321	G321	1273	11/9/2016 16:58	1087351.91	747555.02	SU-3	NO	NO	33.19	2.64
322	G322	1275	11/9/2016 17:01	1087384.72	747555.02	SU-3	NO	NO	102.02	4.3
323	G323	1276	11/9/2016 17:03	1087417.53	747555.02	SU-3	NO	NO	40.34	2.74
324	G324	1277	11/9/2016 17:05	1087450.34	747555.02	SU-3	NO	NO	34.74	2.55
325	G325	1278	11/9/2016 17:07	1087483.15	747555.02	SU-3	NO	NO	42.18	2.99
326	G326	1279	11/9/2016 17:09	1087515.96	747555.02	SU-3	NO	NO	41.48	2.75
327	G327	1280	11/9/2016 17:12	1087548.76	747555.02	SU-3	NO	NO	33.09	2.6
328	G328	1281	11/9/2016 17:13	1087581.57	747555.02	SU-3	NO	NO	41.24	2.98
329	G329	1266	11/9/2016 16:35	1087286.30	747522.21	SU-3	NO	NO	23.09	2.42
330	G330	1265	11/9/2016 16:33	1087319.11	747522.21	SU-3	NO	NO	26.65	2.77
331	G331	1264	11/9/2016 16:31	1087351.91	747522.21	SU-3	NO	NO	20.36	2.44
332	G332	1263	11/9/2016 16:29	1087384.72	747522.21	SU-3	NO	NO	26.55	2.56
333	G333	1262	11/9/2016 16:26	1087515.96	747522.21	SU-3	NO	NO	55.21	3.1
334	G334	1261	11/9/2016 16:22	1087548.76	747522.21	SU-3	NO	NO	42	3.02
335	G335	1260	11/9/2016 16:19	1087581.57	747522.21	SU-3	NO	NO	53.57	3.12
336	G336	1268	11/9/2016 16:39	1087286.30	747489.40	SU-3	NO	NO	21.69	2.41
337	G337	1269	11/9/2016 16:41	1087286.30	747456.59	SU-3	NO	NO	15.24	2.3
338	G338	1270	11/9/2016 16:43	1087319.11	747423.78	SU-3	NO	NO	11.33	2.13

SURVEY AREA BLUFF I

IN-SITU XRF MEASUREMENTS

GEOSPATIAL COORDINATES AND SAMPLING INFORMATION

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
1	I1	272	10/11/2016 17:50	1086531.70	747653.44	SU-4	NO	32	2.67
2	I2	275	10/11/2016 17:53	1086564.51	747653.44	SU-4	NO	34	2.84
3	I3	277	10/11/2016 17:55	1086498.90	747620.63	SU-4	NO	30	2.68
4	I4	278	10/11/2016 17:58	1086531.70	747620.63	SU-4	NO	34	2.72
5	I5	358	10/14/2016 10:43	1086564.51	747620.63	SU-4	NO	36	2.76
6	I6	271	10/11/2016 16:50	1086597.32	747620.63	SU-4	NO	35	2.78
7	I7	264	10/11/2016 16:39	1086498.90	747587.83	SU-4	NO	32	2.71
8	I8	267	10/11/2016 16:43	1086531.70	747587.83	SU-4	NO	24	2.67
9	I9	269	10/11/2016 16:46	1086564.51	747587.83	SU-4	NO	27	3.02
10	I10	357	10/14/2016 10:41	1086597.32	747587.83	SU-4	NO	18	2.65
11	I11	359	10/14/2016 10:46	1086630.13	747587.83	SU-4	NO	13	2.05
12	I12	256	10/11/2016 16:25	1086466.09	747555.02	SU-1	NO	36	2.95
13	I13	258	10/11/2016 16:28	1086498.90	747555.02	SU-4	NO	23	2.51
14	I14	259	10/11/2016 16:30	1086531.70	747555.02	SU-4	NO	25	3.17
15	I15	261	10/11/2016 16:33	1086564.51	747555.02	SU-4	NO	20	2.56
16	I16	1111	10/11/2016 13:40	1086597.32	747555.02	SU-4	NO	21	1
17	I17	482	10/17/2016 16:55	1086630.13	747555.02	SU-4	NO	11	1.94
18	I18	483	10/17/2016 16:58	1086662.94	747555.02	SU-4	NO	15	2.18
19	I19	356	10/14/2016 10:38	1086695.75	747555.02	SU-4	NO	17	2.32
20	I20	485	10/17/2016 17:00	1086728.55	747555.02	SU-4	NO	19	2.34
21	I21	360	10/14/2016 10:49	1086761.36	747555.02	SU-4	NO	22	2.44
22	I22	362	10/14/2016 10:53	1086794.17	747555.02	SU-4	NO	32	2.7
23	I23	363	10/14/2016 10:55	1086826.98	747555.02	SU-4	NO	33	2.82
24	I24	172	10/10/2016 14:49	1086236.43	747522.21	SU-1	NO	25	2.47
25	I25	332	10/12/2016 17:55	1086433.28	747522.21	SU-1	NO	28	2.71
26	I26	330	10/12/2016 17:51	1086466.09	747522.21	SU-1	NO	29	2.71
27	I27	507	10/18/2016 15:48	1086498.90	747522.21	SU-4	YES	21	2.12
28	I28	329	10/12/2016 17:48	1086531.70	747522.21	SU-4	NO	24	2.78
29	I29	328	10/12/2016 17:46	1086564.51	747522.21	SU-4	NO	21	2.51
30	I30	327	10/12/2016 17:43	1086597.32	747522.21	SU-4	NO	28	2.61
31	I31	480	10/17/2016 16:50	1086630.13	747522.21	SU-4	NO	10	2.16
32	I32	481	10/17/2016 16:52	1086662.94	747522.21	SU-4	NO	20	2.29
33	I33	355	10/14/2016 10:35	1086695.75	747522.21	SU-4	NO	26	2.63
34	I34	365	10/14/2016 10:58	1086728.55	747522.21	SU-4	NO	30	2.69
35	I35	367	10/14/2016 11:01	1086761.36	747522.21	SU-4	NO	38	3.04
36	I36	368	10/14/2016 11:03	1086794.17	747522.21	SU-4	NO	33	2.79
37	I37	369	10/14/2016 11:06	1086826.98	747522.21	SU-4	NO	35	2.76
38	I38	370	10/14/2016 11:08	1086859.79	747522.21	SU-4	NO	35	2.76
39	I39	164	10/10/2016 14:28	1086072.39	747489.40	SU-1	NO	19	2.65
40	I40	167	10/10/2016 14:33	1086105.19	747489.40	SU-1	NO	23	2.67
41	I41	168	10/10/2016 14:36	1086138.00	747489.40	SU-1	YES	24	2.84
42	I42	169	10/10/2016 14:41	1086170.81	747489.40	SU-1	NO	30	2.86
43	I43	170	10/10/2016 14:44	1086203.62	747489.40	SU-1	NO	27	2.72
44	I44	171	10/10/2016 14:46	1086236.43	747489.40	SU-1	NO	25	2.7
45	I45	319	10/12/2016 17:24	1086433.28	747489.40	SU-1	NO	24	2.65
46	I46	320	10/12/2016 17:27	1086466.09	747489.40	SU-1	NO	23	2.65
47	I47	321	10/12/2016 17:30	1086498.90	747489.40	SU-4	NO	33	2.85
48	I48	322	10/12/2016 17:32	1086531.70	747489.40	SU-4	NO	36	2.84
49	I49	323	10/12/2016 17:34	1086564.51	747489.40	SU-4	NO	21	2.57
50	I50	324	10/12/2016 17:37	1086597.32	747489.40	SU-4	NO	32	2.78
51	I51	478	10/17/2016 16:41	1086630.13	747489.40	SU-4	NO	23	2.61
52	I52	479	10/17/2016 16:44	1086662.94	747489.40	SU-4	NO	24	2.5
53	I53	354	10/14/2016 10:33	1086695.75	747489.40	SU-4	NO	28	2.95
54	I54	371	10/14/2016 11:11	1086728.55	747489.40	SU-4	NO	31	2.79
55	I55	372	10/14/2016 11:14	1086761.36	747489.40	SU-4	NO	33	2.99
56	I56	373	10/14/2016 11:18	1086794.17	747489.40	SU-4	NO	39	2.97

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
57	I57	374	10/14/2016 11:20	1086826.98	747489.40	SU-4	NO	34	2.81
58	I58	375	10/14/2016 11:22	1086859.79	747489.40	SU-4	NO	35	2.88
59	I59	488	10/17/2016 17:22	1085777.11	747456.59	SU-1	NO	10	2.03
60	I60	489	10/17/2016 17:25	1085809.92	747456.59	SU-1	NO	19	2.4
61	I61	163	10/10/2016 14:24	1086039.58	747456.59	SU-1	NO	13	2.38
62	I62	161	10/10/2016 14:20	1086072.39	747456.59	SU-1	NO	22	2.6
63	I63	160	10/10/2016 14:18	1086105.19	747456.59	SU-1	NO	34	2.82
64	I64	159	10/10/2016 14:15	1086138.00	747456.59	SU-1	NO	28	2.74
65	I65	158	10/10/2016 14:13	1086170.81	747456.59	SU-1	NO	31	2.9
66	I66	157	10/10/2016 14:10	1086203.62	747456.59	SU-1	NO	26	2.84
67	I67	156	10/10/2016 14:08	1086236.43	747456.59	SU-1	NO	28	2.76
68	I68	318	10/12/2016 17:21	1086400.47	747456.59	SU-1	NO	30	2.77
69	I69	317	10/12/2016 17:19	1086433.28	747456.59	SU-1	NO	29	2.69
70	I70	316	10/12/2016 17:16	1086466.09	747456.59	SU-1	NO	29	2.76
71	I71	314	10/12/2016 17:11	1086498.90	747456.59	SU-4	NO	38	3.14
72	I72	313	10/12/2016 17:08	1086531.70	747456.59	SU-4	NO	32	2.8
73	I73	312	10/12/2016 17:05	1086564.51	747456.59	SU-4	NO	29	2.73
74	I74	326	10/12/2016 17:39	1086597.32	747456.59	SU-4	NO	29	2.75
75	I75	474	10/17/2016 16:34	1086630.13	747456.59	SU-4	NO	22	2.38
76	I76	477	10/17/2016 16:38	1086662.94	747456.59	SU-4	NO	24	2.59
77	I77	353	10/14/2016 10:31	1086695.75	747456.59	SU-4	NO	22	2.7
78	I78	382	10/14/2016 11:36	1086728.55	747456.59	SU-4	NO	31	2.69
79	I79	381	10/14/2016 11:34	1086761.36	747456.59	SU-4	NO	32	2.75
80	I80	380	10/14/2016 11:31	1086794.17	747456.59	SU-4	NO	29	2.93
81	I81	377	10/14/2016 11:27	1086826.98	747456.59	SU-4	NO	30	2.87
82	I82	376	10/14/2016 11:25	1086859.79	747456.59	SU-4	NO	42	2.95
83	I83	486	10/17/2016 17:07	1086892.60	747456.59	SU-4	NO	34	3.01
84	I84	487	10/17/2016 17:09	1086925.40	747456.59	SU-5	NO	13	2.02
85	I85	490	10/17/2016 17:27	1085777.11	747423.78	SU-1	NO	22	2.36
86	I86	491	10/17/2016 17:29	1085809.92	747423.78	SU-1	NO	21	2.44
87	I87	145	10/10/2016 13:37	1086006.77	747423.78	SU-1	NO	27	2.92
88	I88	1111	10/10/2016 23:30	1086039.58	747423.78	SU-1	NO	18	1
89	I89	147	10/10/2016 13:42	1086072.39	747423.78	SU-1	NO	29	2.83
90	I90	148	10/10/2016 13:45	1086105.19	747423.78	SU-1	NO	33	2.96
91	I91	149	10/10/2016 13:48	1086138.00	747423.78	SU-1	NO	36	2.84
92	I92	150	10/10/2016 13:50	1086170.81	747423.78	SU-1	NO	25	2.61
93	I93	151	10/10/2016 13:53	1086203.62	747423.78	SU-1	NO	30	2.74
94	I94	152	10/10/2016 13:55	1086236.43	747423.78	SU-1	NO	29	2.91
95	I95	153	10/10/2016 13:58	1086269.24	747423.78	SU-1	NO	43	3.05
96	I96	154	10/10/2016 14:02	1086302.04	747423.78	SU-1	NO	30	2.98
97	I97	155	10/10/2016 14:04	1086334.85	747423.78	SU-1	NO	36	2.94
98	I98	503	10/18/2016 15:34	1086367.66	747423.78	SU-1	NO	5	1.69
99	I99	505	10/18/2016 15:38	1086400.47	747423.78	SU-1	NO	10	1.7
100	I100	307	10/12/2016 16:48	1086433.28	747423.78	SU-1	NO	30	2.72
101	I101	308	10/12/2016 16:51	1086466.09	747423.78	SU-1	NO	30	2.95
102	I102	309	10/12/2016 16:54	1086498.90	747423.78	SU-4	NO	33	2.87
103	I103	310	10/12/2016 16:57	1086531.70	747423.78	SU-4	NO	30	2.84
104	I104	311	10/12/2016 17:00	1086564.51	747423.78	SU-4	NO	33	2.84
105	I105	471	10/17/2016 16:20	1086597.32	747423.78	SU-4	NO	24	2.46
106	I106	472	10/17/2016 16:22	1086630.13	747423.78	SU-4	NO	36	2.9
107	I107	473	10/17/2016 16:24	1086662.94	747423.78	SU-4	NO	21	2.52
108	I108	351	10/14/2016 10:28	1086695.75	747423.78	SU-4	NO	26	2.66
109	I109	383	10/14/2016 11:39	1086728.55	747423.78	SU-4	NO	25	2.86
110	I110	384	10/14/2016 11:42	1086761.36	747423.78	SU-4	NO	36	2.87
111	I111	385	10/14/2016 11:45	1086794.17	747423.78	SU-4	NO	38	2.8
112	I112	386	10/14/2016 11:47	1086826.98	747423.78	SU-4	NO	32	2.74

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
113	I113	389	10/14/2016 11:53	1086859.79	747423.78	SU-4	YES	37	2.88
114	I114	390	10/14/2016 11:57	1086892.60	747423.78	SU-4	YES	32	2.85
115	I115	391	10/14/2016 12:01	1086925.40	747423.78	SU-5	NO	31	2.68
116	I116	392	10/14/2016 12:03	1086958.21	747423.78	SU-5	NO	36	2.92
117	I117	393	10/14/2016 12:05	1086991.02	747423.78	SU-5	NO	35	2.78
118	I118	184	10/10/2016 15:24	1086006.77	747390.98	SU-1	NO	21	2.63
119	I119	182	10/10/2016 15:20	1086039.58	747390.98	SU-1	NO	37	3.05
120	I120	181	10/10/2016 15:17	1086072.39	747390.98	SU-1	NO	27	2.6
121	I121	180	10/10/2016 15:15	1086105.19	747390.98	SU-1	NO	33	2.91
122	I122	179	10/10/2016 15:12	1086138.00	747390.98	SU-1	NO	31	2.86
123	I123	178	10/10/2016 15:06	1086170.81	747390.98	SU-1	YES	21	2.79
124	I124	177	10/10/2016 15:03	1086203.62	747390.98	SU-1	NO	26	2.6
125	I125	176	10/10/2016 15:01	1086236.43	747390.98	SU-1	NO	34	3.11
126	I126	175	10/10/2016 14:58	1086269.24	747390.98	SU-1	NO	30	2.86
127	I127	174	10/10/2016 14:56	1086302.04	747390.98	SU-1	NO	43	3.63
128	I128	173	10/10/2016 14:54	1086334.85	747390.98	SU-1	NO	37	3.04
129	I129	506	10/18/2016 15:41	1086367.66	747390.98	SU-1	YES	27	2.62
130	I130	305	10/12/2016 16:44	1086400.47	747390.98	SU-1	NO	32	2.74
131	I131	304	10/12/2016 16:41	1086433.28	747390.98	SU-1	NO	34	2.81
132	I132	303	10/12/2016 16:39	1086466.09	747390.98	SU-1	NO	30	2.71
133	I133	302	10/12/2016 16:36	1086498.90	747390.98	SU-4	NO	27	2.73
134	I134	301	10/12/2016 16:34	1086531.70	747390.98	SU-4	NO	22	2.66
135	I135	1088	11/7/2016 15:19	1086630.13	747390.98	SU-4	NO	33	3.14
136	I136	1089	11/7/2016 15:22	1086662.94	747390.98	SU-4	NO	18	2.89
137	I137	350	10/14/2016 10:24	1086695.75	747390.98	SU-4	NO	30	2.82
138	I138	1092	11/7/2016 15:28	1086728.55	747390.98	SU-4	NO	24	2.86
139	I139	1093	11/7/2016 15:30	1086761.36	747390.98	SU-4	NO	78	3.91
140	I140	1094	11/7/2016 15:32	1086794.17	747390.98	SU-4	NO	25	2.74
141	I141	1095	11/7/2016 15:34	1086826.98	747390.98	SU-4	NO	32	3.11
142	I142	416	10/14/2016 14:10	1086859.79	747390.98	SU-4	NO	28	2.65
143	I143	414	10/14/2016 14:08	1086892.60	747390.98	SU-4	NO	36	2.85
144	I144	413	10/14/2016 14:05	1086925.40	747390.98	SU-5	NO	31	2.91
145	I145	412	10/14/2016 14:03	1086958.21	747390.98	SU-5	NO	39	2.98
146	I146	411	10/14/2016 14:01	1086991.02	747390.98	SU-5	NO	35	2.87
147	I147	410	10/14/2016 13:59	1087023.83	747390.98	SU-5	NO	38	2.91
148	I148	409	10/14/2016 13:56	1087056.64	747390.98	SU-5	NO	33	2.98
149	I149	187	10/10/2016 17:20	1086039.58	747358.17	SU-1	YES	46	3.07
150	I150	188	10/10/2016 17:24	1086072.39	747358.17	SU-1	NO	29	2.9
151	I151	189	10/10/2016 17:27	1086105.19	747358.17	SU-1	NO	40	2.92
152	I152	190	10/10/2016 17:29	1086138.00	747358.17	SU-1	NO	38	2.99
153	I153	191	10/10/2016 17:31	1086170.81	747358.17	SU-1	YES	28	2.72
154	I154	192	10/10/2016 17:38	1086203.62	747358.17	SU-1	NO	30	2.74
155	I155	193	10/10/2016 17:41	1086236.43	747358.17	SU-1	NO	41	3.16
156	I156	194	10/10/2016 17:43	1086269.24	747358.17	SU-1	NO	33	2.94
157	I157	195	10/10/2016 17:46	1086302.04	747358.17	SU-1	NO	43	2.98
158	I158	196	10/10/2016 17:49	1086334.85	747358.17	SU-1	NO	37	2.91
159	I159	255	10/11/2016 16:19	1086367.66	747358.17	SU-1	NO	29	2.56
160	I160	254	10/11/2016 16:17	1086400.47	747358.17	SU-1	NO	32	2.83
161	I161	252	10/11/2016 16:13	1086433.28	747358.17	SU-1	NO	29	2.59
162	I162	250	10/11/2016 16:10	1086466.09	747358.17	SU-1	NO	39	3.1
163	I163	249	10/11/2016 16:06	1086498.90	747358.17	SU-4	NO	22	2.45
164	I164	1087	11/7/2016 15:16	1086531.70	747358.17	SU-4	NO	20	2.53
165	I165	1086	11/7/2016 15:14	1086564.51	747358.17	SU-3	NO	15	2.06
166	I166	1084	11/7/2016 15:12	1086597.32	747358.17	SU-3	NO	18	2.42
167	I167	1083	11/7/2016 15:10	1086630.13	747358.17	SU-3	NO	27	2.6
168	I168	1082	11/7/2016 15:08	1086662.94	747358.17	SU-3	NO	28	2.61

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
169	I169	1081	11/7/2016 15:06	1086695.75	747358.17	SU-3	NO	15	2.24
170	I170	394	10/14/2016 13:24	1086761.36	747358.17	SU-4	NO	25	2.79
171	I171	395	10/14/2016 13:27	1086794.17	747358.17	SU-4	NO	32	3.06
172	I172	396	10/14/2016 13:29	1086826.98	747358.17	SU-4	NO	34	2.84
173	I173	397	10/14/2016 13:32	1086859.79	747358.17	SU-4	NO	33	2.74
174	I174	398	10/14/2016 13:34	1086892.60	747358.17	SU-4	NO	36	2.67
175	I175	399	10/14/2016 13:36	1086925.40	747358.17	SU-5	NO	41	3.13
176	I176	400	10/14/2016 13:38	1086958.21	747358.17	SU-5	NO	46	3.3
177	I177	401	10/14/2016 13:40	1086991.02	747358.17	SU-5	NO	25	2.95
178	I178	402	10/14/2016 13:42	1087023.83	747358.17	SU-5	NO	33	2.97
179	I179	405	10/14/2016 13:46	1087056.64	747358.17	SU-5	NO	36	2.93
180	I180	406	10/14/2016 13:48	1087089.45	747358.17	SU-5	NO	38	2.95
181	I181	407	10/14/2016 13:50	1087122.25	747358.17	SU-5	NO	37	2.87
182	I182	408	10/14/2016 13:53	1087155.06	747358.17	SU-5	NO	32	2.72
183	I183	210	10/10/2016 18:13	1086072.39	747325.36	SU-1	NO	27	2.82
184	I184	207	10/10/2016 18:10	1086105.19	747325.36	SU-1	NO	40	2.95
185	I185	206	10/10/2016 18:07	1086138.00	747325.36	SU-1	NO	33	2.82
186	I186	205	10/10/2016 18:05	1086170.81	747325.36	SU-1	NO	32	2.86
187	I187	204	10/10/2016 18:03	1086203.62	747325.36	SU-1	NO	29	2.72
188	I188	201	10/10/2016 17:59	1086236.43	747325.36	SU-1	NO	39	2.95
189	I189	199	10/10/2016 17:57	1086269.24	747325.36	SU-1	NO	38	2.82
190	I190	198	10/10/2016 17:55	1086302.04	747325.36	SU-1	NO	40	2.92
191	I191	197	10/10/2016 17:52	1086334.85	747325.36	SU-1	NO	35	2.82
192	I192	1097	11/7/2016 15:46	1086367.66	747325.36	SU-1	NO	50	3.39
193	I193	1096	11/7/2016 15:45	1086400.47	747325.36	SU-1	NO	21	2.16
194	I194	248	10/11/2016 15:59	1086433.28	747325.36	SU-1	NO	30	2.7
195	I195	247	10/11/2016 15:54	1086466.09	747325.36	SU-1	YES	28	3.19
196	I196	246	10/11/2016 15:47	1086498.90	747325.36	SU-4	YES	32	2.67
197	I197	1073	11/7/2016 14:49	1086531.70	747325.36	SU-3	NO	20	2.33
198	I198	1074	11/7/2016 14:51	1086564.51	747325.36	SU-3	NO	39	3.04
199	I199	1075	11/7/2016 14:53	1086597.32	747325.36	SU-3	NO	15	2.18
200	I200	1076	11/7/2016 14:55	1086630.13	747325.36	SU-3	NO	19	2.37
201	I201	1077	11/7/2016 14:57	1086662.94	747325.36	SU-3	NO	10	2.06
202	I202	1078	11/7/2016 14:59	1086695.75	747325.36	SU-3	NO	18	2.19
203	I203	1079	11/7/2016 15:01	1086728.55	747325.36	SU-5	NO	25	2.4
204	I204	1080	11/7/2016 15:03	1086761.36	747325.36	SU-4	NO	22	2.47
205	I205	850	11/2/2016 13:26	1086794.17	747325.36	SU-4	YES	27	2.74
206	I206	417	10/14/2016 17:28	1086826.98	747325.36	SU-4	NO	30	2.75
207	I207	418	10/14/2016 17:30	1086859.79	747325.36	SU-4	NO	38	2.92
208	I208	419	10/14/2016 17:32	1086892.60	747325.36	SU-4	NO	35	3.16
209	I209	420	10/14/2016 17:34	1086925.40	747325.36	SU-5	NO	45	4.68
210	I210	421	10/14/2016 17:36	1086958.21	747325.36	SU-5	NO	23	3.13
211	I211	422	10/14/2016 17:38	1086991.02	747325.36	SU-5	NO	35	2.88
212	I212	423	10/14/2016 17:40	1087023.83	747325.36	SU-5	NO	35	2.76
213	I213	424	10/14/2016 17:43	1087056.64	747325.36	SU-5	NO	32	3.04
214	I214	425	10/14/2016 17:46	1087089.45	747325.36	SU-5	NO	34	2.87
215	I215	426	10/14/2016 17:48	1087122.25	747325.36	SU-5	NO	39	2.97
216	I216	427	10/14/2016 17:51	1087155.06	747325.36	SU-5	NO	36	3.07
217	I217	823	11/1/2016 17:07	1086105.19	747292.55	SU-2	NO	14	2.32
218	I218	469	10/17/2016 16:03	1086138.00	747292.55	SU-1	NO	42	3.05
219	I219	470	10/17/2016 16:05	1086170.81	747292.55	SU-1	NO	16	2.21
220	I220	1111	10/11/2016 8:39	1086203.62	747292.55	SU-1	NO	29	1
221	I221	233	10/11/2016 10:49	1086236.43	747292.55	SU-1	NO	29	2.91
222	I222	234	10/11/2016 10:52	1086269.24	747292.55	SU-1	NO	35	2.8
223	I223	236	10/11/2016 10:55	1086302.04	747292.55	SU-1	NO	26	2.88
224	I224	237	10/11/2016 10:57	1086334.85	747292.55	SU-1	NO	34	2.84

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
225	I225	1098	11/7/2016 15:49	1086367.66	747292.55	SU-1	NO	52	3.21
226	I226	1099	11/7/2016 15:50	1086400.47	747292.55	SU-1	NO	37	2.92
227	I227	245	10/11/2016 15:30	1086433.28	747292.55	SU-1	NO	38	2.92
228	I228	244	10/11/2016 15:27	1086466.09	747292.55	SU-1	NO	36	3.04
229	I229	1072	11/7/2016 14:45	1086531.70	747292.55	SU-3	NO	16	2.18
230	I230	1071	11/7/2016 14:43	1086564.51	747292.55	SU-3	NO	20	2.28
231	I231	1070	11/7/2016 14:41	1086597.32	747292.55	SU-3	NO	27	2.6
232	I232	1069	11/7/2016 14:39	1086630.13	747292.55	SU-3	NO	16	2.37
233	I233	1067	11/7/2016 14:36	1086662.94	747292.55	SU-3	NO	25	2.35
234	I234	1066	11/7/2016 14:34	1086695.75	747292.55	SU-3	NO	15	2.24
235	I235	1065	11/7/2016 14:32	1086728.55	747292.55	SU-5	NO	9	1.93
236	I236	1064	11/7/2016 14:30	1086761.36	747292.55	SU-5	NO	28	2.61
237	I237	1063	11/7/2016 14:28	1086794.17	747292.55	SU-5	NO	34	2.66
238	I238	445	10/17/2016 10:18	1086826.98	747292.55	SU-4	NO	30	3.19
239	I239	444	10/17/2016 10:14	1086859.79	747292.55	SU-4	NO	39	2.78
240	I240	446	10/17/2016 10:20	1086892.60	747292.55	SU-5	NO	29	2.52
241	I241	447	10/17/2016 10:22	1086925.40	747292.55	SU-5	NO	27	2.53
242	I242	448	10/17/2016 10:25	1086958.21	747292.55	SU-5	NO	33	3.31
243	I243	449	10/17/2016 10:27	1086991.02	747292.55	SU-5	NO	34	2.83
244	I244	433	10/14/2016 18:07	1087023.83	747292.55	SU-5	NO	31	2.8
245	I245	431	10/14/2016 18:03	1087056.64	747292.55	SU-5	NO	46	3.2
246	I246	430	10/14/2016 18:01	1087089.45	747292.55	SU-5	NO	38	3.07
247	I247	429	10/14/2016 17:58	1087122.25	747292.55	SU-5	NO	40	3
248	I248	428	10/14/2016 17:55	1087155.06	747292.55	SU-5	NO	34	2.86
249	I249	1100	11/7/2016 17:46	1087253.49	747292.55	SU-6	NO	18	3.05
250	I250	1101	11/7/2016 17:48	1087286.30	747292.55	SU-6	NO	14	2.34
251	I251	824	11/1/2016 17:12	1086105.19	747259.74	SU-2	YES	12	2.22
252	I252	825	11/1/2016 17:15	1086138.00	747259.74	SU-2	NO	23	2.44
253	I253	826	11/1/2016 17:17	1086170.81	747259.74	SU-2	NO	11	2.14
254	I254	827	11/1/2016 17:20	1086203.62	747259.74	SU-1	NO	20	2.27
255	I255	829	11/1/2016 17:24	1086236.43	747259.74	SU-2	NO	9	1.94
256	I256	1255	11/9/2016 12:08	1086269.24	747259.74	SU-2	NO	34	2.72
257	I257	1256	11/9/2016 12:09	1086302.04	747259.74	SU-1	NO	34	2.7
258	I258	1257	11/9/2016 12:11	1086334.85	747259.74	SU-1	NO	18	2.35
259	I259	1258	11/9/2016 12:15	1086367.66	747259.74	SU-1	NO	29	2.61
260	I260	1259	11/9/2016 12:17	1086400.47	747259.74	SU-1	NO	26	2.57
261	I261	243	10/11/2016 15:24	1086433.28	747259.74	SU-1	NO	40	2.83
262	I262	241	10/11/2016 15:20	1086466.09	747259.74	SU-1	NO	29	2.6
263	I263	1053	11/7/2016 14:06	1086498.90	747259.74	SU-3	NO	15	2.28
264	I264	1054	11/7/2016 14:08	1086531.70	747259.74	SU-3	NO	24	2.6
265	I265	1055	11/7/2016 14:10	1086564.51	747259.74	SU-3	NO	11	2.02
266	I266	1056	11/7/2016 14:12	1086597.32	747259.74	SU-3	NO	27	2.55
267	I267	871	11/2/2016 16:57	1086630.13	747259.74	SU-3	YES	26	2.52
268	I268	1057	11/7/2016 14:14	1086662.94	747259.74	SU-3	NO	24	2.64
269	I269	1058	11/7/2016 14:16	1086695.75	747259.74	SU-3	NO	14	2.08
270	I270	1059	11/7/2016 14:18	1086728.55	747259.74	SU-5	NO	24	2.5
271	I271	1060	11/7/2016 14:20	1086761.36	747259.74	SU-5	NO	21	2.21
272	I272	1061	11/7/2016 14:23	1086794.17	747259.74	SU-5	NO	14	2.03
273	I273	1062	11/7/2016 14:25	1086826.98	747259.74	SU-4	NO	27	2.62
274	I274	450	10/17/2016 10:30	1086859.79	747259.74	SU-4	NO	35	2.71
275	I275	451	10/17/2016 10:33	1086892.60	747259.74	SU-5	NO	27	2.71
276	I276	452	10/17/2016 10:35	1086925.40	747259.74	SU-5	NO	37	2.68
277	I277	453	10/17/2016 10:37	1086958.21	747259.74	SU-5	NO	34	2.89
278	I278	454	10/17/2016 10:40	1086991.02	747259.74	SU-5	NO	27	2.93
279	I279	455	10/17/2016 10:42	1087023.83	747259.74	SU-5	NO	39	2.87
280	I280	456	10/17/2016 10:45	1087056.64	747259.74	SU-5	YES	47	3.44

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
281	I281	458	10/17/2016 11:13	1087089.45	747259.74	SU-5	NO	42	2.86
282	I282	459	10/17/2016 11:15	1087122.25	747259.74	SU-5	NO	37	3.19
283	I283	460	10/17/2016 11:17	1087155.06	747259.74	SU-6	NO	35	2.9
284	I284	1102	11/7/2016 17:50	1087187.87	747259.74	SU-6	NO	47	2.93
285	I285	1103	11/7/2016 17:52	1087220.68	747259.74	SU-6	NO	9	1.87
286	I286	843	11/2/2016 11:46	1087253.49	747259.74	SU-6	YES	36	2.95
287	I287	1104	11/7/2016 17:54	1087286.30	747259.74	SU-6	NO	32	2.77
288	I288	1105	11/7/2016 17:56	1087319.11	747259.74	SU-6	NO	19	2.25
289	I289	1106	11/7/2016 17:58	1087351.91	747259.74	SU-6	NO	31	2.97
290	I290	834	11/1/2016 17:37	1086138.00	747226.93	SU-2	NO	17	2.33
291	I291	833	11/1/2016 17:35	1086170.81	747226.93	SU-2	NO	6	1.78
292	I292	832	11/1/2016 17:31	1086203.62	747226.93	SU-2	NO	12	2.26
293	I293	831	11/1/2016 17:29	1086236.43	747226.93	SU-2	NO	9	1.91
294	I294	830	11/1/2016 17:27	1086269.24	747226.93	SU-2	NO	15	2.38
295	I295	910	11/3/2016 12:55	1086302.04	747226.93	SU-2	NO	14	2.32
296	I296	909	11/3/2016 12:50	1086367.66	747226.93	SU-1	NO	30	2.52
297	I297	238	10/11/2016 15:12	1086400.47	747226.93	SU-1	NO	39	3.19
298	I298	1111	10/11/2016 13:07	1086433.28	747226.93	SU-1	NO	31	1
299	I299	908	11/3/2016 12:47	1086466.09	747226.93	SU-3	NO	45	3.19
300	I300	907	11/3/2016 12:45	1086498.90	747226.93	SU-3	NO	44	2.93
301	I301	906	11/3/2016 12:43	1086531.70	747226.93	SU-3	NO	44	2.88
302	I302	870	11/2/2016 16:46	1086564.51	747226.93	SU-3	YES	21	2.65
303	I303	905	11/3/2016 12:40	1086597.32	747226.93	SU-3	NO	35	2.76
304	I304	903	11/3/2016 12:36	1086630.13	747226.93	SU-3	NO	32	2.56
305	I305	902	11/3/2016 12:34	1086662.94	747226.93	SU-3	NO	52	3.28
306	I306	901	11/3/2016 12:33	1086695.75	747226.93	SU-3	NO	47	3.02
307	I307	900	11/3/2016 12:31	1086728.55	747226.93	SU-5	NO	40	2.96
308	I308	1245	11/9/2016 11:44	1086761.36	747226.93	SU-5	NO	34	2.66
309	I309	1246	11/9/2016 11:47	1086794.17	747226.93	SU-5	NO	42	2.79
310	I310	1253	11/9/2016 12:01	1086826.98	747226.93	SU-5	NO	33	2.78
311	I311	1254	11/9/2016 12:03	1086859.79	747226.93	SU-5	NO	23	2.53
312	I312	468	10/17/2016 11:38	1086892.60	747226.93	SU-5	NO	26	2.78
313	I313	467	10/17/2016 11:35	1086925.40	747226.93	SU-5	NO	35	2.81
314	I314	466	10/17/2016 11:33	1086958.21	747226.93	SU-5	NO	37	3.03
315	I315	465	10/17/2016 11:31	1086991.02	747226.93	SU-5	NO	32	2.77
316	I316	464	10/17/2016 11:29	1087023.83	747226.93	SU-5	NO	50	3.03
317	I317	463	10/17/2016 11:27	1087056.64	747226.93	SU-5	NO	40	3.25
318	I318	462	10/17/2016 11:23	1087089.45	747226.93	SU-5	YES	39	2.93
319	I319	461	10/17/2016 11:21	1087122.25	747226.93	SU-5	NO	43	2.91
320	I320	1114	11/7/2016 18:14	1087155.06	747226.93	SU-6	NO	20	2.42
321	I321	1113	11/7/2016 18:12	1087187.87	747226.93	SU-6	NO	24	2.43
322	I322	1112	11/7/2016 18:10	1087220.68	747226.93	SU-6	NO	41	2.93
323	I323	1111	11/7/2016 18:08	1087253.49	747226.93	SU-6	NO	19	2.13
324	I324	1110	11/7/2016 18:06	1087286.30	747226.93	SU-6	NO	43	2.88
325	I325	844	11/2/2016 11:54	1087319.11	747226.93	SU-6	YES	27	2.8
326	I326	1109	11/7/2016 18:04	1087351.91	747226.93	SU-6	NO	23	2.43
327	I327	1108	11/7/2016 18:02	1087384.72	747226.93	SU-6	NO	32	2.72
328	I328	835	11/1/2016 17:40	1086138.00	747194.13	SU-2	NO	3	1.58
329	I329	836	11/1/2016 17:45	1086170.81	747194.13	SU-2	YES	23	2.44
330	I330	885	11/3/2016 11:59	1086203.62	747194.13	SU-2	NO	10	2.15
331	I331	886	11/3/2016 12:01	1086236.43	747194.13	SU-2	NO	12	2.15
332	I332	861	11/2/2016 15:19	1086269.24	747194.13	SU-2	YES	18	2.34
333	I333	887	11/3/2016 12:04	1086302.04	747194.13	SU-2	NO	19	2.57
334	I334	888	11/3/2016 12:06	1086334.85	747194.13	SU-3	NO	14	2.32
335	I335	889	11/3/2016 12:08	1086367.66	747194.13	SU-3	NO	20	2.48
336	I336	890	11/3/2016 12:10	1086400.47	747194.13	SU-3	NO	42	3

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
337	I337	891	11/3/2016 12:12	1086433.28	747194.13	SU-3	NO	48	2.98
338	I338	892	11/3/2016 12:14	1086466.09	747194.13	SU-3	NO	46	2.88
339	I339	893	11/3/2016 12:16	1086498.90	747194.13	SU-3	NO	50	3
340	I340	894	11/3/2016 12:18	1086531.70	747194.13	SU-3	NO	76	3.43
341	I341	895	11/3/2016 12:20	1086564.51	747194.13	SU-3	NO	48	2.94
342	I342	1052	11/7/2016 14:01	1086597.32	747194.13	SU-3	NO	8	1.67
343	I343	896	11/3/2016 12:22	1086630.13	747194.13	SU-3	NO	41	2.78
344	I344	897	11/3/2016 12:24	1086662.94	747194.13	SU-3	NO	41	2.95
345	I345	898	11/3/2016 12:26	1086695.75	747194.13	SU-3	NO	42	3.08
346	I346	899	11/3/2016 12:28	1086728.55	747194.13	SU-5	NO	46	2.97
347	I347	1243	11/9/2016 11:40	1086761.36	747194.13	SU-5	NO	32	2.65
348	I348	1242	11/9/2016 11:38	1086794.17	747194.13	SU-5	NO	33	2.54
349	I349	1241	11/9/2016 11:36	1086826.98	747194.13	SU-5	NO	22	2.36
350	I350	1240	11/9/2016 11:34	1086859.79	747194.13	SU-5	NO	45	2.86
351	I351	1239	11/9/2016 11:32	1086892.60	747194.13	SU-5	NO	18	2.27
352	I352	1238	11/9/2016 11:30	1086925.40	747194.13	SU-5	NO	25	2.39
353	I353	1237	11/9/2016 11:28	1086958.21	747194.13	SU-5	NO	43	2.85
354	I354	1236	11/9/2016 11:26	1086991.02	747194.13	SU-5	NO	35	2.78
355	I355	847	11/2/2016 12:42	1087089.45	747194.13	SU-5	YES	34	3.1
356	I356	1115	11/7/2016 18:17	1087122.25	747194.13	SU-6	NO	76	3.61
357	I357	1116	11/7/2016 18:19	1087155.06	747194.13	SU-6	NO	31	2.78
358	I358	1117	11/7/2016 18:20	1087187.87	747194.13	SU-6	NO	19	2.25
359	I359	1118	11/7/2016 18:22	1087220.68	747194.13	SU-6	NO	46	2.92
360	I360	1120	11/7/2016 18:26	1087253.49	747194.13	SU-6	NO	22	2.25
361	I361	1127	11/7/2016 18:35	1087286.30	747194.13	SU-6	NO	32	2.58
362	I362	1128	11/7/2016 18:37	1087319.11	747194.13	SU-6	NO	27	2.44
363	I363	1129	11/7/2016 18:43	1087351.91	747194.13	SU-6	NO	24	2.43
364	I364	1130	11/7/2016 18:44	1087384.72	747194.13	SU-6	NO	11	2.05
365	I365	1131	11/7/2016 18:46	1087417.53	747194.13	SU-6	NO	26	2.69
366	I366	911	11/3/2016 13:00	1086105.19	747161.32	SU-2	NO	8	1.94
367	I367	912	11/3/2016 13:02	1086138.00	747161.32	SU-2	NO	5	2.04
368	I368	913	11/3/2016 13:04	1086170.81	747161.32	SU-2	NO	12	2.11
369	I369	914	11/3/2016 13:06	1086203.62	747161.32	SU-2	NO	11	2.14
370	I370	915	11/3/2016 13:09	1086236.43	747161.32	SU-2	NO	22	2.55
371	I371	916	11/3/2016 13:11	1086269.24	747161.32	SU-2	NO	24	2.43
372	I372	917	11/3/2016 13:13	1086302.04	747161.32	SU-2	NO	9	1.99
373	I373	918	11/3/2016 13:15	1086334.85	747161.32	SU-3	NO	14	2.3
374	I374	919	11/3/2016 13:17	1086367.66	747161.32	SU-3	NO	28	2.76
375	I375	921	11/3/2016 13:21	1086400.47	747161.32	SU-3	NO	29	2.77
376	I376	922	11/3/2016 13:23	1086433.28	747161.32	SU-3	NO	45	2.94
377	I377	923	11/3/2016 13:25	1086466.09	747161.32	SU-3	NO	50	3.1
378	I378	865	11/2/2016 15:52	1086498.90	747161.32	SU-3	YES	62	3.97
379	I379	924	11/3/2016 13:27	1086531.70	747161.32	SU-3	NO	46	3.13
380	I380	925	11/3/2016 13:29	1086564.51	747161.32	SU-3	NO	46	3.01
381	I381	926	11/3/2016 13:31	1086597.32	747161.32	SU-3	NO	42	2.96
382	I382	927	11/3/2016 13:34	1086630.13	747161.32	SU-3	NO	64	3.27
383	I383	928	11/3/2016 13:36	1086662.94	747161.32	SU-3	NO	46	3.02
384	I384	929	11/3/2016 13:38	1086695.75	747161.32	SU-3	NO	34	2.82
385	I385	930	11/3/2016 13:40	1086728.55	747161.32	SU-5	NO	55	3.13
386	I386	1205	11/8/2016 16:23	1086761.36	747161.32	SU-5	NO	13	2.08
387	I387	1207	11/8/2016 16:27	1086794.17	747161.32	SU-5	NO	23	2.38
388	I388	849	11/2/2016 13:10	1086826.98	747161.32	SU-5	YES	34	2.66
389	I389	1208	11/8/2016 16:29	1086859.79	747161.32	SU-5	NO	33	2.68
390	I390	1209	11/8/2016 16:32	1086892.60	747161.32	SU-5	NO	26	2.4
391	I391	1210	11/8/2016 16:37	1086925.40	747161.32	SU-5	NO	18	2.12
392	I392	1211	11/8/2016 16:39	1086958.21	747161.32	SU-5	NO	27	2.58

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
393	I393	1212	11/8/2016 16:43	1086991.02	747161.32	SU-5	NO	16	2.01
394	I394	1213	11/8/2016 16:45	1087023.83	747161.32	SU-5	NO	16	2.38
395	I395	1214	11/8/2016 16:47	1087056.64	747161.32	SU-5	NO	28	2.73
396	I396	1215	11/8/2016 16:49	1087089.45	747161.32	SU-6	NO	59	3.34
397	I397	1216	11/8/2016 16:50	1087122.25	747161.32	SU-6	NO	23	2.57
398	I398	1217	11/8/2016 16:52	1087155.06	747161.32	SU-6	NO	35	2.76
399	I399	1218	11/8/2016 16:54	1087187.87	747161.32	SU-6	NO	39	2.65
400	I400	1219	11/8/2016 16:56	1087220.68	747161.32	SU-6	NO	35	2.79
401	I401	1220	11/8/2016 16:58	1087253.49	747161.32	SU-6	NO	21	2.22
402	I402	1221	11/8/2016 17:00	1087286.30	747161.32	SU-6	NO	21	2.23
403	I403	1222	11/8/2016 17:01	1087319.11	747161.32	SU-6	NO	25	2.48
404	I404	1223	11/8/2016 17:03	1087351.91	747161.32	SU-6	NO	16	2.21
405	I405	1224	11/8/2016 17:05	1087384.72	747161.32	SU-6	NO	21	2.17
406	I406	1225	11/8/2016 17:07	1087417.53	747161.32	SU-6	NO	17	2.25
407	I407	931	11/4/2016 12:46	1086072.39	747128.51	SU-2	NO	13	2.64
408	I408	932	11/4/2016 12:48	1086105.19	747128.51	SU-2	NO	13	2.26
409	I409	933	11/4/2016 12:50	1086138.00	747128.51	SU-2	NO	19	2.34
410	I410	934	11/4/2016 12:52	1086170.81	747128.51	SU-2	NO	0	3.36
411	I411	935	11/4/2016 12:55	1086203.62	747128.51	SU-2	NO	7	1.9
412	I412	942	11/4/2016 13:05	1086236.43	747128.51	SU-2	NO	12	2.11
413	I413	943	11/4/2016 13:07	1086269.24	747128.51	SU-2	NO	9	2.06
414	I414	944	11/4/2016 13:09	1086302.04	747128.51	SU-2	NO	13	2.15
415	I415	864	11/2/2016 15:38	1086334.85	747128.51	SU-3	YES	14	2.21
416	I416	945	11/4/2016 13:11	1086367.66	747128.51	SU-3	NO	51	3.39
417	I417	946	11/4/2016 13:14	1086400.47	747128.51	SU-3	NO	27	2.59
418	I418	947	11/4/2016 13:16	1086433.28	747128.51	SU-3	NO	53	3.36
419	I419	948	11/4/2016 13:18	1086466.09	747128.51	SU-3	NO	44	2.95
420	I420	949	11/4/2016 13:20	1086498.90	747128.51	SU-3	NO	59	3.28
421	I421	950	11/4/2016 13:22	1086531.70	747128.51	SU-3	NO	56	3.08
422	I422	951	11/4/2016 13:24	1086564.51	747128.51	SU-3	NO	69	3.34
423	I423	952	11/4/2016 13:26	1086597.32	747128.51	SU-3	NO	51	3.06
424	I424	953	11/4/2016 13:29	1086630.13	747128.51	SU-3	NO	54	3.3
425	I425	955	11/4/2016 13:32	1086662.94	747128.51	SU-3	NO	63	3.45
426	I426	956	11/4/2016 13:34	1086695.75	747128.51	SU-3	NO	65	3.24
427	I427	957	11/4/2016 13:36	1086728.55	747128.51	SU-5	NO	42	2.98
428	I428	1204	11/8/2016 16:14	1086761.36	747128.51	SU-5	NO	16	2.23
429	I429	1203	11/8/2016 16:12	1086794.17	747128.51	SU-5	NO	11	1.95
430	I430	1202	11/8/2016 16:10	1086826.98	747128.51	SU-5	NO	17	2.13
431	I431	1201	11/8/2016 16:04	1086859.79	747128.51	SU-5	NO	26	2.44
432	I432	1200	11/8/2016 16:02	1086892.60	747128.51	SU-5	NO	12	2.11
433	I433	1199	11/8/2016 16:00	1086925.40	747128.51	SU-5	NO	24	2.46
434	I434	1198	11/8/2016 15:58	1086958.21	747128.51	SU-5	NO	17	2.12
435	I435	1197	11/8/2016 15:55	1086991.02	747128.51	SU-5	NO	23	2.62
436	I436	1196	11/8/2016 15:52	1087023.83	747128.51	SU-5	NO	23	2.44
437	I437	1195	11/8/2016 15:50	1087056.64	747128.51	SU-5	NO	22	2.32
438	I438	1194	11/8/2016 15:46	1087089.45	747128.51	SU-6	NO	23	2.31
439	I439	1193	11/8/2016 15:44	1087122.25	747128.51	SU-6	NO	21	2.3
440	I440	1192	11/8/2016 15:42	1087155.06	747128.51	SU-6	NO	39	2.81
441	I441	1191	11/8/2016 15:40	1087187.87	747128.51	SU-6	NO	16	2.06
442	I442	1190	11/8/2016 15:38	1087220.68	747128.51	SU-6	NO	25	2.48
443	I443	1189	11/8/2016 15:36	1087253.49	747128.51	SU-6	NO	38	2.71
444	I444	1188	11/8/2016 15:34	1087286.30	747128.51	SU-6	NO	16	2.13
445	I445	1187	11/8/2016 15:32	1087319.11	747128.51	SU-6	NO	17	2.27
446	I446	1186	11/8/2016 15:30	1087351.91	747128.51	SU-6	NO	20	2.51
447	I447	1185	11/8/2016 15:27	1087384.72	747128.51	SU-6	NO	13	2.08
448	I448	1184	11/8/2016 15:25	1087417.53	747128.51	SU-6	NO	14	2.22

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
449	I449	1183	11/8/2016 15:23	1087450.34	747128.51	SU-6	NO	7	1.79
450	I450	978	11/4/2016 14:22	1086072.39	747095.70	SU-2	NO	6	1.88
451	I451	977	11/4/2016 14:20	1086105.19	747095.70	SU-2	NO	14	2.39
452	I452	976	11/4/2016 14:17	1086138.00	747095.70	SU-2	NO	9	2.14
453	I453	975	11/4/2016 14:15	1086170.81	747095.70	SU-2	NO	14	2.28
454	I454	974	11/4/2016 14:13	1086203.62	747095.70	SU-2	NO	9	2.11
455	I455	973	11/4/2016 14:10	1086236.43	747095.70	SU-2	NO	16	2.27
456	I456	972	11/4/2016 14:09	1086269.24	747095.70	SU-2	NO	8	2.13
457	I457	971	11/4/2016 14:06	1086302.04	747095.70	SU-2	NO	16	2.48
458	I458	970	11/4/2016 14:04	1086334.85	747095.70	SU-3	NO	13	2.16
459	I459	969	11/4/2016 14:02	1086367.66	747095.70	SU-3	NO	26	2.71
460	I460	968	11/4/2016 14:00	1086400.47	747095.70	SU-3	NO	36	2.98
461	I461	967	11/4/2016 13:58	1086433.28	747095.70	SU-3	NO	39	3.19
462	I462	966	11/4/2016 13:56	1086466.09	747095.70	SU-3	NO	34	2.72
463	I463	873	11/2/2016 17:30	1086498.90	747095.70	SU-3	YES	52	2.98
464	I464	965	11/4/2016 13:53	1086531.70	747095.70	SU-3	NO	49	3.17
465	I465	963	11/4/2016 13:50	1086564.51	747095.70	SU-3	NO	52	3.14
466	I466	962	11/4/2016 13:47	1086597.32	747095.70	SU-3	NO	63	3.34
467	I467	961	11/4/2016 13:45	1086630.13	747095.70	SU-3	NO	65	3.45
468	I468	960	11/4/2016 13:43	1086662.94	747095.70	SU-3	NO	48	3.14
469	I469	959	11/4/2016 13:41	1086695.75	747095.70	SU-3	NO	54	3.13
470	I470	958	11/4/2016 13:39	1086728.55	747095.70	SU-5	NO	65	3.38
471	I471	872	11/2/2016 17:13	1086761.36	747095.70	SU-5	YES	31	2.76
472	I472	1162	11/8/2016 13:53	1086794.17	747095.70	SU-5	NO	13	2.25
473	I473	1163	11/8/2016 13:55	1086826.98	747095.70	SU-5	NO	16	2.11
474	I474	1165	11/8/2016 13:59	1086859.79	747095.70	SU-5	NO	26	2.71
475	I475	1166	11/8/2016 14:01	1086892.60	747095.70	SU-5	NO	21	2.33
476	I476	1167	11/8/2016 14:03	1086925.40	747095.70	SU-5	NO	26	2.49
477	I477	848	11/2/2016 12:57	1086958.21	747095.70	SU-5	YES	13	2.11
478	I478	1168	11/8/2016 14:05	1086991.02	747095.70	SU-5	NO	17	2.25
479	I479	1169	11/8/2016 14:07	1087023.83	747095.70	SU-5	NO	46	2.86
480	I480	1170	11/8/2016 14:09	1087056.64	747095.70	SU-5	NO	19	2.27
481	I481	1171	11/8/2016 14:11	1087089.45	747095.70	SU-6	NO	26	2.7
482	I482	1172	11/8/2016 14:13	1087122.25	747095.70	SU-6	NO	32	2.72
483	I483	1173	11/8/2016 14:15	1087155.06	747095.70	SU-6	NO	27	2.53
484	I484	1174	11/8/2016 14:17	1087187.87	747095.70	SU-6	NO	31	2.38
485	I485	1175	11/8/2016 14:19	1087220.68	747095.70	SU-6	NO	18	2.21
486	I486	1176	11/8/2016 14:21	1087253.49	747095.70	SU-6	NO	16	2.22
487	I487	1177	11/8/2016 14:23	1087286.30	747095.70	SU-6	NO	10	1.83
488	I488	1178	11/8/2016 14:25	1087319.11	747095.70	SU-6	NO	16	2.28
489	I489	1179	11/8/2016 14:27	1087351.91	747095.70	SU-6	NO	9	1.85
490	I490	1180	11/8/2016 14:29	1087384.72	747095.70	SU-6	NO	14	2.14
491	I491	845	11/2/2016 12:06	1087417.53	747095.70	SU-6	YES	21	2.44
492	I492	1181	11/8/2016 14:31	1087450.34	747095.70	SU-6	NO	10	1.9
493	I493	1182	11/8/2016 14:34	1087483.15	747095.70	SU-6	NO	15	2.24
494	I494	794	10/27/2016 16:59	1086039.58	747062.89	SU-2	NO	40	3.1
495	I495	795	10/27/2016 17:01	1086072.39	747062.89	SU-2	NO	19	2.57
496	I496	796	10/27/2016 17:04	1086105.19	747062.89	SU-2	YES	18	2.64
497	I497	798	10/27/2016 17:09	1086138.00	747062.89	SU-2	NO	20	2.57
498	I498	799	10/27/2016 17:11	1086170.81	747062.89	SU-2	NO	19	2.38
499	I499	800	10/27/2016 17:13	1086203.62	747062.89	SU-2	NO	20	2.44
500	I500	801	10/27/2016 17:15	1086236.43	747062.89	SU-2	NO	16	2.4
501	I501	802	10/27/2016 17:18	1086269.24	747062.89	SU-2	NO	18	2.41
502	I502	979	11/4/2016 16:08	1086302.04	747062.89	SU-2	NO	15	2.21
503	I503	980	11/4/2016 16:10	1086334.85	747062.89	SU-3	NO	12	2.18
504	I504	981	11/4/2016 16:12	1086367.66	747062.89	SU-3	NO	26	2.62

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
505	I505	982	11/4/2016 16:17	1086400.47	747062.89	SU-3	NO	32	2.73
506	I506	983	11/4/2016 16:19	1086433.28	747062.89	SU-3	NO	38	2.79
507	I507	984	11/4/2016 16:21	1086466.09	747062.89	SU-3	NO	30	2.89
508	I508	985	11/4/2016 16:23	1086498.90	747062.89	SU-3	NO	44	3.08
509	I509	986	11/4/2016 16:25	1086531.70	747062.89	SU-3	NO	40	3.18
510	I510	988	11/4/2016 16:28	1086564.51	747062.89	SU-3	NO	44	3.02
511	I511	989	11/4/2016 16:30	1086597.32	747062.89	SU-3	NO	47	2.96
512	I512	990	11/4/2016 16:33	1086630.13	747062.89	SU-3	NO	64	3.23
513	I513	991	11/4/2016 16:35	1086662.94	747062.89	SU-3	NO	66	3.45
514	I514	1161	11/8/2016 13:50	1086859.79	747062.89	SU-5	NO	38	2.68
515	I515	1160	11/8/2016 13:48	1086892.60	747062.89	SU-5	NO	36	2.76
516	I516	1159	11/8/2016 13:45	1086925.40	747062.89	SU-5	NO	22	2.46
517	I517	1158	11/8/2016 13:43	1086958.21	747062.89	SU-5	NO	16	2.32
518	I518	1157	11/8/2016 13:41	1086991.02	747062.89	SU-5	NO	19	2.3
519	I519	1156	11/8/2016 13:39	1087023.83	747062.89	SU-5	NO	21	2.41
520	I520	1155	11/8/2016 13:37	1087056.64	747062.89	SU-5	NO	7	1.86
521	I521	1154	11/8/2016 13:35	1087089.45	747062.89	SU-6	NO	11	1.84
522	I522	1153	11/8/2016 13:32	1087122.25	747062.89	SU-6	NO	30	2.79
523	I523	1152	11/8/2016 13:30	1087155.06	747062.89	SU-6	NO	87	4.15
524	I524	1151	11/8/2016 13:28	1087187.87	747062.89	SU-6	NO	68	3.27
525	I525	1150	11/8/2016 13:26	1087253.49	747062.89	SU-6	NO	16	2.27
526	I526	1149	11/8/2016 13:24	1087286.30	747062.89	SU-6	NO	20	2.23
527	I527	1148	11/8/2016 13:22	1087319.11	747062.89	SU-6	NO	20	2.33
528	I528	1147	11/8/2016 13:20	1087351.91	747062.89	SU-6	NO	23	2.24
529	I529	1146	11/8/2016 13:18	1087384.72	747062.89	SU-6	NO	17	2.2
530	I530	1145	11/8/2016 13:16	1087417.53	747062.89	SU-6	NO	15	2.11
531	I531	1144	11/8/2016 13:14	1087450.34	747062.89	SU-6	NO	22	2.39
532	I532	1143	11/8/2016 13:12	1087483.15	747062.89	SU-6	NO	16	2.33
533	I533	752	10/27/2016 15:18	1086039.58	747030.08	SU-2	NO	34	2.71
534	I534	753	10/27/2016 15:21	1086072.39	747030.08	SU-2	NO	67	4.8
535	I535	754	10/27/2016 15:23	1086105.19	747030.08	SU-2	NO	13	2.42
536	I536	755	10/27/2016 15:25	1086138.00	747030.08	SU-2	NO	15	2.46
537	I537	756	10/27/2016 15:27	1086170.81	747030.08	SU-2	NO	38	2.89
538	I538	757	10/27/2016 15:29	1086203.62	747030.08	SU-2	NO	39	3.53
539	I539	758	10/27/2016 15:31	1086236.43	747030.08	SU-2	NO	18	2.41
540	I540	759	10/27/2016 15:33	1086269.24	747030.08	SU-2	NO	18	2.3
541	I541	760	10/27/2016 15:35	1086302.04	747030.08	SU-2	NO	16	2.42
542	I542	1001	11/4/2016 16:56	1086334.85	747030.08	SU-2	NO	14	2.29
543	I543	1000	11/4/2016 16:54	1086367.66	747030.08	SU-2	NO	20	2.97
544	I544	999	11/4/2016 16:52	1086400.47	747030.08	SU-2	NO	41	3.09
545	I545	998	11/4/2016 16:50	1086433.28	747030.08	SU-2	NO	33	2.8
546	I546	997	11/4/2016 16:48	1086466.09	747030.08	SU-2	NO	33	2.82
547	I547	996	11/4/2016 16:46	1086498.90	747030.08	SU-2	NO	35	2.72
548	I548	995	11/4/2016 16:44	1086531.70	747030.08	SU-2	NO	37	2.76
549	I549	994	11/4/2016 16:42	1086564.51	747030.08	SU-2	NO	47	2.95
550	I550	993	11/4/2016 16:40	1086597.32	747030.08	SU-2	NO	69	3.68
551	I551	992	11/4/2016 16:38	1086630.13	747030.08	SU-2	NO	61	3.36
552	I552	846	11/2/2016 12:16	1087450.34	747030.08	SU-6	YES	52	3.38
553	I553	1142	11/8/2016 13:09	1087483.15	747030.08	SU-6	NO	34	2.83
554	I554	769	10/27/2016 15:59	1086105.19	746997.27	SU-2	NO	17	2.43
555	I555	767	10/27/2016 15:53	1086138.00	746997.27	SU-2	YES	13	2.55
556	I556	766	10/27/2016 15:50	1086170.81	746997.27	SU-2	NO	17	2.33
557	I557	765	10/27/2016 15:48	1086203.62	746997.27	SU-2	NO	17	2.45
558	I558	764	10/27/2016 15:46	1086236.43	746997.27	SU-2	NO	28	2.7
559	I559	762	10/27/2016 15:40	1086269.24	746997.27	SU-2	YES	23	2.65
560	I560	761	10/27/2016 15:38	1086302.04	746997.27	SU-2	NO	16	2.63

Grid Overlay ID	ID	XRF no.	Time	Easting (feet)	Northing (feet)	Survey Unit Contained	Soil Sample Collected	XRF Arsenic	XRF Arsenic Precision
561	I561	1002	11/4/2016 16:59	1086334.85	746997.27	SU-2	NO	7	2.39
562	I562	1003	11/4/2016 17:01	1086367.66	746997.27	SU-2	NO	28	2.91
563	I563	1010	11/4/2016 17:12	1086400.47	746997.27	SU-2	NO	28	2.72
564	I564	1011	11/4/2016 17:14	1086433.28	746997.27	SU-2	NO	36	2.73
565	I565	1012	11/4/2016 17:16	1086466.09	746997.27	SU-2	NO	24	2.46
566	I566	1013	11/4/2016 17:18	1086498.90	746997.27	SU-2	NO	39	2.95
567	I567	1014	11/4/2016 17:20	1086531.70	746997.27	SU-2	NO	33	2.74
568	I568	1015	11/4/2016 17:22	1086564.51	746997.27	SU-2	NO	43	3.26
569	I569	1016	11/4/2016 17:24	1086597.32	746997.27	SU-2	NO	72	3.48
570	I570	1017	11/4/2016 17:26	1086630.13	746997.27	SU-2	NO	40	2.92
571	I571	770	10/27/2016 16:02	1086170.81	746964.47	SU-2	NO	18	2.5
572	I572	771	10/27/2016 16:05	1086203.62	746964.47	SU-2	NO	23	2.56
573	I573	772	10/27/2016 16:07	1086236.43	746964.47	SU-2	NO	21	2.68
574	I574	773	10/27/2016 16:09	1086269.24	746964.47	SU-2	NO	22	2.51
575	I575	774	10/27/2016 16:13	1086302.04	746964.47	SU-2	NO	18	2.36
576	I576	1026	11/4/2016 17:46	1086334.85	746964.47	SU-2	NO	26	2.51
577	I577	1025	11/4/2016 17:44	1086367.66	746964.47	SU-2	NO	17	2.41
578	I578	1024	11/4/2016 17:42	1086400.47	746964.47	SU-2	NO	23	2.42
579	I579	1023	11/4/2016 17:40	1086433.28	746964.47	SU-2	NO	45	3.1
580	I580	1022	11/4/2016 17:38	1086466.09	746964.47	SU-2	NO	39	2.81
581	I581	1021	11/4/2016 17:36	1086498.90	746964.47	SU-2	NO	34	2.74
582	I582	1020	11/4/2016 17:34	1086531.70	746964.47	SU-2	NO	30	2.79
583	I583	1019	11/4/2016 17:32	1086564.51	746964.47	SU-2	NO	39	3.16
584	I584	1018	11/4/2016 17:29	1086597.32	746964.47	SU-2	NO	59	3.4
585	I585	1037	11/7/2016 13:27	1086236.43	746931.66	SU-2	NO	14	2.26
586	I586	787	10/27/2016 16:35	1086269.24	746931.66	SU-2	NO	35	2.81
587	I587	786	10/27/2016 16:32	1086302.04	746931.66	SU-2	NO	33	3.11
588	I588	785	10/27/2016 16:30	1086334.85	746931.66	SU-2	NO	21	2.52
589	I589	784	10/27/2016 16:27	1086367.66	746931.66	SU-2	NO	23	2.59
590	I590	866	11/2/2016 16:15	1086400.47	746931.66	SU-2	YES	41	2.92
591	I591	1038	11/7/2016 13:30	1086433.28	746931.66	SU-2	NO	37	3.05
592	I592	1039	11/7/2016 13:32	1086466.09	746931.66	SU-2	NO	10	1.98
593	I593	1040	11/7/2016 13:34	1086498.90	746931.66	SU-2	NO	16	2.2
594	I594	1041	11/7/2016 13:36	1086531.70	746931.66	SU-2	NO	36	2.76
595	I595	1042	11/7/2016 13:38	1086564.51	746931.66	SU-2	NO	9	1.94
596	I596	1043	11/7/2016 13:40	1086597.32	746931.66	SU-2	NO	32	3.18
597	I597	788	10/27/2016 16:37	1086334.85	746898.85	SU-2	NO	19	2.39
598	I598	789	10/27/2016 16:39	1086367.66	746898.85	SU-2	NO	44	2.98
599	I599	790	10/27/2016 16:42	1086400.47	746898.85	SU-2	NO	30	2.76
600	I600	1049	11/7/2016 13:52	1086433.28	746898.85	SU-2	NO	17	2.17
601	I601	1048	11/7/2016 13:50	1086466.09	746898.85	SU-2	NO	18	2.17
602	I602	1047	11/7/2016 13:48	1086498.90	746898.85	SU-2	NO	10	2.02
603	I603	1046	11/7/2016 13:46	1086531.70	746898.85	SU-2	NO	26	2.5
604	I604	1045	11/7/2016 13:44	1086564.51	746898.85	SU-2	NO	14	2.09
605	I605	792	10/27/2016 16:52	1086367.66	746866.04	SU-2	NO	35	2.92
606	I606	791	10/27/2016 16:44	1086400.47	746866.04	SU-2	NO	36	2.88
607	I607	1050	11/7/2016 13:54	1086498.90	746866.04	SU-2	NO	22	2.61
608	I608	1051	11/7/2016 13:56	1086531.70	746866.04	SU-2	NO	27	2.55
609	I609	793	10/27/2016 16:54	1086367.66	746833.23	SU-2	NO	25	2.55

APPENDIX C

LABORATORY ANALYTICAL REPORTS

FINAL LABORATORY REPORTS

ARSENIC LAB ANALYSIS

Thursday, September 22, 2016

Aaron Orechwa
Tetra Tech MM, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525

Re: ALS Workorder: 1609139
Project Name: Riley Pass
Project Number: 114-560543

Dear Mr. Orechwa:

Thirteen soil samples were received from Tetra Tech MM, Inc., on 9/9/2016. The samples were scheduled for the following analysis:

Metals

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Amy R. Wolf
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1609139

Metals:
The samples were analyzed following SW-846, 3rd Edition procedures. Analysis by ICPMS followed method 6020A and the current revision of SOP 827.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1609139
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass
Client Project Number: 114-560543
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
AS-G104-01	1609139-1		SOIL	06-Sep-16	10:56
AS-G163-01	1609139-2		SOIL	06-Sep-16	12:45
AS-G184-01	1609139-3		SOIL	06-Sep-16	14:30
AS-G184-02	1609139-4		SOIL	06-Sep-16	14:30
AS-G226-01	1609139-5		SOIL	06-Sep-16	15:00
AS-G247-01	1609139-6		SOIL	06-Sep-16	15:22
AS-F103-01	1609139-7		SOIL	07-Sep-16	15:35
AS-F44-01	1609139-8		SOIL	07-Sep-16	15:45
AS-F71-01	1609139-9		SOIL	07-Sep-16	15:52
AS-F71-02	1609139-10		SOIL	07-Sep-16	15:52
AS-F64-01	1609139-11		SOIL	07-Sep-16	16:15
AS-F21-01	1609139-12		SOIL	07-Sep-16	16:30
AS-F27-01	1609139-13		SOIL	07-Sep-16	16:40

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	1609139
PAGE	1 of 2
DISPOSAL	BY LAB or RETURN

TURNAROUND TIME		SAMPLER	Aaron Orechwa
SITE ID			
EDD FORMAT			
PURCHASE ORDER			
BILL TO COMPANY			
INVOICE ATTN TO			
ADDRESS			
CITY / STATE / ZIP			
PHONE			
FAX			
E-MAIL			

PROJECT NAME	Riley Pass
PROJECT No.	114-560543
COMPANY NAME	Tetra Tech
SEND REPORT TO	Aaron Orechwa
ADDRESS	3801 Automation Way Ste 100
CITY / STATE / ZIP	Ft. Collins, CO 80525
PHONE	(970) 420-9395
FAX	
E-MAIL	aaron.orechwa@tetratech.com

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	ARSENIC (6020A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
(1)	AS-G104-01	S	9/6/16	1056	1			X										
(2)	AS-G163-01	S	9/6/16	1245	1			X										
(3)	AS-G184-01	S	9/6/16	1430	1			X										
(4)	AS-G184-02	S	9/6/16	1430	1			X										
(5)	AS-G226-01	S	9/6/16	1500	1			X										
(6)	AS-G247-01	S	9/6/16	1522	1			X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES

Please call Aaron when samples were completed. Please email upon receipt of delivery.

REPORT LEVEL / QC REQUIRED

- Summary (Standard QC)
- LEVEL II (Standard QC)
- LEVEL III (Std QC + forms)
- LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	9/9/16	1030
RECEIVED BY		Rebecca Merola	9/9/16	1335
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1609139	
PAGE	2 of 2
DISPOSAL	BY LAB or RETURN

PROJECT NAME	Rilley Pass	TURNAROUND TIME	SAMPLER
PROJECT No.	114-560543	SITE ID	
		EDD FORMAT	
COMPANY NAME	Tetra Tech	PURCHASE ORDER	
SEND REPORT TO		BILL TO COMPANY	
ADDRESS	* See attached business card *	INVOICE ATTN TO	
CITY / STATE / ZIP		ADDRESS	
PHONE		CITY / STATE / ZIP	
FAX		PHONE	
E-MAIL		FAX	
		E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Arsenic (6020A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
(7)	AS-F103-01		9/7/16	1535				X										
(8)	AS-F44-01		9/7/16	1545				X										
(9)	AS-F71-01		9/7/16	1552				X										
(10)	AS-F71-02		9/7/16	1552				X										
(11)	AS-F64-01		9/7/16	1615				X										
(12)	AS-F21-01		9/7/16	1630				X										
(13)	AS-F27-01		9/7/16	1640				X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
* email upon receipt of delivery	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Cheshire	9/9/2016	1030
RECEIVED BY		Rebecca Nevola	9/9/16	1335
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1609139

Project Manager: AW Initials: CDS Date: 9-9-16

1. Does this project require any special handling in addition to standard ALS procedures?		YES	(NO)
2. Are custody seals on shipping containers intact?	(NONE)	YES	NO
3. Are Custody seals on sample containers intact?	(NONE)	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		(YES)	NO
5. Are the COC and bottle labels complete and legible?		(YES)	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were airbills / shipping documents present and/or removable?	(DROP OFF)	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
10. Is there sufficient sample for the requested analyses?		(YES)	NO
11. Were all samples placed in the proper containers for the requested analyses?		(YES)	NO
12. Are all samples within holding times for the requested analyses?		(YES)	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	(N/A)	YES	NO
16. Were the samples shipped on ice?		YES	(NO)
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	Amb							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information External µR/hr reading:	NA							
Background µR/hr reading:	NA							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / (NA) (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 9/12/16

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-G104-01	**Lab ID:**	1609139-1
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 10:56	**Percent Moisture:**	9.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**26**		**0.21**	**MG/KG**	10	0.023	9/20/2016 03:13

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-G163-01	**Lab ID:**	1609139-2
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 12:45	**Percent Moisture:**	14.0

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**41**		**0.22**	**MG/KG**	10	0.024	9/20/2016 03:16

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-G184-01	**Lab ID:**	1609139-3
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 14:30	**Percent Moisture:**	15.0

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**15**		**0.22**	**MG/KG**	10	0.023	9/20/2016 03:19

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-G184-02	**Lab ID:**	1609139-4
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 14:30	**Percent Moisture:**	16.6

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**17**		**0.21**	**MG/KG**	10	0.023	9/20/2016 03:22

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-G226-01	**Lab ID:**	1609139-5
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 15:00	**Percent Moisture:**	14.9

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**23**		**0.22**	**MG/KG**	10	0.024	9/20/2016 03:25

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-G247-01	**Lab ID:**	1609139-6
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 15:22	**Percent Moisture:**	13.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**25**		**0.19**	**MG/KG**	10	0.021	9/20/2016 03:28

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F103-01	**Lab ID:**	1609139-7
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:35	**Percent Moisture:**	18.3

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**30**		**0.22**	**MG/KG**	10	0.024	9/20/2016 03:31

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F44-01	**Lab ID:**	1609139-8
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:45	**Percent Moisture:**	13.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**20**		**0.22**	**MG/KG**	10	0.024	9/20/2016 03:46

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F71-01	**Lab ID:**	1609139-9
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:52	**Percent Moisture:**	16.3

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**25**		**0.21**	**MG/KG**	10	0.023	9/20/2016 03:49

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F71-02	**Lab ID:**	1609139-10
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:52	**Percent Moisture:**	15.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**31**		**0.2**	**MG/KG**	10	0.021	9/20/2016 03:52

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F64-01	**Lab ID:**	1609139-11
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 16:15	**Percent Moisture:**	12.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**25**		**0.22**	**MG/KG**	10	0.024	9/20/2016 03:55

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F21-01	**Lab ID:**	1609139-12
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 16:30	**Percent Moisture:**	14.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**27**		**0.19**	**MG/KG**	10	0.021	9/20/2016 03:58

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F27-01	**Lab ID:**	1609139-13
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 16:40	**Percent Moisture:**	12.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **9/16/2016**		PrepBy: **NAQ**
ARSENIC	**25**		**0.21**	**MG/KG**	10	0.023	9/20/2016 04:01

Client:	Tetra Tech MM, Inc.	**Date:**	*22-Sep-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609139
Sample ID:	AS-F27-01	**Lab ID:**	1609139-13
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 16:40	**Percent Moisture:**	12.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

QC BATCH REPORT

Batch ID: **IP160916-1-3** Instrument ID **ICPMS2** Method: **SW6020**

LCS Sample ID: **IM160916-1** Units: **MG/KG** Analysis Date: **9/20/2016 03:07**

Client ID: Run ID: **IM160919-10A19** Prep Date: **9/16/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	9.79	0.2	10		98	80-120				20	

MB Sample ID: **IP160916-1** Units: **MG/KG** Analysis Date: **9/20/2016 03:04**

Client ID: Run ID: **IM160919-10A19** Prep Date: **9/16/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	ND	0.2									

The following samples were analyzed in this batch:

1609139-1	1609139-2	1609139-3
1609139-4	1609139-5	1609139-6
1609139-7	1609139-8	1609139-9
1609139-10	1609139-11	1609139-12
1609139-13		

Tuesday, November 15, 2016

Aaron Orechwa
Tetra Tech MM, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525

Re: ALS Workorder: 1610590
Project Name: Riley Pass Phase 2
Project Number: 114-560543

Dear Mr. Orechwa:

Twenty two soil samples were received from Tetra Tech MM, Inc., on 10/31/2016. The samples were scheduled for the following analysis:

Metals

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1610590

Metals:
The samples were analyzed following SW-846, 3rd Edition procedures. Analysis by ICPMS followed method 6020A and the current revision of SOP 827.

- A matrix spike and matrix spike duplicate were digested and analyzed with the IP161107-5-1 batch. Acceptance criteria for accuracy were met with the following exception:

Analyte	Sample ID
Arsenic	1610590-1MSD

The native sample result is flagged for matrix spike failure and an analytical post spike was performed. The result of the spike was acceptable indicating that the matrix was not significantly affecting quantitation of this analyte.

All remaining acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1610590
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass Phase 2
Client Project Number: 114-560543
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
AS-G5-01	1610590-1		SOIL	25-Oct-16	14:18
AS-G25-01	1610590-2		SOIL	25-Oct-16	14:45
AS-G50-01	1610590-3		SOIL	24-Oct-16	15:18
AS-G73-01	1610590-4		SOIL	24-Oct-16	14:48
AS-G77-01	1610590-5		SOIL	24-Oct-16	14:34
AS-G90-01	1610590-6		SOIL	24-Oct-16	14:06
AS-G94-01	1610590-7		SOIL	24-Oct-16	14:19
AS-I27-01	1610590-8		SOIL	18-Oct-16	13:40
AS-I41-01	1610590-9		SOIL	10-Oct-16	12:28
AS-I113-01	1610590-10		SOIL	14-Oct-16	9:45
AS-I114-01	1610590-11		SOIL	14-Oct-16	9:49
AS-I123-01	1610590-12		SOIL	10-Oct-16	13:00
AS-I129-01	1610590-13		SOIL	18-Oct-16	13:33
AS-I149-01	1610590-14		SOIL	10-Oct-16	15:11
AS-I153-01	1610590-15		SOIL	10-Oct-16	15:25
AS-I195-01	1610590-16		SOIL	11-Oct-16	13:46
AS-I196-01	1610590-17		SOIL	11-Oct-16	13:40
AS-I280-01	1610590-18		SOIL	17-Oct-16	8:37
AS-I318-01	1610590-19		SOIL	17-Oct-16	9:15
AS-I496-01	1610590-20		SOIL	27-Oct-16	14:56
AS-I555-01	1610590-21		SOIL	27-Oct-16	13:46
AS-I559-01	1610590-22		SOIL	27-Oct-16	13:33

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.
Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1610590	
PAGE	1 of 3
DISPOSAL	BY LAB or RETURN

PROJECT NAME	Riley Pass Phase II	TURNAROUND TIME	
PROJECT No.	114-560543	SAMPLER	AO/CK
		SITE ID	
COMPANY NAME	Tetra Tech	EDD FORMAT	
SEND REPORT TO	Aaron Orechwa	PURCHASE ORDER	
ADDRESS	3801 Automation Way Suite 100	BILL TO COMPANY	SAME
CITY / STATE / ZIP	Fort Collins, CO 80525	INVOICE ATTN TO	
PHONE	970-420-9395	ADDRESS	
FAX		CITY / STATE / ZIP	
E-MAIL	aaron.orechwa@tetratech.com	PHONE	
		FAX	
		E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Arsenic (6020A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
1	AS-G5-01	S	10/25/16	1418	-	-	-	X										
2	AS-G25-01	S	10/25/16	1445	-	-	-	X										
3	AS-G50-01	S	10/24/16	1518	-	-	-	X										
4	AS-G73-01	S	10/24/16	1448	-	-	-	X										
5	AS-G77-01	S	10/24/16	1434	-	-	-	X										
6	AS-G90-01	S	10/24/16	1406	-	-	-	X										
7	AS-G94-01	S	10/24/16	1419	-	-	-	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Report units in "mg/kg".	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	10/31/16	1300
RECEIVED BY		Max Sundberg	10/31/16	1510
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER # 1610590

PAGE 2 of 3

DISPOSAL BY LAB or RETURN

PROJECT NAME	Riley Pass Phase II Sampling	TURNAROUND TIME	
PROJECT No.	114-560543	SITE ID	
		EDD FORMAT	
COMPANY NAME	Tetra Tech	PURCHASE ORDER	
SEND REPORT TO	Aaron Orechia	BILL TO COMPANY	
ADDRESS	Sel Business Card Attached	INVOICE ATTN TO	
CITY / STATE / ZIP		ADDRESS	
PHONE		CITY / STATE / ZIP	
FAX		PHONE	
E-MAIL		FAX	
		E-MAIL	
		SAMPLER	Ao / CK

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Arsenic (6020A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
8	AS-I27-01	S	10/18/16	1340	-	-	-	X										
9	AS-I41-01	S	10/18/16	1228	-	-	-	X										10/10/16
10	AS-I113-01	S	10/14/16	945	-	-	-	X										
11	AS-I114-01	S	10/14/16	949	-	-	-	X										
12	AS-I123-01	S	10/10/16	1300	-	-	-	X										
13	AS-I129-01	S	10/18/16	1333	-	-	-	X										
14	AS-I149-01	S	10/10/16	1511	-	-	-	X										
15	AS-I153-01	S	10/10/16	1525	-	-	-	X										
16	AS-I195-01	S	10/11/16	1346	-	-	-	X										
17	AS-I196-01	S	10/11/16	1340	-	-	-	X										
18	AS-I280-01	S	10/17/16	837	-	-	-	X										
19	AS-I318-01	S	10/17/16	915	-	-	-	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Report units in "mg/kg"	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		AARON ORECHIA	10/31/16	1300
RECEIVED BY		Max Sundberg	10/31/16	1519
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1610590	
PAGE	3 of 3
DISPOSAL	BY LAB or RETURN

PROJECT NAME	Riley Pass Phase II Sampling	TURNAROUND TIME	
PROJECT No.	114-560543	SAMPLER	AO/CK
COMPANY NAME	TETRA TECH	SITE ID	
SEND REPORT TO	Aaron Orechwa	EDD FORMAT	
ADDRESS	SEE BUSINESS CARD	PURCHASE ORDER	
CITY / STATE / ZIP		BILL TO COMPANY	
PHONE		INVOICE ATTN TO	SAME
FAX		ADDRESS	
E-MAIL		CITY / STATE / ZIP	
		PHONE	
		FAX	
		E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	ARSENIC (6020A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
20	AS-I496-01	S	10/27/16	1456	-	-	-	X										
21	AS-I555-01	S	10/27/16	1346	-	-	-	X										
22	AS-I559-01	S	10/27/16	1333	-	-	-	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Report units in "mg/kg"	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		AARON ORECHWA	10/31/16	1300
RECEIVED BY		Max Sundberg	10/31/16	1510
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Tetratech Workorder No: 1610590

Project Manager: SS Initials: JB Date: 10/31/16

1. Does this project require any special handling in addition to standard ALS procedures?		YES	(NO)
2. Are custody seals on shipping containers intact?	(NONE)	YES	NO
3. Are Custody seals on sample containers intact?	(NONE)	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		(YES)	NO
5. Are the COC and bottle labels complete and legible?		(YES)	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were airbills / shipping documents present and/or removable?	(DROP OFF)	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
10. Is there sufficient sample for the requested analyses?		(YES)	NO
11. Were all samples placed in the proper containers for the requested analyses?		(YES)	NO
12. Are all samples within holding times for the requested analyses?		(YES)	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	(N/A)	YES	NO
16. Were the samples shipped on ice?		YES	(NO)
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	amb.							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	NA							
Background µR/hr reading:	11							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO** (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: Shulah Lamy

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G5-01	**Lab ID:**	1610590-1
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/25/2016 14:18	**Percent Moisture:**	6.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**38**	N	**0.2**	**MG/KG**	10	0.022	11/10/2016 05:20

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G25-01	**Lab ID:**	1610590-2
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/25/2016 14:45	**Percent Moisture:**	6.0

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**36**		**0.19**	**MG/KG**	10	0.02	11/10/2016 05:38

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G50-01	**Lab ID:**	1610590-3
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/24/2016 15:18	**Percent Moisture:**	8.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**32**		**0.2**	**MG/KG**	10	0.021	11/10/2016 05:41

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G73-01	**Lab ID:**	1610590-4
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/24/2016 14:48	**Percent Moisture:**	6.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**36**		**0.21**	**MG/KG**	10	0.022	11/10/2016 05:56

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G77-01	**Lab ID:**	1610590-5
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/24/2016 14:34	**Percent Moisture:**	9.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**33**		**0.2**	**MG/KG**	10	0.022	11/10/2016 05:59

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G90-01	**Lab ID:**	1610590-6
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/24/2016 14:06	**Percent Moisture:**	7.9

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**37**		**0.19**	**MG/KG**	10	0.02	11/10/2016 06:02

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-G94-01	**Lab ID:**	1610590-7
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/24/2016 14:19	**Percent Moisture:**	5.7

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**36**		**0.2**	**MG/KG**	10	0.022	11/10/2016 06:05

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I27-01	**Lab ID:**	1610590-8
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/18/2016 13:40	**Percent Moisture:**	17.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**41**		**0.23**	**MG/KG**	10	0.025	11/10/2016 06:08

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I41-01	**Lab ID:**	1610590-9
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/10/2016 12:28	**Percent Moisture:**	11.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**29**		**0.22**	**MG/KG**	10	0.024	11/10/2016 06:11

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I113-01	**Lab ID:**	1610590-10
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/14/2016 09:45	**Percent Moisture:**	7.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**48**		**0.2**	**MG/KG**	10	0.022	11/10/2016 06:14

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I114-01	**Lab ID:**	1610590-11
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/14/2016 09:49	**Percent Moisture:**	5.8

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**40**		**0.19**	**MG/KG**	10	0.021	11/10/2016 06:17

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I123-01	**Lab ID:**	1610590-12
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/10/2016 13:00	**Percent Moisture:**	11.0

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**32**		**0.22**	**MG/KG**	10	0.023	11/10/2016 06:20

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I129-01	**Lab ID:**	1610590-13
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/18/2016 13:33	**Percent Moisture:**	12.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**48**		**0.22**	**MG/KG**	10	0.024	11/10/2016 06:23

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I149-01	**Lab ID:**	1610590-14
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/10/2016 15:11	**Percent Moisture:**	9.3

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**64**		**0.22**	**MG/KG**	10	0.023	11/10/2016 06:38

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I153-01	**Lab ID:**	1610590-15
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/10/2016 15:25	**Percent Moisture:**	8.8

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**39**		**0.2**	**MG/KG**	10	0.022	11/10/2016 06:41

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I195-01	**Lab ID:**	1610590-16
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/11/2016 13:46	**Percent Moisture:**	8.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**46**		**0.21**	**MG/KG**	10	0.022	11/10/2016 06:44

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I196-01	**Lab ID:**	1610590-17
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/11/2016 13:40	**Percent Moisture:**	10.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**46**		**0.22**	**MG/KG**	10	0.024	11/10/2016 06:47

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I280-01	**Lab ID:**	1610590-18
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/17/2016 08:37	**Percent Moisture:**	8.7

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**54**		**0.2**	**MG/KG**	10	0.021	11/10/2016 06:50

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I318-01	**Lab ID:**	1610590-19
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/17/2016 09:15	**Percent Moisture:**	7.6

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**52**		**0.21**	**MG/KG**	10	0.022	11/10/2016 06:53

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I496-01	**Lab ID:**	1610590-20
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/27/2016 14:56	**Percent Moisture:**	7.6

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**25**		**0.21**	**MG/KG**	10	0.023	11/10/2016 06:56

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I555-01	**Lab ID:**	1610590-21
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/27/2016 13:46	**Percent Moisture:**	6.7

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**20**		**0.21**	**MG/KG**	10	0.023	11/10/2016 04:17

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I559-01	**Lab ID:**	1610590-22
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/27/2016 13:33	**Percent Moisture:**	6.9

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/7/2016**		PrepBy: **AJL2**
ARSENIC	**25**		**0.2**	**MG/KG**	10	0.022	11/10/2016 04:20

Client:	Tetra Tech MM, Inc.	**Date:**	*15-Nov-16*
Project:	114-560543 Riley Pass Phase 2	**Work Order:**	1610590
Sample ID:	AS-I559-01	**Lab ID:**	1610590-22
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/27/2016 13:33	**Percent Moisture:**	6.9

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

Batch ID: **IP161107-5-1** Instrument ID **ICPMS2** Method: **SW6020**

DUP Sample ID: **1610590-1** Units: **MG/KG** Analysis Date: **11/10/2016 05:26**
Client ID: **AS-G5-01** Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	35.6	0.207						38	6	20	

LCS Sample ID: **IM161107-5** Units: **MG/KG** Analysis Date: **11/10/2016 05:17**
Client ID: Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	9.73	0.2	10		97	80-120				20	

MB Sample ID: **IP161107-5** Units: **MG/KG** Analysis Date: **11/10/2016 05:14**
Client ID: Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	ND	0.2									

MS Sample ID: **1610590-1** Units: **MG/KG** Analysis Date: **11/10/2016 05:29**
Client ID: **AS-G5-01** Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	47.3	0.205	10.3	38	91	75-125				20	

MSD Sample ID: **1610590-1** Units: **MG/KG** Analysis Date: **11/10/2016 05:32**
Client ID: **AS-G5-01** Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	54.8	0.207	10.4	38	162	75-125		47.3	15	20	N

The following samples were analyzed in this batch:

1610590-1	1610590-2	1610590-3
1610590-4	1610590-5	1610590-6
1610590-7	1610590-8	1610590-9
1610590-10	1610590-11	1610590-12
1610590-13	1610590-14	1610590-15
1610590-16	1610590-17	1610590-18
1610590-19	1610590-20	

QC BATCH REPORT

Batch ID: **IP161107-6-2** Instrument ID **ICPMS2** Method: **SW6020**

LCS Sample ID: **IM161107-6** Units: **MG/KG** Analysis Date: **11/10/2016 04:14**
Client ID: Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	8.88	0.2	10		89	80-120				20	

MB Sample ID: **IP161107-6** Units: **MG/KG** Analysis Date: **11/10/2016 04:11**
Client ID: Run ID: **IM161109-10A13** Prep Date: **11/7/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	ND	0.2									

The following samples were analyzed in this batch: 1610590-21 1610590-22

Wednesday, November 30, 2016

Aaron Orechwa
Tetra Tech MM, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525

Re: ALS Workorder: 1611081
Project Name: Riley Pass Phase III Sampling
Project Number: 114-560543

Dear Mr. Orechwa:

Twenty six soil samples were received from Tetra Tech MM, Inc., on 11/3/2016. The samples were scheduled for the following analysis:

Metals

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1611081

The samples were received at ambient temperature.

Metals:
The samples were analyzed following SW-846, 3rd Edition procedures. Analysis by ICPMS followed method 6020A and the current revision of SOP 827.

Matrix spike recoveries could not be evaluated for the following analyte:

Analyte	Sample ID
Arsenic	1611081-1

The concentration of this analyte in the native sample was greater than four times the concentration of matrix spike added during the digestion. When sample concentration is that much greater than the spike added, spike recoveries may not be accurate. The laboratory control sample indicates that the digestion and analysis were in control.

All remaining acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1611081
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass Phase III Sampling
Client Project Number: 114-560543
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
AS-G126-01	1611081-1		SOIL	01-Nov-16	11:45
AS-G190-01	1611081-2		SOIL	01-Nov-16	11:30
AS-G253-01	1611081-3		SOIL	01-Nov-16	11:10
AS-G305-01	1611081-4		SOIL	01-Nov-16	10:40
AS-G307-01	1611081-5		SOIL	01-Nov-16	10:50
AS-G314-01	1611081-6		SOIL	01-Nov-16	10:25
AS-I251-01	1611081-7		SOIL	01-Nov-16	15:01
AS-I329-01	1611081-8		SOIL	01-Nov-16	15:45
AS-I590-01	1611081-9		SOIL	02-Nov-16	14:05
AS-I590-02	1611081-10		SOIL	02-Nov-16	14:05
AS-I332-01	1611081-11		SOIL	02-Nov-16	13:10
AS-I332-02	1611081-12		SOIL	02-Nov-16	13:10
AS-I415-01	1611081-13		SOIL	02-Nov-16	13:30
AS-I267-01	1611081-14		SOIL	02-Nov-16	14:50
AS-I302-01	1611081-15		SOIL	02-Nov-16	14:35
AS-I378-01	1611081-16		SOIL	02-Nov-16	13:45
AS-I463-01	1611081-17		SOIL	02-Nov-16	15:20
AS-I205-01	1611081-18		SOIL	02-Nov-16	11:15
AS-I471-01	1611081-19		SOIL	02-Nov-16	15:05
AS-I355-01	1611081-20		SOIL	02-Nov-16	10:35
AS-I388-01	1611081-21		SOIL	02-Nov-16	11:00
AS-I477-01	1611081-22		SOIL	02-Nov-16	10:50
AS-I286-01	1611081-23		SOIL	02-Nov-16	9:30
AS-I325-01	1611081-24		SOIL	02-Nov-16	9:45
AS-I491-01	1611081-25		SOIL	02-Nov-16	9:55
AS-I552-01	1611081-26		SOIL	02-Nov-16	10:10

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.
Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER # 1611081

TURNAROUND TIME		SAMPLER	AO/CK	PAGE	1 of 3
PROJECT NAME	Rilley Pass Phase III Sampling	SITE ID		DISPOSAL	BY LAB or RETURN
PROJECT No.	114-560543	EDD FORMAT		PARAMETER/METHOD REQUEST FOR ANALYSIS	
		PURCHASE ORDER		A	Arsenic (6020A)
COMPANY NAME	Tetra Tech	BILL TO COMPANY		B	
SEND REPORT TO	Aaron Orechwa	INVOICE ATTN TO		C	
ADDRESS	↑	ADDRESS	Same	D	
CITY / STATE / ZIP	see attached	CITY / STATE / ZIP		E	
PHONE	business	PHONE	↓	F	
FAX	card	FAX		G	
E-MAIL	↓	E-MAIL		H	
				I	
				J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
1	AS-G126-01	S	11/1/16	11:45	-	-	-	X										
2	AS-G190-01	S	11/1/16	11:30	-	-	-	X										
3	AS-G253-01	S	11/1/16	11:10	-	-	-	X										
4	AS-G305-01	S	11/1/16	10:40	-	-	-	X										
5	AS-G307-01	S	11/1/16	10:50	-	-	-	X										
6	AS-G314-01	S	11/1/16	10:25	-	-	-	X										
7	AS-~~G251-01~~ I251-01	S	11/1/16	15:01	-	-	-	X										
8	AS-~~G329-01~~ I329-01	S	11/1/16	15:45	-	-	-	X										
9	AS-I590-01	S	11/2/16	14:05	-	-	-	X										
10	AS-I590-02	S	11/2/16	14:05	-	-	-	X										
11	AS-I332-01	S	11/2/16	13:10	-	-	-	X										
12	AS-I332-02	S	11/2/16	13:10	-	-	-	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Please homogenize	Summary (Standard QC)
Report in "mg/kg"	LEVEL II (Standard QC)
Return coolers please	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	11/3/16	1520
RECEIVED BY		SHAY KOETTING	11/3/16	1520
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

5 of 37

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	1611081
PAGE	2 of 3
DISPOSAL	BY LAB or RETURN

PROJECT NAME	Riley Pass Phase II Sampling	TURNAROUND TIME	SAMPLER
PROJECT No.	114-560543	SITE ID	
		EDD FORMAT	
COMPANY NAME	TETRA TECH	PURCHASE ORDER	
SEND REPORT TO	Aaron Orechwa	BILL TO COMPANY	
ADDRESS	↑	INVOICE ATTN TO	
CITY / STATE / ZIP		ADDRESS	
PHONE	See COC #1	CITY / STATE / ZIP	
FAX		PHONE	
E-MAIL	↓	FAX	
		E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	ARSENIC (6020A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
13	AS-I 415-01	S	11/2/16	13:30	—	—	—	X										
14	AS-I 267-01	S	11/2/16	14:50	—	—	—	X										
15	AS-I 302-01	S	11/2/16	14:35	—	—	—	X										
18	AS-I 378-01	S	11/2/16	13:45	—	—	—	X										
17	AS-I 463-01	S	11/2/16	15:20	—	—	—	X										
18	AS-I 205-01	S	11/2/16	11:15	—	—	—	X										
19	AS-I 471-01	S	11/2/16	15:05	—	—	—	X										
20	AS-I 355-01	S	11/2/16	10:35	—	—	—	X										
21	AS-I 388-01	S	11/2/16	11:00	—	—	—	X										
22	AS-I 477-01	S	11/2/16	10:50	—	—	—	X										
23	AS-I 286-01	S	11/2/16	9:30	—	—	—	X										
24	AS-I 325-01	S	11/2/16	9:45														

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
See COC #1	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	11/3/16	1526
RECEIVED BY		SHAY KOETTING	11/3/16	1520
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1611081	
PAGE	3 of 3
DISPOSAL	BY LAB or RETURN

TURNAROUND TIME		SAMPLER	AO/CK
PROJECT NAME	~~Tetra T~~ AO See COC #1	SITE ID	
PROJECT No.	See COC #1	EDD FORMAT	
		PURCHASE ORDER	
COMPANY NAME	TetraTech	BILL TO COMPANY	
SEND REPORT TO	Aaron Orechwa	INVOICE ATTN TO	
ADDRESS		ADDRESS	
CITY / STATE / ZIP		CITY / STATE / ZIP	
PHONE		PHONE	
FAX		FAX	
E-MAIL		E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Arsenic (6020 A)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
25	AS-I491-01	S	11/2/16	9:55	-	-	-	X										
26	AS-I552-01	S	11/2/16	1010	-	-	-	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
See COC #1	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

7 of 37

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	11/3/16	1520
RECEIVED BY		SHAY KOETTING	11/3/16	1520
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1611081

Project Manager: SJS Initials: JH Date: 11/3/16

1. Does this project require any special handling in addition to standard ALS procedures?		YES	(NO)
2. Are custody seals on shipping containers intact?	(NONE)	YES	NO
3. Are Custody seals on sample containers intact?	(NONE)	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		(YES)	NO
5. Are the COC and bottle labels complete and legible?		(YES)	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were airbills / shipping documents present and/or removable?	(DROP OFF)	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
10. Is there sufficient sample for the requested analyses?		(YES)	NO
11. Were all samples placed in the proper containers for the requested analyses?		(YES)	NO
12. Are all samples within holding times for the requested analyses?		(YES)	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	(N/A)	YES	NO
16. Were the samples shipped on ice?		YES	(NO)
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	AMB							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	N/A							
Background µR/hr reading:	11							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: _____

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-G126-01	**Lab ID:**	1611081-1
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 11:45	**Percent Moisture:**	11.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**47**		**0.19**	**MG/KG**	10	0.021	11/19/2016 17:46

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-G190-01	**Lab ID:**	1611081-2
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 11:30	**Percent Moisture:**	16.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**70**		**0.21**	**MG/KG**	10	0.023	11/19/2016 18:04

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-G253-01	**Lab ID:**	1611081-3
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 11:10	**Percent Moisture:**	13.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**68**		**0.22**	**MG/KG**	10	0.024	11/19/2016 18:07

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-G305-01	**Lab ID:**	1611081-4
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 10:40	**Percent Moisture:**	12.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**49**		**0.21**	**MG/KG**	10	0.023	11/19/2016 18:22

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-G307-01	**Lab ID:**	1611081-5
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 10:50	**Percent Moisture:**	11.0

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**55**		**0.22**	**MG/KG**	10	0.023	11/19/2016 18:25

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-G314-01	**Lab ID:**	1611081-6
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 10:25	**Percent Moisture:**	12.6

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**45**		**0.2**	**MG/KG**	10	0.022	11/19/2016 18:28

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I251-01	**Lab ID:**	1611081-7
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 15:01	**Percent Moisture:**	9.7

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**15**		**0.19**	**MG/KG**	10	0.02	11/19/2016 18:31

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I329-01	**Lab ID:**	1611081-8
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 15:45	**Percent Moisture:**	14.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**20**		**0.22**	**MG/KG**	10	0.023	11/19/2016 18:34

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I590-01	**Lab ID:**	1611081-9
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:05	**Percent Moisture:**	10.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**45**		**0.21**	**MG/KG**	10	0.022	11/19/2016 18:37

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I590-02	**Lab ID:**	1611081-10
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:05	**Percent Moisture:**	10.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**68**		**0.22**	**MG/KG**	10	0.024	11/19/2016 18:40

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I332-01	**Lab ID:**	1611081-11
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:10	**Percent Moisture:**	13.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**18**		**0.23**	**MG/KG**	10	0.025	11/19/2016 18:43

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I332-02	**Lab ID:**	1611081-12
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:10	**Percent Moisture:**	13.6

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**17**		**0.21**	**MG/KG**	10	0.023	11/19/2016 18:46

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I415-01	**Lab ID:**	1611081-13
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:30	**Percent Moisture:**	8.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**15**		**0.19**	**MG/KG**	10	0.02	11/19/2016 18:49

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I267-01	**Lab ID:**	1611081-14
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:50	**Percent Moisture:**	8.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**38**		**0.21**	**MG/KG**	10	0.022	11/19/2016 19:03

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I302-01	**Lab ID:**	1611081-15
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:35	**Percent Moisture:**	7.8

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**47**		**0.21**	**MG/KG**	10	0.022	11/19/2016 19:06

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I378-01	**Lab ID:**	1611081-16
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:45	**Percent Moisture:**	16.2

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**77**		**0.21**	**MG/KG**	10	0.023	11/19/2016 19:09

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I463-01	**Lab ID:**	1611081-17
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 15:20	**Percent Moisture:**	5.9

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**57**		**0.18**	**MG/KG**	10	0.02	11/19/2016 19:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I205-01	**Lab ID:**	1611081-18
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 11:15	**Percent Moisture:**	15.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**55**		**0.2**	**MG/KG**	10	0.022	11/19/2016 19:15

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I471-01	**Lab ID:**	1611081-19
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 15:05	**Percent Moisture:**	12.9

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**67**		**0.22**	**MG/KG**	10	0.023	11/19/2016 19:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I355-01	**Lab ID:**	1611081-20
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 10:35	**Percent Moisture:**	15.8

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/9/2016**		PrepBy: **AJL2**
ARSENIC	**48**		**0.2**	**MG/KG**	10	0.022	11/19/2016 19:21

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I388-01	**Lab ID:**	1611081-21
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 11:00	**Percent Moisture:**	18.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/21/2016**		PrepBy: **AJL2**
ARSENIC	**89**		**0.24**	**MG/KG**	10	0.026	11/30/2016 01:10

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I477-01	**Lab ID:**	1611081-22
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 10:50	**Percent Moisture:**	17.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/21/2016**		PrepBy: **AJL2**
ARSENIC	**22**		**0.24**	**MG/KG**	10	0.026	11/30/2016 01:28

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I286-01	**Lab ID:**	1611081-23
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 09:30	**Percent Moisture:**	8.4

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/21/2016**		PrepBy: **AJL2**
ARSENIC	**50**		**0.22**	**MG/KG**	10	0.023	11/30/2016 01:31

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I325-01	**Lab ID:**	1611081-24
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 09:45	**Percent Moisture:**	10.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/21/2016**		PrepBy: **AJL2**
ARSENIC	**43**		**0.22**	**MG/KG**	10	0.023	11/30/2016 01:46

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I491-01	**Lab ID:**	1611081-25
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 09:55	**Percent Moisture:**	10.5

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/21/2016**		PrepBy: **AJL2**
ARSENIC	**77**		**0.22**	**MG/KG**	10	0.023	11/30/2016 01:49

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I552-01	**Lab ID:**	1611081-26
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 10:10	**Percent Moisture:**	19.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed
ICPMS METALS			**SW6020**		Prep Date: **11/21/2016**		PrepBy: **AJL2**
ARSENIC	**81**		**0.24**	**MG/KG**	10	0.026	11/30/2016 01:52

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase III Sampling	**Work Order:**	1611081
Sample ID:	AS-I552-01	**Lab ID:**	1611081-26
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 10:10	**Percent Moisture:**	19.1

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	MDL	Date Analyzed

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

G - Sample density differs by more than 15% of LCS density.

D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

Batch ID: **IP161109-5-1** Instrument ID: **ICPMS2** Method: **SW6020**

LCS Sample ID: **IM161109-5** Units: **MG/KG** Analysis Date: **11/19/2016 17:43**

Client ID: Run ID: **IM161119-10A3** Prep Date: **11/9/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	9.83	0.2	10		98	80-120				20	

MB Sample ID: **IP161109-5** Units: **MG/KG** Analysis Date: **11/19/2016 17:40**

Client ID: Run ID: **IM161119-10A3** Prep Date: **11/9/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	ND	0.2									

MS Sample ID: **1611081-1** Units: **MG/KG** Analysis Date: **11/19/2016 17:55**

Client ID: **AS-G126-01** Run ID: **IM161119-10A3** Prep Date: **11/9/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	61.5	0.208	10.4	47	137	75-125				20	

MSD Sample ID: **1611081-1** Units: **MG/KG** Analysis Date: **11/19/2016 17:58**

Client ID: **AS-G126-01** Run ID: **IM161119-10A3** Prep Date: **11/9/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	66.1	0.222	11.1	47	170	75-125		61.5	7	20	

The following samples were analyzed in this batch:

1611081-1	1611081-2	1611081-3
1611081-4	1611081-5	1611081-6
1611081-7	1611081-8	1611081-9
1611081-10	1611081-11	1611081-12
1611081-13	1611081-14	1611081-15
1611081-16	1611081-17	1611081-18
1611081-19	1611081-20	

Client: Tetra Tech MM, Inc.
Work Order: 1611081
Project: 114-560543 Riley Pass Phase III Sampling

QC BATCH REPORT

Batch ID: **IP161121-7-1** Instrument ID: **ICPMS2** Method: **SW6020**

LCS Sample ID: **IM161121-7** Units: **MG/KG** Analysis Date: **11/30/2016 01:07**
Client ID: Run ID: **IM161129-10A5** Prep Date: **11/21/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	10.5	0.2	10		105	80-120				20	

MB Sample ID: **IP161121-7** Units: **MG/KG** Analysis Date: **11/30/2016 01:04**
Client ID: Run ID: **IM161129-10A5** Prep Date: **11/21/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	ND	0.2									

MS Sample ID: **1611081-21** Units: **MG/KG** Analysis Date: **11/30/2016 01:19**
Client ID: **AS-I388-01** Run ID: **IM161129-10A5** Prep Date: **11/21/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	103	0.238	11.9	89	112	75-125				20	

MSD Sample ID: **1611081-21** Units: **MG/KG** Analysis Date: **11/30/2016 01:22**
Client ID: **AS-I388-01** Run ID: **IM161129-10A5** Prep Date: **11/21/2016** DF: **10**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
ARSENIC	103	0.238	11.9	89	117	75-125		103	1	20	

The following samples were analyzed in this batch:

1611081-21	1611081-22	1611081-23
1611081-24	1611081-25	1611081-26

FINAL LABORATORY REPORTS

RADIUM-226 LAB ANALYSIS

Tuesday, October 11, 2016

Aaron Orechwa
Tetra Tech MM, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525

Re: ALS Workorder: 1609140
Project Name: Riley Pass
Project Number: 114-560543

Dear Mr. Orechwa:

Thirteen soil samples were received from Tetra Tech MM, Inc., on 9/9/2016. The samples were scheduled for the following analysis:

Gamma Spectroscopy

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1609140

Gamma Spectroscopy:

These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans and stored for at least 21 days prior to analysis.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1609140
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass
Client Project Number: 114-560543
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
RA-G104-01	1609140-1		SOIL	06-Sep-16	10:56
RA-G104-02	1609140-2		SOIL	06-Sep-16	10:56
RA-G163-01	1609140-3		SOIL	06-Sep-16	12:45
RA-G184-01	1609140-4		SOIL	06-Sep-16	14:30
RA-G226-01	1609140-5		SOIL	06-Sep-16	15:00
RA-G247-01	1609140-6		SOIL	06-Sep-16	15:22
RA-F103-01	1609140-7		SOIL	07-Sep-16	15:35
RA-F44-01	1609140-8		SOIL	07-Sep-16	15:45
RA-F71-01	1609140-9		SOIL	07-Sep-16	15:52
RA-F71-02	1609140-10		SOIL	07-Sep-16	15:52
RA-F64-01	1609140-11		SOIL	07-Sep-16	16:15
RA-F21-01	1609140-12		SOIL	07-Sep-16	16:30
RA-F27-01	1609140-13		SOIL	07-Sep-16	16:40

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1609140	
PAGE	1 of 2
DISPOSAL	BY LAB or RETURN

TURNAROUND TIME	30 days	SAMPLER	Aaron Orechwa		
PROJECT NAME	Rilley Pass	SITE ID			
PROJECT No.	114-560543	EDD FORMAT			
		PURCHASE ORDER			
COMPANY NAME	Tetra Tech	BILL TO COMPANY			
SEND REPORT TO	* See attached *	INVOICE ATTN TO			
ADDRESS	* CARD *	ADDRESS			
CITY / STATE / ZIP		CITY / STATE / ZIP			
PHONE		PHONE			
FAX		FAX			
E-MAIL	aaron.orechwa@tetratech.com	E-MAIL			

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	* RADium-226 (E901.1)
B	(equilibrium, ingrowth)
C	
D	
E	Call Aaron for Details
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
(1)	RA-G104-01	S	9/6/16	1056	1			X										
(2)	RA-G104-02	S	9/6/16	1056	1			X										
(3)	RA-G163-01	S	9/6/16	1245	1			X										
(4)	RA-G184-01	S	9/6/16	1430	1			X										
(5)	RA-G226-01	S	9/6/16	1500	1			X										
(6)	RA-G247-01	S	9/6/16	1522	1			X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
email aaron upon receipt →	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

5 of 21

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	9/9/2016	1030
RECEIVED BY		Rebecca Merola	9/9/2016	1335
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1609140	
PAGE	2 of 2
DISPOSAL	BY LAB or RETURN

TURNAROUND TIME		SAMPLER	Aaron Orechwa
SITE ID			
EDD FORMAT			
PURCHASE ORDER			
BILL TO COMPANY			
INVOICE ATTN TO			
ADDRESS			
CITY / STATE / ZIP			
PHONE			
FAX			
E-MAIL			

PROJECT NAME	Rico Pass
PROJECT No.	114-560 543
COMPANY NAME	Tetra Tech
SEND REPORT TO	aaron orechwa
ADDRESS	
CITY / STATE / ZIP	*See Card*
PHONE	
FAX	
E-MAIL	aaron.orechwa@tetratech.com

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Radium-226 (E 901.1)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
7	RA - F103 - 01	S	9/7/16	1535				X										
8	RA - F44 - 01	S	9/7/16	1545				X										
9	RA - F71 - 01	S	9/7/16	1552				X										
10	RA - F71 - 02	S	9/7/16	1552				X										
11	RA - F64 - 01	S	9/7/16	1615				X										
12	RA - F21 - 01	S	9/7/16	1630				X										
13	RA - F27 - 01	S	9/7/16	1640				X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
* email upon receipt of delivery	Summary (Standard QC)
* Call Aaron w/ questions	LEVEL II (Standard QC)
* see attach card for info	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	9/9/16	1030
RECEIVED BY		Rebecca Merola	9/9/16	1335
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Tetra Tech Workorder No: 1609140

Project Manager: AW Initials: CDS Date: 9-9-16

1.	Does this project require any special handling in addition to standard ALS procedures?		YES	(NO)
2.	Are custody seals on shipping containers intact?	(NONE)	YES	NO
3.	Are Custody seals on sample containers intact?	(NONE)	YES	NO
4.	Is there a COC (Chain-of-Custody) present or other representative documents?		(YES)	NO
5.	Are the COC and bottle labels complete and legible?		(YES)	NO
6.	Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7.	Were airbills / shipping documents present and/or removable?	(DROP OFF)	YES	NO
8.	Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	(N/A)	YES	NO
9.	Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
10.	Is there sufficient sample for the requested analyses?		(YES)	NO
11.	Were all samples placed in the proper containers for the requested analyses?		(YES)	NO
12.	Are all samples within holding times for the requested analyses?		(YES)	NO
13.	Were all sample containers received intact? (not broken or leaking, etc.)		(YES)	NO
14.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	(N/A)	YES	NO
15.	Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	(N/A)	YES	NO
16.	Were the samples shipped on ice?		YES	(NO)
17.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	Amb							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	NA							
Background µR/hr reading:	NA							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / (NA) (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: 9/12/16

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-G104-01	**Lab ID:**	1609140-1
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 10:56	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **9/15/2016**		PrepBy: **JSJ**
Ra-226	**9.4 (+/- 1.2)**		**0.6**	**pCi/g**	NA	10/6/2016 09:31

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-G104-02	**Lab ID:**	1609140-2
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 10:56	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**8.8 (+/- 1.2)**	G	**0.7**	**pCi/g**	NA	10/6/2016 09:31

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-G163-01	**Lab ID:**	1609140-3
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 12:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**7.4 (+/- 1)**	G	**0.8**	**pCi/g**	NA	10/6/2016 09:31

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-G184-01	**Lab ID:**	1609140-4
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 14:30	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**6.24 (+/- 0.95)**	G	**0.83**	**pCi/g**	NA	10/6/2016 09:32

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-G226-01	**Lab ID:**	1609140-5
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 15:00	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**7.3 (+/- 1.1)**	G	**0.9**	**pCi/g**	NA	10/6/2016 09:32

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-G247-01	**Lab ID:**	1609140-6
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/6/2016 15:22	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**6.71 (+/- 0.95)**	G	**0.75**	**pCi/g**	NA	10/6/2016 09:32

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-F103-01	**Lab ID:**	1609140-7
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:35	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**12.1 (+/- 1.6)**	G	**0.7**	**pCi/g**	NA	10/6/2016 09:32

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-F44-01	**Lab ID:**	1609140-8
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**5.31 (+/- 0.75)**		**0.52**	**pCi/g**	NA	10/6/2016 09:33

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-F71-01	**Lab ID:**	1609140-9
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:52	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **9/15/2016**		PrepBy: **JSJ**
Ra-226	**8.4 (+/- 1.1)**		**0.7**	**pCi/g**	NA	10/6/2016 09:33

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-F71-02	**Lab ID:**	1609140-10
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 15:52	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**8.2 (+/- 1.1)**		**0.6**	**pCi/g**	NA	10/6/2016 10:27

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-F64-01	**Lab ID:**	1609140-11
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 16:15	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **9/15/2016**		PrepBy: **JSJ**
Ra-226	**6.11 (+/- 0.84)**		**0.57**	**pCi/g**	NA	10/6/2016 10:27

Client:	Tetra Tech MM, Inc.	**Date:**	*11-Oct-16*
Project:	114-560543 Riley Pass	**Work Order:**	1609140
Sample ID:	RA-F21-01	**Lab ID:**	1609140-12
Legal Location:		**Matrix:**	SOIL
Collection Date:	9/7/2016 16:30	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **9/15/2016**		PrepBy: **JSJ**
Ra-226	**8.8 (+/- 1.2)**		**0.7**	**pCi/g**	NA	10/6/2016 10:27

Client: Tetra Tech MM, Inc. **Date:** *11-Oct-16*
Project: 114-560543 Riley Pass **Work Order:** 1609140
Sample ID: RA-F27-01 **Lab ID:** 1609140-13
Legal Location: **Matrix:** SOIL
Collection Date: 9/7/2016 16:40 **Percent Moisture:**

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **9/15/2016**	PrepBy: **JSJ**
Ra-226	**8.2 (+/- 1.1)**	G	**0.7**	**pCi/g**	NA	10/6/2016 10:27

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
G - Sample density differs by more than 15% of LCS density.
D - DER is greater than Control Limit
M - Requested MDC not met.
LT - Result is less than requested MDC but greater than achieved MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
NC - Not Calculated for duplicate results less than 5 times MDC
B - Analyte concentration greater than MDC.
B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).
U or ND - Indicates that the compound was analyzed for but not detected.
E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
M - Duplicate injection precision was not met.
N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
* - Duplicate analysis (relative percent difference) not within control limits.
S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.
B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.
E - Analyte concentration exceeds the upper level of the calibration range.
J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).
A - A tentatively identified compound is a suspected aldol-condensation product.
X - The analyte was diluted below an accurate quantitation level.
* - The spike recovery is equal to or outside the control criteria used.
+ - The relative percent difference (RPD) equals or exceeds the control criteria.
G - A pattern resembling gasoline was detected in this sample.
D - A pattern resembling diesel was detected in this sample.
M - A pattern resembling motor oil was detected in this sample.
C - A pattern resembling crude oil was detected in this sample.
4 - A pattern resembling JP-4 was detected in this sample.
5 - A pattern resembling JP-5 was detected in this sample.
H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.
L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.
Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

Batch ID: **GS160915-1-1** Instrument ID: **GAMMA** Method: **Gamma Spectroscopy Results**

DUP Sample ID: **1609140-13** Units: **pCi/g** Analysis Date: **10/6/2016 10:28**

Client ID: **RA-F27-01** Run ID: **GS160915-1A** Prep Date: **9/15/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	7.13 (+/- 0.95)	0.54						8.2	0.69	2.13	G

LCS Sample ID: **GS160915-1** Units: **pCi/g** Analysis Date: **10/6/2016 10:28**

Client ID: Run ID: **GS160915-1A** Prep Date: **9/15/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	459 (+/- 54)	2	468.7		98	85-115					P,M3

MB Sample ID: **GS160915-1** Units: **pCi/g** Analysis Date: **10/6/2016 10:28**

Client ID: Run ID: **GS160915-1A** Prep Date: **9/15/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	-0.01 (+/- 0.14)	0.26									U

The following samples were analyzed in this batch:

1609140-1	1609140-2	1609140-3
1609140-4	1609140-5	1609140-6
1609140-7	1609140-8	1609140-9
1609140-10	1609140-11	1609140-12
1609140-13		

Wednesday, November 30, 2016

Aaron Orechwa
Tetra Tech MM, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525

Re: ALS Workorder: 1610597
Project Name: Riley Pass Phase A Sampling
Project Number: 114-560543

Dear Mr. Orechwa:

Fifteen soil samples were received from Tetra Tech MM, Inc., on 10/31/2016. The samples were scheduled for the following analysis:

Gamma Spectroscopy

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1610597

Gamma Spectroscopy:
These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans and stored for at least 21 days prior to analysis.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1610597
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass Phase A Sampling
Client Project Number: 114-560543
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
RA-I27-01	1610597-1		SOIL	28-Oct-16	9:35
RA-I41-01	1610597-2		SOIL	28-Oct-16	9:15
RA-I113-01	1610597-3		SOIL	28-Oct-16	9:45
RA-I114-01	1610597-4		SOIL	28-Oct-16	9:50
RA-I123-01	1610597-5		SOIL	28-Oct-16	8:50
RA-I129-01	1610597-6		SOIL	28-Oct-16	9:25
RA-I149-01	1610597-7		SOIL	28-Oct-16	8:40
RA-I153-01	1610597-8		SOIL	28-Oct-16	8:45
RA-I195-01	1610597-9		SOIL	28-Oct-16	10:40
RA-I196-01	1610597-10		SOIL	28-Oct-16	10:45
RA-I280-01	1610597-11		SOIL	28-Oct-16	10:05
RA-I318-01	1610597-12		SOIL	28-Oct-16	10:15
RA-I496-01	1610597-13		SOIL	28-Oct-16	8:25
RA-I555-01	1610597-14		SOIL	28-Oct-16	8:11
RA-I559-01	1610597-15		SOIL	28-Oct-16	8:16

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER # 1610597

PAGE 1 of 2

DISPOSAL BY LAB or RETURN

PROJECT NAME	Riley Ass Phase I Sampling	TURNAROUND TIME	SAMPLER AD / CK
PROJECT No.	114-560543	SITE ID	
		EDD FORMAT	
COMPANY NAME	Tetra Tech	PURCHASE ORDER	↑
SEND REPORT TO	Aaron Orechwa	BILL TO COMPANY	SAME
ADDRESS	3801 Automation Way St #100	INVOICE ATTN TO	
CITY / STATE / ZIP	Ft. Collins, CO 80525	ADDRESS	
PHONE	970-420-9395	CITY / STATE / ZIP	
FAX	–	PHONE	
E-MAIL	aaron.orechwa@tetratech.com	FAX	↓
	(See Business CARD)	E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A: RADium-226 (E901.1)

B:

C:

D:

E:

F:

G:

H:

I:

J:

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
(1)	RA-I27-01	S	10/28/16	0935	–	–	–	X										
(2)	RA-I41-01	S	10/28/16	0915	–	–	–	X										
(3)	RA-I113-01	S	10/28/16	0945	–	–	–	X										
(4)	RA-I114-01	S	10/28/16	0950	–	–	–	X										
(5)	RA-I123-01	S	10/28/16	0850	–	–	–	X										
(6)	RA-I129-01	S	10/28/16	0925	–	–	–	X										
(7)	RA-I149-01	S	10/28/16	0840	–	–	–	X										
(8)	RA-I153-01	S	10/28/16	0845	–	–	–	X										
(9)	RA-I195-01	S	10/28/16	1040	–	–	–	X										
(10)	RA-I196-01	S	10/28/16	1045	–	–	–	X										
(11)	RA-I280-01	S	10/28/16	1005	–	–	–	X										
(12)	RA-I318-01	S	10/28/16	1015	–	–	–	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Radium by gamma spec after homogenization and equilibrium (21d)	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	10/31/16	1300
RECEIVED BY	C Trumble	C Trumble	10-31-16	1510
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1610597	
PAGE	2 of 2
DISPOSAL	BY LAB or RETURN

TURNAROUND TIME		SAMPLER	AO/CK
PROJECT NAME	Riley Pass Phase II Sampling	SITE ID	
PROJECT No.	114-560543	EDD FORMAT	
		PURCHASE ORDER	
COMPANY NAME	Teta Tech	BILL TO COMPANY	
SEND REPORT TO	Aaron Orechwa	INVOICE ATTN TO	
ADDRESS	↑	ADDRESS	
CITY / STATE / ZIP	See Business CARD	CITY / STATE / ZIP	
PHONE		PHONE	
FAX		FAX	
E-MAIL	↓	E-MAIL	

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	RADium-226 (MOD E901.1)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
(13)	RA-I496-01	S	10/28/16	825	-	-	-	X										
(14)	RA-I555-01	S	10/28/16	811	-	-	-	X										
(15)	RA-I559-01	S	10/28/16	816	-	-	-	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Radium by gamma spec after drying, homogenization, and equilibrium (21 days).	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw)

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		AARON ORECHWA	10/31/16	1300
RECEIVED BY	C Trumble	C TRUMBLE	10-31-16	1510
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Tetra Tech Workorder No: 1610557

Project Manager: SS Initials: CDT Date: 10-31-16

1. Does this project require any special handling in addition to standard ALS procedures?		YES	(NO)
2. Are custody seals on shipping containers intact?	(NONE)	YES	NO
3. Are Custody seals on sample containers intact?	(NONE)	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		(YES)	NO
5. Are the COC and bottle labels complete and legible?		(YES)	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were airbills / shipping documents present and/or removable?	(DROP OFF)	(YES)	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
10. Is there sufficient sample for the requested analyses?		(YES)	NO
11. Were all samples placed in the proper containers for the requested analyses?		(YES)	NO
12. Are all samples within holding times for the requested analyses?		(YES)	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	(N/A)	YES	NO
16. Were the samples shipped on ice?		YES	(NO)
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	(RAD ONLY)	YES	(NO)

Cooler #:	1							
Temperature (°C):	Amb							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	NA							
Background µR/hr reading:	NA							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO (NA) (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? YES / NO / NA Contacted: _____ Date/Time: _____

Project Manager Signature / Date: Chilah Lemmy

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

Form 201r24.xls (06/04/2012)

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I27-01	**Lab ID:**	1610597-1
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 09:35	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**17 (+/- 2.1)**	G	**0.7**	**pCi/g**	NA	11/28/2016 08:43

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I41-01	**Lab ID:**	1610597-2
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 09:15	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**11.1 (+/- 1.4)**	G	**0.6**	**pCi/g**	NA	11/28/2016 08:43

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I113-01	**Lab ID:**	1610597-3
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 09:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**16.3 (+/- 2.1)**	G	**0.9**	**pCi/g**	NA	11/28/2016 08:44

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I114-01	**Lab ID:**	1610597-4
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 09:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**15.4 (+/- 1.9)**		**0.7**	**pCi/g**	NA	11/28/2016 08:44

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I123-01	**Lab ID:**	1610597-5
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 08:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**13.8 (+/- 1.8)**	G	**0.7**	**pCi/g**	NA	11/28/2016 08:44

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I129-01	**Lab ID:**	1610597-6
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 09:25	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**16.7 (+/- 2.1)**	G	**0.7**	**pCi/g**	NA	11/28/2016 08:44

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I149-01	**Lab ID:**	1610597-7
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 08:40	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**13.7 (+/- 1.8)**	G	**0.7**	**pCi/g**	NA	11/28/2016 08:44

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I153-01	**Lab ID:**	1610597-8
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 08:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**12.9 (+/- 1.7)**	G	**0.7**	**pCi/g**	NA	11/28/2016 09:35

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I195-01	**Lab ID:**	1610597-9
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 10:40	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**14.8 (+/- 1.9)**	G	**0.7**	**pCi/g**	NA	11/28/2016 09:35

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I196-01	**Lab ID:**	1610597-10
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 10:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**15 (+/- 1.9)**		**0.8**	**pCi/g**	NA	11/28/2016 09:36

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I280-01	**Lab ID:**	1610597-11
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 10:05	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**19.7 (+/- 2.5)**		**0.9**	**pCi/g**	NA	11/28/2016 09:36

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I318-01	**Lab ID:**	1610597-12
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 10:15	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**17.9 (+/- 2.2)**		**0.7**	**pCi/g**	NA	11/28/2016 09:36

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I496-01	**Lab ID:**	1610597-13
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 08:25	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**4.87 (+/- 0.68)**		**0.45**	**pCi/g**	NA	11/28/2016 09:36

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I555-01	**Lab ID:**	1610597-14
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 08:11	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**5.93 (+/- 0.81)**		**0.49**	**pCi/g**	NA	11/28/2016 09:36

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	114-560543 Riley Pass Phase A Sampling	**Work Order:**	1610597
Sample ID:	RA-I559-01	**Lab ID:**	1610597-15
Legal Location:		**Matrix:**	SOIL
Collection Date:	10/28/2016 08:16	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**8.2 (+/- 1.1)**		**0.6**	**pCi/g**	NA	11/28/2016 09:36

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
G - Sample density differs by more than 15% of LCS density.
D - DER is greater than Control Limit

M - Requested MDC not met.

LT - Result is less than requested MDC but greater than achieved MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).

U or ND - Indicates that the compound was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

M - Duplicate injection precision was not met.

N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

* - Duplicate analysis (relative percent difference) not within control limits.

S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.

B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.

E - Analyte concentration exceeds the upper level of the calibration range.

J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).

A - A tentatively identified compound is a suspected aldol-condensation product.

X - The analyte was diluted below an accurate quantitation level.

* - The spike recovery is equal to or outside the control criteria used.

+ - The relative percent difference (RPD) equals or exceeds the control criteria.

G - A pattern resembling gasoline was detected in this sample.

D - A pattern resembling diesel was detected in this sample.

M - A pattern resembling motor oil was detected in this sample.

C - A pattern resembling crude oil was detected in this sample.

4 - A pattern resembling JP-4 was detected in this sample.

5 - A pattern resembling JP-5 was detected in this sample.

H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.

L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.

Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

Batch ID: **GS161107-1-2** Instrument ID: **GAMMA** Method: **Gamma Spectroscopy Results**

DUP Sample ID: **1610597-2** Units: **pCi/g** Analysis Date: **11/28/2016 08:43**

Client ID: **RA-I41-01** Run ID: **GS161107-1B** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	13 (+/- 1.7)	0.9						11.1	0.84	2.13	G

LCS Sample ID: **GS161107-1A** Units: **pCi/g** Analysis Date: **11/28/2016 10:22**

Client ID: Run ID: **GS161107-1B** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	462 (+/- 54)	3	468.6		98.6	85-115					P,M3

MB Sample ID: **GS161107-1** Units: **pCi/g** Analysis Date: **11/28/2016 10:22**

Client ID: Run ID: **GS161107-1B** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	0.08 (+/- 0.2)	0.35									U

The following samples were analyzed in this batch:

1610597-1	1610597-2	1610597-3
1610597-4	1610597-5	1610597-6
1610597-7	1610597-8	1610597-9
1610597-10	1610597-11	1610597-12
1610597-13	1610597-14	1610597-15

Wednesday, November 30, 2016

Aaron Orechwa
Tetra Tech MM, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525

Re: ALS Workorder: 1611084
Project Name: Riley Pass Phase III Sampling
Project Number:

Dear Mr. Orechwa:

Thirty three soil samples were received from Tetra Tech MM, Inc., on 11/3/2016. The samples were scheduled for the following analysis:

Gamma Spectroscopy

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Shiloh J. Summy
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
AIHA	214884
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280

1611084

Gamma Spectroscopy:
These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans and stored for at least 21 days prior to analysis.

All acceptance criteria were met.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1611084
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass Phase III Sampling
Client Project Number:
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
RA-G126-01	1611084-1		SOIL	01-Nov-16	11:45
RA-G190-01	1611084-2		SOIL	01-Nov-16	11:30
RA-G253-01	1611084-3		SOIL	01-Nov-16	11:10
RA-G305-01	1611084-4		SOIL	01-Nov-16	10:40
RA-G307-01	1611084-5		SOIL	01-Nov-16	10:50
RA-G314-01	1611084-6		SOIL	01-Nov-16	10:25
RA-G5-01	1611084-7		SOIL	01-Nov-16	13:10
RA-G50-01	1611084-8		SOIL	01-Nov-16	13:50
RA-G73-01	1611084-9		SOIL	01-Nov-16	13:20
RA-G77-01	1611084-10		SOIL	01-Nov-16	13:40
RA-G90-01	1611084-11		SOIL	01-Nov-16	13:30
RA-G94-01	1611084-12		SOIL	01-Nov-16	13:35
RA-G25-01	1611084-13		SOIL	01-Nov-16	14:00
RA-I251-01	1611084-14		SOIL	01-Nov-16	14:40
RA-I329-01	1611084-15		SOIL	01-Nov-16	14:50
RA-I590-01	1611084-16		SOIL	02-Nov-16	14:05
RA-I590-02	1611084-17		SOIL	02-Nov-16	14:05
RA-I332-01	1611084-18		SOIL	02-Nov-16	13:10
RA-I332-02	1611084-19		SOIL	02-Nov-16	13:10
RA-I415-01	1611084-20		SOIL	02-Nov-16	13:30
RA-I267-01	1611084-21		SOIL	02-Nov-16	14:50
RA-I302-01	1611084-22		SOIL	02-Nov-16	14:35
RA-I378-01	1611084-23		SOIL	02-Nov-16	13:45
RA-I463-01	1611084-24		SOIL	02-Nov-16	15:20
RA-I205-01	1611084-25		SOIL	02-Nov-16	11:15
RA-I471-01	1611084-26		SOIL	02-Nov-16	15:05
RA-I355-01	1611084-27		SOIL	02-Nov-16	10:35
RA-I388-01	1611084-28		SOIL	02-Nov-16	11:00
RA-I477-01	1611084-29		SOIL	02-Nov-16	10:50
RA-I296-01	1611084-30		SOIL	02-Nov-16	9:30

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1611084
Client Name: Tetra Tech MM, Inc.
Client Project Name: Riley Pass Phase III Sampling
Client Project Number:
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
RA-I325-01	1611084-31		SOIL	02-Nov-16	9:45
RA-I491-01	1611084-32		SOIL	02-Nov-16	9:55
RA-I552-01	1611084-33		SOIL	02-Nov-16	10:10

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.
Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1611084	
PAGE	1 of 3
DISPOSAL	BY LAB or RETURN

TURNAROUND TIME		SAMPLER	AO/CK
SITE ID			
EDD FORMAT			
PURCHASE ORDER			
BILL TO COMPANY	↑		
INVOICE ATTN TO	↑		
ADDRESS	Same		
CITY / STATE / ZIP	Same		
PHONE	↓		
FAX	↓		
E-MAIL			

PROJECT NAME	Riley Pass Phase III Sampling
PROJECT No.	
COMPANY NAME	Tetra Tech
SEND REPORT TO	Aaron Orechwa
ADDRESS	↑
CITY / STATE / ZIP	See Card
PHONE	
FAX	↓
E-MAIL	↓

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Radium-226 (E901.1)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
1	RA-G126-01	S	11/1/16	11:45	–	–	–	X										
2	RA-G190-01	S	11/1/16	11:30	–	–	–	X										
3	RA-G253-01	S	11/1/16	11:10	–	–	–	X										
4	RA-G305-01	S	11/1/16	10:40	–	–	–	X										
5	RA-G307-01	S	11/1/16	10:50	–	–	–	X										
6	RA-G314-01	S	11/1/16	10:25	–	–	–	X										
7	RA-G5-01	S	11/1/16	13:10	–	–	–	X										
8	RA-G50-01	S	11/1/16	13:50	–	–	–	X										
9	RA-G73-01	S	11/1/16	13:20	–	–	–	X										
10	RA-G77-01	S	11/1/16	13:40	–	–	–	X										
11	RA-G90-01	S	11/1/16	13:30	–	–	–	X										
12	RA-G94-01	S	11/1/16	13:35	–	–	–	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
Ra-226 by gamma spec Homogenize, equilibrate. Call/Email Aaron w/questions Return coolers 4°C	Summary (Standard QC) LEVEL II (Standard QC) LEVEL III (Std QC + forms) LEVEL IV (Std QC + forms + raw

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	11/3/16	1520
RECEIVED BY		SHAY KOETTING	11/3/16	1520
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #
1611084

TURNAROUND TIME		SAMPLER		PAGE	2 of 3
				DISPOSAL	BY LAB or RETURN

				PARAMETER/METHOD REQUEST FOR ANALYSIS	
PROJECT NAME	Rocky Flats Phase III Sampling	SITE ID			
PROJECT No.		EDD FORMAT			
		PURCHASE ORDER		A	Radium-226 (E901.1)
COMPANY NAME	Tetra Tech	BILL TO COMPANY	↑	B	
SEND REPORT TO	Aaron Orechwa	INVOICE ATTN TO	Same	C	
ADDRESS		ADDRESS		D	
CITY / STATE / ZIP	↑	CITY / STATE / ZIP	↓	E	
PHONE	See COC #1	PHONE		F	
FAX		FAX		G	
E-MAIL	↓	E-MAIL		H	
				I	
				J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
13	RA-G25-01	S	11/1/16	14:00	—	—	—	X										
14	RA ~~G25-01~~ I25-01	S	11/1/16	14:40	—	—	—	X										
15	RA-G329-01 I329-01	S	11/1/16	14:50	—	—	—	X										
16	RA-I590-01	S	11/2/16	14:05	—	—	—	X										
17	RA-I590-02	S	11/2/16	14:05	—	—	—	X										
18	RA-I332-01	S	11/2/16	13:10	—	—	—	X										
19	RA-I332-02	S	11/2/16	13:10	—	—	—	X										
20	RA-I415-01	S	11/2/16	13:30	—	—	—	X										
21	RA-I267-01	S	11/2/16	14:50	—	—	—	X										
22	RA-I302-01	S	11/2/16	14:35	—	—	—	X										
23	RA-I378-01	S	11/2/16	13:45	—	—	—	X										
24	RA-I463-01	S	11/2/16	15:20	—	—	—	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
See COC #1	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY	1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	11/3/16	1520
RECEIVED BY		STAY KOETTING	11/3/16	1520
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #	
1611084	
PAGE	3 of 3
DISPOSAL	BY LAB or RETURN

PROJECT NAME	Riley Pass Phase IA Sampling	TURNAROUND TIME	
PROJECT No.	114-560543	SITE ID	
		EDD FORMAT	
COMPANY NAME	Tetra Tech	PURCHASE ORDER	
SEND REPORT TO	Aaron Orechwa	BILL TO COMPANY	
ADDRESS		INVOICE ATTN TO	
CITY / STATE / ZIP		ADDRESS	
PHONE	See COC #1	CITY / STATE / ZIP	
FAX		PHONE	
E-MAIL		FAX	
		E-MAIL	

SAMPLER: AO / CIC

PARAMETER/METHOD REQUEST FOR ANALYSIS

A	Radium-226 (E901.1)
B	
C	
D	
E	
F	
G	
H	
I	
J	

LAB ID	FIELD ID	MATRIX	SAMPLE DATE	SAMPLE TIME	# OF BOTTLES	PRESERVATIVE	QC	A	B	C	D	E	F	G	H	I	J	SEE NOTES SECTION
25	RA-I205-01	S	11/2/16	11:15	—	—	—	X										
26	RA-I471-01	S	11/2/16	15:05	—	—	—	X										
27	RA-I355-01	S	11/2/16	10:35	—	—	—	X										
28	RA-I388-01	S	11/2/16	11:00	—	—	—	X										
29	RA-I477-01	S	11/2/16	10:50	—	—	—	X										
30	RA-I296-01	S	11/2/16	9:30	—	—	—	X										
31	RA-I325-01	S	11/2/16	9:45	—	—	—	X										
32	RA-I491-01	S	11/2/16	9:55	—	—	—	X										
33	RA-I552-01	S	11/2/16	10 10	—	—	—	X										

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

NOTES	REPORT LEVEL / QC REQUIRED
See COC #1	Summary (Standard QC)
	LEVEL II (Standard QC)
	LEVEL III (Std QC + forms)
	LEVEL IV (Std QC + forms + raw

PRESERVATION KEY: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaOH/ZnAcetate 6-NaHSO4 7-4°C 8-Other

Form 202r9

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY		Aaron Orechwa	11/3/16	1520
RECEIVED BY		SKAY KOETTING	11/3/16	1520
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1611084

Project Manager: SJS Initials: JH Date: 11/3/16

1. Does this project require any special handling in addition to standard ALS procedures?		YES	(NO)
2. Are custody seals on shipping containers intact?	(NONE)	YES	NO
3. Are Custody seals on sample containers intact?	(NONE)	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		(YES)	NO
5. Are the COC and bottle labels complete and legible?		(YES)	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were airbills / shipping documents present and/or removable?	(PROP OFF)	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	(N/A)	YES	NO
10. Is there sufficient sample for the requested analyses?		(YES)	NO
11. Were all samples placed in the proper containers for the requested analyses?		(YES)	NO
12. Are all samples within holding times for the requested analyses?		(YES)	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	(N/A)	YES	NO
16. Were the samples shipped on ice?		YES	(NO)
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	AMB							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	N/A							
Background µR/hr reading:	15							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: _____

*IR Gun #2: Oakton, SN 29922500201-0066
*IR Gun #4: Oakton, SN 2372220101-0002

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G126-01	**Lab ID:**	1611084-1
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 11:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**10.2 (+/- 1.3)**		**0.6**	**pCi/g**	NA	11/29/2016 07:11

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G190-01	**Lab ID:**	1611084-2
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 11:30	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**11.2 (+/- 1.4)**		**0.6**	**pCi/g**	NA	11/29/2016 07:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G253-01	**Lab ID:**	1611084-3
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 11:10	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**10 (+/- 1.3)**		**0.6**	**pCi/g**	NA	11/29/2016 07:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G305-01	**Lab ID:**	1611084-4
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 10:40	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**9.8 (+/- 1.3)**		**0.8**	**pCi/g**	NA	11/29/2016 07:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G307-01	**Lab ID:**	1611084-5
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 10:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**9.7 (+/- 1.3)**		**0.6**	**pCi/g**	NA	11/29/2016 07:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G314-01	**Lab ID:**	1611084-6
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 10:25	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**8 (+/- 1)**		**0.5**	**pCi/g**	NA	11/29/2016 07:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G5-01	**Lab ID:**	1611084-7
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 13:10	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**12.7 (+/- 1.6)**		**0.6**	**pCi/g**	NA	11/29/2016 07:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G50-01	**Lab ID:**	1611084-8
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 13:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**9.6 (+/- 1.3)**	G	**0.8**	**pCi/g**	NA	11/29/2016 07:15

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G73-01	**Lab ID:**	1611084-9
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 13:20	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**12.8 (+/- 1.6)**		**0.7**	**pCi/g**	NA	11/29/2016 08:17

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G77-01	**Lab ID:**	1611084-10
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 13:40	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**10.8 (+/- 1.4)**		**0.6**	**pCi/g**	NA	11/29/2016 08:17

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G90-01	**Lab ID:**	1611084-11
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 13:30	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**14.1 (+/- 1.8)**	G	**0.9**	**pCi/g**	NA	11/29/2016 08:17

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G94-01	**Lab ID:**	1611084-12
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 13:35	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**15.3 (+/- 2)**	G	**0.9**	**pCi/g**	NA	11/29/2016 08:17

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-G25-01	**Lab ID:**	1611084-13
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 14:00	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**15.6 (+/- 1.9)**	G	**0.6**	**pCi/g**	NA	11/29/2016 08:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I251-01	**Lab ID:**	1611084-14
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 14:40	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**3.22 (+/- 0.54)**		**0.68**	**pCi/g**	NA	11/29/2016 08:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I329-01	**Lab ID:**	1611084-15
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/1/2016 14:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**3.2 (+/- 0.51)**	G	**0.41**	**pCi/g**	NA	11/29/2016 08:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I590-01	**Lab ID:**	1611084-16
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:05	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**18.2 (+/- 2.3)**		**0.6**	**pCi/g**	NA	11/29/2016 08:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I590-02	**Lab ID:**	1611084-17
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:05	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**17.2 (+/- 2.2)**		**0.7**	**pCi/g**	NA	11/29/2016 08:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I332-01	**Lab ID:**	1611084-18
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:10	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**4.59 (+/- 0.68)**		**0.49**	**pCi/g**	NA	11/29/2016 09:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I332-02	**Lab ID:**	1611084-19
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:10	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**4.1 (+/- 0.59)**		**0.47**	**pCi/g**	NA	11/29/2016 09:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I415-01	**Lab ID:**	1611084-20
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:30	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**3.89 (+/- 0.59)**		**0.5**	**pCi/g**	NA	11/29/2016 09:18

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I267-01	**Lab ID:**	1611084-21
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**8.8 (+/- 1.2)**		**0.7**	**pCi/g**	NA	11/29/2016 09:19

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I302-01	**Lab ID:**	1611084-22
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 14:35	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**18.5 (+/- 2.3)**		**0.7**	**pCi/g**	NA	11/29/2016 09:19

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I378-01	**Lab ID:**	1611084-23
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 13:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**26.8 (+/- 3.3)**		**0.9**	**pCi/g**	NA	11/29/2016 09:19

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I463-01	**Lab ID:**	1611084-24
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 15:20	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**16.5 (+/- 2.1)**		**0.8**	**pCi/g**	NA	11/29/2016 10:11

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I205-01	**Lab ID:**	1611084-25
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 11:15	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**13.5 (+/- 1.8)**	G	**0.7**	**pCi/g**	NA	11/29/2016 10:11

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I471-01	**Lab ID:**	1611084-26
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 15:05	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**5.11 (+/- 0.74)**		**0.59**	**pCi/g**	NA	11/29/2016 10:11

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I355-01	**Lab ID:**	1611084-27
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 10:35	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**17.4 (+/- 2.2)**	G	**0.9**	**pCi/g**	NA	11/29/2016 10:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I388-01	**Lab ID:**	1611084-28
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 11:00	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**17.5 (+/- 2.2)**	G	**0.7**	**pCi/g**	NA	11/29/2016 10:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I477-01	**Lab ID:**	1611084-29
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 10:50	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**4.7 (+/- 0.71)**		**0.63**	**pCi/g**	NA	11/29/2016 10:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I296-01	**Lab ID:**	1611084-30
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 09:30	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**15.7 (+/- 1.9)**		**0.6**	**pCi/g**	NA	11/29/2016 10:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I325-01	**Lab ID:**	1611084-31
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 09:45	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**			Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**15.8 (+/- 2)**		**0.6**	**pCi/g**	NA	11/29/2016 10:12

Client:	Tetra Tech MM, Inc.	**Date:**	*30-Nov-16*
Project:	Riley Pass Phase III Sampling	**Work Order:**	1611084
Sample ID:	RA-I491-01	**Lab ID:**	1611084-32
Legal Location:		**Matrix:**	SOIL
Collection Date:	11/2/2016 09:55	**Percent Moisture:**	

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results		**PAI 713**		Prep Date: **11/7/2016**		PrepBy: **MRL**
Ra-226	**4.64 (+/- 0.69)**		**0.54**	**pCi/g**	NA	11/29/2016 10:12

Client: Tetra Tech MM, Inc. **Date:** *30-Nov-16*
Project: Riley Pass Phase III Sampling **Work Order:** 1611084
Sample ID: RA-I552-01 **Lab ID:** 1611084-33
Legal Location: **Matrix:** SOIL
Collection Date: 11/2/2016 10:10 **Percent Moisture:**

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Gamma Spectroscopy Results			**PAI 713**		Prep Date: **11/7/2016**	PrepBy: **MRL**
Ra-226	**13.2 (+/- 1.7)**	G	**0.8**	**pCi/g**	NA	11/29/2016 10:56

Explanation of Qualifiers

Radiochemistry:

U or ND - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
G - Sample density differs by more than 15% of LCS density.
D - DER is greater than Control Limit
M - Requested MDC not met.
LT - Result is less than requested MDC but greater than achieved MDC.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits
NC - Not Calculated for duplicate results less than 5 times MDC
B - Analyte concentration greater than MDC.
B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).
U or ND - Indicates that the compound was analyzed for but not detected.
E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
M - Duplicate injection precision was not met.
N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
* - Duplicate analysis (relative percent difference) not within control limits.
S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

U or ND - Indicates that the compound was analyzed for but not detected.
B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.
E - Analyte concentration exceeds the upper level of the calibration range.
J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).
A - A tentatively identified compound is a suspected aldol-condensation product.
X - The analyte was diluted below an accurate quantitation level.
* - The spike recovery is equal to or outside the control criteria used.
+ - The relative percent difference (RPD) equals or exceeds the control criteria.
G - A pattern resembling gasoline was detected in this sample.
D - A pattern resembling diesel was detected in this sample.
M - A pattern resembling motor oil was detected in this sample.
C - A pattern resembling crude oil was detected in this sample.
4 - A pattern resembling JP-4 was detected in this sample.
5 - A pattern resembling JP-5 was detected in this sample.
H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.
L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.
Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
- gasoline
- JP-8
- diesel
- mineral spirits
- motor oil
- Stoddard solvent
- bunker C

QC BATCH REPORT

Batch ID: **GS161108-1-1** Instrument ID: **GAMMA** Method: **Gamma Spectroscopy Results**

DUP Sample ID: **1611084-2** Units: **pCi/g** Analysis Date: **11/29/2016 07:12**

Client ID: **RA-G190-01** Run ID: **GS161108-1A** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	11.4 (+/- 1.5)	0.8						11.2	0.1	2.13	

LCS Sample ID: **GS161108-1** Units: **pCi/g** Analysis Date: **11/29/2016 09:19**

Client ID: Run ID: **GS161108-1A** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	464 (+/- 54)	2	468.6		99	85-115					P,M3

MB Sample ID: **GS161108-1** Units: **pCi/g** Analysis Date: **11/29/2016 09:18**

Client ID: Run ID: **GS161108-1A** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	-0.15 (+/- 0.24)	0.47									U

The following samples were analyzed in this batch:

1611084-1	1611084-2	1611084-3
1611084-4	1611084-5	1611084-6
1611084-7	1611084-8	1611084-9
1611084-10	1611084-11	1611084-12
1611084-13	1611084-14	1611084-15
1611084-16	1611084-17	1611084-18
1611084-19	1611084-20	

QC BATCH REPORT

Batch ID: **GS161108-2-1** Instrument ID: **GAMMA** Method: **Gamma Spectroscopy Results**

DUP Sample ID: **1611084-21** Units: **pCi/g** Analysis Date: **11/29/2016 09:19**
Client ID: **RA-I267-01** Run ID: **GS161108-2A** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	8.9 (+/- 1.2)	0.6						8.8	0.10	2.13	

LCS Sample ID: **GS161108-2** Units: **pCi/g** Analysis Date: **11/29/2016 10:56**
Client ID: Run ID: **GS161108-2A** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	466 (+/- 55)	3	468.6		99.4	85-115					P,M3

MB Sample ID: **GS161108-2** Units: **pCi/g** Analysis Date: **11/29/2016 10:56**
Client ID: Run ID: **GS161108-2A** Prep Date: **11/7/2016** DF: **NA**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	DER Ref Value	DER	DER Limit	Qual
Ra-226	-0.12 (+/- 0.17)	0.34									U

The following samples were analyzed in this batch:

1611084-21	1611084-22	1611084-23
1611084-24	1611084-25	1611084-26
1611084-27	1611084-28	1611084-29
1611084-30	1611084-31	1611084-32
1611084-33		

APPENDIX D

SCANNED COPY OF FIELD LOGBOOK AND FIELD SHEETS

FIELD LOGBOOK

GAMMA RADIATION SURVEY AND XRF FIELD NOTES

RILEY PASS ABANDONED URANIUM MINES

2016 FIELD LOGBOOK

Forestry Suppliers, Inc.
1-800-647-5368
#49355 Level Book

114-560543

114-560543 9/5/16

TRAVEL/FIELD PREP DAY

AARON OFFICE @ 1000

ALICIA OFFICE @ 1400

PERFORMED PRE SURVEY QC CHECKS

FOR XRF + GAMMA INSTRUMENTS PER USP.

LEFT FORT COLLINS @ 1500

ARRIVE IN BOWMAN, ND @ 2306

END OF FIELD ENTRIES

FOR 9/5/16



114-560543 TUESDAY 9/6/16

0530 FIELD PREP (AO)

0600 QC → XRF/RAD

	BG	FS	Cs137
MFG 12	11.5	12.1	200

LEFT TO SITE @ 0700

ARRIVE AT OFFICE @ 0800

MEETING W/ CODY KNOWLTON 0800-0900

▷ SAFETY, RADIATION H&S, ALARA, etc.

CONDUCT VERIFICATION SURVEYS @

BLUFF G TOP.

▷ XRF FIELD LOGS CONDUCTED BY FIELD ENGINEERS; CONSULT THESE FOR SAMPLING INFORMATION

END OF ENTRIES FOR PAGE

114-560543 TUESDAY 9/6/16

SOIL SAMPLE INFORMATION PROVIDED FOR BLUFF G (TOP):

XRF ID	DATE	TIME	DUP/TYPE
G104	9/6/16	1056	YES / RADIUM ONLY
G163	9/6/16	1245	NO
G184	9/6/16	1430	YES / ARSENIC ONLY
G226	9/6/16	1500	NO
G247	9/6/16	1522	NO

○ GAMMA SURVEY PERFORMED AT SAME TIME AS XRF, 1300-1600

BLUFF F (2x PRECISION XRF) @ 1800-1900

LEFT RILEY PASS @ 1900

ARRIVE HOTEL @ 1945 QC @ 2000

	BG	FS	Cs137
MFG 12	11.7	12.0	202

Data Analysis (2 hours)

END OF FIELD ENTRIES FOR 9/6/16

114-560543 WEDNESDAY 9/7/16

0700 QC @ Bowman, ND 1/2 Rainy 600
1/2 Sunny 750

	BG	FS	Cs137
MFG 12	11.6	11.1	201
MFG-15	11.6	11.6	212

0730-1000 RAIN DELAY

LEFT HOTEL 1000

ARRIVE @ FIELD OFFICE 1020
- Safety meeting
- training/orientation

INITIATE SCAN @ 1100 OF BLUFF F

COMPLETE SCAN @ 1300 AT BLUFF F

INITIATED XRF SURVEYS @ 1415 BLUFF F

END OF FIELD ENTRIES See PAGE

114-560543 WEDNESDAY 9/7/16

• XRF FIELD LOGS COMPLETED BY FIELD ENGINEERS

SOIL SAMPLE INFORMATION:

XRF ID	DATE	TIME	DUP/TYPE
F103	9/7/16	1535	NO
F44	9/7/16	1545	NO
F71	9/7/16	1552	Yes (Depth)
F64	9/7/16	1615	NO
F21	9/7/16	1630	
F27	9/7/16	1640	NO

LEFT SITE 1900

ARRIVE HOTEL 1930 QC 1930

	BG	FS	Cs137
MFG 12	11.1	11.4	201
MFG 15	11.0	11.4	212

Field demobilization 2 days
9/9/16

end of field entries 9/9/16

114-560543 Thursday 9/8/16

LEFT HOTEL 0600

LEFT SITE 1000

ARRIVE FT COLLINS 2000

END OF FIELD

ENTRIES FOR

9/8/16

PAGE LEFT

BLANK

INTENTIONALLY

SEPARATION

BETWEEN

PHASE I & PHASE II

114-560543

OCTOBER 26, 2016 PHASE II TRIP

LEFT HOTEL @ 0500 Sunny 70°

ARRIVE @ BOWMAN TO DO QC

ID	BG	FS	Cs137
MFG 12	12.1	11.9	208

ARRIVE TO BLUFF G @ 1230

SAFETY MEETING; DISCUSSED PLANS FOR DAY

PERFORMED GAMMA SURVEYS @ BLUFF G ON THE WEST/NORTH SIDE.

LEFT SITE 1730

ARRIVE @ HOTEL 1830, QC @ NORTHWINDS.

ID	BG	FS	Cs 137
MFG 12	12.1	11.9	197

Data Analysis 2000 - 2100

END OF FIELD ENTRIES FOR 10/26/16

OCTOBER 27, 2016 THURSDAY 114-560545

QC @ HOTEL 0630

ID	BG	FS	Cs137
MFG12	11.9	11.1	199

LEFT HOTEL @ 0730 70° sunny

ARRIVE ONSITE @ 0815

FIELD OFFICE TRAILER MTG

- SAFETY MEETING
- DISCUSS PLANS FOR DAY

0830 SCAN AT BLUFF G supplemental
→ NORTH AND WEST SIDE

1300 - DATA ANALYSIS

1330 - 1700 SCAN AT BLUFF I SLOPE

left site 1700
ARRIVE HOTEL 1800
QC @ 1800-1815

MP	BG	FS	Cs 137
MFG12	12.3	12.0	203

END OF FIELD ENTRIES FOR 10/27

OCTOBER 28, 2016 FRIDAY 117-560543

QC @ HOTEL 0500

ID	BG	FS	Cs137
MFG12	11.8	12.6	201

WINDY
Partly cloudy
60°

LEFT HOTEL 0530

ARRIVE ON SITE 0600

0800 - SCAN/SOIL SAMPLE

> CONDUCT RADIUM SOIL SAMPLING AT BLUFF I ON AREAS WHERE RECLAMATION WAS COMPLETED.

NOVEMBER 1, 2016 117-560543

LEFT SPEARFISH 0500 65° Sunny

QC @ BOWMAN 0700

ID	BG	FS	Cs 137
MFG12	11.8	11.7	201

ARRIVE ONSITE @ 0745

MEETING W/ MARY BETH & CARRY

0900 BLUFF G EAST
> conduct SCAN 100%
> Cody collected soil samples
> performed correlation scanning

1100 BLUFF G WEST
> Radium sampling, and correlation
> Fill in scans at Bluff G

1445 BLUFF I TOPS
> As & Radium sampling (Cody)
> Finish Scanning

LEFT SITE @ 1730
QC @ HOTEL

ID	BG	FS	Cs137
MFG 12	11.5	11.4	203

END OF FIELD ENTRIES FOR 11/1/16

NOVEMBER 2, 2016

114-560543

QC @ HOTEL 0530

70° Sunny

ID	BG	PS	Cs 137
MPG 2	11.7	11.2	199

ARRIVE ONSITE 0730

0800 Scan BLUFF I

CORRELATION samples
Sample Radium & Arsenic

1200 Data Analysis @ trailer

1300 Scan Bluff I

Correlation / Arsenic Sampling of Bluff I
(CLC) - see logsheets

END SCAN 1730
Leave site 1730
ARRIVE HOTEL 1830
QC @ 1630-1700

ID	BG	PS	Cs-137
MPG-2	11.8	11.4	203

Soil QC 2 hrs

END OF FIELD
ENTRIES
FOR 11/2/16

FIELD SHEETS

XRF NIST STANDARD CALIBRATION CHECKS

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA 180-436

SRM Arsenic Concentration: mg/kg

Measurement #	XRF # 57181	XRF #	XRF #
1	370		
2	366		
3	372		
4	384		
5	364		
6	373		
7	369		
8	366		
9	375		
10	358		
Average	369.7		

Date	Time
10/10/16	8:00

Measurement #	XRF # 57181	XRF #	XRF #
1	357		
2	369		
3	368		
4	377		
5	364		
6	368		
7	371		
8	371		
9	370		
10	374		
Average	368.9		

Date	Time
10/11/16	7:25

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA 180-436

SRM Arsenic Concentration: mg/kg

Measurement #	XRF # 57181	XRF #	XRF #
1	~~355~~ 363		
2	368		
3	379		
4	375		
5	369		
6	377		
7	364		
8	370		
9	378		
10	383		
Average	372.6		

Date	Time
10-12-16	14:00

Measurement #	XRF # 57181	XRF #	XRF #
1	376		
2	372		
3	369		
4	376		
5	371		
6	383		
7	376		
8	384		
9	368		
10	366		
Average	374.1		

Date	Time
10/14/16	6:45

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA 180-436

SRM Arsenic Concentration: mg/kg

Measurement #	XRF # 57181	XRF #	XRF #
1	372		
2	356		
3	371		
4	375		
5	374		
6	376		
7	366		
8	378		
9	370		
10	373		
Average	371.1		

Date	Time
10/17/16	7:00

Measurement #	XRF # 57181	XRF #	XRF #
1	375		
2	375		
3	386		
4	369		
5	374		
6	376		
7	374		
8	384		
9	367		
10	376		
Average	375.6		

Date	Time
10/18/16	13:00

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: T-21

SRM Arsenic Concentration: mg/kg 51 ± 7

Measurement #	XRF # 57181	XRF #	XRF #
1	90		
2	86		
3	87		
4	91		
5	87		
6	91		
7	92		
8	91		
9	90		
10	92		
Average	89.7		

Date	Time
10/19/16	7:22

Measurement #	XRF # 57181	XRF #	XRF #
1	92		
2	92		
3	92		
4	94		
5	93		
6	96		
7	91		
8	89		
9	91		
10	90		
Average	91.4		

Date	Time
10/20/16	7:25

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: EN 71-3 LOT #T-21

SRM Arsenic Concentration: mg/kg 51 ± 7

Measurement #	XRF # 57181	XRF #	XRF #
1	90		
2	91		
3	90		
4	88		
5	90		
6	90		
7	91		
8	87		
9	89		
10	92		
Average	89.8		

Date	Time
10/24/16	12:45

Measurement #	XRF # 57181	XRF #	XRF #
1	360		
2	374		
3	368		
4	366		
5	365		
6	366		
7	382		
8	360		
9	369		
10	374		
Average	368.4		

Date	Time
10/25/16	9:05

66
-31
35
50
85

307-754-3910

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA 180-436

SRM Arsenic Concentration: mg/kg

Measurement #	XRF # 57181	XRF #	XRF #
1	374		
2	369		
3	376		
4	366		
5	364		
6	374		
7	370		
8	371		
9	370		
10	367		
Average	370.1		

Date	Time
10/26/16	7:30

Measurement #	XRF # 57181	XRF #	XRF #
1	377		
2	369		
3	371		
4	375		
5	381		
6	371		
7	381		
8	372		
9	378		
10	372		
Average	374.7		

Date	Time
10/27/16	8:08

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA

SRM Arsenic Concentration: mg/kg 180-436

Measurement #	XRF # 57181	XRF #	XRF #
1	383		
2	370		
3	361		
4	372		
5	375		
6	381		
7	374		
8	373		
9	374		
10	369		
Average	373.2		

Date	Time
11/1/16	8/28

Measurement #	XRF # 57181	XRF #	XRF #
1	375		
2	~~369~~ 376		
3	372		
4	362		
5	375		
6	368		
7	363		
8	384		
9	369		
10	375		
Average	371.3		

Date	Time
11/2/16	12:00

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA

SRM Arsenic Concentration: mg/kg

180 - 436

Measurement #	XRF # 57181	XRF #	XRF #
1	366		
2	364		
3	368		
4	381		
5	367		
6	372		
7	360		
8	378		
9	368		
10	372		
Average	369.0		

Date	Time
11/3/16	8:20

Measurement #	XRF # 57181	XRF #	XRF #
1	366		
2	377		
3	358		
4	373		
5	375		
6	367		
7	368		
8	364		
9	370		
10	369		
Average	368.7		

Date	Time
11/7/16	8:45

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA

SRM Arsenic Concentration: mg/kg
180 – 436

Measurement #	XRF # 57181	XRF #	XRF #
1	372		
2	372		
3	372		
4	369		
5	372		
6	364		
7	375		
8	383		
9	370		
10	373		
Average	372.2		

Date	Time
11/8/16	8:40

Measurement #	XRF # 57181	XRF #	XRF #
1	379		
2	369		
3	378		
4	381		
5	377		
6	375		
7	376		
8	372		
9	373		
10	371		
Average	375.1		

Date	Time
11/9/16	7:00

TETRA TECH

Standard Reference Material XRF Calibration Check Sheet

SRM ID: RCRA

SRM Arsenic Concentration: mg/kg 180-436

Measurement #	XRF # 5718	XRF #	XRF #
1	368		
2	373		
3	359		
4	373		
5	375		
6	379		
7	369		
8	367		
9	373		
10	365		
Average	369.9		

Date	Time
11/10/16	8:35

Measurement #	XRF #	XRF #	XRF #
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Average			

Date	Time

FIELD SHEETS

XRF PRECISION CHECK

TETRA TECH

XRF Precision Check Sheet

Project: Riley Pass - Bluff F

XRF #: 5718

Measurement #	Date: 9/6/16 Time : 1810	Date: 9/7/16 Time : 1420	Date: Time :	Date: Time :	Date: Time :
1	33	28			
2	32	26			
3	29	26			
4	27	25			
5	28	28			
6	28	26			
7	30	26			
8					
9					
10					

@ F5 location @ F96

TETRA TECH

XRF Precision Check Sheet

Project: Riley Pass - Bluff F

XRF #: 47412

Measurement #	Date: 9/6/16 Time : 1825	Date: 9/7/16 Time : 1420	Date: _____ Time : _____	Date: _____ Time : _____	Date: _____ Time : _____
1	30	29			
2	34	28			
3	33	28			
4	33	29			
5	34	30			
6	31	29			
7	35	28			
8					
9					
10					

@ F4 location | @ F98

TETRA TECH

XRF Precision Check Sheet

Project: Riley Pass

XRF #: 57181

Measurement #	Date: 10-10-16 Time : 16:00	Date: 10-11-16 Time : 15:50	Date: 10/12/16 Time : 15:45	Date: 10/27/16 Time : 14:04	Date: 10/18/16 Time : 14:53
1	37	33	28	18	27
2	38	33	30	17	28
3	38	34	32	17	30
4	37	35	31	20	28
5	35	33	31	23	29
6	37	36	30	21	30
7	37	36	33	19	29
8	36				
9	37				
10	35				
	I 2.19		I 25	I 575	I 329

11/1/16
15:35
23
17
16
15
15
16
13

TETRA TECH

XRF Precision Check Sheet

Project: Riley Pass

XRF #: 57181

Measurement #	Date: 10/20/16 Time : 15:40	Date: _____ Time : _____	Date: 10/25/16 Time : 15:10	Date: 10/26/16 Time : 12:12	Date: _____ Time : _____
1	29		24	31	
2	30		25	34	
3	29		27	30	
4	27		28	33	
5	31		28	32	
6	29		27	30	
7	28		26	35	
8					
9					
10					

G 108 G 39 G67

TETRA TECH

XRF Precision Check Sheet

Project: Riley Pass

XRF #: 57181

Measurement #	Date: 11/3/16 Time : 14:20	Date: 11/4/16 Time : 14:56	Date: 11/7/16 Time : 15:15	Date: 11/10/16 Time : 14:12	Date: 11/9/16 Time :
1	7	28	22	27	42
2	7	27	22	24	38
3	9	27	26	25	38
4	6	28	25	27	39
5	8	25	24	22	40
6	7	25	24	27	40
7	10	28	25	24	39
8					
9					
10					

~~11/10~~

I562 I360 I 309

FIELD SHEETS

BLUFF F XRF FIELD SHEETS

Sampler ID: [illegible] Study Area: [illegible]

XRF ID: 57181 (XRF-1) Field Conditions: 60°, cloudy
47412 (XRF-2)

TETRA TECH

	XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID	
XRF 2	F1	1085645.88	747686.25	N	9/7/16	1734	33	-	-	-	
XRF 2	F2	1085645.88	747719.06	N	9/7/16	1719	48	-	-	-	
XRF 1	F3	1085645.88	747751.87	N	9/7/16	1718	37	-	-	-	
XRF-2→	F4	1085645.88	747784.68	N	9/6/16	1805	30	34	-	-	precision check
XRF-1 →	F5	1085645.88	747817.48	N	9/6/16	1810	33	32	-	-	precision check done
XRF 1	F6	1085678.69	747653.44		9/7/16	1736	55	-	.	-	
XRF 1	F7	1085678.69	747686.25	N	9/7/16	1734	36	-	-	-	
XRF 1	F8	1085678.69	747719.06	N	9/7/16	1720	23	-	-	-	
XRF 1	F9	1085678.69	747751.87	N	9/7/16	1716	31	-	-	-	
XRF 2	F10	1085678.69	747784.68	N	9/7/16	1700	33	-	-	-	
XRF 2	F11	1085711.49	747620.63	N	9/7/16	1747	20	-	-	-	
XRF 2	F12	1085711.49	747653.44	N	9/7/16	1737	27	-	-	-	
XRF 1	F13	1085711.49	747686.25	N	9/7/16	1732	48	-	-	-	
XRF 2	F14	1085711.49	747719.06	N	9/7/16	1722	30	-	-	-	
XRF 2	F15	1085711.49	747751.87	N	9/7/16	1716	74	-	-	.	
XRF 1	F16	1085711.49	747784.68	N	9/7/16	1700	25	-	-	-	
XRF 1	F17	1085744.30	747620.63	N	9/7/16	1746	19	-	-	-	
XRF 1	F18	1085744.30	747653.44	N	9/7/16	1738	9	-	.	-	
XRF 2	F19	1085744.30	747686.25	N	9/7/16	1732	27	-	-	-	
XRF 1	F20	1085744.30	747719.06	N	9/7/16	1720	18	-	-	-	
	F21	1085744.30	747751.87	N	9/7/16	1630	22	20	Y-S AS - F21 -01 KA - F21 -01		
XRF 1	F22	1085744.30	747784.68	N	9/7/16	1702	15	-	.	.	

XRF ID: 2F Field Conditions: 70° Sunny, windy

TETRA TECH

XRF1 57181
XRF2 47142 (AS)

	XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
XRF2	F23	1085777.11	747620.63	N	9/7/16	1745	25	—	-	—
XRF2	F24	1085777.11	747653.44	N	9/7/16	1739	27	-	—	-
XRF 1	F25	1085777.11	747686.25	N	9/7/16	1736	15	—	—	—
XRF2	F26	1085777.11	747719.06	N	9/7/16	1722	26	-	—	-
XRF2	F27	1085777.11	747751.87	N	9/7/16	1640	29	28	AS - F27-01 RA - F27-01	—
XRF 2	F28	1085777.11	747784.68	N	9/7/16	1703	18	—	—	-
XRF1	F29	1085809.92	747620.63	N	9/7/16	1744	17	—	—	-
XRF 1	F30	1085809.92	747653.44	N	9/7/16	1740	20	—	-	—
XRF 2	F31	1085809.92	747686.25	N	9/7/16	1729	29	—	—	—
XRF1	F32	1085809.92	747719.06	N	9/7/16	1723	18	-	·	·
XRF1	F33	1085809.92	747751.87	N	9/7/16	1715	21	—	—	-
XRF 1	F34	1085809.92	747784.68	N	9/7/16	1705	18	-	-	-
XRF1	F35	1085809.92	747817.48	N	9/7/16	1749	15	-	-	—
XRF 2	F36	1085809.92	747850.29	9/7/16 ↔ N 9/7/16		1502	15	-	-	·
XRF2	F37	1085842.73	747620.63	~~9/7/16~~ N	9/7/16	1743	15	-	-	—
XRF 2	F38	1085842.73	747653.44	~~9/7/16~~ N	9/7/16	1741	17	—	—	—
XRF1	F39	1085842.73	747686.25	N	9/7/16	1728	13	—	-	—
XRF 2	F40	1085842.73	747719.06	N	9/7/16	1725	21	—	—	-
XRP1	F41	1085842.73	747751.87	N	9/7/16	1713	18	—	—	—
XRF 2	F42	1085842.73	747784.68	N	9/7/16	1705	23	—	-	·
XRF 2	F43	1085842.73	747817.48	N	9/7/16	1751	13	—	-	—
XRF 2 *	F44	1085842.73	747850.29	~~9/7~~ N	9/7/16	1545	33	36	AS - F44-01 RA - F44-01	

Sampler ID: BOAS

XRF ID: 2

Study Area: Bluff E

Field Conditions: Sunny 70°; windy

TETRA TECH

XRF1 S7181

XRF2 47142

	XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
XRF1	F45	1085875.54	747653.44	N	9/7/16	1745	13	—	—	—
XRF2	F46	1085875.54	747686.25	N	9/7/16	1727	16	—	—	—
XRF1	F47	1085875.54	747719.06	N	9/7/16	1725	17	—	—	.
XRF2	F48	1085875.54	747751.87	N	9/7/16	1713	16	—	—	—
XRF1	F49	1085875.54	747784.68	N	9/7/16	1706	11	—	—	—
XRF1	F50	1085875.54	747817.48	N	9/7/16	1751	14	—	.	.
XRF1	F51	1085875.54	747850.29	N	9/7/16	1459	44	—	.	—
XRF1	F52	1085908.34	747719.06	N	9/7/16	1727	13	—	—	—
XRF1	F53	1085908.34	747751.87	N	9/7/16	1712	19	—	—	.
XRF2	F54	1085908.34	747784.68	N	9/7/16	1708	OK			
XRF2	F55	1085908.34	747817.48	N	9/7/16	1753	24	—	—	—
XRF2	F56	1085908.34	747850.29	N	9/7/16	1457	19	—	—	.
XRF2	F57	1085941.15	747751.87	N	9/7/16	1710	24	—	.	.
XRF1	F58	1085941.15	747784.68	N	9/7/16	1706	11	—	—	—
XRF1	F59	1085941.15	747817.48	N	9/7/16	1754	14			
XRF1	F60	1085973.96	747784.68	N	9/7/16	1708	23	—	—	—
XRF2	F61	1085973.96	747817.48	N	9/7/16	1755	15	—	—	—
XRF1	F62	1085317.79	747915.91	N	9/7/16	1656	22	—	—	—
XRF2	F63	1085350.60	747817.48	N	9/7/16	1649	23	—	—	—
XRF2	F64	1085383.41	747817.48	N	9/7/16	1615	25	31	RA-F64-01 AS F64-4	1615
XRF2	F65	1085416.22	747817.48	N	9/7/16	1650	27	—	—	—
XRF2	F66	1085416.22	747850.29	N	9/7/16	1651	20	—	.	—

cast one

XRF ID: C2x3 ✓ Field Conditions: windy, sunny, 70°F

XRF1 57181

XRF2 49142

TETRA TECH

	XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
XRF 1	F67	1085481.83	747850.29	Y	9/7/16	1653	20	-	-	-
XRF 2	F68	1085613.07	747915.91	N	9/7/16	1511	22	-	-	
XRF 1	F69	1085613.07	747948.72	N	9/7/16	1510	18	-	-	-
XRF 1	F70	1085613.07	747981.53	~~Y~~ N	9/7/16	1509	24	-	-	-
Soil Sump	F71	1085645.88	747981.53	N	9/7/16	1552	27	29	Yes A3-F71-01 AC-F71-02 RA-F71-01 RA-F71-02	DUPs for F071
XRF 2	F72	1085678.69	747948.72	N	9/7/16	1508	20	-	Yes -	-
XRF 2	F73	1085678.69	747981.53	N	9/7/16	1506	30	-	-	-
XRF 1	F74	1085678.69	748014.34	Y	9/7/16	1506	20	-	-	-
XRF 2	F75	1085711.49	747981.53	N	9/7/16	1504	29	-	-	-
XRF 1	F76	1085744.30	747948.72	N	9/7/16	1503	23	-	-	-
XRF 1	F77	1085744.30	747981.53	N	9/7/16	1505	21	-	-	-
XRF 1	F78	1085809.92	747883.10	N	9/7/16	1453	13	-	-	-
XRF 2	F79	1085809.92	747915.91	N	9/7/16	1452	16	-	-	-
XRF 1	F80	1085809.92	747948.72	N	9/7/16	1446	10	-	-	-
XRF 1	F81	1085809.92	747981.53	N	9/7/16	1444	10	-	-	-
XRF 1	F82	1085809.92	748014.34	N	9/7/16	1442	17	-	-	-
XRF 1	F83	1085842.73	747883.10	N	9/7/16	1435	11	-	-	-
XRF 1	F84	1085842.73	747915.91	N	9/7/16	1452	10	-	-	-
XRF 2	F85	1085842.73	747948.72	N	9/7/16	1446	19	-	-	-
XRF 2	F86	1085842.73	747981.53	N	9/7/16	1444	14	-	-	-
XRF 2	F87	1085842.73	748014.34	N	9/7/16	1441	19	-	-	-
XRF 2	F88	1085875.54	747883.10	N	9/7/16	1453	13	-	-	-

XRF ID: (2 used) Field Conditions: Sunny 70°, windy

XRF1 57181 (CK)

XRF2 47142 (AS)

TETRA TECH

	XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
XRF 1	F89	1085875.54	747915.91	N	9/7/16	1450	12	-	-	-
XRF 1	F90	1085875.54	747948.72	N	9/7/16	1448	15	-	-	-
XRF1	F91	1085908.34	747883.10	N	9/7/16	1458	11			
XRF 2	F92	1085908.34	747915.91	N	9/7/16	1451	16	-	-	-
XRF 2	F93	1085908.34	747948.72	N	9/7/16	1448	18	-	-	-
XRF1	F94	1085556.81	748191.90	~~1415~~ N	9/7/16 1415	1415	60	-	-	-
XRF2	F95	1085565.14	748211.18	N	1415 9/7/16	1415	45	-	-	-
XRF1	F96	1085645.88	748112.76	N	9/7/16	1420	28	26	* Precision 9/7/16 -	- *
XRF 1	F97	1085678.69	748112.76	N	9/7/16	1429	24	-	-	-
XRF 2	F98	1085678.69	748145.57	N	9/7/16	1420	29	28	* Precision 9/7/16 N	-
LF 1	F99	1085809.92	748079.95	N	9/7/16	1438	21	-	-	-
RF 1	F100	1085842.73	748047.14	N	9/7/16	1440	16	-	-	-
XRF 2	F101	1085842.73	748079.95	N	9/7/16	1439	22	-	-	-
XRF 1	F102	1085842.73	748112.76	N	9/7/16	1436	23			
RF2 *	F103	1085842.73	748145.57	YES	9/7/16	1535	20	23	YES AS - F103-01 RA - F103-01	
XRF 2	F104	1085842.73	748178.38	N	9/7/16	1433	26			
XRF 1	F105	1085842.73	748211.19	N	9/7/16	1432	38			
XRF 2	F106	1085875.54	748079.95	N	9/7/16	1436	21	-	-	-
XRF2	F107	1085875.54	748112.76	~~YES~~ CLIFF	9/7/16	1435	22		-	-
XRF 1	F108	1085875.54	748145.57	YES - OFF CLIFF	9/7/16	1434	38			
XRF2	F109	1085468.88	747807.15	N	9/7/16	1634	24	-	-	-
XRF1	F110	1085304.51	747806.11	N	9/7/16	1650	19	-	-	-

XRF ID: 57181 Field Conditions: 70° Sunny

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
F111	1085502.05	747852.59	N	9/7/16	1654	19	—	.	-

XRF1

FIELD SHEETS

BLUFF G XRF FIELD SHEETS

Sampler ID: CK
XRF ID: 57181
Study Area: Bluff G
Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G1	1087220.68	748178.38	N	10/25/16	13:54	24	—	—	—
G2	1087253.49	748178.38	N	10/25/16	13:57	34	—	—	—
G3	1087286.30	748178.38	N	10/25/16	13:57	38	—	—	—
G4	1087089.45	748145.57	N	10/25/16	14:15	33	—	—	—
G5	1087122.25	748145.57	N	10/25/16	14:18	27	26	Yes	G5
G6	1087155.06	748145.57	N	10/25/16	14:23	29	—	—	—
G7	1087187.87	748145.57	N	10/25/16	14:24	36	—	—	—
G8	1087220.68	748145.57	N	10/25/16	14:27	37	—	—	—
G9	1087253.49	748145.57	N	10/25/16	14:30	29	—	—	—
G10	1087286.30	748145.57	N	10/25/16	14:32	35	—	—	—
G11	1087319.11	748145.57	N	10/25/16	14:35	37	—	—	—
G12	1087351.91	748145.57	N	10/25/16	14:37	37	—	—	—
G13	1086956.21	748112.76	N	10/18/16	14:42	22	—	—	—
G14	1086991.02	748112.76	N	10/18/16	14:44	26	—	—	—
G15	1087023.83	748112.76	N	10/18/16	14:47	28	—	—	—
G16	1087056.64	748112.76	N	10/18/16	14:50	25	—	—	—
G17	1087089.45	748112.76	N	10/18/16	15:04	31	—	—	—
G18	1087122.25	748112.76	N	10/18/16	15:02	27	—	—	—
G19	1087155.06	748112.76	N	10/25/16	15:00	33	—	—	—
G20	1087187.87	748112.76	N	10/25/16	14:57	22	—	—	—
G21	1087220.68	748112.76	N	10/25/16	14:55	24	—	—	—
G22	1087253.49	748112.76	N	10/25/16	14:52	26	—	—	—

Sampler ID: CC Study Area: Bluff G

XRF ID: 57181 Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G23	1087286.30	748112.76	N	10/25/16	14:51	34	—	—	—
G24	1087319.11	748112.76	N	10/25/16	14:48	48	—	—	—
G25	1087351.91	748113.76	N	10/25/16	14:45	80	29	Yes	G25
G26	1087384.72	748112.76	N	10/25/16	14:40	34	—	—	—
G27	1087417.53	748112.76	N	10/25/16	14:38	18	—	—	—
G28	1086956.21	748079.95	N	10/18/16	14:52	27	28	—	—
G29	1086991.02	748079.95	N	10/18/16	15:04	27	—	—	—
G30	1087023.83	748079.95	N	10/18/16	15:06	25	—	—	—
G31	1087056.64	748079.95	N	10/18/16	15:09	24	—	—	—
G32	1087089.45	748079.95	N	10/18/16	15:11	24	—	—	—
G33	1087122.25	748079.95	N	10/18/16	15:37	30	—	—	—
G34	1087155.06	748079.95	N	10/24/16	15:35	30	—	—	—
G35	1087187.87	748079.95	N	10/24/16	15:31	30	—	—	—
G36	1087220.68	748079.95	N	10/24/16	15:28	24	—	—	—
G37	1087253.49	748079.95	N	10/24/16	15:25	32	—	—	—
G38	1087286.30	748079.95	N	10/25/16	15:06	14	—	—	—
G39	1087319.11	748079.95	N	10/25/16	15:22	24	25	—	—
G40	1087351.91	748079.95	N	10/25/16	15:24	26	~~26~~ cc	—	—
G41	1087384.72	748079.95	N	10/25/16	15:27	34	—	—	—
G42	1087417.53	748079.95	N	10/25/16	15:30	16	—	—	—
G43	1087450.34	748079.95	N	10/25/16	15:31	16			
G44	1087023.83	748047.14	N	10/24/16	14:55	31	—	—	—

Sampler ID: CR Study Area: Bluff G

XRF ID: 57181 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G45	1087056.64	748047.14	N	10/18/16	15:17	34	—	—	—
G46	1087089.45	748047.14	N	10/18/16	15:19	22	—	—	—
G47	1087122.25	748047.14	N	10/24/16	15:05	36	—	—	—
G48	1087155.06	748047.14	N	10/24/16	15:12	35	—	—	—
G49	1087187.87	748047.14	N	10/24/16	15:15	18	—	—	—
G50	1087220.68	748047.14	N	10/24/16	15:18	28	30	Yes	G50
G51	1087253.49	748047.14	N	10/24/16	15:22	27	—	—	—
G52	1087286.30	748047.14	N	10/25/16	15:47	23	20	Yes	G52
G53	1087319.11	748047.14	N	10/25/16	15:43	21	—	—	—
G54	1087351.91	748047.14	N	10/25/16	15:41	16	—	—	—
G55	1087384.72	748047.14	N	10/25/16	15:38	31	—	—	—
G56	1087417.53	748047.14	N	10/25/16	15:36	15	—	—	—
G57	1087450.34	748047.14	N	10/25/16	15:34	16	—	—	—
G58	1086991.02	748014.34	N	10/18/16	15:32	26	—	—	—
G59	1087023.83	748014.34	N	10/18/16	15:29	27	—	—	—
G60	1087056.64	748014.34	N	10/18/16	15:26	28	—	—	—
G61	1087089.45	748014.34	N	10/18/16	15:24	26	—	—	—
G62	1087122.25	748014.34	N	10/18/16	15:22	28	—	—	—
G63	1087155.06	748014.34	N	10/26/16	12:01	32	—	—	—
G64	1087187.87	748014.34	N	10/26/16	12:03	35	—	—	—
G65	1087220.68	748014.34	N	10/26/16	12:06	20	—	—	—
G66	1087253.49	748014.34	N	10/26/16	12:08	38	—	—	—

Sampler ID: CK
XRF ID: 57181
Study Area: Bluff G
Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G67	1087286.30	748014.34	N	10/26/16	12:12	31	34	Yes	G67
G68	1087319.11	748014.34	N	10/26/16	12:25	19	—	—	—
G69	1087351.91	748014.34	N	10/26/16	12:28	44	—	—	—
G70	1087384.72	748014.34	N	10/26/16	12:30	41	—	—	—
G71	1087417.53	748014.34	N	10/26/16	12:34	31	—	—	—
G72	1087450.34	748014.34	N	10/26/16	12:37	24	—	—	—
G73	1086991.02	747981.53	N	10/24/16	14:48	32	30	Yes	G73
G74	1087023.83	747981.53	N	10/24/16	14:44	30	—	—	—
G75	1087056.64	747981.53	N	10/24/16	14:42	32	—	—	—
G76	1087089.45	747981.53	N	10/24/16	14:37	28	—	—	—
G77	1087122.25	747981.53	N	10/24/16	14:34	31	29	Yes	G77
G78	1087155.06	747981.53	N	10/24/16	14:31	15	—	—	—
G79	1087187.87	747981.53	N	10/24/16	14:28	46	—	—	—
G80	1087220.68	747981.53							
G81	1087253.49	747981.53							
G82	1087286.30	747981.53							
G83	1087319.11	747981.53							
G84	1087351.91	747981.53							
G85	1087384.72	747981.53							
G86	1087417.53	747981.53							

Sampler ID: AD/AS Study Area: BLUFF G (TOP)

XRF ID: 47412 Field Conditions: SUNNY, 60° F

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G67	1087286.30	748014.34							
G68	1087319.11	748014.34							
G69	1087351.91	748014.34							
G70	1087384.72	748014.34							
G71	1087417.53	748014.34							
G72	1087450.34	748014.34							
G73	1086991.02	747981.53							
G74	1087023.83	747981.53							
G75	1087056.64	747981.53							
G76	1087089.45	747981.53							
G77	1087122.25	747981.53							
G78	1087155.06	747981.53							
G79	1087187.87	747981.53	Y	9/6/16	1014	117			
G80	1087220.68	747981.53	N	9/6/16	1008	19			
G81	1087253.49	747981.53	N	9/6/16	1004	14			
G82	1087286.30	747981.53	N	9/6/16	1000	22 (22)			
G83	1087319.11	747981.53	Y (cliff)	9/6/16	0958	10			
G84	1087351.91	747981.53	Y (cliff)	9/6/16	0956	6			
G85	1087384.72	747981.53	N	9/6/16	0953	13			
G86	1087417.53	747981.53	Y	09/06/16	0951	5			

Sampler ID: AO/AS Study Area: Bluff 6 (TOA)

XRF ID: 97412 Field Conditions: Sunny, 60°F

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G87	1087450.34	747981.53	Y	9/6/16	0948	14	-	-	-
G88	1087483.15	747981.53	Y	9/6/16	0945	16.0	-	-	-
G89	1087515.96	747981.53	Y	9/6/16	0938	27	-	-	-
G90	1086958.21	747948.72							
G91	1086991.02	747948.72							
G92	1087023.83	747948.72							
G93	1087056.64	747948.72							
G94	1087089.45	747948.72							
G95	1087122.25	747948.72							
G96	1087155.06	747948.72	N	9/6/16	1029	22	-	-	-
G97	1087187.87	747948.72	N	9/6/16	1022	22	-	-	-
G98	1087220.68	747948.72	N	9/6/16	1026	20	-	-	-
G99	1087253.49	747948.72	N	9/6/16	1028	26	-	-	-
G100	1087286.30	747948.72	N	9/6/16	1032	38	-	-	-
G101	1087319.11	747948.72	N	9/6/16	1036	11	-	-	-
G102	1087351.91	747948.72	N	9/6/16	1038	17	-	-	-
G103	1087384.72	747948.72	N	9/6/16	1042	18 (18)	-	-	-

Sampler ID: CR Study Area: Bluff G

XRF ID: 57181 Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G87	1087450.34	747981.53							
G88	1087483.15	747981.53							
G89	1087515.96	747981.53							
G90	1086958.21	747948.72	N	10/24/16	14:06	31	37	Yes	G90
G91	1086991.02	747948.72	N	10/24/16	14:11	31	—	—	—
G92	1087023.83	747948.72	N	10/24/16	14:14	25	—	—	—
G93	1087056.64	747948.72	N	10/24/16	14:16	34	—	—	—
G94	1087089.45	747948.72	N	10/24/16	14:19	31	—	Yes	G94
G95	1087122.25	747948.72	N	10/24/16	14:23	78	—	—	—
G96	1087155.06	747948.72							
G97	1087187.87	747948.72							
G98	1087220.68	747948.72							
G99	1087253.49	747948.72							
G100	1087286.30	747948.72							
G101	1087319.11	747948.72							
G102	1087351.91	747948.72							
G103	1087384.72	747948.72							

Sampler ID: AG Study Area: Bluff (OC Top)

XRF ID: 47412 Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G104	1087417.53	747948.72	N	9/6/16	1056	14	16	AS-G104-01 RA-G104-01 RA-G104-02	1056 1056 + DUP-B
G105	1087450.34	747948.72	N	9/6/16	1104	30	–	–	–
G106	1087483.15	747948.72	N	9/6/16	1108	23	–	–	–
G107	1087548.76	747948.72							
G108	1086925.40	747915.91							
G109	1086958.21	747915.91							
G110	1086991.02	747915.91							
G111	1087023.83	747915.91							
G112	1087056.64	747915.91							
G113	1087089.45	747915.91							
G114	1087122.25	747915.91	N	9/6/16	1148	35	–	–	–
G115	1087155.06	747915.91	N	9/6/16	1144	14	–	–	–
G116	1087187.87	747915.91	N	9/6/16	1142	27	–	–	–
G117	1087220.68	747915.91	N	9/6/16	1138	17	–	–	–
G118	1087253.49	747915.91	N	9/6/16	1134	20	–	–	–
G119	1087286.30	747915.91	N	9/6/16	1132	19	–	–	–
G120	1087319.11	747915.91	N	9/6/16	1128	18	–	–	–

Sampler ID: DC

XRF ID: 57181

Study Area: Plant 6

Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G104	1087417.53	747948.72							
G105	1087450.34	747948.72							
G106	1087483.15	747948.72							
G107	1087548.76	747948.72	NO	11/1/16	11:57	32			
G108	1086925.40	747915.91	NO	10/20/16	13:48	29	30	—	—
G109	1086958.21	747915.91	NO	10/24/16	13:34	26	—	—	—
G110	1086991.02	747915.91	NO	10/24/16	13:37	29	—	—	—
G111	1087023.83	747915.91	NO	10/24/16	13:39	28	—	—	—
G112	1087056.64	747915.91	NO	10/24/16	13:42	40	—	—	—
G113	1087089.45	747915.91	NO	10/24/16	13:45	34	—	—	—
G114	1087122.25	747915.91							
G115	1087155.06	747915.91							
G116	1087187.87	747915.91							
G117	1087220.68	747915.91							
G118	1087253.49	747915.91							
G119	1087286.30	747915.91							
G120	1087319.11	747915.91							

XRF ID: 47412 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G121	1087351.91	747915.91	N	09/06/16	1124	19	–	–	–
G122	1087384.72	747915.91	N	09/06/16	1121	7	–	–	–
G123	1087417.53	747915.91	N	09/06/16	1118	29	–	–	–
G124	1087450.34	747915.91	N	09/06/16 1115	1125	27	–	–	–
G125	1087515.96	747915.91							
G126	1087548.76	747915.91							
G127	1087581.57	747915.91							
G128	1086892.60	747883.10							
G129	1086925.40	747883.10							
G130	1086958.21	747883.10							
G131	1086991.02	747883.10							
G132	1087023.83	747883.10							
G133	1087056.64	747883.10							
G134	1087122.25	747883.10	N	9/6/16	1212	31	–	–	–
G135	1087155.06	747883.10	N	9/6/16	1216	34	–	–	–
G136	1087187.87	747883.10	N	9/6/16	1218	18	–	–	–
G137	1087220.68	747883.10	N	9/6/16	1222	27	–	–	

XRF ID: CH Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G121	1087351.91	747915.91							
G122	1087384.72	747915.91							
G123	1087417.53	747915.91							
G124	1087450.34	747915.91							
G125	1087515.96	747915.91	N	11/1/16	12:00	46	—	—	—
G126	1087548.76	747915.91	N	11/1/16	11:45	43	—	—	—
G127	1087581.57	747915.91	N	11/1/16	11:54	41	—	—	—
G128	1086892.60	747883.10	N	10/24/16	14:00	31	—	—	—
G129	1086925.40	747883.10	N	10/24/16	13:58	24	—	—	—
G130	1086958.21	747883.10	N	10/24/16	13:56	31	—	—	—
G131	1086991.03	747883.10	N	10/24/16	13:54	33	—	—	—
G132	1087023.83	747883.10	N	10/24/16	13:51	26	—	—	—
G133	1087056.64	747883.10	N	10/24/16	13:49	29	—	—	—
G134	1087123.25	747883.10							
G135	1087155.06	747883.10							
G136	1087187.87	747883.10							
G137	1087220.68	747883.10							

XRF ID: 57/81 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G138	1087253.49	747883.10							
G139	1087286.30	747883.10							
G140	1087319.11	747883.10							
G141	1087351.91	747883.10							
G142	1087384.72	747883.10							
G143	1087417.53	747883.10	Cliff Edge						
G144	1087450.34	747883.10	No Access						
G145	1087483.15	747883.10	N	11/10/16	15:13	176	Cliff Edge No cover soil		
G146	1087515.96	747883.10	N	11/10/16	15:15	21	—	—	—
G147	1087548.76	747883.10	N	11/10/16	15:17	21	—	—	—
G148	1087581.57	747883.10	N	11/10/16	15:20	32	—	—	—
G149	1087614.38	747883.10	N	11/10/16	15:22	22	—	—	—
G150	1086892.60	747850.29	N	10/20/16	15:00	31	—	—	—
G151	1086925.40	747850.29	N	10/20/16	15:03	30	—	—	—
G152	1086958.21	747850.29	N	10/20/16	15:06	25	—	—	—
G153	1086991.02	747850.29	N	10/20/16	15:09	29	—	—	—
G154	1087023.83	747850.29	N	10/20/16	15:11	33	—	—	—

Sampler ID: _____ Study Area: DLA H-G

XRF ID: 57181 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G155	1087058.64	747850.29	N	10/20/16	15:14	32	—	—	—
G156	1087083.45	747850.29	N	10/20/16	15:16	56	—	—	—
G157	1087122.25	747850.29							
G158	1087155.06	747850.29							
G159	1087187.87	747850.29							
G160	1087220.68	747850.29							
G161	1087253.49	747850.29							
G162	1087286.30	747850.29							
G163	1087319.11	747850.29							
G164	1087351.91	747850.29							
G165	1087384.72	747850.29							
G166	1087417.53	747850.29	Cliff Edge			No Access			
G167	1087450.34	747850.29	N	11/10/16	15:08	25	—	—	—
G168	1087483.15	747850.29	N	11/10/16	15:06	26	—	—	—
G169	1087515.96	747850.29	N	11/10/16	15:04	23	—	—	—
G170	1087548.76	747850.29	N	11/10/16	15:02	33	—	—	—
G171	1087581.57	747850.29	N	11/10/16	15:00	18	—	—	—

Study Area: [illegible]

XRF ID: S7181 Field Conditions: 70°-75° F, Sunny

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G155	1087056.64	747850.29							
G156	1087089.45	747850.29	Yes (offset ft)	9/6/16	1210	21	-	-	-
G157	1087122.25	747850.29	N	9/6/16	1212	18	-	-	-
G158	1087155.06	747850.29	N	9/6/16	1214	21	-	-	-
G159	1087187.87	747850.29	N	9/6/16	1216	22	-	-	-
G160	1087220.68	747850.29	N	9/6/16	1217	20	-	-	-
G161	1087253.49	747850.29	N	9/6/16	1219	8	-	-	-
G162	1087286.30	747850.29	N	9/6/16	1223	600 [3,9]	-	-	-
G163	1087319.11	747850.29	N	9/6/16	1245	21	27	AS-G163-01 RA-G163-01	
G164	1087351.91	747850.29	N	9/16/16	1226	9	-	-	-
G165	1087384.72	747850.29	N	9/6/16	1230	14	-	-	-
G166	1087417.53	747850.29							
G167	1087450.34	747850.29							
G168	1087483.15	747850.29							
G169	1087515.96	747850.29							
G170	1087548.76	747850.29							
G171	1087581.57	747850.29							

XRF ID: 57181 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G172	1087614.38	747850.29	N	11/10/16	14:58	19	—	—	—
G173	1087647.19	747850.29	N	11/10/16	14:56	22	—	—	—
G174	1086925.40	747817.48	N	10/20/16	15:36	24	—	—	—
G175	1086958.21	747817.48	N	10/20/16	15:33	24	—	—	—
G176	1086991.02	747817.48	N	10/20/16	15:30	39	—	—	—
G177	1087023.83	747817.48	N	10/20/16	15:27	28	—	—	—
G178	1087056.64	747817.48	N	10/20/16	15:25	25	—	—	—
G179	1087089.45	747817.48	N	10/20/16	15:22	21	—	—	—
G180	1087122.25	747817.48							
G181	1087155.06	747817.48							
G182	1087187.87	747817.48							
G183	1087220.68	747817.48							
G184	1087253.49	747817.48							
G185	1087286.30	747817.48							
G186	1087319.11	747817.48							
G187	1087351.91	747817.48							
G188	1087384.73	747817.48	N	11/10/16	14:40	57	—	—	—

Sampler ID: AS

XRF ID: 47412

Study Area: Bluff Gulch Trap

Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G172	1087614.36	747850.29							
G173	1087647.19	747850.29							
G174	1086925.40	747817.48							
G175	1086958.21	747817.48							
G176	1086991.02	747817.48							
G177	1087023.83	747817.48							
G178	1087056.64	747817.48							
~~G179~~	~~1087089.45~~	~~747817.48~~	N	9/6/16					
G180	1087122.25	747817.48	N	9/6/16	1322	27	-	-	-
G181	1087155.06	747817.48	N	9/6/16	1318	22	-	-	-
G182	1087187.87	747817.48	N	9/6/16	1316	23	-	-	-
G183	1087220.68	747817.48	N	9/6/16	1310	15	-	-	-
* G184 (prc AS)	1087153.49	747817.48	N	9/6/16	1430	7	12	AS-G184-01 +DP AS-G184-02 RA-G184-01	
G185	1087286.30	747817.48	N	9/6/16	1308	6	-	-	-
G186	1087319.11	747817.48	N	9/6/16	1304	22	-	-	-
G187	1087351.91	747817.48	N	9/6/16	1302	16	-	-	-
G188	1087384.72	747817.48							

Sampler ID: _____ Study Area: _____

XRF ID: 57181 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G189	1087417.53	747817.48	N	11/10/16	14:42	16			
G190	1087450.34	747817.48	N	11/1/16	11:30	64	-	yes	-
G191	1087483.15	747817.48	N	11/10/16	14:44	28	-	-	-
G192	1087515.96	747817.48	N	11/10/16	14:46	23	-	-	-
G193	1087548.76	747817.48	N	11/10/16	14:49	15	14	-	-
G194	1087581.57	747817.48	N	11/10/16	14:51	45	-	-	-
G195	1087614.38	747817.48	N	11/10/16	14:53	24	-	-	-
G196	1086958.21	747784.68	N	10/20/16	12:40	31	-	-	-
G197	1086991.02	747784.68	N	10/20/16	12:37	29	-	-	-
G198	1087023.83	747784.68	N	10/20/16	12:36	26	-	-	-
G199	1087056.64	747784.68	N	10/20/16	12:33	28	-	-	-
G200	1087089.45	747784.68	N	10/20/16	12:30	57	-	-	-
G201	1087122.25	747784.68	N	10/20/16	12:26	107	-	-	-
G202	1087155.06	747784.68							
G203	1087187.87	747784.68							
G204	1087220.68	747784.68							
G205	1087253.49	747784.68							

Sampler ID: CK Study Area: Blatt G

XRF ID: 57181 Field Conditions: Sunny 80°

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G189	1087417.53	747817.48							
G190	1087450.34	747817.48							
G191	1087483.15	747817.48							
G192	1087515.96	747817.48							
G193	1087548.76	747817.48							
G194	1087581.57	747817.48							
G195	1087614.38	747817.48							
G196	1086958.21	747784.68							
G197	1086991.02	747784.68							
G198	1087023.83	747784.68							
G199	1087056.64	747784.68							
G200	1087089.45	747784.68							
G201	1087122.25	747784.68							
G202	1087155.06	747784.68	N	9/6/16	13:41	24	—	—	—
G203	1087187.87	747784.68	N	9/6/16	13:39	26	—	—	—
G204	1087220.68	747784.68	N	9/6/16	13:35	10	—	—	—
G205	1087253.49	747784.68	N	9/6/16	13:28	13	—	—	—

Sampler ID: MG/CL
XRF ID: 57181
Study Area: Blight G
Field Conditions: Sunny, 75°

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G206	1087286.30	747784.68		9/6/16	13:12	5			
G207	1087319.11	747784.68	N	9/6/16	1310	21	-	-	-
G208	1087351.91	747784.68	N	9/6/16	13:12	5	—	—	—
G209	1087384.72	747784.68							
G210	1087417.53	747784.68							
G211	1087450.34	747784.68							
G212	1087483.15	747784.68							
G213	1087515.96	747784.68							
G214	1087548.76	747784.68							
G215	1087581.57	747784.68							
G216	1087614.38	747784.68							
G217	1087647.19	747784.68							
G218	1086958.21	747751.87							
G219	1086991.02	747751.87							
G220	1087023.83	747751.87							
G221	1087056.64	747751.87							
G222	1087089.45	747751.87							

Labled G208

Labled G208 Rem1

XRF ID: 57181 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G206	1087286.30	747784.68							
G207	1087319.11	747784.68							
G208	1087351.91	747784.68	N	11/10/16	14:24	57	—	—	—
G209	1087384.72	747784.68	N	11/10/16	14:22	67	—	—	—
G210	1087417.53	747784.68	N	11/10/16	14:20	26	—	—	—
G211	1087450.34	747784.68	N	11/10/16	14:18	21	—	—	—
G212	1087483.15	747784.68	N	11/10/16	14:16	40	—	—	—
G213	1087515.96	747784.68	N	11/10/16	14:14	30	—	—	—
G214	1087548.76	747784.68	N	11/10/16	14:12	27	24	—	—
G215	1087581.57	747784.68	N	11/10/16	14:07	27	—	—	—
G216	1087614.38	747784.68	N	11/10/16	14:05	18	—	—	—
G217	1087647.19	747784.68	N	11/10/16	14:02	25	—	—	—
G218	1086958.21	747751.87	N	10/20/16	12:09	32	—	—	—
G219	1086991.02	747751.87	N	10/20/16	12:12	19	—	—	—
G220	1087023.83	747751.87	N	10/20/16	12:14	31	—	—	—
G221	1087056.64	747751.87	N	10/20/16	12:17	35	—	—	—
G222	1087089.45	747751.87	N	10/20/16	12:20	34	—	—	—

Sampler ID: CC
XRF ID: 57181
Study Area: Bluff G
Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G223	1087122.25	747751.87	N	10/20/16	12:22	46	—	—	—
G224	1087155.06	747751.87							
G225	1087187.87	747751.87							
G226	1087220.68	747751.87							
G227	1087253.49	747751.87							
G228	1087286.30	747751.87							
G229	1087319.11	747751.87							
G230	1087384.72	747751.87	N	11/10/16	13:36	96	—	—	—
G231	1087417.53	747751.87	N	11/10/16	13:38	19	—	—	—
G232	1087450.34	747751.87	N	11/10/16	13:41	42	—	—	—
G233	1087483.15	747751.87	N	11/10/16	13:43	41	42	—	—
G234	1087515.96	747751.87	N	11/10/16	13:45	50	—	—	—
G235	1087548.76	747751.87	N	11/10/16	13:47	83	—	—	—
G236	1087581.57	747751.87	N	11/10/16	13:49	32	—	—	—
G237	1087614.38	747751.87	N	11/10/16	13:51	17	—	—	—
G238	1087647.19	747751.87	N	11/10/16	13:53	12	—	—	—
G239	1087680.00	747751.87	N	11/10/16	13:55	38	—	—	—

Sampler ID: [illegible] Study Area: Pit G (Top)

XRF ID: 47412 Field Conditions: Sunny

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G223	1087122.25	747751.87							
G224	1087155.06	747751.87	N	9/6/16	1330	18	-	-	-
G225	1087187.87	747751.87	N	9/6/16	1336	20	-	-	-
*PCAB G226	1087220.68	747751.87	N	9/6/16	1500 [illegible]	8	4	AS- G226-01 RA- G226-01	
G227	1087253.49	747751.87	N	9/6/16	1338	11	-	-	-
G228	1087286.30	747751.87	N	9/6/16	1342	23	-	-	-
G229	1087319.11	747751.87	N	9/6/16	1344	29	-	-	-
G230	1087384.72	747751.87							
G231	1087417.53	747751.87							
G232	1087450.34	747751.87							
G233	1087483.15	747751.87							
G234	1087515.96	747751.87							
G235	1087548.76	747751.87							
G236	1087581.57	747751.87							
G237	1087614.38	747751.87							
G238	1087647.19	747751.87							
G239	1087680.00	747751.87							

267

Sampler ID: ___ Study Area: Bluff G

XRF ID: 57181 Field Conditions: ___

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G240	1086991.02	747719.06	N	10/20/16	11:35	31	—	—	—
G241	1087023.83	747719.06	N	10/20/16	11:38	29	—	—	—
G242	1087056.64	747719.06	N	10/20/16	11:41	25	—	—	—
G243	1087089.45	747719.06	N	10/20/16	11:43	32	—	—	—
G244	1087122.25	747719.06	N	10/20/16	11:47	30	29	—	—
G245	1087187.87	747719.06							
G246	1087220.68	747719.06							
G247	1087253.48	747719.06							
G248	1087286.30	747719.06							
G249	1087319.11	747719.06							
G250	1087351.91	747719.06	N	11/10/16	13:32	35	—	—	—
G251	1087384.72	747719.06	N	11/10/16	13:36	35	—	—	—
G252	1087417.53	747719.06	N	11/10/16	13:28	30	—	—	—
G253	1087450.34	747719.06	N	11/1/16	11:18	32			
G254	1087483.15	747719.06	N	11/1/16	13:24	38	—	—	—
G255	1087515.96	747719.06	N	11/10/16	13:22	17	—	—	—
G256	1087548.76	747719.06	N	11/10/16	13:20	34	—	—	—

Soil Below

G253 Shot twice 11/10/16 43 — — —
13:26

XRF ID: 57181 Field Conditions: Sunny 75°

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G240	1086991.02	747719.06	~~N~~	9/6/16	~~13:46~~	~~9~~ cc	—	—	—
G241	1087023.83	747719.06							
G242	1087056.64	747719.06							
G243	1087089.45	747719.06							
G244	1087122.25	747719.06							
G245	1087187.87	747719.06	N	9/6/16	13:46	9	—	—	—
G246	1087220.68	747719.06	N	9/6/16	13:51	19	—	—	—
G247	1087253.48	747719.06	N	9/6/16	15:22	20	21	AS-G247-01 RA-G247-01	
G248	1087286.30	747719.06	N	9/6/16	13:54	28	—	—	—
G249	1087319.11	747719.06	N	9/6/16	13:56	21			
G250	1087351.91	747719.06							
G251	1087384.72	747719.06							
G252	1087417.53	747719.06							
G253	1087450.34	747719.06							
G254	1087483.15	747719.06							
G255	1087515.96	747719.06							
G256	1087548.76	747719.06							

Pictures ARS

Sampler ID: _____ XRF ID: 57181 Study Area: DRAFT

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G257	1087581.57	747719.06	N	11/10/16	13:17	45	—	—	—
G258	1087023.83	747686.25	N	10/20/16	12:05	31	—	—	—
G259	1087056.64	747686.25	N	10/20/16	12:02	32	—	—	—
G260	1087089.45	747686.25	N	10/20/16	11:59	31	—	—	—
G261	1087122.25	747686.25	N	10/20/16	11:57	50	—	—	—
G262	1087155.06	747686.25	N	10/20/16	11:54	39	—	—	—
G263	1087187.87	747686.25	N	10/20/16	11:51	34	—	—	—
G264	1087220.68	747686.25	were Not Reclaimed						
G265	1087253.49	747686.25							
G266	1087286.30	747686.25							
G267	1087319.11	747686.25							
G268	1087351.91	747686.25	N	11/10/16	11:39	19	—	—	—
G269 Entered Into XRF as 267	1087384.72	747686.25	N	11/10/16	11:41	67	68	—	—
G270	1087417.53	747686.25	N	11/10/16	11:43	26	—	—	—
G271	1087450.34	747686.25	N	11/10/16	11:45	18	—	—	—
G272	1087483.15	747686.25	N	11/10/16	11:48	53	—	—	—
G273	1087515.96	747686.25	N	11/10/16	11:51	33	—	—	—

XRF ID: 47412 Field Conditions: Sunny

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G257	1087581.57	747719.06							
G258	1087023.83	747686.25							
G259	1087056.64	747686.25							
G260	1087089.45	747686.25							
G261	1087122.25	747686.25							
G262	1087155.06	747686.25							
G263	1087187.87	747686.25							
G264	1087220.68	747686.25	N	9/6/16	1402	10	-	-	-
G265	1087253.49	747686.25	N	9/6/16	1400	34	-	-	-
G266	1087286.30	747686.25	N	9/6/16	1358	23	-	-	-
G267	1087319.11	747686.25	N	9/6/16	1354	15	-	-	-
G268	1087351.91	747686.25							
G269	1087384.72	747686.25							
G270	1087417.53	747686.25							
G271	1087450.34	747686.25							
G272	1087483.15	747686.25							
G273	1087515.96	747686.25							

61 Total

Sampler ID: ~~DL~~

XRF ID: ~~Bluff~~ 57181

Study Area: SLuff G

Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G274	1087548.76	747686.25	N	11/10/16	11:54	57	—	—	—
G275	1087712.81	747686.25	N	11/10/16	11:57	22	—	—	—
G276	1087823.83	747653.44	N	10/19/16	12:51	32	30	-	-
G277	1087056.64	747653.44	N	10/19/16	12:48	33	-	-	-
G278	1087089.45	747653.44	N	10/19/16	12:46	33	-	-	-
G279	1087122.25	747653.44	N	10/19/16	12:43	36	-	-	-
G280	1087155.06	747653.44	N	10/19/16	12:40	28	-	-	-
G281	1087187.87	747653.44	N	10/19/16	12:38	25	-	-	-
G282	1087220.68	747653.44	N	10/19/16	12:34	49	-	-	-
G283	1087253.48	747653.44	~~N~~	~~11~~	~~11~~	~~181~~	No Access		Not cover with cover soil on cliff edge
G284	1087286.30	747653.44	N	11/10/16	11:33	181	—	—	
G285	1087351.91	747653.44	N	11/10/16	11:31	23	—	—	-
G286	1087384.72	747653.44	N	11/10/16	11:29	28	—	—	—
G287	1087417.53	747653.44	N	11/10/16	11:27	51	—	—	—
G288	1087450.34	747653.44	N	11/10/16	11:25	45	—	—	—
G289	1087483.15	747653.44	N	11/10/16	11:23	64	—	—	—
G290	1087515.96	747653.44	N	11/10/16	11:21	53	—	—	—

Sampler ID: [illegible]

XRF ID: 57181

Study Area: Platt 6

Field Conditions: Sunny 75°

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G274	1087548.76	747686.25							
G275	1087712.81	747686.25							
G276	1087023.83	747653.44							
G277	1087056.64	747653.44							
G278	1087089.45	747653.44							
G279	1087122.25	747653.44							
G280	1087155.06	747653.44							
G281	1087187.87	747653.44							
G282	1087220.68	747653.44							
G283	1087253.49	747653.44	N	9/6/16	14:04	30	—	—	—
G284	1087286.30	747653.44	N	9/6/16	14:01	19	—	—	—
G285	1087351.91	747653.44							
G286	1087384.72	747653.44							
G287	1087417.53	747653.44							
G288	1087450.34	747653.44							
G289	1087483.15	747653.44							
G290	1087515.96	747653.44							

Sampler ID: _____ XRF ID: 57181 Study Area: Duff G

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G291	1087548.76	747653.44	N	11/10/16	11:19	58	—	—	—
G292	1087581.57	747653.44	N	11/10/16	11:17	33	—	—	—
G293	1087614.38	747653.44	N	11/10/16	11:15	42	—	—	—
G294	1087680.00	747653.44	N	11/10/16	11:13	57	—	—	—
G295	1087712.81	747653.44	N	11/10/16	11:11	69	—	—	—
G296	1087056.64	747620.63	N	10/19/16	12:21	29	—	—	—
G297	1087089.45	747620.63	N	10/19/16	12:24	31	—	—	—
G298	1087122.25	747620.63	N	10/19/16	12:26	28	—	—	—
G299	1087155.06	747620.63	N	10/19/16	12:29	25	—	—	—
G300	1087286.30	747620.63	No Access						→
G301	1087319.11	747620.63	N	11/9/16	14:26	20	—	—	—
G302	1087351.91	747620.63	N	11/9/16	14:29	27	24	—	—
G305	1087384.72	747620.63	N	11/1/16	10:40	40	—	—	—
G304	1087417.53	747620.63	N	11/9/16	14:33	26	—	—	—
G303	1087450.34	747620.63	N	11/1/16	14:31	21	—	—	—
G306	1087483.15	747620.63	N	11/1/16	14:34	28	—	—	—
G307	1087515.96	747620.63	N	11/1/16	10:56	58	—	✓	—

XRF ID: 57181 Field Conditions: Sunny 78°

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G291	1087548.76	747653.44							
G292	1087581.57	747653.44							
G293	1087614.38	747653.44							
G294	1087680.00	747653.44							
G295	1087712.81	747653.44							
G296	1087056.64	747620.63							
G297	1087089.45	747620.63							
G298	1087122.25	747620.63							
G299	1087155.06	747620.63							
G300	1087286.30	747620.63	N	9/6/16	14:11	60	—	—	—
G301	1087319.11	747620.63							
G302	1087351.91	747620.63							
G303	1087384.72	747620.63							
G304	1087417.53	747620.63							
G305	1087450.34	747620.63							
G306	1087483.15	747620.63							
G307	1087515.96	747620.63							

24
Total

61+
24

85
↓
5 Samples

Sampler ID: [illegible]

XRF ID: 57181

Study Area: Blackett G

Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G308	1087548.78	747620.63	N	11/9/16	14:38	59	—	—	—
G309	1087581.57	747620.63	N	11/9/16	14:40	60	—	—	—
G310	1087286.30	747587.83	N	11/9/16	14:20	33	—	—	—
G311	1087319.11	747587.83	N	11/9/16	14:18	30	—	—	—
G312	1087351.91	747587.83	N	11/9/16	14:16	23	—	—	—
G313	1087384.72	747587.83	N	11/9/16	14:14	27	—	—	—
G314	1087417.53	747587.83	N	11/1/16	10:25	36	—	Yes	AS-6324-01
G315	1087450.34	747587.83	N	11/9/16	14:12	34	—	—	—
G316	1087483.15	747587.83	N	11/9/16	14:10	59	—	—	—
G317	1087515.96	747587.83	N	11/9/16	14:08	42	—	—	—
G318	1087548.76	747587.83	N	11/9/16	14:06	52	—	—	—
G319	1087286.30	747555.02	N	11/9/16	13:37	26	—	—	—
G320	1087319.11	747555.02	N	11/9/16	13:39	27	—	—	—
G321	1087351.91	747555.02	N	11/9/16	13:41	33	32	—	—
G322	1087384.72	747555.02	N	11/9/16	13:44	102	—	—	—
G323	1087417.53	747555.02	N	11/9/16	13:47	40	—	—	—
G324	1087450.34	747555.02	N	11/9/16	~~14:00~~ 13:50	35	—	—	—

Compiler Id: _____ Study Area: Unit C

XRF ID: 57181 Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
G325	1087483.15	747555.02	N	11/9/16	14:00	42	—	—	—
G326	1087515.96	747555.02	N	11/9/16	14:02	41	—	—	—
G327	1087548.76	747555.02	N	11/9/16	14:04	33	—	—	—
G328	1087581.57	747555.02	N	11/9/16	14:06	41	—	—	—
G329	1087286.30	747522.21	N	11/9/16	13:26	23	25	—	—
G330	1087319.11	747522.21	N	11/9/16	13:23	27	—	—	-
G331	1087351.91	747522.21	N	11/9/16	13:21	20	—	—	—
G332	1087384.72	747522.21	N	11/9/16	13:18	27	—	—	—
G333	1087515.96	747522.21	N	11/9/16	13:15	55	—	—	—
G334	1087548.76	747522.21	N	11/9/16	13:11	42	—	—	—
G335	1087581.57	747522.21	N	11/9/16	13:09	54	—	—	—
G336	1087286.30	747489.40	N	11/9/16	13:29	22	—	—	—
G337	1087286.30	747456.59	N	11/9/16	13:31	15	—	—	—
G338	1087319.11	747423.78	N	11/9/16	13:33	11	—	—	—

FIELD SHEETS

BLUFF I XRF FIELD SHEETS

500

Sampler ID: CK

XRF ID: 57181

Study Area: Bluff I

Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I1	1086531.70	747653.44	N	10-11-16	15:42	32	~~32~~	—	—
I2	1086564.51	747653.44	N	10-11-16	15:45	34	~~34~~	—	—
I3	1086498.90	747620.63	N	10-11-16	15:48	30	~~30~~		
I4	1086531.70	747620.63	N	10-11-16	15:51	34	—	—	—
I5	1086564.51	747620.83	N	10-14-16	8:36	36	—	—	—
I6	1086597.32	747620.63	N	10-11-16	14:42	35	—	—	—
I7	1086466.90	747587.83	N	10-11-16	14:33	32	36	—	—
I8	1086531.70	747587.83	N	10-11-16	14:36	24	—	—	—
I9	1086564.51	747587.83	N	10-11-16	14:39	27	—	—	—
I10	1086597.32	747587.83	N	10/14/16	8:32	18	—	—	—
I11	1086630.13	747587.83	N	10/14/16	8:38	13	—	—	—
I12	1086466.09	747555.02	N	10-11-16	14:17	36	—	—	—
I13	1086498.90	747555.02	N	10-11-16	14:20	23	—	—	—
I14	1086531.70	747555.02	N	10-11-16	14:23	25	—	—	—
I15	1086564.51	747555.02	N	10-11-16	14:26	20	—	—	—
I16	1086597.32	747555.02	N	10-11-16	14:36	21	—	—	—
I17	1086630.13	747555.02	N	10/17/16	14:47	11	—	—	—
I18	1086662.94	747555.02	N	10/17/16	14:56	15	—	—	—
I19	1086695.75	747555.02	N	10/14/16	8:30	17	—	—	—
I20	1086728.55	747555.02	N	10/17/16	14:52	19	—	—	—
I21	1086761.36	747555.02	N	10/14/16	8:41	22	21	—	—
I22	1086794.17	747555.02	N	10/14/16	8:44	32	—	—	—
I23	1086826.98	747555.02	N	10/14/16	8:47	33	—	—	—
I24	1086236.43	747522.21	N	10-10-16	12:41	25	—	—	—
I25	1086433.28	747522.21	N	10/12/16	15:45	28	30	—	—
I26	1086466.09	747522.21	N	10-12-16	15:44	28	—	—	—
I27	1086498.90	747522.21	N	10/18/16	13:40	21	—	Yes	I27
I28	1086531.70	747522.21	N	10/12/16	15:41	24	—	—	—
I29	1086564.51	747522.21	N	10-12-16	15:38	21	—	—	—
I30	1086597.32	747522.21	N	10-12-16	15:35	28	—	—	—
I31	1086630.13	747522.21	N	10/17/16	14:41	10	—	—	—
I32	1086662.94	747522.21	N	10/17/16	14:44	20	—	—	—
I33	1086695.75	747522.21	N	10/14/16	8:27	26	—	—	—
I34	1086728.55	747522.21	N	10/14/16	8:50	30	—	—	—
I35	1086761.36	747522.21	N	10/14/16	8:53	38	—	—	—
I36	1086794.17	747522.21	N	10/14/16	8:56	33	—	—	—
I37 ~~I37~~	1086826.98	747522.21	N	10/14/16	8:14	30	—	—	—
I38	1086859.79	747522.21	N	10/14/16	9:00	35	—	—	—
I39	1086072.39	747488.40	N	10-10-16	12:20	19	18	—	—
I40	1086105.19	747488.40	N	10-10-16	12:25	23	—	—	—
I41	1086138.00	747488.40	N	10-10-16	12:28	24	—	Y	I41

I37 N 10/14/16 8:57 35 — — —

Sampler ID: CK
XRF ID: 57181

Study Area: Blatt I
Field Conditions: Dry, clear, 58°

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
142	1086170.81	747488.40	N	10-10-16	12:33	30	—	—	—
143	1086203.63	747488.40	N	10-10-16	12:36	27	—	—	—
144	1086236.43	747488.40	N	10-10-16	12:39	25	—	—	—
145	1086433.28	747488.40	N	10/12/16	15:16	24	—	—	—
146	1086466.09	747488.40	N	10/12/16	15:19	23	—	—	—
147	1086498.90	747488.40	N	10/12/16	15:22	33	—	—	—
148	1086531.70	747488.40	N	10/12/16	15:25	36	—	—	—
149	1086564.51	747488.40	N	10/12/16	15:27	21	—	—	—
150	1086597.32	747488.40	N	10/12/16	15:30	32	—	—	—
151	1086630.13	747488.40	N	10/17/16	14:33	23	—	—	—
152	1086662.94	747488.40	N	10/17/16	14:35	24	—	—	—
153	1086685.75	747488.40	N	10/14/16	8:24	28	—	—	—
154	1086728.55	747488.40	N	10/14/16	9:03	31	—	—	—
155	1086761.36	747488.40	N	10/14/16	9:06	33	—	—	—
156	1086794.17	747488.40	N	10/14/16	9:10	39	—	—	—
157	1086826.98	747488.40	N	10/14/16	9:13	34	—	—	—
158	1086858.79	747488.40	N	10/14/16	9:16	35	—	—	—
159	1083777.13	747456.59	N	10/17/16	15:14	10	—	—	—
160	1083809.92	747456.59	N	10/17/16	15:16	19	—	—	—
161	1086039.58	747456.59	N	10-10-16	12:16	13	—	—	—
162	1086072.39	747456.59	N	10-10-16	12:13	22	—	—	—
163	1086105.19	747456.59	N	10-10-16	12:11	34	—	—	—
164	1086138.00	747456.59	N	10-10-16	12:08	28	—	—	—
165	1086170.81	747456.59	N	10-10-16	12:05	31	—	—	—
166	1086203.62	747456.59	N	10-10-16	12:02	26	—	—	—
167	1086236.43	747456.59	N	10-10-16	12:00	28	—	—	—
168	1086400.47	747456.59	N	10-12-16	15:14	30	—	—	—
169	1086433.28	747456.59	N	10/12/16	15:11	29	—	—	—
170	1086466.09	747456.59	N	10/12/16	15:08	29	—	—	—
171	1086498.90	747456.59	N	10/12/16	15:05	38	27	—	—
172	1086531.70	747456.59	N	10/12/16	15:32	29	—	—	—
173	1086564.51	747456.59	N	10-12-16	15:00	29	—	—	—
174	1086597.32	747456.59	N	10-12-16	15:02	32	—	—	—
175	1086630.13	747456.59	N	10/17/16	14:27	22	25	—	—
176	1086662.94	747456.59	N	10/17/16	14:29	24	—	—	—
177	1086685.75	747456.59	N	10/14/16	8:20	22	—	—	—
178	1086728.55	747456.59	N	10/14/16	9:28	31	—	—	—
179	1086761.36	747456.59	N	10/14/16	9:25	32	—	—	—
180	1086794.17	747456.59	N	10/14/16	9:23	3029	—	—	—
181	1086826.98	747456.59	N	10/14/16	9:19	30	27	—	—
182	1086858.79	747456.59	N	10/14/16	9:17	42	—	—	—

Sampler ID: CW
XRF ID: 57181

Study Area: _____
Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I83	1086892.60	747436.59	N	10/17/16	14:58	34	—	—	—
I84	1086825.40	747436.59	N	10/17/16	15:06	13	—	—	—
I85	1085777.11	747423.78	N	10/17/16	15:19	22	—	—	—
I86	1085809.92	747423.78	N	10/17/16	15:22	21	21	—	✓
I87	1086008.77	747423.78	N	10-10-16	11:26	27	—	N	—
I88	1086039.58	747423.76	No	10-10-16	11:30	18	—	—	—
I89	1086072.39	747423.76	N	10-10-16	11:34	29	—	—	—
I90	1086103.19	747423.78	N	10-10-16	11:37	33	—	—	—
I91	1086138.00	747423.78	N	10-10-16	11:39	36	—	—	—
I92	1086170.81	747423.78	N	10-10-16	11:42	25	—	—	—
I93	1086203.62	747423.78	N	10-10-16	11:45	30	—	—	—
I94	1086234.43	747423.78	N	10-10-16	11:47	29	—	—	—
I95	1086269.24	747423.78	N	10-10-16	11:51	43	—	—	—
I96	1086302.04	747423.78	N	10-10-16	11:54	30	—	—	—
I97	1086334.85	747423.78	N	10-10-16	11:57	36	—	—	—
I98	1086367.66	747423.78	No	10/18-16	13:26	5	6	—	—
I99	1086400.47	747423.78	N	10/18/16	13:28	10	—	—	—
I100	1086433.28	747423.78	N	10-12-16	14:46	30	—	—	—
I101	1086466.09	747423.78	N	10/12/16	14:43	30	—	—	—
I102	1086498.90	747423.78	N	10/12/16	14:47	33	—	—	—
I103	1086531.70	747423.78	N	10/12/16	14:50	30	—	—	—
I104	1086564.51	747423.78	N	10/12/16	14:53	33	—	—	—
I105	1086597.32	747423.78	N	10/17/16	14:11	24	—	—	—
I106	1086630.13	747423.76	N	10/17/16	14:13	36	—	—	—
I107	1086662.94	747423.78	N	10/17/16	14:16	21	—	—	—
I108	1086695.75	747423.78	N	10/14/16	8:17	26	—	—	—
I109	1086728.55	747423.78	N	10/14/16	9:31	25	—	—	—
I110	1086761.36	747423.78	N	10/14/16	9:34	36	—	—	—
I111	1086794.17	747423.78	N	10/14/16	9:37	38	—	—	—
I112	1086824.98	747423.76	N	10/14/16	9:46	32	33	—	—
I113	1086858.79	747423.78	N	10/14/16	9:45	37	—	Yes	I113
I114	1086892.60	747423.78	N	10/14/16	9:49	32	—	Yes	I114
I115	1086925.40	747423.78	N	10/14/16	9:52	31	—	—	—
I116	1086958.21	747423.78	N	10/14/16	9:55	36	—	—	—
I117	1086991.02	747423.78	N	10/14/16	9:58	35	—	—	—
I118	1086008.77	747390.88	N	10-10-16	13:19	32	21	✓	—
I119	1086039.58	747390.96	N	10-10-16	13:14	37	—	—	—
I120	1086072.39	747390.96	N	10-10-16	13:11	27	—	—	—
I121	1086105.19	747390.96	N	10-10-16	12:08	33	—	—	—
I122	1086138.00	747390.98	N	10-10-16	13:05	31	—	—	—
I123	1086170.81	747390.98	N	10-10-16	13:00	21	—	Yes	I123

Sampler ID: CH

XRF ID: 57181

Study Area: _____

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I124	1086203.62	747390.98	N	10-10-16	12:55	26	—	—	—
I125	1086236.43	747390.98	N	10-10-16	12:53	34	—	—	—
I126	1086268.14	747390.98	N	10-10-16	12:51	30	—	—	—
I127	1086302.04	747390.98	N	10-10-16	12:49	43	—	—	—
I128	1086334.85	747390.98	N	10-10-16	12:46	37	—	—	—
I129	1086367.66	747390.98	N	10/14/16	13:33	27	—	—	—
I130	1086400.47	747390.98	N	10-12-16	14:36	32	—	—	—
I131	1086433.28	747390.98	N	10-12-16	14:33	34	—	—	—
I132	1086466.09	747390.98	N	10-12-16	14:31	30	—	—	—
I133	1086498.90	747390.98	N	10-12-16	14:27	27	—	—	—
I134	1086531.70	747390.98	N	10-12-16	14:24	22	—	—	—
I135	1086430.13	747390.98	N	11-7-16	12:16	33	—	—	—
I136	1086662.94	747390.98	N	11-7-16	12:12	18	—	—	—
I137	1086695.75	747390.98	N	11/7/16	12:15	17	14	—	—
I138	1086728.55	747390.98	N	11/7/16	12:17	24	—	—	—
I139	1086761.36	747390.98	N	11/7/16	12:19	78	—	—	—
I140	1086794.17	747390.98	N	11/7/16	12:22	25	—	—	—
I141	1086826.98	747390.98	N	11/7/16	12:24	32	—	—	—
I142	1086859.79	747390.98	N	10/14/16	12:03	28	—	—	—
I143	1086892.60	747390.98	N	10/14/16	12:00	36	—	—	—
I144	1086925.40	747390.98	N	10/14/16	11:58	31	—	—	—
I145	1086958.21	747390.98	N	10/14/16	11:56	39	—	—	—
I146	1086991.02	747390.98	N	10/14/16	11:53	35	—	—	—
I147	1087023.83	747390.98	N	10/14/16	11:50	38	—	—	—
I148	1087056.64	747390.98	N	10/14/16	11:48	33	—	—	—
I149	1086089.38	747358.17	N	10-10-16	15:11	46	—	Yes	I149
I150	1086072.39	747358.17	N	10-10-16	15:16	29	—	—	—
I151	1086105.19	747358.17	N	10-10-16	15:19	40	—	—	—
I152	1086138.00	747358.17	N	10-10-16	15:21	38	—	—	—
I153	1086170.81	747358.17	N	10-10-16	15:25	28	—	Yes	I153
I154	1086203.62	747358.17	N	10-10-16	15:30	36	—	—	—
I155	1086236.43	747358.17	N	10-10-16	15:33	41	—	—	—
I156	1086269.24	747358.17	N	10-10-16	15:35	33	—	—	—
I157	1086302.04	747358.17	N	10-10-16	15:38	43	—	—	—
I158	1086334.85	747358.17	N	10-10-16	15:41	37	—	—	—
I159	1086367.66	747358.17	N	10-11-16	14:12	29	—	—	—
I160	1086400.47	747358.17	N	10-11-16	14:08	32	—	—	—
I161	1086433.28	747358.17	N	10-11-16	14:05	29	—	—	—
I162	1086466.09	747358.17	N	10-11-16	14:02	39	—	—	—
I163	1086498.90	747358.17	N	10-11-16	14:28	22	—	—	—
I164	1086531.70	747358.17	N	11/7/16	12:08	20	—	—	—

Sampler ID: CL

XRF ID: 57181

Study Area: _____

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I165	1086584.51	747358.17	N	11/7/16	12:04	15	—	—	—
I166	1086597.32	747358.17	N	11/7/16	12:02	18	—	—	—
I167	1086630.13	747358.17	N	11/7/16	12:00	27	—	—	—
I168	1086662.94	747358.17	N	11/7/16	11:58	28	—	—	—
I169	1086695.75	747358.17	N	11/7/16	11:56	15	—	—	—
I170	1086761.36	747358.17	N	10/14/16	11:14	25	—	—	—
I171	1086794.17	747358.17	N	10/14/16	11:17	32	—	—	—
I172	1086826.98	747358.17	N	10/14/16	11:21	34	—	—	—
I173	1086858.79	747358.17	N	10/14/16	11:25	33	—	—	—
I174	1086892.60	747358.17	N	10/14/16	11:27	36	—	—	—
I175	1086925.40	747358.17	N	10/14/16	11:29	41	—	—	—
I176	1086958.21	747358.17	N	10/14/16	11:31	46	—	—	—
I177	1086991.02	747358.17	N	10/14/16	11:33	25	—	—	—
I178	1087023.83	747358.17	N	10/14/16	11:35	33	36	—	—
I179	1087056.64	747358.17	N	10/14/16	11:38	36	—	—	—
I180	1087089.45	747358.17	N	10/14/16	11:40	38	—	—	—
I181	1087122.25	747358.17	N	10/14/16	11:42	37	—	—	—
I182	1087155.08	747358.17	N	10/14/16	11:45	32	—	—	—
I183	1086072.39	747325.36	N	10-10-16	14:06	27	~~27~~	—	—
I184	1086105.18	747325.36	N	10-10-16	14:03	40	37	—	—
I185	1086138.00	747325.36	N	10-10-16	14:00	33	—	—	—
I186	1086170.81	747325.36	N	10-10-16	13:58	31	—	—	—
I187	1086203.62	747325.36	N	10-10-16	13:55	29	—	—	—
I188	1086236.43	747325.36	N	10-10-16	13:52	39	—	—	—
I189	1086269.24	747325.36	N	10-10-16	13:50	38	—	—	—
I190	1086302.04	747325.36	N	10-10-16	13:47	40	—	—	—
I191	1086334.85	747325.36	N	10-10-16	13:44	35	—	—	—
I192	1086367.66	747325.36	N	11/7/16	12:37	50	—	—	—
I193	1086400.47	747325.36	N	11/7/16	12:35	21	—	—	—
I194	1086433.28	747325.36	N	10-11-16	13:51	30	—	—	—
I195	1086466.09	747325.36	N	10-11-16	13:46	28	—	Yes	—
I196	1086466.90	747325.36	N	10-11-16	13:40	32	—	Yes	—
I197	1086531.70	747325.36	N	11/7/16	11:40	20	—	—	—
I198	1086564.51	747325.36	N	11/7/16	11:42	39	—	—	—
I199	1086597.32	747325.36	N	11/7/16	11:44	15	—	—	—
I200	1086630.13	747325.36	N	11/7/16	11:46	19	—	—	—
I201	1086662.94	747325.36	N	11/7/16	11:48	16	—	—	—
I202	1086695.75	747325.36	N	11/7/16	11:50	18	—	—	—
I203	1086728.55	747325.36	N	11/7/16	11:52	25	—	—	—
I204	1086761.36	747325.36	N	11/7/16	11:54	22	—	—	—
I205	1086794.17	747325.36	N	11/2/16	11:15	27	—	Yes	AS-I205-01

Sampler ID: CC

XRF ID: 57181

Study Area: _____

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I206	1086826.98	747325.36	N	10/14/16	13:18	30	—	—	—
I207	1086856.79	747325.36	N	10/14/16	13:20	38	—	—	—
I208	1086892.60	747325.36	N	10/14/16	13:24	35	—	—	—
I209	1086925.40	747325.36	N	10/14/16	13:26	45	—	—	—
I210	1086958.21	747325.36	N	10/14/16	13:29	23	—	—	—
I211	1086991.02	747325.36	N	10/14/16	13:31	35	—	—	—
I212	1087023.83	747325.36	N	10/14/16	13:33	35	—	—	—
I213	1087056.64	747325.36	N	10/14/16	13:36	32	—	—	—
I214	1087089.45	747325.36	N	10/14/16	13:39	34	—	—	—
I215	1087122.25	747325.36	N	10/14/16	14:01	31	—	—	—
I216	1087155.06	747325.36	N	10/14/16	14:03	36	—	—	—
I217	1086105.19	747292.55	N	10/1/16	14:58	14	—	—	—
I218	1086136.00	747292.55	N	10/17/16	13:53	42	—	—	—
~~I219~~	~~1086170.81~~	~~747292.55~~	~~N~~	~~10-11-16~~	~~8:41~~	~~29~~	~~—~~	~~—~~	~~—~~
I220	1086203.62	747292.55	N	10-4-16	8:39	29	—	—	—
I221	1086236.43	747292.55	N	10-11-16	8:41	29			
I222	1086269.24	747292.55	N	10-11-16	8:43	31	—	—	—
I223	1086302.04	747292.55	N	10/11/16	8:47	26	—	—	—
I224	1086334.85	747292.55	N	10/11/16	8:51	34	—	—	—
I225	1086367.66	747292.55	N	11/7/16	12:40	52	—	—	—
I226	1086400.47	747292.55	N	11/7/16	12:42	37	—	—	—
I227	1086433.28	747292.55	N	10/11/16	13:22	38	—	—	—
I228	1086466.09	747292.55	N	10/11/16	13:19	36	—	—	—
I229	1086531.70	747292.55	N	11/7/16	11:37	16	—	—	—
I230	1086564.51	747292.55	N	11/7/16	11:35	20	—	—	—
I231	1086597.32	747292.55	N	11/7/16	11:33	27	—	—	—
I232	1086630.13	747292.55	N	11/7/16	11:36	16	—	—	—
I233	1086662.94	747292.55	N	11/7/16	11:28	25	23	—	—
I234	1086695.75	747292.55	N	11/7/16	11:24	15	—	—	—
I235	1086728.55	747292.55	N	11/7/16	11:22	9	—	—	—
I236	1086761.36	747292.55	N	11/7/16	11:20	28	—	—	—
I237	1086794.17	747292.55	N	11/7/16	11:18	34	—	—	—
I238	1086826.98	747292.55	N	10/17/16	8:09	30	—	—	—
I239	1086858.79	747292.55	N	10/17/16	8:06	39	—	—	—
I240	1086892.60	747292.55	N	10/17/16	8:12	29	—	—	—
I241	1086923.40	747292.55	N	10/17/16	8:15	27	—	—	—
I242	1086958.21	747292.55	N	10/17/16	8:17	33	—	—	—
I243	1086991.02	747292.55	N	10/17/16	8:19	34	—	—	—
I244	1087023.83	747292.55	N	10/14/16	15:59	31	—	—	—
I245	1087056.64	747292.55	N	10/14/16	15:56	46	46	—	—
I246	1087089.45	747292.55	N	10/14/16	15:53	38	—	—	—
I219			N	10/17/16	14:00	16	—	—	—

Sampler ID: CM
XRF ID: 57181
Study Area:
Field Conditions:

TETRATECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
1247			N	10/14/16	15:53	48	—	—	—
1248			N	10/14/16	15:48	34	—	—	—
1249			N	10/7/16	14:36	18	—	—	—
1250			N	10/7/16	14:38	14	—	—	—
1251			N	11/1/16	15:01	12	—	Yes	AS-I251-01
1252			N	11/1/16	15:06	23	—	—	—
1253			N	11/1/16	15:08	11	—	—	—
1254			N	11/1/16	15:11	20	19	—	—
1255			N	11/1/16	15:14	9	—	—	—
1256			N	11/9/16	8:58	34	—	—	—
1257			N	10/9/16	9:00	34	—	—	—
1258			N	10/9/16	9:02	18	—	—	—
1259			N	10/9/16	9:04	29	—	—	—
1260			N	10/9/16	9:06	26	—	—	—
1261			N	10/12/16	13:17	40	—	—	—
1262			N	10/12/16	13:14	29	27	—	—
1263			N	10/7/16	10:56	15	—	—	—
1264			N	10/7/16	10:58	24	—	—	—
1265			N	10/7/16	11:00	11	—	—	—
1266			N	10/7/16	11:02	27	—	—	—
1267			N	10/2/16	14:50	26	—	Yes	AS-I267-01
1268			N	10/2/16	11:05	24	—	—	—
1269			N	10/7/16	11:07	14	—	—	—
1270			N	10/7/16	11:09	24	—	—	—
1271			N	10/7/16	11:11	21	—	—	—
1272			N	10/7/16	11:13	14	—	—	—
1273			N	10/7/16	11:15	27	—	—	—
1274			N	10/17/16	8:22	35	—	—	—
1275			N	10/17/16	8:24	27	—	—	—
1276			N	10/17/16	8:27	37	—	—	—
1277			N	10/17/16	8:29	34	—	—	—
1278			N	10/17/16	8:31	27	—	—	—
1279			N	10/17/16	8:33	39	—	—	—
1280			N	10/17/16	8:37	47	42	Yes	I280
1281			N	10/17/16	9:04	42	—	—	—
1282			N	10/17/16	9:06	37	—	—	—
1283			N	10/17/16	9:09	35	—	—	—
1284			N	11/7/16	14:40	47	—	—	—
1285			N	11/7/16	14:42	9	—	—	—
1286			N	11/2/16	9:30	36	—	Yes	AS-I286-01
1287			N	11/7/16	14:42	32	—	—	—

Sampler ID: CL
XRF ID: 57181

Study Area:
Field Conditions:

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I288	1087319.13	747259.74	N	11/2/16	14:48	19	—	—	—
I289	1087351.91	747259.74	N	11/7/16	14:56	31	28	—	—
I290	1086138.00	747226.93	N	11/1/16	15:28	17	—	—	—
I291	1086170.81	747226.93	N	11/1/16	15:26	6	—	—	—
I292	1086203.62	747226.93	N	11/1/16	15:24	12	—	—	—
I293	1086236.43	747226.93	N	11/1/16	15:20	9	—	—	—
I294	1086269.24	747226.93	N	11/1/16	15:17	15	—	—	—
I295	1086302.04	747226.93	N	11/3/16	10:46	14	—	—	—
I296	1086367.66	747226.93	N	10/3/16	18:47	30	—	—	—
I297	1086400.47	747226.93	N	10/11/16	13:04	39	—	—	—
I298	1086433.28	747226.93	N	10/11/16	13:07	31	—	—	—
I299	1086464.09	747226.93	N	11/3/16	10:35	45	—	—	—
I300	1086498.90	747226.93	N	11/3/16	10:33	44	—	—	—
I301	1086531.70	747226.93	N	11/3/16	10:31	44	—	—	—
I302	1086564.51	747226.93	N	11/2/16	14:35	21	—	Yes	AS-I302-01
I303	1086597.32	747226.93	N	11/3/16	10:29	35	—	—	—
I304	1086630.13	747226.93	N	11/3/16	10:27	32	32	—	—
I305	1086662.94	747226.93	N	11/3/16	10:25	52	—	—	—
I306	1086695.75	747226.93	N	11/3/16	10:23	47	—	—	—
I307	1086728.55	747226.93	N	11/3/16	10:21	40	—	—	—
I308	1086761.36	747226.93	N	11/9/16	8:34	34	—	—	—
I309	1086794.17	747226.93	N	11/9/16	8:48	42	38	—	—
I310	1086828.98	747226.93	N	11/9/16	8:56	33	—	—	—
I311	1086858.79	747226.93	N	11/9/16	8:52	23	—	—	—
I312	1086892.60	747226.93	N	10/17/16	9:28	26	—	—	—
I313	1086925.40	747226.93	N	10/17/16	9:26	35	—	—	—
I314	1086958.21	747226.93	N	10/17/16	9:24	37	—	—	—
I315	1086991.02	747226.93	N	10/17/16	9:22	32	—	—	—
I316	1087023.83	747226.93	N	10/17/16	9:20	50	—	—	—
I317	1087056.64	747226.93	N	10/17/16	9:18	40	—	—	—
I318	1087089.45	747226.93	N	10/17/16	9:15	39	—	Yes	I318
I319	1087122.25	747226.93	N	10/17/16	9:12	43	—	—	—
I320	1087155.06	747226.93	N	11/7/16	15:04	20	—	—	—
I321	1087187.87	747226.93	N	11/7/16	15:02	24	—	—	—
I322	1087220.68	747226.93	N	11/7/16	15:00	41	—	—	—
I323	1087253.49	747226.93	N	11/7/16	14:58	19	—	—	—
I324	1087286.30	747226.93	N	11/7/16	14:56	43	—	—	—
I325	1087319.11	747226.93	N	11/2/16	9:45	27	—	Yes	AS-I325-01
I326	1087351.91	747226.93	N	11/7/16	14:54	23	—	—	—
I327	1087384.72	747226.93	N	11/7/16	14:52	32	—	—	—
I328	1086138.00	747194.13	N	11/1/16	15:31	3	—	—	—

Sampler ID: CK

XRF ID: 57181

Study Area: _____

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I329	1086170.81	747194.13	N	11/3/16	9:48	5	—	—	—
I330	1086203.62	747194.13	N	11/3/16	9:50	10	—	—	—
I331	1086236.43	747194.13	N	11/3/16	9:52	12	—	—	—
I332	1086269.24	747194.13	N	11/2/16	13:10	18	15	Yes	AS-I332-01
I333	1086302.04	747194.13	N	11/3/16	9:55	19	—	—	—
I334	1086334.85	747194.13	N	11/3/16	9:57	14	—	—	—
I335	1086367.66	747194.13	N	11/3/16	10:00	26	—	—	—
I336	1086400.47	747194.13	N	11/3/16	10:02	42	—	—	—
I337	1086433.28	747194.13	N	11/3/16	10:04	48	—	—	—
I338	1086466.09	747194.13	N	11/3/16	10:06	46	—	—	—
I339	1086498.90	747194.13	N	11/3/16	10:08	50	—	—	—
I340	1086531.70	747194.13	N	11/3/16	10:10	76	—	—	—
I341	1086564.51	747194.13	N	11/3/16	10:12	48	—	—	—
I342	1086597.32	747194.13	N	11/7/16	10:52	8	—	—	—
I343	1086630.13	747194.13	N	11/3/16	10:14	41	—	—	—
I344	1086662.94	747194.13	N	11/3/16	10:16	41	—	—	—
I345	1086695.75	747194.13	N	11/3/16	10:18	42	—	—	—
I346	1086728.55	747194.13	N	11/3/16	10:20	46	—	—	—
I347	1086761.36	747194.13	N	11/3/16	8:33	32	31	—	—
I348	1086794.17	747194.13	N	11/9/16	8:29	33	—	—	—
I349	1086826.98	747194.13	N	11/9/16	8:27	22	—	—	—
I350	1086858.79	747194.13	N	11/9/16	8:25	45	—	—	—
I351	1086892.60	747194.13	N	11/9/16	8:22	18	—	—	—
I352	1086925.40	747194.13	N	11/9/16	8:20	25	—	—	—
I353	1086958.21	747194.13	N	11/9/16	8:18	43	—	—	—
I354	1086991.02	747194.13	N	11/9/16	8:16	35	—	—	—
I355	1087089.43	747194.13	N	11/2/16	10:35	34	N	Yes	AS-I355-01
I356	1087122.25	747194.13	N	11/7/16	15:07	76	—	—	—
I357	1087155.06	747194.13	N	11/7/16	15:09	31	—	—	—
I358	1087187.87	747194.13	N	11/7/16	15:11	19	—	—	—
I359	1087220.68	747194.13	N	11/7/16	15:13	46	—	—	—
I360	1087253.49	747194.13	N	11/7/16	15:23	22	22	—	—
I361	1087286.30	747194.13	N	11/7/16	15:25	32	—	—	—
I362	1087319.11	747194.13	N	11/7/16	15:28	27	—	—	—
I363	1087351.91	747194.13	N	11/7/16	15:32	24	—	—	—
I364	1087384.72	747194.13	N	11/7/16	15:34	11	—	—	—
I365	1087417.53	747194.13	N	11/7/16	15:36	26	—	—	—
I366	1088105.19	747161.32	N	11/3/16	10:50	8	N	—	—
I367	1086138.00	747161.32	N	11/3/16	10:52	5	—	—	—
I368	1086170.81	747161.32	N	11/3/16	10:54	12	—	—	—
I369	1086203.62	747161.32	N	11/3/16	10:57	11	—	—	—

Sampler ID: CM

XRF ID: 57181

Study Area: _____

Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I370	1086236.43	747161.32	N	11/3/16	11:06	22	—	—	—
I371	1086269.14	747161.32	N	11/3/16	11:02	24	—	—	—
I372	1086302.04	747161.32	N	11/3/16	11:04	9	—	—	—
I373	1086334.85	747161.32	N	11/3/16	11:06	14	—	—	—
I374	1086367.66	747161.32	N	11/3/16	11:09	28	29	—	—
I375	1086400.47	747161.32	N	11/3/16	11:11	29	—	—	—
I376	1086433.28	747161.32	N	11/3/16	11:13	45	—	—	—
I377	1086466.08	747161.32	N	11/3/16	11:15	50	—	—	—
I378	1086498.90	747161.32	N	11/2/16	13:48	62	—	Yes	AS-I378-01
I379	1086531.70	747161.32	N	11/3/16	11:18	46	—	—	—
I380	1086564.51	747161.32	N	11/3/16	11:20	46	—	—	—
I381	1086597.32	747161.32	N	11/3/16	11:22	42	—	—	—
I382	1086630.13	747161.32	N	11/3/16	11:24	64	—	—	—
I383	1086662.94	747161.32	N	11/3/16	11:26	46	—	—	—
I384	1086695.75	747161.32	N	11/3/16	11:29	34	—	—	—
I385	1086728.55	747161.32	N	11/3/16	11:31	55	—	—	—
I386	1086761.36	747161.32	N	11/8/16	13:14	13	16	—	—
I387	1086794.17	747161.32	N	11/8/16	13:16	23	—	—	—
I388	1086826.98	747161.32	N	11/2/16	11:00	34	—	Yes	AS-I388-01 Dup
I389	1086859.79	747161.32	N	11/8/16	13:20	53	—	—	—
I390	1086892.60	747161.32	N	11/8/16	13:22	26	—	—	—
I391	1086925.40	747161.32	N	11/8/16	13:27	18	—	—	—
I392	1086958.21	747161.32	N	11/8/16	13:29	27	—	—	—
I393	1086991.02	747161.32	N	11/8/16	13:32	16	—	—	—
I394	1087023.82	747161.32	N	11/8/16	13:35	16	—	—	—
I395	1087056.64	747161.32	N	11/8/16	13:37	28	—	—	—
I396	1087089.45	747161.32	N	11/8/16	13:39	59	—	—	—
I397	1087122.25	747161.32	N	11/8/16	13:41	23	—	—	—
I398	1087155.06	747161.32	N	11/8/16	13:44	35	—	—	—
I399	1087187.87	747161.32	N	11/8/16	13:46	39	—	—	—
I400	1087220.66	747161.32	N	11/8/16	13:48	35	—	—	—
I401	1087253.48	747161.32	N	11/8/16	13:50	21	—	—	—
I402	1087286.30	747161.32	N	11/8/16	13:52	21	—	—	—
I403	1087319.11	747161.32	N	11/8/16	13:54	25	—	—	—
I404	1087351.91	747161.32	N	11/8/16	13:56	16	—	—	—
I405	1087384.72	747161.32	N	11/8/16	13:58	21	—	—	—
I406	1087417.53	747161.32	N	11/8/16	14:00	17	—	—	—
I407	1086672.39	747128.51	N	11/3/16	14:10	13	—	—	—
I408	1086105.19	747128.51	N	11/3/16	14:12	13	—	—	—
I409	1086138.00	747128.51	N	11/3/16	14:14	19	—	—	—
I410	1086170.81	747128.51	N	11/3/16	14:16	3	—	—	—

Sampler ID: _____ Study Area: _____

XRF ID: _____ Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I411	1086203.62	747128.51	N	11/3/16	14:20	7	7	+	—
I412	1086236.43	747128.51	N	11/4/16	10:55	12	—	—	—
I413	1086269.24	747128.51	N	11/4/16	10:57	9	—	—	—
I414	1086302.04	747128.51	N	11/4/16	10:59	13	—	—	—
I415	1086334.85	747128.51	N	11/2/16	13:30	14	N	Yes	AS-I415-01
I416	1086367.66	747128.51	N	11/2/16	11:01	51	—	—	—
I417	1086400.47	747128.51	N	11/2/16	11:03	27	—	—	—
I418	1086433.28	747128.51	N	11/4/16	11:05	53	—	—	—
I419	1086466.09	747128.51	N	11/4/16	11:08	44	—	—	—
I420	1086498.90	747128.51	N	11/4/16	11:10	59	—	—	—
I421	1086531.70	747128.51	N	11/4/16	11:12	56	—	—	—
I422	1086564.51	747128.51	N	11/4/16	11:14	69	—	—	—
I423	1086597.32	747128.51	N	11/4/16	11:16	51	—	—	—
I424	1086630.13	747128.51	N	11/4/16	11:18	54	54	—	—
I425	1086662.94	747128.51	N	11/4/16	11:20	63	—	—	—
I426	1086695.75	747128.51	N	11/4/16	11:22	65	—	—	—
I427	1086728.55	747128.51	N	11/4/16	11:26	42	—	—	—
I428	1086761.36	747128.51	N	11/8/16	13:02	16	—	—	—
I429	1086794.17	747128.51	N	11/8/16	12:00	11	—	—	—
I430	1086826.98	747128.51	N	11/8/16	12:57	17	—	—	—
I431	1086859.79	747128.51	N	11/8/16	12:54	26	—	—	—
I432	1086892.60	747128.51	N	11/8/16	12:51	12	—	—	—
I433	1086925.40	747128.51	N	11/8/16	12:49	24	—	—	—
I434	1086958.21	747128.51	N	11/8/16	12:46	17	—	—	—
I435	1086991.02	747128.51	N	11/8/16	12:43	23	—	—	—
I436	1087023.83	747128.51	N	11/8/16	12:40	23	—	—	—
I437	1087056.64	747128.51	N	11/8/16	12:38	22	—	—	—
I438	1087089.45	747128.51	N	11/8/16	12:36	23	—	—	—
I439	1087122.25	747128.51	N	11/8/16	12:34	21	—	—	—
I440	1087155.06	747128.51	N	11/8/16	12:32	39	—	—	—
I441	1087187.87	747128.51	N	11/8/16	12:30	16	—	—	—
I442	1087220.68	747128.51	N	11/8/16	12:27	25	—	—	—
I443	1087253.49	747128.51	N	11/8/16	12:25	38	—	—	—
I444	1087286.30	747128.51	N	11/8/16	12:23	16	—	—	—
I445	1087319.11	747128.51	N	11/8/16	12:21	17	—	—	—
I446	1087351.91	747128.51	N	11/8/16	12:19	20	—	—	—
I447	1087384.72	747128.51	N	11/8/16	12:17	13	—	—	—
I448	1087417.53	747128.51	N	11/8/16	12:15	14	—	—	—
I449	1087450.34	747128.51	N	11/8/16	12:13	7	—	—	—
I450	1086072.39	747095.70	N	11/4/16	12:12	6	—	—	—
I451	1086105.19	747095.70	N	11/4/16	12:10	14	—	—	—

Sampler ID: _____ Study Area: _____

XRF ID: _____ Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I452	1088138.00	747085.70	N	11/4/16	12:09	9	—	—	—
I453	1088170.81	747085.70	N	11/4/16	12:07	14	—	—	—
I454	1088203.62	747085.70	N	11/4/16	12:05	9	—	—	—
I455	1088236.43	747085.70	N	11/4/16	12:03	16	—	—	—
I456	1088269.24	747095.70	N	11/4/16	12:01	8	—	—	—
I457	1088302.04	747085.70	N	11/4/16	11:59	16	—	—	—
I458	1088334.85	747095.70	N	11/4/16	11:57	13	—	—	—
I459	1088367.66	747085.70	N	11/4/16	11:55	26	—	—	—
I460	1088400.47	747085.70	N	11/4/16	11:53	36	—	—	—
I461	1088433.28	747085.70	N	11/4/16	11:51	39	—	—	—
I462	1088466.09	747085.70	N	11/4/16	11:47	34	—	—	—
I463	1088498.90	747095.70	N	11/4/16	13:45	62	—	Yes	AS-I463-01
I464	1088531.70	747085.70	N	11/2/16	11:43	49	—	—	—
I465	1088564.51	747085.70	N	11/4/16	11:41	52	52	—	—
I466	1088597.32	747095.70	N	11/4/16	11:39	63	—	—	—
I467	1088630.13	747085.70	N	11/4/16	11:37	65	—	—	—
I468	1088662.94	747095.70	N	11/4/16	11:34	48	—	—	—
I469	1088695.75	747085.70	N	11/4/16	11:32	54	—	—	—
I470	1088728.55	747095.70	N	11/4/16	11:29	65	—	—	—
I471	1088761.36	747095.70	N	11/2/16	15:05	31	—	Yes	AS-I471-01
I472	1088794.17	747085.70	N	11/8/16	10:44	13	—	—	—
I473	1088826.98	747085.70	N	11/8/16	10:47	16	17	—	—
I474	1088859.79	747085.70	N	11/8/16	10:49	26	—	—	—
I475	1088892.60	747095.70	N	11/8/16	10:51	21	—	—	—
I476	1088925.40	747085.70	N	11/8/16	10:53	26	—	—	—
I477	1088958.21	747085.70	N	11/2/16	10:50	13	—	Yes	AS-I477-01
I478	1088991.02	747095.70	N	11/8/16	10:55	17	—	—	—
I479	1087023.83	747095.70	N	11/8/16	10:57	46	—	—	—
I480	1087056.64	747095.70	N	11/8/16	10:59	19	—	—	—
I481	1087089.45	747085.70	N	11/8/16	11:01	26	—	—	—
I482	1087122.25	747095.70	N	11/8/16	11:04	32	—	—	—
I483	1087155.06	747095.70	N	11/8/16	11:06	27	—	—	—
I484	1087187.87	747085.70	N	11/8/16	11:08	31	—	—	—
I485	1087220.68	747085.70	N	11/8/16	11:10	18	—	—	—
I486	1087253.49	747085.70	N	11/8/16	11:12	16	—	—	—
I487	1087286.30	747085.70	N	11/8/16	11:14	10	—	—	—
I488	1087319.11	747085.70	N	11/8/16	11:16	16	—	—	—
I489	1087351.91	747085.70	N	11/8/16	11:18	9	—	—	—
I490	1087384.72	747085.70	N	11/8/16	11:20	14	—	—	—
I491	1087417.53	747085.70	N	11/2/16	9:55	21	—	Yes	AS-I491-01
I492	1087450.34	747085.70	N	11/8/16	11:21	18	—	—	—

DUP

DUP

Sampler ID: _____ Study Area: _____

XRF ID: _____ Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I493	1087483.15	747085.70	N	11/8/16	11:24	15	—	—	—
I494	1086039.58	747062.89	N	10/27/16	14:58	40	—	—	—
I495	1086071.39	747062.89	N	10/27/16	14:53	19	—	—	—
I496	1086105.19	747062.89	N	10/27/16	14:56	18	170	Yes	I-496
I497	1086138.00	747062.89	N	10/27/16	15:00	20	—	—	—
I498	1086170.81	747062.89	N	10/27/16	15:03	19	—	—	—
I499	1086203.62	747062.89	N	10/27/16	15:06	28	—	—	—
I500	1086236.43	747062.89	N	10/27/16	15:09	16	—	—	—
I501	1086269.24	747062.89	N	10/27/16	15:11	18	—	—	—
I502	1086302.04	747062.89	N	11/4/16	14:00	15	—	—	—
I503	1086334.85	747062.89	N	11/4/16	14:02	12	—	—	—
I504	1086367.66	747062.89	N	11/4/16	14:04	26	—	—	—
I505	1086400.47	747062.88	N	11/4/16	14:06	32	—	—	—
I506	1086433.28	747062.89	N	11/4/16	14:08	38	—	—	—
I507	1086466.09	747062.89	N	11/4/16	14:10	30	—	—	—
I508	1086498.90	747062.89	N	11/4/16	14:13	44	—	—	—
I509	1086531.70	747062.88	N	11/4/16	14:15	40	45	—	—
I510	1086564.51	747062.89	N	11/4/16	14:18	44	—	—	—
I511	1086597.32	747062.88	N	11/4/16	14:21	47	—	—	—
I512	1086630.13	747062.89	N	11/4/16	14:22	64	—	—	—
I513	1086662.94	747062.89	N	11/4/16	14:25	66	—	—	—
I514	1086458.79	747062.89	N	11/8/16	14:40	38	—	—	—
I515	1086892.60	747062.89	N	11/8/16	10:38	36	—	—	—
I516	1086925.40	747062.89	N	11/8/16	10:35	22	—	—	—
I517	1086958.21	747062.89	N	11/8/16	10:33	16	—	—	—
I518	1086991.02	747062.89	N	11/8/16	10:31	19	—	—	—
I519	1087023.83	747062.89	N	11/8/16	10:29	21	—	—	—
I520	1087056.64	747062.89	N	11/8/16	10:27	7	—	—	—
I521	1087089.45	747062.89	N	11/8/16	10:25	11	—	—	—
I522	1087122.25	747062.89	N	11/8/16	10:23	30	—	—	—
I523	1087155.06	747062.89	N	11/8/16	10:21	87	—	—	—
I524	1087187.87	747062.89	N	11/8/16	10:19	68	—	—	—
I525	1087253.49	747062.89	N	11/8/16	10:16	16	—	—	—
I526	1087286.30	747062.88	N	11/8/16	10:14	20	—	—	—
I527	1087319.11	747062.89	N	11/8/16	10:12	20	—	—	—
I528	1087351.91	747062.88	N	11/8/16	10:10	23	—	—	—
I529	1087384.72	747062.89	N	11/8/16	10:08	17	—	—	—
I530	1087417.53	747062.89	N	11/8/16	10:06	15	—	—	—
I531	1087450.34	747062.89	N	11/8/16	10:04	22	—	—	—
I532	1087483.15	747062.88	N	11/8/16	10:02	16	—	—	—
I533	1086039.58	747030.08	N	10/27/16	13:09	34	—	—	—

Sampler ID: _____ Study Area: _____

XRF ID: _____ Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I534	1086072.39	747030.86	N	10/27/16	13:11	67	—	—	—
I535	1086105.19	747030.08	N	10/27/16	13:14	13	—	—	—
I536	1086138.00	747030.06	N	10/27/16	13:16	15	—	—	—
I537	1086170.81	747030.06	N	10/27/16	13:18	38	—	—	—
I538	1086203.62	747030.06	N	10/27/16	13:21	39	—	—	—
I539	1086236.43	747030.08	N	10/27/16	13:24	18	—	—	—
I540	1086269.24	747030.08	N	10/27/16	13:26	18	—	—	—
I541	1086302.04	747030.08	N	10/27/16	13:28	16	—	—	—
I542	1086334.85	747030.08	N	11/4/16	14:52	14	—	—	—
I543	1086367.66	747030.08	N	11/4/16	14:50	20	—	—	—
I544	1086400.47	747030.08	N	11/4/16	14:47	41	—	—	—
I545	1086433.28	747030.08	N	11/4/16	14:44	33	—	—	—
I546	1086466.09	747030.08	N	11/4/16	14:41	33	—	—	—
I547	1086498.90	747030.08	N	11/4/16	14:38	35	—	—	—
I548	1086531.70	747030.08	N	11/4/16	14:35	37	—	—	—
I549	1086564.51	747030.08	N	11/4/16	14:33	47	—	—	—
I550	1086597.32	747030.08	N	11/4/16	14:31	69	—	—	—
I551	1086630.13	747030.08	N	11/4/16	14:28	61	—	—	—
I552	1087450.34	747030.08	N	11/2/16	10:10	52	—	Yes	AS-I552-01
I553	1087483.15	747030.08	N	11/8/16	16:60	34	—	—	—
I554	1086105.19	746997.27	N	10/27/16	13:56	17	—	—	—
I555	1086138.00	746997.27	N	10/27/16	13:46	13	16	Yes	I555
I556	1086170.81	746997.27	N	10/27/16	13:39	17	—	—	—
I557	1086203.62	746997.27	N	10/27/16	13:37	17	—	—	—
I558	1086236.43	746997.27	N	10/27/16	13:35	28	—	—	—
I559	1086269.24	746997.27	N	10/27/16	13:33	23	24	Yes	I559
I560	1086302.04	746997.27	N	10/27/16	13:30	16	—	—	—
I561	1086334.85	746997.27	N	11/4/16	14:54	7	—	—	—
I562	1086367.66	746997.27	N	11/4/16	14:56	28	27		
I563	1086400.47	746997.27	N	11/4/16	15:02	28	—	—	—
I564	1086433.28	746997.27	N	11/4/16	15:04	36	—	—	—
I565	1086466.09	746997.27	N	11/4/16	15:07	24	—	—	—
I566	1086498.90	746997.27	N	11/4/16	15:09	38	—	—	—
I567	1086531.70	746997.27	N	11/4/16	15:12	33	—	—	—
I568	1086564.51	746997.27	N	11/4/16	15:15	43	—	—	—
I569	1086597.32	746997.27	N	11/4/16	15:17	72	—	—	—
I570	1086630.13	746997.27	N	11/4/16	15:20	40	—	—	—
I571	1086170.81	746964.47	N	10/27/16	13:53	18	—	—	—
I572	1086203.62	746964.47	N	10/27/16	13:56	23	—	—	—
I573	1086236.43	746964.47	N	10/27/16	13:59	21	—	—	—
I574	1086269.24	746964.47	N	10/27/16	14:02	22	—	—	—

NO Sample

No Sample

Sampler ID: _____ Study Area: _____

XRF ID: _____ Field Conditions: _____

TETRA TECH

XRF ID	Easting (ft)	Northing (ft)	New GPS (Y/N)	Date	Time	Arsenic (Primary XRF)	Arsenic (Dup XRF)	Soil ? (Y/N)	Soil ID
I575	1086302.04	746964.47	N	14:13	10/27/16	17	18	—	—
I576	1086334.85	746964.47	N	14/4/16	13:38	26	—	—	—
I577	1086367.66	746964.47	N	11/4/16	13:36	17	—	—	—
I578	1086400.47	746964.47	N	11/4/16	13:34	23	—	—	—
I579	1086433.28	746964.47	N	11/4/16	13:32	45	—	—	—
I580	1086466.09	746964.47	N	11/4/16	13:30	39	—	—	—
I581	1086498.90	746964.47	N	11/4/16	13:28	34	—	—	—
I582	1086531.70	746964.47	N	11/4/16	13:26	30	—	—	—
I583	1086564.51	746964.47	N	11/4/16	13:24	39	—	—	—
I584	1086597.32	746964.47	N	11/4/16	13:21	59	—	—	—
I585	1086236.43	746931.66	N	11/7/16	10:17	14	—	—	—
I586	1086269.24	746931.66	N	10/27/16	14:26	35	—	—	—
I587	1086302.04	746931.66	N	10/27/16	14:23	33	—	—	—
I588	1086334.85	746931.66	N	10/27/16	14:21	21	—	—	—
I589	1086367.66	746931.66	N 11/27	~~14:18~~	14:18	23	—	—	—
I590	1086400.47	746831.66	N 11/2	~~14:05~~	14:05	41	44	Yes	AS-I590-01
I591	1086433.28	746831.66	N	11/7/16	10:21	37	—	—	—
I592	1086466.09	746831.66	N	11/7/16	10:23	10	—	—	—
I593	1086498.90	746831.66	N	11/7/16	10:26	16	—	—	—
I594	1086531.70	746931.66	N	11/7/16	10:28	36	—	—	—
I595	1086564.51	746931.66	N	11/7/16	10:30	9	—	—	—
I596	1086597.32	746831.66	N	11/7/16	10:33	32	31	—	—
I597	1086334.85	746898.85	N	10/27/16	14:28	19	—	—	—
I598	1086367.66	746898.85	N	10/27/16	14:31	44	—	—	—
I599	1086400.47	746898.85	N	10/27/16	14:34	30	—	—	—
I600	1086433.28	746898.85	N	11/7/16	10:44	17	—	—	—
I601	1086466.09	746898.85	N	11/7/16	10:41	18	—	—	—
I602	1086498.90	746898.85	N	11/7/16	10:39	10	—	—	—
I603	1086531.70	746898.85	N	11/7/16	10:37	26	—	—	—
I604	1086564.51	746898.85	N	11/7/16	10:35	14	—	—	—
I605	1086367.66	746866.04	N	10/27/16	14:42	35	—	—	—
I606	1086400.47	746866.04	N	10/27/16	14:36	36	—	—	—
I607	1086498.90	746866.04	N	11/7/16	10:46	22	—	—	—
I608	1086531.70	746866.04	N	11/7/16	10:48	27	—	—	—
I609	1086367.66	746833.23	N	10/27/16	14:45	25	—	—	—

APPENDIX E

FIELD SAMPLING PHOTOGRAPHIC LOG

Appendix E – Field Sampling Photographic Log



Photo 1: Removal Activities at Bluff I from Bluff G



Photo 2: Grid Sample Location I555



Photo 3: Grid Sample Location I559



Photo 4: Grid Sample Location I496

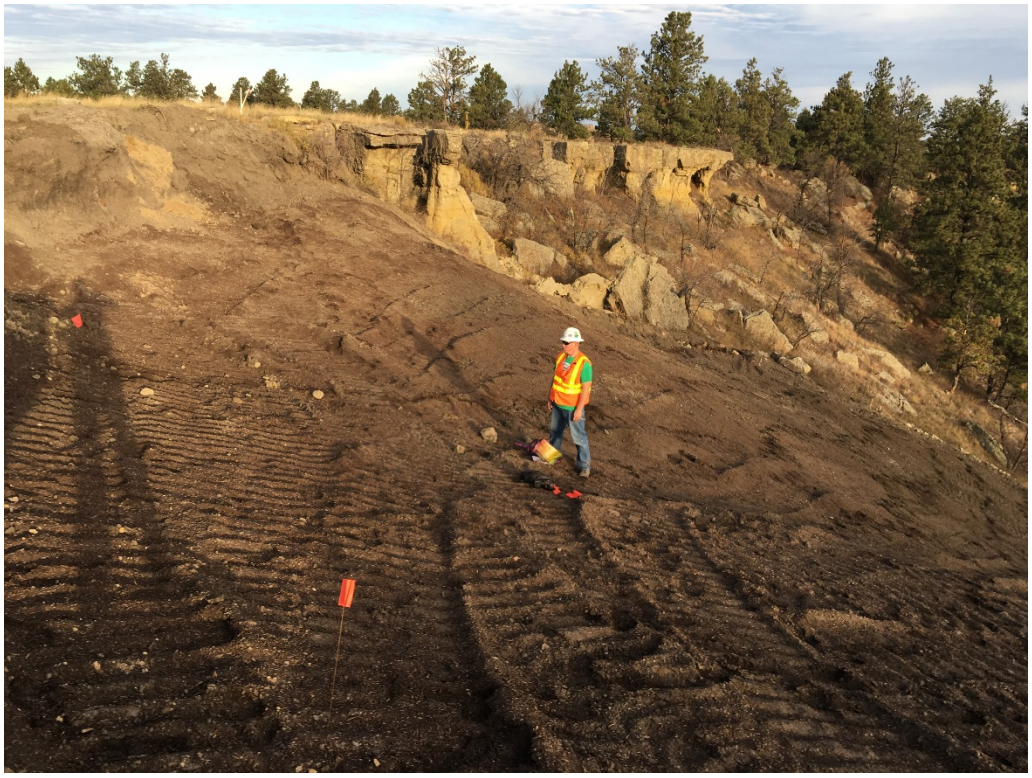


Photo 5: Photo X: Grid Sample Location I119



Photo 6: Grid Sample Location I123



Photo 7: Grid Sample Location I41

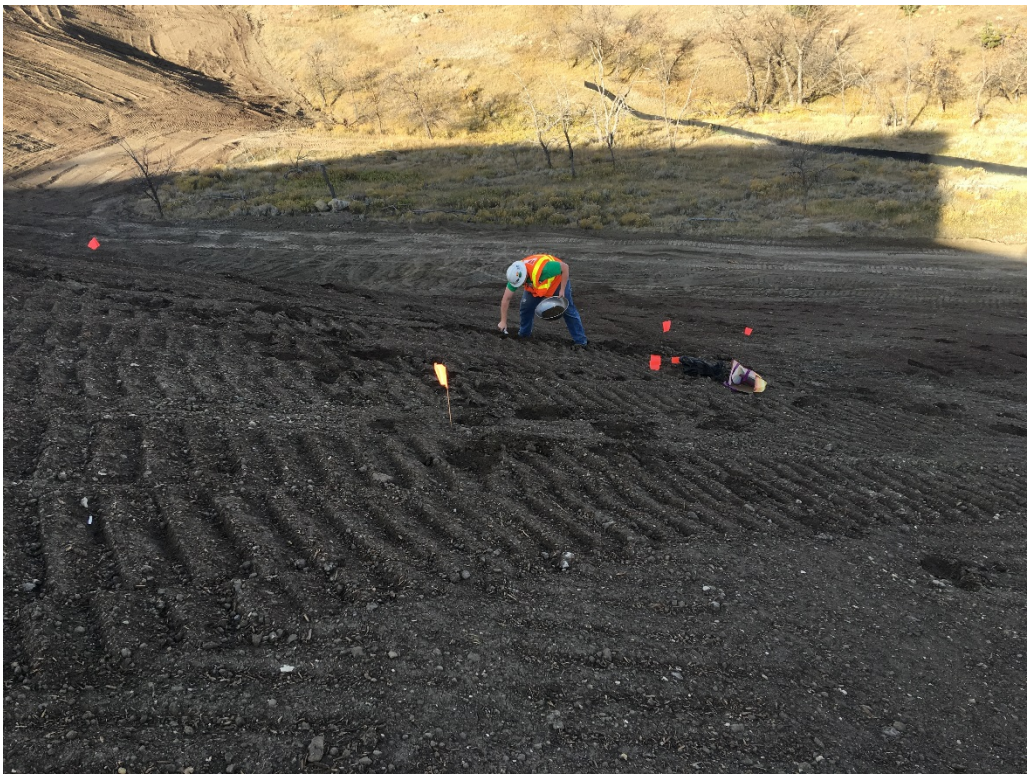


Photo 8: Grid Sample Location I27



Photo 9: Grid Sample Location I113



Photo 10: Grid Sample Location I280

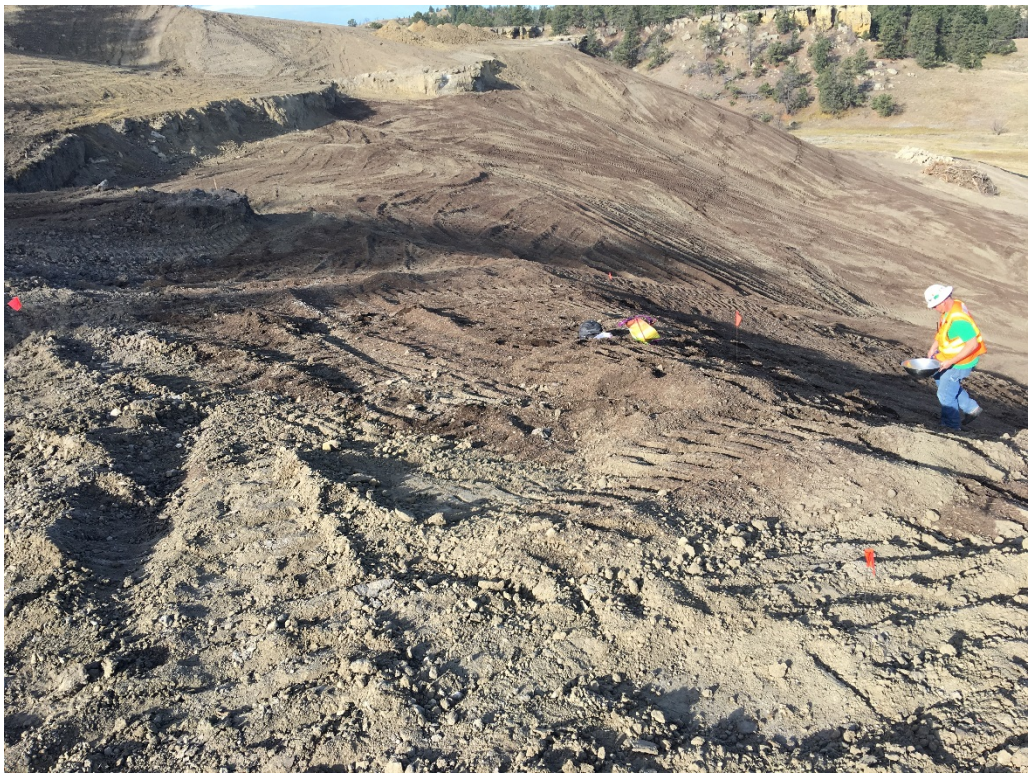


Photo 11: Grid Sample Location I318



Photo 12: Grid Sample Location I195



Photo 13: Grid Sample Location I196



Photo 14: Verification Sampling on Bluff G



Photo 15: Grid Sample Location I552



Photo 16: Grid Sample Location I355



Photo 17: Grid Sample Location I388

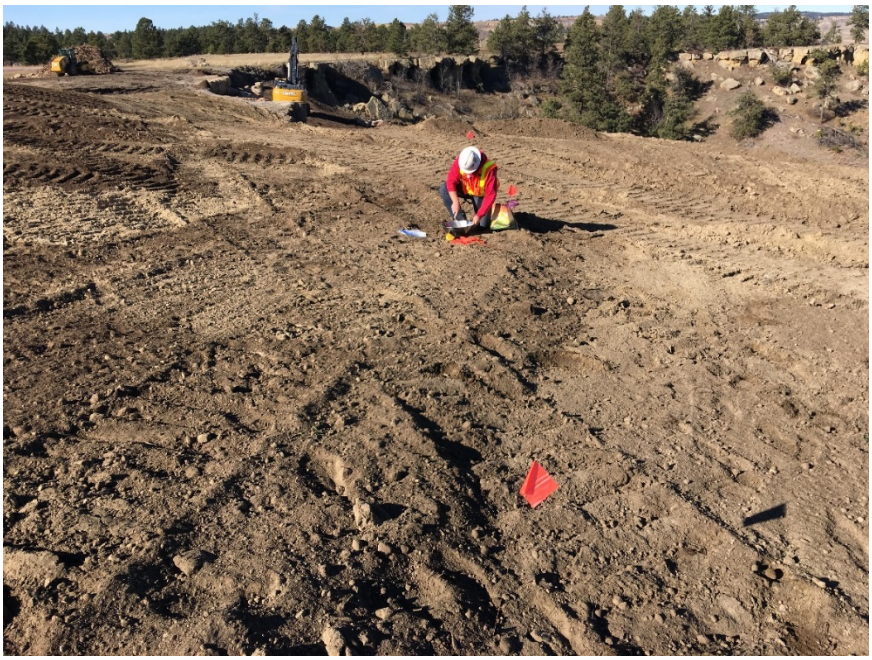


Photo 18: Grid Sample Location I332



Photo 19: Grid Sample Location I302

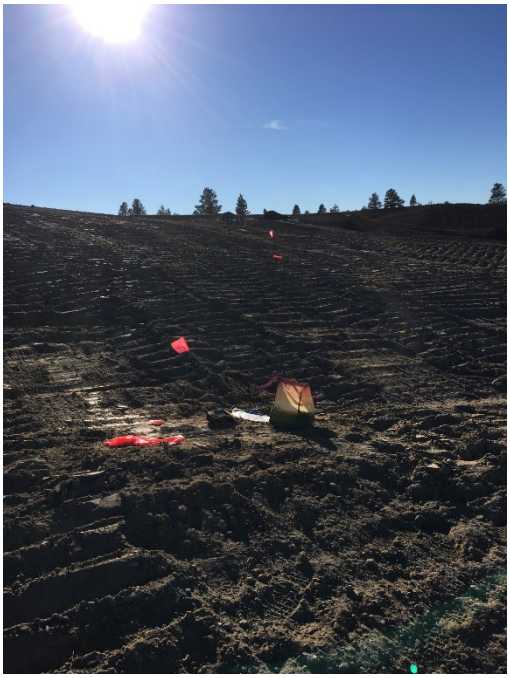


Photo 20: Grid Sample Location I267

APPENDIX F

PROUCL STATISTICAL SOFTWARE OUTPUT RESULTS

ProUCL Statistical Software

OUTPUT

Determination of Sample Size of In-Situ XRF Arsenic Measurements using Single Sample Size for Sign Test

	A	B	C	D	E	F	G	H	I	J	K	L	M
1					**Sample Sizes for Single Sample Sign Test (Bluff F XRF Samples)**								
2					**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
3				Date/Time of Computation	12/22/2016 10:46:43 AM								
4				User Selected Options									
5				False Rejection Rate [Alpha]	0.05								
6				False Acceptance Rate [Beta]	0.05								
7				Width of Gray Region [Delta]	109								
8				Estimate of Standard Deviation	14.7								
9													
10					Approximate Minimum Sample Size								
11				One Sided Alternative Hypothesis	11								
12				Two Sided Alternative Hypothesis	13								
13													
14													
15					**Sample Sizes for Single Sample Sign Test (Bluff F XRF Samples)**								
16					**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
17				Date/Time of Computation	12/22/2016 10:46:05 AM								
18				User Selected Options									
19				False Rejection Rate [Alpha]	0.05								
20				False Acceptance Rate [Beta]	0.05								
21				Width of Gray Region [Delta]	91.4								
22				Estimate of Standard Deviation	27.9								
23													
24					Approximate Minimum Sample Size								
25				One Sided Alternative Hypothesis	11								
26				Two Sided Alternative Hypothesis	14								
27													
28													
29					**Sample Sizes for Single Sample Sign Test (Bluff I XRF Samples)**								
30					**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
31				Date/Time of Computation	12/23/2016 10:36:10 AM								
32				User Selected Options									
33				False Rejection Rate [Alpha]	0.05								
34				False Acceptance Rate [Beta]	0.05								
35				Width of Gray Region [Delta]	82.8								
36				Estimate of Standard Deviation	23								
37													
38					Approximate Minimum Sample Size								
39				One Sided Alternative Hypothesis	11								
40				Two Sided Alternative Hypothesis	14								
41													

ProUCL Statistical Software

OUTPUT

One Sample Sign Test for Uncensored Full Data Sets without NDs for In-situ XRF Arsenic Measurements

One Sample Sign Test for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	12/23/2016 3:09:05 PM
From File	Bluff_G.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Action Level	142.000
Selected Null Hypothesis	Median <= Action Level (Form 1)
Alternative Hypothesis	Median > the Action Level

Bluff G XRF (su-1)

One Sample Sign Test

Raw Statistics

Number of Valid Observations	110
Number of Distinct Observations	108
Minimum	7.493
Maximum	89.98
Mean	34.81
Median	33.81
SD	14.04
SE of Mean	1.338
Number Above Action Level	0
Number Equal Action Level	0
Number Below Action Level	110

H0: Sample Median <= 142 (Form 1)

Large Sample Z Test Statistic	-10.49
P-Value	1

Conclusion with Alpha = 0.05

Do Not Reject H0 at the specified level of significance (0.05), Conclude Median <= 142

P-Value > Alpha (0.05)

Bluff G XRF (su-2)

One Sample Sign Test

Raw Statistics

Number of Valid Observations	118
Number of Distinct Observations	113
Minimum	25.19
Maximum	144.9
Mean	47.89
Median	46.55
SD	13.62
SE of Mean	1.254

	A	B	C	D	E	F	G	H	I	J	K	L
53					Number Above Action Level	1						
54					Number Equal Action Level	0						
55					Number Below Action Level	117						
56												
57	**H0: Sample Median <= 142 (Form 1)**											
58												
59					Large Sample Z Test Statistic	-10.68						
60					P-Value	1						
61												
62	**Conclusion with Alpha = 0.05**											
63	**Do Not Reject H0 at the specified level of significance (0.05), Conclude Median <= 142**											
64	**P-Value > Alpha (0.05)**											
65												
66												
67	**Bluff G XRF (su-3)**											
68												
69					**One Sample Sign Test**							
70												
71					**Raw Statistics**							
72					Number of Valid Observations	108						
73					Number of Distinct Observations	106						
74					Minimum	19.56						
75					Maximum	225						
76					Mean	56.46						
77					Median	50.62						
78					SD	27.87						
79					SE of Mean	2.682						
80					Number Above Action Level	1						
81					Number Equal Action Level	0						
82					Number Below Action Level	107						
83												
84	**H0: Sample Median <= 142 (Form 1)**											
85												
86					Large Sample Z Test Statistic	-10.2						
87					P-Value	1						
88												
89	**Conclusion with Alpha = 0.05**											
90	**Do Not Reject H0 at the specified level of significance (0.05), Conclude Median <= 142**											
91	**P-Value > Alpha (0.05)**											

ProUCL Statistical Software

OUTPUT

Determination of Soil Sample Size for Determination of Sample Size Required for Estimation of Mean

Arsenic

Radium-226

	A	B	C	D	E	F	G	H	I	J	K	L
1				**Sample Size for Estimation of Mean for Bluff F (Arsenic Soil Samples)**								
2				**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
3			Date/Time of Computation	12/20/2016 5:22:05 PM								
4			User Selected Options									
5			Confidence Coefficient	95%								
6			Allowable Error Margin	14.2								
7			Estimate of Standard Deviation	3.26								
8												
9					Approximate Minimum Sample Size							
10			95% Confidence Coefficient		**3**							
11												
12												
13				**Sample Size for Estimation of Mean for Bluff G (Arsenic Soil Samples)**								
14				**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
15			Date/Time of Computation	12/20/2016 5:17:41 PM								
16			User Selected Options									
17			Confidence Coefficient	95%								
18			Allowable Error Margin	14.2								
19			Estimate of Standard Deviation	14.5								
20												
21					Approximate Minimum Sample Size							
22			95% Confidence Coefficient		**6**							
23												
24												
25				**Sample Size for Estimation of Mean for Bluff I (Arsenic Soil Samples)**								
26				**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
27			Date/Time of Computation	12/20/2016 5:23:22 PM								
28			User Selected Options									
29			Confidence Coefficient	95%								
30			Allowable Error Margin	14.2								
31			Estimate of Standard Deviation	19.2								
32												
33					Approximate Minimum Sample Size							
34			95% Confidence Coefficient		**9**							

	A	B	C	D	E	F	G	H	I	J	K	L
1				**Sample Size for Estimation of Mean for Bluff F (Radium-226 Soil Samples)**								
2				**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
3			Date/Time of Computation	12/20/2016 5:30:06 PM								
4			User Selected Options									
5			Confidence Coefficient	95%								
6			Allowable Error Margin	3								
7			Estimate of Standard Deviation	2.17								
8												
9					Approximate Minimum Sample Size							
10			95% Confidence Coefficient		**4**							
11												
12												
13				**Sample Size for Estimation of Mean for Bluff G (Radium-226 Soil Samples)**								
14				**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
15			Date/Time of Computation	12/20/2016 5:34:26 PM								
16			User Selected Options									
17			Confidence Coefficient	95%								
18			Allowable Error Margin	3								
19			Estimate of Standard Deviation	2.73								
20												
21					Approximate Minimum Sample Size							
22			95% Confidence Coefficient		**6**							
23												
24												
25				**Sample Size for Estimation of Mean for Bluff I (Radium-226 Soil Samples)**								
26				**Based on Specified Values of Decision Parameters/DQOs (Data Quality Objectives)**								
27			Date/Time of Computation	12/20/2016 5:36:13 PM								
28			User Selected Options									
29			Confidence Coefficient	95%								
30			Allowable Error Margin	3								
31			Estimate of Standard Deviation	5.88								
32												
33					Approximate Minimum Sample Size							
34			95% Confidence Coefficient		**17**							

ProUCL Statistical Software

OUTPUT

Evaluation of 95% UCL for Soil Arsenic Confirmation Samples

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	1/13/2017 1:36:46 PM
From File	ALL_Arsenic_Soil_Confirmation.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

F

General Statistics

Total Number of Observations	7	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	20	Mean	25.43
Maximum	30	Median	25
SD	2.992	Std. Error of Mean	1.131
Coefficient of Variation	0.118	Skewness	-0.528

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	27.63	95% Adjusted-CLT UCL (Chen-1995)	27.05
		95% Modified-t UCL (Johnson-1978)	27.59

Gamma GOF Test

A-D Test Statistic	0.511	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.311	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.311	Data Not Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	80.4	k star (bias corrected MLE)	46.04
Theta hat (MLE)	0.316	Theta star (bias corrected MLE)	0.552
nu hat (MLE)	1126	nu star (bias corrected)	644.5
MLE Mean (bias corrected)	25.43	MLE Sd (bias corrected)	3.748
		Approximate Chi Square Value (0.05)	586.6
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	569.8

53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))				27.94	95% Adjusted Gamma UCL (use when n<50)					28.76	
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic				0.884	**Shapiro Wilk Lognormal GOF Test**						
58	5% Shapiro Wilk Critical Value				0.803	Data appear Lognormal at 5% Significance Level						
59	Lilliefors Test Statistic				0.322	**Lilliefors Lognormal GOF Test**						
60	5% Lilliefors Critical Value				0.335	Data appear Lognormal at 5% Significance Level						
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data				2.996	Mean of logged Data					3.23	
65	Maximum of Logged Data				3.401	SD of logged Data					0.122	
66												
67	**Assuming Lognormal Distribution**											
68	95% H-UCL				27.99	90% Chebyshev (MVUE) UCL					28.96	
69	95% Chebyshev (MVUE) UCL				30.56	97.5% Chebyshev (MVUE) UCL					32.78	
70	99% Chebyshev (MVUE) UCL				37.13							
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76	95% CLT UCL				27.29	95% Jackknife UCL					27.63	
77	95% Standard Bootstrap UCL				27.2	95% Bootstrap-t UCL					27.43	
78	95% Hall's Bootstrap UCL				27.48	95% Percentile Bootstrap UCL					27	
79	95% BCA Bootstrap UCL				26.86							
80	90% Chebyshev(Mean, Sd) UCL				28.82	95% Chebyshev(Mean, Sd) UCL					30.36	
81	97.5% Chebyshev(Mean, Sd) UCL				32.49	99% Chebyshev(Mean, Sd) UCL					36.68	
82												
83	**Suggested UCL to Use**											
84	95% Student's-t UCL				27.63							
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
88	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
89	For additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												
94												
95	**G**											
96												
97	**General Statistics**											
98	Total Number of Observations				18	Number of Distinct Observations					16	
99						Number of Missing Observations					0	
100	Minimum				15	Mean					39.56	
101	Maximum				70	Median					36.5	
102	SD				14.49	Std. Error of Mean					3.416	
103	Coefficient of Variation				0.366	Skewness					0.664	
104												

105	**Normal GOF Test**											
106					Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**					
107					5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level					
108					Lilliefors Test Statistic	0.154	**Lilliefors GOF Test**					
109					5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level					
110	**Data appear Normal at 5% Significance Level**											
111												
112	**Assuming Normal Distribution**											
113	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
114					95% Student's-t UCL	45.5	95% Adjusted-CLT UCL (Chen-1995)	45.75				
115							95% Modified-t UCL (Johnson-1978)	45.59				
116												
117	**Gamma GOF Test**											
118					A-D Test Statistic	0.245	**Anderson-Darling Gamma GOF Test**					
119					5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level					
120					K-S Test Statistic	0.112	**Kolmogrov-Smirnoff Gamma GOF Test**					
121					5% K-S Critical Value	0.204	Detected data appear Gamma Distributed at 5% Significance Level					
122	**Detected data appear Gamma Distributed at 5% Significance Level**											
123												
124	**Gamma Statistics**											
125					k hat (MLE)	7.794	k star (bias corrected MLE)	6.532				
126					Theta hat (MLE)	5.075	Theta star (bias corrected MLE)	6.055				
127					nu hat (MLE)	280.6	nu star (bias corrected)	235.2				
128					MLE Mean (bias corrected)	39.56	MLE Sd (bias corrected)	15.48				
129							Approximate Chi Square Value (0.05)	200.7				
130					Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	197.6				
131												
132	**Assuming Gamma Distribution**											
133					95% Approximate Gamma UCL (use when n>=50))	46.36	95% Adjusted Gamma UCL (use when n<50)	47.07				
134												
135	**Lognormal GOF Test**											
136					Shapiro Wilk Test Statistic	0.967	**Shapiro Wilk Lognormal GOF Test**					
137					5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level					
138					Lilliefors Test Statistic	0.137	**Lilliefors Lognormal GOF Test**					
139					5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level					
140	**Data appear Lognormal at 5% Significance Level**											
141												
142	**Lognormal Statistics**											
143					Minimum of Logged Data	2.708	Mean of logged Data	3.612				
144					Maximum of Logged Data	4.248	SD of logged Data	0.382				
145												
146	**Assuming Lognormal Distribution**											
147					95% H-UCL	47.57	90% Chebyshev (MVUE) UCL	50.6				
148					95% Chebyshev (MVUE) UCL	55.55	97.5% Chebyshev (MVUE) UCL	62.42				
149					99% Chebyshev (MVUE) UCL	75.92						
150												
151	**Nonparametric Distribution Free UCL Statistics**											
152	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
153												
154	**Nonparametric Distribution Free UCLs**											
155					95% CLT UCL	45.17	95% Jackknife UCL	45.5				
156					95% Standard Bootstrap UCL	44.96	95% Bootstrap-t UCL	46.45				

157				95% Hall's Bootstrap UCL	46.69					95% Percentile Bootstrap UCL	45.39
158				95% BCA Bootstrap UCL	45.61						
159				90% Chebyshev(Mean, Sd) UCL	49.8					95% Chebyshev(Mean, Sd) UCL	54.44
160				97.5% Chebyshev(Mean, Sd) UCL	60.89					99% Chebyshev(Mean, Sd) UCL	73.54
161											
162				**Suggested UCL to Use**							
163				95% Student's-t UCL	45.5						
164											
165	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
166	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)										
167	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.										
168	For additional insight the user may want to consult a statistician.										
169											
170											
171	I										
172											
173				**General Statistics**							
174				Total Number of Observations	33					Number of Distinct Observations	26
175										Number of Missing Observations	0
176				Minimum	15					Mean	44.64
177				Maximum	89					Median	46
178				SD	19.54					Std. Error of Mean	3.401
179				Coefficient of Variation	0.438					Skewness	0.411
180											
181				**Normal GOF Test**							
182				Shapiro Wilk Test Statistic	0.952					**Shapiro Wilk GOF Test**	
183				5% Shapiro Wilk Critical Value	0.931					Data appear Normal at 5% Significance Level	
184				Lilliefors Test Statistic	0.0983					**Lilliefors GOF Test**	
185				5% Lilliefors Critical Value	0.154					Data appear Normal at 5% Significance Level	
186				**Data appear Normal at 5% Significance Level**							
187											
188				**Assuming Normal Distribution**							
189				**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**	
190				95% Student's-t UCL	50.4					95% Adjusted-CLT UCL (Chen-1995)	50.49
191										95% Modified-t UCL (Johnson-1978)	50.44
192											
193				**Gamma GOF Test**							
194				A-D Test Statistic	0.507					**Anderson-Darling Gamma GOF Test**	
195				5% A-D Critical Value	0.749					Detected data appear Gamma Distributed at 5% Significance Level	
196				K-S Test Statistic	0.12					**Kolmogrov-Smirnoff Gamma GOF Test**	
197				5% K-S Critical Value	0.154					Detected data appear Gamma Distributed at 5% Significance Level	
198				**Detected data appear Gamma Distributed at 5% Significance Level**							
199											
200				**Gamma Statistics**							
201				k hat (MLE)	4.925					k star (bias corrected MLE)	4.498
202				Theta hat (MLE)	9.063					Theta star (bias corrected MLE)	9.924
203				nu hat (MLE)	325.1					nu star (bias corrected)	296.9
204				MLE Mean (bias corrected)	44.64					MLE Sd (bias corrected)	21.05
205										Approximate Chi Square Value (0.05)	257.9
206				Adjusted Level of Significance	0.0419					Adjusted Chi Square Value	256.1
207											
208				**Assuming Gamma Distribution**							

209	95% Approximate Gamma UCL (use when n>=50))					51.37	95% Adjusted Gamma UCL (use when n<50)					51.74
210												
211	**Lognormal GOF Test**											
212	Shapiro Wilk Test Statistic					0.938	**Shapiro Wilk Lognormal GOF Test**					
213	5% Shapiro Wilk Critical Value					0.931	Data appear Lognormal at 5% Significance Level					
214	Lilliefors Test Statistic					0.151	**Lilliefors Lognormal GOF Test**					
215	5% Lilliefors Critical Value					0.154	Data appear Lognormal at 5% Significance Level					
216	**Data appear Lognormal at 5% Significance Level**											
217												
218	**Lognormal Statistics**											
219	Minimum of Logged Data					2.708	Mean of logged Data					3.694
220	Maximum of Logged Data					4.489	SD of logged Data					0.487
221												
222	**Assuming Lognormal Distribution**											
223	95% H-UCL					53.39	90% Chebyshev (MVUE) UCL					57.01
224	95% Chebyshev (MVUE) UCL					62.42	97.5% Chebyshev (MVUE) UCL					69.93
225	99% Chebyshev (MVUE) UCL					84.69						
226												
227	**Nonparametric Distribution Free UCL Statistics**											
228	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
229												
230	**Nonparametric Distribution Free UCLs**											
231	95% CLT UCL					50.23	95% Jackknife UCL					50.4
232	95% Standard Bootstrap UCL					50.16	95% Bootstrap-t UCL					50.53
233	95% Hall's Bootstrap UCL					50.46	95% Percentile Bootstrap UCL					49.91
234	95% BCA Bootstrap UCL					50.42						
235	90% Chebyshev(Mean, Sd) UCL					54.84	95% Chebyshev(Mean, Sd) UCL					59.46
236	97.5% Chebyshev(Mean, Sd) UCL					65.88	99% Chebyshev(Mean, Sd) UCL					78.48
237												
238	**Suggested UCL to Use**											
239	95% Student's-t UCL					50.4						
240												
241	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
242	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
243	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
244	For additional insight the user may want to consult a statistician.											
245												

ProUCL Statistical Software

OUTPUT

Single Sample Hypothesis Sign Test for Grid Averaged Radium-226 Measurements

One Sample Sign Test for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	1/12/2017 11:59:36 PM
From File	Bluff_F_Ra226_from_Equation3.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0.000
Action Level	30.000
Selected Null Hypothesis	Median <= Action Level (Form 1)
Alternative Hypothesis	Median > the Action Level

C0

One Sample Sign Test

Raw Statistics

Number of Valid Observations	111
Number of Missing Observations	1
Number of Distinct Observations	111
Minimum	7.151
Maximum	55.89
Mean	16.33
Median	13.67
SD	8.765
SE of Mean	0.832
Number Above Action Level	9
Number Equal Action Level	0
Number Below Action Level	102

H0: Sample Median <= 30 (Form 1)

Large Sample Z Test Statistic	-8.827
P-Value	1

Conclusion with Alpha = 0.05

Do Not Reject H0 at the specified level of significance (0.05), Conclude Median <= 30

P-Value > Alpha (0.05)

ProUCL Statistical Software

OUTPUT

Evaluation of 95% UCL for Soil Radium-226 Confirmation Samples

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	12/20/2016 5:49:05 PM
From File	Radium soil.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

F

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	5.31	Mean	8.153
Maximum	12.1	Median	8.3
SD	2.38	Std. Error of Mean	0.972
Coefficient of Variation	0.292	Skewness	0.673

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.226	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.11	95% Adjusted-CLT UCL (Chen-1995)	10.04
		95% Modified-t UCL (Johnson-1978)	10.16

Gamma GOF Test

A-D Test Statistic	0.294	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.21	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.4	k star (bias corrected MLE)	7.312
Theta hat (MLE)	0.566	Theta star (bias corrected MLE)	1.115
nu hat (MLE)	172.8	nu star (bias corrected)	87.74
MLE Mean (bias corrected)	8.153	MLE Sd (bias corrected)	3.015
		Approximate Chi Square Value (0.05)	67.15
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	60.67

53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))				10.65	95% Adjusted Gamma UCL (use when n<50)					11.79	
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic				0.952	**Shapiro Wilk Lognormal GOF Test**						
58	5% Shapiro Wilk Critical Value				0.788	Data appear Lognormal at 5% Significance Level						
59	Lilliefors Test Statistic				0.223	**Lilliefors Lognormal GOF Test**						
60	5% Lilliefors Critical Value				0.362	Data appear Lognormal at 5% Significance Level						
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data				1.67	Mean of logged Data					2.063	
65	Maximum of Logged Data				2.493	SD of logged Data					0.291	
66												
67	**Assuming Lognormal Distribution**											
68	95% H-UCL				10.94	90% Chebyshev (MVUE) UCL					11.05	
69	95% Chebyshev (MVUE) UCL				12.37	97.5% Chebyshev (MVUE) UCL					14.19	
70	99% Chebyshev (MVUE) UCL				17.78							
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76	95% CLT UCL				9.751	95% Jackknife UCL					10.11	
77	95% Standard Bootstrap UCL				9.596	95% Bootstrap-t UCL					10.51	
78	95% Hall's Bootstrap UCL				10.41	95% Percentile Bootstrap UCL					9.668	
79	95% BCA Bootstrap UCL				9.802							
80	90% Chebyshev(Mean, Sd) UCL				11.07	95% Chebyshev(Mean, Sd) UCL					12.39	
81	97.5% Chebyshev(Mean, Sd) UCL				14.22	99% Chebyshev(Mean, Sd) UCL					17.82	
82												
83	**Suggested UCL to Use**											
84	95% Student's-t UCL				10.11							
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
88	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
89	For additional insight the user may want to consult a statistician.											
90												
91												
92	**G**											
93												
94	**General Statistics**											
95	Total Number of Observations				18	Number of Distinct Observations					18	
96						Number of Missing Observations					0	
97	Minimum				6.24	Mean					10.38	
98	Maximum				15.6	Median					9.9	
99	SD				2.813	Std. Error of Mean					0.663	
100	Coefficient of Variation				0.271	Skewness					0.441	
101												
102	**Normal GOF Test**											
103	Shapiro Wilk Test Statistic				0.947	**Shapiro Wilk GOF Test**						
104	5% Shapiro Wilk Critical Value				0.897	Data appear Normal at 5% Significance Level						

	A	B	C	D	E	F	G	H	I	J	K	L
105					Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**					
106					5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level					
107	**Data appear Normal at 5% Significance Level**											
108												
109	**Assuming Normal Distribution**											
110	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
111					95% Student's-t UCL	11.53	95% Adjusted-CLT UCL (Chen-1995)					11.54
112							95% Modified-t UCL (Johnson-1978)					11.55
113												
114	**Gamma GOF Test**											
115					A-D Test Statistic	0.283	**Anderson-Darling Gamma GOF Test**					
116					5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level					
117					K-S Test Statistic	0.11	**Kolmogrov-Smirnoff Gamma GOF Test**					
118					5% K-S Critical Value	0.203	Detected data appear Gamma Distributed at 5% Significance Level					
119	**Detected data appear Gamma Distributed at 5% Significance Level**											
120												
121	**Gamma Statistics**											
122					k hat (MLE)	14.55	k star (bias corrected MLE)					12.16
123					Theta hat (MLE)	0.713	Theta star (bias corrected MLE)					0.854
124					nu hat (MLE)	523.8	nu star (bias corrected)					437.8
125					MLE Mean (bias corrected)	10.38	MLE Sd (bias corrected)					2.977
126							Approximate Chi Square Value (0.05)					390.3
127					Adjusted Level of Significance	0.0357	Adjusted Chi Square Value					386
128												
129	**Assuming Gamma Distribution**											
130				95% Approximate Gamma UCL (use when n>=50))		11.64	95% Adjusted Gamma UCL (use when n<50)					11.77
131												
132	**Lognormal GOF Test**											
133					Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk Lognormal GOF Test**					
134					5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level					
135					Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**					
136					5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level					
137	**Data appear Lognormal at 5% Significance Level**											
138												
139	**Lognormal Statistics**											
140					Minimum of Logged Data	1.831	Mean of logged Data					2.305
141					Maximum of Logged Data	2.747	SD of logged Data					0.272
142												
143	**Assuming Lognormal Distribution**											
144					95% H-UCL	11.75	90% Chebyshev (MVUE) UCL					12.4
145					95% Chebyshev (MVUE) UCL	13.32	97.5% Chebyshev (MVUE) UCL					14.59
146					99% Chebyshev (MVUE) UCL	17.09						
147												
148	**Nonparametric Distribution Free UCL Statistics**											
149	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
150												
151	**Nonparametric Distribution Free UCLs**											
152					95% CLT UCL	11.47	95% Jackknife UCL					11.53
153					95% Standard Bootstrap UCL	11.43	95% Bootstrap-t UCL					11.69
154					95% Hall's Bootstrap UCL	11.51	95% Percentile Bootstrap UCL					11.45
155					95% BCA Bootstrap UCL	11.5						
156					90% Chebyshev(Mean, Sd) UCL	12.37	95% Chebyshev(Mean, Sd) UCL					13.27

157			97.5% Chebyshev(Mean, Sd) UCL			14.52			99% Chebyshev(Mean, Sd) UCL			16.98
158												
159					**Suggested UCL to Use**							
160			95% Student's-t UCL			11.53						
161												
162					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
163					These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)							
164					and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.							
165					For additional insight the user may want to consult a statistician.							
166												
167												
168	I											
169												
170					**General Statistics**							
171			Total Number of Observations			33			Number of Distinct Observations			33
172									Number of Missing Observations			0
173			Minimum			3.2			Mean			12.56
174			Maximum			26.8			Median			13.8
175			SD			5.966			Std. Error of Mean			1.039
176			Coefficient of Variation			0.475			Skewness			-0.104
177												
178					**Normal GOF Test**							
179			Shapiro Wilk Test Statistic			0.912			**Shapiro Wilk GOF Test**			
180			5% Shapiro Wilk Critical Value			0.931			Data Not Normal at 5% Significance Level			
181			Lilliefors Test Statistic			0.159			**Lilliefors GOF Test**			
182			5% Lilliefors Critical Value			0.154			Data Not Normal at 5% Significance Level			
183					**Data Not Normal at 5% Significance Level**							
184												
185					**Assuming Normal Distribution**							
186			**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**			
187			95% Student's-t UCL			14.32			95% Adjusted-CLT UCL (Chen-1995)			14.25
188									95% Modified-t UCL (Johnson-1978)			14.32
189												
190					**Gamma GOF Test**							
191			A-D Test Statistic			1.903			**Anderson-Darling Gamma GOF Test**			
192			5% A-D Critical Value			0.752			Data Not Gamma Distributed at 5% Significance Level			
193			K-S Test Statistic			0.227			**Kolmogrov-Smirnoff Gamma GOF Test**			
194			5% K-S Critical Value			0.154			Data Not Gamma Distributed at 5% Significance Level			
195					**Data Not Gamma Distributed at 5% Significance Level**							
196												
197					**Gamma Statistics**							
198			k hat (MLE)			3.479			k star (bias corrected MLE)			3.183
199			Theta hat (MLE)			3.61			Theta star (bias corrected MLE)			3.946
200			nu hat (MLE)			229.6			nu star (bias corrected)			210.1
201			MLE Mean (bias corrected)			12.56			MLE Sd (bias corrected)			7.041
202									Approximate Chi Square Value (0.05)			177.6
203			Adjusted Level of Significance			0.0419			Adjusted Chi Square Value			176
204												
205					**Assuming Gamma Distribution**							
206			95% Approximate Gamma UCL (use when n>=50))			14.86			95% Adjusted Gamma UCL (use when n<50)			14.99
207												
208					**Lognormal GOF Test**							

209	Shapiro Wilk Test Statistic				0.847	**Shapiro Wilk Lognormal GOF Test**						
210	5% Shapiro Wilk Critical Value				0.931	Data Not Lognormal at 5% Significance Level						
211	Lilliefors Test Statistic				0.251	**Lilliefors Lognormal GOF Test**						
212	5% Lilliefors Critical Value				0.154	Data Not Lognormal at 5% Significance Level						
213	**Data Not Lognormal at 5% Significance Level**											
214												
215	**Lognormal Statistics**											
216	Minimum of Logged Data				1.163	Mean of logged Data					2.38	
217	Maximum of Logged Data				3.288	SD of logged Data					0.609	
218												
219	**Assuming Lognormal Distribution**											
220	95% H-UCL				16.18	90% Chebyshev (MVUE) UCL					17.3	
221	95% Chebyshev (MVUE) UCL				19.28	97.5% Chebyshev (MVUE) UCL					22.04	
222	99% Chebyshev (MVUE) UCL				27.44							
223												
224	**Nonparametric Distribution Free UCL Statistics**											
225	**Data do not follow a Discernible Distribution (0.05)**											
226												
227	**Nonparametric Distribution Free UCLs**											
228	95% CLT UCL				14.27	95% Jackknife UCL					14.32	
229	95% Standard Bootstrap UCL				14.19	95% Bootstrap-t UCL					14.24	
230	95% Hall's Bootstrap UCL				14.26	95% Percentile Bootstrap UCL					14.19	
231	95% BCA Bootstrap UCL				14.24							
232	90% Chebyshev(Mean, Sd) UCL				15.68	95% Chebyshev(Mean, Sd) UCL					17.09	
233	97.5% Chebyshev(Mean, Sd) UCL				19.05	99% Chebyshev(Mean, Sd) UCL					22.9	
234												
235	**Suggested UCL to Use**											
236	95% Chebyshev (Mean, Sd) UCL				17.09							
237												
238	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
239	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
240	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
241	For additional insight the user may want to consult a statistician.											
242												
243	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
244	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
245												



Tetra Tech, Inc.
3801 Automation Way, Suite 100
Fort Collins, CO 80525
Phone: 970-223-9600

www.tetratech.com