

# 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: 160-11319-2

Client Project/Site: HDP

For:

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

Attn: Brian Miller



Authorized for release by:  
5/11/2015 2:35:30 PM

Ivan Vania, Project Manager II  
(314)298-8566  
[ivan.vania@testamericainc.com](mailto:ivan.vania@testamericainc.com)

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*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.*

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# Case Narrative

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

TestAmerica Job ID: 160-11319-2

**Job ID: 160-11319-2**

**Laboratory: TestAmerica St. Louis**

**Narrative**

## CASE NARRATIVE

**Client: Perma-Fix Environmental Services Inc.**

**Project: HDP**

**Report Number: 160-11319-2**

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 04/14/2015; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the coolers at receipt was 18.0 C.

### **RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)**

Samples L10-13-01-B-E-S-00 (160-11319-1), L10-13-02-B-R-S-00 (160-11319-2), L10-13-03-B-E-S-00 (160-11319-3), L10-13-04-B-E-S-00 (160-11319-4), L10-13-05-B-R-S-00 (160-11319-5), L10-13-06-B-E-S-00 (160-11319-6), L10-13-07-B-R-S-00 (160-11319-7), L10-13-08-B-E-S-00 (160-11319-8), L10-13-09-B-E-S-00 (160-11319-9), L10-13-10-B-R-S-00 (160-11319-10), L10-13-11-B-E-S-00 (160-11319-11), L10-13-12-B-E-S-00 (160-11319-12), L10-13-13-B-R-B-00 (160-11319-13) and L10-13-07-B-R-Q-00 (160-11319-14) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA\_01\_R. The samples were leached on 04/14/2015, prepared on 04/16/2015 and analyzed on 05/07/2015.

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

**TestAmerica St. Louis**

13715 Rider Trail North



160-11319 Chain of Custody

**Chain of Custody Record**
**TestAmerica**

THE LEADER IN ENVIRONMENTAL TESTING

Earth City, MO 63045

phone 314.298.8566 fax

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☒ Other:

TestAmerica Laboratories, Inc.

<b>Client Contact</b>		<b>Project Manager: Brian Miller</b>		<b>Site Contact: Ellen Jakub</b>		<b>Date: 04/14/2015</b>		<b>COC No: 041415-FSS1</b>				
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vanya		Carrier: Courier		1 of 2 COCs				
2800 Solway Road		<b>Analysis Turnaround Time</b>		Filtered Sample (Y/N) Gamma Spec (Ra-226, Th-232, U-235, U-238) Alpha Spec ICP/MS (Tc-99) Gamma Spec (Ra-226: post-21 day ingrowth)				Sampler:				
Knoxville, TN 37931		<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						For Lab Use Only:				
(865) 690-0501 Phone								Walk-in Client:				
(865) 539-9868 FAX								Lab Sampling:				
Project Name: Hematite Decommissioning Project								Job / SDG No.:				
Site: Westinghouse Hematite, MO												
P O # 832953												
<b>Sample Identification</b>	<b>Sample Date</b>	<b>Sample Time</b>	<b>Sample Type (C=Comp, G=Grab)</b>	<b>Matrix</b>	<b># of Cont.</b>	<b>Filtered</b>	<b>Perform MS / MSD (Y/N)</b>	<b>Gamma Spec (Ra-226, Th-232, U-235, U-238)</b>	<b>Alpha Spec</b>	<b>ICP/MS (Tc-99)</b>	<b>Gamma Spec (Ra-226: post-21 day ingrowth)</b>	<b>Sample Specific Notes:</b>
L10-13-01-B-E-S-00	4/10/15	1525	C	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-02-B-R-S-00	4/10/15	1610	C	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-03-B-E-S-00	4/10/15	1620	G	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-04-B-E-S-00	4/10/15	1535	G	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-05-B-R-S-00	4/10/15	1630	C	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-06-B-E-S-00	4/10/15	1635	G	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-07-B-R-S-00	4/10/15	1510	C	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-08-B-E-S-00	4/10/15	1515	G	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-09-B-E-S-00	4/10/15	1540	G	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-10-B-R-S-00	4/10/15	1645	C	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-11-B-E-S-00	4/10/15	1650	G	Soil	1	N		X		X	X	Sampler Matt Cushman
L10-13-12-B-E-S-00	4/10/15	1550	G	Soil	1	N		X		X	X	Sampler Matt Cushman
<b>Preservation Used:</b> 1= Ice, 2= HCl, 3= H2SO4, 4=HNO3, 5=NaOH, 6= Other None												
<b>Possible Hazard Identification:</b> 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.						<b>Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)</b>						
<input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown						<input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months						
<b>Special Instructions/QC Requirements &amp; Comments: Potential for Radiological Contamination</b>												
Custody Seals Intact: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No						Custody Seal No.: _____ Cooler Temp. (°C): Obs'd: _____ Cor'd: _____ Therm ID No.: _____						
Relinquished by: <i>Brian Miller</i>		Company: <i>Perma-Fix</i>		Date/Time: <i>4/14/15 0912</i>		Received by: <i>John R. Settle</i>		Company: <i>Crossroads</i>		Date/Time: <i>4/14/15 0912</i>		
Relinquished by: <i>John R. Settle</i>		Company: <i>Crossroads</i>		Date/Time: <i>4/14/15 1020</i>		Received by: <i>John Clarke</i>		Company: <i>TA STL</i>		Date/Time: <i>4.14.15 1020</i>		
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:		

Hematite Decommissioning Project

Permafix (for Westinghouse) Non-Proprietary Class 3

Procedure: HDP-PR-QA-006, Chain of Custody

Revision: 3

# TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045  
phone 314.298.8566 fax

## Chain of Custody Record

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☒ Other:

TestAmerica Laboratories, Inc.

<b>Client Contact</b>		<b>Project Manager: Brian Miller</b>		<b>Site Contact: Ellen Jakub</b>		<b>Date: 04/14/2015</b>		<b>COC No: 041415-FSS1</b>	
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vanya		Carrier: Courier		2 of 2 COCs	
2800 Solway Road		<b>Analysis Turnaround Time</b>		Filtered Sample (Y/N) Perform MS / MSD (Y/N) Gamma Spec (Ra-226, Th-232, U-235, U-238) Alpha Spec ICP/MS (Tc-99) Gamma Spec (Ra-226: post-21 day ingrowth)				Sampler:	
Knoxville, TN 37931		<input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS TAT if different from Below _____						For Lab Use Only:	
(865) 690-0501 Phone		<input type="checkbox"/> 2 weeks <input checked="" type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day						Walk-in Client:	
(865) 539-9868 FAX								Lab Sampling:	
Project Name: Hematite Decommissioning Project								Job / SDG No.:	
Site: Westinghouse Hematite, MO									
P O # 832953									
<b>Sample Identification</b>	<b>Sample Date</b>	<b>Sample Time</b>	<b>Sample Type</b> (C=Comp, G=Grab)	<b>Matrix</b>	<b># of Cont.</b>				<b>Sample Specific Notes:</b>
L10-13-13-B-R-B-00	4/10/15	1600	C	Soil	1	N	X	X	Sampler Matt Cushman
L10-13-07-B-R-Q-00	4/10/15	1510	G	Soil	1	N	X	X	Sampler Matt Cushman
N / A									
Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4= HNO3, 5= NaOH, 6= Other, None									
<b>Possible Hazard Identification:</b> 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.						<b>Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)</b> <input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months			
<input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown									
<b>Special Instructions/QC Requirements &amp; Comments: Potential for Radiological Contamination</b>									
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: 4-14-15/0912		Received by: <i>John R. Settle</i>		Company: Crossroads	
Relinquished by: <i>John R. Settle</i>		Company: Crossroads		Date/Time: 4/14/15 1020		Received by: <i>John R. Settle</i>		Company: TA STZ	
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:	

Hematite Decommissioning Project

Permafix (for Westinghouse) Non-Proprietary Class 3

Procedure: HDP-PR-QA-006, Chain of Custody

Revision: 3

## Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-11319-2

Login Number: 11319

List Source: TestAmerica St. Louis

List Number: 1

Creator: Clarke, Jill C

Question	Answer	Comment
Radioactivity wasn't checked or is </= 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?	True	
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 <6mm (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: 160-11319-2

### Qualifiers

#### Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.

#### Rad TICs

Qualifier	Qualifier Description
U	Result is less than the sample detection 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: 160-11319-2

Method	Method Description	Protocol	Laboratory
GA-01-R	Radium-226 & Other Gamma Emitters (GS)	DOE	TAL SL

### Protocol References:

DOE = U.S. Department of Energy

### 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: 160-11319-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-11319-1	L10-13-01-B-E-S-00	Solid	04/10/15 15:25	04/14/15 10:20
160-11319-2	L10-13-02-B-R-S-00	Solid	04/10/15 16:10	04/14/15 10:20
160-11319-3	L10-13-03-B-E-S-00	Solid	04/10/15 16:20	04/14/15 10:20
160-11319-4	L10-13-04-B-E-S-00	Solid	04/10/15 15:35	04/14/15 10:20
160-11319-5	L10-13-05-B-R-S-00	Solid	04/10/15 16:30	04/14/15 10:20
160-11319-6	L10-13-06-B-E-S-00	Solid	04/10/15 16:35	04/14/15 10:20
160-11319-7	L10-13-07-B-R-S-00	Solid	04/10/15 15:10	04/14/15 10:20
160-11319-8	L10-13-08-B-E-S-00	Solid	04/10/15 15:15	04/14/15 10:20
160-11319-9	L10-13-09-B-E-S-00	Solid	04/10/15 15:40	04/14/15 10:20
160-11319-10	L10-13-10-B-R-S-00	Solid	04/10/15 16:45	04/14/15 10:20
160-11319-11	L10-13-11-B-E-S-00	Solid	04/10/15 16:50	04/14/15 10:20
160-11319-12	L10-13-12-B-E-S-00	Solid	04/10/15 15:50	04/14/15 10:20
160-11319-13	L10-13-13-B-R-B-00	Solid	04/10/15 16:00	04/14/15 10:20
160-11319-14	L10-13-07-B-R-Q-00	Solid	04/10/15 15:10	04/14/15 10:20

# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-01-B-E-S-00

Lab Sample ID: 160-11319-1

Date Collected: 04/10/15 15:25

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.890		0.151	0.176		0.143	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Bismuth 212	1.24		0.428	0.447		0.435	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Bismuth 214	1.12		0.110	0.161		0.0683	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Lead 212	1.04		0.0739	0.154		0.0611	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Lead 214	1.31		0.106	0.172		0.0850	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Potassium 40	19.0		1.21	2.30		0.225	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Protactinium 231	-0.581	U	0.750	0.753		1.24	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Radium 226	1.12		0.110	0.161	1.00	0.0683	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Thorium 232	0.890		0.151	0.176		0.143	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Thorium 234	1.66		0.551	0.578		0.849	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Uranium 235	0.360		0.157	0.162		0.225	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Americium 241	-0.0203	U	0.0621	0.0621		0.104	pCi/g	04/16/15 12:40	05/07/15 19:39	1
Protactinium 234m	3.59	U	3.45	3.47		5.60	pCi/g	04/16/15 12:40	05/07/15 19:39	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.366		0.0629	0.0735		0.0503	pCi/g	04/16/15 12:40	05/07/15 19:39	1

Client Sample ID: L10-13-02-B-R-S-00

Lab Sample ID: 160-11319-2

Date Collected: 04/10/15 16:10

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.09		0.126	0.168		0.0978	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Bismuth 212	1.15		0.356	0.375		0.336	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Bismuth 214	1.09		0.0984	0.150		0.0599	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Lead 212	1.19		0.0726	0.170		0.0540	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Lead 214	1.26		0.0864	0.157		0.0628	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Potassium 40	19.8		1.14	2.33		0.283	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Protactinium 231	-0.483	U	0.625	0.627		1.03	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Radium 226	1.09		0.0984	0.150	1.00	0.0599	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Thorium 232	1.09		0.126	0.168		0.0978	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Thorium 234	0.908		0.277	0.292		0.815	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Uranium 235	0.0783	U	0.125	0.125		0.224	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Americium 241	-0.00112	U	0.0610	0.0610		0.103	pCi/g	04/16/15 12:40	05/07/15 09:43	1
Protactinium 234m	5.22		2.76	2.81		3.05	pCi/g	04/16/15 12:40	05/07/15 09:43	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.317		0.0434	0.0544		0.0337	pCi/g	04/16/15 12:40	05/07/15 09:43	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-03-B-E-S-00

Lab Sample ID: 160-11319-3

Date Collected: 04/10/15 16:20

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.06		0.152	0.187		0.115	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Bismuth 212	1.52		0.367	0.400		0.303	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Bismuth 214	1.13		0.0978	0.153		0.0601	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Lead 212	1.15		0.0750	0.167		0.0699	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Lead 214	1.28		0.0949	0.163		0.0724	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Potassium 40	20.4		1.14	2.38		0.380	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Protactinium 231	0.364	U	0.224	0.228		1.17	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Radium 226	1.13		0.0978	0.153	1.00	0.0601	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Thorium 232	1.06		0.152	0.187		0.115	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Thorium 234	0.814	U	0.333	0.344		1.06	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Uranium 235	0.200	U	0.145	0.146		0.212	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Americium 241	-0.00739	U	0.0642	0.0642		0.108	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Protactinium 234m	2.40	U	2.89	2.90		4.75	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.366		0.0484	0.0615		0.0361	pCi/g	04/16/15 12:40	05/07/15 10:44	1

Client Sample ID: L10-13-04-B-E-S-00

Lab Sample ID: 160-11319-4

Date Collected: 04/10/15 15:35

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.05		0.143	0.179		0.0981	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Bismuth 212	1.79		0.436	0.474		0.348	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Bismuth 214	1.56		0.140	0.214		0.0869	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Lead 212	1.27		0.0837	0.184		0.0689	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Lead 214	1.66		0.114	0.207		0.0727	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Potassium 40	19.6		1.30	2.39		0.360	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Protactinium 231	0.943	U	0.385	0.399		1.07	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Radium 226	1.56		0.140	0.214	1.00	0.0869	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Thorium 232	1.05		0.143	0.179		0.0981	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Thorium 234	0.952	U	0.320	0.336		0.957	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Uranium 235	0.138	U	0.148	0.149		0.266	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Americium 241	-0.00103	U	0.0632	0.0632		0.107	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Protactinium 234m	2.53	U	3.15	3.16		5.61	pCi/g	04/16/15 12:40	05/07/15 10:44	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
U-238	0.952	U	0.320	0.336		0.957	pCi/g	04/16/15 12:40	05/07/15 10:44	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-05-B-R-S-00

Lab Sample ID: 160-11319-5

Date Collected: 04/10/15 16:30

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.27		0.164	0.208		0.139	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Bismuth 212	1.46		0.477	0.500		0.438	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Bismuth 214	1.28		0.113	0.174		0.0707	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Lead 212	1.28		0.0830	0.186		0.0809	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Lead 214	1.46		0.104	0.184		0.0837	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Potassium 40	23.1		1.22	2.63		0.305	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Protactinium 231	0.556	U	0.232	0.240		1.34	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Radium 226	1.28		0.113	0.174	1.00	0.0707	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Thorium 232	1.27		0.164	0.208		0.139	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Thorium 234	1.33		0.540	0.558		0.855	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Uranium 235	0.197	U	0.183	0.184		0.260	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Americium 241	0.00164	U	0.0663	0.0663		0.112	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Protactinium 234m	1.26	U	2.96	2.96		5.07	pCi/g	04/16/15 12:40	05/07/15 10:45	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.410		0.0541	0.0686		0.0419	pCi/g	04/16/15 12:40	05/07/15 10:45	1

Client Sample ID: L10-13-06-B-E-S-00

Lab Sample ID: 160-11319-6

Date Collected: 04/10/15 16:35

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.12		0.108	0.157		0.0992	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Bismuth 212	1.09		0.304	0.325		0.382	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Bismuth 214	1.03		0.0959	0.144		0.0615	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Lead 212	1.11		0.0656	0.158		0.0484	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Lead 214	1.12		0.0750	0.138		0.0631	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Potassium 40	19.0		1.06	2.22		0.312	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Protactinium 231	0.482	U	0.207	0.214		1.07	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Radium 226	1.03		0.0959	0.144	1.00	0.0615	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Thorium 232	1.12		0.108	0.157		0.0992	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Thorium 234	1.11		0.478	0.492		0.760	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Uranium 235	0.198		0.118	0.120		0.163	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Americium 241	-0.0176	U	0.0594	0.0594		0.0993	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Protactinium 234m	1.90	U	2.35	2.35		3.93	pCi/g	04/16/15 12:40	05/07/15 10:47	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.345		0.0485	0.0603		0.0385	pCi/g	04/16/15 12:40	05/07/15 10:47	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-07-B-R-S-00

Lab Sample ID: 160-11319-7

Date Collected: 04/10/15 15:10

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.35		0.178	0.225		0.190	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Bismuth 212	2.04		0.587	0.624		0.478	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Bismuth 214	1.42		0.147	0.209		0.0945	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Lead 212	1.16		0.0920	0.176		0.0883	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Lead 214	1.55		0.129	0.206		0.0856	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Potassium 40	18.4		1.45	2.38		0.523	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Protactinium 231	0.356	U	0.237	0.240		1.58	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Radium 226	1.42		0.147	0.209	1.00	0.0945	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Thorium 232	1.35		0.178	0.225		0.190	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Thorium 234	1.31		0.642	0.656		1.02	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Uranium 235	0.134	U	0.160	0.160		0.287	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Americium 241	0.00593	U	0.0768	0.0768		0.129	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Protactinium 234m	0.302	U	4.06	4.06		5.14	pCi/g	04/16/15 12:40	05/07/15 13:00	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.534		0.0681	0.0878		0.0455	pCi/g	04/16/15 12:40	05/07/15 13:00	1

Client Sample ID: L10-13-08-B-E-S-00

Lab Sample ID: 160-11319-8

Date Collected: 04/10/15 15:15

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.06		0.115	0.158		0.112	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Bismuth 212	1.17		0.295	0.319		0.359	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Bismuth 214	1.20		0.101	0.160		0.0583	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Lead 212	1.04		0.0673	0.151		0.0644	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Lead 214	1.15		0.0771	0.142		0.0653	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Potassium 40	18.9		1.00	2.18		0.262	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Protactinium 231	-0.531	U	0.667	0.669		1.10	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Radium 226	1.20		0.101	0.160	1.00	0.0583	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Thorium 232	1.06		0.115	0.158		0.112	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Thorium 234	1.09		0.478	0.491		0.759	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Uranium 235	0.126	U	0.125	0.125		0.228	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Americium 241	0.0379	U	0.0589	0.0590		0.0975	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Protactinium 234m	6.22		2.55	2.63		4.56	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.71		0.672	0.701		0.791	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Tl-208	0.380		0.0446	0.0595		0.0323	pCi/g	04/16/15 12:40	05/07/15 12:57	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-09-B-E-S-00

Lab Sample ID: 160-11319-9

Date Collected: 04/10/15 15:40

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.28		0.136	0.189		0.107	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Bismuth 212	1.80		0.505	0.539		0.444	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Bismuth 214	1.34		0.126	0.188		0.0769	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Lead 212	1.31		0.0808	0.187		0.0616	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Lead 214	1.36		0.101	0.174		0.0837	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Potassium 40	17.7		1.20	2.18		0.342	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Protactinium 231	0.459	U	0.233	0.238		1.27	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Radium 226	1.34		0.126	0.188	1.00	0.0769	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Thorium 232	1.28		0.136	0.189		0.107	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Thorium 234	1.21		0.534	0.549		0.845	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Uranium 235	0.194	U	0.148	0.149		0.213	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Americium 241	0.0146	U	0.0629	0.0629		0.105	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Protactinium 234m	0.636	U	3.51	3.51		6.22	pCi/g	04/16/15 12:40	05/07/15 12:57	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.415		0.0585	0.0726		0.0448	pCi/g	04/16/15 12:40	05/07/15 12:57	1

Client Sample ID: L10-13-10-B-R-S-00

Lab Sample ID: 160-11319-10

Date Collected: 04/10/15 16:45

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.19		0.117	0.167		0.142	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Bismuth 212	1.33		0.401	0.423		0.388	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Bismuth 214	1.16		0.107	0.160		0.0684	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Lead 212	1.15		0.0751	0.167		0.0753	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Lead 214	1.38		0.0899	0.170		0.0741	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Potassium 40	21.8		1.15	2.48		0.379	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Protactinium 231	0.876		0.414	0.425		0.831	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Radium 226	1.16		0.107	0.160	1.00	0.0684	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Thorium 232	1.19		0.117	0.167		0.142	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Thorium 234	1.29		0.495	0.513		0.780	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Uranium 235	0.0797	U	0.140	0.140		0.258	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Americium 241	-0.0123	U	0.393	0.393		0.0838	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Protactinium 234m	0.173	U	2.08	2.08		6.79	pCi/g	04/16/15 12:40	05/07/15 12:58	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.428		0.0525	0.0685		0.0385	pCi/g	04/16/15 12:40	05/07/15 12:58	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-11-B-E-S-00

Lab Sample ID: 160-11319-11

Date Collected: 04/10/15 16:50

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.09		0.125	0.167		0.0920	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Bismuth 212	1.27		0.399	0.420		0.384	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Bismuth 214	0.990		0.0983	0.142		0.0647	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Lead 212	1.16		0.0682	0.165		0.0521	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Lead 214	1.03		0.0758	0.131		0.0639	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Potassium 40	17.2		1.01	2.03		0.265	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Protactinium 231	0.449	U	0.238	0.243		1.09	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Radium 226	0.990		0.0983	0.142	1.00	0.0647	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Thorium 232	1.09		0.125	0.167		0.0920	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Thorium 234	1.04		0.273	0.293		0.770	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Uranium 235	0.247		0.155	0.157		0.199	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Americium 241	-0.000137	U	0.0462	0.0462		0.0783	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Protactinium 234m	1.88	U	2.58	2.59		4.35	pCi/g	04/16/15 12:40	05/07/15 12:59	1
Other Detected			Count	Total						
			Uncert.	Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.385		0.0549	0.0679		0.0424	pCi/g	04/16/15 12:40	05/07/15 12:59	1

Client Sample ID: L10-13-12-B-E-S-00

Lab Sample ID: 160-11319-12

Date Collected: 04/10/15 15:50

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)						
Actinium 228	1.28		0.129	0.183		0.137	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Bismuth 212	1.52		0.430	0.458		0.400	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Bismuth 214	1.20		0.109	0.166		0.0899	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Lead 212	1.35		0.0792	0.192		0.0571	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Lead 214	1.50		0.101	0.185		0.0717	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Potassium 40	18.1		1.15	2.19		0.214	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Protactinium 231	0.364	U	0.213	0.216		1.19	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Radium 226	1.20		0.109	0.166	1.00	0.0899	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Thorium 232	1.28		0.129	0.183		0.137	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Thorium 234	0.937		0.289	0.305		0.835	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Uranium 235	0.108	U	0.135	0.135		0.247	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Americium 241	-0.0101	U	0.0618	0.0618		0.104	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Protactinium 234m	2.94	U	3.10	3.12		5.10	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Other Detected			Count	Total						
			Uncert.	Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.409		0.0565	0.0706		0.0442	pCi/g	04/16/15 12:40	05/07/15 13:56	1

TestAmerica St. Louis



# Client Sample Results

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

TestAmerica Job ID: 160-11319-2

Client Sample ID: L10-13-13-B-R-B-00

Lab Sample ID: 160-11319-13

Date Collected: 04/10/15 16:00

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.38		0.157	0.209		0.0768	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Bismuth 212	1.58		0.508	0.533		0.452	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Bismuth 214	1.04		0.0957	0.144		0.0855	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Lead 212	1.22		0.0780	0.177		0.0747	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Lead 214	1.31		0.0883	0.163		0.0632	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Potassium 40	19.7		1.11	2.27		0.338	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Protactinium 231	0.626	U	0.342	0.349		1.06	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Radium 226	1.04		0.0957	0.144	1.00	0.0855	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Thorium 232	1.38		0.157	0.209		0.0768	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Thorium 234	3.43		0.680	0.770		1.02	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Uranium 235	1.09		0.175	0.208		0.240	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Americium 241	-0.0482	U	0.119	0.119		0.129	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Protactinium 234m	5.67		3.61	3.65		5.31	pCi/g	04/16/15 12:40	05/07/15 13:56	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.435		0.0594	0.0744		0.0457	pCi/g	04/16/15 12:40	05/07/15 13:56	1

Client Sample ID: L10-13-07-B-R-Q-00

Lab Sample ID: 160-11319-14

Date Collected: 04/10/15 15:10

Matrix: Solid

Date Received: 04/14/15 10:20

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	1.15		0.117	0.166		0.114	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Bismuth 212	1.04		0.319	0.337		0.416	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Bismuth 214	1.31		0.106	0.172		0.0627	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Lead 212	1.24		0.0734	0.177		0.0588	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Lead 214	1.38		0.0844	0.166		0.0747	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Potassium 40	18.1		1.05	2.13		0.268	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Protactinium 231	0.422	U	0.205	0.210		1.11	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Radium 226	1.31		0.106	0.172	1.00	0.0627	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Thorium 232	1.15		0.117	0.166		0.114	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Thorium 234	1.26		0.510	0.527		0.807	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Uranium 235	0.124	U	0.124	0.125		0.231	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Americium 241	0.000941	U	0.0591	0.0591		0.0997	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Protactinium 234m	0.346	U	1.05	1.05		6.31	pCi/g	04/16/15 12:40	05/07/15 13:58	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.387		0.0489	0.0633		0.0367	pCi/g	04/16/15 12:40	05/07/15 13:58	1

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# QC Sample Results

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

TestAmerica Job ID: 160-11319-2

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS)

Lab Sample ID: MB 160-186067/1-A

Matrix: Solid

Analysis Batch: 189881

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 186067

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.01368	U	0.0297	0.0297		0.0525	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Bismuth 212	0.0000	U	0.0204	0.0204		0.0752	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Bismuth 214	0.007554	U	0.0148	0.0148		0.0311	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Lead 212	0.007332	U	0.0128	0.0128		0.0240	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Lead 214	-0.003069	U	0.0226	0.0226		0.0281	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Potassium 40	-0.09646	U	3.86	3.86		0.202	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Protactinium 231	0.02005	U	0.0925	0.0925		0.317	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Radium 226	0.007554	U	0.0148	0.0148	1.00	0.0311	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Thorium 232	0.01368	U	0.0297	0.0297		0.0525	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Thorium 234	-0.006040	U	0.136	0.136		0.249	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Uranium 235	0.01897	U	0.0376	0.0376		0.0670	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Americium 241	0.01011	U	0.0126	0.0126		0.0207	pCi/g	04/16/15 12:40	05/07/15 09:41	1
Protactinium 234m	0.4151	U	0.714	0.715		3.91	pCi/g	04/16/15 12:40	05/07/15 09:41	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	04/16/15 12:40	05/07/15 09:41	1

Lab Sample ID: LCS 160-186067/2-A

Matrix: Solid

Analysis Batch: 189920

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 186067

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	103.0		10.7		0.493	pCi/g	102	87 - 116
Cesium 137	34.8	35.23		3.69		0.178	pCi/g	101	87 - 120
Cobalt 60	35.7	35.43		3.58		0.113	pCi/g	99	87 - 115

Lab Sample ID: 160-11319-1 DU

Matrix: Solid

Analysis Batch: 189919

Client Sample ID: L10-13-01-B-E-S-00

Prep Type: Total/NA

Prep Batch: 186067

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	0.890		1.088		0.162		0.0915	pCi/g	0.59	1
Bismuth 212	1.24		1.472		0.449		0.383	pCi/g	0.26	1
Bismuth 214	1.12		1.220		0.164		0.0608	pCi/g	0.30	1
Lead 212	1.04		1.129		0.163		0.0603	pCi/g	0.28	1
Lead 214	1.31		1.377		0.171		0.0748	pCi/g	0.20	1
Potassium 40	19.0		18.09		2.17		0.437	pCi/g	0.21	1
Protactinium 231	-0.581	U	-0.5451	U	0.626		1.02	pCi/g	0.03	1
Radium 226	1.12		1.220		0.164	1.00	0.0608	pCi/g	0.30	1
Thorium 232	0.890		1.088		0.162		0.0915	pCi/g	0.59	1
Thorium 234	1.66		1.374		0.593		0.779	pCi/g	0.24	1
Uranium 235	0.360		0.2845		0.155		0.181	pCi/g	0.24	1
Americium 241	-0.0203	U	0.03411	U	0.0607		0.101	pCi/g	0.44	1

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# QC Sample Results

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

TestAmerica Job ID: 160-11319-2

## Method: GA-01-R - Radium-226 & Other Gamma Emitters (GS) (Continued)

Lab Sample ID: 160-11319-1 DU

Matrix: Solid

Analysis Batch: 189919

Client Sample ID: L10-13-01-B-E-S-00

Prep Type: Total/NA

Prep Batch: 186067

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	3.59	U	-0.6409	U	11.2		4.43	pCi/g	0.29	1
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Other Detected Radionuclides	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Tl-208	0.366		0.3366		0.0634		0.0416	pCi/g	0.22	1

# QC Association Summary

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

TestAmerica Job ID: 160-11319-2

## Rad

### Leach Batch: 185650

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11319-1	L10-13-01-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-1 DU	L10-13-01-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-2	L10-13-02-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-11319-3	L10-13-03-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-4	L10-13-04-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-5	L10-13-05-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-11319-6	L10-13-06-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-7	L10-13-07-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-11319-8	L10-13-08-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-9	L10-13-09-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-10	L10-13-10-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-11319-11	L10-13-11-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-12	L10-13-12-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-11319-13	L10-13-13-B-R-B-00	Total/NA	Solid	Dry and Grind	
160-11319-14	L10-13-07-B-R-Q-00	Total/NA	Solid	Dry and Grind	

### Prep Batch: 186067

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11319-1	L10-13-01-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-1 DU	L10-13-01-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-2	L10-13-02-B-R-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-3	L10-13-03-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-4	L10-13-04-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-5	L10-13-05-B-R-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-6	L10-13-06-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-7	L10-13-07-B-R-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-8	L10-13-08-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-9	L10-13-09-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-10	L10-13-10-B-R-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-11	L10-13-11-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-12	L10-13-12-B-E-S-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-13	L10-13-13-B-R-B-00	Total/NA	Solid	Fill_Geo-21	185650
160-11319-14	L10-13-07-B-R-Q-00	Total/NA	Solid	Fill_Geo-21	185650
LCS 160-186067/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-186067/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	

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