

**Pit 1 Pile Investigation
St. Anthony Mine Site
Seboyeta, New Mexico**

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1.0 Introduction and Background

This report provides the results of the Pit 1 piles radiologic characterization (Pit 1 Investigation) that was conducted at the St. Anthony Mine Site (Site) near Seboyeta, New Mexico. The purpose of this investigation was to estimate the Ra-226 concentrations of the piles in Pit 1. The characterization was performed by collecting soil samples from test pits, and conducting onsite ex-situ gamma radiation soil screening and vendor laboratory analysis on the samples. Field activities began on November 4, 2019 and were completed on November 6, 2019. The methods and procedures used were consistent with Section 4 of the 2018 Supplemental Investigations Work Plan (2018 Work Plan; Stantec, 2019). Test pit names and locations are shown in Figure 1.

Mine site features were characterized in 2007, as described in the *Materials Characterization Report, Saint Anthony Mine Site* (MWH, 2007). The remaining areas of the Site were characterized during the 2018 Supplemental Radiologic Characterization (AVM, 2018). The following sections describe the methods and procedures that were used and the results of the Pit 1 Investigation.

2.0 Previous Characterizations

As noted above, only the mine site features were radiologically characterized during the 2007 Materials Characterization. The features defined in the 2007 Materials Characterization included the Background Area, Borrow Sources, Top Soil Stockpiles, Non-Economic Materials Storage Piles, and the Western Shaft Area. Gamma exposure rate surveys and soil sampling were conducted during the 2007 Material Characterization. The 2007 characterization included gamma exposure rate surveys in Pit 1 with gamma exposure rates measured at one meter above the ground surface with shielded and unshielded meters. Measurements were also collected with a shielded meter at ground surface contact. Areas between the site features were not radiologically characterized in 2007 and the lateral extent of radiologic contamination was still unknown. Background levels were established during this phase of work at a Ra-226 value of 1.6 pCi/g for the Site.

The 2018 Supplemental Radiological Characterization was performed to delineate the radiologic contamination boundary based upon an Investigation Level (IL) of 5.0 pCi/g plus 1.6 pCi/g background level, and to characterize the Site by performing radiological surveys and collecting soil samples in the areas between the mine features. No sampling of the piles in Pit 1 was conducted during the previous Site radiologic characterizations.

3.0 Objective of the Pit 1 Pile Investigation

The Site is a former uranium mine, therefore the surface and subsurface soil within the piles are expected to be impacted by radionuclides associated with the uranium decay series, with Ra-226 being the primary Constituent of Concern (COC). The objective of the Pit 1 Investigation was to estimate the concentration of Ra-226 in the Pit 1 Piles.

4.0 Field Investigation

Field activities for the Pit 1 Investigation were conducted consistent with the methods and procedures specified in the 2018 Work Plan. The field investigation activities included field-locating test pit locations, excavation of test pits, soil sampling and transport of the soil samples to the onsite ex-situ soil screening station for analysis. Provisional test pit locations were selected prior to conducting the field activities using satellite imagery. As each provisional test pit was field-located using a sub-meter accurate Differential Global Positioning System (DGPS), they were relocated as needed to ensure both horizontal and vertical characterization of each pile to the extent practical. Cuts large enough to safely excavate test pits were made on the sides of large piles midway from the top and bottom. Each test pit consisted of three or four depth samples, depending on professional judgement and test pit excavation refusal. Table 1 shows test pit sample data and radiological data. A track excavator was used to excavate a trench at each test pit location for subsurface soil sample collection. At each depth, a soil sample was collected in a gallon Ziploc bag. Each sample was labeled based on the test pit location and depth of sample from the test pit surface. As an example, "TP-03-06" designates a sample from Test Pit 03 that is six feet below the surface prior to excavation. Any large rocks or debris were omitted from the sample. Upon completion of each test pit, the samples were then transported to the onsite ex-situ soil screening station located in a low radiation exposure area to minimize gamma radiation influence on the sample counts. The test pit excavation geotechnical logs are included in Appendix A. Prior to leaving any test pit location, the test pit was backfilled, leveled and marked with labeled pin flags. Each test pit location ID and corresponding coordinates were logged using a DGPS and are listed in Table 1 and test pit locations are shown in Figure 1.

4.1 Ex-Situ Gamma Radiation Soil Screening

The ex-situ gamma radiation soil screening was conducted in accordance with AVM SOP-4, included in the 2018 Work Plan, and provides a real-time estimate of Ra-226 concentrations in soil samples. This method is more reliable than the in-situ direct gamma surveys for real-time Ra-226 assessment in soils. The on-site ex-situ soil screening method consists of selectively measuring the 609 KeV region gamma radiations of Bi-214, a decay product of Ra-226. A single channel analyzer (Ludlum L2221) integrated with a Ludlum 44-20 3x3 NaI scintillation detector was used to measure the 609 keV energy peak region of Bi-214. The soil sample was placed around the plastic lined detector in a heavily shielded counting chamber. The heavily shielded counting chamber lowers the system background counts, thus improving the system's minimum detectable concentration (MDC). A 50 pCi/g reference soil was used for soil screening calibration checks. The test pit soil screening data is summarized in Table 1.

A total of 71 soil samples from 19 test pit locations were collected and analyzed by ex-situ soil screening. The Field Soil Sample Gamma Radiation Screening Forms completed during the ex-situ soil screening are included in Appendix B. One sample from each test pit was selected to be sent to the offsite vender laboratory, ALS, Inc. in Fort Collins, CO (ALS). Based on the ex-situ scanning concentration of the samples in the test pit, one sample which represented the average or slightly higher concentration of the test pit was selected for lab analysis. Additionally, two field QA/QC duplicate samples were also sent to ALS. These soil

samples were analyzed for Ra-226 using EPA Method 901.1 (modified for soil matrix) for confirmation of the onsite soil screening results, and for uranium using EPA Method SW3050B/6020.

5.0 Soil Sample Results

The sample chain of custody and laboratory results reports are included in Appendix C. The test pit soil sample ex-situ gamma radiation field soil screening results and the vendor laboratory results are summarized in Table 1. The ex-situ gamma radiation field soil screening results for Ra-226 conform with the vendor laboratory Ra-226 results. Ra-226 concentrations in the individual soil samples from the piles range from 7.5 pCi/g to 125.5 pCi/g. As shown in Table 2, the average Ra-226 concentration in individual test pits range from 13.7 pCi/g to 103.5 pCi/g, and the average Ra-226 concentration in the piles range from 25.0 pCi/g to 77.2 pCi/g. Uranium concentrations in the individual samples sent to the vendor laboratory from the test pits ranged from 19 mg/Kg to 130 mg/Kg, as shown in Table 1.

6.0 Quality Assurance and Quality Control Measures

Quality Assurance/Quality Control (QA/QC) measures as specified in the 2018 Work Plan were also implemented during the Pit 1 Investigation to ensure that the data is of acceptable quality. All radiologic survey instruments, including personnel and vehicle contamination friskers, were calibrated as specified in AVM SOP-1 which is included in the 2018 Work Plan. Additionally, operational function checks were performed on all radiologic instruments daily prior to use. The calibration, correlation and function check documents are included in Appendix D. During this characterization, no instruments were found to be out of calibration or inoperable as indicated by the daily operational function checks. A calibration/correlation of the ex-situ soil screening system was performed prior to mobilizing in the field using 25 pCi/g, 50 pCi/g, and 100 pCi/g reference soils. Daily operational function checks were performed on the ex-situ soil screening system prior to daily use. Based on the highest system background (blank) measurements from daily operational function checks and efficiency (pCi/g/cpm), the highest Ra-226 MDC for the screening system calculated was less than 0.8 pCi/g, significantly less than the expected concentrations in the test pit samples. The MDCs during the investigation met the QA objectives.

The QA/QC measures also included field QA/QC duplicate soil sampling at a frequency of 10% of the soil samples collected for laboratory analysis. As discussed above, field QA/QC duplicate soil samples were collected and sent to the laboratory for analysis, and the QA/QC duplicate results are included in the same tables with the original samples and are identified with a -D at the end of the sample name.

7.0 References

AVM, 2018. *Supplemental Radiologic Characterization, St. Anthony Mine Site*. August 13.

MWH, 2007. *Materials Characterization Report: Saint Anthony Mine Site*. October 26.

Stantec, 2018. *St. Anthony Supplemental Investigations Work Plan*. February 23.

Tables

Table 1
St. Anthony Mine Site
Pit 1 Pile Investigation Soil Sample Results Summary

Test Pit Sample Information							Field Soil Gamma Screening Data			Laboratory Data				Laboratory Data
Test Pit ID	Sample ID	Sample Date	Sample Time	Northing NAD83 NM West (feet)	Easting NAD83 NM West (feet)	Test Pit Elevation (feet)	Sample CPM (net avg)	Comments	Estimated Ra-226 pCi/g	Sample Sent to Lab	Ra-226 pCi/g	Error Estimate pCi/g	MDC pCi/g	Uranium mg/Kg
TP-01	TP-01-01	11/5/19	1400	1,516,031.0	2,880,739.3	6,011.5	6807	Field QA/QC Dup	116.4	Y	120.0	14.0	1.0	100
	TP-01-01-D	11/5/19								Y	117.0	14.0	2.0	110
	TP-01-03	11/5/19	1415				4531		76.8	N	-	-	-	-
	TP-01-06	11/5/19	1420				5592		95.3	N	-	-	-	-
	TP-01-08	11/5/19	1430				7332		125.5	N	-	-	-	-
TP-02	TP-02-02	11/5/19	1440	1,516,031.6	2,880,915.5	6,003.8	2480		41.1	N	-	-	-	-
	TP-02-03	11/5/19	1445				3646		61.4	N	-	-	-	-
	TP-02-06	11/5/19	1450				5775		98.5	N	-	-	-	-
	TP-02-08	11/5/19	1500				4167		70.5	Y	68.2	8.2	1.5	83
TP-03	TP-03-01	11/6/19	805	1,515,881.7	2,880,927.0	5,987.4	3369		56.6	N	-	-	-	-
	TP-03-03	11/6/19	810				3953		66.8	N	-	-	-	-
	TP-03-06	11/6/19	820				3827		64.6	Y	65.6	7.8	1.0	93
	TP-03-08	11/6/19	825				2622		43.6	N	-	-	-	-
TP-04	TP-04-01	11/5/19	1510	1,516,000.6	2,880,983.4	5,987.3	3041		50.9	N	-	-	-	-
	TP-04-03	11/5/19	1515				5214		88.7	Y	94.0	11.0	2.0	130
	TP-04-06	11/5/19	1520				4623		78.4	N	-	-	-	-
	TP-04-07	11/5/19	1530				4078		68.9	N	-	-	-	-
TP-05	TP-05-01	11/6/19	830	1,515,828.9	2,880,972.0	5,974.8	5273		89.7	Y	94.0	11.0	1.0	97
	TP-05-05	11/6/19	840				4727		80.2	N	-	-	-	-
TP-06	TP-06-01	11/5/19	1105	1,514,967.3	2,881,320.8	5,923.2	1562		25.1	N	-	-	-	-
	TP-06-03	11/5/19	1115				2539		42.1	N	-	-	-	-
	TP-06-06	11/5/19	1120				1141		17.8	N	-	-	-	-
	TP-06-07	11/5/19	1130				1937		31.7	Y	34.7	4.2	0.8	50
TP-07	TP-07-03	11/5/19	1005	1,514,972.3	2,881,538.1	5,925.8	1280		20.2	N	-	-	-	-
	TP-07-06	11/5/19	1010				1686		27.3	N	-	-	-	-
	TP-07-09	11/5/19	1020				1486		23.8	Y	23.4	2.9	0.9	45

Table 1 (Continued)
St. Anthony Mine Site
Pit 1 Pile Investigation Soil Sample Results Summary

Test Pit Sample Information							Field Soil Gamma Screening Data			Laboratory Data				Laboratory Data	
Test Pit ID	Sample ID	Sample Date	Sample Time	Northing NAD83 NM West (feet)	Easting NAD83 NM West (feet)	Test Pit Elevation (feet)	Sample CPM (net avg)	Comments	Estimated Ra-226 pCi/g	Sample Sent to Lab	Ra-226 pCi/g	Error Estimate pCi/g	MDC pCi/g	Uranium mg/Kg	
TP-08	TP-08-01	11/5/19	1040	1,514,859.3	2,881,358.3	5,930.9	550		7.5	N	-	-	-	-	
	TP-08-03	11/5/19	1045				1228		19.3	N	-	-	-	-	-
	TP-08-06	11/5/19	1050				686		9.9	N	-	-	-	-	-
	TP-08-08	11/5/19	1055				1155		18.1	Y	18.4	2.3	0.8	19	
TP-09	TP-09-01	11/5/19	930	1,514,918.2	2,881,617.3	5,937.9	1933		31.6	N	-	-	-	-	
	TP-09-03	11/5/19	935				4077		68.9	N	-	-	-	-	
	TP-09-05	11/5/19	945				2053		33.7	N	-	-	-	-	
	TP-09-07	11/5/19	950				2644		43.8	Y	47.0	5.7	1.2	47	
	TP-09-07-D	11/5/19	1000					Field QA/QC Dup		43.8	Y	41.5	5.1	1.2	55
TP-10	TP-10-01	11/5/19	1255	1,514,777.6	2,881,405.0	5,909.0	1301		20.6	N	-	-	-	-	
	TP-10-03	11/5/19	1300				1886		30.8	Y	31.0	3.7	0.7	39	
	TP-10-06	11/5/19	1310				1610		26.0	N	-	-	-	-	
	TP-10-08	11/5/19	1315				3535		59.5	N	-	-	-	-	
TP-11	TP-11-01	11/5/19	1320	1,514,832.0	2,881,495.3	5,910.5	1156		18.1	N	-	-	-	-	
	TP-11-03	11/5/19	1325				1324		21.0	N	-	-	-	-	
	TP-11-06	11/5/19	1335				1633		26.4	Y	22.8	2.8	1.0	37	
	TP-11-08	11/5/19	1340				1646		26.6	N	-	-	-	-	
TP-12	TP-12-01	11/5/19	915	1,514,769.6	2,881,541.2	5,894.9	1707		27.7	Y	24.8	3.0	0.8	49	
	TP-12-03	11/5/19	910				2439		40.4	N	-	-	-	-	
	TP-12-06	11/5/19	900				1481		23.7	N	-	-	-	-	
TP-13	TP-13-01	11/4/19	1255	1,514,619.8	2,880,964.2	5,882.8	2220		36.6	N	-	-	-	-	
	TP-13-03	11/4/19	1300				2604		43.3	N	-	-	-	-	
	TP-13-06	11/4/19	1305				2316		38.3	Y	35.0	4.2	0.6	52	
	TP-13-08	11/4/19	1315				2188		36.0	N	-	-	-	-	

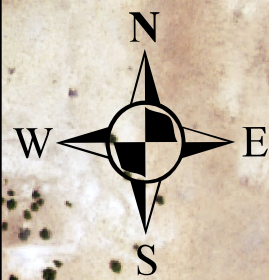
Table 1 (Continued)
St. Anthony Mine Site
Pit 1 Pile Investigation Soil Sample Results Summary

Test Pit Sample Information							Field Soil Gamma Screening Data			Laboratory Data				Laboratory Data
Test Pit ID	Sample ID	Sample Date	Sample Time	Northing NAD83 NM West (feet)	Easting NAD83 NM West (feet)	Test Pit Elevation (feet)	Sample CPM (net avg)	Comments	Estimated Ra-226 pCi/g	Sample Sent to Lab	Ra-226 pCi/g	Error Estimate pCi/g	MDC pCi/g	Uranium mg/Kg
TP-14	TP-14-01	11/4/19	1530	1,514,655.1	2,881,446.1	5,919.6	2657	FSS on 11/5	44.2	N	-	-	-	-
	TP-14-03	11/4/19	1540				1104	FSS on 11/5	17.2	N	-	-	-	-
	TP-14-07	11/4/19	1545				2409	FSS on 11/5	39.9	Y	40.0	4.8	1.0	31
	TP-14-08	11/4/19	1555				1802	FSS on 11/5	29.3	N	-	-	-	-
TP-15	TP-15-01	11/4/19	1455	1,514,592.1	2,881,305.6	5,900.9	1789		29.1	N	-	-	-	-
	TP-15-03	11/4/19	1500				2252		37.2	N	-	-	-	-
	TP-15-06	11/4/19	1505				2507		41.6	Y	35.5	4.3	0.8	26
	TP-15-07	11/4/19	1515				3630		61.1	N	-	-	-	-
TP-16	TP-16-01	11/4/19	1325	1,514,547.0	2,880,882.3	5,882.8	1644		26.6	N	-	-	-	-
	TP-16-03	11/4/19	1335				1582		25.5	N	-	-	-	-
	TP-16-07	11/4/19	1345				1749		28.4	N	25.5	3.1	0.6	38
	TP-16-09	11/4/19	1355				2036	Weight Corrected	33.4	Y	-	-	-	-
TP-17	TP-17-01	11/4/19	1055	1,514,531.7	2,881,025.3	5,911.4	993		15.2	N	-	-	-	-
	TP-17-03	11/4/19	1100				1201		18.9	Y	15.1	1.9	0.6	30
	TP-17-05	11/4/19	1105				1219		19.2	N	-	-	-	-
TP-18	TP-18-01	11/4/19	1415	1,514,630.9	2,881,198.0	5,900.6	2813	Weight Corrected	46.9	N	-	-	-	-
	TP-18-03	11/4/19	1420				2987	Weight Corrected	49.9	N	-	-	-	-
	TP-18-06	11/4/19	1425				2193		36.1	Y	34.7	4.2	1.0	46
	TP-18-08	11/4/19	1430				1899		31.0	N	-	-	-	-
TP-19	TP-19-01	11/4/19	1115	1,514,571.1	2,881,135.1	5,917.8	1460		23.4	N	-	-	-	-
	TP-19-03	11/4/19	1123				2039		33.4	Y	33.7	4.1	0.7	30
	TP-19-05	11/4/19	1130				1886		30.8	N	-	-	-	-
	TP-19-07	11/4/19	1140				2423		40.1	N	-	-	-	-

Table 2
St. Anthony Mine Site
Pit 1 Pile Investigation Ra-226 Results Summary

Pile ID	Test Pit ID	Test Pit Average Ra-226 pCi/g	Pile Average Ra-226 pCi/g
Pile 1	TP-01	103.5	77.2
	TP-02	67.9	
	TP-03	57.9	
	TP-04	71.7	
	TP-05	85.0	
Pile 2	TP-06	29.2	25.0
	TP-08	13.7	
	TP-10	34.2	
	TP-11	23.0	
Pile 3	TP-07	23.8	34.1
	TP-09	44.5	
Pile 4	TP-12	30.6	35.2
	TP-14	32.6	
	TP-15	42.2	
Pile 5	TP-13	38.5	31.5
	TP-16	28.5	
	TP-17	17.8	
	TP-18	41.0	
	TP-19	31.9	

Figure



Pile ID	Test Pit ID	Test Pit Average Ra-226 pCi/g	Pile Average Ra-226 pCi/g
Pile 1	TP-01	103.5	77.2
	TP-02	67.9	
	TP-03	57.9	
	TP-04	71.7	
	TP-05	85.0	
Pile 2	TP-06	29.2	25.0
	TP-08	13.7	
	TP-10	34.2	
	TP-11	23.0	
Pile 3	TP-07	23.8	34.1
	TP-09	44.5	
Pile 4	TP-12	32.9	34.2
	TP-14	35.5	
	TP-15	34.3	
Pile 5	TP-13	30.3	32.9
	TP-16	34.3	
	TP-17	37.7	
	TP-18	24.0	
	TP-19	38.0	



Legend

- x Test Pit Location
- Pile 2
- Pile 4
- Pile 1
- Pile 3
- Pile 5

Figure 1
Test Pit Locations

Appendix A

Test Pit Geotechnical Logs

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-01

Sheet NO.: TP- _____

GENERAL LOCATION: _____

DATE: 11/5/19

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: B. Van

EASTING: _____

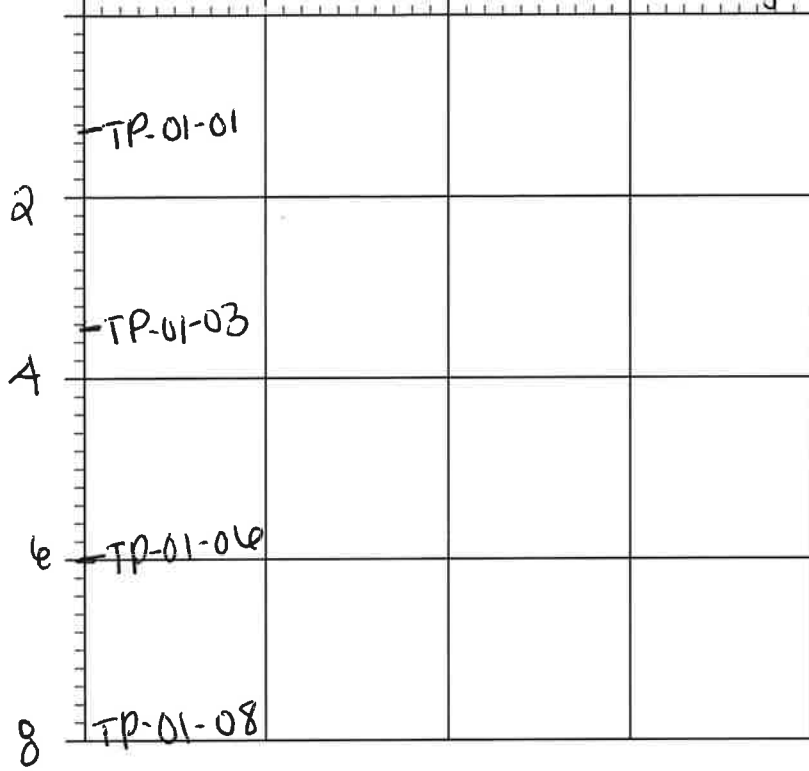
PIT FACE LOGGED: _____

Geologist

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ⊗ GROUNDWATER LEVEL
- ⊗ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-01-01	1.2	14:00	SM
TP-01-03	3.5	14:15	SM
TP-01-06	6	14:20	SM
TP-01-08	8	14:30	SM

Pit Width: 3
 Pit Length: 11
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
		Fines ~ 80%. Gray, green. gravel + cobbles sieve 1/4"

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
 GEOTECHNICAL TEST PIT LOGGING

Test Pit ID: TP-02

Sheet NO.: TP- _____

GENERAL LOCATION: _____
 PIT TREND: _____
 PIT FACE LOGGED: _____

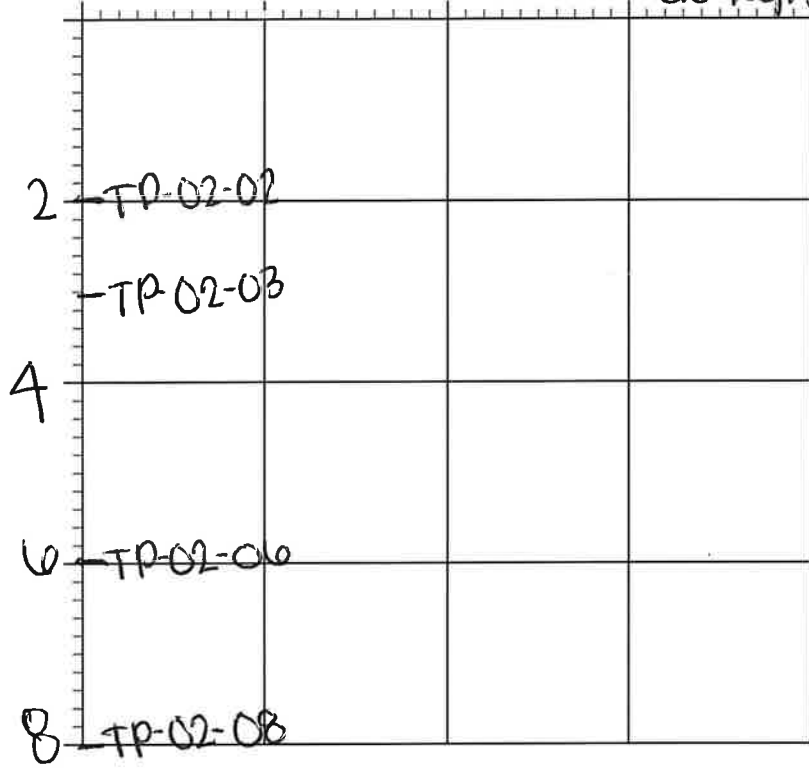
DATE: 9/15/19
 FIELD ENGINEER: B. Van
 GEOLOGIST

NORTHING: _____
 EASTING: _____

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-02-02	2	14:40	SM
TP-02-03	3	14:45	SM
TP-02-06	6.5	14:50	SM
TP-02-08	8.5	15:00	SM

Pit Width: 3
 Pit Length: 11
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		Fines ~ 60%. Gravel + sand. Gray-tan w/ some green 1/4" # sieve

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-05

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: _____
PIT FACE LOGGED: _____

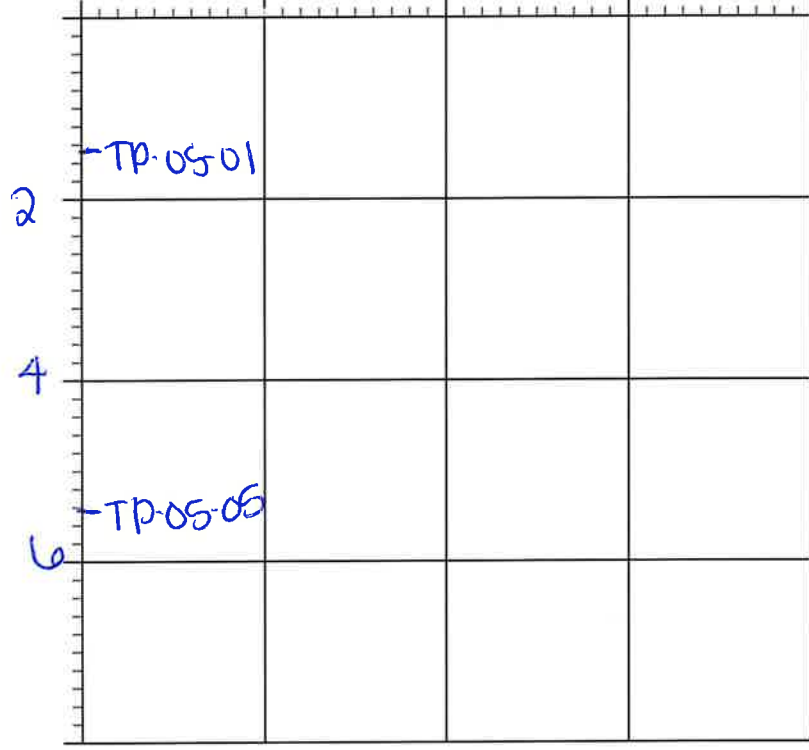
DATE: 11/6/19
FIELD ENGINEER: _____
geologist

NORTHING: _____
EASTING: _____

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP05-01	1.5	8:30	SM
TP05-05	5.5	8:40	SM

Pit Width: 3
Pit Length: 11
Pit Depth: _____
GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
Sm		Fines approx 75%. with cobbles + gravel 1/4" sieve gray-brown w/ some green wet bc of rain

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-06

Sheet NO.: TP- _____

GENERAL LOCATION: _____

DATE: 11/5/19

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: B. Van

EASTING: _____

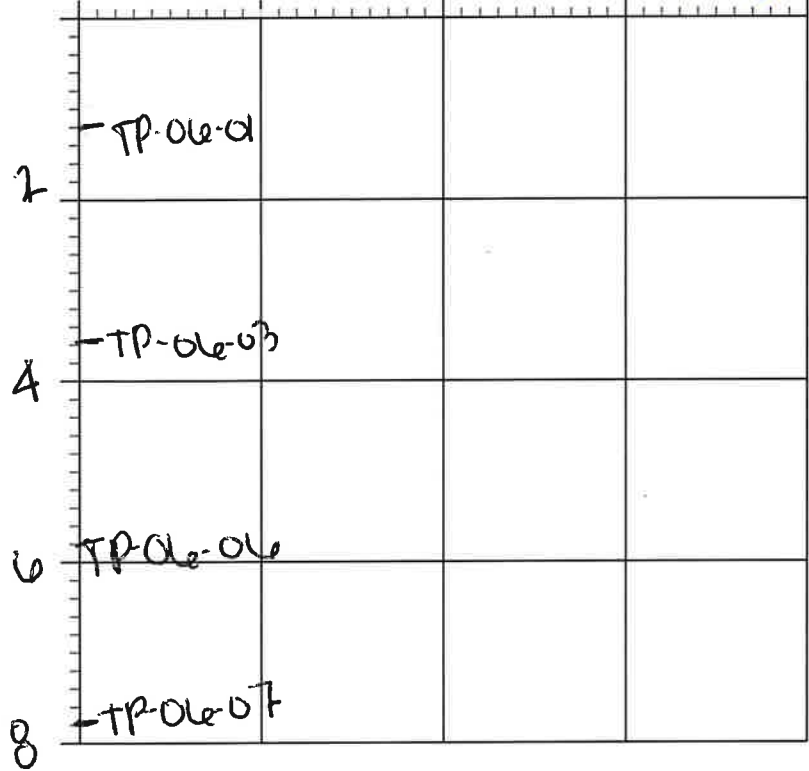
PIT FACE LOGGED: _____

geologist

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-06-01	1.3	11:05	SM
TP-06-03	3.5	11:15	SM
TP-06-06	6	11:20	SM
TP-06-07	7.5	11:30	SM

Pit Width: 3
 Pit Length: 11
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
		light tan/brown, moist Fines ~ 80% w/ gravel + cobbles 1/4" sieve

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-07

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: _____
PIT FACE LOGGED: _____

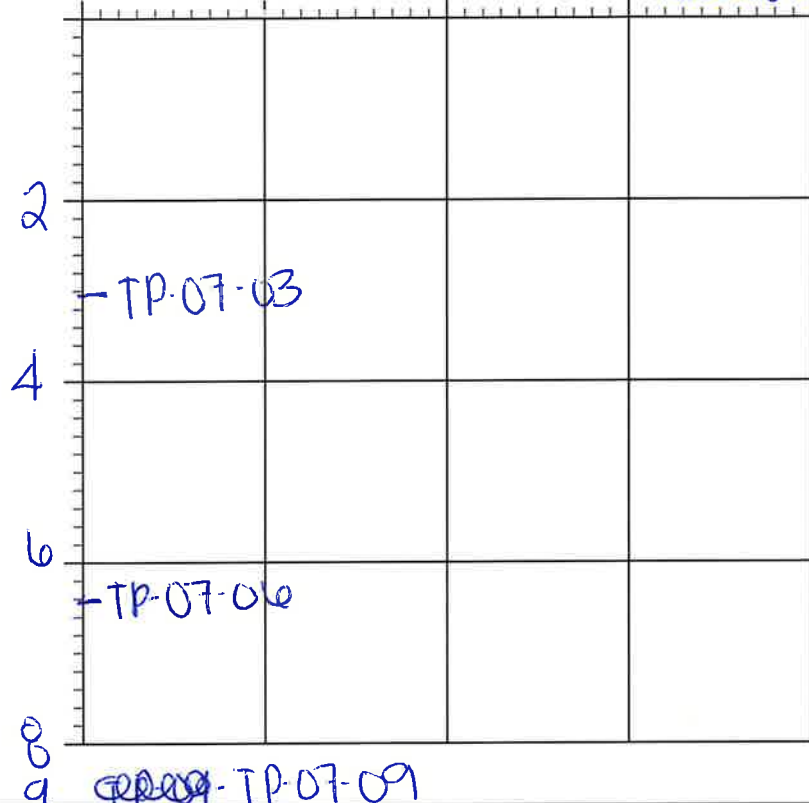
DATE: 11/5
FIELD ENGINEER: B. Van Geologist

NORTHING: _____
EASTING: _____

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ⊗ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-07-03	3	10:05	SM
TP-07-06	6.5	10:10	SM
TP-07-09	9	10:20	SM

Pit Width: ~3
Pit Length: ~11
Pit Depth: _____
GW Depth: _____

TP-07-09

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		light tan/brown color. Took some sample from top of bank above roadcut ~85% fines w/ gravel + cobbles TP-07-06 slightly darker w/ some gray-green TP-07-09 similar color

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-09

Sheet NO.: TP- _____

GENERAL LOCATION: _____

DATE: 11/5

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: B. van

EASTING: _____

PIT FACE LOGGED: _____

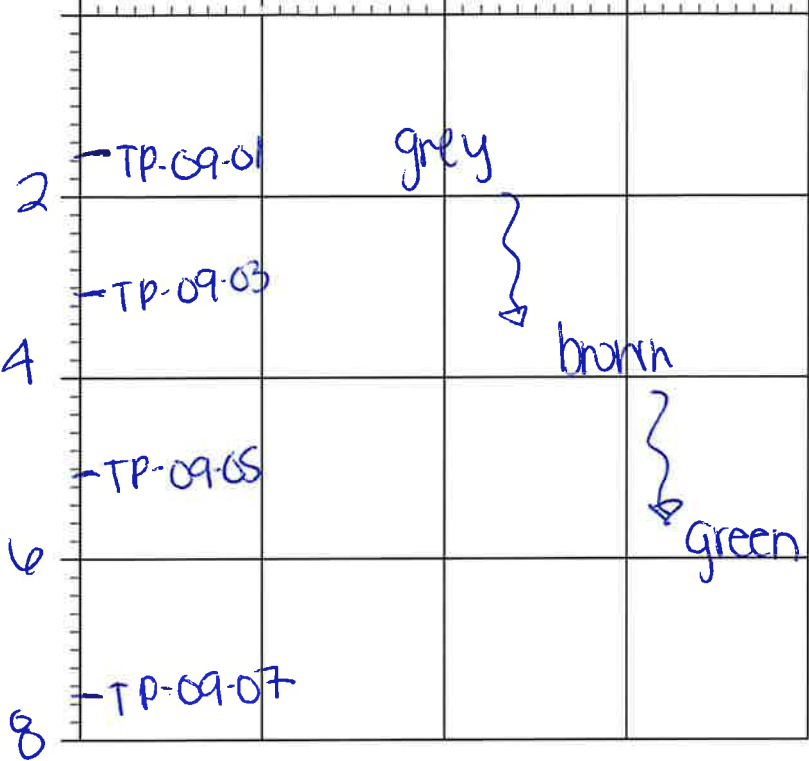
Geologist

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- Σ GROUNDWATER LEVEL
- ☒ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE
TP-09-01	1.5	9:30	SM
TP-09-03	3	9:35	SM
TP-09-05	5.5	9:45	SM
TP-09-07	7.5	9:50	SM



Pit Width: 3
 Pit Length: 11
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		<p>~75% fines, cobbles + gravel 1/4 sieve + ~5 ft since pit in road on top of pile gray brown samples some green material towards bottom</p>

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-10

Sheet NO.: TP- _____

GENERAL LOCATION: _____

DATE: 11/5/19

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: B. Van

EASTING: _____

PIT FACE LOGGED: _____

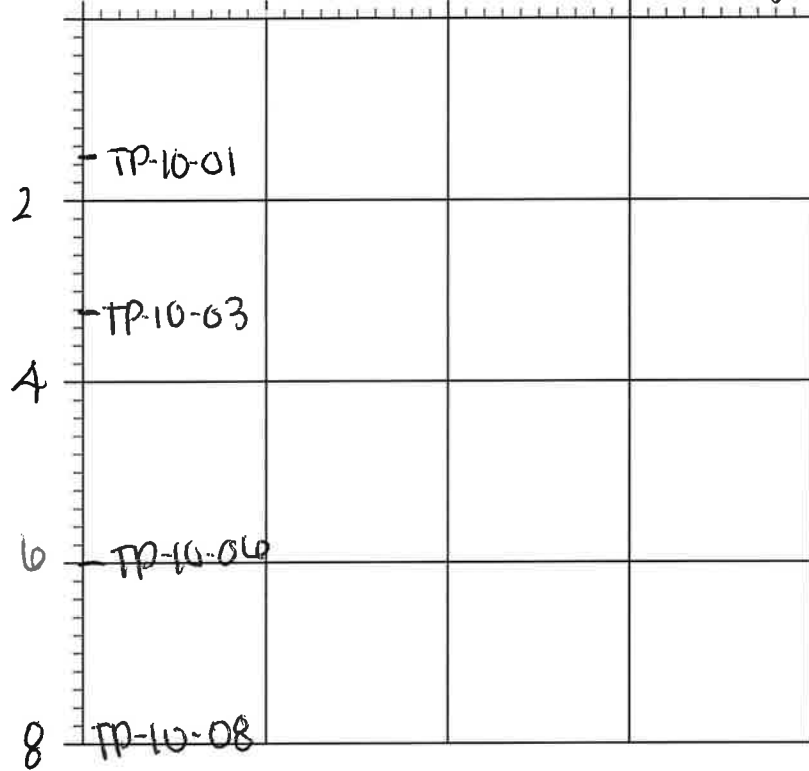
Geologist

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ⊗ SAMPLE

(ft)



SAMPLE No.	DEPTH	TIME	TYPE
TP-10-01	1.3	12:55	SM
TP-10-03	3.2	13:00	SM
TP-10-06	6.2	13:16	SM
TP-10-08	8	13:15	SM

Pit Width: 3.5
 Pit Length: 11
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		Gray-brown material. 90% fines. Mostly sand. Moist. Some gravel & cobbles. 1/4" sieve

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-12

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: _____
PIT FACE LOGGED: _____

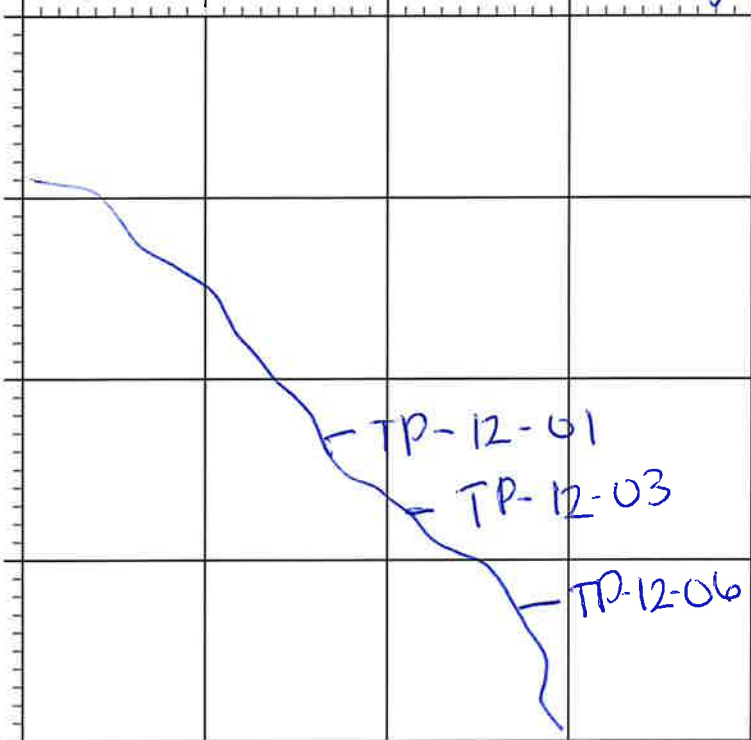
DATE: 11/5
FIELD ENGINEER: B. Van Geologist

NORTHING: _____
EASTING: _____

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-12-06	~0	9:00	
TP-12-06	~0	9:00	SM
TP-12-03	~3	9:10	SM
TP-12-01	~1	9:15	SM

Pit Width: 3
Pit Length: 12
Pit Depth: _____
GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
-------------	-----------	---------------------------------------

		<p>Fine, moist material. Fines ~90% 1/4 sieve started @ bottom of bank + moved up - that's why shallowest depth has latest time. Brown</p>
--	--	--

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-13

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: _____
PIT FACE LOGGED: _____

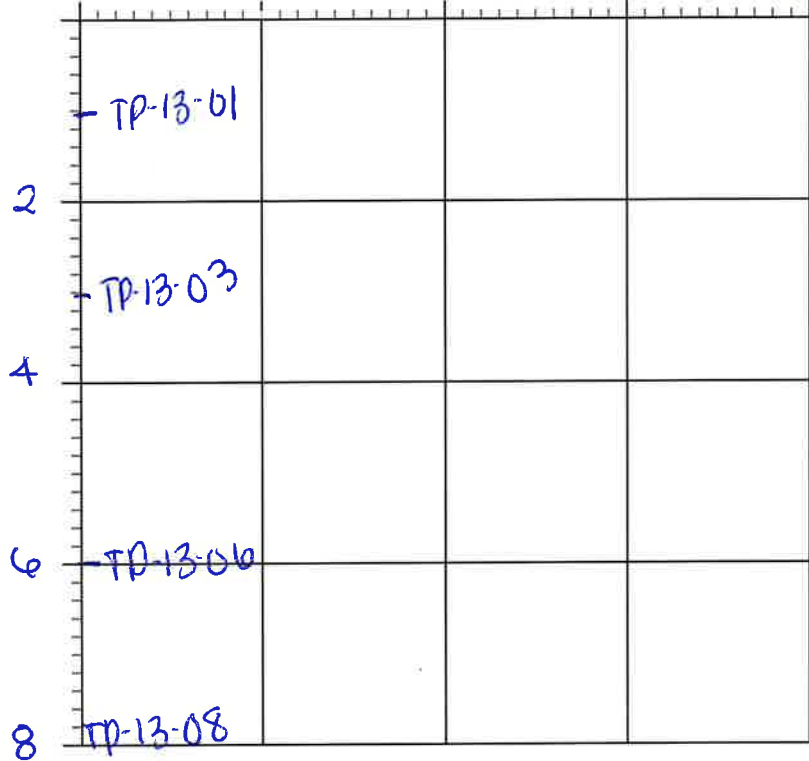
DATE: 11-4-19
FIELD ENGINEER: B. Van Geologist

NORTHING: _____
EASTING: _____

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-13-01	1.0		
TP-13-01	1.0	12:55	SM
TP-13-03	3.0	13:00	SM
TP-13-06	6.0	13:05	SM
TP-13-08	8.0	13:15	SM

Pit Width: 3.5ft
Pit Length: 11ft
Pit Depth: _____
GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		Fines ~80% some gravels + cobbles sieving 1/4"

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-14

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: _____
PIT FACE LOGGED: _____

DATE: 11/1
FIELD ENGINEER: B. Van

NORTHING: _____
EASTING: _____

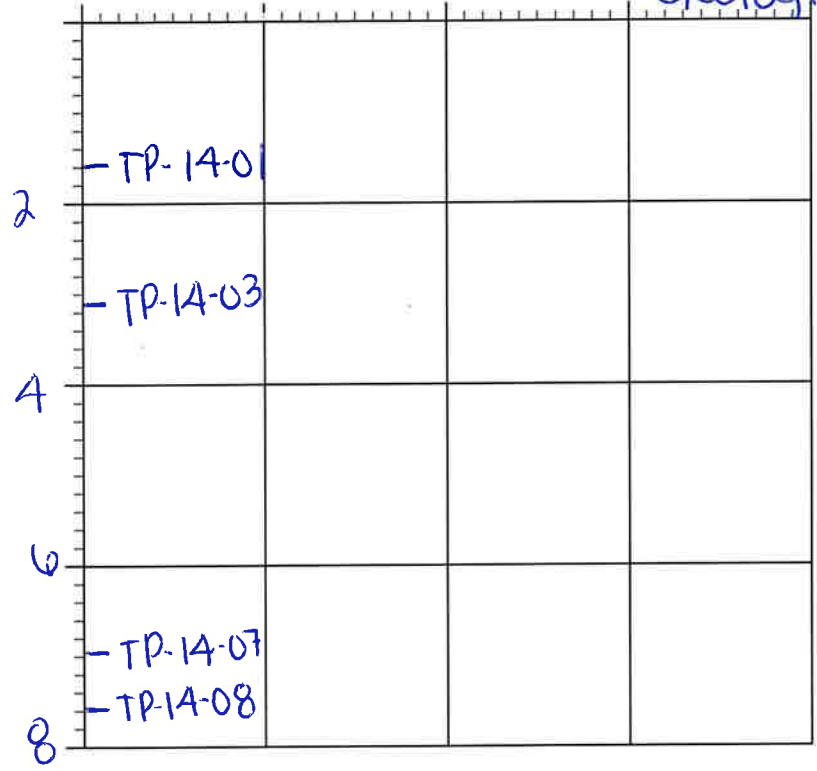
Geologist

TEST PIT LOG

30(250)

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-14-01	1.5	15:30	SM
TP-14-03	3	15:40	SM
TP-14-07	7	15:45	SM
TP-14-08	7.5	15:55	SM

Pit Width: ~3
Pit Length: ~11
Pit Depth: _____
GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
		<u>70% fines, cobbles + gravel</u>

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-16

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: _____
PIT FACE LOGGED: _____

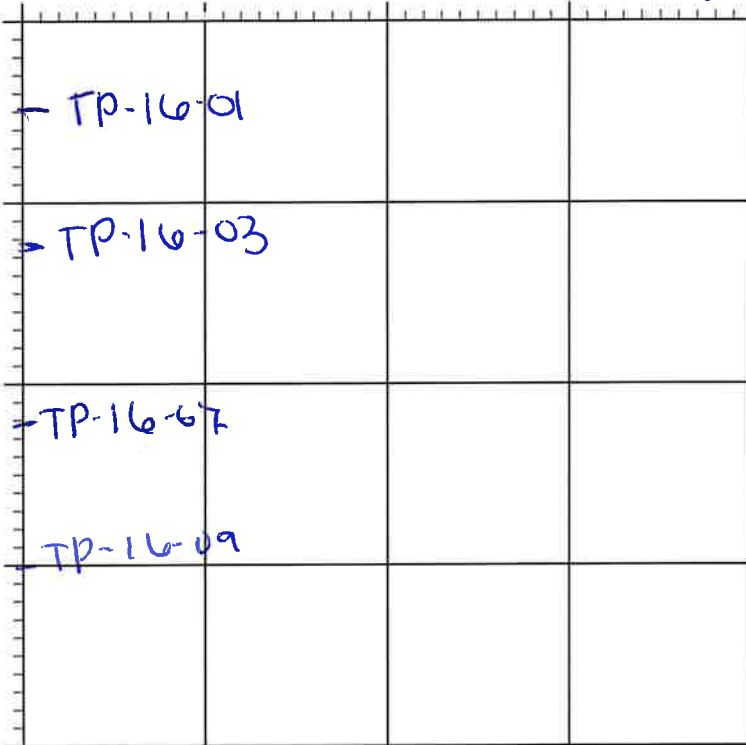
DATE: 11/4/19
FIELD ENGINEER: B. Van Geologist

NORTHING: _____
EASTING: _____

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-16-01	1.5	13:25	SM
TP-16-03	3.5	13:35	SM
TP-16-05			
TP-16-07	7.5	13:45	SM
TP-16-09	9.0	13:55	SM

20(250)

Pit Width: 3 ft
Pit Length: 13 ft
Pit Depth: _____
GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		<p>SM</p> <p>Fine S ~ 60% Moist 85%</p>

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-17

Sheet NO.: TP-_____

GENERAL LOCATION: _____

DATE: 11/4/19

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: Breanna Van

EASTING: _____

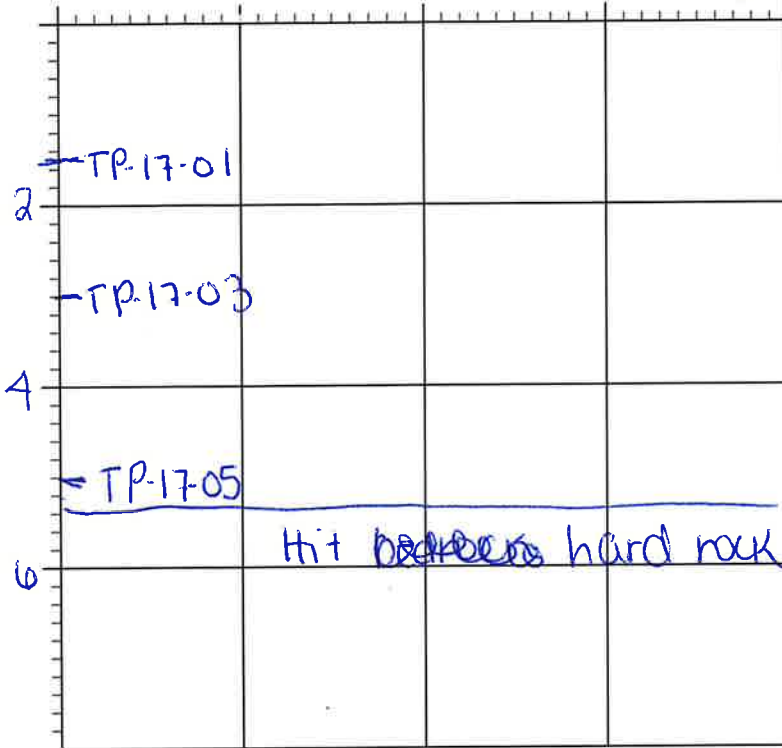
PIT FACE LOGGED: _____

Geologist

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ☒ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-17-01	1.5	10:55	sand w/ rocks
TP-17-03	3.0	11:00	sand w/ rocks
TP-17-04	4.75	11:05	rock
TP-17-05	5.0	11:05	mostly fine sand
			SW-2M

Pit Width: 3 ft
 Pit Length: 11 ft
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SW-SM		sand, silt w/ rocks. Around 5 ft mostly fine. Hit hard rock @ 5.3 ft, not able to go down farther Sieving to 1/4"

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

**ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING**

Test Pit ID: TP-18

Sheet NO.: TP- _____

GENERAL LOCATION: _____

DATE: 11/4/19

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: B. Van

EASTING: _____

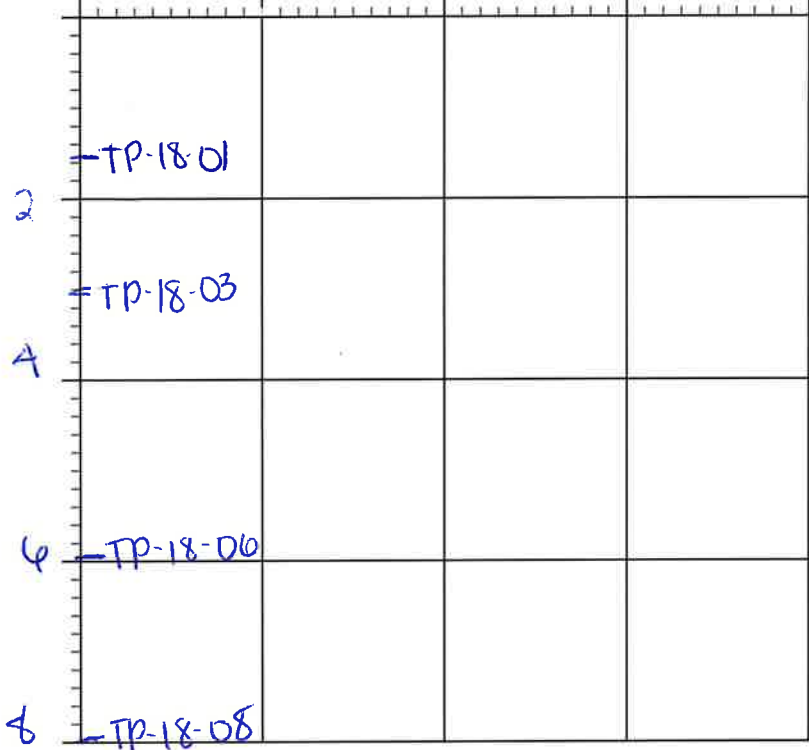
PIT FACE LOGGED: _____

20
(250)

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ∇ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-18-01	1.5	14:15	SM
TP-18-03	3.25	14:20	SM
TP-18-06	6.3	14:25	SM
TP-18-08	8.0	14:30	SM

Pit Width: 3ft
 Pit Length: 11ft
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SM		Fines ~85% 1/4" sieve mostly sand, some gravel & cobbles

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
 GEOTECHNICAL TEST PIT LOGGING

Test Pit ID: TP-19

Sheet NO.: TP- _____

GENERAL LOCATION: _____

DATE: 11/4/19

NORTHING: _____

PIT TREND: _____

FIELD ENGINEER: B. Van

EASTING: _____

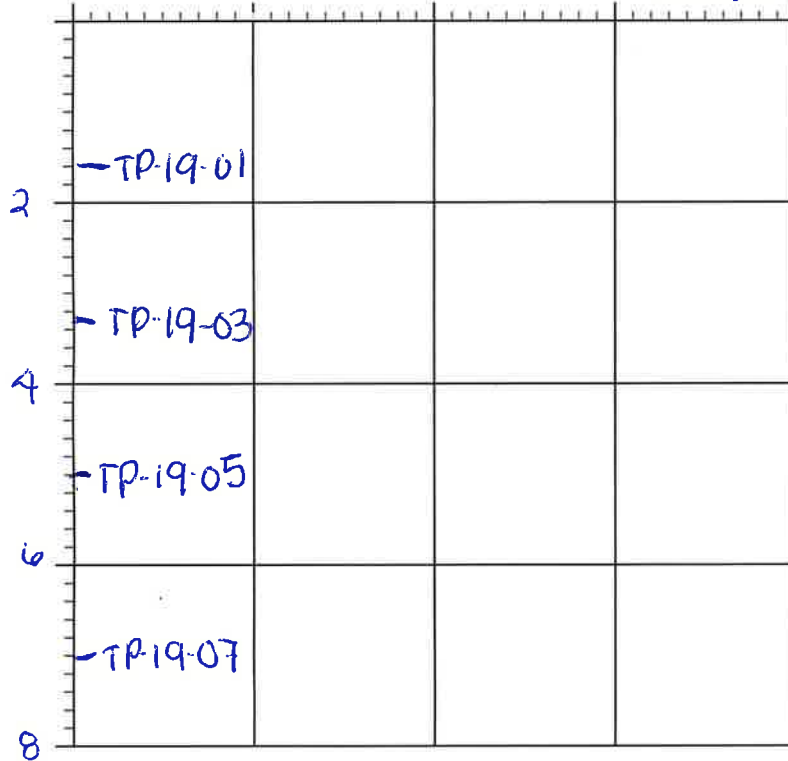
PIT FACE LOGGED: _____

Geologist

TEST PIT LOG

LEGEND

- SOIL HORIZON
- HORIZON CONTRACT
- ☒ GROUNDWATER LEVEL
- ☒ SAMPLE



SAMPLE No.	DEPTH	TIME	TYPE
TP-19-01	1.75	11:15	SM SW-SM
TP-19-03	3.2	11:23	SM SW-SM
TP-19-05	5.5	11:30	SM SW-SM
TP-19-07	7.5	11:40	SM

Pit Width: 3 ft
 Pit Length: 11 ft
 Pit Depth: _____
 GW Depth: _____

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SW-SM		poorly sorted, fines & larger. silt, sand, gravel sieving to 1/4"
SM		At ~7ft mostly fines ~80%

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

Appendix B

Field Soil Sample Gamma Radiation Screening Forms

AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form

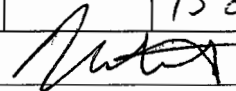
Instrumentation : Scaler/Ratemeter L2221 s# 290801 Detector: L44-20 s# 295573
 Instrument Calibration Date: 10-1-19 / 10-2-19 Instrument Function Check Performed: ✓
 Survey Area/Unit Description: Pit 1 pile investigation 19-20 UR/hr.

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts	Weight Corrected Counts	CPM Net (avg)	Estimated Ra-226 pCi/g	Comments
11-4-19	Blank	-	58 70 74	-	67		
11-4-19	50 pCi/g Standard	3000	4130 4152 4101	-	4061		
11-4-19	TP-17-01 @ 1055	3000	1093 1027	-	993		
11-4-19	TP-17-03 @ 1100	3000	1267 1268	-	1201		To Lab
11-4-19	TP-17-05 @ 1105	3000	1262 1310		1219		
11-4-19	TP-19-00 @ 1140	3000	2524 2456		2423		
11-4-19	TP-19-01 @ 1115	3000	1581 1472		1460		
11-4-19	TP-19-03 @ 1123	3000	2079 2132		2039		To Lab
11-4-19	TP-19-05 @ 1130	3000	1932 1974		1886		
11-4-19	TP-13-01 @ 1255	3000	2261 2312		2220		
11-4-19	TP-13-03 @ 1300	3000	2711 2631		2604		
11-4-19	TP-13-06 @ 1305	3000	2410 2356		2316		To Lab
11-4-19	TP-13-08 @ 1315	3000	2236 2273		2188		
11-4-19	TP-16-01 @ 1325	3000	1774 1648		1644		
11-4-19	TP-16-03 @ 1335	3000	1622 1675		1582		

Technician Signature



Reviewed by



AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form

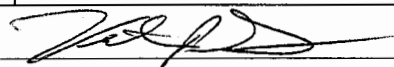
Instrumentation: Scaler/Ratemeter L2221 #290801 Detector: L44-20 #295573

Instrument Calibration Date: 10-1-19 Instrument Function Check Performed:

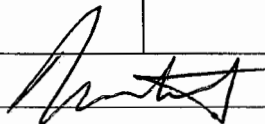
Survey Area/Unit Description: Pit 1 pile investigation 19-20 U_R/hr.

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts	Weight Corrected Counts	CPM Net (avg)	Estimated Ra-226 pCi/g	Comments
11-4-19	TP-16-07 @ 1345	3000	1875 1757	-	1749		To Lab
11-4-19	TP-16-09 @ 1355	2766	1952 1925	2117 2088	2036		
11-4-19	TP-18-01 @ 1415	2580	2485 2467	2890 2869	2813		Sample bags mislabeled FP-15-01 VP
11-4-19	TP-18-03 @ 1420	2656	2674 2614	3020 2953	2987		FP-15-03 VP
11-4-19	TP-18-06 @ 1425	3000	2210 2309	-	2193		FP-15-06 VP To Lab
11-4-19	TP-18-08 @ 1430	3000	1966 1965	-	1899		FP-15-08 VP
11-4-19	TP-15-01 @ 1455	3000	1863 1848	-	1789		Sample bags mislabeled FP-18-01 VP
11-4-19	TP-15-03 @ 1500	3000	2272 2367	-	2252		TP-18-03 VP
11-4-19	TP-15-06 @ 1505	3000	2618 2529	-	2507		TP-18-06 VP To Lab
11-4-19	TP-15-07 @ 1515	3000	3679 3715	-	3630		TP-18-07 VP

Technician Signature



Reviewed by



AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form

Instrumentation : Scaler/Ratemeter L2221 SH 290801 Detector: L44-20 SH 295573
 Instrument Calibration Date: 10-1-19 Instrument Function Check Performed:
 Survey Area/Unit Description: Pt 1 Pile Investigation 19-20 uR/hr

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) KeV Gross Counts	Weight Corrected Counts	CPM Net (avg)	Estimated Ra-226 pCi/g	Comments
11-5-19	Blank	-	77 81 79	-	79		
11-5-19	50 pCi/g Standard	3000	3832 3856 3867	-	3773		
11-5-19	TP-14-01 @ 11-4-19 1530	3000	2685 2787	-	2657		
11-5-19	TP-14-03 @ 11-4-19 1540	3000	1202 1163	-	1104		
11-5-19	TP-14-07 @ 11-4-19 1545	3000	2521 2455	-	2409		To Lab
11-5-19	TP-14-08 @ 11-4-19 1550	3000	1878 1884	-	1862		
11-5-19	TP-12-06 @ 900	3000	1558 1562	-	1481		
11-5-19	TP-12-03 @ 910	3000	2519 2517	-	2439		
11-5-19	TP-12-01 @ 915	3000	1789 1782	-	1707		To Lab
11-5-19	TP-09-01 @ 930	3000	2053 1970	-	1933		
11-5-19	TP-09-03 @ 935	3000	4603 3708	-	4077		
11-5-19	TP-09-05 @ 945	3000	2092 2171	-	2053		
11-5-19	TP-09-07 @ 950	3000	2720 2726	-	2644		To Lab Dup TP-09-07-0 11-5-19 @ 1000
11-5-19	TP-07-03 @ 1005	3000	1366 1352	-	1280		
11-5-19	TP-07-06 @ 1010	3000	1763 1766	-	1686		

Technician Signature [Signature] Reviewed by [Signature]

AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form

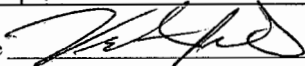
Instrumentation: Scaler/Ratemeter L2221 s# 290801 Detector: L44-20 s# 295573

Instrument Calibration Date: 10-1-19 Instrument Function Check Performed:

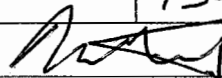
Survey Area/Unit Description: Pit 1 pile investigation 19-20 Ue/hr.

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Key Gross Counts	Weight Corrected Counts	CPM Net (avg)	Estimated Ra-226 pCi/g	Comments
11-5-19	TP-07-09 @ 1020	3000	1574 1555	-	1486		To Lab
11-5-19	TP-08-01 @ 1040	3000	651 607	-	550		
11-5-19	TP-08-03 @ 1045	3000	1312 1302	-	1228		
11-5-19	TP-08-06 @ 1050	3000	770 765	-	686		
11-5-19	TP-08-08 @ 1055	3000	1259 1209	-	1155		To Lab
11-5-19	TP-06-01 @ 1105	3000	1617 1665	-	1562		
11-5-19	TP-06-03 @ 1115	3000	2574 2661	-	2539		
11-5-19	TP-06-06 @ 1120	3000	1174 1266	-	1141		
11-5-19	TP-06-07 @ 1130	3000	2022 2010	-	1937		To Lab
11-5-19	TP-10-01 @ 1255	3000	1420 1340	-	1301		
11-5-19	TP-10-03 @ 1300	3000	2008 1921	-	1886		To Lab
11-5-19	TP-10-06 @ 1310	3000	1649 1728	-	1610		
11-5-19	TP-10-08 @ 1315	3000	3678 3549	-	3535		
11-5-19	TP-11-01 @ 1320	3000	1222 1247	-	1156		
11-5-19	TP-11-03 @ 1325	3000	1366 1439	-	1324		

Technician Signature



Reviewed by



AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form

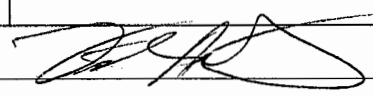
Instrumentation: Scaler/Ratemeter L2221 SA#290801 Detector: L44-20 SA#295573

Instrument Calibration Date: 10-1-19 Instrument Function Check Performed:

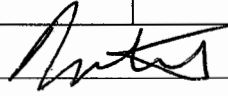
Survey Area/Unit Description: Pit 1 Pile Investigation 19-20 uR/hr.

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts	Weight Corrected Counts	CPM Net (avg)	Estimated Ra-226 pCi/g	Comments
11-5-19	TP-11-06 @ 1335	3000	1768 1656	-	1633		To Lab
11-5-19	TP-11-08 @ 1340	3000	1724 1726	-	1646		
11-5-19	TP-01-01 @ 1400	3000	6810 6962	-	6807		To Lab Field Dup. TP-01-01-D
11-5-19	TP-01-03 @ 1415	3000	4741 4479	-	4531		
11-5-19	TP-01-06 @ 1420	3000	5714 5627	-	5592		
11-5-19	TP-01-08 @ 1430	3000	7465 7357	-	7332		
11-5-19	TP-02-02 @ 1440	3000	2633 2485	-	2480		
11-5-19	TP-02-03 @ 1445	3000	3710 3740	-	3646		
11-5-19	TP-02-06 @ 1450	3000	5892 5815	-	5775		
11-5-19	TP-02-08 @ 1500	3000	4280 4211	-	4167		To Lab

Technician Signature



Reviewed by

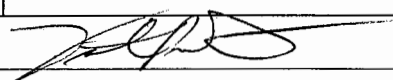


AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form

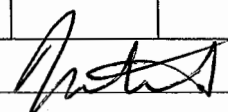
Instrumentation : Scaler/Ratemeter L2221 #290801 Detector: L44-20 #295573
 Instrument Calibration Date: 10-1-19 Instrument Function Check Performed:
 Survey Area/Unit Description: Pit 1 pile investigation 19-22 uR/hr

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts	Weight Corrected Counts	CPM Net (avg)	Estimated Ra-226 pCi/g	Comments
11-6-19	Blank	-	72,677 70	-	70		
11-6-19	50 K/g Standard	3000	3911 3961 3895	-	3852		
11-6-19	TP-04-01 @ 11-5-19 1510	3000	3073 3149	-	3041		
11-6-19	TP-04-03 @ 11-5-19 1515	3000	5344 5223	-	5214		To Lab
11-6-19	TP-04-06 @ 11-5-19 1520	3000	4699 4687	-	4623		
11-6-19	TP-04-07 @ 11-5-19 1530	3000	4114 4121	-	4078		
11-6-19	TP-03-01 @ 11-6-19 0805	3000	3438 3439	-	3369		
11-6-19	TP-03-03 @ 11-6-19 810	3000	3992 4053	-	3953		
11-6-19	TP-03-06 @ 11-6-19 0820	3000	3876 3918	-	3827		To Lab
11-6-19	TP-03-08 @ 11-6-19 0825	3000	2728 2655	-	2622		
11-6-19	TP-05-01 @ 11-6-19 0830	3000	5321 5364	-	5273		To Lab
11-6-19	TP-05-05 @ 11-6-19 840	3000	4810 4784	-	4727		

Technician Signature



Reviewed by



Appendix C

Sample Chain of Custody and Laboratory Result Reports



Gamma Spectroscopy Case Narrative

Stantec Consulting Services

St. Anthony – 233001363

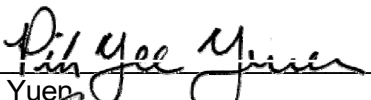
Work Order Number: 1911207

1. The following report consists of analytical results for 10 soil samples received by ALS on 11/11/2019.
2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 11/15/2019 and stored for at least 21 days to allow ^{222}Rn to approach secular equilibrium with its parent, ^{226}Ra . The degree of ingrowth achieved prior to analysis on 12/06/2019 is at least 97.8%. Conservatively assuming a radon emanation efficiency of approximately 50%, the effective radon progeny ingrowth for these samples would be greater than 98.9%.
3. The samples were analyzed for the presence of gamma emitting radionuclides according to the current revision of SOP 713. The analyses were completed on 12/06/2019.
4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram. The samples were not sieved.
5. ALS has observed a reproducible low bias in ^{226}Ra results (about -30% for the geometry in question) when using a mixed gamma source for the calibration of HPGe detectors for solid samples. This bias is eliminated by calibration using a NIST traceable ^{226}Ra source in the same geometry and configuration as the samples.
6. The library used for calibration and analysis employs multiple peaks for the ^{226}Ra progeny, ^{214}Pb (352 and 295 keV) and ^{214}Bi (609 and 1120 keV). Using these peaks avoids the use of the problematic ^{226}Ra photopeak at 186 keV, which suffers from poorly resolvable interference from ^{235}U at the same energy. Final activity results for ^{226}Ra are calculated, using the uncertainty-weighted mean of the activities for the four photopeaks, by the Seeker gamma spectroscopy software assuming secular equilibrium.



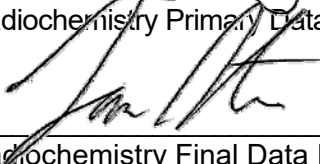
7. There are cases where the sample density is less than the associated calibration standard density. Cases that exceed the limit of +/- 15% of the density of the calibration standard are flagged with a 'G', denoting a significant density difference between the sample and calibration standard. Consequently, the results may be biased high for the flagged results in this work order. If requested, ALS can perform a transmission spike in order to estimate a magnitude of this bias. The results are reported without further qualification.
8. The requested detection limit was not achieved for all samples. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an "M3" flag on the final reports
9. Passing daily checks are required for all detectors on which client samples are counted for the day of the sample count and the day following the sample count. Samples 1911207-2, 1911207-7, and the Laboratory Control Sample associated with batch GS191114-3 were counted in detector 2 on 12/6/2019. Detector 2 failed the daily check performed on 12/9/2019. However, the Laboratory Control Sample associated with batch GS191114-3 was the last of these samples counted in detector 2 on 12/6/2019. This LCS passed ALS's QC acceptance criteria and will be evaluated as a passing check of performance for these samples counted in detector 2. Results are submitted without further qualification. Please refer to QASS 476111 at the end of this report.
10. No further problems were encountered with either the client samples or the associated quality control samples. All remaining quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



Pik Yee Yuen
Radiochemistry Primary Data Reviewer

12/12/19
Date



Radiochemistry Final Data Reviewer

12/13/19
Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1911207

Client Name: Stantec Consulting Services

Client Project Name: St. Anthony

Client Project Number: 233001363

Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
TP-01-01-D	1911207-1		SOIL	05-Nov-19	14:00
TP-06-07	1911207-2		SOIL	05-Nov-19	11:30
TP-15-06	1911207-3		SOIL	04-Nov-19	15:05
TP-19-03	1911207-4		SOIL	04-Nov-19	11:23
TP-07-09	1911207-5		SOIL	05-Nov-19	10:20
TP-16-07	1911207-6		SOIL	04-Nov-19	13:45
TP-12-01	1911207-7		SOIL	05-Nov-19	9:15
TP-17-03	1911207-8		SOIL	04-Nov-19	11:00
TP-09-07-D	1911207-9		SOIL	05-Nov-19	10:00
TP-09-07	1911207-10		SOIL	05-Nov-19	9:50



ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
 TF: (900) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Form 2026

WORKORDER # 1911207

PROJECT NAME	St. Anthony	SAMPLER	Breanna Van	DATE	11/16/19	TURNAROUND	Standard	PAGE	1 of 1
PROJECT No.	233001363	SITE ID	St. Anthony	By Lab or		DISPOSAL		Return to Client	
COMPANY NAME	Stantec	EDD FORMAT							
SEND REPORT TO	Kelly Johnson	PURCHASE ORDER							
ADDRESS	2880 East Cottonwood Parkway Suite 300	BILL TO COMPANY	Stantec						
CITY / STATE / ZIP	Salt Lake City, UT 84121-7238	INVOICE ATTN TO	Melanie Davis						
PHONE	801-617-3340	ADDRESS	3325 S. Timberline Rd Suite 150						
FAX		CITY / STATE / ZIP	Fort Collins, CO 80525						
E-MAIL	Kelly.Johnson@stantec.com	PHONE	970-212-2749						
		FAX							
		E-MAIL	melanie.davis@stantec.com						

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC
1	TP-01-01-D	S	11/5/19	14:00	1	NA	✓
2	TP-06-07	S	11/5/19	11:30	1	NA	✓
3	TP-15-06	S	11/4/19	15:05	1	NA	✓
4	TP-19-03	S	11/4/19	11:23	1	NA	✓
5	TP-07-09	S	11/5/19	10:20	1	NA	✓
6	TP-10-17 TP-16-07	S	11/4/19	13:45	1	NA	✓
7	TP-12-01	S	11/5/19	9:15	1	NA	✓
8	TP-17-03	S	11/4/19	11:00	1	NA	✓
9	TP-09-07-D	S	11/5/19	10:00	1	NA	✓
10	TP-09-07	S	11/5/19	9:50	1	NA	✓

*Time Zone (Circle): EST CST (MST) PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

For metals or anions, please detail analytes below.

Comments:		SIGNATURE	Breanna Van	PRINTED NAME	Breanna Van	DATE	11/01/19 10:25	TIME	
		RELINQUISHED BY	Breanna Van						
		RECEIVED BY	C. Mumbach						
		RELINQUISHED BY							
		RECEIVED BY							
		RELINQUISHED BY							
		RECEIVED BY							

Preservative Key: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaHSO4 7-Other 8-4 degrees C 9-5035



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Stantec

Workorder No: 1911207

Project Manager: LS

Initials: CDT Date: 11-11-19

1. Are airbills / shipping documents present and/or removable?		DROP OFF	<input checked="" type="radio"/> YES	<input type="radio"/> NO
2. Are custody seals on shipping containers intact?		<input checked="" type="radio"/> NONE	<input type="radio"/> YES	<input type="radio"/> NO *
3. Are custody seals on sample containers intact?		<input checked="" type="radio"/> NONE	<input type="radio"/> YES	<input type="radio"/> NO *
4. Is there a COC (chain-of-custody) present?			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
5. Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)			<input type="radio"/> YES	<input checked="" type="radio"/> NO *
6. Are short-hold samples present?			<input type="radio"/> YES	<input checked="" type="radio"/> NO *
7. Are all samples within holding times for the requested analyses?			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
8. Were all sample containers received intact? (not broken or leaking)			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
9. Is there sufficient sample for the requested analyses?			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
10. Are samples in proper containers for requested analyses? (form 250, Sample Handling Guidelines)			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
11. Are all aqueous samples preserved correctly, if required? (excluding volatiles)		<input checked="" type="radio"/> N/A	<input type="radio"/> YES	<input type="radio"/> NO *
12. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)		<input checked="" type="radio"/> N/A	<input type="radio"/> YES	<input type="radio"/> NO
13. Were the samples shipped on ice?			<input type="radio"/> YES	<input checked="" type="radio"/> NO
14. Were cooler temperatures measured at 0.1-6.0°C?	IR gun used*:	#3	#5	RAD ONLY
				<input type="radio"/> YES <input checked="" type="radio"/> NO
Cooler #:	<u>1</u>			
Temperature (°C):	<u>Amb</u>			
# of custody seals on cooler:	<u>0</u>			
External mR/hr reading:	<u>22</u>			
Background mR/hr reading:	<u>11</u>			
Were external mR/hr readings ≤ two times background and within DOT acceptance criteria? <input checked="" type="radio"/> YES / <input type="radio"/> NO / <input type="radio"/> NA (If no, see Form 008.)				

* Please provide details here for NO responses to gray boxes above - for 2 thru 5 & 7 thru 12, notify PM & continue w/ login.

1911207-6 - bottle label has TP-14-07. This is correct. COC has TP-14-17. DATES AND TIMES ARE THE SAME 11/12/19

SAMPLE 9 TP-09-07-D. Presume it is a duplicate of 10- TP-09-07, however they have different times. This is OK.

Were unpreserved bottles pH checked? YES NA

All client bottle ID's vs ALS lab ID's double-checked by: CDT

If applicable, was the client contacted? YES / NO / NA Contact: Breanna Van Date/Time: 11/12/19

Project Manager Signature / Date: [Signature] 11/12/19

FROM: (303) 506-9177
BREANNA VAN
STANTEC
3325 S TIMBERLINE RD
SUITE 150
Fort Collins CO 80525
US

SHIP DATE: 07NOV19
ACTWT: 21.20 LB
CAD: 6993643/SSFE2021
DIMMED: 15 X 12 X 12 IN

1911207

TO **ATTN: LANCE STEERE**
ALS ENVIRONMENTAL
225 COMMERCE DR

22

0-

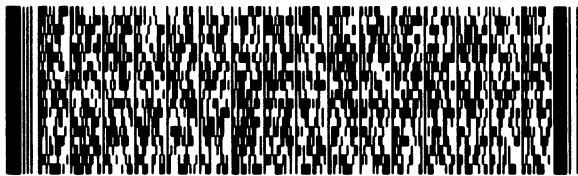
FORT COLLINS CO 80524

(US)

(619) 729-7292
INU:
PO:

REF:

DEPT:



FedEx
Ground



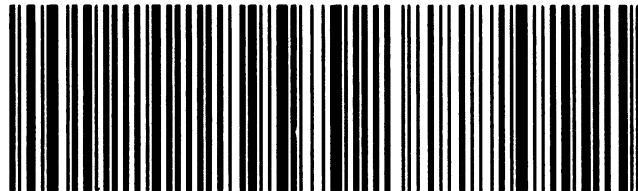
1 of 2

TRK# **7808 0805 8314**

MASTER

80524

9622 0019 0 (000 000 0000) 0 00 7808 0805 8314



Gamma Spectroscopy Results

PAI 713 Rev 1

Method Blank Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911207

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Lab ID: GS191114-2MB	Sample Matrix: SOIL	Prep Batch: GS191114-2	Final Aliquot: 215 g
Library: RA226.LIB	Prep SOP: PAI 739 Rev 12	QCBatchID: GS191114-2-1	Result Units: pCi/g
	Date Collected: 14-Nov-19	Run ID: GS191114-2A	File Name: 191442d08
	Date Prepared: 14-Nov-19	Count Time: 30 minutes	
	Date Analyzed: 06-Dec-19		

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	-0.06 +/- 0.18	0.36	0.5	NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
!!
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
M - Requested MDC not met.
B - Analyte concentration greater than MDC.
B3 - Analyte concentration greater than MDC but less than Requested MDC.
DL - Decision Level

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Lab ID: GS191114-2LCS	Sample Matrix: SOIL	Prep Batch: GS191114-2	Final Aliquot: 215 g
Library: RA226.LIB	Prep SOP: PAI 739 Rev 12	QCBatchID: GS191114-2-1	Result Units: pCi/g
	Date Collected: 14-Nov-19	Run ID: GS191114-2A	File Name: 191325d09
	Date Prepared: 14-Nov-19	Count Time: 30 minutes	
	Date Analyzed: 06-Dec-19		

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	470 +/- 55	2	468.0	100	85 - 115	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS Recovery within control limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Minimum Detectable Concentration

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins

Work Order Number: 1911207

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-19-03
Lab ID:	1911207-4DUP

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 201 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191471d01

CASNO	Analyte	Sample				Duplicate				DER	DER Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
13982-63-3	Ra-226	33.7 +/-	4.1	0.7	M3	33.6 +/-	4.1	1.0	M3	0.0103	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits

Abbreviations:

TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-01-01-D
Lab ID:	1911207-1

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 178 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191470d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	117 +/- 14	2	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-06-07
Lab ID:	1911207-2

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QC Batch ID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 196 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191496d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	34.7 +/- 4.2	0.8	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-15-06
Lab ID:	1911207-3

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QC Batch ID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 170 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 192007d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	35.5 +/- 4.3	0.8	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-19-03
Lab ID:	1911207-4

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QC Batch ID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 201 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191441d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	33.7 +/- 4.1	0.7	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1

Sample Duplicate Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-19-03
Lab ID:	1911207-4DUP

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 201 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191471d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	33.6 +/- 4.1	1.0	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halfives.
G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

Data Package ID: GSS1911207-1

Date Printed:

Thursday, December 12, 2019

ALS -- Fort Collins

LIMS Version: 6.918

Page 1 of 1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-07-09
Lab ID:	1911207-5

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 169 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191324d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	23.4 +/- 2.9	0.9	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-16-07
Lab ID:	1911207-6

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 168 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 190945d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	25.5 +/- 3.1	0.6	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-12-01
Lab ID:	1911207-7

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QC Batch ID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 190 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191497d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	24.8 +/- 3.0	0.8	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-17-03
Lab ID:	1911207-8

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QC Batch ID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 200 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 192008d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	15.1 +/- 1.9	0.6	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-09-07-D
Lab ID:	1911207-9

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 165 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 192747d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	41.5 +/- 5.1	1.2	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halfives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

Gamma Spectroscopy Results

PAI 713 Rev 1 Sample Results

Lab Name: ALS -- Fort Collins
Work Order Number: 1911207
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Field ID:	TP-09-07
Lab ID:	1911207-10

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-2
QCBatchID: GS191114-2-1
Run ID: GS191114-2A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 168 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191278d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	47.0 +/- 5.7	1.2	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911207-1

QUALITY ASSURANCE SUMMARY SHEET

ALS W.O. # / BATCH 1911207 / GS191114-2
 TEST gamma
 METHOD gamma scan
 SOP/REV (PREP) —
 SOP/REV (ANAL) 713

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

12112

In order to fulfill ALS Laboratory Group's Data Quality Objectives, passing daily checks are required for all detectors on which client samples are counted for the day of the sample count and the day following the sample count. Samples 1911207-2 and 1911207-7 and the Laboratory Control Sample associated with batch GS191114-3 were counted in detector 2 on 12/6/2019. Detector 2 failed the daily check performed on 12/9/2019. However, the Laboratory Control Sample was the last sample counted in detector 2 on 12/6/2019. This LCS passed ALS's QC acceptance criteria and will be evaluated as a passing check of performance for the samples counted in detector 2. Results are submitted without further qualification.

12112

TECHNICIAN/ANALYST



DATE 12/12/19

DEPARTMENT MANAGER

DATE 12/12/19



Gamma Spectroscopy Case Narrative

Stantec Consulting Services

St. Anthony – 233001363

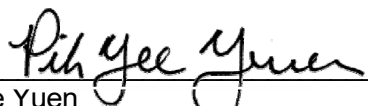
Work Order Number: 1911208

1. The following report consists of analytical results for 11 soil samples received by ALS on 11/11/2019.
2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 11/15/2019 and stored for at least 21 days to allow ^{222}Rn to approach secular equilibrium with its parent, ^{226}Ra . The degree of ingrowth achieved prior to analysis on 12/06/2019 is at least 97.8%. Conservatively assuming a radon emanation efficiency of approximately 50%, the effective radon progeny ingrowth for these samples would be greater than 98.9%.
3. The samples were analyzed for the presence of gamma emitting radionuclides according to the current revision of SOP 713. The analyses were completed on 12/06/2019.
4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram. The samples were not sieved.
5. ALS has observed a reproducible low bias in ^{226}Ra results (about -30% for the geometry in question) when using a mixed gamma source for the calibration of HPGe detectors for solid samples. This bias is eliminated by calibration using a NIST traceable ^{226}Ra source in the same geometry and configuration as the samples.
6. The library used for calibration and analysis employs multiple peaks for the ^{226}Ra progeny, ^{214}Pb (352 and 295 keV) and ^{214}Bi (609 and 1120 keV). Using these peaks avoids the use of the problematic ^{226}Ra photopeak at 186 keV, which suffers from poorly resolvable interference from ^{235}U at the same energy. Final activity results for ^{226}Ra are calculated, using the uncertainty-weighted mean of the activities for the four photopeaks, by the Seeker gamma spectroscopy software assuming secular equilibrium.



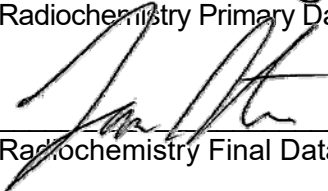
7. There are cases where the sample density is less than the associated calibration standard density. Cases that exceed the limit of +/- 15% of the density of the calibration standard are flagged with a 'G', denoting a significant density difference between the sample and calibration standard. Consequently, the results may be biased high for the flagged results in this work order. If requested, ALS can perform a transmission spike in order to estimate a magnitude of this bias. The results are reported without further qualification.
8. The requested detection limit was not achieved for all samples. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an "M3" flag on the final reports
9. Passing daily checks are required for all detectors on which client samples are counted for the day of the sample count and the day following the sample count. Sample 1911208-5 and the Laboratory Control Sample associated with batch GS191114-3 were counted in detector 2 on 12/6/2019. Detector 2 failed the daily check performed on 12/9/2019. However, the LCS was the last of these samples counted in detector 2 on 12/6/2019. This LCS passed ALS's QC acceptance criteria and will be evaluated as a passing check of performance for the samples counted in detector 2. Results are submitted without further qualification. Please refer to QASS 476110 at the end of this report.
10. No further problems were encountered with either the client samples or the associated quality control samples. All remaining quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



Pik Yee Yuen
Radiochemistry Primary Data Reviewer

12/11/19
Date



Radiochemistry Final Data Reviewer

12/13/19
Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1911208

Client Name: Stantec Consulting Services

Client Project Name: St. Anthony

Client Project Number: 233001363

Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
TP-04-03	1911208-1		SOIL	05-Nov-19	15:15
TP-03-06	1911208-2		SOIL	06-Nov-19	8:20
TP-08-08	1911208-3		SOIL	05-Nov-19	10:55
TP-13-06	1911208-4		SOIL	04-Nov-19	13:05
TP-14-07	1911208-5		SOIL	04-Nov-19	15:45
TP-18-06	1911208-6		SOIL	04-Nov-19	14:25
TP-11-06	1911208-7		SOIL	05-Nov-19	13:35
TP-02-08	1911208-8		SOIL	05-Nov-19	15:00
TP-01-01	1911208-9		SOIL	05-Nov-19	14:00
TP-05-01	1911208-10		SOIL	06-Nov-19	8:30
TP-10-03	1911208-11		SOIL	05-Nov-19	13:00



ALS Environmental

225 Commerce Drive, Fort Collins, Colorado, 80524
 TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Form 202r8

PROJECT NAME St. Anthony		SAMPLER St. Anthony		BREANNA VAN		DATE 11/19/19		WORKORDER # 1911208	
PROJECT No. 233001363		SITE ID St. Anthony		St. Anthony		TURNAROUND Standard		PAGE 1 of 2	
COMPANY NAME Stantec		EDD FORMAT		PURCHASE ORDER		DISPOSAL		By Lab or Return to Client	
SEND REPORT TO Kelly Johnson		BILL TO COMPANY Stantec		INVOICE ATTN TO Melanie Davis		Uranium (SW6020)			
ADDRESS 2890 East Cottonwood Parkway Suite 300		ADDRESS 3325 S. Timberline Rd Suite 150		Fort Collins, CO 80525		Ra 226 (901.1 modified)			
CITY/STATE/ZIP Salt Lake City, UT 84121-7238		CITY/STATE/ZIP Fort Collins, CO 80525		PHONE 970-212-2749		Uranium (SW6020)			
PHONE 801-617-3340		FAX		E-MAIL melanie.davis@stantec.com					
FAX		E-MAIL kelly.johnson@stantec.com							
Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC		
1	TP-04-03	S	11/5/19	15:15	1	NA	✓		
2	TP-03-06	S	11/6/19	8:20	1	NA	✓		
3	TP-08-08	S	11/5/19	16:55	1	NA	✓		
4	TP-13-06	S	11/4/19	13:05	1	NA	✓		
5	TP-14-07	S	11/4/19	15:45	1	NA	✓		
6	TP-18-06	S	11/4/19	14:25	1	NA	✓		
7	TP-11-06	S	11/5/19	13:35	1	NA	✓		
8	TP-02-08	S	11/5/19	15:00	1	NA	✓		
9	TP-01-01	S	11/5/19	14:00	1	NA	✓		
10	TP-05-01	S	11/6/19	8:30	1	NA	✓		

*Time Zone (Circle): EST CST (MS) PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

For metals or anions, please detail analytes below.

Comments:

QC PACKAGE (check below)	
<input type="checkbox"/>	LEVEL II (Standard QC)
<input type="checkbox"/>	LEVEL III (Std QC + forms)
<input type="checkbox"/>	LEVEL IV (Std QC + forms + raw data)

Preservative Key: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaHSO4 7-Other 8-4 degrees C 9-5035

RELINQUISHED BY	SIGNATURE	PRINTED NAME	DATE	TIME
RECEIVED BY	<i>Breanna Van</i>	Breanna Van	11/19/19	16:00
RELINQUISHED BY	<i>C. Trumbull</i>	C Trumbull	11-19-19	12:50
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

FROM: (303) 506-9177
BREANNA VAN
STANTEC
3325 S TIMBERLINE RD
SUITE 150
Fort Collins CO 80525
US

SHIP DATE: 07NOV19
ACTWGT: 21.20 LB
CAD: 6993643/SSFE2021
DIMMED: 15 X 12 X 12 IN

1711208

TO **ATTN: LANCE STEERE**
ALS ENVIRONMENTAL
225 COMMERCE DR

19

FORT COLLINS CO 80524

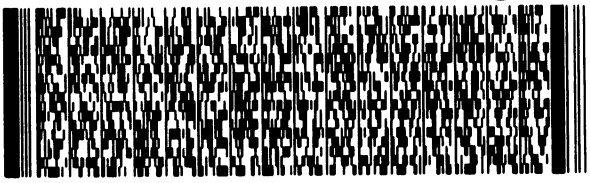
(US)

(619) 729-7292
INVT
PO:

REF:

DEPT:

0-



FedEx
Ground



Ab

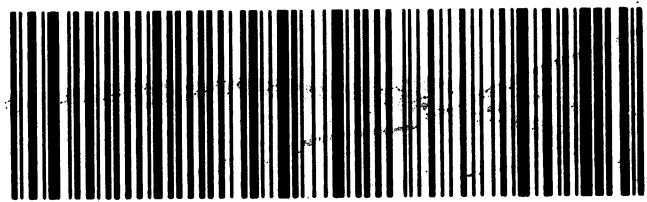
2 of 2

MPS# **7808 0805 8325**

Mstr# 7808 0805 8314

80524

9622 0019 0 (000 000 0000) 0 00 7808 0805 8325



Gamma Spectroscopy Results

PAI 713 Rev 15

Method Blank Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Lab ID: GS191114-3MB	Sample Matrix: SOIL	Prep Batch: GS191114-3	Final Aliquot: 215 g
Library: RA226.LIB	Prep SOP: PAI 739 Rev 12	QCBatchID: GS191114-3-2	Result Units: pCi/g
	Date Collected: 14-Nov-19	Run ID: GS191114-3A	File Name: 191474d01
	Date Prepared: 14-Nov-19	Count Time: 30 minutes	
	Date Analyzed: 06-Dec-19		

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.02 +/- 0.22	0.40	0.5	NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
!!
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
M - Requested MDC not met.
B - Analyte concentration greater than MDC.
B3 - Analyte concentration greater than MDC but less than Requested MDC.
DL - Decision Level

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins
Work Order Number: 1911208
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001363

Lab ID: GS191114-3LCS	Sample Matrix: SOIL	Prep Batch: GS191114-3	Final Aliquot: 215 g
Library: RA226.LIB	Prep SOP: PAI 739 Rev 12	QCBatchID: GS191114-3-2	Result Units: pCi/g
	Date Collected: 14-Nov-19	Run ID: GS191114-3A	File Name: 191500d02
	Date Prepared: 14-Nov-19	Count Time: 30 minutes	
	Date Analyzed: 06-Dec-19		

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	466 +/- 55	3	468.0	99.7	85 - 115	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TPU
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS Recovery within control limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Minimum Detectable Concentration

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-04-03
Lab ID:	1911208-1

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 05-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 154 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 191279d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	94 +/- 11	2	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-03-06
Lab ID:	1911208-2

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 06-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 190 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 191443d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	65.6 +/- 7.8	1.0	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-08-08
Lab ID:	1911208-3

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3
QCBatchID: GS191114-3-2
Run ID: GS191114-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 167 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 191326d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	18.4 +/- 2.3	0.8	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halfives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-13-06
Lab ID:	1911208-4

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 04-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3
QCBatchID: GS191114-3-2
Run ID: GS191114-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 170 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 190947d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	35.0 +/- 4.2	0.6	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 halfives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-14-07
Lab ID:	1911208-5

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 04-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 162 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 191499d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	40.0 +/- 4.8	1.0	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-18-06
Lab ID:	1911208-6

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 04-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 146 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 192010d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	34.7 +/- 4.2	1.0	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-11-06
Lab ID:	1911208-7

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 05-Nov-19
Date Prepared: 14-Nov-19
Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3
QCBatchID: GS191114-3-2
Run ID: GS191114-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 179 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 192749d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	22.8 +/- 2.8	1.0	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty
MDC - Sample specific Minimum Detectable Concentration
BDL - Below Detection Limit
DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.
SI - Nuclide identification and/or quantitation is tentative.
TI - Nuclide identification is tentative.
R - Nuclide has exceeded 8 half-lives.
G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-02-08
Lab ID:	1911208-8

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 05-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 159 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 191280d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	68.2 +/- 8.2	1.5	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-01-01
Lab ID:	1911208-9

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 05-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 174 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 191444d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	120 +/- 14	1	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-05-01
Lab ID:	1911208-10

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 06-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 190 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 191327d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	94 +/- 11	1	0.5	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

Gamma Spectroscopy Results

PAI 713 Rev 15

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Field ID:	TP-10-03
Lab ID:	1911208-11

Library: RA226.LIB

Sample Matrix: SOIL

Prep SOP: PAI 739 Rev 12

Date Collected: 05-Nov-19

Date Prepared: 14-Nov-19

Date Analyzed: 06-Dec-19

Prep Batch: GS191114-3

QC Batch ID: GS191114-3-2

Run ID: GS191114-3A

Count Time: 30 minutes

Report Basis: Dry Weight

Final Aliquot: 159 g

Prep Basis: Dry Weight

Moisture(%): NA

Result Units: pCi/g

File Name: 190948d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	31.0 +/- 3.7	0.7	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 half-lives.

G - Sample density differs by more than 15% of LCS density.

Data Package ID: GSS1911208-1

QUALITY ASSURANCE SUMMARY SHEET

ALS W.O. # / BATCH 1911188 / 206 65191114-3
 TEST Gamma
 METHOD GammaScan
 SOP/REV (PREP) —
 SOP/REV (ANAL) 713

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

12/6/19

In order to fulfill ALS Laboratory Group's Data Quality Objectives, passing daily checks are required for all detectors on which client samples are counted for the day of the sample count and the day following the sample count. Samples 1911188-20, 1911208-5 and the Laboratory Control Sample associated with batch GS191114-3 were counted in detector 2 on 12/6/2019. Detector 2 failed the daily check performed on 12/9/2019. However, the Laboratory Control Sample was the last sample counted in detector 2 on 12/6/2019. This LCS passed ALS's QC acceptance criteria and will be evaluated as a passing check of performance for the samples counted in detector 2. Results are submitted without further qualification.

12/6/19

12/9/19

12/6/19

[Large handwritten signature/initials across the lined section]

TECHNICIAN/ANALYST *[Signature]*

DATE 12/11/19

DEPARTMENT MANAGER *[Signature]*

DATE 12/11/19



Metals

Case Narrative

Stantec Consulting Services

St. Anthony – 233001363

Work Order Number: 1911207

1. This report consists of 10 soil samples.
2. The samples were received intact at ambient temperature by ALS on 11/11/2019.
3. The samples were prepared and analyzed based on SW-846, 3rd Edition procedures.

For analysis by ICP-MS, the samples were digested following method 3050B and the current revision of SOP 806.

4. Analysis by ICP-MS followed method 6020B and the current revision of SOP 827.
5. All standards and solutions are NIST traceable and were used within their recommended shelf life.
6. The samples were prepared and analyzed within the established hold times.

All in house quality control procedures were followed, as described below.

7. General quality control procedures.
 - A preparation (method) blank and laboratory control sample were digested and analyzed with the samples in this digestion batch.
 - The preparation (method) blank associated with this digestion batch was below the reporting limit for the requested analyte.
 - All laboratory control sample criteria were met.
 - All initial and continuing calibration blanks were below the reporting limit for the requested analyte.



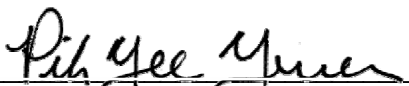
- All initial and continuing calibration verifications were within the acceptance criteria for the requested analyte.
- The interference check samples associated with Method 6020A were analyzed.

8. Matrix specific quality control procedures.

Per method requirements, matrix QC was performed for this analysis. Since a sample from this order number was not the selected quality control (QC) sample, matrix specific QC results are not included in this report.

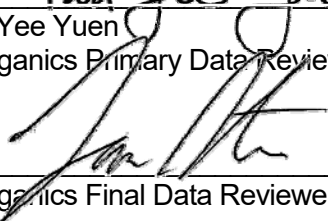
9. It is a standard practice that samples for ICP-MS are analyzed at a dilution.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



Pik Yee Yuen
Inorganics Primary Data Reviewer

12/13/19
Date



Inorganics Final Data Reviewer

12/13/19
Date



Inorganic Data Reporting Qualifiers

The following qualifiers are used by the laboratory when reporting results of inorganic analyses:

- Result qualifier -- If the analyte was analyzed for but not detected a "U" is entered.
- QC qualifier -- Specified entries and their meanings are as follows:
 - E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
 - M - Duplicate injection precision was not met.
 - N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
 - Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
 - * - Duplicate analysis (relative percent difference) not within control limits.
 - S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1911207

Client Name: Stantec Consulting Services

Client Project Name: St. Anthony

Client Project Number: 233001363

Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
TP-01-01-D	1911207-1		SOIL	05-Nov-19	14:00
TP-06-07	1911207-2		SOIL	05-Nov-19	11:30
TP-15-06	1911207-3		SOIL	04-Nov-19	15:05
TP-19-03	1911207-4		SOIL	04-Nov-19	11:23
TP-07-09	1911207-5		SOIL	05-Nov-19	10:20
TP-16-07	1911207-6		SOIL	04-Nov-19	13:45
TP-12-01	1911207-7		SOIL	05-Nov-19	9:15
TP-17-03	1911207-8		SOIL	04-Nov-19	11:00
TP-09-07-D	1911207-9		SOIL	05-Nov-19	10:00
TP-09-07	1911207-10		SOIL	05-Nov-19	9:50



ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
 TF: (900) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Form 2026

PROJECT NAME St. Anthony		SAMPLER Breanna Van		DATE 11/16/19		WORKORDER # 1911207	
PROJECT No. 233001363		SITE ID St. Anthony		TURNAROUND Standard		PAGE 1 of 1	
COMPANY NAME Stantec		PURCHASE ORDER		DISPOSAL		By Lab or Return to Client	
SEND REPORT TO Kelly Johnson		BILL TO COMPANY Stantec		Uranium (SW620)			
ADDRESS 2880 East Cottonwood Parkway Suite 300		INVOICE ATTN TO Melanie Davis		Ra 226 (901.1 modified)			
CITY / STATE / ZIP Salt Lake City, UT 84121-7238		ADDRESS 3325 S. Timberline Rd Suite 150					
PHONE 801-617-3340		CITY / STATE / ZIP Fort Collins, CO 80525					
FAX		PHONE 970-212-2749					
E-MAIL Kelly.Johnson@stantec.com		FAX					
E-MAIL melanie.davis@stantec.com							

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC	RELINQUISHED BY	SIGNATURE	PRINTED NAME	DATE	TIME
1	TP-01-01-D	S	11/5/19	14:00	1	NA	✓	Breanna Van	Breanna Van	Breanna Van	11/01/19	10:25
2	TP-06-07	S	11/5/19	11:30	1	NA	✓	C. Mumbach	C. Mumbach	C. Mumbach	11-11-19	12:50
3	TP-15-06	S	11/4/19	15:05	1	NA	✓					
4	TP-19-03	S	11/4/19	11:23	1	NA	✓					
5	TP-07-09	S	11/5/19	10:20	1	NA	✓					
6	TP-10-17 TP-16-07	S	11/4/19	13:45	1	NA	✓					
7	TP-12-01	S	11/5/19	9:15	1	NA	✓					
8	TP-17-03	S	11/4/19	11:00	1	NA	✓					
9	TP-09-07-D	S	11/5/19	10:00	1	NA	✓					
10	TP-09-07	S	11/5/19	9:50	1	NA	✓					

*Time Zone (Circle): EST CST (MST) PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

For metals or anions, please detail analytes below.

Comments:

QC PACKAGE (check below)
LEVEL II (Standard QC)
LEVEL III (Std QC + forms)
LEVEL IV (Std QC + forms + raw data)

Preservative Key: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaHSO4 7-Other 8-4 degrees C 9-5035



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Stantec

Workorder No: 1911207

Project Manager: LS

Initials: CDT Date: 11-11-19

1. Are airbills / shipping documents present and/or removable?		DROP OFF	<input checked="" type="radio"/> YES	<input type="radio"/> NO
2. Are custody seals on shipping containers intact?		<input checked="" type="radio"/> NONE	<input type="radio"/> YES	<input type="radio"/> NO *
3. Are custody seals on sample containers intact?		<input checked="" type="radio"/> NONE	<input type="radio"/> YES	<input type="radio"/> NO *
4. Is there a COC (chain-of-custody) present?			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
5. Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)			<input type="radio"/> YES	<input checked="" type="radio"/> NO *
6. Are short-hold samples present?			<input type="radio"/> YES	<input checked="" type="radio"/> NO *
7. Are all samples within holding times for the requested analyses?			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
8. Were all sample containers received intact? (not broken or leaking)			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
9. Is there sufficient sample for the requested analyses?			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
10. Are samples in proper containers for requested analyses? (form 250, Sample Handling Guidelines)			<input checked="" type="radio"/> YES	<input type="radio"/> NO *
11. Are all aqueous samples preserved correctly, if required? (excluding volatiles)		<input checked="" type="radio"/> N/A	<input type="radio"/> YES	<input type="radio"/> NO *
12. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)		<input checked="" type="radio"/> N/A	<input type="radio"/> YES	<input type="radio"/> NO
13. Were the samples shipped on ice?			<input type="radio"/> YES	<input checked="" type="radio"/> NO
14. Were cooler temperatures measured at 0.1-6.0°C?	IR gun used*:	#3	#5	RAD ONLY
				<input type="radio"/> YES <input checked="" type="radio"/> NO
Cooler #:	<u>1</u>			
Temperature (°C):	<u>Amb</u>			
# of custody seals on cooler:	<u>0</u>			
External mR/hr reading:	<u>22</u>			
Background mR/hr reading:	<u>11</u>			
Were external mR/hr readings ≤ two times background and within DOT acceptance criteria? <input checked="" type="radio"/> YES / <input type="radio"/> NO / <input type="radio"/> NA (If no, see Form 008.)				

* Please provide details here for NO responses to gray boxes above - for 2 thru 5 & 7 thru 12, notify PM & continue w/ login.

1911207-6 - bottle label has TP-14-07. This is correct. COC has TP-14-17. DATES AND TIMES ARE THE SAME *n/12/19*

SAMPLE 9 TP-09-07-D. Presume it is a duplicate of 10- TP-09-07, however they have different times. This is OK.

Were unpreserved bottles pH checked? YES NA

All client bottle ID's vs ALS lab ID's double-checked by: CDT

If applicable, was the client contacted? YES / NO / NA Contact: Breanna Van Date/Time: 11/12/19

Project Manager Signature / Date: [Signature] 11/12/19

FROM: (303) 506-9177
BREANNA VAN
STANTEC
3325 S TIMBERLINE RD
SUITE 150
Fort Collins CO 80525
US

SHIP DATE: 07NOV19
ACTWT: 21.20 LB
CAD: 6993643/SSFE2021
DIMMED: 15 X 12 X 12 IN

1911207

TO **ATTN: LANCE STEERE**
ALS ENVIRONMENTAL
225 COMMERCE DR

22

0-

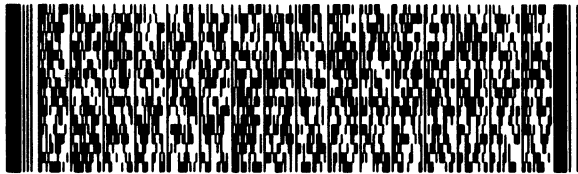
FORT COLLINS CO 80524

(US)

(619) 729-7292
INU:
PO:

REF:

DEPT:



FedEx
Ground



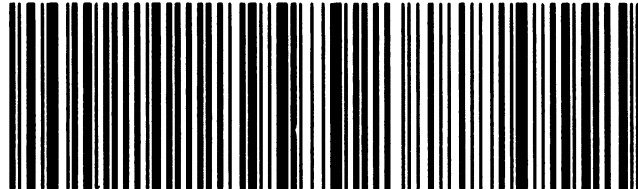
1 of 2

TRK# **7808 0805 8314**

MASTER

80524

9622 0019 0 (000 000 0000) 0 00 7808 0805 8314



Total URANIUM

Method SW6020 Revision B

Sample Results

Lab Name: ALS -- Fort Collins
Client Name: Stantec Consulting Services
Client Project ID: St. Anthony 233001363
Work Order Number: 1911207 **Final Volume:** 100 ml
Reporting Basis: Dry Weight **Matrix:** SOIL
Prep Method: SW3050B **Result Units:** UG/KG
Analyst: Nicole C. Chirban

Client Sample ID	Lab ID	Date Collected	Date Prepared	Date Analyzed	Percent Moisture	Dilution Factor	Result	RptLimit/ LOQ/LOD	Flag	Sample Aliquot
TP-01-01-D	1911207-1	11/05/2019	12/05/2019	12/06/2019	6.3	10	110000	10		1.052 g
TP-06-07	1911207-2	11/05/2019	12/05/2019	12/06/2019	4.9	10	50000	9.9		1.061 g
TP-15-06	1911207-3	11/04/2019	12/05/2019	12/06/2019	7.6	10	26000	10		1.048 g
TP-19-03	1911207-4	11/04/2019	12/05/2019	12/06/2019	5.5	10	30000	9.3		1.139 g
TP-07-09	1911207-5	11/05/2019	12/05/2019	12/06/2019	6.7	10	45000	9.5		1.133 g
TP-16-07	1911207-6	11/04/2019	12/05/2019	12/06/2019	6.9	10	38000	9.9		1.085 g
TP-12-01	1911207-7	11/05/2019	12/05/2019	12/06/2019	4.9	10	49000	9.9		1.067 g
TP-17-03	1911207-8	11/04/2019	12/05/2019	12/06/2019	4.5	10	30000	9.8		1.073 g
TP-09-07-D	1911207-9	11/05/2019	12/05/2019	12/06/2019	7.9	10	55000	10		1.037 g
TP-09-07	1911207-10	11/05/2019	12/05/2019	12/06/2019	7.6	10	47000	11		1.007 g

Comments:

1. ND or U = Not Detected at or above the client requested detection limit.

Data Package ID: IM1911207-1

ICPMS Metals

Method SW6020B

Method Blank

Lab Name: ALS -- Fort Collins

Work Order Number: 1911207

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Lab ID: IP191205-4MB

Sample Matrix: SOIL

% Moisture: N/A

Date Collected: N/A

Date Extracted: 05-Dec-19

Date Analyzed: 06-Dec-19

Prep Method: SW3050 Rev B

Prep Batch: IP191205-4

QCBatchID: IP191205-4-3

Run ID: IM191206-10A3

Cleanup: NONE

Basis: N/A

File Name: 025SMPL_

Sample Aliquot: 1 g

Final Volume: 100 ml

Result Units: UG/KG

Clean DF: 1

CASNO	Target Analyte	DF	Result	Result Qualifier	Reporting Limit	DL
7440-61-1	URANIUM	10	10	U	10	

Data Package ID: IM1911207-1

Date Printed: Thursday, December 12, 2019

ALS -- Fort Collins

Page 1 of 1

LIMS Version: 6.918

ICPMS Metals

Method SW6020B

Laboratory Control Sample

Lab Name: ALS -- Fort Collins

Work Order Number: 1911207

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Lab ID: IM191205-4LCS	Sample Matrix: SOIL % Moisture: N/A Date Collected: N/A Date Extracted: 12/05/2019 Date Analyzed: 12/06/2019 Prep Method: SW3050B	Prep Batch: IP191205-4 QCBatchID: IP191205-4-3 Run ID: IM191206-10A3 Cleanup: NONE Basis: N/A File Name: 026SMPL_	Sample Aliquot: 1 g Final Volume: 100 ml Result Units: UG/KG Clean DF: 1
------------------------------	--	--	---

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
7440-61-1	URANIUM	1000	954	10		95	80 - 120%

Data Package ID: *IM1911207-1*



Metals

Case Narrative

Stantec Consulting Services

St. Anthony – 233001363

Work Order Number: 1911208

1. This report consists of 11 soil samples.
2. The samples were received intact at ambient temperature by ALS on 11/11/2019.
3. The samples were prepared and analyzed based on SW-846, 3rd Edition procedures.

For analysis by ICP-MS, the samples were digested following method 3050B and the current revision of SOP 806.

4. Analysis by ICP-MS followed method 6020B and the current revision of SOP 827.
5. All standards and solutions are NIST traceable and were used within their recommended shelf life.
6. The samples were prepared and analyzed within the established hold times.

All in house quality control procedures were followed, as described below.

7. General quality control procedures.
 - A preparation (method) blank and laboratory control sample were digested and analyzed with the samples in this digestion batch.
 - The preparation (method) blank associated with this digestion batch was below the reporting limit for the requested analyte.
 - All laboratory control sample criteria were met.
 - All initial and continuing calibration blanks were below the reporting limit for the requested analyte.



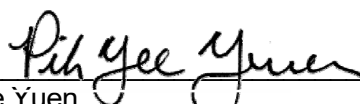
- All initial and continuing calibration verifications were within the acceptance criteria for the requested analyte.
- The interference check samples associated with Method 6020A were analyzed.

8. Matrix specific quality control procedures.

Per method requirements, matrix QC was performed for this analysis. Since a sample from this order number was not the selected quality control (QC) sample, matrix specific QC results are not included in this report.

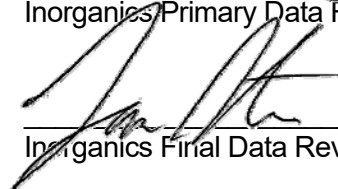
9. It is a standard practice that samples for ICP-MS are analyzed at a dilution.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.



Pik Yee Yuen
Inorganics Primary Data Reviewer

12/13/19
Date



Inorganics Final Data Reviewer

12/13/19
Date



Inorganic Data Reporting Qualifiers

The following qualifiers are used by the laboratory when reporting results of inorganic analyses:

- Result qualifier -- If the analyte was analyzed for but not detected a "U" is entered.
- QC qualifier -- Specified entries and their meanings are as follows:
 - E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
 - M - Duplicate injection precision was not met.
 - N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
 - Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
 - * - Duplicate analysis (relative percent difference) not within control limits.
 - S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1911208

Client Name: Stantec Consulting Services

Client Project Name: St. Anthony

Client Project Number: 233001363

Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
TP-04-03	1911208-1		SOIL	05-Nov-19	15:15
TP-03-06	1911208-2		SOIL	06-Nov-19	8:20
TP-08-08	1911208-3		SOIL	05-Nov-19	10:55
TP-13-06	1911208-4		SOIL	04-Nov-19	13:05
TP-14-07	1911208-5		SOIL	04-Nov-19	15:45
TP-18-06	1911208-6		SOIL	04-Nov-19	14:25
TP-11-06	1911208-7		SOIL	05-Nov-19	13:35
TP-02-08	1911208-8		SOIL	05-Nov-19	15:00
TP-01-01	1911208-9		SOIL	05-Nov-19	14:00
TP-05-01	1911208-10		SOIL	06-Nov-19	8:30
TP-10-03	1911208-11		SOIL	05-Nov-19	13:00



ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
 TF: (970) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Form 202r6

PROJECT NAME St. Anthony		SAMPLER St. Anthony		BREANNAN VAN		DATE 11/19/19		PAGE 1 of 2		WORKORDER # 1911208	
PROJECT No. 233001363		SITE ID St. Anthony		Standard		TURNAROUND		DISPOSAL		By Lab or Return to Client	
COMPANY NAME Stantec		EDD FORMAT		PURCHASE ORDER		Standard					
SEND REPORT TO Kelly Johnson		BILL TO COMPANY Stantec		INVOICE ATTN TO Melanie Davis							
ADDRESS 2890 East Cottonwood Parkway Suite 300		ADDRESS 3325 S. Timberline Rd Suite 150									
CITY/STATE/ZIP Salt Lake City, UT 84121-7238		CITY/STATE/ZIP Fort Collins, CO 80525									
PHONE 801-617-3340		PHONE 970-212-2749									
FAX		FAX									
E-MAIL Kelly.Johnson@stantec.com		E-MAIL melanie.davis@stantec.com									
Lab ID		Field ID		Matrix		Sample Date		Sample Time		# Bottles	
1		TP-04-03		S		11/5/19		15:15		1	
2		TP-03-06		S		11/6/19		8:20		1	
3		TP-08-08		S		11/5/19		16:55		1	
4		TP-13-06		S		11/4/19		13:05		1	
5		TP-14-07		S		11/4/19		15:45		1	
6		TP-18-06		S		11/4/19		14:25		1	
7		TP-11-06		S		11/5/19		13:35		1	
8		TP-02-08		S		11/5/19		15:06		1	
9		TP-01-01		S		11/5/19		14:00		1	
10		TP-05-01		S		11/6/19		8:30		1	
								Ra 226 (901.1 modified)		Pres. NA	
								Uranium (SW6020)		QC	

*Time Zone (Circle): EST CST (MS) PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

For metals or anions, please detail analytes below.

Comments:

QC PACKAGE (check below)	
LEVEL II (Standard QC)	
LEVEL III (Std QC + forms)	
LEVEL IV (Std QC + forms + raw data)	

Preservative Key: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaHSO4 7-Other 8-4 degrees C 9-5035

RELINQUISHED BY	SIGNATURE	PRINTED NAME	DATE	TIME
RECEIVED BY	Breanna Van	Breanna Van	11/19/19	16:00
RELINQUISHED BY	C. Trumbull	C. Trumbull	11-19-19	12:50
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				



ALS Environmental

225 Commerce Drive, Fort Collins, Colorado 80524
 TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Form 2028

PROJECT NAME St. Anthony		SAMPLER Breanna Van		DATE 11/6/19		WORKORDER # 1911208	
PROJECT No. 233001363		SITE ID St. Anthony		TURMAROUND Standard		PAGE 2 of 2	
COMPANY NAME Stantec		PURCHASE ORDER		DISPOSAL		By Lab or Return to Client	
SEND REPORT TO Kelly Johnson		BILL TO COMPANY Stantec		Ra 226 (901.1 modified)			
ADDRESS 2890 East Cottonwood Parkway Suite 300		INVOICE ATTN TO Melanie Davis		Uranium (SW6020)			
CITY / STATE / ZIP Salt Lake City, UT 84121-7238		ADDRESS 3325 S. Timberline Rd Suite 150					
PHONE 801-617-3340		CITY / STATE / ZIP Fort Collins, CO 80525					
FAX		PHONE 970-212-2749					
E-MAIL Kelly.Johnson@stantec.com		E-MAIL melanie.davis@stantec.com					
Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC
11	TP-10-03	S	11/5/19	13:00	1	NA	✓
		S				NA	
		S				NA	
		S				NA	
		S				NA	
		S				NA	
		S				NA	
		S				NA	
		S				NA	
		S				NA	
		S				NA	

*Time Zone (Circle): EST CST MST PST Matrix: O = oil S = soil NS = non-soil solid W = water L = liquid E = extract F = filter

For metals or anions, please detail analytes below.

Comments:

RELINQUISHED BY	SIGNATURE	PRINTED NAME	DATE	TIME
RECEIVED BY	Breanna Van	Breanna Van	11/6/19	16:00
RELINQUISHED BY	C. Trumble	C. Trumble	11-11-19	12:50
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

QC PACKAGE (check below)

LEVEL II (Standard QC)
LEVEL III (Std QC + forms)
LEVEL IV (Std QC + forms + raw data)

Preservative Key: 1-HCl 2-HNO3 3-H2SO4 4-NaOH 5-NaHSO4 7-Other 8-4 degrees C 9-5035

FROM: (303) 506-9177
BREANNA VAN
STANTEC
3325 S TIMBERLINE RD
SUITE 150
Fort Collins CO 80525
US

SHIP DATE: 07NOV19
ACTWGT: 21.20 LB
CAD: 6993643/SSFE2021
DIMMED: 15 X 12 X 12 IN

1711208

TO **ATTN: LANCE STEERE**
ALS ENVIRONMENTAL
225 COMMERCE DR

19

FORT COLLINS CO 80524

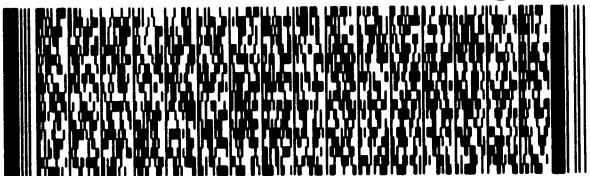
(US)

(619) 729-7292
INVT
PO:

REF:

DEPT:

0-



FedEx
Ground



Abb

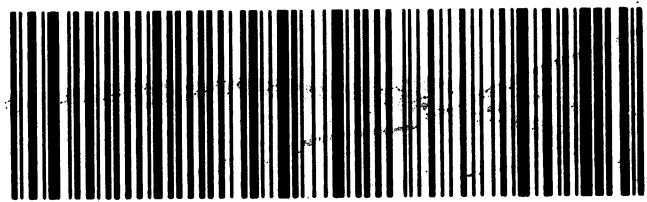
2 of 2

MPS# **7808 0805 8325**

Mstr# 7808 0805 8314

80524

9622 0019 0 (000 000 0000) 0 00 7808 0805 8325



Total URANIUM

Method SW6020 Revision B

Sample Results

Lab Name: ALS -- Fort Collins
Client Name: Stantec Consulting Services
Client Project ID: St. Anthony 233001363
Work Order Number: 1911208 **Final Volume:** 100 ml
Reporting Basis: Dry Weight **Matrix:** SOIL
Prep Method: SW3050B **Result Units:** UG/KG
Analyst: Nicole C. Chirban

Client Sample ID	Lab ID	Date Collected	Date Prepared	Date Analyzed	Percent Moisture	Dilution Factor	Result	RptLimit/ LOQ/LOD	Flag	Sample Aliquot
TP-04-03	1911208-1	11/05/2019	12/05/2019	12/09/2019	7.7	10	130000	11		1.028 g
TP-03-06	1911208-2	11/06/2019	12/05/2019	12/09/2019	4.9	10	93000	11		1.001 g
TP-08-08	1911208-3	11/05/2019	12/05/2019	12/09/2019	6.4	10	19000	10		1.032 g
TP-13-06	1911208-4	11/04/2019	12/05/2019	12/09/2019	7.4	10	52000	10		1.045 g
TP-14-07	1911208-5	11/04/2019	12/05/2019	12/09/2019	6.6	10	31000	10		1.065 g
TP-18-06	1911208-6	11/04/2019	12/05/2019	12/09/2019	8.4	10	46000	11		1.027 g
TP-11-06	1911208-7	11/05/2019	12/05/2019	12/09/2019	4.9	10	37000	9.9		1.064 g
TP-02-08	1911208-8	11/05/2019	12/05/2019	12/09/2019	7.4	10	83000	11		1.028 g
TP-01-01	1911208-9	11/05/2019	12/05/2019	12/09/2019	5.9	10	100000	10		1.039 g
TP-05-01	1911208-10	11/06/2019	12/05/2019	12/09/2019	6.0	10	97000	10		1.022 g
TP-10-03	1911208-11	11/05/2019	12/05/2019	12/09/2019	6.2	10	39000	11		1.009 g

Comments:

1. ND or U = Not Detected at or above the client requested detection limit.

Data Package ID: *IM1911208-1*

ICPMS Metals

Method SW6020B

Method Blank

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Lab ID: IP191205-6MB

Sample Matrix: SOIL

% Moisture: N/A

Date Collected: N/A

Date Extracted: 05-Dec-19

Date Analyzed: 09-Dec-19

Prep Method: SW3050 Rev B

Prep Batch: IP191205-6

QCBatchID: IP191205-6-2

Run ID: IM191209-10A3

Cleanup: NONE

Basis: N/A

File Name: 081SMPL_

Sample Aliquot: 1 g

Final Volume: 100 ml

Result Units: UG/KG

Clean DF: 1

CASNO	Target Analyte	DF	Result	Result Qualifier	Reporting Limit	DL
7440-61-1	URANIUM	10	10	U	10	

Data Package ID: IM1911208-1

Date Printed: Friday, December 13, 2019

ALS -- Fort Collins

Page 1 of 1

LIMS Version: 6.918

ICPMS Metals

Method SW6020B

Laboratory Control Sample

Lab Name: ALS -- Fort Collins

Work Order Number: 1911208

Client Name: Stantec Consulting Services

ClientProject ID: St. Anthony 233001363

Lab ID: IM191205-6LCS	Sample Matrix: SOIL	Prep Batch: IP191205-6	Sample Aliquot: 1 g
	% Moisture: N/A	QCBatchID: IP191205-6-2	Final Volume: 100 ml
	Date Collected: N/A	Run ID: IM191209-10A3	Result Units: UG/KG
	Date Extracted: 12/05/2019	Cleanup: NONE	Clean DF: 1
	Date Analyzed: 12/09/2019	Basis: N/A	
	Prep Method: SW3050B	File Name: 082SMPL_	

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
7440-61-1	URANIUM	1000	916	10		92	80 - 120%

Data Package ID: *IM1911208-1*

Appendix D
Radiologic Instrument Calibration, Correlation and Operational Function Check
Documentation

**AVM Environmental Services Inc.
Scaler/Ratemeter - Detector Calibration Form**

Scaler/Ratemeter: L2221 s# 68782
 Detector: L44-20 s# 295573

page 1 of 2

Source: U308 Ore in Can s# FC-1 Strength 1%

Scaler/Ratemeter Threshold set @ 10 mV, Window IN/OUT OUT, Window n/a mV

HV	Reading, CPM (Source)	Reading, CPM (Background)
500	114327	2792
550	151379	3422
600	187928	4996
650	206513	5789
700	210777	6059
750	212988	6226
800	213432	6337
850	214134	6349
900	224999	6556
950	267052	6983
1000	338798	8299
1050	411130	11839
1100	488653	15432
1150		
1200		
1250		
1300		
1350		
1400		

Background reading at designated function check location in AVM office.

Count #	Reading (CPM)	
	Bare	Collimated
1	22615	8586
2	22337	8383
3	22285	8382
4	22057	8312
5	22304	8411
Average	22320	8415
FC Range	17856 - 26784	6732 - 10098

Count Readings with 1 percent U₃O₈ can directly under collimated detector on designated function check location in AVM office.

Count #	Reading (CPM)
1	213154
2	212668
3	213477
4	213078
5	212583
Average	213046

HV Set @ 750 VDC (Instrument) 750 VDC (DVM Fluke 8020B)

Input Sensitivity (THR), mV 10

Function Check with 1 percent U₃O₈ ore in can. Can Directly under the detector in the collimator.

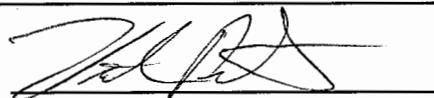
Acceptable Function check range is 170437 to 255655 CPM

Notes:

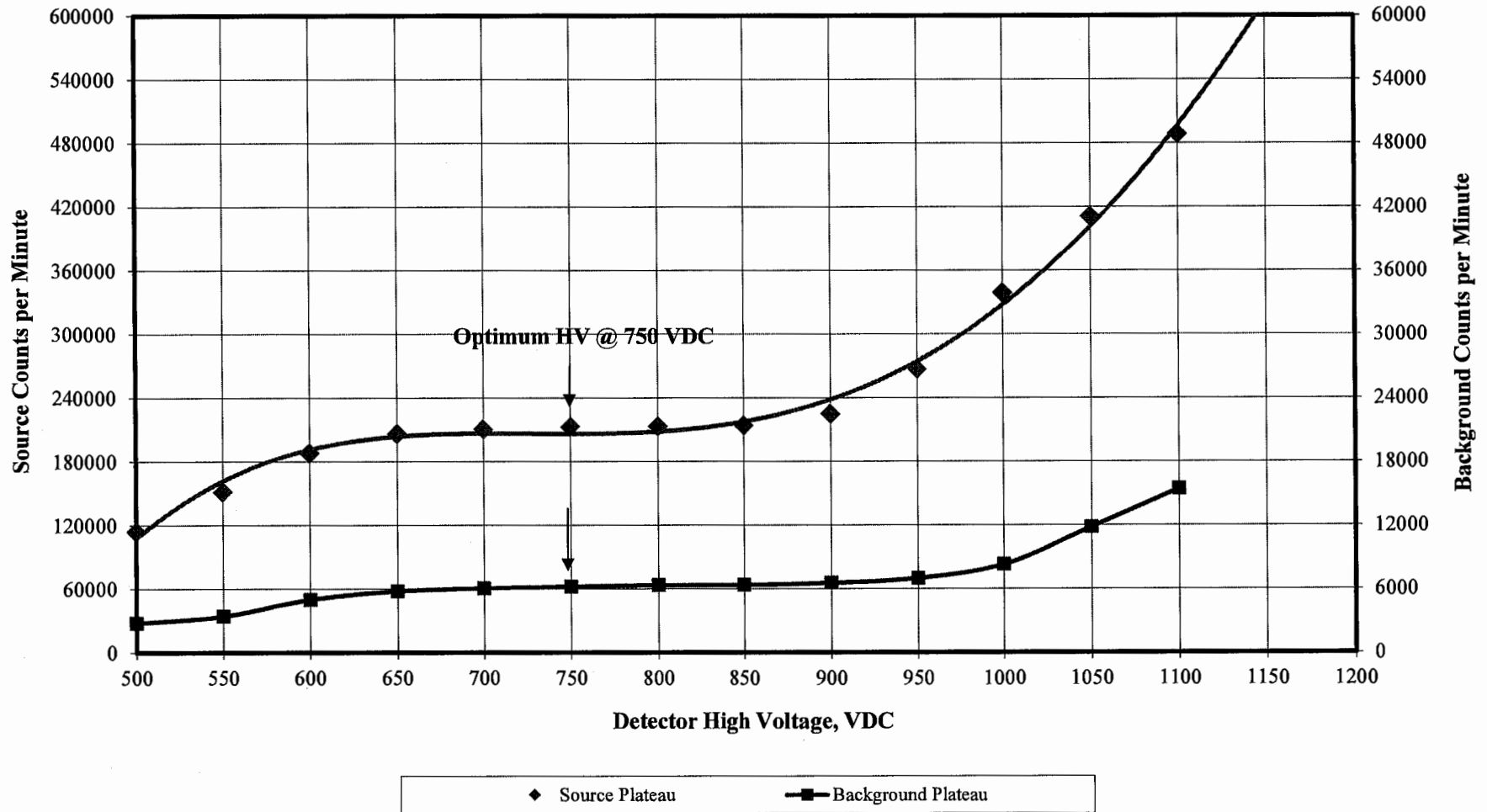
Date

10-2-19

By



Detector High Voltage Plateau
L44-20, Sr#PR295573 with Ludlum 2221 #68782
1% Uranium Ore in Sealed Can
October 02,2019



AVM Environmental Services Inc.

Scaler/Ratemeter Calibration Form

Model : L2221

S/N: 68782

Reference Instrument/Source: Ludlum Pulser 500, S/N:114513

HV Calibration

HV Test (2 points): Ref/Inst 600/600 Ref/Inst 900/900

Ratemeter Calibration

Instrument Threshold @ 100 (10 mV), WIN: Out, HV 900VDC; Pulser Threshold @ 200 (20mV)

Range/Mode	Range Multiplier	Calibration Point (Pulser Setting) cpm x multiplier	Target CPM (±5%)	As Found Reading		Left or Set Reading
Ratemeter	x1	40x1	38-42	39-40		39-40
	x1	40x10	380-420	390-410		390-410
	x10	40x100	3800-4200	4000		4000
	x100	40x1K	38K-42K	40K		40K
	x1K	40x10K	380K-420K	400K		400K
Digital Ratemeter	-	40x1	38-42	39-41		39-41
	-	40x10	380-420	395-400		395-400
	-	40x100	3800-4200	3956-4000		3956-4000
	-	40x1K	38K-42K	39600-40000		39600-40000
	-	40x10K	380K-420K	397K-400K		397K-400K

Threshold/Gain Calibration

WIN OUT

Pulser Amplitude (mV)	Pulser CPM		L2221 Theshold (mv)	Target CPM	L2221 CPM Found		L2221 CPM Left or Set @
10.0	40000		100 (10 mV)	27K -33K	31547		31547
20.0	40000		200 (20 mV)	27K -33K	31263		31263
30.0	40000		300 (30 mV)	27K -33K	30240		30240
40.0	40000		400 (40 mV)	27K -33K	30698		30698
50.0	40000		500 (50 mV)	27K -33K	32964		32964

Note: Use R174 Gain Control on Power Supply Board to adjust L2221 CPM @75% for Threshold/Gain Calibration

Window Cut-off Points Check

L2221 Threshold set @100 (10.0 mv)

WIN @ 100 (10.0 mV) Y WIN @ 400 (40.0 mV) Y
 WIN @ 200 (20.0 mV) Y WIN @ 500 (50.0 mV) Y

Date 10-1-19

Calibrated By 



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.



CERT # 4084.01

Customer AVM ENVIRONMENTAL SERVICES

ORDER NO. 20355895/478808

Mfr Ludlum Measurements, Inc. Model 19

Serial No. 76248

Model _____ Serial No. _____

Cal. Date 16-May-19 Cal Due Date 16-May-20 Cal. Interval 1 Year Meterface 202-016

Check mark Applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 59 % Alt 704.0 mm Hg

New Instrument Instrument Received Within Toler. +/-10% 10-20% Out of Tol. Requiring Repair Other-See comments

Mechanical ck. Meter Zeroed Background Subtract Input Sens. Linearity

F/S Resp. ck. Reset ck. Window Operation Geotropism

Audio ck. Alarm Setting ck. Batt. ck.

Calibrated in accordance with LMI SOP 14.8 Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 850 V Input Sens. 37 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

Multimeter uncertainty within 1.3% of reading, Gamma uncertainty within 5.0% of reading, Neutron uncertainty within 7.0% of reading, Count rate uncertainty within 5.4% of reading

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING
5000	4000 uR/hr	4200	4000
5000	1000 uR/hr	1100	1000
500	400 uR/hr = 72,000 cpm	410	400
500	100 uR/hr	105	100
250	200 uR/hr = 36,800 cpm	210	200
250	100 uR/hr	105	100
50	7200 cpm	42	40
50	1800 cpm	10.5	10
25	3680 cpm	21	20
25	920 cpm	5.5	5

50, 25 Range(s) Calibrated Electronically

Digital Readout	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors. Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2. The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323AB-2013

ISO/IEC 17025:2017(E)
State of Texas Calibration License No. LO-1983

Reference Instruments and/or Sources: Cs-137 S/N: 059 2171CP 2261CP 720 734 781 1131 1616 1696 1909 1916CP 2324/2521
 5717CO 5719CO 60646 70897 73410 E552 G112 2168CP S-394 S-1054 T10081 T10082 Neutron Am-241 Be T-304 Ra-226 Y982
 E551 5105 CSV280

Alpha S/N _____ Beta S/N _____ Other _____

m 500 S/N 130362 Oscilloscope S/N _____ Multimeter S/N 78401031

Calibrator Scott Stroman Title Calibrator Date 16-May-19

QC'd By [Signature] Title Final QC Date 16 May 19

AC Inst. Only Failed: _____
Passed Dielectric (Hi-Pot) and Continuity Test



CERTIFICATE OF CALIBRATION



CERT # 4084.01

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20356583/479228

Mfr. Ludlum Measurements, Inc. Model 12S Serial No. 11090

N. _____ Model _____ Serial No. _____

Cal. Date 28-May-19 Cal Due Date 28-May-20 Cal. Interval 1 Year Meterface X4

- Check mark Applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 62 % Alt 697.0 mm Hg
- New Instrument Instrument Received Within Toler. +-10% 10-20% Out of Tol. Requiring Repair Other-See comments
- Mechanical ck. Meter Zeroed Background Subtract Input Sens. Linearity
- F/S Resp. ck. Reset ck. Window Operation Geotropism
- Audio ck. Alarm Setting ck. Batt. ck.
- Calibrated in accordance with LMI SOP 14.8 Calibrated in accordance with LMI SOP 14.9
- Instrument Volt Set 750 V Input Sens. 37 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV
- HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1000	2000 uR/hr	2	2
X 1000	1000 uR/hr	1	1
X 100	200 uR/hr = <u>35000 cpm</u>	2	2
X 100	100 uR/hr	1	1
X 10	<u>3500</u> cpm	2	2
X 10	<u>1750</u> cpm	1	1
x 1	<u>350</u> cpm	2	2
x 1	<u>175</u> cpm	1	1

*Uncertainty within ± 10% C.F. within ± 20% X10, X1 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978 ISO/IE 17025:2005(E) State of Texas Calibration License No. LO-1963

- Reference Instruments and/or Sources: Cs-137 S/N: 059 2171CP 2261CP 720 734 781 1131 1616 1696 1909 1916CP 2324/2521
- 5717CO 5719CO 60646 70897 73410 E552 G112 2168CP S-394 S-1054 T10081 T10082 Neutron Am-241 Be T-304 Ra-226 Y982
- Alpha S/N _____ Beta S/N _____ Other _____
- m 500 S/N 189509 Oscilloscope S/N _____ Multimeter S/N 71300492

Calibrator WENDELL WILLIAMS *Wendell Williams* Title Calibrator Date 28 MAY 19

QC'd By *[Signature]* Title Final QC Date 29 May 19

AVM Environmental Services, Inc.
HP-210/Scaler Calibration

Scaler/Ratemeter: L12 s#274126 HP-210L: ANA-1

Source: SrY-90 DNS-14 #5442-05, 4370 dpm (3-28-05), 3199 (3-13-2018)

Scaler HV: 900 Scaler Threshold (Input Sensitivity): 10 mV

Source Counts 964 / 1 Minutes

Background Counts 42 / 1 Minutes

Net CPM: 922

Source CPM	BKG CPM
964	40
962	43
955	42
959	44
980	40

Average 964 42

Eff = Net cpm/source dpm
Eff= 0.29

Function Check:

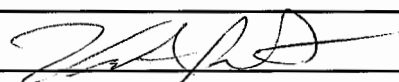
FC Source: 1% U308 in can s# FC-1

FC CPM: 3600

FC CPM Range: 2880 - 4320

Comments

Date: 10-2-19

Calibrated by: 



www.ludlums.com

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.



CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES

ORDER NO. 20355896/478809

Date 16-May-19 Cal Due Date 16-May-20 Cal. Interval 1 Year Procedure 500/Rev 7

New Instrument Instrument Received Within Tolerance Out of Tol. Requiring Repair Other-See Comments

T. 72 °F RH 52 % Alt 705.0 mm Hg Meter Zeroed Mechanical Check

PULSE WIDTH Uncertainty within 0.85% of reading

	As Found	As Left	Acceptable Range (µs)
NEG PULSE	<u>1.7</u>	<u>1.7</u>	1.5 - 1.9
POS PULSE	<u>1.6</u>	<u>1.6</u>	< 2.25

PULSE AMPLITUDE (NEGATIVE) Uncertainty within 1.3% of reading

Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range	Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range
1 V	<u>1 V</u>	<u>1 V</u>	0.9 - 1.1	4 V	<u>4.2 V</u>	<u>4.2 V</u>	3.6 - 4.4
100 mV	<u>100 mV</u>	<u>100 mV</u>	90 - 110	400 mV	<u>420 mV</u>	<u>420 mV</u>	360 - 440
10 mV	<u>10 mV</u>	<u>10 mV</u>	9 - 11	40 mV	<u>42 mV</u>	<u>42 mV</u>	36 - 44
1 mV	<u>1 mV</u>	<u>1 mV</u>	0.9 - 1.1	4 mV	<u>4.3 mV</u>	<u>4.2 mV</u>	3.6 - 4.4

PULSE AMPLITUDE (POSITIVE) Uncertainty within 1.3% of reading

Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range
3 V	<u>3.1 V</u>	<u>3.1 V</u>	2.7 - 3.3
300 mV	<u>310 mV</u>	<u>310 mV</u>	270 - 330
30 mV	<u>31 mV</u>	<u>31 mV</u>	27 - 33
3 mV	<u>3.1 mV</u>	<u>3.1 mV</u>	2.7 - 3.3

Digital High Voltage Uncertainty within 1.3% of reading

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range
500 V			490 - 510
1500 V			1470 - 1530

Analog High Voltage Uncertainty within 1.3% of reading

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range
500 V	<u>500</u>	<u>500</u>	475 - 525
2000 V	<u>1980</u>	<u>1980</u>	1900 - 2100

PULSE FREQUENCY (PERIOD) Uncertainty within 0.46% of reading

Pulser Range	As Found Period	As Left Period	Acceptable Range
x 10K	<u>6.667</u>	<u>6.667</u>	6.534 - 6.8
x 1K	<u>66.69</u>	<u>66.69</u>	65.34 - 68
x 100	<u>666.9</u>	<u>666.9</u>	653.4 - 680
x 10	<u>6669</u>	<u>6669</u>	6534 - 6800
x 1	<u>66.69</u>	<u>66.69</u>	65.34 - 68
x 0.1	<u>90</u>	<u>90</u>	88.2 - 91.8 Counts

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range
MAX	<u>992</u>	<u>992</u>	981 - 999
MIN	<u>0-1</u>	<u>0-1</u>	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW OR MAIN BOARD = 5208-066

COMMENTS:

Cal'd w/ 39" cable.

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. All pass/fail determinations are based on the manufacturer's specifications without considering uncertainty factors. Measurement results represent expanded uncertainties expressed at approximately the 95% level of confidence, using a coverage factor of k=2. The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323AB-2013

ISO/IEC 17025:2017(E)
State of Texas Calibration License No. LO-1963

Reference Instruments: Frequency Counter Model BK 1856 D S/N 332 E 18137 Cal Date 29-Oct-2018
 Oscilloscope Model TENNA 22-6820 S/N 0004404 Cal Date 11-Oct-2018
 Voltmeter Model Fluke 83 V S/N 18900314 Cal Date 29-May-2018

Calibrator William Tinsley Title Calibrator Date 16-May-2019

QC'd By [Signature] Title Final QC Date 16 May 19

AC Inst. Passed Dielectric (Hi-Pot) and Continuity Test
 Only Failed:

AVM Environmental Services Inc.
L2221 SCA/L44-20 Energy Calibration Form

SCA: L2221, SR #68782

Detector: Ludlum 44-20 (3x3 NaI Scintillator)

Calibration Source: Cs-137 Check Source, 5 uCi (August 2008) For 662 KeV Peak Cal

Threshold (input sensitivity) **652**

Window, In/Out IN Window 20

HV Initial 400, At Peak 588

Maximum CPM: 132,550 Background CPM: 10

HV Set @ 588 VDC

For Bi-214 609.2 KeV Peak (559 - 659 KeV ROI), Set Threshold @ 559, Window @ 100

Calibration Check w 1% U3O8 Ore Check Source: 15699 CPM

Blank BK6 @ AVM Office Parking lot 62 cpm

Date 11-1-19

Calibrated By 

AVM Environmental Services, Inc.
Field Soil Sample Gamma Radiation Screening Calibration Form

Instrumentation : Scaler/Ratemeter L2221 s# 290801 Detector: L44-20 s# 295573

Instrument Calibration Date: 10-1-19 Instrument Function Check Performed:

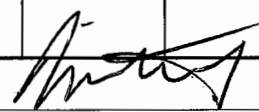
Survey Area/Unit Description: AVM office parking lot

Date/Time	Sample ID	Sample Weight Grams	609 (559-669) Kev Gross CPM	Weight Corrected CPM	CPM Net (avg)	Ra-226 pCi/g	Comments
11-1-19	Blank	-	59 64 63	-	62		$Ra_{226} = (0.0112 \times CPM) = 0.3188$
"	25 pCi/g Reference Soil	3000	1765	-	1605	25	
"	"	"	1630	-			
"	"	"	1640	-			
"	"	"	1682	-			
"	"	"	1619	-			
"	50 pCi/g Reference Soil	"	3095	-	3009	50	
"	"	"	3070	-			
"	"	"	3079	-			
"	"	"	3041	-			
"	"	"	3070	-			
"	100 pCi/g Reference Soil	"	5910	-	5818	100	
"	"	"	5916	-			
"	"	"	5886	-			
"	"	"	5810	-			
"	"	"	5879	-			

Technician Signature

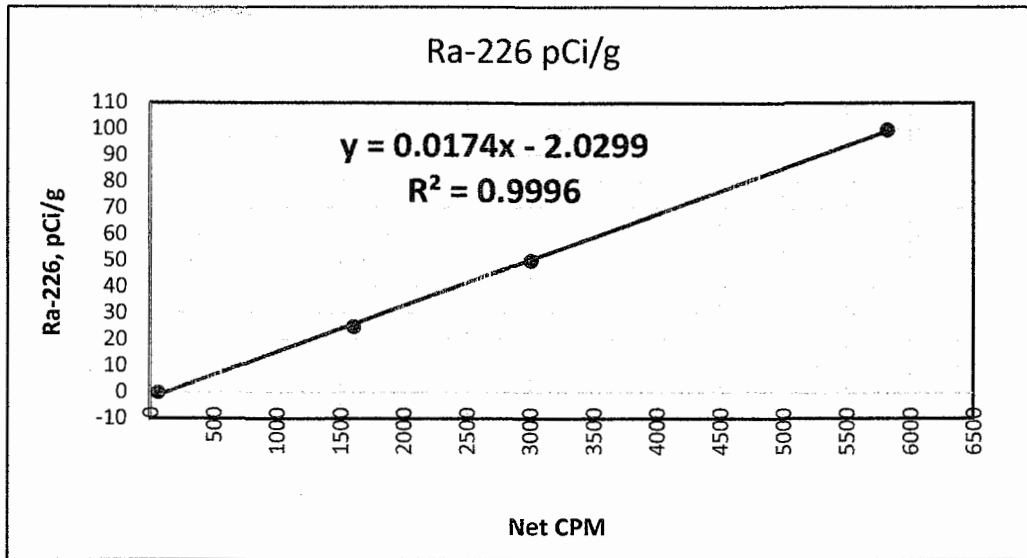


Reviewed by



Correlation for soil screening

Source/sample	Gross Counts	Gross CPM	Net CPM	Ra-226 pCi/g
Blank	62	62	62	0
25 pCi/g Ref Soil	1667	1667	1605	25
50 pCi/g Ref Soil	3071	3071	3009	50
100 pCi/g Ref Soil	5880	5880	5818	100



**AVM Environmental Services, Inc.
Micro R Meter Function Check Form**

Micro R Meter: Ludlum 12S, SR#11090

Function Check Source ID: 1% U₃O₈ Ore in Sealed can

Function Check @ Calibration 120

Acceptable Function Check Reading (uR/hr) Range (20%) 96 to 144

Date	Physical Check	Cal Date	Battery ⁽¹⁾ Volts or OK	BKG Reading uR/hr	Source Reading ⁽²⁾ uR/hr	Within Acceptable Range Y or N	Cal Due	Tech
10-3-19	✓	5-28-19	✓	8	120	Y	5-28-19	JP
10-21-19	✓	"	✓	8	120	Y	"	JP
11-3-19	✓	"	✓	9	120	Y	"	JP
11-4-19	✓	"	✓	9	120	Y	"	JP
11-5-19	✓	"	✓	8	120	Y	"	JP
11-6-19	✓	"	✓	8	120	Y	"	JP
11-8-19	✓	"	✓	9	120	Y	"	JP

Note: (1) Battery Voltage must be within BAT TEST Range (2) Function Check Source must be placed in the circle on the front side of the meter

