

# 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: 160-10373-2

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:

3/6/2015 10:11:38 AM

Rhonda Ridenhower, Manager of Project Management  
[rhonda.ridenhower@testamericainc.com](mailto:rhonda.ridenhower@testamericainc.com)

Designee for

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: 160-10373-2

**Job ID: 160-10373-2**

**Laboratory: TestAmerica St. Louis**

**Narrative**

### CASE NARRATIVE

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

**Project: HDP**

**Report Number: 160-10373-2**

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 02/05/2015; the samples arrived in good condition, properly preserved. The temperature of the coolers at receipt was 18.0 C.

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

Samples L10-02-01-B-S-S-00 (160-10373-1), L10-02-02-B-R-S-00 (160-10373-2), L10-02-03-B-E-S-00 (160-10373-3), L10-02-04-B-S-S-00 (160-10373-4), L10-02-05-B-R-S-00 (160-10373-5), L10-02-06-B-E-S-00 (160-10373-6), L10-02-07-B-E-S-00 (160-10373-7), L10-02-08-B-E-S-00 (160-10373-8), L10-02-09-B-E-S-00 (160-10373-9), L10-02-10-B-E-S-00 (160-10373-10), L10-02-11-B-E-S-00 (160-10373-11), L10-02-12-B-E-S-00 (160-10373-12), L10-02-13-B-E-B-00 (160-10373-13) and L10-02-11-B-E-Q-00 (160-10373-14) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA\_01\_R. The samples were dried on 02/05/2015, prepared on 02/09/2015 and analyzed on 03/03/2015 and 03/04/2015.

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

# 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: 02/05/2015</b>		<b>COC No: 020515-FSS1</b>						
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vanya		Carrier: Courier		Page 1 of 2						
2800 Solway Road		<b>Analysis Turnaround Time</b>		<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		Perform MS / MSD (Y / N) Gamma Spec (Westinghouse HDP library) Alpha Spec ICP/MS (Tc-99) Gamma Spec (Ra-226: post-21 day ingrowth)		Sampler:						
Knoxville, TN 37931								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 Sample (Y / N)</b>	<b>Perform MS / MSD (Y / N)</b>	<b>Gamma Spec (Westinghouse HDP library)</b>	<b>Alpha Spec</b>	<b>ICP/MS (Tc-99)</b>	<b>Gamma Spec (Ra-226: post-21 day ingrowth)</b>	<b>Field Sampler Name</b>		
L10-02-01-B-S-S-00	2/3/15	1525	G	Soil	1	N	X	X	X			Matt Cushman		
L10-02-02-B-R-S-00	2/3/15	1615	C	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-03-B-E-S-00	2/3/15	1620	G	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-04-B-S-S-00	2/3/15	1425	G	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-05-B-R-S-00	2/3/15	1515	C	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-06-B-E-S-00	2/3/15	1520	G	Soil	1	N	X	X	X			Matt Cushman		
L10-02-07-B-E-S-00	2/3/15	1125	G	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-08-B-E-S-00	2/3/15	1055	G	Soil	1	N	X	X	X			Matt Cushman		
L10-02-09-B-E-S-00	2/3/15	1100	G	Soil	1	N	X	X	X			Matt Cushman		
L10-02-10-B-E-S-00	2/3/15	1150	G	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-11-B-E-S-00	2/3/15	1135	G	Soil	1	N	X	X	X			Jahmai Williams		
L10-02-12-B-E-S-00	2/3/15	1415	G	Soil	1	N	X	X	X			Matt Cushman		
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. <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>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								
<b>Special Instructions/QC Requirements &amp; Comments:</b> 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: 2/5/15 0932			Received by: <i>Ellen Jakub</i>			Company: Per (TA)		
Relinquished by: <i>Ivan Vanya</i>			Company: Crossroads			Date/Time: 2/5/15 11:00			Received by: <i>Ellen Jakub</i>			Company: Per (TA)		
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

# TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045  
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## 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: 02/05/2015</b>		<b>COC No: 020515-FSS1</b>		
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vanya		Carrier: Courier		Page 2 of 2		
2800 Solway Road		<b>Analysis Turnaround Time</b>		Filtered Sample (Y/N) Perform MS / MSD (Y/N) Gamma Spec (Westinghouse HDP library) 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						For Lab Use Only:		
(865) 690-0501 Phone		TAT if different from Below _____						Walk-in Client:		
(865) 539-9868 FAX		<input type="checkbox"/> 2 weeks <input checked="" type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day						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>Field Sampler Name</b>
L10-02-13-B-E-B-00	2/3/15	1045	G	Soil	1	N	X	X	X	Jahmai Williams
L10-02-11-B-E-Q-00	2/3/15	1135	G	Soil	1	N	X	X	X	Jahmai Williams
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.						Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)				
<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				
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: <i>Perma-Fix</i>		Date/Time: <i>2/5/15 0932</i>		Received by: <i>Sherry Stanton</i>		Company: <i>for (TA)</i>		Date/Time: <i>2/5/15 0932</i>
Relinquished by: <i>Brian Stanton</i>		Company: <i>Crossroads</i>		Date/Time: <i>11:00</i>		Received by: <i>Brian Stanton</i>		Company: <i>HST</i>		Date/Time: <i>2-5-15 1100</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

## Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

Job Number: 160-10373-2

Login Number: 10373

List Source: TestAmerica St. Louis

List Number: 1

Creator: Daniels, Brian J

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.	False	
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 $<6\text{mm}$ (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: 160-10373-2

### Qualifiers

#### Rad

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: 160-10373-2

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: 160-10373-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-10373-1	L10-02-01-B-S-S-00	Solid	02/03/15 15:25	02/05/15 11:00
160-10373-2	L10-02-02-B-R-S-00	Solid	02/03/15 16:15	02/05/15 11:00
160-10373-3	L10-02-03-B-E-S-00	Solid	02/03/15 16:20	02/05/15 11:00
160-10373-4	L10-02-04-B-S-S-00	Solid	02/03/15 14:25	02/05/15 11:00
160-10373-5	L10-02-05-B-R-S-00	Solid	02/03/15 15:15	02/05/15 11:00
160-10373-6	L10-02-06-B-E-S-00	Solid	02/03/15 15:20	02/05/15 11:00
160-10373-7	L10-02-07-B-E-S-00	Solid	02/03/15 11:25	02/05/15 11:00
160-10373-8	L10-02-08-B-E-S-00	Solid	02/03/15 10:55	02/05/15 11:00
160-10373-9	L10-02-09-B-E-S-00	Solid	02/03/15 11:00	02/05/15 11:00
160-10373-10	L10-02-10-B-E-S-00	Solid	02/03/15 11:50	02/05/15 11:00
160-10373-11	L10-02-11-B-E-S-00	Solid	02/03/15 11:35	02/05/15 11:00
160-10373-12	L10-02-12-B-E-S-00	Solid	02/03/15 14:15	02/05/15 11:00
160-10373-13	L10-02-13-B-E-B-00	Solid	02/03/15 10:45	02/05/15 11:00
160-10373-14	L10-02-11-B-E-Q-00	Solid	02/03/15 11:35	02/05/15 11:00

# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

**Client Sample ID: L10-02-01-B-S-S-00**

**Lab Sample ID: 160-10373-1**

Date Collected: 02/03/15 15:25

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	0.987		0.125	0.161		0.108	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Bismuth 212	0.821		0.382	0.392		0.390	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Bismuth 214	0.998		0.103	0.146		0.0666	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Lead 212	0.920		0.0724	0.139		0.0620	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Lead 214	1.13		0.101	0.154		0.0689	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Potassium 40	17.0		1.14	2.08		0.268	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Protactinium 231	0.356	U	0.215	0.219		1.20	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Radium 226	0.998		0.103	0.146	1.00	0.0666	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Thorium 232	0.987		0.125	0.161		0.108	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Thorium 234	0.858		0.294	0.308		0.826	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Uranium 235	0.242		0.112	0.115		0.159	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Americium 241	0.0134	U	0.0503	0.0504		0.0849	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Protactinium 234m	0.977	U	2.85	2.85		5.78	pCi/g	02/09/15 09:32	03/03/15 22:10	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	2.17		0.723	0.767		0.885	pCi/g	02/09/15 09:32	03/03/15 22:10	1
Tl-208	0.330		0.0449	0.0565		0.0321	pCi/g	02/09/15 09:32	03/03/15 22:10	1

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

**Lab Sample ID: 160-10373-2**

Date Collected: 02/03/15 16:15

Matrix: Solid

Date Received: 02/05/15 11:00

## 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		0.158	0.191		0.127	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Bismuth 212	1.44		0.500	0.522		0.466	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Bismuth 214	1.11		0.128	0.172		0.0831	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Lead 212	1.04		0.0872	0.160		0.0761	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Lead 214	1.22		0.109	0.167		0.0723	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Potassium 40	19.3		1.46	2.45		0.445	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Protactinium 231	1.17		0.522	0.538		0.748	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Radium 226	1.11		0.128	0.172	1.00	0.0831	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Thorium 232	1.05		0.158	0.191		0.127	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Thorium 234	1.19		0.332	0.355		0.929	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Uranium 235	0.0991	U	0.161	0.161		0.286	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Americium 241	0.0308	U	0.0583	0.0584		0.0973	pCi/g	02/09/15 09:32	03/03/15 22:41	1
Protactinium 234m	-0.0786	U	4.14	4.14		7.45	pCi/g	02/09/15 09:32	03/03/15 22:41	1
<b>Other Detected</b>										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.346		0.0572	0.0676		0.0442	pCi/g	02/09/15 09:32	03/03/15 22:41	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

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

Lab Sample ID: 160-10373-3

Date Collected: 02/03/15 16:20

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	1.17		0.179	0.215		0.118	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Bismuth 212	1.15		0.365	0.384		0.457	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Bismuth 214	1.21		0.126	0.178		0.0794	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Lead 212	1.19		0.0817	0.175		0.0636	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Lead 214	1.30		0.100	0.169		0.0812	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Potassium 40	20.2		1.31	2.44		0.457	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Protactinium 231	-0.760	U	0.794	0.798		1.30	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Radium 226	1.21		0.126	0.178	1.00	0.0794	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Thorium 232	1.17		0.179	0.215		0.118	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Thorium 234	1.42		0.552	0.571		0.865	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Uranium 235	0.151	U	0.109	0.110		0.187	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Americium 241	0.00270	U	0.0674	0.0674		0.114	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Protactinium 234m	1.83	U	3.67	3.67		6.31	pCi/g	02/09/15 09:32	03/03/15 22:43	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.352		0.0592	0.0696		0.0477	pCi/g	02/09/15 09:32	03/03/15 22:43	1

Client Sample ID: L10-02-04-B-S-S-00

Lab Sample ID: 160-10373-4

Date Collected: 02/03/15 14:25

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	0.936		0.201	0.222		0.133	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Bismuth 212	1.98		0.659	0.691		0.528	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Bismuth 214	1.16		0.134	0.181		0.0552	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Lead 212	0.925		0.104	0.158		0.117	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Lead 214	1.14		0.134	0.179		0.105	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Potassium 40	16.9		1.63	2.38		0.691	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Protactinium 231	0.0803	U	0.0847	0.0851		1.52	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Radium 226	1.16		0.134	0.181	1.00	0.0552	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Thorium 232	0.936		0.201	0.222		0.133	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Thorium 234	1.08	U	0.689	0.699		1.12	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Uranium 235	0.188	U	0.194	0.195		0.310	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Americium 241	0.0158	U	0.0753	0.0753		0.127	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Protactinium 234m	0.646	U	5.15	5.15		8.93	pCi/g	02/09/15 09:32	03/03/15 23:19	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.352		0.0610	0.0711		0.0414	pCi/g	02/09/15 09:32	03/03/15 23:19	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

Client Sample ID: L10-02-05-B-R-S-00

Lab Sample ID: 160-10373-5

Date Collected: 02/03/15 15:15

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	1.11		0.129	0.172		0.137	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Bismuth 212	1.47		0.364	0.395		0.323	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Bismuth 214	1.21		0.107	0.165		0.0671	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Lead 212	1.10		0.0778	0.162		0.0768	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Lead 214	1.32		0.0986	0.169		0.0673	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Potassium 40	18.6		1.12	2.21		0.359	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Protactinium 231	0.532	U	0.349	0.354		1.03	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Radium 226	1.21		0.107	0.165	1.00	0.0671	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Thorium 232	1.11		0.129	0.172		0.137	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Thorium 234	0.911		0.301	0.316		0.900	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Uranium 235	0.0424	U	0.159	0.159		0.268	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Americium 241	0.0192	U	0.0676	0.0676		0.113	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Protactinium 234m	5.51		2.29	2.36		5.08	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208			0.0548	0.0686		0.0438	pCi/g	02/09/15 09:32	03/03/15 23:17	1

Client Sample ID: L10-02-06-B-E-S-00

Lab Sample ID: 160-10373-6

Date Collected: 02/03/15 15:20

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	1.24		0.138	0.187		0.114	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Bismuth 212	1.87		0.580	0.612		0.485	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Bismuth 214	1.22		0.147	0.194		0.106	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Lead 212	1.15		0.0845	0.171		0.0687	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Lead 214	1.40		0.113	0.184		0.0771	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Potassium 40	19.2		1.37	2.39		0.404	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Protactinium 231	-0.709	U	0.823	0.826		1.35	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Radium 226	1.22		0.147	0.194	1.00	0.106	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Thorium 232	1.24		0.138	0.187		0.114	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Thorium 234	1.21		0.744	0.755		0.995	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Uranium 235	0.171	U	0.148	0.149		0.252	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Americium 241	0.000921	U	0.0605	0.0605		0.103	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Protactinium 234m	0.326	U	3.46	3.46		6.21	pCi/g	02/09/15 09:32	03/03/15 23:16	1
Other Detected			Count	Total						
Radionuclides			Uncert.	Uncert.						
			(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208			0.0536	0.0647		0.0443	pCi/g	02/09/15 09:32	03/03/15 23:16	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

Client Sample ID: L10-02-07-B-E-S-00

Lab Sample ID: 160-10373-7

Date Collected: 02/03/15 11:25

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	1.04		0.160	0.192		0.161	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Bismuth 212	1.90		0.583	0.616		0.453	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Bismuth 214	1.17		0.172	0.211		0.134	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Lead 212	1.10		0.0987	0.173		0.0996	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Lead 214	1.39		0.123	0.190		0.0922	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Potassium 40	18.8		1.47	2.43		0.363	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Protactinium 231	0.464	U	0.268	0.273		1.58	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Radium 226	1.17		0.172	0.211	1.00	0.134	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Thorium 232	1.04		0.160	0.192		0.161	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Thorium 234	0.626	U	0.435	0.440		1.31	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Uranium 235	0.0594	U	0.183	0.183		0.320	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Americium 241	-0.0261	U	0.0807	0.0807		0.135	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Protactinium 234m	0.000	U	4.13	4.13		6.68	pCi/g	02/09/15 09:32	03/03/15 23:17	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.387		0.0549	0.0680		0.0363	pCi/g	02/09/15 09:32	03/03/15 23:17	1

Client Sample ID: L10-02-08-B-E-S-00

Lab Sample ID: 160-10373-8

Date Collected: 02/03/15 10:55

Matrix: Solid

Date Received: 02/05/15 11:00

## 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		0.131	0.170		0.119	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Bismuth 212	1.74		0.423	0.460		0.352	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Bismuth 214	1.16		0.105	0.159		0.0661	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Lead 212	1.15		0.0766	0.168		0.0621	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Lead 214	1.27		0.0954	0.163		0.0768	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Potassium 40	18.2		1.13	2.18		0.246	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Protactinium 231	0.590	U	0.386	0.392		0.881	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Radium 226	1.16		0.105	0.159	1.00	0.0661	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Thorium 232	1.06		0.131	0.170		0.119	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Thorium 234	1.41		0.513	0.534		0.800	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Uranium 235	0.118	U	0.153	0.153		0.261	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Americium 241	0.0295	U	0.0617	0.0618		0.103	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Protactinium 234m	1.38	U	2.84	2.84		4.94	pCi/g	02/09/15 09:32	03/03/15 23:18	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.338		0.0474	0.0590		0.0368	pCi/g	02/09/15 09:32	03/03/15 23:18	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

Client Sample ID: L10-02-09-B-E-S-00

Lab Sample ID: 160-10373-9

Date Collected: 02/03/15 11:00

Matrix: Solid

Date Received: 02/05/15 11:00

## 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		0.177	0.207		0.0835	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Bismuth 212	0.429	U	0.393	0.396		0.626	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Bismuth 214	1.03		0.129	0.167		0.0829	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Lead 212	0.667		0.0792	0.117		0.0914	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Lead 214	1.14		0.112	0.163		0.0965	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Potassium 40	12.6		1.22	1.78		0.460	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Protactinium 231	0.342	U	0.318	0.320		1.08	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Radium 226	1.03		0.129	0.167	1.00	0.0829	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Thorium 232	1.05		0.177	0.207		0.0835	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Thorium 234	0.515	U	0.667	0.670		1.11	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Uranium 235	0.0966	U	0.167	0.167		0.256	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Americium 241	-0.0155	U	0.0692	0.0692		0.116	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Protactinium 234m	3.90	U	4.15	4.17		6.44	pCi/g	02/09/15 09:32	03/04/15 17:32	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.301		0.0555	0.0636		0.0409	pCi/g	02/09/15 09:32	03/04/15 17:32	1

Client Sample ID: L10-02-10-B-E-S-00

Lab Sample ID: 160-10373-10

Date Collected: 02/03/15 11:50

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	0.939		0.140	0.170		0.127	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Bismuth 212	1.30		0.570	0.586		0.520	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Bismuth 214	0.941		0.115	0.151		0.0858	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Lead 212	0.943		0.0779	0.145		0.0663	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Lead 214	1.11		0.0933	0.148		0.0595	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Potassium 40	16.0		1.23	2.05		0.274	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Protactinium 231	0.821	U	0.354	0.366		0.878	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Radium 226	0.941		0.115	0.151	1.00	0.0858	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Thorium 232	0.939		0.140	0.170		0.127	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Thorium 234	1.68		0.611	0.636		0.807	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Uranium 235	0.116	U	0.134	0.135		0.246	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Americium 241	0.0555	U	0.0598	0.0601		0.0981	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Protactinium 234m	2.47	U	3.96	3.97		6.06	pCi/g	02/09/15 09:32	03/04/15 17:27	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.319		0.0493	0.0593		0.0372	pCi/g	02/09/15 09:32	03/04/15 17:27	1

TestAmerica St. Louis

# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

Client Sample ID: L10-02-11-B-E-S-00

Lab Sample ID: 160-10373-11

Date Collected: 02/03/15 11:35

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	0.843		0.135	0.160		0.0839	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Bismuth 212	1.01		0.387	0.401		0.359	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Bismuth 214	0.956		0.117	0.154		0.0738	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Lead 212	0.632		0.0751	0.111		0.0877	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Lead 214	1.00		0.102	0.146		0.0763	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Potassium 40	12.9		1.17	1.77		0.410	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Protactinium 231	0.334	U	0.215	0.219		1.14	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Radium 226	0.956		0.117	0.154	1.00	0.0738	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Thorium 232	0.843		0.135	0.160		0.0839	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Thorium 234	0.875		0.490	0.498		0.785	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Uranium 235	0.135	U	0.116	0.117		0.163	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Americium 241	0.00288	U	0.0587	0.0587		0.0996	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Protactinium 234m	0.000	U	0.877	0.877		6.64	pCi/g	02/09/15 09:32	03/04/15 18:05	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.286		0.0453	0.0542		0.0265	pCi/g	02/09/15 09:32	03/04/15 18:05	1

Client Sample ID: L10-02-12-B-E-S-00

Lab Sample ID: 160-10373-12

Date Collected: 02/03/15 14:15

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	0.336		0.0581	0.0675		0.0417	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Bismuth 212	0.520		0.228	0.234		0.213	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Bismuth 214	0.734		0.0754	0.107		0.0409	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Lead 212	0.285		0.0382	0.0531		0.0403	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Lead 214	0.793		0.0684	0.107		0.0482	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Potassium 40	4.81		0.555	0.742		0.185	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Protactinium 231	0.0899	U	0.0855	0.0860		0.758	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Radium 226	0.734		0.0754	0.107	1.00	0.0409	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Thorium 232	0.336		0.0581	0.0675		0.0417	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Thorium 234	1.71		0.403	0.441		0.582	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Uranium 235	0.326		0.104	0.109		0.119	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Americium 241	-0.0133	U	0.0404	0.0404		0.0679	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Protactinium 234m	3.62	U	1.47	1.52		3.74	pCi/g	02/09/15 09:32	03/04/15 18:02	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.0999		0.0218	0.0241		0.0178	pCi/g	02/09/15 09:32	03/04/15 18:02	1

TestAmerica St. Louis



# Client Sample Results

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

TestAmerica Job ID: 160-10373-2

Client Sample ID: L10-02-13-B-E-B-00

Lab Sample ID: 160-10373-13

Date Collected: 02/03/15 10:45

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	1.08		0.191	0.220		0.115	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Bismuth 212	1.69		0.517	0.546		0.391	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Bismuth 214	0.953		0.141	0.173		0.101	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Lead 212	0.933		0.103	0.159		0.119	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Lead 214	1.25		0.135	0.187		0.0885	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Potassium 40	18.3		1.56	2.44		0.512	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Protactinium 231	0.108	U	0.233	0.234		1.35	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Radium 226	0.953		0.141	0.173	1.00	0.101	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Thorium 232	1.08		0.191	0.220		0.115	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Thorium 234	1.24		0.688	0.700		1.10	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Uranium 235	0.224	U	0.183	0.184		0.320	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Americium 241	0.0211	U	0.0754	0.0754		0.127	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Protactinium 234m	1.95	U	4.75	4.76		8.21	pCi/g	02/09/15 09:32	03/04/15 18:39	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.354		0.0639	0.0737		0.0470	pCi/g	02/09/15 09:32	03/04/15 18:39	1

Client Sample ID: L10-02-11-B-E-Q-00

Lab Sample ID: 160-10373-14

Date Collected: 02/03/15 11:35

Matrix: Solid

Date Received: 02/05/15 11:00

## 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	0.577		0.112	0.127		0.0649	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Bismuth 212	0.683		0.276	0.285		0.354	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Bismuth 214	0.812		0.0927	0.125		0.0586	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Lead 212	0.722		0.0624	0.112		0.0552	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Lead 214	0.912		0.0900	0.131		0.0796	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Potassium 40	11.8		0.954	1.54		0.224	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Protactinium 231	0.266	U	0.229	0.231		0.880	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Radium 226	0.812		0.0927	0.125	1.00	0.0586	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Thorium 232	0.577		0.112	0.127		0.0649	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Thorium 234	0.536	U	0.238	0.244		0.712	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Uranium 235	0.101	U	0.119	0.119		0.195	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Americium 241	0.0130	U	0.0498	0.0498		0.0838	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Protactinium 234m	0.318	U	3.15	3.15		5.60	pCi/g	02/09/15 09:32	03/04/15 18:37	1
Other Detected			Count Uncert.	Total Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.214		0.0364	0.0426		0.0368	pCi/g	02/09/15 09:32	03/04/15 18:37	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-10373-2

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

Lab Sample ID: MB 160-172876/1-A

Matrix: Solid

Analysis Batch: 176950

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 172876

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	0.004371	U	0.0114	0.0114		0.0414	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Bismuth 212	0.08107	U	0.109	0.110		0.178	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Bismuth 214	0.003050	U	0.0216	0.0216		0.0436	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Lead 212	-0.003612	U	0.0344	0.0344		0.0281	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Lead 214	0.005473	U	0.0141	0.0141		0.0267	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Potassium 40	-0.1134	U	0.706	0.706		0.364	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Protactinium 231	0.0000	U	0.135	0.135		0.536	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Radium 226	0.003050	U	0.0216	0.0216	1.00	0.0436	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Thorium 232	0.004371	U	0.0114	0.0114		0.0414	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Thorium 234	-0.02939	U	0.152	0.152		0.253	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Uranium 235	0.007713	U	0.0176	0.0176		0.0511	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Americium 241	0.004184	U	0.0129	0.0129		0.0230	pCi/g	02/09/15 09:32	03/03/15 22:44	1
Protactinium 234m	-0.1139	U	1.49	1.49		2.98	pCi/g	02/09/15 09:32	03/03/15 22:44	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	02/09/15 09:32	03/03/15 22:44	1

Lab Sample ID: LCS 160-172876/2-A

Matrix: Solid

Analysis Batch: 176956

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 172876

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	94.24		9.82		0.614	pCi/g	93	87 - 116
Cesium 137	34.9	33.42		3.51		0.197	pCi/g	96	87 - 120
Cobalt 60	36.6	34.98		3.53		0.144	pCi/g	96	87 - 115

Lab Sample ID: 160-10373-1 DU

Matrix: Solid

Analysis Batch: 176953

Client Sample ID: L10-02-01-B-S-S-00

Prep Type: Total/NA

Prep Batch: 172876

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	0.987		0.9832		0.157		0.114	pCi/g	0.01	1
Bismuth 212	0.821		1.550		0.486		0.380	pCi/g	0.83	1
Bismuth 214	0.998		1.036		0.149		0.0625	pCi/g	0.13	1
Lead 212	0.920		0.9446		0.142		0.0657	pCi/g	0.09	1
Lead 214	1.13		1.284		0.163		0.0728	pCi/g	0.50	1
Potassium 40	17.0		18.51		2.23		0.340	pCi/g	0.35	1
Protactinium 231	0.356	U	0.4266	U	0.460		0.745	pCi/g	0.10	1
Radium 226	0.998		1.036		0.149	1.00	0.0625	pCi/g	0.13	1
Thorium 232	0.987		0.9832		0.157		0.114	pCi/g	0.01	1
Thorium 234	0.858		1.510		0.581		0.870	pCi/g	0.73	1
Uranium 235	0.242		0.2136		0.158		0.196	pCi/g	0.10	1
Americium 241	0.0134	U	0.01352	U	0.0644		0.108	pCi/g	0	1

TestAmerica St. Louis

# QC Sample Results

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

TestAmerica Job ID: 160-10373-2

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

Lab Sample ID: 160-10373-1 DU

Matrix: Solid

Analysis Batch: 176953

Client Sample ID: L10-02-01-B-S-S-00

Prep Type: Total/NA

Prep Batch: 172876

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	0.977	U	3.187	U	2.25		5.26	pCi/g	0.43	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
Pb-210	2.17		1.811		0.663		0.818	pCi/g	0.25	1
Tl-208	0.330		0.3011		0.0561		0.0355	pCi/g	0.25	1

# QC Association Summary

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

TestAmerica Job ID: 160-10373-2

## Rad

### Leach Batch: 172318

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10373-1	L10-02-01-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10373-1 DU	L10-02-01-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10373-2	L10-02-02-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10373-3	L10-02-03-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-4	L10-02-04-B-S-S-00	Total/NA	Solid	Dry and Grind	
160-10373-5	L10-02-05-B-R-S-00	Total/NA	Solid	Dry and Grind	
160-10373-6	L10-02-06-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-7	L10-02-07-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-8	L10-02-08-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-9	L10-02-09-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-10	L10-02-10-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-11	L10-02-11-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-12	L10-02-12-B-E-S-00	Total/NA	Solid	Dry and Grind	
160-10373-13	L10-02-13-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10373-14	L10-02-11-B-E-Q-00	Total/NA	Solid	Dry and Grind	

### Prep Batch: 172876

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10373-1	L10-02-01-B-S-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-1 DU	L10-02-01-B-S-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-2	L10-02-02-B-R-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-3	L10-02-03-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-4	L10-02-04-B-S-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-5	L10-02-05-B-R-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-6	L10-02-06-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-7	L10-02-07-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-8	L10-02-08-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-9	L10-02-09-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-10	L10-02-10-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-11	L10-02-11-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-12	L10-02-12-B-E-S-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-13	L10-02-13-B-E-B-00	Total/NA	Solid	Fill_Geo-21	172318
160-10373-14	L10-02-11-B-E-Q-00	Total/NA	Solid	Fill_Geo-21	172318
LCS 160-172876/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-172876/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	

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