Ft. Collins, Colorado LIMS Version: 6.907 

Sunday, September 15, 2019

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

Re: ALS Workorder: 1908378
Project Name: AEA, August 2019
Project Number: I19-025

Dear Ms. Waters-Husted:

Six water samples were received from CH2M HILL Plateau Remediation Company, on 8/16/2019. The samples were scheduled for the following analyses:

| |
|---|
| Gamma Spectroscopy |
| Metals |
| Technetium-99 |

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. OBrien
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

**OrderNum:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**Client Project Name:** AEA, August 2019
**Client Project Number:** I19-025
**Client PO Number:** BOA 54854

| Client Sample Number | Lab Sample Number | COC Number | Matrix | Date Collected | Time Collected |
|---|---|---|---|---|---|
| B3PTT7 | 1908378-1 | | WATER | 14-Aug-19 | 9:00 |
| B3PTT6 | 1908378-2 | | WATER | 14-Aug-19 | 7:40 |
| B3PV88 | 1908378-3 | | WATER | 14-Aug-19 | 6:50 |
| B3PV89 | 1908378-4 | | WATER | 14-Aug-19 | 10:25 |
| B3PV82 | 1908378-5 | | WATER | 14-Aug-19 | 9:47 |
| B3PV81 | 1908378-6 | | WATER | 14-Aug-19 | 9:47 |

| CH2MHill Plateau Remediation Company | CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST 1908378 | C.O.C. # I19-025-009 Page 1 of 1 |
|---|---|---|

| | | |
|---|---|---|
| **Collector:** Roger Friesz Jr. /CHPRC | **Contact/Requester:** Karen Waters-Husted | **Telephone No.:** 509-376-4650 |
| **SAF No.:** I19-025 | **Sampling Origin:** Hanford Site | **Purchase Order/Charge Code:** 300071 |
| **Project Title:** AEA, August 2019 | **Logbook No.:** HNF-N-506 111-2 | **Ice Chest No.:** GWS0164 |
| **Shipped To (Lab):** ALS Environmental Ft. Collins | **Method of Shipment** Commercial Carrier | **Bill of Lading/Air Bill No.:** 775992048340 |
| **Protocol:** SURV | **Priority:** 30 Days | **Offsite Property No.:** 11454 |

**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 | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|---|---|---|---|---|---|---|---|---|
| B3PTT7 | N | W | AUG 14 2019 | 0900 | 1x1-L G/P | GAMMA_GS: COMMON; GAMMA_GS: GW 01 | 6 Months | HNO3 to pH <2 |
| B3PTT7 | N | W | " | 0900 | 1x500-mL G/P | TC99_SEP_LSC: 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* |
| Roger Friesz Jr. /CHPRC | | AUG 14 2019 0915 | Janelle Zunker CHPRC | | AUG 14 2019 0915 |
| Janelle Zunker CHPRC | | AUG 14 2019 1630 | SSU-1 | SSU-1 | AUG 14 2019 1630 |
| SSU-1 | SSU-1 | AUG 15 2019 0035 | Janelle Zunker CHPRC | | AUG 15 2019 0035 |
| Janelle Zunker CHPRC | | AUG 15 2019 1400 | FEDEX | FEDEX | |
| | FEDEX | | EMILY LYONS | Emily Lyons 08.16.19 0930 | |
| | | | | | |

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: |
|---|---|---|---|

| CH2MHill Plateau Remediation Company | CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST 1908378 | C.O.C. # I19-025-008 Page 1 of 1 |
|---|---|---|

| | | |
|---|---|---|
| **Collector:** Roger Friesz Jr /CHPRC | **Contact/Requester:** Karen Waters-Husted | **Telephone No.:** 509-376-4650 |
| **SAF No.:** I19-025 | **Sampling Origin:** Hanford Site | **Purchase Order/Charge Code:** 300071 |
| **Project Title:** AEA, August 2019 | **Logbook No.:** HNF-N-506 111-2 | **Ice Chest No.:** GWS-064 |
| **Shipped To (Lab):** ALS Environmental Ft. Collins | **Method of Shipment** Commercial Carrier | **Bill of Lading/Air Bill No.:** 775992048340 |
| **Protocol:** SURV | **Priority:** 30 Days | **Offsite Property No.:** 11454 |

**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 | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|---|---|---|---|---|---|---|---|---|
| B3PTT6 2 | N | W | AUG 14 2019 | 0740 | 1x500-mL G/P | TC99_SEP_LSC: COMMON | 6 Months | HNO3 to pH <2 |
| B3PTT6 ↓ | N | W | AUG 14 2019 | 0740 | 1x1-L G/P | GAMMA_GS: COMMON; GAMMA_GS: GW 01 | 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* |
| Roger Friesz Jr. /CHPRC | | AUG 14 2019 0939 | Janelle Zunker CHPRC | | AUG 14 2019 0939 |
| Janelle Zunker CHPRC | SSU-1 | AUG 14 2019 1032 | SSU-1 | SSU-1 | AUG 14 2019 1032 |
| SSU-1 | | AUG 15 2019 0635 | Janelle Zunker CHPRC | | AUG 15 2019 0635 |
| Janelle Zunker CHPRC | | AUG 15 2019 1400 | FEDEX | FEDEX | |
| | FEDEX | | EMILY LYONS | Emily Lyons | 08-16-19 0930 |
| | | | | | |

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: |
|---|---|---|---|

| CH2MHill Plateau Remediation Company | CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST 1908378 | C.O.C. # I19-025-023 |
|---|---|---|
| | | Page 1 of 1 |

| | | |
|---|---|---|
| **Collector:** Kevin Patterson /CHPRC | **Contact/Requester:** Karen Waters-Husted | **Telephone No.:** 509-376-4650 |
| **SAF No.:** I19-025 | **Sampling Origin:** Hanford Site | **Purchase Order/Charge Code:** 300071 |
| **Project Title:** AEA, August 2019 | **Logbook No.:** HNF-N-506 109 | **Ice Chest No.:** GWS-064 |
| **Shipped To (Lab):** ALS Environmental Ft. Collins | **Method of Shipment** Commercial Carrier | **Bill of Lading/Air Bill No.:** 7759 9204 8340 |
| **Protocol:** SURV | **Priority:** 30 Days | **Offsite Property No.:** 11454 |

**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 | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|---|---|---|---|---|---|---|---|---|
| B3PV88 3 | N | W | AUG 14 2019 | 0650 | 1x500-mL G/P | TC99_SEP_LSC: COMMON | 6 Months | HNO3 to pH <2 |

| Relinquished By | Received By | Matrix * |
|---|---|---|
| Kevin Patterson /CHPRC — AUG 14 2019 1200 | SSU-1 — AUG 14 2019 1200 | S = Soil, SE = Sediment, SO = Solid, SL = Sludge, W = Water, O = Oil, A = Air, DS = Drum Solids, DL = Drum Liquid, T = Tissue, WI = Wipe, L = Liquid, V = Vegetation, X = Other |
| SSU-1 — AUG 15 2019 0635 | Janelle Zunker CHPRC — AUG 15 2019 0635 | |
| Janelle Zunker CHPRC — AUG 15 2019 1400 | FEDEX | |
| FEDEX | EMILY LYONS — 08-16-19 1936 | |

| FINAL SAMPLE DISPOSITION | Disposal Method (e.g., Return to customer, per lab procedure, used in process): | Disposed By: | Date/Time: |
|---|---|---|---|

| CH2MHill Plateau Remediation Company | CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST 1908378 | C.O.C. # I19-025-024 Page 1 of 1 |
|---|---|---|

| | | |
|---|---|---|
| **Collector:** Kevin Patterson /CHPRC | **Contact/Requester:** Karen Waters-Husted | **Telephone No.:** 509-376-4650 |
| **SAF No.:** I19-025 | **Sampling Origin:** Hanford Site | **Purchase Order/Charge Code:** 300071 |
| **Project Title:** AEA, August 2019 | **Logbook No.:** HNF-N-506 109 | **Ice Chest No.:** GWS 004 |
| **Shipped To (Lab):** ALS Environmental Ft. Collins | **Method of Shipment** Commercial Carrier | **Bill of Lading/Air Bill No.:** 775992048340 |
| **Protocol:** SURV | **Priority:** 30 Days | **Offsite Property No.:** 11454 |

**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 | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|---|---|---|---|---|---|---|---|---|
| B3PV89 4 | N | W | AUG 14 2019 | 1035 | 1x500-mL G/P | TC99_SEP_LSC: COMMON | 6 Months | HNO3 to pH <2 |

| Relinquished By | Received By | Matrix * |
|---|---|---|
| Kevin Patterson /CHPRC — AUG 14 2019 1200 (Print First and Last Name / Signature / Date/Time) | SSU-1 — AUG 14 2019 1200 (Print First and Last Name / Signature / Date/Time) | S = Soil, SE = Sediment, SO = Solid, SL = Sludge, W = Water, O = Oil, A = Air; DS = Drum Solids, DL = Drum Liquid, T = Tissue, WI = Wipe, L = Liquid, V = Vegetation, X = Other |
| SSU-1 — AUG 15 2019 1035 (Print First and Last Name / Signature / Date/Time) | Janelle Zunker CHPRC — AUG 15 2019 1035 (Print First and Last Name / Signature / Date/Time) | |
| Janelle Zunker CHPRC — AUG 15 2019 1400 (Print First and Last Name / Signature / Date/Time) | FEDEX (Print First and Last Name / Signature / Date/Time) | |
| FEDEX (Print First and Last Name / Signature / Date/Time) | Emily Lyons 08-16-19 0930 (Print First and Last Name / Signature / Date/Time) | |

| FINAL SAMPLE DISPOSITION | Disposal Method (e.g., Return to customer, per lab procedure, used in process): | Disposed By: | Date/Time: |
|---|---|---|---|

| CH2MHill Plateau Remediation Company | CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST 1908378 | C.O.C. # I19-025-022 Page 1 of 1 |
|---|---|---|

| | | |
|---|---|---|
| **Collector:** Kevin Patterson /CHPRC | **Contact/Requester:** Karen Waters-Husted | **Telephone No.:** 509-376-4650 |
| **SAF No.:** I19-025 | **Sampling Origin:** Hanford Site | **Purchase Order/Charge Code:** 300071 |
| **Project Title:** AEA, August 2019 | **Logbook No.:** HNF-N-506 109 | **Ice Chest No.:** GWS-064 |
| **Shipped To (Lab):** ALS Environmental Ft. Collins | **Method of Shipment** Commercial Carrier | **Bill of Lading/Air Bill No.:** 7759 9204 8340 |
| **Protocol:** SURV | **Priority:** 30 Days | **Offsite Property No.:** 11454 |

**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 | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|---|---|---|---|---|---|---|---|---|
| B3PV82 5 | N | W | AUG 14 2019 | 0947 | 1x500-mL G/P | 6020_METALS_ICPMS: Uranium (1) | 6 Months | HNO3 to pH <2 |

| Relinquished By | Print First and Last Name | Signature | Date/Time | Received By | Print First and Last Name | Signature | Date/Time |
|---|---|---|---|---|---|---|---|
| Relinquished By: | Kevin Patterson /CHPRC | | AUG 14 2019 1200 | Received By: | SSU-1 | | AUG 14 2019 1200 |
| Relinquished By: | SSU-1 | | AUG 15 2019 0635 | Received By: | Janelle Zunker CHPRC | | AUG 15 2019 0635 |
| Relinquished By: | Janelle Zunker CHPRC | | AUG 15 2019 1400 | Received By: | FEDEX | | |
| Relinquished By: | FEDEX | | | Received By: | EMILY LYONS | Emily Lyons | 08.16.19 0930 |

Matrix *

| | | | |
|---|---|---|---|
| S = Soil | | DS = Drum Solids | |
| SE = Sediment | | DL = Drum Liquid | |
| 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: |
|---|---|---|---|


Printed On 6/10/2019
FSR ID = FSR80911
A-6004-842 (REV 3)

| CH2MHill Plateau Remediation Company | CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST 1908378 | C.O.C. # I19-025-021 Page 1 of 1 |
|---|---|---|

| | | |
|---|---|---|
| **Collector:** Kevin Patterson /CHPRC | **Contact/Requester:** Karen Waters-Husted | **Telephone No.:** 509-376-4650 |
| **SAF No.:** I19-025 | **Sampling Origin:** Hanford Site | **Purchase Order/Charge Code:** 300071 |
| **Project Title:** AEA, August 2019 | **Logbook No.:** HNF-N-506 109 | **Ice Chest No.:** GWS-004 |
| **Shipped To (Lab):** ALS Environmental Ft. Collins | **Method of Shipment** Commercial Carrier | **Bill of Lading/Air Bill No.:** 7759 9204 8340 |
| **Protocol:** SURV | **Priority:** 30 Days | **Offsite Property No.:** 11454 |

**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 | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|---|---|---|---|---|---|---|---|---|
| B3PV81 6 | N | W | AUG 14 2019 | 0947 | 1x500-mL G/P | 6020_METALS_ICPMS: Uranium (1) | 6 Months | HNO3 to pH <2 |

| | | | |
|---|---|---|---|
| Relinquished By: Kevin Patterson /CHPRC — Print First and Last Name / Signature / AUG 14 2019 1200 Date/Time | Received By: SSU-1 — Print First and Last Name / Signature / AUG 14 2019 1200 Date/Time | Matrix * | |
| Relinquished By: SSU-1 — Print First and Last Name / Signature / AUG 15 2019 0635 Date/Time | Received By: Janelle Zunker CHPRC — Print First and Last Name / Signature / AUG 15 2019 0635 Date/Time | S = Soil | DS = Drum Solids |
| Relinquished By: Janelle Zunker CHPRC — Print First and Last Name / Signature / AUG 15 2019 1400 Date/Time | Received By: FEDEX — Print First and Last Name / Signature / Date/Time | SE = Sediment | DL = Drum Liquid |
| Relinquished By: FEDEX — Print First and Last Name / Signature / Date/Time | Received By: EMILY LYONS — Print First and Last Name / Signature / 08-16-19 0930 Date/Time | 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: |
|---|---|---|---|


Printed On 6/10/2019 FSR ID = FSR80911 A-6004-842 (REV 3)

**ALS Environmental - Fort Collins**
**CONDITION OF SAMPLE UPON RECEIPT FORM**

Client: CHPRC Workorder No: 1908378

Project Manager: KMO Initials: EL Date: 8/16/19

| | | | | |
|---|---|---|---|---|
| 1. | Are airbills / shipping documents present and/or removable? | DROP OFF | YES | NO |
| 2. | Are custody seals on **shipping** containers intact? | NONE | YES | NO * |
| 3. | Are custody seals on **sample** containers intact? | NONE | YES | NO * |
| 4. | Is there a COC (chain-of-custody) present? | | YES | NO * |
| 5. | Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.) | | YES | NO * |
| 6. | Are short-hold samples present? | | YES | NO |
| 7. | Are all samples within holding times for the requested analyses? | | YES | NO * |
| 8. | Were all sample containers received intact? (not broken or leaking) | | YES | NO * |
| 9. | Is there sufficient sample for the requested analyses? | | YES | NO * |
| 10. | Are all samples in the proper containers for the requested analyses? | | YES | NO * |
| 11. | Are all aqueous samples preserved correctly, if required? (excluding volatiles) | N/A | YES | NO * |
| 12. | Are all aqueous non-preserved samples pH 4-9? | N/A | 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) | N/A | YES | NO |
| 14. | Were the samples shipped on ice? | | YES | NO |
| 15. | Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 (#3) #4 | RAD ONLY | YES | NO |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cooler #: | 1 | | | | | | | |
| Temperature (°C): | 2.9 | | | | | | | |
| No. of custody seals on cooler: | 2 | | | | | | | |
| DOT Survey/ Acceptance Information — External µR/hr reading: | 14 | | | | | | | |
| Background µR/hr reading: | 13 | | | | | | | |

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **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: NJ

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

**Project Manager Signature / Date:** 8/19/19

Form 201r27.xls
(02/11/2019)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

1908378




**After printing this label**:
1. Use the 'Print' button on this page to print your label to your laser or inkjet printer.
2. Fold the printed page along the horizontal line.
3. Place label in shipping pouch and affix it to your shipment so that the barcode portion of the label can be read and scanned.

**Warning**: Use only the printed original label for shipping. Using a photocopy of this label for shipping purposes is fraudulent and could result in additional billing charges, along with the cancellation of your FedEx account number.
Use of this system constitutes your agreement to the service conditions in the current FedEx Service Guide, available on fedex.com.FedEx will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, non-delivery,misdelivery,or misinformation, unless you declare a higher value, pay an additional charge, document your actual loss and file a timely claim.Limitations found in the current FedEx Service Guide apply. Your right to recover from FedEx for any loss, including intrinsic value of the package, loss of sales, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental,consequential, or special is limited to the greater of $100 or the authorized declared value. Recovery cannot exceed actual documented loss.Maximum for items of extraordinary value is $1,000, e.g. jewelry, precious metals, negotiable instruments and other items listed in our ServiceGuide. Written claims must be filed within strict time limits, see current FedEx Service Guide.

# Gamma Spectroscopy

## Case Narrative

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## CH2M HILL Plateau Remediation Company

AEA, August 2019 – I19-025

Work Order Number: 1908378

1. The samples were prepared according to the current revision of SOP739.

2. The samples were analyzed for the presence of gamma emitting radionuclides according to the current revision of SOP713. The analyses were completed on 09/10/2019.

3. The analysis results for the samples are reported in units of pCi/L. The samples were not filtered prior to analysis.

4. Sample volume was insufficient to allow preparation of a duplicate. A duplicate analysis of sample 1908378-1 was performed in lieu of a prepared duplicate.

5. 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. 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.

6. There are cases where the magnitude of negative activity is greater than the $2\sigma$ TPU. Under typical conditions, where background data is normally distributed and analyzed by paired observations, this event is likely to occur at least 2.5% of the time. Review of the data does not indicate a problem with the instrument or reporting systems and results are reported without further qualification.

7. No problems were encountered with either the client samples or the associated quality control samples. 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 — 9/12/19
Pik Yee Yuen
Radiochemistry Primary Data Reviewer
Date

9/15/19
Radiochemistry Final Data Reviewer
Date

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Method Blank Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Lab ID:** GS190905-1MB
**Library:** FANP.LIB

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 05-Sep-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 10-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 1000 minutes

**Final Aliquot:** 1000 ml
**Result Units:** pCi/l
**File Name:** 190999d01

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 10198-40-0 | Co-60 | 3.43E-01 +/- 3.22E+00 | 5.51E+00 | | NA | U |
| 13967-70-9 | Cs-134 | 3.07E-01 +/- 3.01E+00 | 5.07E+00 | | NA | U |
| 10045-97-3 | Cs-137 | 3.13E-01 +/- 2.99E+00 | 5.06E+00 | 1.00E+01 | NA | U |
| 14683-23-9 | Eu-152 | 1.94E+00 +/- 1.57E+01 | 2.69E+01 | | NA | U |
| 15585-10-1 | Eu-154 | -5.27E+00 +/- 1.66E+01 | 2.87E+01 | | NA | U |
| 14391-16-3 | Eu-155 | 6.28E+00 +/- 9.28E+00 | 1.53E+01 | | NA | U |
| 13966-00-2 | K-40 | -1.29E+01 +/- 9.92E+01 | 1.66E+02 | | NA | U |
| 14234-35-6 | Sb-125 | 3.28E+00 +/- 6.77E+00 | 1.18E+01 | | NA | U |

## Comments:

**Qualifiers/Flags:**

U - Result is less than the sample specific MDC or less than the associated TP
U
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

**Data Package ID:** *GSW1908378-1*

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Laboratory Control Sample(s)

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Lab ID:** GS190905-1LCS

**Library:** ANALYTICAL.LI

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 05-Sep-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 06-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 30 minutes

**Final Aliquot:** 1000 ml
**Result Units:** pCi/l
**File Name:** 190863d09

| CASNO | Target Nuclide | Results +/- 2s TPU | MDC | Spike Added | % Rec | Control Limits | Lab Qualifier |
|---|---|---|---|---|---|---|---|
| 14596-10-2 | Am-241 | 9.98E+04 +/- 1.17E+04 | 4.82E+02 | 1.010E+05 | 98.5 | 85 - 115 | |
| 10198-40-0 | Co-60 | 4.09E+04 +/- 4.80E+03 | 1.20E+02 | 4.080E+04 | 100 | 85 - 115 | |
| 10045-97-3 | Cs-137 | 3.86E+04 +/- 4.54E+03 | 2.30E+02 | 3.800E+04 | 102 | 85 - 115 | |

### Comments:

**Qualifiers/Flags:**

U - Result is less than the sample specific MDC or less than the associated TPU

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

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

**Data Package ID:** *GSW1908378-1*

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Duplicate Sample Results (DER)

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT7
**Lab ID:** 1908378-1DUP

**Library:** FANP.LIB

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 09-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 500 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 1000 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** 190855d07

| CASNO | Analyte | Sample | | | Duplicate | | | DER | DER Lim |
|---|---|---|---|---|---|---|---|---|---|
| | | Result +/- 2 s TPU | MDC | Flags | Result +/- 2 s TPU | MDC | Flags | | |
| 10198-40-0 | Co-60 | -6.55E-01 +/- 3.61E+00 | 6.52E+00 | U | -2.93E+00 +/- 3.56E+00 | 6.61E+00 | U | 0.898 | 3 |
| 13967-70-9 | Cs-134 | -3.47E+00 +/- 3.64E+00 | 6.48E+00 | U | -1.13E+00 +/- 3.56E+00 | 6.15E+00 | U | 0.918 | 3 |
| 10045-97-3 | Cs-137 | -2.22E-01 +/- 3.36E+00 | 5.84E+00 | U | 9.40E-01 +/- 3.51E+00 | 5.95E+00 | U | 0.479 | 3 |
| 14683-23-9 | Eu-152 | 2.08E+01 +/- 2.15E+01 | 3.46E+01 | U | 2.05E+00 +/- 1.73E+01 | 3.02E+01 | U | 1.36 | 3 |
| 15585-10-1 | Eu-154 | -2.28E+00 +/- 2.10E+01 | 3.69E+01 | U | -7.39E+00 +/- 2.06E+01 | 3.64E+01 | U | 0.347 | 3 |
| 14391-16-3 | Eu-155 | -4.84E+00 +/- 6.34E+00 | 1.10E+01 | U | 5.12E+00 +/- 1.18E+01 | 1.97E+01 | U | 1.48 | 3 |
| 13966-00-2 | K-40 | 2.30E+01 +/- 7.58E+01 | 1.28E+02 | U | -1.03E+02 +/- 8.04E+01 | 1.40E+02 | U | 2.27 | 3 |
| 14234-35-6 | Sb-125 | 3.14E+00 +/- 7.52E+00 | 1.40E+01 | U | 4.41E+00 +/- 7.42E+00 | 1.35E+01 | U | 0.241 | 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
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

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

**Data Package ID:** *GSW1908378-1*

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Duplicate Sample Results (RPD)

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT7
**Lab ID:** 1908378-1DUP
**Library:** FANP.LIB

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 09-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 500 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 1000 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** 190855d07

| CASNO | Analyte | Sample | | | Duplicate | | | RPD | RPD Lim |
|---|---|---|---|---|---|---|---|---|---|
| | | Result +/- 2 s TPU | MDC | Flags | Result +/- 2 s TPU | MDC | Flags | | |
| 10198-40-0 | Co-60 | -6.55E-01 +/- 3.61E+00 | 6.52E+00 | U | -2.93E+00 +/- 3.56E+00 | 6.61E+00 | U | NC | 20 |
| 13967-70-9 | Cs-134 | -3.47E+00 +/- 3.64E+00 | 6.48E+00 | U | -1.13E+00 +/- 3.56E+00 | 6.15E+00 | U | NC | 20 |
| 10045-97-3 | Cs-137 | -2.22E-01 +/- 3.36E+00 | 5.84E+00 | U | 9.40E-01 +/- 3.51E+00 | 5.95E+00 | U | NC | 20 |
| 14683-23-9 | Eu-152 | 2.08E+01 +/- 2.15E+01 | 3.46E+01 | U | 2.05E+00 +/- 1.73E+01 | 3.02E+01 | U | NC | 20 |
| 15585-10-1 | Eu-154 | -2.28E+00 +/- 2.10E+01 | 3.69E+01 | U | -7.39E+00 +/- 2.06E+01 | 3.64E+01 | U | NC | 20 |
| 14391-16-3 | Eu-155 | -4.84E+00 +/- 6.34E+00 | 1.10E+01 | U | 5.12E+00 +/- 1.18E+01 | 1.97E+01 | U | NC | 20 |
| 13966-00-2 | K-40 | 2.30E+01 +/- 7.58E+01 | 1.28E+02 | U | -1.03E+02 +/- 8.04E+01 | 1.40E+02 | U | NC | 20 |
| 14234-35-6 | Sb-125 | 3.14E+00 +/- 7.52E+00 | 1.40E+01 | U | 4.41E+00 +/- 7.42E+00 | 1.35E+01 | U | NC | 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
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:

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

**Data Package ID:** *GSW1908378-1*

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT7
**Lab ID:** 1908378-1

**Library:** FANP.LIB
**Analysis ReqCode:** GAMMA_GS: CO

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 07-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 500 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 1000 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** 190867d09

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 10198-40-0 | Co-60 | -6.55E-01 +/- 3.61E+00 | 6.52E+00 | | NA | U |
| 13967-70-9 | Cs-134 | -3.47E+00 +/- 3.64E+00 | 6.48E+00 | | NA | U |
| 10045-97-3 | Cs-137 | -2.22E-01 +/- 3.36E+00 | 5.84E+00 | 1E+01 | NA | U |
| 14683-23-9 | Eu-152 | 2.08E+01 +/- 2.15E+01 | 3.46E+01 | | NA | U |
| 15585-10-1 | Eu-154 | -2.28E+00 +/- 2.10E+01 | 3.69E+01 | | NA | U |
| 14391-16-3 | Eu-155 | -4.84E+00 +/- 6.34E+00 | 1.10E+01 | | NA | U |
| 13966-00-2 | K-40 | 2.30E+01 +/- 7.58E+01 | 1.28E+02 | | NA | U |
| 14234-35-6 | Sb-125 | 3.14E+00 +/- 7.52E+00 | 1.40E+01 | | NA | U |

## Comments:

**Qualifiers/Flags:**

U - Result is less than the sample specific MDC or less than the associated TP

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.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

**Data Package ID:** *GSW1908378-1*

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Sample Duplicate Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT7
**Lab ID:** 1908378-1DUP
**Library:** FANP.LIB

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 09-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 500 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 1000 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** 190855d07

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 10198-40-0 | Co-60 | -2.93E+00 +/- 3.56E+00 | 6.61E+00 | | NA | U |
| 13967-70-9 | Cs-134 | -1.13E+00 +/- 3.56E+00 | 6.15E+00 | | NA | U |
| 10045-97-3 | Cs-137 | 9.40E-01 +/- 3.51E+00 | 5.95E+00 | 1E+01 | NA | U |
| 14683-23-9 | Eu-152 | 2.05E+00 +/- 1.73E+01 | 3.02E+01 | | NA | U |
| 15585-10-1 | Eu-154 | -7.39E+00 +/- 2.06E+01 | 3.64E+01 | | NA | U |
| 14391-16-3 | Eu-155 | 5.12E+00 +/- 1.18E+01 | 1.97E+01 | | NA | U |
| 13966-00-2 | K-40 | -1.03E+02 +/- 8.04E+01 | 1.40E+02 | | NA | U |
| 14234-35-6 | Sb-125 | 4.41E+00 +/- 7.42E+00 | 1.35E+01 | | NA | U |

## Comments:

**Qualifiers/Flags:**

U - Result is less than the sample specific MDC or less than the associated TPU.
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.
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halflives.
G - Sample density differs by more than 15% of LCS density.
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:** *GSW1908378-1*

**Date Printed:** Thursday, September 12, 2019

**ALS -- Fort Collins**
LIMS Version: 6.907

# Gamma Spectroscopy Results

## PAI 713 Rev 14

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT6
**Lab ID:** 1908378-2

**Library:** FANP.LIB
**Analysis ReqCode:** GAMMA_GS: CO

**Sample Matrix:** WATER
**Prep SOP:** PAI 739 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 05-Sep-19
**Date Analyzed:** 10-Sep-19

**Prep Batch:** GS190905-1
**QCBatchID:** GS190905-1-1
**Run ID:** GS190905-1A
**Count Time:** 240 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 1000 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** 190874d09

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 10198-40-0 | Co-60 | -2.67E+00 +/- 6.10E+00 | 1.15E+01 | | NA | U |
| 13967-70-9 | Cs-134 | -1.34E+00 +/- 5.30E+00 | 9.39E+00 | | NA | U |
| 10045-97-3 | Cs-137 | 1.39E+00 +/- 4.63E+00 | 8.01E+00 | 1E+01 | NA | U |
| 14683-23-9 | Eu-152 | -5.42E+00 +/- 2.68E+01 | 5.01E+01 | | NA | U |
| 15585-10-1 | Eu-154 | -3.01E+01 +/- 3.24E+01 | 6.19E+01 | | NA | U |
| 14391-16-3 | Eu-155 | 1.37E+00 +/- 9.07E+00 | 1.55E+01 | | NA | U |
| 13966-00-2 | K-40 | -6.00E+01 +/- 8.56E+01 | 1.58E+02 | | NA | U |
| 14234-35-6 | Sb-125 | 2.65E+00 +/- 1.05E+01 | 1.81E+01 | | NA | U |

## Comments:

**Qualifiers/Flags:**

U - Result is less than the sample specific MDC or less than the associated TP

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.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

**Data Package ID:** *GSW1908378-1*

# Prep Batch ID: GS190905-1

**Start Date:** 09/05/19
**Start Time:** 10:44
**Prep Analyst:** Alex H. Jouney

**End Date:** 09/05/19
**End Time:** 10:44

**Concentration Method:** NONE
**Extract Method:** PAI 73912
**Initial Volume Units:** ml
**Final Volume Units:** ml

**Batch Created By:** ahj
**Date Created:** 09/05/19
**Time Created:** 10:44
**Validated By:** smg
**Date Validated:** 09/06/19
**Time Validated:** 8:16

**Comments:**

**QC Batch ID:** GS190905-1-1

| Lab ID | QC Type | Field ID | Matrix | Date Collected | Initial Wt/Vol | Final Wt/Vol | Cleanup Method | Cleanup DF | Order Number |
|---|---|---|---|---|---|---|---|---|---|
| GS190905-1 | MB | XXXXXX | WATER | XXXXXX | 1000 | 1000 | NONE | 1 | 1908378 |
| GS190905-1 | LCS | XXXXXX | WATER | XXXXXX | 1000 | 1000 | NONE | 1 | 1908378 |
| 1908378-1 | DUP | B3PTT7 | WATER | 8/14/2019 | 1000 | 1000 | NONE | 1 | 1908378 |
| 1908378-1 | SMP | B3PTT7 | WATER | 8/14/2019 | 1000 | 1000 | NONE | 1 | 1908378 |
| 1908378-2 | SMP | B3PTT6 | WATER | 8/14/2019 | 1000 | 1000 | NONE | 1 | 1908378 |

**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

AEA, August 2019 -- I19-025

Work Order Number: 1908378

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

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

2. Analysis by ICP-MS followed method 6020B and the current revision of SOP 827.

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.
   - 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 associated with Method 6020B were analyzed.

6. Matrix specific quality control procedures.

   Sample 1908464-1 was designated as the quality control sample for this analysis. Results for the shared quality control samples are included at the client's request.

   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. It is a standard practice that samples for ICP-MS are analyzed at a dilution. The 10X factor can be considered an artifact of the prep and does not indicate a secondary dilution and is therefore not flagged as a dilution. The samples were further diluted in order to bring uranium into the analytical range of the instrument.

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 — 9/9/19
Megan Johnstone
Inorganics Primary Data Reviewer
Date

Inorganics Final Data Reviewer — 9/15/19
Inorganics Final Data Reviewer
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 <=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 URANIUM

## Method SW6020B

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Client Name:** CH2M HILL Plateau Remediation Company
**Client Project ID:** AEA, August 2019 I19-025
**Work Order Number:** 1908378 **Final Volume:** 50 ml
**Reporting Basis:** As Received **Matrix:** WATER
**Analyst:** Nicole C. Chirban **Result Units:** UG/L

| Client Sample ID | Lab ID | Date Collected | Date Prepared | Date Analyzed | Percent Moisture | Dilution Factor | Result | RptLimit/ LOQ/LOD | MDL/DL | Flag | Sample Aliquot |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B3PV82 | 1908378-5 | 8/14/2019 | 8/29/2019 | 09/06/2019 | N/A | 1000 | 46000 | 10 | 0.49 | D | 50 ml |
| B3PV81 | 1908378-6 | 8/14/2019 | 8/29/2019 | 09/06/2019 | N/A | 1000 | 46000 | 10 | 0.49 | D | 50 ml |

**Comments:**

1. ND or U = Not Detected at or above the client requested detection limit.

**Data Package ID:** *IM1908378-1*

# ICPMS Metals

## Method SW6020B

## Method Blank

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Lab ID:** IP190829-3MB

**Sample Matrix:** WATER
**% Moisture:** N/A
**Date Collected:** N/A
**Date Extracted:** 29-Aug-19
**Date Analyzed:** 06-Sep-19

**Prep Batch:** IP190829-3
**QCBatchID:** IP190829-3-3
**Run ID:** IM190906-10A2
**Cleanup:** NONE
**Basis:** N/A
**File Name:** 024SMPL_

**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 |
|---|---|---|---|---|---|---|
| 7440-61-1 | URANIUM | 10 | 0.0049 | U | 0.1 | 0.0049 |

**Data Package ID:** *IM1908378-1*

# ICPMS Metals

## Method SW6020B

## Laboratory Control Sample

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Lab ID:** IM190829-3LCS

**Sample Matrix:** WATER
**% Moisture:** N/A
**Date Collected:** N/A
**Date Extracted:** 08/29/2019
**Date Analyzed:** 09/06/2019
**Prep Method:** SW3005A

**Prep Batch:** IP190829-3
**QCBatchID:** IP190829-3-3
**Run ID:** IM190906-10A2
**Cleanup:** NONE
**Basis:** N/A
**File Name:** 025SMPL_

**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 |
|---|---|---|---|---|---|---|---|
| 7440-61-1 | URANIUM | 10 | 9.76 | 0.1 | | 98 | 80 - 120% |

**Data Package ID:** *IM1908378-1*

# ICPMS Metals

## Method SW6020B

## Matrix Spike And Matrix Spike Duplicate

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** SHARED QC
**LabID:** 1908464-1MS

**Sample Matrix:** WATER
**% Moisture:** N/A
**Date Collected:** 19-Aug-19
**Date Extracted:** 29-Aug-19
**Date Analyzed:** 05-Sep-19
**Prep Method:** SW3005 Rev A

**Prep Batch:** IP190829-3
**QCBatchID:** IP190829-3-3
**Run ID:** IM190905-10A4
**Cleanup:** NONE
**Basis:** As Received

**Sample Aliquot:** 50 ml
**Final Volume:** 50 ml
**Result Units:** UG/L
**File Name:** 106SMPL_

| CASNO | Target Analyte | Sample Result | Samp Qual | MS Result | MS Qual | Reporting Limit | Spike Added | MS % Rec. | Control Limits |
|---|---|---|---|---|---|---|---|---|---|
| 7440-61-1 | URANIUM | 13 | | 21.7 | | 0.1 | 10 | 90 | 75 - 125% |

**Field ID:** SHARED QC
**LabID:** 1908464-1MSD

**Sample Matrix:** WATER
**% Moisture:** N/A
**Date Collected:** 19-Aug-19
**Date Extracted:** 29-Aug-19
**Date Analyzed:** 05-Sep-19
**Prep Method:** SW3005 Rev A

**Prep Batch:** IP190829-3
**QCBatchID:** IP190829-3-3
**Run ID:** IM190905-10A4
**Cleanup:** NONE
**Basis:** As Received

**Sample Aliquot:** 50 ml
**Final Volume:** 50 ml
**Result Units:** UG/L
**File Name:** 107SMPL_

| CASNO | Target Analyte | MSD Result | MSD Qual | Spike Added | MSD % Rec. | Reporting Limit | RPD Limit | RPD |
|---|---|---|---|---|---|---|---|---|
| 7440-61-1 | URANIUM | 21.5 | | 10 | 89 | 0.1 | 20 | 1 |

**Data Package ID:** *IM1908378-1*

# Prep Batch ID: IP190829-3

**Start Date:** 08/29/19
**Start Time:** 10:27
**Prep Analyst:** Jill M. Latelle

**End Date:** 08/29/19
**End Time:** 18:00

**Concentration Method:** NONE
**Extract Method:** SW3005A
**Initial Volume Units:** ml
**Final Volume Units:** ml

**Batch Created By:** jml
**Date Created:** 08/29/19
**Time Created:** 10:27
**Validated By:** jml
**Date Validated:** 08/29/19
**Time Validated:** 11:02

**Comments:**

**QC Batch ID:** IP190829-3-3

| Lab ID | QC Type | Field ID | Matrix | Date Collected | Initial Wt/Vol | Final Wt/Vol | Cleanup Method | Cleanup DF | Order Number |
|---|---|---|---|---|---|---|---|---|---|
| IP190829-3 | MB | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908464 |
| IM190829-3 | LCS | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908464 |
| 1908464-1 | MS | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908464 |
| 1908464-1 | MSD | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908464 |
| 1908378-5 | SMP | B3PV82 | WATER | 8/14/2019 | 50 | 50 | NONE | 1 | 1908378 |
| 1908378-6 | SMP | B3PV81 | WATER | 8/14/2019 | 50 | 50 | NONE | 1 | 1908378 |
| 1908464-1 | SMP | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908464 |
| 1908543-2 | SMP | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908543 |
| 1908543-3 | SMP | XXXXXX | WATER | XXXXXX | 50 | 50 | NONE | 1 | 1908543 |

**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 |

# Technetium-99

## Case Narrative

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## CH2M HILL Plateau Remediation Company

AEA, August 2019 – I19-025

Work Order Number: 1908378

1. The samples were prepared according to the current revision of SOP 755, with procedure modifications outlined in QASS 378635 and 378636.

2. The samples were analyzed for the presence of $^{99}$Tc according to the current revision of SOP 704. The analyses were completed on 09/04/2019.

3. The analysis results for the samples are reported in units of pCi/L. The samples were not filtered prior to analysis.

4. The duplicate of sample 1908376-8 is shared for this work order. The duplicate was performed on a CH2M HILL Plateau Remediation Company sample. The results can be found in the following report.

5. In accordance with project specific instructions, the evaluation threshold for Relative Percent Difference (RPD) has been set at 20%. RPD is defined as:

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

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

6. The calculated yield as determined by gamma spectrometric analysis of the $^{99m}$Tc tracer, for sample 1908378-2 fell between 100% and 110%. To minimize the potential for low bias, results have been calculated conservatively assuming quantitative chemical yield (100%). The magnitude of the low bias is estimated to be less than 10% of the reported value and is acceptable according the ALS LQAP.

7. No anomalous situations were encountered during the preparation or analysis of these samples. 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 — 9/12/19
Pik Yee Yuen — Date
Radiochemistry Primary Data Reviewer

9/15/19
Radiochemistry Final Data Reviewer — Date

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Method Blank Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Lab ID:** TC190828-2MB

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 28-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes

**Final Aliquot:** 250 ml
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | -3.43E-01 +/- 1.08E+00 | 2.05E+00 | 2.00E+01 | NA | U |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.57E+03 | Pci | 98.0 | 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.

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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Laboratory Control Sample(s)

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Lab ID:** TC190828-2LCS

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 28-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes

**Final Aliquot:** 250 ml
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Results +/- 2s TPU | MDC | Spike Added | % Rec | Control Limits | Lab Qualifier |
|---|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | 8.84E+02 +/- 1.42E+02 | 2.13E+00 | 9.110E+02 | 97.1 | 75 - 125 | |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.44E+03 | Pci | 95.3 | 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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Duplicate Sample Results (DER)

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** Shared QC
**Lab ID:** 1908376-8DUP

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Analyte | Sample | | | Duplicate | | | DER | DER Lim |
|---|---|---|---|---|---|---|---|---|---|
| | | Result +/- 2 s TPU | MDC | Flags | Result +/- 2 s TPU | MDC | Flags | | |
| 14133-76-7 | Tc-99 | 2.41E+04 +/- 3.83E+03 | 5.67E+00 | | 2.57E+04 +/- 4.09E+03 | 5.99E+00 | | 0.569 | 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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Duplicate Sample Results (RPD)

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** Shared QC
**Lab ID:** 1908376-8DUP

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Analyte | Sample | | | Duplicate | | | RPD | RPD Lim |
|---|---|---|---|---|---|---|---|---|---|
| | | Result +/- 2 s TPU | MDC | Flags | Result +/- 2 s TPU | MDC | Flags | | |
| 14133-76-7 | Tc-99 | 2.41E+04 +/- 3.83E+03 | 5.67E+00 | | 2.57E+04 +/- 4.09E+03 | 5.99E+00 | | 6.00 | 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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** Shared QC
**Lab ID:** 1908376-8

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | 2.41E+04 +/- 3.83E+03 | 5.67E+00 | 2E+01 | NA | |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.32E+03 | Pci | 92.7 | 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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Sample Duplicate Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** Shared QC
**Lab ID:** 1908376-8DUP

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | 2.57E+04 +/- 4.09E+03 | 5.99E+00 | 2E+01 | NA | |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.12E+03 | Pci | 88.3 | 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.

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:** *TC1908378-1*

**Date Printed:** Thursday, September 12, 2019

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT7
**Lab ID:** 1908378-1

**Analysis ReqCode:** TC99_SEP_LSC

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | 9.69E+00 +/- 4.76E+00 | 6.19E+00 | 2E+01 | NA | |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.01E+03 | Pci | 86.1 | 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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PTT6
**Lab ID:** 1908378-2

**Analysis ReqCode:** TC99_SEP_LSC

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | -3.00E-01 +/- 2.75E+00 | 5.08E+00 | 2E+01 | NA | U |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.70E+03 | Pci | 101 | 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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PV88
**Lab ID:** 1908378-3

**Analysis ReqCode:** TC99_SEP_LSC

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | -1.25E+00 +/- 2.76E+00 | 5.32E+00 | 2E+01 | NA | U |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.39E+03 | Pci | 94.2 | 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.

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:** *TC1908378-1*

# Technetium-99 by Liquid Scintillation

## PAI 704_Tc99 Rev 12

## Sample Results

**Lab Name:** ALS -- Fort Collins
**Work Order Number:** 1908378
**Client Name:** CH2M HILL Plateau Remediation Company
**ClientProject ID:** AEA, August 2019 I19-025

**Field ID:** B3PV89
**Lab ID:** 1908378-4

**Analysis ReqCode:** TC99_SEP_LSC

**Sample Matrix:** WATER
**Prep SOP:** PAI 755 Rev 12
**Date Collected:** 14-Aug-19
**Date Prepared:** 28-Aug-19
**Date Analyzed:** 04-Sep-19

**Prep Batch:** TC190828-2
**QCBatchID:** TC190828-2-1
**Run ID:** TC190828-2A
**Count Time:** 30 minutes
**Report Basis:** Unfiltered

**Final Aliquot:** 100 ml
**Prep Basis:** Unfiltered
**Moisture(%):** NA
**Result Units:** pCi/l
**File Name:** Z20190903_0906

| CASNO | Target Nuclide | Result +/- 2 s TPU | MDC | Requested MDC | DL | Lab Qualifier |
|---|---|---|---|---|---|---|
| 14133-76-7 | Tc-99 | 3.59E+04 +/- 5.71E+03 | 5.79E+00 | 2E+01 | NA | |

## Chemical Yield Summary

| Carrier/Tracer | Amount Added | Result | Units | Yield | Control Limits | Flag |
|---|---|---|---|---|---|---|
| Tc-99m | 4.660E+03 | 4.24E+03 | Pci | 90.9 | 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:** *TC1908378-1*

# Prep Batch ID: TC190828-2

**Start Date:** 08/28/19
**Start Time:** 12:32
**Prep Analyst:** John C. Petrovic

**End Date:** 08/28/19
**End Time:** 12:32

**Concentration Method:** NONE
**Extract Method:** PAI 75512
**Initial Volume Units:** ml
**Final Volume Units:** ml

**Batch Created By:** jcp
**Date Created:** 08/28/19
**Time Created:** 12:32
**Validated By:** jcp
**Date Validated:** 08/29/19
**Time Validated:** 10:14

**Comments:**

**QC Batch ID:** TC190828-2-1

| Lab ID | QC Type | Field ID | Matrix | Date Collected | Initial Wt/Vol | Final Wt/Vol | Cleanup Method | Cleanup DF | Order Number |
|---|---|---|---|---|---|---|---|---|---|
| TC190828-2 | MB | XXXXXX | WATER | XXXXXX | 250 | 250 | NONE | 1 | 1908376 |
| TC190828-2CB1 | MB | XXXXXX | WATER | XXXXXX | 250 | 250 | NONE | 1 | 1908376 |
| TC190828-2CB2 | MB | XXXXXX | WATER | XXXXXX | 250 | 250 | NONE | 1 | 1908376 |
| TC190828-2CB3 | MB | XXXXXX | WATER | XXXXXX | 250 | 250 | NONE | 1 | 1908376 |
| TC190828-2 | LCS | XXXXXX | WATER | XXXXXX | 250 | 250 | NONE | 1 | 1908376 |
| 1908376-8 | DUP | XXXXXX | WATER | XXXXXX | 100 | 100 | NONE | 1 | 1908376 |
| 1908376-8 | SMP | XXXXXX | WATER | XXXXXX | 100 | 100 | NONE | 1 | 1908376 |
| 1908378-1 | SMP | B3PTT7 | WATER | 8/14/2019 | 100 | 100 | NONE | 1 | 1908378 |
| 1908378-2 | SMP | B3PTT6 | WATER | 8/14/2019 | 100 | 100 | NONE | 1 | 1908378 |
| 1908378-3 | SMP | B3PV88 | WATER | 8/14/2019 | 100 | 100 | NONE | 1 | 1908378 |
| 1908378-4 | SMP | B3PV89 | WATER | 8/14/2019 | 100 | 100 | NONE | 1 | 1908378 |
| 1908559-2 | SMP | XXXXXX | WATER | XXXXXX | 100 | 100 | NONE | 1 | 1908559 |

**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 | |

ALS Laboratory Group - Fort Collins

# QUALITY ASSURANCE SUMMARY SHEET

PAR W.O. # / BATCH General
TEST Tc99
METHOD Prep
SOP/REV (PREP) 755
SOP/REV (ANAL) _____

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

CAS 8/12/09

$Tc99^m$ 711.2613.17 was used as a tracer for this batch. It has a half-life of 6 hours and therefore must be delivered the day of prep and diluted to a working level solution. The procedure noted below is standard for all $Tc99^m$ dilutions.

1. Open the Pb shielded container and carefully remove the vial containing the Tc99m primary standard.
2. Withdraw a 1 mL aliquot of the $Tc99^m$ primary standard from the vial using a 10 mL syringe fitted with a hypodermic needle. Dispense the aliquot into a disposable beaker that contains ~100 mL of DI water. Cap and mix well. This intermediate solution is a 1/100x dilution of the primary standard.
3. Using a 10 mL syringe, transfer 10 mL of the intermediate solution prepared in step 2 into a disposable beaker that contains ~70 mL of DI water. Cap and mix well. This working standard solution is a 1/800x dilution of the primary standard.

CAS 8/12/09

CAS 8/12/09

Attach vendor lab

CardinalHealth
CARDINAL HEALTH 414, LLC
DENVER
10400 48TH AVE,STE B
DENVER CO 80238
303 373.0579

**Rx# 803002**
Date Ordered : 28Aug2019
Date/Time Prepared : 29Aug2019 00:10 MT
**ALS LABORATORY GROUP**
225 COMMERCE DR
FORT COLLINS CO 80524-2762
1 0430 Fort Collins

Safetrac™ CH102984

Patient : **Per Physician Order**

CAUTION
RADIOACTIVE MATERIALS

Product : Tc-99m **Sodium Pertechnetate Unit Dose mCi (HC**
Disp Amt : **0.52 mCi**
Calibration: **29Aug2019 08:00 MT**
Patient ID :
Ordered Amount : 0.50 mCi
Volume : 10.00 mL
Conc : 0.05 mCi/mL

Source - Not for Human Use For Calibration Use Only
Indication : **Point Source mCi**
Dispense Date : 29Aug2019 Lot# : E19241-0001 Price(est) : N/A
Use By : 30Aug2019 00:10 MT Physician : Charles Orchard, RSO NPT :
Notes NDC : RPh : A.Worthem

Caution: Federal law prohibits dispensing without a prescription. - Rx only; All Tc-99m drugs are below 0.15 uCi of Mo-99/mCi of Tc-99m at BUD

TECHNICIAN/ANALYST Crystal Sheppler DATE 8/12/09

DEPARTMENT MANAGER _____ DATE 8/12/09

378636

ALS Laboratory Group - Fort Collins

# QUALITY ASSURANCE SUMMARY SHEET

PAR W.O. # / BATCH Generic
TEST Tc99
METHOD Prep
SOP/REV (PREP) 755
SOP/REV (ANAL) _____

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

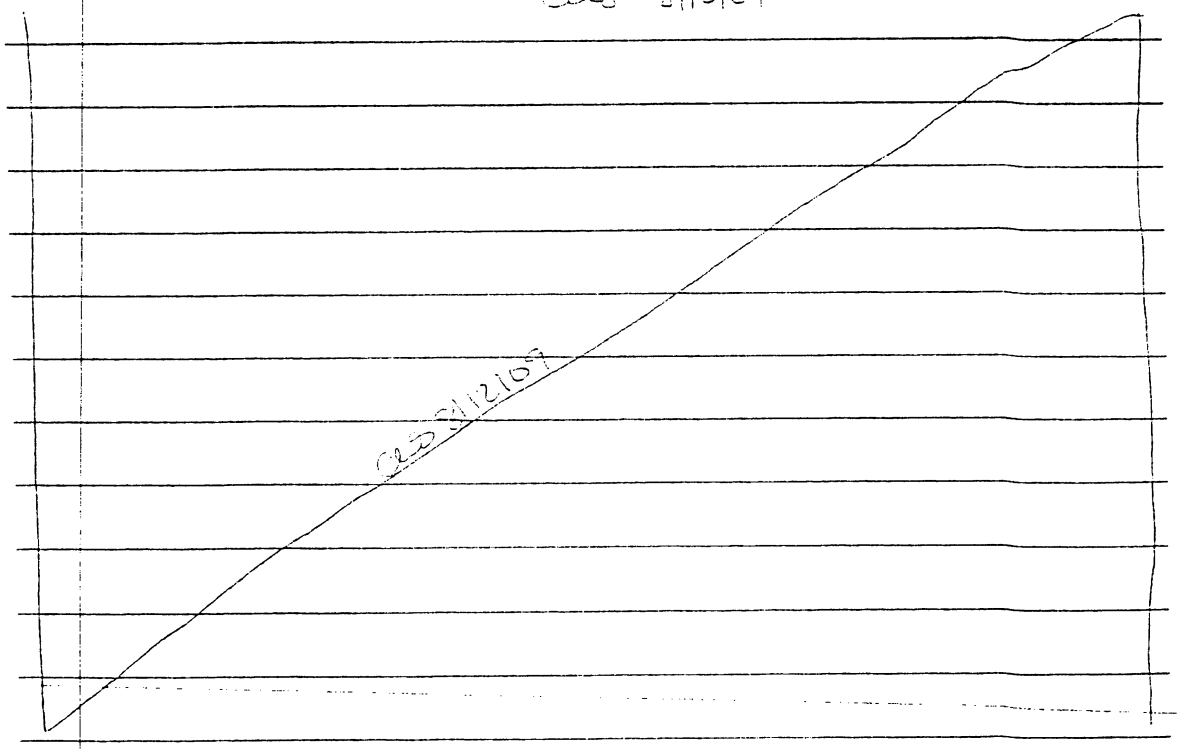
CWS 8/12/09

CWS 8/12/09

CWS 8/12/09

Due to possible matrix interference, a ferric hydroxide precipitation was performed on all samples per SOP 755, section 8.2.10

CWS 8/12/09




TECHNICIAN/ANALYST Courtney Shewfelt DATE 8/12/09

DEPARTMENT MANAGER [signature] DATE 8/12/09

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