

Analytical Data Package Prepared For
CH2M Hill Plateau Remediation

Radiochemical Analysis By
TestAmerica Inc

2800 G.W. Way, Richland Wa, 99354, (509)-375-3131.

Assigned Laboratory Code: TARL

Data Package Contains 14 Pages

Report No.: 67640

Results in this report relate only to the sample(s) analyzed.

| SDG No. | Order No. | Client Sample ID (List Order) | Lot-Sa No. | Work Order | Report DB ID | Batch No. |
|---------|-----------|-------------------------------|-------------|------------|--------------|-----------|
| W07301 | X15-051 | B32JK3 | J5J290412-1 | M7T0G1AA | 9M7T0G10 | 5302030 |



Certificate of Analysis

CH2M Hill Plateau Remediation Company
 P.O. Box 1600
 Mail Stop – R3-60
 Richland, WA 99352

November 20, 2015

Attention: Scot Fitzgerald

| | | |
|-------------------|---|------------------|
| SAF Number | : | X15-051 |
| Date SDG Closed | : | October 29, 2015 |
| Number of Samples | : | One (1) |
| Sample Type | : | Water |
| SDG Number | : | W071301 |
| Data Deliverable | : | 21-Day / Summary |

CASE NARRATIVE

I. Introduction

On October 29, 2015, one sample was received at TestAmerica (TARL). Upon receipt, the sample was assigned laboratory ID numbers to correspond with the CH2M specific IDs.

II. Sample Receipt

The sample was received in good condition and no anomalies were noted during check-in.

III. Analytical Results/Methodology

The analytical results for this report are presented by laboratory sample ID. Each set of data includes sample identification information, analytical results and the appropriate associated statistical errors.

The requested analyses were:

Liquid Scintillation Counting
 Mid-Level Tritium by method RL-LSC-005

CH2M Hill Plateau Remediation Company
November 20, 2015

IV. Quality Control

The analytical results for each analysis performed includes a minimum of one laboratory control sample (LCS), one method (reagent) blank, and one duplicate sample analysis. Any exceptions have been noted in the "Comments" section.

QC and sample results are reported in the same units.

V. Comments

Liquid Scintillation Counting

Mid-Level Tritium by method RL-LSC-005:

No analytical or quality issues were noted. The sample results and associated batch QC results are within contractual requirements.

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.

Reviewed and approved:



Digitally signed by
Whitney Ritari
Date: 2015.11.20
12:18:20 -08'00'

Whitney Ritari
Project Manager

Drinking Water Method Cross References

| DRINKING WATER ASTM METHOD CROSS REFERENCES | | |
|---|-------------------------------|--------------------------------|
| Referenced Method | Isotope(s) | TestAmerica Richland's SOP No. |
| EPA 901.1 | Cs-134, I-131 | RL-GAM-001 |
| EPA 900.0 | Alpha & Beta | RL-GPC-001 |
| EPA 00-02 | Gross Alpha (Coprecipitation) | RL-GPC-002 |
| EPA 903.0 | Total Alpha Radium (Ra-226) | RL-RA-002 |
| EPA 903.1 | Ra-226 | RL-RA-001 |
| EPA 904.0 | Ra-228 | RL-RA-001 |
| EPA 905.0 | Sr-89/90 | RL-GPC-003 |
| ASTM D5174 | Uranium | RL-KPA-003 |
| EPA 906.0 | Tritium | RL-LSC-005 |
| | | |
| | | |

Results in this report relate only to the sample(s) analyzed.

Uncertainty Estimation

TestAmerica Richland has adopted the internationally accepted approach to estimating uncertainties described in "NIST Technical Note 1297, 1994 Edition". The approach, "Law of Propagation of Errors", involves the identification of all variables in an analytical method which are used to derive a result. These variables are related to the analytical result (R) by some functional relationship, $R = \text{constants} * f(x,y,z,\dots)$. The components (x,y,z) are evaluated to determine their contribution to the overall method uncertainty. The individual component uncertainties (u_i) are then combined using a statistical model that provides the most probable overall uncertainty value. All component uncertainties are categorized as type A, evaluated by statistical methods, or type B, evaluated by other means. Uncertainties not included in the components, such as sample homogeneity, are combined with the component uncertainty as the square root of the sum-of-the-squares of the individual uncertainties. The uncertainty associated with the derived result is the combined uncertainty (u_c) multiplied by the coverage factor (1,2, or 3).

When three or more sample replicates are used to derive the analytical result, the type A uncertainty is the standard deviation of the mean value (S/\sqrt{n}), where S is the standard deviation of the derived results. The type B uncertainties are all other random or non-random components that are not included in the standard deviation.

The derivation of the general "Law of Propagation of Errors" equations and specific example are available on request.

Report Definitions

| | |
|--|--|
| Action Lev | An agreed upon activity level used to trigger some action when the final result is greater than or equal to the Action Level. Often the Action Level is related to the Decision Limit. |
| Batch | The QC preparation batch number that relates laboratory samples to QC samples that were prepared and analyzed together. |
| Bias | Defined by the equation (Result/Expected)-1 as defined by ANSI N13.30. |
| COC No | Chain of Custody Number assigned by the Client or TestAmerica. |
| Count Error (#s) | Poisson counting statistics of the gross sample count and background. The uncertainty is absolute and in the same units as the result. For Liquid Scintillation Counting (LSC) the batch blank count is the background. |
| CSU (#s) <i>u_c Combined Standard Uncert.</i> | All known uncertainties associated with the preparation and analysis of the sample are propagated to give a measure of the uncertainty associated with the result, <i>u_c the combined standard uncertainty</i> . The uncertainty is absolute and in the same units as the result. |
| (#s), Coverage Factor | The coverage factor defines the width of the confidence interval, 1, 2 or 3 standard deviations. |
| CRDL (RL) | Contractual Required Detection Limit as defined in the Client's Statement Of Work or TestAmerica "default" nominal detection limit. Often referred to the reporting level (RL) |
| Lc | Decision Level based on instrument background or blank, adjusted by the Efficiency, Chemical Yield, and Volume associated with the sample. The Type I error probability is approximately 5%. $Lc = (1.645 * \sqrt{2 * (BkgrndCnt / BkgrndCntMin) / SCntMin}) * (ConvFct / (Eff * Yld * Abn * Vol) * IngrFct)$. For LSC methods the batch blank is used as a measure of the background variability. Lc cannot be calculated when the background count is zero. |
| Lot-Sample No | The number assigned by the LIMS software to track samples received on the same day for a given client. The sample number is a sequential number assigned to each sample in the Lot. |
| MDC MDA | Detection Level based on instrument background or blank, adjusted by the Efficiency, Chemical Yield, and Volume with a Type I and II error probability of approximately 5%. $MDC = (4.65 * \sqrt{(BkgrndCnt / BkgrndCntMin) / SCntMin} + 2.71 / SCntMin) * (ConvFct / (Eff * Yld * Abn * Vol) * IngrFct)$. For LSC methods the batch blank is used as a measure of the background variability. |
| Primary Detector | The instrument identifier associated with the analysis of the sample aliquot. |
| Ratio U-234/U-238 | The U-234 result divided by the U-238 result. The U-234/U-238 ratio for natural uranium in NIST SRM 4321C is 1.038. |
| Rst/MDC | Ratio of the Result to the MDC. A value greater than 1 may indicate activity above background at a high level of confidence. Caution should be used when applying this factor and it should be used in concert with the qualifiers associated with the result. |
| Rst/TotUcert | Ratio of the Result to the Total Uncertainty. If the uncertainty has a coverage factor of 2 a value greater than 1 may indicate activity above background at approximately the 95% level of confidence assuming a two-sided confidence interval. Caution should be used when applying this factor and it should be used in concert with the qualifiers associated with the result. |
| Report DB No | Sample Identifier used by the report system. The number is based upon the first five digits of the Work Order Number. |
| RER | The equation Replicate Error Ratio = $(S - D) / [\sqrt{TPUs^2 + TPUD^2}]$ as defined by ICPT BOA where S is the original sample result, D is the result of the duplicate, TPUs is the total uncertainty of the original sample and TPUD is the total uncertainty of the duplicate sample. |
| SDG | Sample Delivery Group Number assigned by the Client or assigned by TestAmerica upon sample receipt. |
| Sum Rpt Alpha Spec Rst(s) | The sum of the reported alpha spec results for tests derived from the same sample excluding duplicate result where the results are in the same units. |
| Work Order | The LIMS software assign test specific identifier. |
| Yield | The recovery of the tracer added to the sample such as Pu-242 used to trace a Pu-239/40 method. |

CH2MHill Plateau Remediation Company

C.O.C. # **X15-051-016**
Page 1 of 1

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

Collector **K.C. Patterson/CHPRC** Telephone No. **376-4650**

SAF No. **X15-051** Purchase Order/Charge Code **302869**

Project Title **200-BP-5 Treatability Test - Week 1** Ice Chest No. **N/A**

Shipped To (Lab) **TestAmerica Incorporated, Richland** Bill of Lading/Air Bill No. **N/A**

Protocol **CERCLA** Priority: **21 Days** Offsite Property No. **N/A**

POSSIBLE SAMPLE HAZARDS/REMARKS

*Contains Radioactive Material at concentrations that are not be regulated for transportation per 49 CFR/IATA Dangerous Goods Regulations but are not releasable per DOE Order 458.1.

SPECIAL INSTRUCTIONS **Hold Time** Total Activity Exemption: Yes No

Priority: 21 Days

| Sample No. | Filter | * | Date | Time | No/Type Container | Sample Analysis | Holding Time | Preservative |
|------------|--------|---|-------------|------|-------------------|-----------------------------|--------------|--------------|
| B32JK3 | N | W | OCT 29 2015 | 0816 | 1x1-LP | 906.0ML_TRITIUM_LSC: COMMON | 6 Months | None |

NATTOG

J5J290412
SDG# W07301



| Relinquished By | Print | Sign | Received By | Print | Sign | Date/Time | Date/Time | Matrix * |
|----------------------|-------|------|-----------------|-------|------|------------------|------------------|--|
| K.C. Patterson/CHPRC | | | F.M. Hall/CHPRC | | | OCT 29 2015 0825 | OCT 29 2015 0825 | S = Soil, SE = Sediment, SO = Solid, SL = Sludge, W = Water, O = Oil, A = Air, DS = Drum Solids, DL = Drum Liquids, T = Tissue, WI = Wipe, L = Liquid, V = Vegetation, X = Other |
| Relinquished By | | | J. Friesz, TARI | | | OCT 29 2015 0945 | OCT 29 2015 0945 | |
| Relinquished By | | | | | | OCT 29 2015 | | |
| Relinquished By | | | | | | | | |

FINAL SAMPLE DISPOSITION

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

Disposd By

Date/Time

Sample Check-in List

Date/Time Received: 10/29/15 0945 Container GM Screen Result: (Airlock) 0 cpm Initials [F]
Sample GM Screen Result (Sample Receiving) 0 cpm Initials [F]

Client: PGW SDG #: W07301 SAF #: X15-051 NA []

Lot Number: A JF 10/29/15 J5J290412

Chain of Custody # X15-051-016

Shipping Container ID or Air Bill Number : NA [F]

Samples received inside shipping container/cooler/box Yes [F] Continue with 1 through 4. Initial appropriate response.
No [] Go to 5, add comment to #16.

- 1. Custody Seals on shipping container intact? Yes [] No [] No Custody Seal [F]
2. Custody Seals dated and signed? Yes [] No [] No Custody Seal [F]
3. Cooler temperature: 7.1 °C SNATCE NA []
4. Vermiculite/packing materials is NA [F] Wet [] Dry []

Item 5 through 16 for samples. Initial appropriate response.

- 5. Chain of Custody record present? Yes [F] No []
6. Number of samples received (Each sample may contain multiple bottles): 1
7. Containers received: 1 xlp

- 8. Sample holding times exceeded? NA [] Yes [] No [F]
9. Samples have: tape hazard labels F custody seals F appropriate sample labels
10. Matrix: A (FLT, Wipe, Solid, Soil) F I (Water) S (Air, Niosh 7400) T (Biological, Ni-63)

11. Samples: F are in good condition are leaking are broken
have air bubbles (Only for samples requiring no head space) Other

- 12. Sample pH appropriate for analysis requested Yes [F] No [] NA []
(If acidification is necessary go to pH area & document sample ID, initial pH, amount of HNO3 added and pH after addition on table)
13. Were any anomalies identified in sample receipt? Yes [] No [F]
14. Description of anomalies (include sample numbers): NA [F]

15. Sample Location, Sample Collector Listed on COC? * Yes [F] No []
*For documentation only. No corrective action needed.

16. Additional Information: N/A

[] Client/Courier denied temperature check. [F] Client/Courier unpack cooler.

Sample Check-in List completed by Sample Custodian:
Signature: [Signature] Date: 10/29/15

Client Notification needed? Yes [] No [F] Date:
By:
Person contacted:

[F] No action necessary; process as is
Project Manager: [Signature] Date: 10-21-15

Sample Results Summary

Date: 20-Nov-15

TestAmerica Inc TARL

Ordered by Method, Batch No., Client Sample ID.

Report No. : 67640

SDG No: W07301

| Batch | Client Id Work Order | Parameter | Result +- CSU (2 s) | Qual | Units | Tracer Yield | MDL | CRDL | RPD |
|---------|-------------------------|-----------|----------------------|------|-------|-----------------|----------|----------|-----|
| 5302030 | 906.0ML_H3_LSC | | | | | | | | |
| | B32JK3 | | | | | | | | |
| | M7T0G1AA | H-3 | 1.20E+04 +- 1.3E+03 | | pCi/L | 100% | 2.33E+01 | 2.50E+01 | |
| | B32JK3 DUP | | | | | | | | |
| | M7T0G1AD | H-3 | 1.17E+04 +- 1.3E+03 | | pCi/L | 100% | 2.29E+01 | 2.50E+01 | 2.6 |
| | No. of Results: | 2 | | | | | | | |

TestAmerica Inc RPD - Relative Percent Difference.

rptTALRchSaSum
mary2 V5.4.1
A2002

QC Results Summary
TestAmerica Inc TARL
 Ordered by Method, Batch No, QC Type,.

Date: 20-Nov-15

Report No. : 67640

SDG No.: W07301

| Batch | Work Order | Parameter | Result +- CSU (2 s) | Qual | Units | Tracer Yield | LCS Recovery | Bias | MDL |
|--------------------------|----------------------|-----------|----------------------|------|-------|--------------|--------------|------|----------|
| 906.0ML_H3_LSC | | | | | | | | | |
| 5302030 | MATRIX SPIKE, B32JK3 | | | | | | | | |
| | M7T0G1AC | H-3 | 1.39E+03 +- 2.0E+03 | | pCi/L | 100% | 92% | -0.1 | 2.75E+01 |
| 5302030 | BLANK QC, | | | | | | | | |
| | M7T201AA | H-3 | 2.49E+01 +- 3.1E+01 | U | pCi/L | 100% | | | 2.53E+01 |
| 5302030 | LCS, | | | | | | | | |
| | M7T201AC | H-3 | 7.59E+03 +- 8.6E+02 | | pCi/L | 100% | 84% | -0.2 | 2.62E+01 |
| No. of Results: 3 | | | | | | | | | |

TestAmerica Inc Bias - (Result/Expected)-1 as defined by ANSI N13.30.
 rptSTLRchQcSummary V5.4.1 A2002 U Qual - Analyzed for but not detected above limiting criteria, Mdc/Mda/Mdl, Total Uncert, RDL or not identified by gamma scan software.

FORM I

Date: 20-Nov-15

SAMPLE RESULTS

Lab Name: TestAmerica Inc
 Lot-Sample No.: J5J290412-1
 Client Sample ID: B32JK3

SDG: W07301
 Report No.: 67640
 COC No.: X15-051-016
 Collection Date: 10/29/2015 8:16:00 AM
 Received Date: 10/29/2015 9:45:00 AM
 Matrix: WATER

Ordered by Client Sample ID, Batch No.

| Parameter | Result | Qual | Count Error (2 s) | CSU (2 s) | MDL, Action Lev | Rpt Unit, Lc | Yield CRDL(RL) | Rst/MDL, Rst/TotUcert | Analysis, Prep Date | Total Sa Size | Aliquot Size | Primary Detector |
|----------------|----------------|------|--------------------|-----------|----------------------|------------------------|----------------|-----------------------|---------------------|---------------|--------------|------------------|
| Batch: 5302030 | 906.0ML_H3_LSC | | | | Work Order: M7T0G1AA | Report DB ID: 9M7T0G10 | | | | | | |
| H-3 | 1.20E+04 | | 7.3E+01 | 1.3E+03 | 2.33E+01 pCi/L | 1.15E+01 | 100% | (515.1) | 11/7/15 10:02 a | | 0.01002 | LSCQ1 |
| | | | | | | 2.50E+01 | | (17.8) | | | L | |

No. of Results: 1 Comments:

FORM II

Date: 20-Nov-15

DUPLICATE RESULTS

Lab Name: TestAmerica Inc
 Lot-Sample No.: J5J290412-1
 Client Sample ID: B32JK3 DUP

SDG: W07301
 Report No.: 67640
 COC No.: X15-051-016
 Matrix: WATER

Collection Date: 10/29/2015 8:16:00 AM
 Received Date: 10/29/2015 9:45:00 AM

| Parameter | Result, Orig Rst | Qual | Count Error (2 s) | CSU (2 s) | MDL, Action Lev | Rpt Unit, CRDL | Yield | Rst/MDL, Rst/TotUcert | Analysis, Prep Date | Total Sa Size | Aliquot Size | Primary Detector |
|----------------|---------------------|------|-----------------------|---------------|--------------------|-------------------|-------|--------------------------|-------------------------|------------------|-----------------|---------------------|
| Batch: 5302030 | 906.0ML_H3_LSC | | | | | | | | | | | |
| H-3 | 1.17E+04 | | 7.2E+01 | 1.3E+03 | 2.29E+01 | pCi/L | 100% | (510.2) | 11/7/15 10:02 a | | 0.01003 | LSCQ1 |
| | 1.20E+04 | | RPD 2.6 | | | 2.50E+01 | | (17.8) | Orig Sa DB ID: 9M7T0G10 | | L | |

No. of Results: 1 Comments:

11 of 14

FORM II
BLANK RESULTS

Date: 20-Nov-15

Lab Name: TestAmerica Inc SDG: W07301
 Matrix: WATER Report No.: 67640

| Parameter | Result | Qual | Count Error (2 s) | CSU (2 s) | MDL, Lc | Rpt Unit, CRDL | Yield | Rst/MDL, Rst/TotUcert | Analysis, Prep Date | Total Sa Size | Aliquot Size | Primary Detector |
|--|----------|------|--------------------|-----------|----------|----------------|-------|-----------------------|---------------------|---------------|--------------|------------------|
| Batch: 5302030 906.0ML_H3_LSC Work Order: M7T201AA Report DB ID: M7T201AB | | | | | | | | | | | | |
| H-3 | 2.49E+01 | U | 2.7E+01 | 3.1E+01 | 2.53E+01 | pCi/L | 100% | 0.98 | 11/7/15 10:02 a | 0.01003 | L | LSCQ1 |
| | | | | | 1.25E+01 | 2.50E+01 | | (1.6) | | | | |

No. of Results: 1 Comments:

FORM II
LCS RESULTS

Date: 20-Nov-15

Lab Name: TestAmerica Inc SDG: W07301
 Matrix: WATER Report No.: 67640

| Parameter | Result | Qual | Count Error (2 s) | CSU (2 s) | MDL | Report Unit | Yield | Expected | Expected Uncert | Recovery, Bias | Analysis, Prep Date | Aliquot Size | Primary Detector |
|----------------------|----------------|------|--------------------|------------|----------|-------------|------------------------|----------|-----------------|----------------|---------------------|--------------|------------------|
| Batch: 5302030 | 906.0ML_H3_LSC | | | | | | | | | | | | |
| | | | 6.6E+01 | 8.6E+02 | 2.62E+01 | pCi/L | 100% | 9.02E+03 | 2.7E+02 | 84% | 11/7/15 10:02 a | 0.01001 | LSCQ1 |
| | 7.59E+03 | | | | | | | | | -0.2 | | L | |
| Work Order: M7T201AC | | | | | | | Report DB ID: M7T201CS | | | | | | |
| Rec Limits: | | | | | | | 70 130 | | | | | | |

No. of Results: 1 Comments:

13 of 14

FORM II

Date: 20-Nov-15

MATRIX SPIKE RESULTS

Lab Name: TestAmerica Inc SDG: W07301 Matrix: WATER
 Lot-Sample No.: J5J290412-1, B32JK3 Report No.: 67640

| Parameter | SpikeResult, Orig Rst | Count Error (2 s) | CSU (2 s) | MDC MDA | Rpt Unit | Yield | Rec-covery | Expected, Uncert | Analysis, Prep Date | Aliquot Size | Analy Method, Primary Detector |
|----------------|-----------------------|------------------------|------------------------|----------|----------|-------------------------|------------|------------------|---------------------|--------------|--------------------------------|
| Batch: 5302030 | Work Order: M7T0G1AC | Report DB ID: M7T0G1CW | Report DB ID: M7T0G1CW | | | Orig Sa DB ID: 9M7T0G10 | | | | | |
| H-3 | 1.39E+03 | 8.4E+01 | 2.0E+03 | 2.75E+01 | pCi/L | 100% | 92.46% | 1.50E+03 | 11/7/15 10:02 a | 0.00859 | 906.0ML_H3_LSC |
| | 1.20E+04 | | | | | | | 4.5E+01 | | L | LSCQ1 |

Number of Results: 1

Comments:

14 of 14

TestAmerica Inc RER - Replicate Error Ratio = (S-D)/[sqrt(sq(TPUs)+sq(TPUd))] as defined by ICPT BOA.
 rptSTLrchMs Bias - (Result/Expected)-1 as defined by ANSI N13.30.
 V5.4.1 A2002