

# 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: 160-10219-2  
Client Project/Site: HDP

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

Attn: Brian Miller



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Authorized for release by:  
2/17/2015 5:32:28 PM

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

### LINKS

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results through  
**TotalAccess**

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[www.testamericainc.com](http://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.*

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# Case Narrative

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

TestAmerica Job ID: 160-10219-2

**Job ID: 160-10219-2**

**Laboratory: TestAmerica St. Louis**

**Narrative**

## CASE NARRATIVE

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

**Project: HDP**

**Report Number: 160-10219-2**

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 01/21/2015; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the coolers at receipt was 20.0 C.

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

Samples L10-04-13-B-E-B-00 (160-10219-1), L10-04-14-B-E-B-00 (160-10219-2), L10-03-01-B-E-S-00 (160-10219-3), L10-03-02-B-E-S-00 (160-10219-4), L10-03-03-B-E-S-00 (160-10219-5), L10-03-04-B-E-S-00 (160-10219-6), L10-03-05-B-E-S-00 (160-10219-7), L10-03-06-B-E-S-00 (160-10219-8), L10-03-07-B-E-S-00 (160-10219-9), L10-03-07-B-E-Q-00 (160-10219-10), L10-03-08-B-R-S-00 (160-10219-11) and L10-03-09-B-E-S-00 (160-10219-12) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA\_01\_R. The samples were leached on 01/21/2015, prepared on 01/26/2015 and analyzed on 02/16/2015.

Batch 170218:

The sample duplicate precision for the following sample associated with prep batch # 170218 was outside control limits. The RPD/RER was outside of the acceptance limits of 40%/1 for Protactinium-231. Both the sample and duplicate activity were less than the MDA.

## Case Narrative

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

TestAmerica Job ID: 160-10219-2

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### Job ID: 160-10219-2 (Continued)

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#### Laboratory: TestAmerica St. Louis (Continued)

(160-10219-1 DU), L10-04-13-B-E-B-00 (160-10219-1). The associated Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD) precision met acceptance criteria.

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

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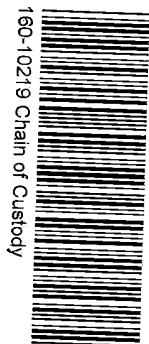
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# Chain of Custody Record

Regulatory Program:  DW  NPDES  RCRA  Other:

<b>Client Contact</b>		<b>Project Manager: Brian Miller</b>		<b>Site Contact: Ellen Jakub</b>		<b>Date: 1/21/15</b>		<b>COC No: 012115-FSS1</b>						
Perma-Fix Environmental Services 2800 Solway Road Knoxville, TN 37931		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vania		Carrier: Courier		Page 1 of 1						
<b>Analysis Turnaround Time</b>		<input checked="" type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS		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: For Lab Use Only: Walk-in Client: Lab Sampling: Job / SDG No.: Sample Specific Notes:						
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												
Project Name: Hematite Decommissioning Project														
Site: Westinghouse Hematite, MO														
P O # 832953														
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 (Ra-226, Th-232, U-235, U-238)	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (Ra-226; post-21 day ingrowth)		
L10-04-13-B-E-B-00		1/20/15	14:20	G	Soil	1	N	X	X	X			LSA 10-04 (bias)	
L10-04-14-B-E-B-00		1/20/15	14:35	G	Soil	1	N	X	X	X			LSA 10-04 (bias)	
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"/> 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: Dry and homogenize samples prior to analyses; potential for radiological contamination</b>														
Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No.:		Cooler Temp. (°C): Obs'd: _____ Cor'd: _____		Therm ID No.:								
Relinquished by: <i>Ellen Jakub</i>		Company: Perma-Fix		Date/Time: 1/21/15 0930		Received by: <i>Ivan Vania</i>		Company: TestAmerica		Date/Time: 1/21/15 930				
Relinquished by: <i>Ivan Vania</i>		Company: <i>Perma-Fix</i>		Date/Time: 1/21/15 1027		Received by: <i>Ellen Jakub</i>		Company: <i>TA SL</i>		Date/Time: 1/21/15 1027				
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:				
Hematite Decommissioning Project		Perma-Fix (for Westinghouse) Non-Proprietary Class 3				Procedure: HDP-PR-QA-006, Chain of Custody				Revision: 3				

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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: 01/21/15 Carrier: Courier		COC No: 012115-FSS2 Page 1 of 1									
		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		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: For Lab Use Only: Walk-in Client: Lab Sampling: Job / SDG No.:	
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 (Ra-226, Th-232, U-235, U-238)	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (Ra-226: post-21 day ingrowth)	Sample Specific Notes:				
L10-03-01-B-E-S-00		1/20/15	14:40	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-02-B-E-S-00		1/20/15	14:45	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-03-B-E-S-00		1/20/15	14:50	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-04-B-E-S-00		1/20/15	14:50	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-05-B-E-S-00		1/20/15	15:10	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-06-B-E-S-00		1/20/15	15:10	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-07-B-E-S-00		1/20/15	15:25	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-07-B-E-Q-00		1/20/15	15:25	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
L10-03-08-B-R-S-00		1/20/15	15:35	C	Soil	1	N	X	X	X			LSA 10-03 systematic (root stratum)				
L10-03-09-B-E-S-00		1/20/15	15:55	G	Soil	1	N	X	X	X			LSA 10-03 systematic				
													N / A				
Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4=HNO3, 5=NaOH, 6= Other None		Sample Disposal ( A fee may be assessed if samples are retained longer than 1 month)															
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-Hazardous		<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	
Special Instructions/QC Requirements & Comments: Dry and homogenize samples before analyses; 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: 01/21/15 0930		Received by: <i>Ellen Jakub</i>		Company: TestAmerica Crossroads		Date/Time: 1/21/15 930							
Relinquished by: <i>Ellen Jakub</i>		Company: <i>Perma-Fix</i>		Date/Time: 1/21/15		Received by: <i>John Clark</i>		Company: TA ST		Date/Time: 1-21-15 1027							
Relinquished by:		Company:		Date/Time:		Received in Laboratory by:		Company:		Date/Time:							
Hematite Decommissioning Project		Perma-Fix (for Westinghouse) Non-Proprietary Class 3				Procedure:HDP-PR-QA-006, Chain of Custody				Revision: 3							

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## Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-10219-2

Login Number: 10219

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?	False	
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 $<6\text{mm}$ (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: 160-10219-2

### 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.
♠	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: 160-10219-2

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

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**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: 160-10219-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-10219-1	L10-04-13-B-E-B-00	Solid	01/20/15 14:20	01/21/15 10:27
160-10219-2	L10-04-14-B-E-B-00	Solid	01/20/15 14:35	01/21/15 10:27
160-10219-3	L10-03-01-B-E-S-00	Solid	01/20/15 14:40	01/21/15 10:27
160-10219-4	L10-03-02-B-E-S-00	Solid	01/20/15 14:45	01/21/15 10:27
160-10219-5	L10-03-03-B-E-S-00	Solid	01/20/15 14:50	01/21/15 10:27
160-10219-6	L10-03-04-B-E-S-00	Solid	01/20/15 14:50	01/21/15 10:27
160-10219-7	L10-03-05-B-E-S-00	Solid	01/20/15 15:10	01/21/15 10:27
160-10219-8	L10-03-06-B-E-S-00	Solid	01/20/15 15:10	01/21/15 10:27
160-10219-9	L10-03-07-B-E-S-00	Solid	01/20/15 15:25	01/21/15 10:27
160-10219-10	L10-03-07-B-E-Q-00	Solid	01/20/15 15:25	01/21/15 10:27
160-10219-11	L10-03-08-B-R-S-00	Solid	01/20/15 15:35	01/21/15 10:27
160-10219-12	L10-03-09-B-E-S-00	Solid	01/20/15 15:55	01/21/15 10:27

# Client Sample Results

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

TestAmerica Job ID: 160-10219-2

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

**Lab Sample ID: 160-10219-1**

Date Collected: 01/20/15 14:20

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.34		0.191	0.235		0.125	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Bismuth 212	0.909		0.425	0.436		0.624	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Bismuth 214	1.44		0.131	0.199		0.0799	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Lead 212	1.26		0.0866	0.185		0.0792	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Lead 214	1.48		0.113	0.191		0.0768	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Potassium 40	19.6		1.28	2.38		0.334	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Protactinium 231	0.525	U	0.277	0.283		1.51	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Radium 226	1.44		0.131	0.199	1.00	0.0799	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Thorium 232	1.34		0.191	0.235		0.125	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Thorium 234	24.4		1.60	3.01		1.63	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Uranium 235	5.57		0.345	0.664		0.355	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Americium 241	0.00361	U	0.111	0.111		0.186	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Protactinium 234m	21.3		5.29	5.71		6.36	pCi/g	01/26/15 12:29	02/16/15 20:19	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.406		0.0562	0.0702		0.0438	pCi/g	01/26/15 12:29	02/16/15 20:19	1

**Client Sample ID: L10-04-14-B-E-B-00**

**Lab Sample ID: 160-10219-2**

Date Collected: 01/20/15 14:35

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.16		0.158	0.197		0.129	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Bismuth 212	1.66		0.470	0.501		0.567	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Bismuth 214	1.20		0.141	0.188		0.0986	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Lead 212	1.00		0.0900	0.158		0.0956	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Lead 214	1.23		0.114	0.171		0.111	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Potassium 40	17.9		1.36	2.28		0.427	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Protactinium 231	0.514	U	0.443	0.447		1.48	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Radium 226	1.20		0.141	0.188	1.00	0.0986	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Thorium 232	1.16		0.158	0.197		0.129	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Thorium 234	42.4		2.28	4.99		2.08	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Uranium 235	1.16		0.223	0.252		0.305	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Americium 241	-0.0594	U	0.146	0.146		0.242	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Protactinium 234m	53.7		8.15	9.79		4.66	pCi/g	01/26/15 12:29	02/16/15 20:19	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.87		1.19	1.21		1.48	pCi/g	01/26/15 12:29	02/16/15 20:19	1
Tl-208	0.341		0.0622	0.0716		0.0510	pCi/g	01/26/15 12:29	02/16/15 20:19	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10219-2

**Client Sample ID: L10-03-01-B-E-S-00**

**Lab Sample ID: 160-10219-3**

Date Collected: 01/20/15 14:40

Matrix: Solid

Date Received: 01/21/15 10:27

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

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Actinium 228	1.45		0.145	0.207		0.137	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Bismuth 212	1.72		0.607	0.633		0.569	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Bismuth 214	1.50		0.141	0.210		0.0927	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Lead 212	1.46		0.0893	0.209		0.0677	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Lead 214	1.74		0.117	0.215		0.0867	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Potassium 40	19.0		1.23	2.30		0.355	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Protactinium 231	-0.814	U	0.813	0.818		1.33	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Radium 226	1.50		0.141	0.210	1.00	0.0927	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Thorium 232	1.45		0.145	0.207		0.137	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Thorium 234	1.32		0.622	0.638		0.995	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Uranium 235	0.235		0.126	0.128		0.207	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Americium 241	-0.0254	U	0.0758	0.0759		0.127	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Protactinium 234m	1.83	U	3.58	3.58		6.15	pCi/g	01/26/15 12:29	02/16/15 20:20	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.70		0.817	0.841		1.02	pCi/g	01/26/15 12:29	02/16/15 20:20	1
Tl-208	0.508		0.0570	0.0776		0.0350	pCi/g	01/26/15 12:29	02/16/15 20:20	1

**Client Sample ID: L10-03-02-B-E-S-00**

**Lab Sample ID: 160-10219-4**

Date Collected: 01/20/15 14:45

Matrix: Solid

Date Received: 01/21/15 10:27

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

Analyte	Result	Qualifier	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
			Uncert. (2σ+/-)	Uncert. (2σ+/-)						
Actinium 228	1.53		0.224	0.273		0.147	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Bismuth 212	1.89		0.570	0.602		0.512	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Bismuth 214	1.62		0.172	0.241		0.113	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Lead 212	1.21		0.110	0.192		0.121	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Lead 214	1.77		0.161	0.244		0.137	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Potassium 40	18.3		1.48	2.39		0.326	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Protactinium 231	0.525	U	0.358	0.363		1.92	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Radium 226	1.62		0.172	0.241	1.00	0.113	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Thorium 232	1.53		0.224	0.273		0.147	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Thorium 234	0.683	U	0.876	0.879		1.46	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Uranium 235	0.145	U	0.198	0.198		0.351	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Americium 241	-0.00383	U	0.0862	0.0862		0.146	pCi/g	01/26/15 12:29	02/16/15 20:52	1
Protactinium 234m	0.162	U	2.06	2.06		10.8	pCi/g	01/26/15 12:29	02/16/15 20:52	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	Uncert. (2σ+/-)	Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.528		0.0834	0.0998		0.0608	pCi/g	01/26/15 12:29	02/16/15 20:52	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10219-2

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

**Lab Sample ID: 160-10219-5**

Date Collected: 01/20/15 14:50

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.27		0.148	0.197		0.162	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Bismuth 212	1.86		0.623	0.652		0.577	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Bismuth 214	1.44		0.134	0.201		0.0852	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Lead 212	1.25		0.0872	0.184		0.0834	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Lead 214	1.46		0.121	0.194		0.0876	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Potassium 40	18.7		1.19	2.25		0.345	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Protactinium 231	0.634	U	0.293	0.301		1.34	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Radium 226	1.44		0.134	0.201	1.00	0.0852	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Thorium 232	1.27		0.148	0.197		0.162	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Thorium 234	1.48		0.597	0.617		0.939	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Uranium 235	0.111	U	0.162	0.163		0.294	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Americium 241	0.0306	U	0.0743	0.0744		0.124	pCi/g	01/26/15 12:29	02/16/15 20:53	1
Protactinium 234m	2.16	U	3.31	3.32		5.59	pCi/g	01/26/15 12:29	02/16/15 20:53	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.430		0.0517	0.0682		0.0382	pCi/g	01/26/15 12:29	02/16/15 20:53	1

**Client Sample ID: L10-03-04-B-E-S-00**

**Lab Sample ID: 160-10219-6**

Date Collected: 01/20/15 14:50

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.30		0.141	0.194		0.112	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Bismuth 212	1.70		0.615	0.640		0.564	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Bismuth 214	1.31		0.137	0.193		0.0937	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Lead 212	1.32		0.0814	0.189		0.0603	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Lead 214	1.46		0.108	0.186		0.0686	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Potassium 40	17.2		1.18	2.12		0.321	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Protactinium 231	0.599	U	0.276	0.284		1.33	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Radium 226	1.31		0.137	0.193	1.00	0.0937	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Thorium 232	1.30		0.141	0.194		0.112	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Thorium 234	0.918	U	0.322	0.336		0.938	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Uranium 235	0.150	U	0.156	0.157		0.263	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Americium 241	-0.0158	U	0.0597	0.0597		0.100	pCi/g	01/26/15 12:29	02/16/15 20:54	1
Protactinium 234m	1.50	U	2.97	2.98		5.07	pCi/g	01/26/15 12:29	02/16/15 20:54	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.417		0.0528	0.0683		0.0403	pCi/g	01/26/15 12:29	02/16/15 20:54	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10219-2

**Client Sample ID: L10-03-05-B-E-S-00**

**Lab Sample ID: 160-10219-7**

Date Collected: 01/20/15 15:10

Matrix: Solid

Date Received: 01/21/15 10:27

**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+/-)						
<b>Actinium 228</b>	<b>1.41</b>		0.183	0.233		0.188	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Bismuth 212	0.667	U	0.542	0.546		0.856	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Bismuth 214</b>	<b>1.46</b>		0.153	0.215		0.0874	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Lead 212</b>	<b>1.21</b>		0.113	0.193		0.126	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Lead 214</b>	<b>1.64</b>		0.138	0.220		0.126	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Potassium 40</b>	<b>16.6</b>		1.43	2.22		0.333	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Protactinium 231	0.648	U	0.399	0.406		1.60	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Radium 226</b>	<b>1.46</b>		0.153	0.215	1.00	0.0874	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Thorium 232</b>	<b>1.41</b>		0.183	0.233		0.188	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Thorium 234	0.953	U	0.428	0.439		1.11	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Uranium 235	0.130	U	0.228	0.228		0.342	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Americium 241	0.0152	U	0.0822	0.0822		0.138	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Protactinium 234m	0.965	U	4.40	4.40		7.79	pCi/g	01/26/15 12:29	02/16/15 21:40	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
<b>Radionuclides</b>	<b>Result</b>	<b>Qualifier</b>	<b>(2σ+/-)</b>	<b>(2σ+/-)</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Pb-210	1.35		0.884	0.898		1.16	pCi/g	01/26/15 12:29	02/16/15 21:40	1
Tl-208	0.496		0.0827	0.0974		0.0602	pCi/g	01/26/15 12:29	02/16/15 21:40	1

**Client Sample ID: L10-03-06-B-E-S-00**

**Lab Sample ID: 160-10219-8**

Date Collected: 01/20/15 15:10

Matrix: Solid

Date Received: 01/21/15 10:27

**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+/-)						
<b>Actinium 228</b>	<b>1.15</b>		0.126	0.172		0.0809	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Bismuth 212</b>	<b>1.10</b>		0.368	0.385		0.496	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Bismuth 214</b>	<b>1.13</b>		0.113	0.163		0.0750	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Lead 212</b>	<b>1.13</b>		0.0753	0.165		0.0625	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Lead 214</b>	<b>1.31</b>		0.0957	0.167		0.0745	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Potassium 40</b>	<b>19.9</b>		1.23	2.38		0.445	pCi/g	01/26/15 12:29	02/16/15 20:56	1
Protactinium 231	0.576	U	0.228	0.237		1.10	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Radium 226</b>	<b>1.13</b>		0.113	0.163	1.00	0.0750	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Thorium 232</b>	<b>1.15</b>		0.126	0.172		0.0809	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Thorium 234</b>	<b>1.38</b>		0.646	0.662		0.860	pCi/g	01/26/15 12:29	02/16/15 20:56	1
Uranium 235	0.172	U	0.141	0.142		0.238	pCi/g	01/26/15 12:29	02/16/15 20:56	1
Americium 241	0.00528	U	0.0622	0.0622		0.105	pCi/g	01/26/15 12:29	02/16/15 20:56	1
Protactinium 234m	2.88	U	3.04	3.06		5.00	pCi/g	01/26/15 12:29	02/16/15 20:56	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
<b>Radionuclides</b>	<b>Result</b>	<b>Qualifier</b>	<b>(2σ+/-)</b>	<b>(2σ+/-)</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Pb-210	1.47		0.624	0.647		0.814	pCi/g	01/26/15 12:29	02/16/15 20:56	1
Tl-208	0.374		0.0467	0.0608		0.0353	pCi/g	01/26/15 12:29	02/16/15 20:56	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10219-2

**Client Sample ID: L10-03-07-B-E-S-00**

**Lab Sample ID: 160-10219-9**

Date Collected: 01/20/15 15:25

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.17		0.133	0.178		0.122	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Bismuth 212	1.32		0.392	0.415		0.383	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Bismuth 214	1.32		0.127	0.187		0.0858	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Lead 212	1.14		0.0798	0.168		0.0791	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Lead 214	1.43		0.100	0.179		0.0828	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Potassium 40	19.9		1.15	2.34		0.304	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Protactinium 231	0.169	U	0.524	0.524		0.890	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Radium 226	1.32		0.127	0.187	1.00	0.0858	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Thorium 232	1.17		0.133	0.178		0.122	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Thorium 234	0.953		0.323	0.338		0.953	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Uranium 235	0.346		0.154	0.158		0.214	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Americium 241	-0.0326	U	0.0730	0.0731		0.122	pCi/g	01/26/15 12:29	02/16/15 21:41	1
Protactinium 234m	5.56		2.13	2.20		4.62	pCi/g	01/26/15 12:29	02/16/15 21:41	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
<b>Radionuclides</b>			<b>Uncert.</b>	<b>Uncert.</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
			(2σ+/-)	(2σ+/-)						
Tl-208	0.395		0.0534	0.0673		0.0393	pCi/g	01/26/15 12:29	02/16/15 21:41	1

**Client Sample ID: L10-03-07-B-E-Q-00**

**Lab Sample ID: 160-10219-10**

Date Collected: 01/20/15 15:25

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.26		0.165	0.209		0.0909	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Bismuth 212	1.27		0.576	0.591		0.554	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Bismuth 214	1.35		0.138	0.197		0.0850	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Lead 212	1.29		0.0877	0.188		0.0701	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Lead 214	1.46		0.112	0.188		0.0968	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Potassium 40	17.3		1.25	2.17		0.261	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Protactinium 231	0.509	U	0.397	0.401		1.31	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Radium 226	1.35		0.138	0.197	1.00	0.0850	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Thorium 232	1.26		0.165	0.209		0.0909	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Thorium 234	1.24		0.321	0.346		0.818	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Uranium 235	0.346		0.159	0.163		0.208	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Americium 241	0.000309	U	0.0675	0.0675		0.114	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Protactinium 234m	2.94	U	3.80	3.81		6.27	pCi/g	01/26/15 12:29	02/16/15 21:42	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
<b>Radionuclides</b>			<b>Uncert.</b>	<b>Uncert.</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
			(2σ+/-)	(2σ+/-)						
Pb-210	1.39		0.625	0.646		0.846	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Tl-208	0.428		0.0625	0.0767		0.0467	pCi/g	01/26/15 12:29	02/16/15 21:42	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10219-2

**Client Sample ID: L10-03-08-B-R-S-00**

**Lab Sample ID: 160-10219-11**

Date Collected: 01/20/15 15:35

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.12		0.157	0.194		0.140	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Bismuth 212	1.50		0.536	0.558		0.485	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Bismuth 214	1.23		0.134	0.185		0.0873	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Lead 212	1.01		0.0902	0.159		0.0934	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Lead 214	1.30		0.120	0.181		0.0987	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Potassium 40	17.6		1.39	2.28		0.470	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Protactinium 231	0.480	U	0.441	0.444		1.42	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Radium 226	1.23		0.134	0.185	1.00	0.0873	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Thorium 232	1.12		0.157	0.194		0.140	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Thorium 234	0.780	U	0.348	0.358		1.02	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Uranium 235	0.126	U	0.188	0.188		0.300	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Americium 241	0.00186	U	0.0749	0.0749		0.126	pCi/g	01/26/15 12:29	02/16/15 21:42	1
Protactinium 234m	1.80	U	3.96	3.97		6.09	pCi/g	01/26/15 12:29	02/16/15 21:42	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.391		0.0676	0.0789		0.0544	pCi/g	01/26/15 12:29	02/16/15 21:42	1

**Client Sample ID: L10-03-09-B-E-S-00**

**Lab Sample ID: 160-10219-12**

Date Collected: 01/20/15 15:55

Matrix: Solid

Date Received: 01/21/15 10:27

**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	1.18		0.152	0.194		0.0974	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Bismuth 212	1.43		0.418	0.444		0.372	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Bismuth 214	1.21		0.105	0.164		0.0639	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Lead 212	1.17		0.0719	0.167		0.0543	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Lead 214	1.33		0.0869	0.163		0.0641	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Potassium 40	18.8		1.10	2.21		0.284	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Protactinium 231	0.510	U	0.358	0.363		0.624	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Radium 226	1.21		0.105	0.164	1.00	0.0639	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Thorium 232	1.18		0.152	0.194		0.0974	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Thorium 234	1.18		0.496	0.511		0.786	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Uranium 235	0.0664	U	0.137	0.137		0.229	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Americium 241	-0.00724	U	0.0620	0.0620		0.104	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Protactinium 234m	2.81	U	3.00	3.02		4.94	pCi/g	01/26/15 12:29	02/16/15 21:43	1
<b>Other Detected</b>			<b>Count</b>	<b>Total</b>						
			<b>Uncert.</b>	<b>Uncert.</b>						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.68		0.610	0.641		0.785	pCi/g	01/26/15 12:29	02/16/15 21:43	1
Tl-208	0.360		0.0440	0.0578		0.0312	pCi/g	01/26/15 12:29	02/16/15 21:43	1

TestAmerica St. Louis



# QC Sample Results

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

TestAmerica Job ID: 160-10219-2

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

**Lab Sample ID: MB 160-170218/1-A**  
**Matrix: Solid**  
**Analysis Batch: 174349**

**Client Sample ID: Method Blank**  
**Prep Type: Total/NA**  
**Prep Batch: 170218**

Analyte	MB	MB	Count	Total	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
	Result	Qualifier	Uncert.	Uncert.						
Actinium 228	-0.001831	U	0.0456	0.0456		0.0895	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Bismuth 212	-0.05224	U	0.175	0.175		0.319	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Bismuth 214	-0.006701	U	0.268	0.268		0.0256	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Lead 212	-0.008128	U	0.325	0.325		0.0253	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Lead 214	0.002033	U	0.0179	0.0179		0.0339	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Potassium 40	-0.07330	U	2.93	2.93		0.553	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Protactinium 231	0.01054	U	0.0871	0.0871		0.265	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Radium 226	-0.006701	U	0.268	0.268	1.00	0.0256	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Thorium 232	-0.001831	U	0.0456	0.0456		0.0895	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Thorium 234	-0.03046	U	0.174	0.174		0.271	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Uranium 235	0.01014	U	0.0280	0.0281		0.0637	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Americium 241	0.004938	U	0.00925	0.00927		0.0161	pCi/g	01/26/15 12:29	02/16/15 20:17	1
Protactinium 234m	-0.06836	U	1.58	1.58		3.15	pCi/g	01/26/15 12:29	02/16/15 20:17	1
<b>Other Detected</b>										
	MB	MB	Count	Total						
<b>Other Detected Radionuclides</b>	<b>Result</b>	<b>Qualifier</b>	<b>Uncert.</b>	<b>Uncert.</b>	<b>RL</b>	<b>MDC</b>	<b>Unit</b>	<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Other Detected Radionuclide	None						pCi/g	01/26/15 12:29	02/16/15 20:17	1

**Lab Sample ID: LCS 160-170218/2-A**  
**Matrix: Solid**  
**Analysis Batch: 174359**

**Client Sample ID: Lab Control Sample**  
**Prep Type: Total/NA**  
**Prep Batch: 170218**

Analyte	Spike Added	LCS Result	LCS Qual	Total	RL	MDC	Unit	%Rec	%Rec.
				Uncert. (2σ+/-)					Limits
Americium 241	101	100.4		10.5		0.545	pCi/g	100	87 - 116
Cesium 137	35.0	34.96		3.66		0.161	pCi/g	100	87 - 120
Cobalt 60	36.8	35.68		3.60		0.121	pCi/g	97	87 - 115

**Lab Sample ID: 160-10219-1 DU**  
**Matrix: Solid**  
**Analysis Batch: 174368**

**Client Sample ID: L10-04-13-B-E-B-00**  
**Prep Type: Total/NA**  
**Prep Batch: 170218**

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total	RL	MDC	Unit	RER	RER
					Uncert. (2σ+/-)					Limit
Actinium 228	1.34		1.197		0.250		0.184	pCi/g	0.30	1
Bismuth 212	0.909		1.932		0.712		0.601	pCi/g	0.89	1
Bismuth 214	1.44		1.301		0.191		0.0850	pCi/g	0.35	1
Lead 212	1.26		1.173		0.179		0.0986	pCi/g	0.24	1
Lead 214	1.48		1.389		0.201		0.104	pCi/g	0.24	1
Potassium 40	19.6		18.63		2.33		0.304	pCi/g	0.20	1
Protactinium 231	0.525	U	-0.8556	U F	0.990		1.62	pCi/g	1.08	1
Radium 226	1.44		1.301		0.191	1.00	0.0850	pCi/g	0.35	1
Thorium 232	1.34		1.197		0.250		0.184	pCi/g	0.30	1
Thorium 234	24.4		23.48		3.12		1.93	pCi/g	0.15	1
Uranium 235	5.57		4.755		0.599		0.412	pCi/g	0.64	1
Americium 241	0.00361	U	0.007695	U	0.119		0.199	pCi/g	0.02	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-10219-2

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

**Lab Sample ID: 160-10219-1 DU**

**Matrix: Solid**

**Analysis Batch: 174368**

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

**Prep Type: Total/NA**

**Prep Batch: 170218**

Analyte	Sample Result	Sample Qual	DU		Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
			Result	Qual						
Protactinium 234m	21.3		30.62		7.30		4.77	pCi/g	0.72	1

Other Detected Radionuclides	Sample Result	Sample Qual	DU		Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
			Result	Qual						
Tl-208	0.406		0.3768		0.0722		0.0499	pCi/g	0.21	1

# QC Association Summary

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

TestAmerica Job ID: 160-10219-2

## Rad

### Leach Batch: 169634

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10219-1	L10-04-13-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10219-1 DU	L10-04-13-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10219-2	L10-04-14-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10219-3	L10-03-01-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-4	L10-03-02-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-5	L10-03-03-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-6	L10-03-04-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-7	L10-03-05-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-8	L10-03-06-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-9	L10-03-07-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10219-10	L10-03-07-B-E-Q-00	Total/NA	Solid	Dry and Grind	
160-10219-11	L10-03-08-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10219-12	L10-03-09-B-E-S-00	Total/NA	Solid	Dry and Grind	

### Prep Batch: 170218

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10219-1	L10-04-13-B-E-B-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-1 DU	L10-04-13-B-E-B-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-2	L10-04-14-B-E-B-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-3	L10-03-01-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-4	L10-03-02-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-5	L10-03-03-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-6	L10-03-04-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-7	L10-03-05-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-8	L10-03-06-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-9	L10-03-07-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-10	L10-03-07-B-E-Q-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-11	L10-03-08-B-R-S-00	Total/NA	Solid	Fill_Geo-21	169634
160-10219-12	L10-03-09-B-E-S-00	Total/NA	Solid	Fill_Geo-21	169634
LCS 160-170218/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-170218/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	