

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045
Tel: (314)298-8566

TestAmerica Job ID: 160-14366-1
Client Project/Site: HDP

For:
Perma-Fix Environmental Services Inc.
2800 Solway Road
Knoxville, Tennessee 37931

Attn: Brian Miller

Rhonda Ridenhower

Authorized for release by:
10/26/2015 1:30:26 PM
Rhonda Ridenhower, Manager of Project Management
rhonda.ridenhower@testamericainc.com

Designee for
Ivan Vania, Project Manager II
(314)298-8566
ivan.vania@testamericainc.com

LINKS

Review your project
results through
TotalAccess

Have a Question?



Visit us at:
www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

1

2

3

4

5

6

7

8

9

10

11

12



Table of Contents

Cover Page	1
Table of Contents	2
Case Narrative	3
Chain of Custody	5
Receipt Checklists	6
Definitions/Glossary	7
Method Summary	8
Sample Summary	9
Client Sample Results	10
QC Sample Results	12
QC Association Summary	15
Tracer Carrier Summary	17

Case Narrative

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Job ID: 160-14366-1

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Perma-Fix Environmental Services Inc.

Project: HDP

Report Number: 160-14366-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 10/20/2015; the samples arrived in good condition, properly preserved. The temperature of the coolers at receipt was 20.3 C.

TECHNETIUM-99 (ICPMS)

Samples L03-02-25-P-S-B-00 (160-14366-1) and L03-02-26-P-S-B-00 (160-14366-2) were analyzed for Technetium-99 (ICPMS) in accordance with EPA SW-846 Method 6020A. The samples were prepared on 10/20/2015 and analyzed on 10/22/2015.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

PERCENT SOLIDS

Samples L03-02-25-P-S-B-00 (160-14366-1) and L03-02-26-P-S-B-00 (160-14366-2) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 10/21/2015.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Case Narrative

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Job ID: 160-14366-1 (Continued)

Laboratory: TestAmerica St. Louis (Continued)

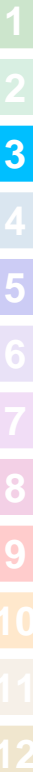
CESIUM-137 & OTHER GAMMA EMITTERS (GS)

Samples L03-02-25-P-S-B-00 (160-14366-1) and L03-02-26-P-S-B-00 (160-14366-2) were analyzed for Cesium-137 & Other Gamma Emitters (GS) in accordance with DOE GA-01-R. The samples were dried on 10/20/2015, prepared on 10/21/2015 and analyzed on 10/22/2015.

The replicate error ratio was outside of the acceptance limits of 1 for protactinium-231. Both the sample and duplicate activity were less than the MDC. The data is reported. L03-02-25-P-S-B-00 (160-14366-1), L03-02-26-P-S-B-00 (160-14366-2), (LCS 160-217683/2-A), (MB 160-217683/1-A), (160-14346-A-1-C) and (160-14346-A-1-D DU)

Radium-226 is reported in these samples at the client's request. Radium-226 is reported from the 609.31 keV line of bismuth-214. Because the samples have not had a 21-day ingrowth, the activity for radium-226 is an estimated value and may be biased low. This bias is caused by the disruption of secular equilibrium between radium-226 and bismuth-214 by the loss of radon-222 during sample preparation. L03-02-25-P-S-B-00 (160-14366-1), L03-02-26-P-S-B-00 (160-14366-2), (LCS 160-217683/2-A), (MB 160-217683/1-A), (160-14346-A-1-C) and (160-14346-A-1-D DU)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.



Earth City, MO 63045
phone 314.298.8566 fax

Regulatory Program: DW NPDES RCRA Other:

TestAmerica Laboratories, Inc.

Client Contact Perma-Fix Environmental Services 2800 Solway Road Knoxville, TN 37931 (865) 690-0501 Phone (865) 539-9868 FAX Project Name: Hematite Decommissioning Project Site: Westinghouse Hematite, MO P O # 832953		Project Manager: Brian Miller Tel/Fax: (314) 810-3333		Site Contact: Ellen Jakub Lab Contact: Ivan Vania		Date: 10/20/2015 Carrier: Courier		COC No: 102015-FSS1 1 of 1 COCs Sampler: For Lab Use Only: Walk-in Client: Lab Sampling: Job / SDG No.:			
		Analysis Turnaround Time <input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS TAT if different from Below _____ <input type="checkbox"/> 2 weeks <input checked="" type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day									
Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Gamma Spec Westinghouse Hematite Library	Alpha Spec	ICP/MS (Tc-99) Gamma Spec (With post-21 day ingrowth)	Sample Specific Notes:
L03-02-25-P-S-B-00	10/19/15	1545	G	Soil	1	N	X	X	X		Matt Cushman
L03-02-26-P-S-B-00	10/19/15	1535	G	Soil	1	N	X	X	X		Matt Cushman
N / A											
Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4= HNO3, 5= NaOH, 6= Other None						Possible Hazard Identification: Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample. <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown					
						Sample Disposal (A fee may be assessed if samples are retained longer than 1 month). <input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months					
Special Instructions/QC Requirements & Comments: Potential for Radiological Contamination											
Custody Seals Intact: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No.:		Cooler Temp. (°C): Obs'd: _____ Corr'd: _____		Therm ID No.:					
Relinquished by: <i>Brian Miller</i>		Company: Perma-Fix		Date/Time: 10-20-15/0905		Received by: <i>K. Miller</i>		Company: Cross Roads		Date/Time: 10-20-15 09:05	
Relinquished by: <i>K. Miller</i>		Company: Cross Roads		Date/Time: 10-20-15/1110		Received by: <i>Debra O'Brien</i>		Company: Abstracts		Date/Time: 10-20-15/1110	
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:	

160-14366 Chain of Custody



Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-14366-1

Login Number: 14366

List Number: 1

Creator: Clarke, Jill C

List Source: TestAmerica St. Louis

Question	Answer	Comment
Radioactivity wasn't checked or is \leq background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <math><6\text{mm}</math> (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Definitions/Glossary

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Qualifiers

Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.
F	Duplicate RPD exceeds the control limit

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Method Summary

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Method	Method Description	Protocol	Laboratory
6020A	Metals (ICP/MS), Tc-99	SW846	TAL SL
Moisture	Percent Moisture	EPA	TAL SL
6020A	Metals (ICP/MS), Tc-99 in Activity	SW846	TAL SL
GA-01-R	Cesium-137 & Other Gamma Emitters (GS)	DOE	TAL SL

Protocol References:

DOE = U.S. Department of Energy

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566



Sample Summary

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-14366-1	L03-02-25-P-S-B-00	Solid	10/19/15 15:45	10/20/15 11:10
160-14366-2	L03-02-26-P-S-B-00	Solid	10/19/15 15:35	10/20/15 11:10

1

2

3

4

5

6

7

8

9

10

11

12

Client Sample Results

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Client Sample ID: L03-02-25-P-S-B-00

Lab Sample ID: 160-14366-1

Date Collected: 10/19/15 15:45

Matrix: Solid

Date Received: 10/20/15 11:10

Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.13		0.114	0.161		0.116	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Americium 241	-0.00257	U	0.101	0.101		0.106	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Bismuth 212	1.58		0.535	0.559		0.457	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Bismuth 214	0.829		0.107	0.136		0.0796	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Lead 212	0.999		0.0871	0.156		0.0794	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Lead 214	0.933		0.0843	0.129		0.0713	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Potassium 40	17.4		1.24	2.15		1.16	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Protactinium 234m	2.74	U	2.16	2.17		5.35	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Protactinium 231	0.422	U	0.219	0.224		1.22	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Radium 226	0.829		0.107	0.136		0.0796	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Thorium 234	1.07		0.358	0.375		0.943	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Uranium 235	0.0857	U	0.144	0.145		0.228	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Thorium 232	1.13		0.114	0.161		0.116	pCi/g	10/21/15 13:17	10/22/15 19:10	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.362		0.0493	0.0618		0.0369	pCi/g	10/21/15 13:17	10/22/15 19:10	1

Client Sample ID: L03-02-25-P-S-B-00

Lab Sample ID: 160-14366-1

Date Collected: 10/19/15 15:45

Matrix: Solid

Date Received: 10/20/15 11:10

Percent Solids: 91.6

Method: 6020A - Metals (ICP/MS), Tc-99

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99		ND	0.000065	0.000019	mg/Kg	☼	10/20/15 15:03	10/22/15 11:11	1

Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Technetium 99	0.0222	U	0.117	0.117	1.30	0.222	pCi/g	10/20/15 15:03	10/22/15 11:11	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	85		30 - 110					10/20/15 15:03	10/22/15 11:11	1

Client Sample ID: L03-02-26-P-S-B-00

Lab Sample ID: 160-14366-2

Date Collected: 10/19/15 15:35

Matrix: Solid

Date Received: 10/20/15 11:10

Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.960		0.0967	0.138		0.0810	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Americium 241	0.00885	U	0.0496	0.0496		0.0835	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Bismuth 212	1.32		0.342	0.369		0.275	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Bismuth 214	0.640		0.0704	0.0969		0.0430	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Lead 212	0.829		0.0657	0.126		0.0538	pCi/g	10/21/15 13:17	10/22/15 19:11	1

TestAmerica St. Louis

Client Sample Results

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Client Sample ID: L03-02-26-P-S-B-00

Lab Sample ID: 160-14366-2

Date Collected: 10/19/15 15:35

Matrix: Solid

Date Received: 10/20/15 11:10

Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS) (Continued)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Lead 214	0.798		0.0683	0.107		0.0603	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Potassium 40	16.3		1.00	1.95		0.267	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Protactinium 234m	0.747	U	1.93	1.93		3.46	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Protactinium 231	-0.535	U	0.635	0.638		1.04	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Radium 226	0.640		0.0704	0.0969		0.0430	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Thorium 234	1.17		0.415	0.433		0.644	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Uranium 235	0.106	U	0.125	0.126		0.198	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Thorium 232	0.960		0.0967	0.138		0.0810	pCi/g	10/21/15 13:17	10/22/15 19:11	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			(2σ+/-)	(2σ+/-)						
Tl-208	0.260		0.0395	0.0478		0.0315	pCi/g	10/21/15 13:17	10/22/15 19:11	1

Client Sample ID: L03-02-26-P-S-B-00

Lab Sample ID: 160-14366-2

Date Collected: 10/19/15 15:35

Matrix: Solid

Date Received: 10/20/15 11:10

Percent Solids: 80.7

Method: 6020A - Metals (ICP/MS), Tc-99

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99		ND	0.000075	0.000023	mg/Kg	☒	10/20/15 15:03	10/22/15 11:15	1

Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Technetium 99	0.265		0.103	0.106	1.50	0.257	pCi/g	10/20/15 15:03	10/22/15 11:15	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Re	83		30 - 110					10/20/15 15:03	10/22/15 11:15	1

QC Sample Results

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Method: 6020A - Metals (ICP/MS), Tc-99

Lab Sample ID: MB 160-217468/1-A
Matrix: Solid
Analysis Batch: 217906

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 217468

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Technetium 99	ND		0.000059	0.000018	mg/Kg		10/20/15 15:03	10/22/15 10:04	1

Lab Sample ID: LCS 160-217468/2-A
Matrix: Solid
Analysis Batch: 217906

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 217468

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	Limits
Technetium 99	0.00123	0.00127		mg/Kg		103	80 - 120

Lab Sample ID: 160-14364-A-14-E MS
Matrix: Solid
Analysis Batch: 217906

Client Sample ID: Matrix Spike
Prep Type: Total/NA
Prep Batch: 217468

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	Limits
Technetium 99	0.00019		0.00136	0.00157		mg/Kg	☼	101	75 - 125

Lab Sample ID: 160-14364-A-14-F MSD
Matrix: Solid
Analysis Batch: 217906

Client Sample ID: Matrix Spike Duplicate
Prep Type: Total/NA
Prep Batch: 217468

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	Limits	RPD	Limit
Technetium 99	0.00019		0.00136	0.00155		mg/Kg	☼	100	75 - 125	1	30

Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Lab Sample ID: MB 160-217468/1-A
Matrix: Solid
Analysis Batch: 217907

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 217468

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Technetium 99	-0.009764	U	0.0569	0.0569	1.19	0.203	pCi/g	10/20/15 15:03	10/22/15 10:04	1

Carrier	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Re	84		30 - 110	10/20/15 15:03	10/22/15 10:04	1

Lab Sample ID: LCS 160-217468/2-A
Matrix: Solid
Analysis Batch: 217907

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 217468

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	Limits
Technetium 99	21.1	21.68		9.84	1.16	0.198	pCi/g	103	80 - 120

Carrier	LCS %Yield	LCS Qualifier	Limits
Re	86		30 - 110

TestAmerica St. Louis

QC Sample Results

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Method: 6020A - Metals (ICP/MS), Tc-99 in Activity (Continued)

Lab Sample ID: 160-14364-A-14-E MS

Matrix: Solid

Analysis Batch: 217907

Client Sample ID: Matrix Spike

Prep Type: Total/NA

Prep Batch: 217468

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Technetium 99	3.17		23.3	26.81		12.7	1.30	0.222	pCi/g	101	75 - 125
Carrier	%Yield	MS Qualifier	Limits								
Re	85		30 - 110								

Lab Sample ID: 160-14364-A-14-F MSD

Matrix: Solid

Analysis Batch: 217907

Client Sample ID: Matrix Spike Duplicate

Prep Type: Total/NA

Prep Batch: 217468

Analyte	Sample Result	Sample Qual	Spike Added	MSD Result	MSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Technetium 99	3.17		23.3	26.58		11.4	1.32	0.226	pCi/g	100	75 - 125	0.01	1
Carrier	%Yield	MSD Qualifier	Limits										
Re	84		30 - 110										

Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS)

Lab Sample ID: MB 160-217683/1-A

Matrix: Solid

Analysis Batch: 217956

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 217683

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.001968	U	0.0284	0.0284		0.0547	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Americium 241	0.009685	U	0.0108	0.0109		0.0174	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Bismuth 212	-0.02393	U	0.0860	0.0860		0.160	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Bismuth 214	0.0008216	U	0.0157	0.0157		0.0343	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Lead 212	0.0007914	U	0.0105	0.0105		0.0215	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Lead 214	-0.01557	U	2.27	2.27		0.0348	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Potassium 40	0.01271	U	0.104	0.104		0.229	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Protactinium 234m	0.1981	U	0.993	0.994		1.88	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Protactinium 231	0.04909	U	0.144	0.145		0.259	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Radium 226	0.0008216	U	0.0157	0.0157		0.0343	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Thorium 234	0.06280	U	0.0787	0.0790		0.239	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Uranium 235	-0.006812	U	0.0418	0.0418		0.0603	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Thorium 232	0.001968	U	0.0284	0.0284		0.0547	pCi/g	10/21/15 13:17	10/22/15 16:29	1
Other Detected Radionuclides	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Other Detected Radionuclide	None						pCi/g	10/21/15 13:17	10/22/15 16:29	1

TestAmerica St. Louis

QC Sample Results

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Method: GA-01-R - Cesium-137 & Other Gamma Emitters (GS) (Continued)

Lab Sample ID: LCS 160-217683/2-A
Matrix: Solid
Analysis Batch: 217754

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 217683

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Americium 241	101	105.9		11.0		0.583	pCi/g	105	87 - 116
Cesium 137	34.4	39.46		4.08	0.200	0.184	pCi/g	115	87 - 120
Cobalt 60	33.6	37.45		3.71		0.129	pCi/g	111	87 - 115

Lab Sample ID: 160-14346-A-1-D DU
Matrix: Solid
Analysis Batch: 217756

Client Sample ID: Duplicate
Prep Type: Total/NA
Prep Batch: 217683

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	0.918		0.8889		0.146		0.106	pCi/g	0.10	1
Americium 241	0.00816	U	0.01831	U	0.0588		0.0984	pCi/g	0.09	1
Bismuth 212	1.58		1.202		0.459		0.376	pCi/g	0.40	1
Bismuth 214	0.801		0.7522		0.122		0.0660	pCi/g	0.20	1
Lead 212	0.948		0.9832		0.145		0.0499	pCi/g	0.12	1
Lead 214	0.876		0.8272		0.116		0.0567	pCi/g	0.21	1
Potassium 40	16.6		16.72		2.01		0.326	pCi/g	0.04	1
Protactinium 234m	5.54		3.419	U	2.58		4.70	pCi/g	0.38	1
Protactinium 231	0.425	U	-0.5922	U F	0.630		1.03	pCi/g	1.16	1
Radium 226	0.801		0.7522		0.122		0.0660	pCi/g	0.20	1
Thorium 234	1.94		2.244		0.566		0.759	pCi/g	0.26	1
Uranium 235	0.523		0.6231		0.208		0.233	pCi/g	0.27	1
Thorium 232	0.918		0.8889		0.146		0.106	pCi/g	0.10	1
Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Pb-210	1.65		1.507		0.683		0.804	pCi/g	0.10	1
Tl-208	0.329		0.3187		0.0533		0.0275	pCi/g	0.09	1

QC Association Summary

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Metals

Prep Batch: 217468

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14364-A-14-E MS	Matrix Spike	Total/NA	Solid	None	
160-14364-A-14-F MSD	Matrix Spike Duplicate	Total/NA	Solid	None	
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	None	
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	None	
LCS 160-217468/2-A	Lab Control Sample	Total/NA	Solid	None	
MB 160-217468/1-A	Method Blank	Total/NA	Solid	None	

Analysis Batch: 217906

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14364-A-14-E MS	Matrix Spike	Total/NA	Solid	6020A	217468
160-14364-A-14-F MSD	Matrix Spike Duplicate	Total/NA	Solid	6020A	217468
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	6020A	217468
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	6020A	217468
LCS 160-217468/2-A	Lab Control Sample	Total/NA	Solid	6020A	217468
MB 160-217468/1-A	Method Blank	Total/NA	Solid	6020A	217468

General Chemistry

Analysis Batch: 217496

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14363-A-1 DU	Duplicate	Total/NA	Solid	Moisture	
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	Moisture	
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	Moisture	

Rad

Leach Batch: 217185

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14346-A-1-D DU	Duplicate	Total/NA	Solid	Dry and Grind	

Leach Batch: 217466

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	Dry and Grind	
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	Dry and Grind	

Prep Batch: 217468

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14364-A-14-E MS	Matrix Spike	Total/NA	Solid	None	
160-14364-A-14-F MSD	Matrix Spike Duplicate	Total/NA	Solid	None	
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	None	
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	None	
LCS 160-217468/2-A	Lab Control Sample	Total/NA	Solid	None	
MB 160-217468/1-A	Method Blank	Total/NA	Solid	None	

Prep Batch: 217683

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-14346-A-1-D DU	Duplicate	Total/NA	Solid	Fill_Geo-0	217185
160-14366-1	L03-02-25-P-S-B-00	Total/NA	Solid	Fill_Geo-0	217466
160-14366-2	L03-02-26-P-S-B-00	Total/NA	Solid	Fill_Geo-0	217466
LCS 160-217683/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-0	

TestAmerica St. Louis

QC Association Summary

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Rad (Continued)

Prep Batch: 217683 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 160-217683/1-A	Method Blank	Total/NA	Solid	Fill_Geo-0	

1

2

3

4

5

6

7

8

9

10

11

12

Tracer/Carrier Summary

Client: Perma-Fix Environmental Services Inc.
Project/Site: HDP

TestAmerica Job ID: 160-14366-1

Method: 6020A - Metals (ICP/MS), Tc-99 in Activity

Matrix: Solid

Prep Type: Total/NA

Percent Yield (Acceptance Limits)

Lab Sample ID	Client Sample ID	Re (30-110)
160-14364-A-14-E MS	Matrix Spike	85
160-14364-A-14-F MSD	Matrix Spike Duplicate	84
160-14366-1	L03-02-25-P-S-B-00	85
160-14366-2	L03-02-26-P-S-B-00	83
LCS 160-217468/2-A	Lab Control Sample	86
MB 160-217468/1-A	Method Blank	84

Tracer/Carrier Legend

Re = Re

1

2

3

4

5

6

7

8

9

10

11

12