

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: 160-10553-2 Client Project/Site: HDP

For:

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

Attn: Brian Miller

# Elizabeth M. Houcher

Authorized for release by: 3/19/2015 11:30:57 AM Elizabeth Hoerchler, Project Mgmt. Assistant elizabeth.hoerchler@testamericainc.com

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



# **Table of Contents**

Cover Page	1
Table of Contents	2
Case Narrative	3
Chain of Custody	4
Receipt Checklists	5
Definitions/Glossary	6
Method Summary	7
Sample Summary	8
Client Sample Results	9
QC Sample Results	10
QC Association Summary	12

#### Job ID: 160-10553-2

#### Laboratory: TestAmerica St. Louis

Narrative

#### CASE NARRATIVE

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

#### **Project: HDP**

#### Report Number: 160-10553-2

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 02/19/2015; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 18.0° C.

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

Sample L10-03-13-B-E-B-00 (160-10553-1) was analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA GA\_01\_R. The samples were dried on 02/19/2015, prepared on 02/23/2015 and analyzed on 03/16/2015.

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

#### **TestAmerica St. Louis**

13715 Rider Trail North

# **Chain of Custody Record**

**TestAmerica** 

THE LEADER IN ENVIRONMENTAL TESTING

4

Earth City, MO 63045

phone 314.298.	3566 fax	Regu	latory Pro	ogram: [	] DW	NPDES		RCRA	고 Ot	her:								TestAmerica L	aboratorie	s Inc
	Client Contact	Project N	lanager: B	rian Miller			Site (	Contact	t: Elle	n Jak	ub	Date	: 02/1	9/2015			-	COC No: 021915	-ESS1	3, 110.
Perma-Fix Envir	onmental Services	Tel/Fax: (	(314) 810-3	333		[i	Lab	Contact	: Ivar	n Vany	a	Carrier: Courier				Page 1 of 1				
2800 Solway Ro	ad		Analysis Turnaround Time								<u> </u>						Sampler			
Knoxville, TN 37	931	CALEN	IDAR DAYS	🗌 wo	RKING DA	YS					1							For Lab Use Only	-	
(865) 690-0501	Phone	TA	T if different f	rom Below			Î	ary										Walk-in Client		1
(865) 539-9868	FAX			2 weeks			2L	Ē										l ab Sampling		
Project Name: H	lematite Decommissioning Project			1 week			212	Ē										Lab Gamping.	L	
Site: Westingho	use Hematite, MO			2 davs		ľ	SIC.	Ξ										Inh ( CDC No.		]
P O # 832953				1 dav				- Su		(6) - H								JUD 7 SDG NU.:		
			1	Sample	Т		Zal Sal	g Sp	bed											
		Sample	Sample	Туре		4.4	2 2	e ti	aS	a mag						1				
	Sample Identification	Date	Time	(C=Comp, G=Grab)	Matrix	Cont.	e le	Ves	현											
					Incuria	<sup>1</sup>	뇬┣	02	4	203	_					_		Sample Sp	ecific Notes	
	L10-03-13-B-E-B-00	2/17/15	1420	G	Soil	1	N	X		x   x								Matt Cushma	n (~ 19 Kcpm	1)
			1	<u> </u>	1							+		┝─┾╴			+	· · · · · · · · · · · · · · · · · · ·		
	<u></u>			L	<u> </u>															
													1		TT	,	TT		∕ 16	
			<u> </u>		+			<b>├</b> ──┤				++		<u> </u>			+			
-																			355	
a												$\mathbf{t}$			+1	$\rightarrow$	F		- G	
ge		$\rightarrow$		<b> </b>	<u> </u>		_					+			$\pm$					
4													-						i i i i i i i i i i i i i i i i i i i	
Q											$\rightarrow$	┢┥┦			+		┼─┼		- 3	
<u></u>			<u> </u>		J		1			1	1								us 🔤	
N				t.	N		/		Δ	5						1		· · · · · · · · · · · · · · · · · · ·	fo a	
	-	÷				<u>،</u>	·	1 1		.4	_	┢╌┼								
			$\square$	T.							$\neg$	++								
					1										11					
				ļ		-	_					-				_				
				Į.													$ \uparrow$			
		1	1		+		1					++		┝╌┼╍	+		╉╼╉			
K			1		1															
Preservation U	sed: 1= ice, 2= HCI; 3= H2SO4; 4=HNO3;	5=NaOH; 6=	OtherN	lone	and a start of the		( <b>1</b> )													
Are any samples	a Identification:	o Liet opy CC	A Waste C			- t- at .	Sa	ample D	)ispo	sal ( A	fee m	ay be	asse	ssed if	fsamp	ples ar	re ret	ained longer than	1 month)	
Comments Sect	ion if the lab is to dispose of the sample	e Listany Er	A waste (	Jodes for th	ie sampi	e in the														
I d Non Horord			- D	· · · · ·	·		_	_												
			10		own			[-/] Retu	m to C	lient		Dispos	al by Lal	)	Ц	Archive f	for	Months		
Special Instruc	tions/QC Requirements & Comments: Pote	ential for Rac	diological	Contamina	tion															
Custody Seals	Infact: Ves No	Custody S	Seat No -						Coole	er Tem	n CC	). Ops	'd		Corr	'd·		Therm ID No.		
Relinguished by	1 1100	Cempany			Date/T	ime:	R	bevience	byr					220		<u> </u>	1			
1 Sprin	- Maller	Perce	1-5	<i>x</i>	2-16	12		<u>u</u>	by.	n	1	५५१		npany.	•				~ ~ 7	1
ω Relinquished by	CALLE	Company		~	Dato	<u>()</u>		$\nabla \mathcal{V}_{\mathcal{G}}$	jer	+a	rla	<u>~</u>		1052	rua	ay		allalis or	5.59	
10 2	74 1-	Company.	·		12/21	11165. Alfont 1.1.1-1			ioy:	11		a.	100	npany:	: <	CP	ľ	Date/Time:	10 -	
N Relinguished A	gunton	1000	270 4 a		JAMI	3 10.1	<u>u</u> c	All	<u> </u>	ra	<u>i</u> k			M	<u> </u>	-7 (		J-14-15	1020	
O houndaished by		Company	•		Date/T	ime:	Re	ceived	ın La	porato	ry by:		Co	npany:	:		1	Date/Time:		
-σ-				<del>,,</del>	<u> </u>															
	Hematite Decommioning Project	Perm	afix (for W	lestinghou	ise) No	n-Proorie	etan	/ Class	3	P	oced	ne H	DP-P	2-0A-	006	Chain	of C	ustody Davi	cian-2	
1		1 .		~	•	94 °			1	l							** 0			

### Login Sample Receipt Checklist

Client: Perma-Fix Environmental Services Inc.

#### Login Number: 10553 List Number: 1

Creator: Clarke, Jill C

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

Job Number: 160-10553-2

List Source: TestAmerica St. Louis

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

5

6

Qualifiers

#### Rad

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.
¤	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)

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

DOE = U.S. Department of Energy

Method Description

Radium-226 & Other Gamma Emitters (GS)

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

Method

GA-01-R

Protocol References:

Laboratory References:

Laboratory

TAL SL

Protocol

DOE

5
7
8
9

## Sample Summary

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

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-10553-1	L10-03-13-B-E-B-00	Solid	02/17/15 14:20	02/19/15 10:20

Total

0.242

0.230

0.600

0.178

0.0955

4.81

Total

Uncert.

*(2σ+/-)* 

0.0849

0.896

Count

0.174

0.183

0.531

0.172

0.0955

4.74

Count

Uncert.

(2**σ**+/-)

0.872

0.0703

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

1.61

1.36

2.68

0.442

8.03

1.78

0.458

U

Result Qualifier

0.00172

Lab Sample ID: 160-10553-1

03/16/15 13:30

03/16/15 13:30

03/16/15 13:30

03/16/15 13:30

03/16/15 13:30

03/16/15 13:30

Analyzed

03/16/15 13:30

03/16/15 13:30

Matrix: Solid

Dil Fac 1

1	
1	
1	8
1	
1	9
1	
1	

1

1

1

1

1

1

Dil Fac

Client Sample ID: L10-03-13-B-E-B-00 Date Collected: 02/17/15 14:20 Date Received: 02/19/15 10:20

Analyte

Actinium 228

**Bismuth 212** 

**Bismuth 214** 

Potassium 40

Radium 226

Thorium 232

Thorium 234

Uranium 235

Americium 241

Other Detected

Radionuclides

Pb-210

TI-208

Protactinium 234m

Protactinium 231

Lead 212

Lead 214

		Uncert.	Uncert.					
Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Prepared	Analyzed
1.36		0.183	0.230		0.131	pCi/g	02/23/15 15:07	03/16/15 13:30
1.42		0.495	0.516		0.514	pCi/g	02/23/15 15:07	03/16/15 13:30
1.61		0.174	0.242		0.109	pCi/g	02/23/15 15:07	03/16/15 13:30
1.21		0.101	0.186		0.102	pCi/g	02/23/15 15:07	03/16/15 13:30
1.63		0.148	0.225		0.104	pCi/g	02/23/15 15:07	03/16/15 13:30
18.5		1.42	2.37		0.324	pCi/g	02/23/15 15:07	03/16/15 13:30
0.545	U	0.437	0.441		1.54	pCi/q	02/23/15 15:07	03/16/15 13:30

1.00

RL

0.109 pCi/g

0.131 pCi/g

1.26 pCi/g

0.284 pCi/g

0.161 pCi/g

7.02 pCi/g

MDC Unit

1.08 pCi/g

0.0518 pCi/g

02/23/15 15:07

02/23/15 15:07

02/23/15 15:07

02/23/15 15:07

02/23/15 15:07

02/23/15 15:07

Prepared

02/23/15 15:07

02/23/15 15:07

Total

Uncert.

(2**σ**+/-)

0.0180

Lab Sample ID: MB 160-175826/1-A

Matrix: Solid

Analyte

Actinium 228

Bismuth 212

Bismuth 214

Potassium 40

Radium 226

Thorium 232

Thorium 234

Uranium 235

Americium 241

Protactinium 234m

Protactinium 231

Lead 212

Lead 214

Analysis Batch: 179434

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

МВ МВ

0.01161 U

0.0000 U

0.006926 U

0.01227 U

-0.01397 U

-0.07816 U

0.05209 U

0.006926 U

0.01161 U

-0.05951 U

0.01312 U

0.0000 U

MR MR

0.004197 U

Result Qualifier

Count

Uncert.

(2**σ**+/-)

0.0180

**Client Sample ID: Method Blank** 

**Client Sample ID: Lab Control Sample** 

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

Prep Type: Total/NA Prep Batch: 175826

Prep Type: Total/NA

Prepared

0

#### Dil Fac Analyzed 02/23/15 15:07 03/16/15 13:28 1 03/16/15 13.28 1

Prep Type: Total/NA

Prep Batch: 175826

0.0958	0.0958		0.257	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.00801	0.00805		0.0383	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.0120	0.0121		0.0196	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.559	0.559		0.0366	pCi/g	02/23/15 15:07	03/16/15 13:28	1
3.13	3.13		0.328	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.154	0.154		0.275	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.00801	0.00805	1.00	0.0383	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.0180	0.0180		0.0545	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.301	0.301		0.261	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.0347	0.0347		0.0604	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.0131	0.0131		0.0229	pCi/g	02/23/15 15:07	03/16/15 13:28	1
0.341	0.341		0.888	pCi/g	02/23/15 15:07	03/16/15 13:28	1
Count	Total						
Uncert.	Uncert.						

MDC Unit

0.0545 pCi/g

Other Detected	MB	MB	Uncert.	Uncert.						
Radionuclides	Result	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC (	Unit	Prepared	Analyzed	Dil Fac
Other Detected	None					, F	oCi/g	02/23/15 15:07	03/16/15 13:28	1

RL

#### Other Detecte Radionuclide

#### Lab Sample ID: LCS 160-175826/2-A Matrix: Solid

#### Analysis Batch: 179436

				Total						
	Spike	LCS	LCS	Uncert.					%Rec.	
Analyte	Added	Result	Qual	(2σ+/-)	RL	MDC	Unit	%Rec	Limits	
Americium 241	101	102.9		10.7		0.479	pCi/g	102	87 - 116	
Cesium 137	34.9	35.32		3.70		0.170	pCi/g	101	87 - 120	
Cobalt 60	36.4	36.35		3.67		0.109	pCi/g	100	87 - 115	

#### Lab Sample ID: 160-10553-1 DU Matrix: Solid

#### Analysis Batch: 179436

Analysis Batch: 179436 Prep E								Prep Batch: 1	atch: 175826	
					Total					
	Sample	Sample	DU	DU	Uncert.					RER
Analyte	Result	Qual	Result	Qual	(2σ+/-)	RL	MDC	Unit	RER	Limit
Actinium 228	1.36		1.373		0.238		0.157	pCi/g	0.02	1
Bismuth 212	1.42		1.391		0.463		0.559	pCi/g	0.03	1
Bismuth 214	1.61		1.608		0.222		0.0912	pCi/g	0.01	1
Lead 212	1.21		1.403		0.204		0.0731	pCi/g	0.51	1
Lead 214	1.63		1.815		0.226		0.100	pCi/g	0.41	1
Potassium 40	18.5		20.45		2.50		0.268	pCi/g	0.40	1
Protactinium 231	0.545	U	-0.7694	U	0.957		1.57	pCi/g	0.94	1
Radium 226	1.61		1.608		0.222	1.00	0.0912	pCi/g	0.01	1
Thorium 232	1.36		1.373		0.238		0.157	pCi/g	0.02	1
Thorium 234	2.68		4.046		0.820		0.975	pCi/g	0.97	1
Uranium 235	0.442		0.6269		0.244		0.273	pCi/g	0.44	1
Americium 241	0.00172	U	0.08658	U	0.0721		0.116	pCi/g	0.51	1

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

Lab Sample ID: Matrix: Solid Analysis Batch	160-1055 : 179436	3-1 DU			Total			Client Sa	Imple ID: L10-03-13-B-I Prep Type: To Prep Batch: 1	E-B-00 tal/NA 75826
	Sample	Sample	DU	DU	Uncert.					RER
Analyte	Result	Qual	Result	Qual	(2σ+/-)	RL	MDC	Unit	RER	Limit
Protactinium 234m	8.03		8.868		3.57		3.00	pCi/g	0.1	1
					Total					
Other Detected	Sample	Sample	DU	DU	Uncert.					RER
Radionuclides	Result	Qual	Result	Qual	(2σ+/-)	RL	MDC	Unit	RER	Limit
Pb-210	1.78		1.880		0.866		1.05	pCi/g	0.05	1
TI-208	0.458		0.4205		0.0764		0.0492	pCi/g	0.24	1

## **QC** Association Summary

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

11

#### Rad

#### Leach Batch: 174830

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10553-1	L10-03-13-B-E-B-00	Total/NA	Solid	Dry and Grind	
160-10553-1 DU	L10-03-13-B-E-B-00	Total/NA	Solid	Dry and Grind	
100-10353-1 DO	L10-03-13-D-L-D-00	Total/NA	Solid	Dry and Grind	

#### Prep Batch: 175826

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-10553-1	L10-03-13-B-E-B-00	Total/NA	Solid	Fill_Geo-21	174830
160-10553-1 DU	L10-03-13-B-E-B-00	Total/NA	Solid	Fill_Geo-21	174830
LCS 160-175826/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-175826/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	