

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: 160-11590-2

Client Project/Site: HDP

For:

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

Attn: Brian Miller



Authorized for release by:
5/28/2015 2:54:00 PM

Ivan Vania, Project Manager II
(314)298-8566
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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: 160-11590-2

Job ID: 160-11590-2

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Perma-Fix Environmental Services Inc.

Project: HDP

Report Number: 160-11590-2

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 04/30/2015; 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 L10-14-10-B-E-B-00 (160-11590-1), L10-14-11-B-E-B-00 (160-11590-2), L10-14-12-B-E-B-00 (160-11590-3) and L10-03-14-B-E-I-01 (160-11590-4) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA_01_R. The samples were leached on 04/30/2015, prepared on 05/04/2015 and analyzed on 05/25/2015.

Batch 189205:

The sample duplicate precision for the following sample associated with 189205 was outside control limits: L10-14-10-B-E-B-00 (160-11590-1) and (160-11590-A-1-A DU). The associated Laboratory Control Sample / Laboratory Control Sample Duplicate (LCS/LCSD) precision met acceptance criteria for Pa-231. Both results were below the MDC, the data is reported with this narrative.

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

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.

Client Contact		Project Manager: Brian Miller		Site Contact: Ellen Jakub		Date: 04/30/2015		COC No: 043015-FSS1	
Perma-Fix Environmental Services		Tel/Fax: (314) 810-3333		Lab Contact: Ivan Vanya		Carrier: Courier		1 of 1 COCs	
2800 Solway Road		Analysis Turnaround Time		<input type="checkbox"/> Filtered Sample (Y/N) <input type="checkbox"/> Perform MS / MSD (Y/N) <input type="checkbox"/> Gamma Spec <input type="checkbox"/> Westinghouse Hematite Library <input type="checkbox"/> Alpha Spec <input type="checkbox"/> ICP/MS (Tc-99) <input type="checkbox"/> Gamma Spec (With 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									

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Gamma Spec	Westinghouse Hematite Library	Alpha Spec	ICP/MS (Tc-99)	Gamma Spec (With post-21 day ingrowth)	Sample Specific Notes:
L10-14-10-B-E-B-00	4/28/15	1114	G	Soil	1	N		X		X	X		Matt Cushman
L10-14-11-B-E-B-00	4/29/15	1020	G	Soil	1	N		X		X	X		Jahmai Williams
L10-14-12-B-E-B-00	4/28/15	1119	G	Soil	1	N		X		X	X		Matt Cushman
N / A													

Preservation Used: 1=Ice, 2=HCl, 3=H2SO4, 4=HNO3, 5=NaOH, 6=Other, None

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☒ Return to Client ☐ Disposal by Lab ☐ 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: _____ Cor'd: _____	Therm ID No.:
Relinquished by: <i>[Signature]</i>	Company: PermaFix	Date/Time: 10:30	Received by: <i>[Signature]</i>
Relinquished by: <i>[Signature]</i>	Company: Crossroads	Date/Time: 4/30/15	Received by: <i>[Signature]</i>
Relinquished by: <i>[Signature]</i>	Company: Crossroads	Date/Time: 4/30/15	Received in Laboratory by: <i>[Signature]</i>

160-11590 Chain of Custody



Hematite Decommissioning Project

Permafix (for Westinghouse) Non-Proprietary Class 3

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

Revision: 3

13715 Rider Trail North

Chain of Custody Record

Earth City, MO 63045
phone 314.298.8566 fax

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

phone 314.298.8566 fax						Regulatory Program: <input type="checkbox"/> DW <input type="checkbox"/> NPDES <input type="checkbox"/> RCRA <input checked="" type="checkbox"/> 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 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						Site Contact: Ellen Jakub Lab Contact: Ivan Vanya Date: 04/16/2015 Carrier: Courier				COC No: 041615-FSS1 ____ of ____ COCs Sampler: For Lab Use Only: Walk-in Client: Lab Sampling: Job / SDG No.: Sample Specific Notes: Sampler Matt Cushman									
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)										
L10-03-14-B-E-I-01						4/15/15	1634	G	Soil	1	N	X		X	X										
N/A																									
Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4= HNO3; 5= NaOH; 6= Other None						Possible Hazard Identification: Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample. <input checked="" type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown										Sample Disposal (A fee may be assessed if samples are retained longer than 1 month) <input checked="" type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months									
Special Instructions/QC Requirements & Comments: Potential for Radiological Contamination																									
Custody Seals Intact: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No						Custody Seal No.:				Cooler Temp. (°C): Obs'd: _____ Cor'd: _____ Therm ID No.:															
Relinquished by: [Signature]						Company: PermaFix				Date/Time: 1030		Received by: [Signature]				Company: Crossroads		Date/Time: 4/15/15 10:50							
Relinquished by: [Signature]						Company: Crossroads				Date/Time: 4/15/15 10:55		Received by: [Signature]				Company: [Signature]		Date/Time: 4/30/15 1055							
Relinquished by: [Signature]						Company: [Signature]				Date/Time: [Signature]		Received in Laboratory by: [Signature]				Company: [Signature]		Date/Time: [Signature]							
Hematite Decommissioning Project						Permafex (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: 160-11590-2

Login Number: 11590

List Source: TestAmerica St. Louis

List Number: 1

Creator: Clarke, Jill C

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?	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: 160-11590-2

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: 160-11590-2

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: 160-11590-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-11590-1	L10-14-10-B-E-B-00	Solid	04/28/15 11:14	04/30/15 10:55
160-11590-2	L10-14-11-B-E-B-00	Solid	04/29/15 10:20	04/30/15 10:55
160-11590-3	L10-14-12-B-E-B-00	Solid	04/28/15 11:19	04/30/15 10:55
160-11590-4	L10-03-14-B-E-I-01	Solid	04/15/15 16:34	04/30/15 10:55

Client Sample Results

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

TestAmerica Job ID: 160-11590-2

Client Sample ID: L10-14-10-B-E-B-00

Date Collected: 04/28/15 11:14

Date Received: 04/30/15 10:55

Lab Sample ID: 160-11590-1

Matrix: Solid

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		0.125	0.165		0.0860	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Bismuth 212	1.15		0.403	0.421		0.402	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Bismuth 214	1.25		0.112	0.172		0.0727	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Lead 212	1.13		0.0733	0.164		0.0566	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Lead 214	1.31		0.0912	0.164		0.0746	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Potassium 40	18.5		1.14	2.21		0.326	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Protactinium 231	0.500	U	0.287	0.292		1.18	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Radium 226	1.25		0.112	0.172	1.00	0.0727	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Thorium 232	1.05		0.125	0.165		0.0860	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Thorium 234	1.20		0.505	0.521		0.801	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Uranium 235	1.47		0.242	0.285		0.290	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Americium 241	-0.0242	U	0.0660	0.0660		0.110	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Protactinium 234m	6.49		2.90	2.97		5.14	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Pb-210	1.36		0.623	0.643		0.835	pCi/g	05/04/15 12:17	05/25/15 20:44	1
Tl-208	0.313		0.0416	0.0528		0.0306	pCi/g	05/04/15 12:17	05/25/15 20:44	1

Client Sample ID: L10-14-11-B-E-B-00

Date Collected: 04/29/15 10:20

Date Received: 04/30/15 10:55

Lab Sample ID: 160-11590-2

Matrix: Solid

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		0.153	0.190		0.133	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Bismuth 212	1.64		0.600	0.623		0.520	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Bismuth 214	1.02		0.129	0.167		0.0909	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Lead 212	1.06		0.0866	0.163		0.0823	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Lead 214	1.21		0.113	0.169		0.0769	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Potassium 40	19.2		1.39	2.41		0.253	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Protactinium 231	0.558	U	0.304	0.310		1.36	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Radium 226	1.02		0.129	0.167	1.00	0.0909	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Thorium 232	1.09		0.153	0.190		0.133	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Thorium 234	0.843	U	0.348	0.359		1.22	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Uranium 235	0.0973	U	0.155	0.155		0.286	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Americium 241	-0.0189	U	0.0759	0.0760		0.127	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Protactinium 234m	0.853	U	3.86	3.86		6.80	pCi/g	05/04/15 12:17	05/25/15 21:16	1
Other Detected										
Radionuclides	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.359		0.0609	0.0713		0.0458	pCi/g	05/04/15 12:17	05/25/15 21:16	1

TestAmerica St. Louis

Client Sample Results

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

TestAmerica Job ID: 160-11590-2

Client Sample ID: L10-14-12-B-E-B-00

Lab Sample ID: 160-11590-3

Date Collected: 04/28/15 11:19

Matrix: Solid

Date Received: 04/30/15 10:55

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	1.16		0.123	0.171		0.126	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Bismuth 212	1.26		0.421	0.441		0.401	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Bismuth 214	1.39		0.102	0.177		0.0583	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Lead 212	1.25		0.0708	0.177		0.0566	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Lead 214	1.51		0.103	0.188		0.0745	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Potassium 40	17.7		0.999	2.07		0.257	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Protactinium 231	0.519	U	0.225	0.232		1.05	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Radium 226	1.39		0.102	0.177	1.00	0.0583	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Thorium 232	1.16		0.123	0.171		0.126	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Thorium 234	0.892		0.505	0.514		0.819	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Uranium 235	0.0797	U	0.133	0.133		0.228	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Americium 241	-0.000155	U	0.0600	0.0600		0.101	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Protactinium 234m	2.71	U	2.80	2.81		4.58	pCi/g	05/04/15 12:17	05/25/15 21:17	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.402		0.0420	0.0592		0.0284	pCi/g	05/04/15 12:17	05/25/15 21:17	1

Client Sample ID: L10-03-14-B-E-I-01

Lab Sample ID: 160-11590-4

Date Collected: 04/15/15 16:34

Matrix: Solid

Date Received: 04/30/15 10:55

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		0.129	0.177		0.107	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Bismuth 212	1.45		0.433	0.458		0.379	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Bismuth 214	1.18		0.124	0.174		0.0898	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Lead 212	0.917		0.108	0.161		0.106	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Lead 214	1.23		0.108	0.167		0.0850	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Potassium 40	18.3		1.12	2.18		0.317	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Protactinium 231	0.341	U	0.525	0.526		0.873	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Radium 226	1.18		0.124	0.174	1.00	0.0898	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Thorium 232	1.19		0.129	0.177		0.107	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Thorium 234	1.22		0.801	0.811		0.999	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Uranium 235	0.330		0.192	0.194		0.228	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Americium 241	0.00784	U	0.0699	0.0699		0.117	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Protactinium 234m	1.26	U	2.94	2.94		5.08	pCi/g	05/04/15 12:17	05/25/15 22:03	1
Other Detected Radionuclides			Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Tl-208	0.371		0.0478	0.0614		0.0366	pCi/g	05/04/15 12:17	05/25/15 22:03	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-11590-2

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

Lab Sample ID: MB 160-189205/1-A

Matrix: Solid

Analysis Batch: 192159

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 189205

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Actinium 228	-0.001688	U	0.0257	0.0257		0.0504	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Bismuth 212	-0.03610	U	0.118	0.118		0.211	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Bismuth 214	0.007265	U	0.00690	0.00694		0.0392	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Lead 212	-0.007202	U	0.0622	0.0622		0.0232	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Lead 214	-0.006770	U	0.0372	0.0372		0.0315	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Potassium 40	0.0000	U	0.0917	0.0917		0.0975	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Protactinium 231	0.04723	U	0.161	0.161		0.289	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Radium 226	0.007265	U	0.00690	0.00694	1.00	0.0392	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Thorium 232	-0.001688	U	0.0257	0.0257		0.0504	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Thorium 234	-0.06163	U	0.329	0.330		0.257	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Uranium 235	0.008159	U	0.0165	0.0165		0.0666	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Americium 241	-0.004918	U	0.0127	0.0127		0.0220	pCi/g	05/04/15 12:17	05/25/15 21:15	1
Protactinium 234m	-0.5558	U	4.51	4.51		2.35	pCi/g	05/04/15 12:17	05/25/15 21:15	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	05/04/15 12:17	05/25/15 21:15	1

Lab Sample ID: LCS 160-189205/2-A

Matrix: Solid

Analysis Batch: 192155

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 189205

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium 241	101	102.6		10.7		0.563	pCi/g	102	87 - 116
Cesium 137	34.8	36.91		3.82		0.153	pCi/g	106	87 - 120
Cobalt 60	35.5	36.80		3.65		0.129	pCi/g	104	87 - 115

Lab Sample ID: 160-11590-1 DU

Matrix: Solid

Analysis Batch: 192155

Client Sample ID: L10-14-10-B-E-B-00

Prep Type: Total/NA

Prep Batch: 189205

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Actinium 228	1.05		1.203		0.182		0.148	pCi/g	0.45	1
Bismuth 212	1.15		1.390		0.490		0.438	pCi/g	0.26	1
Bismuth 214	1.25		1.224		0.167		0.0727	pCi/g	0.08	1
Lead 212	1.13		1.147		0.169		0.0796	pCi/g	0.04	1
Lead 214	1.31		1.356		0.182		0.0843	pCi/g	0.12	1
Potassium 40	18.5		23.74		2.70		0.260	pCi/g	1.07	1
Protactinium 231	0.500	U	-0.6367	U	0.787		1.29	pCi/g	1.05	1
Radium 226	1.25		1.224		0.167	1.00	0.0727	pCi/g	0.08	1
Thorium 232	1.05		1.203		0.182		0.148	pCi/g	0.45	1
Thorium 234	1.20		1.397		0.635		0.988	pCi/g	0.17	1
Uranium 235	1.47		1.640		0.275		0.265	pCi/g	0.31	1
Americium 241	-0.0242	U	0.01721	U	0.0709		0.119	pCi/g	0.30	1

TestAmerica St. Louis

QC Sample Results

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

TestAmerica Job ID: 160-11590-2

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

Lab Sample ID: 160-11590-1 DU

Matrix: Solid

Analysis Batch: 192155

Client Sample ID: L10-14-10-B-E-B-00

Prep Type: Total/NA

Prep Batch: 189205

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Protactinium 234m	6.49		8.213		3.73		3.12	pCi/g	0.26	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	1.36		1.542		0.851		1.00	pCi/g	0.12	1
Tl-208	0.313		0.4379		0.0742		0.0427	pCi/g	0.98	1

QC Association Summary

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

TestAmerica Job ID: 160-11590-2

Rad

Leach Batch: 188779

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11590-1	L10-14-10-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11590-1 DU	L10-14-10-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11590-2	L10-14-11-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11590-3	L10-14-12-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-11590-4	L10-03-14-B-E-I-01	Total/NA	Solid	Dry and Grind	

Prep Batch: 189205

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-11590-1	L10-14-10-B-E-B-00	Total/NA	Solid	Fill_Geo-21	188779
160-11590-1 DU	L10-14-10-B-E-B-00	Total/NA	Solid	Fill_Geo-21	188779
160-11590-2	L10-14-11-B-E-B-00	Total/NA	Solid	Fill_Geo-21	188779
160-11590-3	L10-14-12-B-E-B-00	Total/NA	Solid	Fill_Geo-21	188779
160-11590-4	L10-03-14-B-E-I-01	Total/NA	Solid	Fill_Geo-21	188779
LCS 160-189205/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-189205/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	