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Data Validation Report for CH2M Hill Plateau Remediation Company

VSR18-005
Project 618-10_618-11

Chemical and Radiochemical Validation - Level C

Validation Performed By:


Eyda Hergenreder

Date: 12-21-2017

Technical Review By:


Ellen McEntee

Date: 12-21-2017

Quality Review By:


Mary Donovan
Quality Assurance Manager

Date: 02-22-2018

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Date: 20 December 2017
 To: CH2M Hill (technical representative)
 From: Analytical Quality Associates, Inc.
 Project: 618-10_618-11
 Subject: Inorganics - Sample Data Groups (SDGs) GEL432978 and SL2666

INTRODUCTION

This memorandum presents the results of data validation for SDG GEL432978 prepared by GEL Laboratories LLC and SDG SL2666 prepared by TestAmerica Laboratories Inc. A list of samples validated along with the analytical methods is provided in the following table.

Sample ID	Sample Date	Media	Validation Level	Analytical Methods
B3DCF2	09/14/17	Soil	C	6020B
B3DCC8	09/14/17	Soil	C	6020A
B3DCD0	09/14/17	Soil	C	6020A
B3DCD2	09/14/17	Soil	C	6020A
B3DCD4	09/14/17	Soil	C	6020A
B3DCD6	09/14/17	Soil	C	6020A
B3DCD8	09/14/17	Soil	C	6020A
B3DCF0	09/14/17	Soil	C	6020A

Data validation was conducted in accordance with the CHPRC validation statement of work and the 300 Area Remedial Action Sampling and Analysis Plan, DOE/RL-2001-48, Rev. 4 (SAP). Appendices 1 through 4 provide the following information as indicated below:

- Appendix 1. Glossary of Data Reporting Qualifiers
- Appendix 2. Summary of Data Qualification
- Appendix 3. Data Validation Supporting Documentation
- Appendix 4. Additional Documentation Requested by Client

DATA QUALITY OBJECTIVES

- **Holding Times and Sample Preservation**

Holding times are calculated from Chain-of-Custody forms to determine the validity of the results. The holding time requirement for ICP/MS metals are analysis within 180 days of sample collection. Sample preservation for soil samples requires chilling to ≤ 6 degrees Celsius.

The samples were analyzed within the prescribed holding times and properly preserved.

- **Blanks**

The blank data results are reviewed to assess the extent of contamination introduced through sampling, sample preparation, and analysis.

Laboratory Blanks

All laboratory blank results were acceptable.

Trip Blanks

No trip blanks were submitted for validation.

Field Blanks

No field blanks were submitted for validation.

Equipment Blanks

No equipment blanks were submitted for validation.

- **Accuracy**

Accuracy is evaluated by reviewing matrix spike sample results, laboratory control sample results, and ICP-AES interference check sample results. According to the SAP, the matrix spike sample accuracy limits are 70% to 130% and the laboratory control sample accuracy limits are ones specified by the DV procedure. The interference check sample limits are ones specified by the DV procedure.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples

All MS/MSD recoveries were acceptable.

Laboratory Control Samples (LCSs)

All LCS recoveries were acceptable.

ICP-AES Interference Check Samples (ICSs)

ICS data was not included in the data package. Sample results should not be qualified based on this.

- **Precision**

Precision is evaluated by reviewing MS/MSD results, laboratory duplicate sample results, field duplicate sample results, field split sample results and ICP serial dilution results. These QC results provide information on the laboratory reproducibility and whether sampling activities are adequate to acquire consistent sample results. According to the SAP, the relative percent difference (RPD) limits are $\pm 30\%$.

MS/MSD Samples

The MS/MSD RPD value was acceptable.

Laboratory Duplicate Samples

The laboratory duplicate results were acceptable.

Field Duplicate Samples

No field duplicates were submitted for validation.

Field Split Samples

No field splits were submitted for validation.

ICP Serial Dilution Samples

ICS serial dilution data was not included in the data package. Sample results should not be qualified based on this.

• ICP-MS Internal Standards

The analysis of ICP-MS internal standards is used to determine the existences and magnitude of instrument drift and physical interferences. The criteria for evaluation of internal standard results apply to all samples (including QC) analyzed during the analytical run, beginning with the calibration.

ICP-MS internal standards data was not included in the data package. Sample results should not be qualified based on this.

• Detection Limits

Reported MDLs are compared against the contractually required detection limits (CRDLs) to ensure that laboratory detection limits meet the required criteria.

All reported sample MDLs for U were above the CRDLs; however all results were detects.

• Completeness

SDGs GEL432978 and SL2666 were submitted for validation and verified for completeness. Completeness is based on the percentage of data determined to be valid (i.e., not rejected). The completion percentage was 100%.

MAJOR DEFICIENCIES

None found.

MINOR DEFICIENCIES

None found.

REFERENCES

GRP-GD-003, Rev. 2, Change 0, *Data Validation for Chemical Analyses*, October 2016.

DOE/RL-2001-48, Rev. 4, *300 Area Remedial Action Sampling and Analysis Plan*, November 2014.

Appendix 1

Glossary of Data Reporting Qualifiers

Qualifiers that may be applied by data validators in compliance with the CHPRC statement of work are as follows:

- **U** — The constituent was analyzed for, but was not detected. The data should be considered usable for decision-making purposes.
- **UJ** — The constituent was analyzed for and was not detected. Due to a quality control deficiency identified during data validation the value reported may not accurately reflect the RL. The data should be considered usable for decision-making purposes.
- **J** — Indicates the constituent was analyzed for and detected. The associated value is estimated due to a quality control deficiency identified during data validation. The data should be considered usable for decision-making purposes.
- **J+** — Indicates the constituent was analyzed for and detected. The associated value is estimated with a suspected positive bias due to a quality control deficiency identified during data validation. The data should be considered usable for decision-making purposes.
- **J-** — Indicates the constituent was analyzed for and detected. The associated value is estimated with a suspected negative bias due to a quality control deficiency identified during data validation. The data should be considered usable for decision-making purposes.
- **N** — The analysis indicates the presence of an analyte that has been tentatively identified.
- **NJ** — The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.
- **NJ+** — The analysis indicates the presence of an analyte that has been tentatively identified. The associated value is estimated with a suspected positive bias due to a quality control deficiency identified during data validation.
- **NJ-** — The analysis indicates the presence of an analyte that has been tentatively identified. The associated value is estimated with a suspected negative bias due to a quality control deficiency identified during data validation.
- **UR** — Indicates the constituent was analyzed for and not detected; however, due to an identified quality control deficiency the data should be considered unusable for decision-making purposes.
- **R** — Indicates the constituent was analyzed for and detected; however, due to an identified quality control deficiency the data should be considered unusable for decision-making purposes.

Appendix 2
Summary of Data Qualification

Inorganic Data Qualification Summary			
SDGs: GEL432978, SL2666	Reviewer: AQA	Project: 618-10 618-11	Page 1 of 1
Analyte(s)	Qualifier	Samples Affected	Reason
U	None	NA	NA

Comments: None

Appendix 3

Data Validation Supporting Documentation

Data Validation for Chemical Analyses

Published Date: 10/03/16

SGRP-GD-SMP-50117

Effective Date: 10/03/16

Appendix A - (Cont.) Chemical Data Validation Checklist

VALIDATION LEVEL:	A	B	<input checked="" type="radio"/> C	D	E
PROJECT: 618-10_618-11			DATA PACKAGE: VSR18-005		
VALIDATOR: Eyda Hergenreder		LAB: GEL, TestAmerica		DATE: 12/20/2017	
			SDG: GEL432978, SL2666		
ANALYSES PERFORMED					
SW-846/ICP	SW-846/GFAA	SW-846/Hg	SW-846 Cyanide	SW-846/ICP-MS X	
SAMPLES/MATRIX Soil					
GEL432978: B3DCF2					
SL2666: B3DCC8, B3DCD0, B3DCD2, B3DCD4, B3DCD6, B3DCD8, B3DCF0					

1. DATA PACKAGE COMPLETENESS AND CASE NARRATIVE

Technical verification documentation present?	Yes <input type="radio"/> No <input checked="" type="radio"/> N/A
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Comments:

Data Validation for Chemical Analyses

Published Date: 10/03/16

SGRP-GD-SMP-50117

Effective Date: 10/03/16

Appendix A - (Cont.) Chemical Data Validation Checklist

2. INSTRUMENT PERFORMANCE AND CALIBRATIONS (Levels D and E)

Initial calibrations performed on all instruments?	Yes No <input checked="" type="radio"/> N/A
Initial calibrations acceptable?	Yes No <input checked="" type="radio"/> N/A
ICP interference checks acceptable?	Yes No <input checked="" type="radio"/> N/A
ICV and CCV checks performed on all instruments?	Yes No <input checked="" type="radio"/> N/A
ICV and CCV checks acceptable?	Yes No <input checked="" type="radio"/> N/A
Standards traceable?	Yes No <input checked="" type="radio"/> N/A
Standards expired?	Yes No <input checked="" type="radio"/> N/A
Calculation check acceptable?	Yes No <input checked="" type="radio"/> N/A

Comments:

3. BLANKS (Levels B, C, D, and E)

ICB and CCB checks performed for all applicable analyses? (Levels D, E)	Yes No <input checked="" type="radio"/> N/A
ICB and CCB results acceptable? (Levels D, E)	Yes No <input checked="" type="radio"/> N/A
Laboratory blanks analyzed?	<input checked="" type="radio"/> Yes No N/A
Laboratory blank results acceptable?	<input checked="" type="radio"/> Yes No N/A
Field blanks analyzed? (Levels C, D, E)	Yes <input checked="" type="radio"/> No N/A
Field blank results acceptable? (Levels C, D, E)	Yes No <input checked="" type="radio"/> N/A
Transcription/calculation errors? (Levels D, E)	Yes No <input checked="" type="radio"/> N/A

Comments:

Data Validation for Chemical Analyses

Published Date: 10/03/16

SGRP-GD-SMP-50117

Effective Date: 10/03/16

Appendix A - (Cont.) Chemical Data Validation Checklist

4. ACCURACY (Levels C, D, and E)

MS/MSD samples analyzed?	<input checked="" type="radio"/> Yes No N/A
MS/MSD results acceptable?	<input checked="" type="radio"/> Yes No N/A
MS/MSD standards NIST traceable? (Levels D, E)	Yes No <input type="radio"/> N/A
MS/MSD standards expired? (Levels D, E)	Yes No <input type="radio"/> N/A
LCS/BSS samples analyzed?	<input checked="" type="radio"/> Yes No N/A
LCS/BSS results acceptable?	<input checked="" type="radio"/> Yes No N/A
Standards traceable? (Levels D, E)	Yes No <input type="radio"/> N/A
Standards expired? (Levels D, E)	Yes No <input type="radio"/> N/A
Transcription/calculation errors? (Levels D, E)	Yes No <input type="radio"/> N/A
Performance audit sample(s) analyzed?	Yes No <input type="radio"/> N/A
Performance audit sample results acceptable?	Yes No <input type="radio"/> N/A

Comments:

Data Validation for Chemical Analyses

Published Date: 10/03/16

SGRP-GD-SMP-50117

Effective Date: 10/03/16

Appendix A - (Cont.) Chemical Data Validation Checklist

6. ICP QUALITY CONTROL (Levels D and E)

ICP serial dilution samples analyzed?	Yes No <input checked="" type="radio"/> N/A
ICP serial dilution %D values acceptable?	Yes No <input checked="" type="radio"/> N/A
ICP post digestion spike required?	Yes No <input checked="" type="radio"/> N/A
ICP post digestion spike values acceptable?	Yes No <input checked="" type="radio"/> N/A
Standards traceable?	Yes No <input checked="" type="radio"/> N/A
Standards expired?	Yes No <input checked="" type="radio"/> N/A
Transcription/calculation errors?	Yes No <input checked="" type="radio"/> N/A

Comments:

7. HOLDING TIMES (all levels)

Samples properly preserved?	<input checked="" type="radio"/> Yes No N/A
Sample holding times acceptable?	<input checked="" type="radio"/> Yes No N/A

Comments:

Appendix 4

Additional Documentation Requested By Client

QC Summary

Report Date: September 29, 2017

Page 1 of 2

CH2M Hill Plateau Remediation Company

MSIN R3-50 CHPRC

PO Box 1600

Richland, Washington

Contact: Mr. Scot Fitzgerald

Workorder: 432978

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time
Metals Analysis - ICPMS											
Batch	1701147										
QC1203876389	432951001	DUP									
Uranium		D	1230	*D	966	ug/kg	23.8	(0%-35%)	BAJ	09/29/17	11:20
QC1203876388	LCS										
Uranium	4800			D	4810	ug/kg	100	(80%-120%)		09/29/17	11:17
QC1203876387	MB										
Uranium				DU	12.8	ug/kg				09/29/17	11:15
QC1203876390	432951001	MS									
Uranium	4820	D	1230	D	5740	ug/kg	93.7	(75%-125%)		09/29/17	11:21
QC1203876391	432951001	SDILT									
Uranium		D	6.73	D	1.27	ug/L	5.28	(0%-10%)		09/29/17	11:24

Notes:

The Qualifiers in this report are defined as follows:

- * Duplicate analysis not within control limits
- + Correlation coefficient for Method of Standard Additions (MSA) is < 0.995
- B The analyte was detected at a value less than the contract required detection limit (RDL), but greater than or equal to the IDL/MDL (as appropriate).
- C Target analyte was detected in the sample and the associated blank. The associated blank concentration is >= EQL or is > 5% of the measured concentration and/or decision level for associated samples.
- D Results are reported from a diluted aliquot of sample.
- E Reported value is estimated due to interferences. See comment in narrative.
- M Duplicate precision not met.
- N Spike Sample recovery is outside control limits.
- S Reported value determined by the Method of Standard Additions (MSA)
- U Analyzed for but not detected above limiting criteria. Includes MDL, MDA, PQL, zero, counting error, and total analytical error.
- W Post-digestion spike recovery for GFAA out of control limit. Sample absorbency < 50% of spike absorbency.
- X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Y Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Page 20 of 42
QC Sample Results

Client: CH2M Hill Plateau Remediation Company
Project/Site: FRC17-09

TestAmerica Job ID: 160-24512-1
SDG: SL2666

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 160-327676/1-A
Matrix: Solid
Analysis Batch: 328372

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 327676

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Uranium	0.036	U D	0.089	0.036	mg/Kg		09/18/17 15:07	09/22/17 03:19	2

Lab Sample ID: LCS 160-327676/2-A
Matrix: Solid
Analysis Batch: 328372

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 327676

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	Limits
Uranium	92.8	90.06	D	mg/Kg		97	80 - 120

Lab Sample ID: 160-24512-1 MS
Matrix: Soil
Analysis Batch: 328372

Client Sample ID: B3DCC8
Prep Type: Total/NA
Prep Batch: 327676

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	Limits
Uranium	0.61	D	101	98.29	D	mg/Kg	☼	97	75 - 125

Lab Sample ID: 160-24512-1 MSD
Matrix: Soil
Analysis Batch: 328372

Client Sample ID: B3DCC8
Prep Type: Total/NA
Prep Batch: 327676

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	Limits	RPD	RPD Limit
Uranium	0.61	D	91.4	90.98	D	mg/Kg	☼	99	75 - 125	8	30

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-328332/1-A
Matrix: Solid
Analysis Batch: 329399

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 328332

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	0.0292	B	0.0311	0.0312	1.00	0.0248	pCi/g	09/21/17 15:00	09/27/17 19:05	1

Tracer	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	88.5		30 - 105	09/21/17 15:00	09/27/17 19:05	1

Lab Sample ID: LCS 160-328332/2-A
Matrix: Solid
Analysis Batch: 329400

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 328332

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	Limits
Thorium-230	24.5	25.25		2.47	1.00	0.0479	pCi/g	103	80 - 120

Tracer	LCS %Yield	LCS Qualifier	Limits
Thorium-229	88.9		30 - 105

TestAmerica St. Louis

Date: 20 December 2017
 To: CH2M Hill (technical representative)
 From: Analytical Quality Associates, Inc.
 Project: 618-10_618-11
 Subject: Radiochemical - Sample Data Groups (SDGs) GEL432978 and SL2666

INTRODUCTION

This memorandum presents the results of data validation for SDG GEL432978 prepared by GEL Laboratories LLC and SL2666 prepared by TestAmerica Laboratories Inc.. A list of samples validated along with the analytical methods is provided in the following table.

Sample ID	Sample Date	Media	Validation Level	Analytical Methods
B3DCF2	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCC8	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCD0	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCD2	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCD4	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCD6	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCD8	09/14/17	Soil	C	Iso-Th, Iso-U
B3DCF0	09/14/17	Soil	C	Iso-Th, Iso-U

Data validation was conducted in accordance with the CHPRC validation statement of work and the 300 Area Remedial Action Sampling and Analysis Plan, DOE/RL-2001-48, Rev. 4 (SAP). Appendices 1 through 4 provide the following information as indicated below:

- Appendix 1. Glossary of Data Reporting Qualifiers
- Appendix 2. Summary of Data Qualification
- Appendix 3. Data Validation Supporting Documentation
- Appendix 4. Additional Documentation Requested by Client

DATA QUALITY OBJECTIVES

- **Holding Times and Sample Preservation**

Holding times are calculated from Chain-of-Custody forms to determine the validity of the results. The maximum holding time for radiochemical analysis is 180 days. There are no specific preservation requirements for soil samples.

The samples were analyzed within the prescribed holding times.

- **Blanks**

The blank data results are reviewed to assess the extent of contamination introduced through sampling, sample preparation, and analysis.

Laboratory Blanks

All laboratory blank results were acceptable with the following exception.

For SDG SL2666, the Th-232 laboratory blank result was > the minimum detectable concentration (MDC). The Th-232 results for samples B3DCC8, B3DCD0, B3DCD4 and B3DCD8 were \geq the MDCs but < 20X the blank result and should be qualified as estimates and flagged "J."

Trip Blanks

No trip blanks were submitted for validation.

Field Blanks

No field blanks were submitted for validation.

Equipment Blanks

No equipment blanks were submitted for validation.

• Accuracy

Accuracy is evaluated by reviewing matrix spike sample results, laboratory control sample results and chemical recovery factors. Chemical recovery factors are determined through use of a carrier or tracer and provide assessment of the chemical separation process that is affected by the laboratory procedure, sample matrix, and/or interference. Chemical recovery factors are used to correct sample concentration, uncertainty, and MDC results. According to the SAP, the laboratory control sample accuracy limits are 70% to 130%. The limits for reported analytes not listed in the SAP are specified by the DV procedure.

Matrix Spike (MS) Samples

MS analyses are not required for alpha spectrometry.

Laboratory Control Samples (LCSs)

All LCS recoveries were acceptable.

Carrier/Tracer Recovery Factors

All carrier/tracer recovery factors were acceptable.

- **Precision**

Precision is evaluated by reviewing laboratory duplicate, field duplicate and field split sample results. These QC results provide information on the laboratory reproducibility and whether sampling activities are adequate to acquire consistent sample results. According to the SAP, the relative percent difference (RPD) limits are $\pm 30\%$. The RPD limits for reported analytes not listed in the SAP are specified by the DV procedure. When duplicate RPDs exceed the limits and have associated results $< 5X$ the MDCs, the precision limits are ones specified by the DV procedure.

Laboratory Duplicate Samples

All laboratory duplicate results were acceptable.

Field Duplicate Samples

No field duplicates were submitted for validation.

Field Split Samples

No field splits were submitted for validation.

- **Detection Limits**

Reported MDCs are compared against the contractually required detection limits (CRDLs) to ensure that laboratory detection limits meet the required criteria.

All reported sample MDCs were below the CRDLs.

- **Completeness**

SDGs GEL432978 and SL2666 were submitted for validation and verified for completeness. Completeness is based on the percentage of data determined to be valid (i.e., not rejected). The completion percentage was 100%.

MAJOR DEFICIENCIES

None found.

MINOR DEFICIENCIES

Minor deficiency leading to qualification of Th-232 sample results as estimates was due to blank contamination. See the table in Appendix 2 for a listing of all affected sample results.

REFERENCES

GRP-GD-002, Rev. 2, Change 0, *Data Validation for Radiochemical Analyses*, September 2016.

DOE/RL-2001-48, Rev. 4, *300 Area Remedial Action Sampling and Analysis Plan*, November 2014.

Appendix 1

Glossary of Data Reporting Qualifiers

Qualifiers that may be applied by data validators in compliance with the CHPRC statement of work are as follows:

- **U** — The constituent was analyzed for and was not detected. The data should be considered usable for decision-making purposes.
- **UJ** — The constituent was analyzed for and was not detected. Due to a quality control deficiency identified during data validation the value reported may not accurately reflect the MDC. The data should be considered usable for decision-making purposes.
- **J** — Indicates the constituent was analyzed for and detected. The associated value is estimated due to a quality control deficiency identified during data validation. The data should be considered usable for decision-making purposes.
- **J+** — Indicates the constituent was analyzed for and detected. The associated value is estimated with a suspected positive bias due to a quality control deficiency identified during data validation. The data should be considered usable for decision-making purposes.
- **J-** — Indicates the constituent was analyzed for and detected. The associated value is estimated with a suspected negative bias due to a quality control deficiency identified during data validation. The data should be considered usable for decision-making purposes.
- **UR** — Indicates the constituent was analyzed for and not detected; however, due to an identified quality control deficiency the data should be considered unusable for decision-making purposes.
- **R** — Indicates the constituent was analyzed for and detected; however, due to an identified quality control deficiency the data should be considered unusable for decision-making purposes.

Appendix 2
Summary of Data Qualification

Radiochemical Data Qualification Summary			
SDGs: GEL432978, SL2666	Reviewer: AQA	Project: 618-10 618-11	Page 1 of 1
Analyte(s)	Qualifier	Samples Affected	Reason
Th-232	J	B3DCC8, B3DCD0, B3DCD4, B3DCD8	Laboratory blank contamination

Comments: None

Appendix 3

Data Validation Supporting Documentation

Data Validation for Radiochemical Analyses

Published Date: 09/13/16

SGRP-GD-SMP-50116

Effective Date: 09/13/16

Appendix B - Radiochemical Data Validation Checklist

Validation Level:	A	B	C	D	E
Project: 618-10_618-11			Data Package: VSR18-005		
Validator: Eyda Hergenreder		Lab: GEL, TestAmerica		Date: 12/20/2017	
			SDG: GEL432978, SL2666		
Analyses Performed					
<input type="checkbox"/> Gross Alpha/Beta	<input type="checkbox"/> Strontium-90	<input type="checkbox"/> Technetium-99	<input checked="" type="checkbox"/> Alpha Spectroscopy	<input type="checkbox"/> Gamma Spectroscopy	<input type="checkbox"/> Tritium
<input type="checkbox"/> Total Uranium	<input type="checkbox"/> Radium-22				
Samples/Matrix Soil					
GEL432978: B3DCF2					
SL2666: B3DCC8, B3DCD0, B3DCD2, B3DCD4, B3DCD6, B3DCD8, B3DCF0					

1. Completeness and Case Narrative	<input type="checkbox"/> N/A
Technical verification forms present?	Yes <input checked="" type="radio"/> No <input type="radio"/> N/A

Comments:

2. Initial Calibration (Levels D, E)	<input checked="" type="checkbox"/> N/A
Instruments/detectors calibrated?	Yes No <input checked="" type="radio"/> N/A
Initial calibration acceptable?	Yes No <input checked="" type="radio"/> N/A
Standards NIST traceable?	Yes No <input checked="" type="radio"/> N/A
Standards expired?	Yes No <input checked="" type="radio"/> N/A
Calculation check acceptable?	Yes No <input checked="" type="radio"/> N/A

Comments:

Data Validation for Radiochemical Analyses

Published Date: 09/13/16

SGRP-GD-SMP-50116

Effective Date: 09/13/16

Appendix B - (Cont.) Radiochemical Data Validation Checklist

3. Continuing Calibration (Levels D, E)	<input checked="" type="checkbox"/> N/A
Calibration checked within required frequency?	Yes No <input type="radio"/> N/A
Calibration check acceptable?	Yes No <input type="radio"/> N/A
Calibration check standards traceable?	Yes No <input type="radio"/> N/A
Calibration check standards expired?	Yes No <input type="radio"/> N/A
Calculation check acceptable?	Yes No <input type="radio"/> N/A
Comments:	

4. Background Counts (Levels D, E)	<input checked="" type="checkbox"/> N/A
Background counts checked within required frequency?	Yes No <input type="radio"/> N/A
Background counts acceptable?	Yes No <input type="radio"/> N/A
Calculation check acceptable?	Yes No <input type="radio"/> N/A
Comments:	

Data Validation for Radiochemical Analyses

Published Date: 09/13/16

SGRP-GD-SMP-50116

Effective Date: 09/13/16

Appendix B - (Cont.) Radiochemical Data Validation Checklist

5. Blanks (Levels B, C, D, E)	<input type="checkbox"/> N/A
Method blank analyzed within required frequency?	(Yes) No N/A
Method blank results acceptable?	Yes (No) N/A
Analytes detected in method blank?	(Yes) No N/A
Field blank(s) analyzed?	Yes (No) N/A
Field blank results acceptable?	Yes No (N/A)
Analytes detected in field blank(s)?	Yes No (N/A)
Transcription/Calculation Errors? (Levels D, E)	Yes No (N/A)

Comments:

SDG SL2666: Th-232 MB 0.0292 pCi/g

6. Laboratory Control Samples or Blank Spike Samples (Levels C, D, E)	<input type="checkbox"/> N/A
LCS /BSS analyzed within required frequency?	(Yes) No N/A
LCS/BSS recoveries acceptable?	(Yes) No N/A
LCS/BSS traceable? (Levels D,E)	Yes No (N/A)
LCS/BSS expired? (Levels D,E)	Yes No (N/A)
LCS/BSS levels correct? (Levels D,E)	Yes No (N/A)
Transcription/Calculation errors? (Levels D, E)	Yes No (N/A)

Comments:

Data Validation for Radiochemical Analyses

Published Date: 09/13/16

SGRP-GD-SMP-50116

Effective Date: 09/13/16

Appendix B - (Cont.) Radiochemical Data Validation Checklist

7. Chemical Carrier Recovery (Levels C, D, E)	<input checked="" type="checkbox"/> N/A
Chemical carrier added?	Yes No <input type="radio"/> N/A
Chemical recovery acceptable?	Yes No <input type="radio"/> N/A
Chemical carrier traceable? (Levels D, E)	Yes No <input type="radio"/> N/A
Chemical carrier expired? (Levels D, E)	Yes No <input type="radio"/> N/A
Transcription/Calculation errors? (Levels D, E)	Yes No <input type="radio"/> N/A

Comments:

8. Tracer Recovery (Levels C, D, E)	<input type="checkbox"/> N/A
Tracer added?	<input checked="" type="radio"/> Yes No <input type="radio"/> N/A
Tracer recovery acceptable?	<input checked="" type="radio"/> Yes No <input type="radio"/> N/A
Tracer traceable? (Levels D, E)	Yes No <input type="radio"/> N/A
Tracer expired? (Levels D, E)	Yes No <input type="radio"/> N/A
Transcription/Calculation errors? (Levels D, E)	Yes No <input type="radio"/> N/A

Comments:

Data Validation for Radiochemical Analyses

Published Date: 09/13/16

SGRP-GD-SMP-50116

Effective Date: 09/13/16

Appendix B - (Cont.) Radiochemical Data Validation Checklist

9. Matrix Spikes (Levels C, D, E)	<input checked="" type="checkbox"/> N/A
Matrix spike analyzed?	Yes No <input type="radio"/> N/A
Spike recoveries acceptable?	Yes No <input type="radio"/> N/A
Spike source traceable? (Levels D, E)	Yes No <input type="radio"/> N/A
Spike source expired? (Levels D, E)	Yes No <input type="radio"/> N/A
Transcription/Calculation errors? (Levels D, E)	Yes No <input type="radio"/> N/A

Comments:

10. Duplicates (Levels C, D, E)	<input type="checkbox"/> N/A
Duplicates analyzed at required frequency?	<input type="radio"/> Yes No <input type="radio"/> N/A
RPD values acceptable?	<input type="radio"/> Yes No <input type="radio"/> N/A
Transcription/Calculation errors? (Levels D, E)	Yes No <input type="radio"/> N/A

Comments:

SDG SL2666: RPDs not reported, RER provided

Data Validation for Radiochemical Analyses

Published Date: 09/13/16

SGRP-GD-SMP-50116

Effective Date: 09/13/16

Appendix B - (Cont.) Radiochemical Data Validation Checklist

11. Field QC Samples (Levels C, D, E)	<input type="checkbox"/> N/A
Field duplicate sample(s) analyzed?	Yes <input checked="" type="radio"/> No N/A
Field duplicate RPD values acceptable?	Yes No <input checked="" type="radio"/> N/A
Field split sample(s) analyzed?	Yes <input checked="" type="radio"/> No N/A
Field split RPD values acceptable?	Yes No <input checked="" type="radio"/> N/A
Performance audit sample(s) analyzed?	Yes No <input checked="" type="radio"/> N/A
Performance audit sample results acceptable?	Yes No <input checked="" type="radio"/> N/A

Comments:

12. Holding Times (All levels)	<input type="checkbox"/> N/A
Are sample holding times acceptable?	<input checked="" type="radio"/> Yes No N/A

Comments:

13. Results and MDCs (All Levels)	<input type="checkbox"/> N/A
Results reported for all required sample analyses?	<input checked="" type="radio"/> Yes No N/A
Results supported in raw data?(Levels D, E)	Yes No <input checked="" type="radio"/> N/A
Results acceptable? (Levels D, E)	Yes No <input checked="" type="radio"/> N/A
MDC's meet required reporting limits?	<input checked="" type="radio"/> Yes No N/A
Transcription/Calculation errors? (Levels D, E)	Yes No <input checked="" type="radio"/> N/A

Comments:

Appendix 4

Additional Documentation Requested By Client

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

QC Summary

Report Date: September 28, 2017
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Client : CH2MHill Plateau Remediation Company
MSIN R3-50 CHPRC
PO Box 1600
Richland, Washington 99352

Contact: Mr. Scot Fitzgerald

Workorder: 432978

Parmname	NOM	Sample	Qual	QC	Units	QC Criteria	Range	Analyst	Date Time
Rad Alpha Spec									
Batch	1701588								
QC1203877562	MB								
Thorium-232			U	0.055	pCi/g			JXR5	09/26/1710:12
				Uncert: +/-0.232					
				TPU: +/-0.232					
**Thorium-229 Tracer	17.5			13.0	pCi/g	REC: 74	(30%-105%)		
				Uncert: +/-2.36					
				TPU: +/-3.68					
QC1203877563	432978001	DUP							
Thorium-232		0.634		1.11	pCi/g				09/26/1710:12
				Uncert: +/-0.530		RPD: 55	(0% - 100%)		
				TPU: +/-0.541		RER: 1.12	(0-2)		
**Thorium-229 Tracer	19.2	11.6		15.6	pCi/g	REC: 81	(30%-105%)		
				Uncert: +/-2.55					
				TPU: +/-3.93					
QC1203877564	LCS								
Thorium-232		16.8		16.7	pCi/g	REC: 99	(80%-120%)		09/26/1710:12
				Uncert: +/-2.10					
				TPU: +/-3.29					
**Thorium-229 Tracer	17.5			15.5	pCi/g	REC: 89	(30%-105%)		
				Uncert: +/-2.16					
				TPU: +/-3.43					
Batch	1701589								
QC1203877574	MB								
Uranium-233/234			U	0.354	pCi/g			JXR5	09/25/1711:15
				Uncert: +/-0.337					
				TPU: +/-0.340					
Uranium-235/236			U	0.378	pCi/g				
				Uncert: +/-0.385					
				TPU: +/-0.388					
Uranium-238			U	0.0488	pCi/g				
				Uncert: +/-0.183					
				TPU: +/-0.183					
**Uranium-232 Tracer	19.4			18.0	pCi/g	REC: 93	(30%-105%)		
				Uncert: +/-2.20					
				TPU: +/-3.43					
QC1203877575	432978001	DUP							
Uranium-233/234		0.907		1.15	pCi/g				
				Uncert: +/-0.507		RPD: 24	(0% - 100%)		
				TPU: +/-0.521		RER: 0.562	(0-2)		
Uranium-235/236		U 0.131	U	-0.0486	pCi/g				
				Uncert: +/-0.257		RPD: 0	N/A		
				TPU: +/-0.258		RER: 1.05	(0-2)		
Uranium-238		0.784		0.596	pCi/g				
				Uncert: +/-0.461		RPD: 27	(0% - 100%)		
				TPU: +/-0.473		RER: 0.538	(0-2)		

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

QC Summary

Workorder: 432978

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Parmname	NOM	Sample	Qual	QC	Units	QC Criteria	Range	Analyst	Date	Time
Rad Alpha Spec										
Batch	1701589									
**Uranium-232 Tracer	20.4	19.0		17.1	pCi/g	REC: 84	(30%-105%)			
	Uncert:	+/-2.14		+/-2.56						
	TPU:	+/-3.36		+/-3.93						
QC1203877576 LCS										
Uranium-233/234				26.3	pCi/g					
	Uncert:			+/-2.74						
	TPU:			+/-4.65						
Uranium-235/236				2.24	pCi/g					
	Uncert:			+/-0.934						
	TPU:			+/-0.988						
Uranium-238	25.0			27.6	pCi/g	REC: 110	(80%-120%)			
	Uncert:			+/-2.80						
	TPU:			+/-4.84						
**Uranium-232 Tracer	19.4			16.9	pCi/g	REC: 87	(30%-105%)			
	Uncert:			+/-2.37						
	TPU:			+/-3.65						

Notes:

TPU and Counting Uncertainty are calculated at the 95% confidence level (1.96-sigma).

The Qualifiers in this report are defined as follows:

- * Duplicate analysis not within control limits
- + Correlation coefficient for Method of Standard Additions (MSA) is < 0.995
- B The analyte was detected at a value less than the contract required detection limit (RDL), but greater than or equal to the IDL/MDL (as appropriate).
- B The associated QC sample blank has a result >= 2X the MDA and, after corrections, result is >= MDA for this sample
- C Target analyte was detected in the sample and the associated blank. The associated blank concentration is >= EQL or is > 5% of the measured concentration and/or decision level for associated samples.
- D Results are reported from a diluted aliquot of sample.
- E Reported value is estimated due to interferences. See comment in narrative.
- M Duplicate precision not met.
- N Spike Sample recovery is outside control limits.
- S Reported value determined by the Method of Standard Additions (MSA)
- U Analyzed for but not detected above limiting criteria. Includes MDL, MDA, PQL, zero, counting error, and total analytical error.
- UX Gamma Spectroscopy--Uncertain identification
- W Post-digestion spike recovery for GFAA out of control limit. Sample absorbency < 50% of spike absorbency.
- X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Y Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Z Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

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QC Sample Results

Client: CH2M Hill Plateau Remediation Company
 Project/Site: FRC17-09

TestAmerica Job ID: 160-24512-1
 SDG: SL2666

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 160-327676/1-A
 Matrix: Solid
 Analysis Batch: 328372

Client Sample ID: Method Blank
 Prep Type: Total/NA
 Prep Batch: 327676

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Uranium	0.036	U D	0.089	0.036	mg/Kg		09/18/17 15:07	09/22/17 03:19	2

Lab Sample ID: LCS 160-327676/2-A
 Matrix: Solid
 Analysis Batch: 328372

Client Sample ID: Lab Control Sample
 Prep Type: Total/NA
 Prep Batch: 327676

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	Limits
Uranium	92.8	90.06	D	mg/Kg		97	80 - 120

Lab Sample ID: 160-24512-1 MS
 Matrix: Soil
 Analysis Batch: 328372

Client Sample ID: B3DCC8
 Prep Type: Total/NA
 Prep Batch: 327676

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	Limits
Uranium	0.61	D	101	98.29	D	mg/Kg	☼	97	75 - 125

Lab Sample ID: 160-24512-1 MSD
 Matrix: Soil
 Analysis Batch: 328372

Client Sample ID: B3DCC8
 Prep Type: Total/NA
 Prep Batch: 327676

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	Limits	RPD	RPD Limit
Uranium	0.61	D	91.4	90.98	D	mg/Kg	☼	99	75 - 125	8	30

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-328332/1-A
 Matrix: Solid
 Analysis Batch: 329399

Client Sample ID: Method Blank
 Prep Type: Total/NA
 Prep Batch: 328332

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	0.0292	B	0.0311	0.0312	1.00	0.0248	pCi/g	09/21/17 15:00	09/27/17 19:05	1

Tracer	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	88.5		30 - 105	09/21/17 15:00	09/27/17 19:05	1

Lab Sample ID: LCS 160-328332/2-A
 Matrix: Solid
 Analysis Batch: 329400

Client Sample ID: Lab Control Sample
 Prep Type: Total/NA
 Prep Batch: 328332

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	Limits
Thorium-230	24.5	25.25		2.47	1.00	0.0479	pCi/g	103	80 - 120

Tracer	LCS %Yield	LCS Qualifier	Limits
Thorium-229	88.9		30 - 105

TestAmerica St. Louis

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QC Sample Results

Client: CH2M Hill Plateau Remediation Company
Project/Site: FRC17-09

TestAmerica Job ID: 160-24512-1
SDG: SL2666

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry) (Continued)

Lab Sample ID: 160-24512-1 DU
Matrix: Soil
Analysis Batch: 329402

Client Sample ID: B3DCC8
Prep Type: Total/NA
Prep Batch: 328332

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Thorium-232	0.515	B	0.424		0.134	1.00	0.0296	pCi/g	0.33	1
Tracer	%Yield	DU Qualifier	Limits							
Thorium-229	79.7		30 - 105							

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Lab Sample ID: MB 160-328333/1-A
Matrix: Solid
Analysis Batch: 329627

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 328333

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.00600	U	0.0165	0.0165	1.00	0.0387	pCi/g	09/21/17 15:00	09/28/17 15:32	1
Uranium 235	0.00747	U	0.0205	0.0205	1.00	0.0482	pCi/g	09/21/17 15:00	09/28/17 15:32	1
Uranium-238	0.000	U	0.0179	0.0179	1.00	0.0533	pCi/g	09/21/17 15:00	09/28/17 15:32	1
Tracer	%Yield	MB Qualifier	Limits				Prepared		Analyzed	Dil Fac
Uranium-232	97.0		30 - 105				09/21/17 15:00		09/28/17 15:32	1

Lab Sample ID: LCS 160-328333/2-A
Matrix: Solid
Analysis Batch: 329380

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 328333

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Uranium-233/234	6.37	6.444		0.703	1.00	0.0378	pCi/g	101	80 - 120
Uranium-238	6.51	6.244		0.686	1.00	0.0377	pCi/g	96	80 - 120
Tracer	%Yield	LCS Qualifier	Limits						
Uranium-232	92.4		30 - 105						

Lab Sample ID: 160-24512-1 DU
Matrix: Soil
Analysis Batch: 329382

Client Sample ID: B3DCC8
Prep Type: Total/NA
Prep Batch: 328333

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Uranium-233/234	0.373		0.500		0.135	1.00	0.0398	pCi/g	0.50	1
Uranium 235	0.000	U	0.0102	U	0.0205	1.00	0.0307	pCi/g	0.40	1
Uranium-238	0.309		0.370		0.116	1.00	0.0548	pCi/g	0.28	1
Tracer	%Yield	DU Qualifier	Limits							
Uranium-232	102		30 - 105							

TestAmerica St. Louis

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Tracer/Carrier Summary

Client: CH2M Hill Plateau Remediation Company
 Project/Site: FRC17-09

TestAmerica Job ID: 160-24512-1
 SDG: SL2666

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Soil

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	Th-229 (30-105)	
160-24512-1	B3DCC8	91.7	
160-24512-1 DU	B3DCC8	79.7	
160-24512-2	B3DCD0	89.7	
160-24512-3	B3DCD2	96.7	
160-24512-4	B3DCD4	77.1	
160-24512-5	B3DCD6	81.4	
160-24512-6	B3DCD8	80.4	
160-24512-7	B3DCF0	82.0	
Tracer/Carrier Legend			
Th-229 = Thorium-229			

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Solid

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	Th-229 (30-105)	
LCS 160-328332/2-A	Lab Control Sample	88.9	
MB 160-328332/1-A	Method Blank	88.5	
Tracer/Carrier Legend			
Th-229 = Thorium-229			

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Matrix: Soil

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	U-232 (30-105)	
160-24512-1	B3DCC8	99.1	
160-24512-1 DU	B3DCC8	102	
160-24512-2	B3DCD0	88.5	
160-24512-3	B3DCD2	99.9	
160-24512-4	B3DCD4	85.0	
160-24512-5	B3DCD6	84.1	
160-24512-6	B3DCD8	99.2	
160-24512-7	B3DCF0	87.0	
Tracer/Carrier Legend			
U-232 = Uranium-232			

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Matrix: Solid

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	U-232 (30-105)	
LCS 160-328333/2-A	Lab Control Sample	92.4	
MB 160-328333/1-A	Method Blank	97.0	

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Tracer/Carrier Summary

Client: CH2M Hill Plateau Remediation Company
Project/Site: FRC17-09

TestAmerica Job ID: 160-24512-1
SDG: SL2666

Tracer/Carrier Legend

U-232 = Uranium-232

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