



Wednesday, October 09, 2019

Karen Waters-Husted  
CH2M HILL Plateau Remediation Company  
825 Jadwin Avenue  
Richland, WA 99352

Re: ALS Workorder: 1909215  
Project Name: Apatite Barrier, September 201  
Project Number: I19-029

Dear Ms. Waters-Husted:

Six water samples were received from CH2M HILL Plateau Remediation Company, on 9/12/2019. The samples were scheduled for the following analyses:

- Gross Alpha/Beta
- Inorganics
- Metals
- Strontium-90

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  
Katie M. O'Brien  
Project Manager

We certify that this data package is in compliance with the SOW, both technically and for completeness, including a full description of, explanation of, and corrective actions for, any and all deviations, from either the analyses requested or the case narrative requested. Release of the data contained in this hard copy data package has been authorized by the Laboratory Analytical Manager (or designee) and the laboratory's client services representative as verified by their signatures on this report.

# ALS -- Fort Collins

## Sample Number(s) Cross-Reference Table

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**OrderNum:** 1909215

**Client Name:** CH2M HILL Plateau Remediation Company

**Client Project Name:** Apatite Barrier, September 201

**Client Project Number:** I19-029

**Client PO Number:** BOA 54854

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Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
B3R566	1909215-1		WATER	10-Sep-19	12:09
B3R589	1909215-2		WATER	10-Sep-19	13:40
B3R5L2	1909215-3		WATER	10-Sep-19	10:47
B3R5L6	1909215-4		WATER	10-Sep-19	10:47
B3R541	1909215-5		WATER	10-Sep-19	10:07
B3R5B4	1909215-6		WATER	10-Sep-19	7:52



<b>CH2M Hill Plateau Remediation Company</b>		<b>CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST</b> <i>1909215</i>		C.O.C.# <b>I19-029-005</b> Page 1 of 1
Collector: <b>Larry Roscoe</b>	Contact/Requester: Karen Waters-Husted	Telephone No.: 509-376-4650	Purchase Order/Charge Code: 300071	
SAF No.: I19-029	Sampling Origin: Hanford Site	Logbook No.: HNF-N-506 <i>110/10</i>	Ice Chest No.: <i>6WS-012</i>	Bill of Lading/Air Bill No.: <i>770210058223</i>
Project Title: Apatite Barrier, September 201	Method of Shipment: Commercial Carrier	Priority: 30 Days	Offsite Property No.: <i>11570</i>	
Shipped To (Lab): ALS Environmental Ft. Collins	SPECIAL INSTRUCTIONS N/A	POSSIBLE SAMPLE HAZARDS/REMARK ** ** Contains Radioactive Material at concentrations that are not regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1		
Protocol: CERCLA	Sample Analysis 300.0_ANIONS_IC: COMMON	Holding Time 48 Hours	Preservative Cool <=6C	
Sample No. B3R589	Filter N	Date SEP 10 2019	Time 1340	No/Type Container 1x125-mL P

Relinquished By		Received By		Matrix *		
Print First and Last Name	Signature	Date/Time	Signature	Date/Time	S = Soil SE = Sediment SO = Solid SL = Sludge O = Oil A = Air	DS = Drum Solids DL = Drum Liquids T = Tissue WI = Wipe L = Liquid V = Vegetation X = Other
<b>Larry Roscoe</b>	<i>Larry Roscoe</i>	SEP 10 2019	SSU-1	SEP 10 2019		
Janelle Zunker CHPRC	<i>Janelle Zunker</i>	SEP 11 2019 0830	SSU-1 Janelle Zunker CHPRC	SEP 11 2019 0830		
FEDEX	<i>FEDEX</i>	SEP 11 2019 1400	FEDEX <i>Kelijean Smith</i>	SEP 11 2019 0850		
Disposal Method (e.g., Return to customer, per lab procedure, used in process):		Disposed By:		Date/Time:		

<b>CH2M Hill Plateau Remediation Company</b>		<b>CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST</b>		C.O.C.# <b>I19-029-007</b> Page 1 of 1
Collector: <b>Mike Esperza /CHPRC</b>		Contact/Requester: <b>Karen Waters-Husted</b>		Telephone No.: <b>509-376-4650</b>
SAF No.: <b>I19-029</b>		Sampling Origin: <b>Hanford Site</b>		Purchase Order/Charge Code: <b>300071</b>
Project Title: <b>Apatite Barrier, September 201</b>		Logbook No.: <b>HNF-N-506-109-36</b>		Ice Chest No.: <b>6WS-012</b>
Shipped To (Lab): <b>ALS Environmental Ft. Collins</b>		Method of Shipment: <b>Commercial Carrier</b>		Bill of Lading/Air Bill No.: <b>71021058223</b>
Protocol: <b>CERCLA</b>		Priority: <b>30 Days</b>		Offsite Property No.: <b>11570</b>
<b>POSSIBLE SAMPLE HAZARDS/REMARK</b>		<b>SPECIAL INSTRUCTIONS</b>		
** ** Contains Radioactive Material at concentrations that are not regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1		N/A		
<b>Sample No.</b>	<b>Filter</b>	<b>Date</b>	<b>Time</b>	<b>No/Type Container</b>
B3R5L2	N	SEP 10 2019	1047	1x500-mL G/P
B3R5L6	Y	SEP 10 2019	1047	1x500-mL G/P
		<b>Sample Analysis</b>		<b>Holding Time</b>
		6010_METALS_ICP: COMMON		6 Months
		6010_METALS_ICP: COMMON		6 Months
				<b>Preservative</b>
				HNO3 to pH <2
				HNO3 to pH <2

Relinquished By		Received By		Matrix *	
Print First and Last Name	Signature	Date/Time	Signature	Date/Time	Matrix *
Mike Esperza /CHPRC		SEP 10 2019 1440	Janelle Zunker /CHPRC	SEP 10 2019 1350	S = Soil SE = Sediment SO = Solid SL = Sludge W = Water O = Oil A = Air
Janelle Zunker /CHPRC		SEP 10 2019 1440	SSU-1	SEP 10 2019 1350	DS = Drum Solids DL = Drum Liquids T = Tissue WI = Wipe L = Liquid V = Vegetation X = Other
Janelle Zunker /CHPRC		SEP 10 2019 1440	FEDEX	SEP 10 2019 0850	
FEDEX			FEDEX	SEP 10 2019 0850	
Disposal Method (e.g., Return to customer, per lab procedure, used in process):		Disposed By:		Date/Time:	

# CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #  
**I19-029-024**  
Page 1 of 1

1909215

<b>Collector:</b> Larry Becerra ALS/CHRC	<b>Contact/Requester:</b> Karen Waters-Husted	<b>Telephone No.:</b> 509-376-4650
<b>SAF No.:</b> I19-029	<b>Sampling Origin:</b> Hanford Site	<b>Purchase Order/Charge Code:</b> 300071
<b>Project Title:</b> Apatite Barrier, September 201	<b>Logbook No.:</b> HNF-N-506 112/10	<b>Ice Chest No.:</b> GWS-612
<b>Shipped To (Lab):</b> ALS Environmental Ft. Collins	<b>Method of Shipment:</b> Commercial Carrier	<b>Bill of Lading/Air Bill No.:</b> 77021005823
<b>Protocol:</b> CERCLA	<b>Priority:</b> 30 Days	<b>Offsite Property No.:</b> 11570

**POSSIBLE SAMPLE HAZARDS/REMARK**  
 \*\* \*\* Contains Radioactive Material at concentrations that are not regulated for transportation per 49 CFR / IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1

**SPECIAL INSTRUCTIONS**  
N/A

Sample No.	Filter	* W	Date	Time	No/Type Container	Sample Analysis	Holding Time	Preservative
B3R541	N	W	SEP 10 2019	1007	1x1-L P	9310_ALPHABETA_GPC: COMMON	6 Months	HNO3 to pH <2

Relinquished By			Received By		
Print First and Last Name	Signature	Date/Time	Print First and Last Name	Signature	Date/Time
Larry Becerra ALS/CHRC		SEP 10 2019 1000	Janelle Zunker CHPRC		SEP 10 2019 1000
Janelle Zunker CHPRC		SEP 10 2019 1100	SSU-1		SEP 10 2019 1100
Janelle Zunker CHPRC		SEP 11 2019 0130	Janelle Zunker CHPRC		SEP 11 2019 0630
Janelle Zunker CHPRC		SEP 11 2019 1400	FEDEX		SEP 11 2019 0850

**Matrix \***  
 S = Soil DS = Drum Solids  
 SE = Sediment DL = Drum Liquids  
 SO = Solid T = Tissue  
 SL = Sludge WI = Wipe  
 W = Water L = Liquid  
 O = Oil V = Vegetation  
 A = Air X = Other

**FINAL SAMPLE DISPOSITION**

Disposal Method (e.g., Return to customer, per lab procedure, used in process):

Disposed By: \_\_\_\_\_ Date/Time: \_\_\_\_\_





ALS Environmental - Fort Collins  
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: CHPRC

Workorder No: 1009215

Project Manager: KNO

Initials: TEM Date: 9/13/19

1. Are airbills / shipping documents present and/or removable?		DROP OFF	<input checked="" type="radio"/> YES	NO			
2. Are custody seals on <b>shipping</b> containers intact?		NONE	<input checked="" type="radio"/> YES	NO *			
3. Are custody seals on <b>sample</b> containers intact?		NONE	<input checked="" type="radio"/> YES	NO *			
4. Is there a COC (chain-of-custody) present?			<input checked="" type="radio"/> YES	NO *			
5. Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)			<input checked="" type="radio"/> YES	NO *			
6. Are short-hold samples present?			YES	<input checked="" type="radio"/> NO			
7. Are all samples within holding times for the requested analyses?			<input checked="" type="radio"/> YES	NO *			
8. Were all sample containers received intact? (not broken or leaking)			<input checked="" type="radio"/> YES	NO *			
9. Is there sufficient sample for the requested analyses?			<input checked="" type="radio"/> YES	NO *			
10. Are all samples in the proper containers for the requested analyses?			<input checked="" type="radio"/> YES	NO *			
11. Are all aqueous samples preserved correctly, if required? (excluding volatiles)		N/A	<input checked="" type="radio"/> YES	NO *			
12. Are all aqueous non-preserved samples pH 4-9?		N/A	<input checked="" type="radio"/> YES	NO *			
13. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)		<input checked="" type="radio"/> N/A	YES	NO			
14. Were the samples shipped on ice?			<input checked="" type="radio"/> YES	NO			
15. Were cooler temperatures measured at 0.1-6.0°C?	IR gun used*:	#1	<input checked="" type="radio"/> #3	#4	RAD ONLY	<input checked="" type="radio"/> YES	NO
Cooler #:		<u>1</u>	<u>2</u>				
Temperature (°C):		<u>1.6</u>	<u>1.8</u>				
No. of custody seals on cooler:		<u>2</u>	<u>2</u>				
External µR/hr reading:		<u>14</u>	<u>13</u>				
Background µR/hr reading:		<u>13</u>					
Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? <input checked="" type="radio"/> YES / NO / NA (If no, see Form 008.)							

\* Please provide details here for NO responses to gray boxes above - for 2 thru 5 & 7 thru 12, notify PM & continue w/ login.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

All client bottle ID's vs ALS lab ID's double-checked by: TEM

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

Project Manager Signature / Date: [Signature] 9/13/19

1909215

UNIFORM ID: PSCA (309) 531-0450  
TROY BACON  
CH2M  
6267 LATAH ST.  
RICHLAND WA 99352  
UNITED STATES US

SHIP DATE: 11SEP19  
ACTWGT: 15.00 LB  
CAD: 107068057/MET4160  
BILL THIRD PARTY

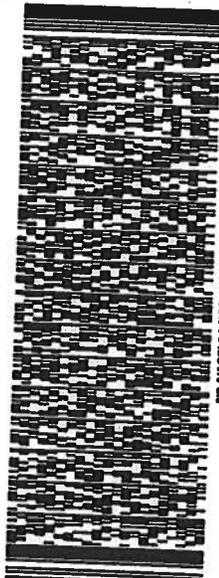
TO JULIE ELLINGSON  
ALS GLOBAL-FORT COLLINS  
225 COMMERCE DR

14-2

FORT COLLINS CO 80524  
NW: (970) 490-1511  
REF: PTR#11982  
DEPT:

1.5

567J19D04J05A2

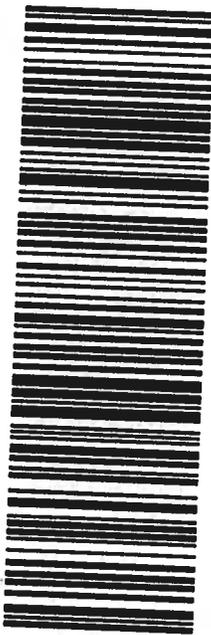


TRK# 7762 1670 5639  
0201

THU - 12 SEP 10:30A  
PRIORITY OVERNIGHT  
DSR

XH FTCA

80524  
CO-US DEN



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# Gross Alpha/Beta Case Narrative

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## CH2M HILL Plateau Remediation Company

Apatite Barrier, September 201 – I19-029

Work Order Number: 1909215

1. These samples were prepared according to the current revision of SOP 702.
2. The samples were analyzed for gross alpha and beta activity by gas flow proportional counting according to the current revision of SOP 724. The analyses were completed on 10/02/2019. Gross alpha results are referenced to  $^{241}\text{Am}$ . Gross beta results are referenced to  $^{90}\text{Sr/Y}$ .
3. The analysis results for these samples are reported in units of pCi/L. The samples were not filtered prior to analysis.
4. The duplicate of sample 1909172-17 and the matrix spikes of sample 1909172-8 are shared for this work order. The duplicate and matrix spikes were performed on CH2M HILL Plateau Remediation Company samples and the results are acceptable. The results can be found in the following report.
5. The radiometric recovery for the matrix spike of sample 1909172-8 is above the upper control limit of 130% at 131% for gross alpha. All other quality control criteria have been met. ALS does not control on matrix spike recovery. The result for this sample is considered an estimated value and is included in this data package.
6. In accordance with project specific instructions, the evaluation threshold for Relative Percent Difference (RPD) has been set at 20%. RPD is defined as:

$$\text{RPD} = \frac{|S - D|}{(S + D)/2} * 100$$

Where: S = sample activity result and D = duplicate activity result. RPD is not evaluated for sample/duplicate pairs where the reported activity is less than 5 times the sample specific MDC, as indicated with an "NC" on the Duplicate Sample Results (RPD) page.



7. Due to a high level of beta activity, and subsequent beta to alpha crosstalk, the requested MDC for gross alpha was not met for samples 1909215-1, -6 and shared QC samples 1909172-8, -17, and -17DUP. The results are flagged with an "X" qualifier on the final reports. The results are submitted without further qualification.
8. Due to a high level of beta activity in these samples, and subsequent beta to alpha crosstalk, the magnitude of the negative gross alpha activity for samples 1909215-1, -6 and shared QC samples 1909172-17 and -17DUP is greater than the 3 sigma TPU. The analyst's review of the data does not indicate a problem with the instrument data or the subsequent reporting systems. It is believed that the data quality is unaffected and the results are submitted without qualification.
9. No further anomalous situations were encountered during the preparation or analysis of these samples. All remaining quality control criteria were met.

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.

  
\_\_\_\_\_  
Pik Yee Yuen  
Radiochemistry Primary Data Reviewer

10/8/19  
Date

  
\_\_\_\_\_  
Radiochemistry Final Data Reviewer

10/9/19  
Date

**Gross Alpha/Beta by GFPC**

PAI 724 Rev 13

**Method Blank Results****Lab Name:** ALS -- Fort Collins**Work Order Number:** 1909215**Client Name:** CH2M HILL Plateau Remediation Company**ClientProject ID:** Apatite Barrier, September 201 I19-029**Lab ID:** AB190930-1MB**Sample Matrix:** WATER**Prep Batch:** AB190930-1**Final Aliquot:** 200 ml**Prep SOP:** PAI 702 Rev 22**QCBatchID:** AB190930-1-1**Result Units:** pCi/l**Date Collected:** 30-Sep-19**Run ID:** AB190930-1A**File Name:** ABC1002B**Date Prepared:** 30-Sep-19**Count Time:** 1000 minutes**Date Analyzed:** 02-Oct-19

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	2.46E-01 +/- 5.11E-01	8.54E-01	3.00E+00	NA	U
12587-47-2	GROSS BETA	4.42E-02 +/- 6.44E-01	1.07E+00	4.00E+00	NA	U

**Comments:****Qualifiers/Flags:**

U - 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.

**Abbreviations:**

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

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

DL - Decision Level

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Laboratory Control Sample(s)

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

**Lab ID:** AB190930-1LCS

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 30-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 30 minutes

**Final Aliquot:** 200 ml  
**Result Units:** pCi/l  
**File Name:** ABC1002A

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
12587-46-1	GROSS ALPHA	2.28E+02 +/- 4.25E+01	7.61E+00	2.320E+02	98.4	72 - 130	
12587-47-2	GROSS BETA	2.28E+02 +/- 3.92E+01	1.16E+01	2.310E+02	98.7	86 - 115	

### Comments:

**Qualifiers/Flags:**

- U - 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.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS Recovery within control limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Minimum Detectable Concentration

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

## PAI 724 Rev 13

### Matrix Spike Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-8MS

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 30 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 170 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002A

**Analysis ReqCode:** 9310\_ALPHABET

CASNO	Target Nuclide	Matrix Spike	Sample Results	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
12587-46-1	GROSS ALPHA	3.56E+02	4.56E-01	1.50E+01	2.720E+02	131	72 - 130	N
12587-47-2	GROSS BETA	9.85E+02	7.07E+02	1.46E+01	2.720E+02	102	86 - 115	

**Comments:**

**Qualifiers/Flags:**

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- N - Matrix Spike Recovery outside control limits
- P - Matrix Spike Recovery within control limits
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

**Abbreviations:**

MDC - Sample specific Minimum Detectable Concentration

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

## PAI 724 Rev 13

### Matrix Spike Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-8MSD

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 30 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 170 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002A

**Analysis ReqCode:** 9310\_ALPHABET

CASNO	Target Nuclide	Matrix Spike	Sample Results	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
12587-46-1	GROSS ALPHA	3.53E+02	4.56E-01	1.46E+01	2.720E+02	129	72 - 130	
12587-47-2	GROSS BETA	9.73E+02	7.07E+02	1.42E+01	2.720E+02	97.8	86 - 115	

**Comments:**

**Qualifiers/Flags:**

- U - Result is less than the sample specific MDC.
- Y1 - Chemical Yield in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- N - Matrix Spike Recovery outside control limits
- P - Matrix Spike Recovery within control limits
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

**Abbreviations:**

MDC - Sample specific Minimum Detectable Concentration

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Sample Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-8

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 210 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 170 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	4.56E-01 +/- 2.39E+00	4.46E+00	3E+00	NA	U,X
12587-47-2	GROSS BETA	7.07E+02 +/- 1.13E+02	2.91E+00	4E+00	NA	

### Comments:

**Qualifiers/Flags:**

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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit
- DL - Decision Level

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Duplicate Sample Results (DER)

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-8MSD

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QC Batch ID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 30 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 170 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002A

CASNO	Analyte	Sample				Duplicate				DER	DER Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
12587-46-1	GROSS ALPHA	3.56E+02 +/- 6.61E+01		1.50E+01	N	3.53E+02 +/- 6.56E+01		1.46E+01		0.0695	3
12587-47-2	GROSS BETA	9.85E+02 +/- 1.60E+02		1.46E+01		9.73E+02 +/- 1.58E+02		1.42E+01		0.109	3

### Comments:

**Duplicate Qualifiers/Flags:**

- U - 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.
- D - DER is greater than Control Limit of 3
- LT - Result is less than Request MDC, greater than sample specific MDC
- M - Requested MDC not met.
- 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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit
- NR - Not Reported

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Duplicate Sample Results (RPD)

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-8MSD

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 30 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 170 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002A

CASNO	Analyte	Sample				Duplicate				RPD	RPD Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
12587-46-1	GROSS ALPHA	3.56E+02 +/-	6.61E+01	1.50E+01	N	3.53E+02 +/-	6.56E+01	1.46E+01		1.00	20
12587-47-2	GROSS BETA	9.85E+02 +/-	1.60E+02	1.46E+01		9.73E+02 +/-	1.58E+02	1.42E+01		1.00	20

### Comments:

**Qualifiers/Flags:**

- + - Duplicate RPD not within limits.
- U - 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.
- M - Requested MDC not met.
- 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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- BDL - Below Detection Limit
- NR - Not Reported

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Duplicate Sample Results (DER)

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-17DUP

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QC Batch ID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 210 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 200 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002

CASNO	Analyte	Sample				Duplicate				DER	DER Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
12587-46-1	GROSS ALPHA	-6.88E+00 +/- 4.45E+00		7.93E+00	U,X	-1.48E+01 +/- 4.55E+00		7.85E+00	U,X	2.49	3
12587-47-2	GROSS BETA	4.32E+03 +/- 6.89E+02		2.67E+00		4.20E+03 +/- 6.70E+02		2.65E+00		0.251	3

### Comments:

**Duplicate Qualifiers/Flags:**

- U - 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.
- D - DER is greater than Control Limit of 3
- LT - Result is less than Request MDC, greater than sample specific MDC
- M - Requested MDC not met.
- 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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit
- NR - Not Reported

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Duplicate Sample Results (RPD)

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Field ID:	Shared QC
Lab ID:	1909172-17DUP

Sample Matrix: WATER  
 Prep SOP: PAI 702 Rev 22  
 Date Collected: 09-Sep-19  
 Date Prepared: 30-Sep-19  
 Date Analyzed: 02-Oct-19

Prep Batch: AB190930-1  
 QCBatchID: AB190930-1-1  
 Run ID: AB190930-1A  
 Count Time: 210 minutes  
 Report Basis: Unfiltered

Final Aliquot: 200 ml  
 Prep Basis: Unfiltered  
 Moisture(%): NA  
 Result Units: pCi/l  
 File Name: ABC1002

CASNO	Analyte	Sample				Duplicate				RPD	RPD Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
12587-46-1	GROSS ALPHA	-6.88E+00 +/-	4.45E+00	7.93E+00	U,X	-1.48E+01 +/-	4.55E+00	7.85E+00	U,X	NC	20
12587-47-2	GROSS BETA	4.32E+03 +/-	6.89E+02	2.67E+00		4.20E+03 +/-	6.70E+02	2.65E+00		3.00	20

### Comments:

**Qualifiers/Flags:**

- + - Duplicate RPD not within limits.
- U - 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.
- M - Requested MDC not met.
- 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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- BDL - Below Detection Limit
- NR - Not Reported

Data Package ID: AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Sample Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-17

<b>Sample Matrix:</b> WATER	<b>Prep Batch:</b> AB190930-1	<b>Final Aliquot:</b> 200 ml
<b>Prep SOP:</b> PAI 702 Rev 22	<b>QCBatchID:</b> AB190930-1-1	<b>Prep Basis:</b> Unfiltered
<b>Date Collected:</b> 09-Sep-19	<b>Run ID:</b> AB190930-1A	<b>Moisture(%):</b> NA
<b>Date Prepared:</b> 30-Sep-19	<b>Count Time:</b> 210 minutes	<b>Result Units:</b> pCi/l
<b>Date Analyzed:</b> 02-Oct-19	<b>Report Basis:</b> Unfiltered	<b>File Name:</b> ABC1002

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	-6.88E+00 +/- 4.45E+00	7.93E+00	3E+00	NA	U,X
12587-47-2	GROSS BETA	4.32E+03 +/- 6.89E+02	2.67E+00	4E+00	NA	

### Comments:

**Qualifiers/Flags:**

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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit
- DL - Decision Level

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Sample Duplicate Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	Shared QC
<b>Lab ID:</b>	1909172-17DUP

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 09-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 210 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 200 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	-1.48E+01 +/- 4.55E+00	7.85E+00	3E+00	NA	U,X
12587-47-2	GROSS BETA	4.20E+03 +/- 6.70E+02	2.65E+00	4E+00	NA	

### Comments:

**Qualifiers/Flags:**

- U - 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.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
  
- D - DER is greater than Control Limit of 3

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit
- DL - Decision Level

**Data Package ID:** AB1909215-1

**Date Printed:**

Tuesday, October 08, 2019

ALS -- Fort Collins

Page 1 of 1

LIMS Version: 6.912

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Sample Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	B3R566
<b>Lab ID:</b>	1909215-1

**Sample Matrix:** WATER  
**Prep SOP:** PAI 702 Rev 22  
**Date Collected:** 10-Sep-19  
**Date Prepared:** 30-Sep-19  
**Date Analyzed:** 02-Oct-19

**Prep Batch:** AB190930-1  
**QCBatchID:** AB190930-1-1  
**Run ID:** AB190930-1A  
**Count Time:** 210 minutes  
**Report Basis:** Unfiltered

**Final Aliquot:** 200 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** ABC1002

**Analysis ReqCode:** 9310\_ALPHABET

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	-6.15E+00 +/- 3.08E+00	5.82E+00	3E+00	NA	U,X
12587-47-2	GROSS BETA	1.99E+03 +/- 3.18E+02	2.51E+00	4E+00	NA	

### Comments:

**Qualifiers/Flags:**

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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit
- DL - Decision Level

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Sample Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	B3R541
<b>Lab ID:</b>	1909215-5

<b>Sample Matrix:</b> WATER	<b>Prep Batch:</b> AB190930-1	<b>Final Aliquot:</b> 200 ml
<b>Prep SOP:</b> PAI 702 Rev 22	<b>QC Batch ID:</b> AB190930-1-1	<b>Prep Basis:</b> Unfiltered
<b>Date Collected:</b> 10-Sep-19	<b>Run ID:</b> AB190930-1A	<b>Moisture(%):</b> NA
<b>Date Prepared:</b> 30-Sep-19	<b>Count Time:</b> 210 minutes	<b>Result Units:</b> pCi/l
<b>Date Analyzed:</b> 02-Oct-19	<b>Report Basis:</b> Unfiltered	<b>File Name:</b> ABC1002

**Analysis ReqCode:** 9310\_ALPHABET

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	-1.06E-01 +/- 1.00E+00	2.35E+00	3E+00	NA	U
12587-47-2	GROSS BETA	4.27E+00 +/- 1.54E+00	2.62E+00	4E+00	NA	

### Comments:

**Qualifiers/Flags:**

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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit
- DL - Decision Level

**Data Package ID:** AB1909215-1

# Gross Alpha/Beta by GFPC

PAI 724 Rev 13

## Sample Results

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	B3R5B4
<b>Lab ID:</b>	1909215-6

<b>Sample Matrix:</b> WATER	<b>Prep Batch:</b> AB190930-1	<b>Final Aliquot:</b> 200 ml
<b>Prep SOP:</b> PAI 702 Rev 22	<b>QCBatchID:</b> AB190930-1-1	<b>Prep Basis:</b> Unfiltered
<b>Date Collected:</b> 10-Sep-19	<b>Run ID:</b> AB190930-1A	<b>Moisture(%):</b> NA
<b>Date Prepared:</b> 30-Sep-19	<b>Count Time:</b> 210 minutes	<b>Result Units:</b> pCi/l
<b>Date Analyzed:</b> 02-Oct-19	<b>Report Basis:</b> Unfiltered	<b>File Name:</b> ABC1002

**Analysis ReqCode:** 9310\_ALPHABET

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	-3.35E+00 +/- 1.61E+00	3.54E+00	3E+00	NA	U,X
12587-47-2	GROSS BETA	6.18E+02 +/- 9.90E+01	2.57E+00	4E+00	NA	

### Comments:

**Qualifiers/Flags:**

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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit
- DL - Decision Level

**Data Package ID:** AB1909215-1

**Prep Batch ID: AB190930-1**

Start Date: 09/30/19	End Date: 09/30/19	Concentration Method: NONE	Batch Created By: mig
Start Time: 8:34	End Time: 8:34	Extract Method: PAI 70222	Date Created: 09/30/19
Prep Analyst: Mikenna I. Gapinski		Initial Volume Units: ml	Time Created: 8:38
<b>Comments:</b>		Final Volume Units: ml	Validated By: mig
			Date Validated: 10/01/19
			Time Validated: 16:44

QC Batch ID: AB190930-1-1

Lab ID	QC Type	Field ID	Matrix	Date Collected	Initial Wt/Vol	Final Wt/Vol	Cleanup Method	Cleanup DF	Order Number
AB190930-1	MB	XXXXXX	WATER	XXXXXX	200	200	NONE	1	1909172
AB190930-1	LCS	XXXXXX	WATER	XXXXXX	200	200	NONE	1	1909172
1909172-8	MS	XXXXXX	WATER	XXXXXX	170	170	NONE	1	1909172
1909172-8	MSD	XXXXXX	WATER	XXXXXX	170	170	NONE	1	1909172
1909172-17	DUP	XXXXXX	WATER	XXXXXX	200	200	NONE	1	1909172
1909172-12	SMP	XXXXXX	WATER	XXXXXX	170	170	NONE	1	1909172
1909172-13	SMP	XXXXXX	WATER	XXXXXX	200	200	NONE	1	1909172
1909172-16	SMP	XXXXXX	WATER	XXXXXX	170	170	NONE	1	1909172
1909172-17	SMP	XXXXXX	WATER	XXXXXX	200	200	NONE	1	1909172
1909172-8	SMP	XXXXXX	WATER	XXXXXX	170	170	NONE	1	1909172
1909215-1	SMP	B3R566	WATER	9/10/2019	200	200	NONE	1	1909215
1909215-5	SMP	B3R541	WATER	9/10/2019	200	200	NONE	1	1909215
1909215-6	SMP	B3R5B4	WATER	9/10/2019	200	200	NONE	1	1909215

**QC Types**

CAR	Carrier reference sample	DLS	Detection Limit Standard
DUP	Laboratory Duplicate	LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicat	LODV	Limit of Detection Verification
LOQV	Limit of Quantitation Verification	MB	Method Blank
MS	Laboratory Matrix Spike	MSD	Laboratory Matrix Spike Duplicate
REP	Sample replicate	RVS	Reporting Level Verification Standar
SMP	Field Sample	SYS	Sample Yield Spike



# Inorganics

## Case Narrative

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### CH2M HILL Plateau Remediation Company

### Apatite Barrier, September 201 -- I19-029

Work Order Number: 1909215

1. The sample was prepared for analysis based on Environmental Monitoring Systems Laboratory (EMSL) Rev 2.1 procedures.
2. The sample was analyzed following EMSL procedures for the current revisions of the following SOPs and methods:

<u>Analyte</u>	<u>Method</u>	<u>SOP #</u>
Chloride	300.0 Revision 2.1	1113
Fluoride	300.0 Revision 2.1	1113
Nitrate as N	300.0 Revision 2.1	1113
Nitrite as N	300.0 Revision 2.1	1113
Sulfate	300.0 Revision 2.1	1113

3. All standards and solutions were used within their recommended shelf life.
4. The sample was prepared and analyzed within the established hold time for this analysis.

All in house quality control procedures were followed, as described below.

5. General quality control procedures.
  - A preparation (method) blank, laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) were prepared and analyzed with the sample in this preparation batch.
  - The method blank associated with this batch was below the reporting limit for the requested analytes. Sample results have been compared to the blank results and are flagged as appropriate.
  - All laboratory control sample criteria were met.



- All initial and continuing calibration blanks were below the reporting limit for the requested analytes.
  - All initial and continuing calibration verifications were within the acceptance criteria for the requested analytes.
6. Matrix specific quality control procedures.

Sample 1909215-2 was designated as the quality control sample for this analysis.

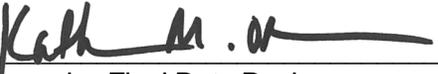
Similarity of matrix and therefore relevance of the QC results should not be automatically inferred for any sample other than the native sample selected for QC.

- A matrix spike (MS) was prepared and analyzed with this batch. All guidance criteria for precision and accuracy were met.
7. It is a standard practice that samples for CHPRC on the ion chromatograph are analyzed at a dilution. The 2X factor can be considered an artifact of the prep and does not indicate a secondary dilution and is therefore not flagged as a dilution.
8. Manual integrations are performed when needed to provide consistent and defensible data following the guidelines in the current revision of SOP 939.

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.

  
\_\_\_\_\_  
Melinda Greubel  
Inorganics Primary Data Reviewer

10/8/19  
Date

  
\_\_\_\_\_  
Kath M. O.  
Inorganics Final Data Reviewer

10/9/19  
Date



### Inorganic Data Reporting Qualifiers

The following qualifiers are used as needed by the laboratory when reporting results of inorganic analyses.

- Concentration qualifier -- A "B" is entered if the reported value was obtained from a reading that was less than the Reporting Limit but greater than or equal to ALS's Method Detection Limit. If the analyte was analyzed for but not detected a "U" is entered.
- QC qualifier -- Specified entries and their meanings are as follows:
  - 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.
  - C - The analyte was detected in both the sample and the associated QC blank, and the sample concentration was  $\leq 20X$  the blank concentration.
  - D - Analyte was reported at a secondary dilution factor, typically  $DF > 1$  (i.e., the primary preparation required dilution to either bring the analyte within the calibration range or to minimize interference). Required for organics/wetchem if the sample was diluted.

# Ion Chromatography

## Method EPA300.0 Revision 2.1

### Sample Results

**Lab Name:** ALS -- Fort Collins

**Work Order Number:** 1909215

**Client Name:** CH2M HILL Plateau Remediation Company

**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	B3R589
<b>Lab ID:</b>	1909215-2

**Sample Matrix:** WATER

**% Moisture:** N/A

**Date Collected:** 10-Sep-19

**Date Extracted:** 12-Sep-19

**Date Analyzed:** 12-Sep-19

**Prep Method:** NONE

**Prep Batch:** IC190912-1

**QCBatchID:** IC190912-1-1

**Run ID:** IC190912-1A3

**Cleanup:** NONE

**Basis:** As Received

**File Name:** 190912IC3LIMS

**Analyst:** Lainey M. Lloyd

**Sample Aliquot:** 5 ml

**Final Volume:** 5 ml

**Result Units:** MG/L

**Clean DF:** 1

CASNO	Target Analyte	Dilution Factor	Result	Result Qualifier	Reporting Limit	MDL
16984-48-8	FLUORIDE AnalysisTime: 12:54	2	0.06	U	0.2	0.06
16887-00-6	CHLORIDE AnalysisTime: 12:54	2	2.1		0.4	0.12
14797-65-0	NITRITE AS N AnalysisTime: 12:54	2	0.29		0.2	0.06
14797-55-8	NITRATE AS N AnalysisTime: 12:54	2	0.64		0.4	0.12
14808-79-8	SULFATE AnalysisTime: 12:54	2	9		2	0.6

**Data Package ID:** IC1909215-1

**Date Printed:** Tuesday, October 08, 2019

**ALS -- Fort Collins**

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LIMS Version: 6.912

# Ion Chromatography

## Method EPA300.0 Revision 2.1

### Method Blank

**Lab Name:** ALS -- Fort Collins

**Work Order Number:** 1909215

**Client Name:** CH2M HILL Plateau Remediation Company

**ClientProject ID:** Apatite Barrier, September 201 I19-029

**Lab ID:** IC190912-1MB

**Sample Matrix:** WATER

**% Moisture:** N/A

**Date Collected:** N/A

**Date Extracted:** 12-Sep-19

**Date Analyzed:** 12-Sep-19

**Prep Batch:** IC190912-1

**QCBatchID:** IC190912-1-1

**Run ID:** IC190912-1A3

**Cleanup:** NONE

**Basis:** N/A

**File Name:** 190912IC3LIMS

**Sample Aliquot:** 5 ml

**Final Volume:** 5 ml

**Result Units:** MG/L

**Clean DF:** 1

CASNO	Target Analyte	DF	Result	Result Qualifier	Reporting Limit	MDL
16984-48-8	FLUORIDE	1	0.03	U	0.1	0.03
16887-00-6	CHLORIDE	1	0.06	U	0.2	0.06
14797-65-0	NITRITE AS N	1	0.03	U	0.1	0.03
14797-55-8	NITRATE AS N	1	0.06	U	0.2	0.06
14808-79-8	SULFATE	1	0.3	U	1	0.3

**Data Package ID:** IC1909215-1

# Ion Chromatography

## Method EPA300.0 Revision 2.1

### Laboratory Control Sample and Laboratory Control Sample Duplicate

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Lab ID: IC190912-1LCS

Sample Matrix: WATER

% Moisture: N/A

Date Collected: N/A

Date Extracted: 09/12/2019

Date Analyzed: 09/12/2019

Prep Method: NONE

Prep Batch: IC190912-1

QCBatchID: IC190912-1-1

Run ID: IC190912-1A3

Cleanup: NONE

Basis: N/A

File Name: 190912IC3LIMS

Sample Aliquot: 5 ml

Final Volume: 5 ml

Result Units: MG/L

Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
16984-48-8	FLUORIDE	5	5	0.1		100	90 - 110%
16887-00-6	CHLORIDE	10	10.1	0.2		101	90 - 110%
14797-65-0	NITRITE AS N	5	4.94	0.1		99	90 - 110%
14797-55-8	NITRATE AS N	10	9.81	0.2		98	90 - 110%
14808-79-8	SULFATE	50	49.9	1		100	90 - 110%

Lab ID: IC190912-1LCSD

Sample Matrix: WATER

% Moisture: N/A

Date Collected: N/A

Date Extracted: 09/12/2019

Date Analyzed: 09/12/2019

Prep Method: NONE

Prep Batch: IC190912-1

QCBatchID: IC190912-1-1

Run ID: IC190912-1A3

Cleanup: NONE

Basis: N/A

File Name: 190912IC3LIMS

Sample Aliquot: 5 ml

Final Volume: 5 ml

Result Units: MG/L

Clean DF: 1

CASNO	Target Analyte	Spike Added	LCSD Result	Reporting Limit	Result Qualifier	LCSD % Rec.	RPD Limit	RPD
16984-48-8	FLUORIDE	5	4.97	0.1		99	15	1
16887-00-6	CHLORIDE	10	9.97	0.2		100	15	1
14797-65-0	NITRITE AS N	5	4.93	0.1		98	15	0
14797-55-8	NITRATE AS N	10	9.81	0.2		98	15	0
14808-79-8	SULFATE	50	49.8	1		100	15	0

Data Package ID: IC1909215-1

# Ion Chromatography

## Method EPA300.0 Revision 2.1

### Matrix Spike

**Lab Name:** ALS -- Fort Collins

**Work Order Number:** 1909215

**Client Name:** CH2M HILL Plateau Remediation Company

**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	B3R589
<b>LabID:</b>	1909215-2MS

**Sample Matrix:** WATER

**% Moisture:** N/A

**Date Collected:** 10-Sep-19

**Date Extracted:** 12-Sep-19

**Date Analyzed:** 12-Sep-19

**Prep Batch:** IC190912-1

**QCBatchID:** IC190912-1-1

**Run ID:** IC190912-1A3

**Cleanup:** NONE

**Basis:** As Received

**Sample Aliquot:** 5 ml

**Final Volume:** 5 ml

**Result Units:** MG/L

**File Name:** 190912IC3LIMS

CASNO	Target Analyte	Sample Result	Samp Qual	MS Result	MS Qual	Reporting Limit	Spike Added	MS % Rec.	Control Limits
16984-48-8	FLUORIDE	0.2	U	4.16		0.2	4	104	85 - 115%
16887-00-6	CHLORIDE	2.1		12.3		0.4	10	102	85 - 115%
14797-65-0	NITRITE AS N	0.29		4.37		0.2	4	102	85 - 115%
14797-55-8	NITRATE AS N	0.64		10.5		0.4	10	99	85 - 115%
14808-79-8	SULFATE	9		47.4		2	40	96	85 - 115%

**Data Package ID:** IC1909215-1

**Date Printed:** Tuesday, October 08, 2019

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**Prep Batch ID: IC190912-1**

<b>Start Date:</b> 09/12/19	<b>End Date:</b> 09/12/19	<b>Concentration Method:</b> NONE	<b>Batch Created By:</b> lml
<b>Start Time:</b> 8:00	<b>End Time:</b> 16:00	<b>Extract Method:</b> NONE	<b>Date Created:</b> 09/12/19
<b>Prep Analyst:</b> Lainey M. Lloyd		<b>Initial Volume Units:</b> ml	<b>Time Created:</b> 14:58
<b>Comments:</b>		<b>Final Volume Units:</b> ml	<b>Validated By:</b> lml
			<b>Date Validated:</b> 09/16/19
			<b>Time Validated:</b> 14:00

QC Batch ID: IC190912-1-1

Lab ID	QC Type	Field ID	Matrix	Date Collected	Initial Wt/Vol	Final Wt/Vol	Cleanup Method	Cleanup DF	Order Number
IC190912-1	MB	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909215
IC190912-1	LCS	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909215
IC190912-1	LCSD	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909215
1909215-2	MS	B3R589	WATER	9/10/2019	5	5	NONE	1	1909215
1909218-9	MS	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909218
1909213-5	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909213
1909214-1	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909214
1909214-3	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909214
1909214-4	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909214
1909214-5	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909214
1909215-2	SMP	B3R589	WATER	9/10/2019	5	5	NONE	1	1909215
1909218-5	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909218
1909218-9	SMP	XXXXXX	WATER	XXXXXX	5	5	NONE	1	1909218

**QC Types**

CAR	Carrier reference sample	DLS	Detection Limit Standard
DUP	Laboratory Duplicate	LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicat	LODV	Limit of Detection Verification
LOQV	Limit of Quantitation Verification	MB	Method Blank
MS	Laboratory Matrix Spike	MSD	Laboratory Matrix Spike Duplicate
REP	Sample replicate	RVS	Reporting Level Verification Standar
SMP	Field Sample	SYS	Sample Yield Spike



# Metals

## Case Narrative

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### **CH2M HILL Plateau Remediation Company**

Apatite Barrier, September 201 -- I19-029

Work Order Number: 1909215

1. The samples were prepared and analyzed based on SW-846, 3<sup>rd</sup> Edition procedures.

For analysis by Trace ICP, the samples were digested following method 3005A and the current revision of SOP 806.

2. Analysis by Trace ICP followed method 6010D and the current revision of SOP 834.
3. All standards and solutions are NIST traceable and were used within their recommended shelf life.
4. The samples were prepared and analyzed within the established hold time.

All in house quality control procedures were followed, as described below.

5. General quality control procedures.
  - A preparation (method) blank and laboratory control sample were digested and analyzed with the samples in this digestion batch.
  - The preparation (method) blank associated with this digestion batch was below the reporting limit for the requested analytes. Sample results have been compared to the blank results and are flagged as appropriate. Arsenic and sodium were detected above the MDL.
  - All laboratory control sample criteria were met.
  - All initial and continuing calibration blanks were below the reporting limit for the requested analytes.
  - All initial and continuing calibration verifications were within the acceptance criteria for the requested analytes.



- The interference check samples and high standard read-backs associated with Method 6010D were within acceptance criteria.

6. Matrix specific quality control procedures.

Sample 1909215-3 was designated as the quality control sample for this analysis.

Similarity of matrix and therefore relevance of the QC results should not be automatically inferred for any sample other than the native sample selected for QC.

- A matrix spike and matrix spike duplicate were digested and analyzed with this batch. All acceptance criteria for accuracy and precision were met.
- A serial dilution was analyzed with this ICP batch. All acceptance criteria were met.

7. Sample dilutions were not required for the requested analysis.

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.

  
\_\_\_\_\_  
Megan Johnstone  
Inorganics Primary Data Reviewer

10/7/19  
Date

  
\_\_\_\_\_  
Inorganics Final Data Reviewer

10/9/19  
Date



### Inorganic Data Reporting Qualifiers

The following qualifiers are used as needed by the laboratory when reporting results of inorganic analyses.

- Result qualifier -- A "B" is entered if the reported value was obtained from a reading that was less than the Reporting Limit but greater than or equal to the Method Detection Limit (MDL). If the analyte was analyzed for but not detected a "U" is entered. For samples, negative values are reported as non-detects ("U" flagged). For blanks, if the absolute value of the negative value is above the MDL and below the reporting limit, then the result is "B" flagged.
- QC qualifier -- Specified entries and their meanings are as follows:
  - 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.
  - C - The analyte was detected in both the sample and the associated QC blank, and the sample concentration was  $\leq 20X$  the blank concentration.
  - D - Analyte was reported at a secondary dilution factor, typically  $DF > 1$  (i.e., the primary preparation required dilution to either bring the analyte within the calibration range or to minimize interference). Required for organics/wetchem if the sample was diluted.

# Total Recoverable ICP Metals

## Method SW6010D

### Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Field ID: B3R5L2

Lab ID: 1909215-3

Sample Matrix: WATER

% Moisture: N/A

Date Collected: 10-Sep-19

Date Extracted: 19-Sep-19

Date Analyzed: 20-Sep-19

Prep Method: SW3005 Rev A

Prep Batch: IP190919-5

QC Batch ID: IP190919-5-4

Run ID: IT190920-2A8

Cleanup: NONE

Basis: As Received

File Name: 190920A.

Analyst: Steve Workman

Sample Aliquot: 50 ml

Final Volume: 50 ml

Result Units: UG/L

Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Result Qualifier	Reporting Limit	MDL
7440-36-0	ANTIMONY	1	0.75	U	20	0.75
7440-38-2	ARSENIC	1	0.46	U	10	0.46
7440-39-3	BARIUM	1	100		20	2.6
7440-43-9	CADMIUM	1	0.11	U	5	0.11
7440-70-2	CALCIUM	1	81000		1000	210
7440-47-3	CHROMIUM	1	7.6	B	10	2.4
7440-48-4	COBALT	1	2.1	B	10	0.19
7440-50-8	COPPER	1	4.8	B	8	0.51
7439-89-6	IRON	1	4300		50	30
7439-95-4	MAGNESIUM	1	14000		750	89
7439-96-5	MANGANESE	1	150		5	0.49
7440-02-0	NICKEL	1	3.3	B	20	1.1
7440-09-7	POTASSIUM	1	2800		1000	130
7440-22-4	SILVER	1	0.73	U	10	0.73
7440-23-5	SODIUM	1	6200		500	38
7440-62-2	VANADIUM	1	9.8	B	10	0.43
7440-66-6	ZINC	1	14	B	20	0.62

Data Package ID: IT1909215-1

Date Printed: Monday, October 07, 2019

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# Dissolved ICP Metals

## Method SW6010D

### Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Field ID: B3R5L6

Lab ID: 1909215-4

Sample Matrix: WATER

% Moisture: N/A

Date Collected: 10-Sep-19

Date Extracted: 19-Sep-19

Date Analyzed: 20-Sep-19

Prep Method: SW3005 Rev A

Prep Batch: IP190919-5

QCBatchID: IP190919-5-4

Run ID: IT190920-2A8

Cleanup: NONE

Basis: As Received

File Name: 190920A.

Analyst: Steve Workman

Sample Aliquot: 50 ml

Final Volume: 50 ml

Result Units: UG/L

Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Result Qualifier	Reporting Limit	MDL
7440-36-0	ANTIMONY	1	0.75	U	20	0.75
7440-38-2	ARSENIC	1	0.46	U	10	0.46
7440-39-3	BARIUM	1	68		20	2.6
7440-43-9	CADMIUM	1	0.11	U	5	0.11
7440-70-2	CALCIUM	1	79000		1000	210
7440-47-3	CHROMIUM	1	2.4	U	10	2.4
7440-48-4	COBALT	1	0.19	U	10	0.19
7440-50-8	COPPER	1	0.68	B	8	0.51
7439-89-6	IRON	1	30	B	50	30
7439-95-4	MAGNESIUM	1	13000		750	89
7439-96-5	MANGANESE	1	1.2	B	5	0.49
7440-02-0	NICKEL	1	1.1	U	20	1.1
7440-09-7	POTASSIUM	1	2400		1000	130
7440-22-4	SILVER	1	0.73	U	10	0.73
7440-23-5	SODIUM	1	5700		500	38
7440-62-2	VANADIUM	1	2	B	10	0.43
7440-66-6	ZINC	1	0.62	U	20	0.62

Data Package ID: IT1909215-1

Date Printed: Monday, October 07, 2019

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# ICP Metals

## Method SW6010D

### Method Blank

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Lab ID: IP190919-5MB

Sample Matrix: WATER

% Moisture: N/A

Date Collected: N/A

Date Extracted: 19-Sep-19

Date Analyzed: 20-Sep-19

Prep Batch: IP190919-5

QCBatchID: IP190919-5-4

Run ID: IT190920-2A8

Cleanup: NONE

Basis: N/A

File Name: 190920A.

Sample Aliquot: 50 ml

Final Volume: 50 ml

Result Units: UG/L

Clean DF: 1

CASNO	Target Analyte	DF	Result	Result Qualifier	Reporting Limit	MDL
7440-36-0	ANTIMONY	1	0.75	U	20	0.75
7440-38-2	ARSENIC	1	0.72	B	10	0.46
7440-39-3	BARIUM	1	2.6	U	20	2.6
7440-43-9	CADMIUM	1	0.11	U	5	0.11
7440-70-2	CALCIUM	1	210	U	1000	210
7440-47-3	CHROMIUM	1	2.4	U	10	2.4
7440-48-4	COBALT	1	0.19	U	10	0.19
7440-50-8	COPPER	1	0.51	U	8	0.51
7439-89-6	IRON	1	30	U	50	30
7439-95-4	MAGNESIUM	1	89	U	750	89
7439-96-5	MANGANESE	1	0.49	U	5	0.49
7440-02-0	NICKEL	1	1.1	U	20	1.1
7440-09-7	POTASSIUM	1	130	U	1000	130
7440-22-4	SILVER	1	0.73	U	10	0.73
7440-23-5	SODIUM	1	120	B	500	38
7440-62-2	VANADIUM	1	0.43	U	10	0.43
7440-66-6	ZINC	1	0.62	U	20	0.62

Data Package ID: IT1909215-1

Date Printed: Monday, October 07, 2019

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# ICP Metals

## Method SW6010D

### Laboratory Control Sample

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Lab ID: IP190919-5LCS

Sample Matrix: WATER

% Moisture: N/A

Date Collected: N/A

Date Extracted: 09/19/2019

Date Analyzed: 09/20/2019

Prep Method: SW3005A

Prep Batch: IP190919-5

QCBatchID: IP190919-5-4

Run ID: IT190920-2A8

Cleanup: NONE

Basis: N/A

File Name: 190920A.

Sample Aliquot: 50 ml

Final Volume: 50 ml

Result Units: UG/L

Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
7440-36-0	ANTIMONY	500	508	20		102	80 - 120%
7440-38-2	ARSENIC	1000	1000	10		100	80 - 120%
7440-39-3	BARIUM	1000	1020	20		102	80 - 120%
7440-43-9	CADMIUM	50	47.2	5		94	80 - 120%
7440-70-2	CALCIUM	40000	39200	1000		98	80 - 120%
7440-47-3	CHROMIUM	200	202	10		101	80 - 120%
7440-48-4	COBALT	500	515	10		103	80 - 120%
7440-50-8	COPPER	250	255	8		102	80 - 120%
7439-89-6	IRON	1000	958	50		96	80 - 120%
7439-95-4	MAGNESIUM	40000	41200	750		103	80 - 120%
7439-96-5	MANGANESE	500	507	5		101	80 - 120%
7440-02-0	NICKEL	500	493	20		99	80 - 120%
7440-09-7	POTASSIUM	40000	40500	1000		101	80 - 120%
7440-22-4	SILVER	100	100	10		100	80 - 120%
7440-23-5	SODIUM	40000	42800	500		107	80 - 120%
7440-62-2	VANADIUM	500	488	10		98	80 - 120%
7440-66-6	ZINC	500	482	20		96	80 - 120%

Data Package ID: *IT1909215-1*

Date Printed: Monday, October 07, 2019

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# ICP Metals

## Method SW6010D

### Matrix Spike And Matrix Spike Duplicate

**Lab Name:** ALS -- Fort Collins

**Work Order Number:** 1909215

**Client Name:** CH2M HILL Plateau Remediation Company

**ClientProject ID:** Apatite Barrier, September 201 I19-029

**Field ID:** B3R5L2

**LabID:** 1909215-3MS

**Sample Matrix:** WATER

**% Moisture:** N/A

**Date Collected:** 10-Sep-19

**Date Extracted:** 19-Sep-19

**Date Analyzed:** 20-Sep-19

**Prep Method:** SW3005 Rev A

**Prep Batch:** IP190919-5

**QC BatchID:** IP190919-5-4

**Run ID:** IT190920-2A8

**Cleanup:** NONE

**Basis:** As Received

**Sample Aliquot:** 50 ml

**Final Volume:** 50 ml

**Result Units:** UG/L

**File Name:** 190920A.

CASNO	Target Analyte	Sample Result	Samp Qual	MS Result	MS Qual	Reporting Limit	Spike Added	MS % Rec.	Control Limits
7440-36-0	ANTIMONY	0.75	U	497		20	500	99	80 - 120%
7440-38-2	ARSENIC	0.46	U	989		10	1000	99	80 - 120%
7440-39-3	BARIUM	100		1130		20	1000	103	80 - 120%
7440-43-9	CADMIUM	0.11	U	46.7		5	50	93	80 - 120%
7440-70-2	CALCIUM	81000		121000		1000	40000	100	80 - 120%
7440-47-3	CHROMIUM	7.6	B	209		10	200	101	80 - 120%
7440-48-4	COBALT	2.1	B	511		10	500	102	80 - 120%
7440-50-8	COPPER	4.8	B	264		8	250	104	80 - 120%
7439-89-6	IRON	4300		5270		50	1000	93	80 - 120%
7439-95-4	MAGNESIUM	14000		55600		750	40000	104	80 - 120%
7439-96-5	MANGANESE	150		653		5	500	101	80 - 120%
7440-02-0	NICKEL	3.3	B	474		20	500	94	80 - 120%
7440-09-7	POTASSIUM	2800		44300		1000	40000	104	80 - 120%
7440-22-4	SILVER	0.73	U	100		10	100	100	80 - 120%
7440-23-5	SODIUM	6200		48900		500	40000	107	80 - 120%
7440-62-2	VANADIUM	9.8	B	497		10	500	98	80 - 120%
7440-66-6	ZINC	14	B	488		20	500	95	80 - 120%

**Data Package ID:** IT1909215-1

# ICP Metals

## Method SW6010D

### Matrix Spike And Matrix Spike Duplicate

**Lab Name:** ALS -- Fort Collins

**Work Order Number:** 1909215

**Client Name:** CH2M HILL Plateau Remediation Company

**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b> B3R5L2
<b>LabID:</b> 1909215-3MSD

**Sample Matrix:** WATER

**% Moisture:** N/A

**Date Collected:** 10-Sep-19

**Date Extracted:** 19-Sep-19

**Date Analyzed:** 20-Sep-19

**Prep Method:** SW3005 Rev A

**Prep Batch:** IP190919-5

**QC BatchID:** IP190919-5-4

**Run ID:** IT190920-2A8

**Cleanup:** NONE

**Basis:** As Received

**Sample Aliquot:** 50 ml

**Final Volume:** 50 ml

**Result Units:** UG/L

**File Name:** 190920A.

CASNO	Target Analyte	MSD Result	MSD Qual	Spike Added	MSD % Rec.	Reporting Limit	RPD Limit	RPD
7440-36-0	ANTIMONY	497		500	99	20	20	0
7440-38-2	ARSENIC	982		1000	98	10	20	1
7440-39-3	BARIUM	1120		1000	102	20	20	1
7440-43-9	CADMIUM	46.2		50	92	5	20	1
7440-70-2	CALCIUM	120000		40000	99	1000	20	0
7440-47-3	CHROMIUM	208		200	100	10	20	1
7440-48-4	COBALT	509		500	101	10	20	0
7440-50-8	COPPER	261		250	102	8	20	1
7439-89-6	IRON	5190		1000	85	50	20	1
7439-95-4	MAGNESIUM	55400		40000	104	750	20	0
7439-96-5	MANGANESE	650		500	100	5	20	0
7440-02-0	NICKEL	475		500	94	20	20	0
7440-09-7	POTASSIUM	44000		40000	103	1000	20	1
7440-22-4	SILVER	102		100	102	10	20	2
7440-23-5	SODIUM	48500		40000	106	500	20	1
7440-62-2	VANADIUM	495		500	97	10	20	1
7440-66-6	ZINC	488		500	95	20	20	0

**Data Package ID:** IT1909215-1

**Prep Batch ID: IP190919-5**

<b>Start Date:</b> 09/19/19 <b>Start Time:</b> 15:07 <b>Prep Analyst:</b> Jill M. Latelle	<b>End Date:</b> 09/19/19 <b>End Time:</b> 18:00	<b>Concentration Method:</b> NONE <b>Extract Method:</b> SW3005A <b>Initial Volume Units:</b> ml <b>Final Volume Units:</b> ml	<b>Batch Created By:</b> jml <b>Date Created:</b> 09/19/19 <b>Time Created:</b> 15:09 <b>Validated By:</b> jml <b>Date Validated:</b> 09/19/19 <b>Time Validated:</b> 15:45
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**Comments:**

QC Batch ID: IP190919-5-4

Lab ID	QC Type	Field ID	Matrix	Date Collected	Initial Wt/Vol	Final Wt/Vol	Cleanup Method	Cleanup DF	Order Number
IP190919-5	MB	XXXXXX	WATER	XXXXXX	50	50	NONE	1	1909215
IP190919-5	LCS	XXXXXX	WATER	XXXXXX	50	50	NONE	1	1909215
1909215-3	MS	B3R5L2	WATER	9/10/2019	50	50	NONE	1	1909215
1909215-3	MSD	B3R5L2	WATER	9/10/2019	50	50	NONE	1	1909215
1909215-3	SMP	B3R5L2	WATER	9/10/2019	50	50	NONE	1	1909215
1909215-4	SMP	B3R5L6	WATER	9/10/2019	50	50	NONE	1	1909215

**QC Types**

CAR	Carrier reference sample	DLS	Detection Limit Standard
DUP	Laboratory Duplicate	LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicat	LODV	Limit of Detection Verification
LOQV	Limit of Quantitation Verification	MB	Method Blank
MS	Laboratory Matrix Spike	MSD	Laboratory Matrix Spike Duplicate
REP	Sample replicate	RVS	Reporting Level Verification Standar
SMP	Field Sample	SYS	Sample Yield Spike



# Strontium-90

## Case Narrative

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### CH2M HILL Plateau Remediation Company

Apatite Barrier, September 201 – I19-029

Work Order Number: 1909215

1. The sample was prepared according to the current revision of SOP 707.
2. The sample was analyzed for the presence of <sup>90</sup>Sr according to the current revision of SOP 724. The analysis was completed on 10/05/2019.
3. Total radio-strontium is reported as <sup>90</sup>Sr. The presence of other radioisotopes of strontium may cause positive bias in the measured strontium concentration.
4. The analysis results for the sample are reported in units of pCi/L. The sample was not filtered prior to analysis.
5. Sample volume was insufficient to allow preparation of a duplicate. A laboratory control sample duplicate (LCSD) was prepared in lieu of a client sample duplicate.
6. In accordance with project specific instructions, the evaluation threshold for Relative Percent Difference (RPD) has been set at 20%. RPD is defined as:

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

Where: S = sample activity result and D = duplicate activity result.

7. No anomalous situations were encountered during the preparation and analysis of this sample. All quality control criteria were met.



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.

Pik Yee Yuen  
Pik Yee Yuen  
Radiochemistry Primary Data Reviewer

10/8/19  
Date

Kath M. W.  
Radiochemistry Final Data Reviewer

10/9/19  
Date

**Strontium-90 by GFPC**

PAI 724 Rev 13

**Method Blank Results**

Lab Name: ALS -- Fort Collins

Work Order Number: 1909215

Client Name: CH2M HILL Plateau Remediation Company

ClientProject ID: Apatite Barrier, September 201 I19-029

Lab ID: SR191002-1MB

Sample Matrix: WATER

Prep Batch: SR191002-1

Final Aliquot: 994 ml

Prep SOP: PAI 707 Rev 15

QCBatchID: SR191002-1-1

Result Units: pCi/l

Date Collected: 02-Oct-19

Run ID: SR191002-1A

File Name: SRC1005C

Date Prepared: 02-Oct-19

Count Time: 90 minutes

Date Analyzed: 05-Oct-19

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
10098-97-2	Sr-90	-8.28E-02 +/- 2.82E-01	6.73E-01	1.00E+00	NA	U

**Chemical Yield Summary**

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
STRONTIUM	1.020E+03	9.22E+02	ug	90.2	40 - 110 %	

**Comments:****Qualifiers/Flags:**

U - 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.

**Abbreviations:**

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

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

DL - Decision Level

**Data Package ID:** SR1909215-1

**Strontium-90 by GFPC**

PAI 724 Rev 13

**Laboratory Control Sample(s)****Lab Name:** ALS -- Fort Collins**Work Order Number:** 1909215**Client Name:** CH2M HILL Plateau Remediation Company**ClientProject ID:** Apatite Barrier, September 201 I19-029**Lab ID:** SR191002-1LCS**Sample Matrix:** WATER**Prep Batch:** SR191002-1**Final Aliquot:** 994 ml**Prep SOP:** PAI 707 Rev 15**QC Batch ID:** SR191002-1-1**Result Units:** pCi/l**Date Collected:** 02-Oct-19**Run ID:** SR191002-1A**File Name:** SRC1005B**Date Prepared:** 02-Oct-19**Count Time:** 30 minutes**Date Analyzed:** 05-Oct-19

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
10098-97-2	Sr-90	1.19E+01 +/- 3.10E+00	1.15E+00	1.160E+01	103	75 - 125	

**Chemical Yield Summary**

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
STRONTIUM	1.020E+03	9.51E+02	ug	93.0	40 - 110 %	

**Comments:****Qualifiers/Flags:**

U - 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.  
 L - LCS Recovery below lower control limit.  
 H - LCS Recovery above upper control limit.  
 P - LCS Recovery within control limits.  
 M - The requested MDC was not met.  
 M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

**Abbreviations:**

TPU - Total Propagated Uncertainty  
 MDC - Minimum Detectable Concentration

**Data Package ID:** SR1909215-1

# Strontium-90 by GFPC

PAI 724 Rev 13

## Laboratory Control Sample(s)

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

**Lab ID:** SR191002-1LCSD

**Sample Matrix:** WATER  
**Prep SOP:** PAI 707 Rev 15  
**Date Collected:** 02-Oct-19  
**Date Prepared:** 02-Oct-19  
**Date Analyzed:** 05-Oct-19

**Prep Batch:** SR191002-1  
**QCBatchID:** SR191002-1-1  
**Run ID:** SR191002-1A  
**Count Time:** 30 minutes

**Final Aliquot:** 994 ml  
**Result Units:** pCi/l  
**File Name:** SRC1005B

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
10098-97-2	Sr-90	1.08E+01 +/- 2.85E+00	1.13E+00	1.160E+01	93.8	75 - 125	

### Chemical Yield Summary

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
STRONTIUM	1.020E+03	9.24E+02	ug	90.4	40 - 110 %	

### Comments:

**Qualifiers/Flags:**

- U - 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.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS Recovery within control limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- MDC - Minimum Detectable Concentration

**Data Package ID:** SR1909215-1

# Strontium-90 by GFPC

PAI 724 Rev 13

## Duplicate Sample Results (DER)

**Lab Name:** ALS -- Fort Collins  
**Work Order Number:** 1909215  
**Client Name:** CH2M HILL Plateau Remediation Company  
**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	
<b>Lab ID:</b>	SR191002-1LCSD

**Sample Matrix:** WATER  
**Prep SOP:** PAI 707 Rev 15  
**Date Collected:** 02-Oct-19  
**Date Prepared:** 02-Oct-19  
**Date Analyzed:** 05-Oct-19

**Prep Batch:** SR191002-1  
**QCBatchID:** SR191002-1-1  
**Run ID:** SR191002-1A  
**Count Time:** 30 minutes

**Final Aliquot:** 994 ml  
**Prep Basis:** Unfiltered  
**Moisture(%):** NA  
**Result Units:** pCi/l  
**File Name:** SRC1005B

CASNO	Analyte	Sample				Duplicate				DER	DER Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
10098-97-2	Sr-90	1.19E+01 +/-	3.10E+00	1.15E+00		1.08E+01 +/-	2.85E+00	1.13E+00		0.515	3

### Comments:

**Duplicate Qualifiers/Flags:**

- U - 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.
- D - DER is greater than Control Limit of 3
- LT - Result is less than Request MDC, greater than sample specific MDC
- M - Requested MDC not met.
- 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

**Abbreviations:**

- TPU - Total Propagated Uncertainty
- DER - Duplicate Error Ratio
- BDL - Below Detection Limit
- NR - Not Reported

**Data Package ID:** SR1909215-1

**Strontium-90 by GFPC**

PAI 724 Rev 13

**Duplicate Sample Results (RPD)****Lab Name:** ALS -- Fort Collins**Work Order Number:** 1909215**Client Name:** CH2M HILL Plateau Remediation Company**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	
<b>Lab ID:</b>	SR191002-1LCSD

**Sample Matrix:** WATER**Prep SOP:** PAI 707 Rev 15**Date Collected:** 02-Oct-19**Date Prepared:** 02-Oct-19**Date Analyzed:** 05-Oct-19**Prep Batch:** SR191002-1**QCBatchID:** SR191002-1-1**Run ID:** SR191002-1A**Count Time:** 30 minutes**Final Aliquot:** 994 ml**Prep Basis:** Unfiltered**Moisture(%):** NA**Result Units:** pCi/l**File Name:** SRC1005B

CASNO	Analyte	Sample				Duplicate				RPD	RPD Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
10098-97-2	Sr-90	1.19E+01 +/-	3.10E+00	1.15E+00		1.08E+01 +/-	2.85E+00	1.13E+00		10.00	20

**Comments:****Qualifiers/Flags:**

+ - Duplicate RPD not within limits.  
 U - 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.  
 M - Requested MDC not met.  
 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

**Abbreviations:**

TPU - Total Propagated Uncertainty  
 BDL - Below Detection Limit  
 NR - Not Reported

**Data Package ID:** SR1909215-1

**Strontium-90 by GFPC**

PAI 724 Rev 13

**Sample Results****Lab Name:** ALS -- Fort Collins**Work Order Number:** 1909215**Client Name:** CH2M HILL Plateau Remediation Company**ClientProject ID:** Apatite Barrier, September 201 I19-029

<b>Field ID:</b>	B3R5B4
<b>Lab ID:</b>	1909215-6

**Sample Matrix:** WATER**Prep SOP:** PAI 707 Rev 15**Date Collected:** 10-Sep-19**Date Prepared:** 02-Oct-19**Date Analyzed:** 05-Oct-19**Prep Batch:** SR191002-1**QCBatchID:** SR191002-1-1**Run ID:** SR191002-1A**Count Time:** 90 minutes**Report Basis:** Unfiltered**Final Aliquot:** 994 ml**Prep Basis:** Unfiltered**Moisture(%):** NA**Result Units:** pCi/l**File Name:** SRC1005A**Analysis ReqCode:** SRISO\_SEP\_PR

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
10098-97-2	Sr-90	2.87E+02 +/- 6.77E+01	7.24E-01	1E+00	NA	

**Chemical Yield Summary**

Carrier/Tracer	Amount Added	Result	Units	Yield	Control Limits	Flag
STRONTIUM	1.030E+03	9.45E+02	ug	91.6	40 - 110 %	

**Comments:****Qualifiers/Flags:**

U - 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.

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

M - The requested MDC was not met.

**Abbreviations:**

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

**Data Package ID:** SR1909215-1

**Prep Batch ID: SR191002-1**

Start Date: 10/02/19	End Date: 10/02/19	Concentration Method: NONE	Batch Created By: jxh
Start Time: 11:12	End Time: 11:12	Extract Method: PAI 70715	Date Created: 10/02/19
Prep Analyst: Jirushaya Hantula		Initial Volume Units: ml	Time Created: 11:13
<u>Comments:</u>		Final Volume Units: ml	Validated By: jxh
<div style="border: 1px solid black; height: 30px; width: 100%;"></div>			Date Validated: 10/04/19
			Time Validated: 13:44

QC Batch ID: SR191002-1-1

Lab ID	QC Type	Field ID	Matrix	Date Collected	Initial Wt/Vol	Final Wt/Vol	Cleanup Method	Cleanup DF	Order Number
SR191002-1	CAR	XXXXXX	WATER	XXXXXX	1000	1000	NONE	1	1909172
SR191002-1	MB	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909172
SR191002-1	LCS	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909172
SR191002-1	LCSD	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909172-13	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909172
1909172-14	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909172
1909172-17	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909172
1909215-6	SMP	B3R5B4	WATER	9/10/2019	1000	994.01	NONE	1	1909215
1909216-1	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909216-2	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909216-3	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909216-4	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909216-5	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909216-6	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909216
1909233-1	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909233
1909233-2	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909233
1909233-3	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909233
1909243-1	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909243
1909243-3	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909243
1909243-4	SMP	XXXXXX	WATER	XXXXXX	1000	994.01	NONE	1	1909243

**Prep Batch ID: SR191002-1**

<b>Start Date:</b> 10/02/19	<b>End Date:</b> 10/02/19	<b>Concentration Method:</b> NONE	<b>Batch Created By:</b> jxh
<b>Start Time:</b> 11:12	<b>End Time:</b> 11:12	<b>Extract Method:</b> PAI 70715	<b>Date Created:</b> 10/02/19
<b>Prep Analyst:</b> Jirushaya Hantula		<b>Initial Volume Units:</b> ml	<b>Time Created:</b> 11:13
<b>Comments:</b>		<b>Final Volume Units:</b> ml	<b>Validated By:</b> jxh
			<b>Date Validated:</b> 10/04/19
			<b>Time Validated:</b> 13:44

**QC Types**

CAR	Carrier reference sample		DLS	Detection Limit Standard	
DUP	Laboratory Duplicate		LCS	Laboratory Control Sample	
LCSD	Laboratory Control Sample Duplicat		LODV	Limit of Detection Verification	
LOQV	Limit of Quantitation Verification		MB	Method Blank	
MS	Laboratory Matrix Spike		MSD	Laboratory Matrix Spike Duplicate	
REP	Sample replicate		RVS	Reporting Level Verification Standar	
SMP	Field Sample		SYS	Sample Yield Spike	