Stantec

Memorandum

To:	Roy Blickwedel General Electric	From:	Toby Leeson, PG Stantec, Steamboat Springs, Colorado
File:	St. Anthony Mine, 233001076	Date:	September 4, 2018

Reference: Summary of Supplemental Materials Characterization, St. Anthony Mine

INTRODUCTION

This memorandum summarizes the results of the Supplemental Materials Characterization of mine waste at the St. Anthony Mine (the site). The work was conducted in accordance with the *Supplemental Investigations Work Plan*, dated February 20, 2018. The Site is located 40 miles west of Albuquerque, New Mexico, approximately 4.6 miles southeast of Seboyeta, New Mexico on the Cebolleta Land Grant. The mine was an open pit and underground shaft uranium mine that includes one sealed shaft, one surface-sealed vent shaft, two open pits, five inactive ponds, seven piles of non-economical mine materials (partially revegetated), three topsoil piles, and several small piles of non-economical mine materials. The mine permit boundary area covers approximately 430 acres that includes these mine features along with roads and other disturbed areas. A site layout map is included on Figure 1.

A Materials Characterization was conducted in 2007 to characterize radiological contamination in surface and subsurface soils within the mine site features, such as the waste piles (MWH, 2007). The Mining and Minerals Division (MMD) noted that soils within the areas between the mine site features were not characterized and an outer boundary for the radiological contamination was not determined, as stated in their letter dated November 24, 2015. Therefore, the Supplemental Radiological Characterization was conducted to characterize the areas within the permit boundary that were excluded from the 2007 Materials Characterization and to estimate the location of the outer boundary (lateral extent) of the mine waste. The results of the Materials Characterization (2007 and 2018) were used to estimate the location and volume of mine waste at the site and will be used in the development of the *Closeout Plan*.

The investigation field work was conducted by AVM Environmental Services, Inc. (AVM) with oversight from Stantec. AVM prepared a *Supplemental Radiologic Characterization Report* that is included as Attachment A to this memorandum. Their report describes the field investigation methods and results of the investigation, and includes gamma survey measurements, subsurface sampling and analytical results, a correlation between gamma radiation and Ra-226 concentrations, and radiologic instrument calibration and function check records.

METHODS

The field investigation included static gamma radiologic survey measurements, Global Positioning System (GPS) based scan surveys, ex-situ and in-situ gamma radiation soil screening, soil sampling and laboratory analysis. Instrumentation for direct gamma radiation level measurements included 2x2 NaI scintillation detectors (Eberline SPA-3 and Ludlum 44-10), paired with a Ludlum 2221 or 2241 scale/rate meter. The scale/rate meters were connected to a Differential Global Positioning system (DGPS) of sub-meter accuracy that has data logging and surveying software capabilities.

The site was divided into 26 zones and surveys were taken along geo-projected transects spaced 30 feet apart, with the detector held one foot above the ground surface. A scan rate of around three feet per second was used and data were collected at a one to two second interval. Transects were created within the survey areas. The survey data were then mapped onto a site map, using different colors delineating the gamma level ranges. In addition to survey areas identified in the work plan, Stantec collected gamma survey data in step-out areas (e.g., areas outside the permit boundary) where gamma measurements exceeded the investigation levels (IL) for Ra-226. The IL for Ra-226 that was used for this investigation was 6.1 pCi/g (5.0 pCi/g above mean background level). The mean background level for Ra-226 was 1.6 pCi/g (MWH, 2007).

Based on the results of the gamma scan, Stantec targeted areas with the highest Ra-226 levels and selected 24 locations for subsurface sampling and analysis from test pits (Figure 3 of Attachment A). Stantec conducted subsurface soil sampling for on-site ex-situ gamma soil screening from April 16 to April 19, 2018. Subsurface samples were taken at one-foot depth intervals from the test pits, with sampling continuing until the gamma readings were below the IL (6.6 pCi/L).

Field personnel conducted ex-situ gamma radiation soil screening from the test pits by measuring the 609 KeV region gamma radiations of Bi-214, a decay product of Ra-226. This was done by using a Ludlum 2221 paired with a Ludlum 44-20 3x3 NaI scintillation detector. As soil sample was collected and then placed in a heavily shielded counting chamber, around a plastic lined detector.

A total of 57 subsurface samples were collected from test pits and 44 soil samples were sent to the laboratory for analysis (ALS Inc., Fort Collins CO). Field QA/QC duplicates, taken at 10 percent frequency (five samples), were split in the field and included in the batch sent to the laboratory. These soil samples were analyzed for Ra-226 using EPA Method 901.1 modified.

AVM developed a site-specific correlation using regression analysis for the collimated and bare 2x2 NaI detectors to convert the detector gamma radiation levels (in cpm) to surface soil Ra-226 concentration (in pCi/g). Correlation locations were determined after investigation confirmed that elevated levels of Ra-226 in the chosen locations were limited to the surface soil and that sources of lateral gamma radiation shine were minimal. Fourteen correlation samples were sent to the laboratory for Ra-226 analysis using EPA Method 901.1 modified. Eight additional samples with some particles greater than 0.25 inches were submitted the laboratory for analysis that included all particle sizes to evaluate if there was a difference compared to the initial samples which were sieved to remove particles greater than 0.25 inches. The results of the correlation are included in Appendix C of Attachment A.

RESULTS

Gamma radiation surveys began March 19, 2018 and were completed on May 12, 2018. The gamma radiation measurements in counts per minute (cpm) were converted to Ra-226 concentrations (activity) in pCi/g using the site-specific correlation. The 2007 Materials Characterization was conducted using exposure rate measurements, which were also converted to Ra-226 concentrations using the site-specific correlation.

The results of the gamma radiation survey in cpm are shown on Figures 1 and 2 of Attachment A, and in equivalent Ra-226 concentrations in pCi/g on Figures 5 and 6 of Attachment A.

The results of the 2007 Material Characterization are also shown on Figure 5 of Attachment A. The 2007 gamma survey results showed that Waste Piles 3, 4, 6, and 7, the Crusher/Stockpile, Pit 1, and the smaller piles at the West Shaft and Ore Storage 1 and 2 areas all had gamma radiation levels above 10 pCi/g. Pile 4 had some readings of 10.1 to 25.0 pCi/g; however, the majority ranged from <1.6 pCi/g to 10 pCi/g. Soils within the other mine features surveyed in 2017 were below the IL of 6.6 pCi/g.

The lateral extent of surface soils with Ra-226 concentrations greater than the IL is generally within the permit boundary, as shown on Figure 5 of Attachment A, except for the access road and some other small areas. The access road extends to the north of the permit boundary and had consistently high gamma measurements (generally between 10.1 and 100.0 pCi/g), as shown on Figure 6 of Attachment A. Other areas where IL exceedances were measured slightly outside the permit boundary included the following:

- South of Shale Pile 1
- South of Pit 1
- Around the West Shaft Area
- North of Pit 1

The highest Ra-226 concentrations within the Site were measured in the central portion of the Site adjacent to the west side of Pile 6, within the Crusher/Stockpile, and within Pile 7. There are numerous small waste piles in the area adjacent to Pile 6 where gamma radiation was measured above 100 pCi/g. The gamma radiation levels tended to decrease with increased distance from the piles and towards the permit boundaries. Ponds 1 through 4 in the West Shaft Area had similarly elevated readings that were generally contained within the pond boundaries. Additionally, the arroyo had readings of approximately 10 to 100 pCi/g in the deepest parts of the channel and readings of 6.6 to 10 pCi/g on the banks and adjacent areas.

Laboratory testing and ex-situ soil screening results are included in Appendix B of Attachment A. These results were generally consistent with the gamma measurements converted to Ra-226 levels. The on-site ex-situ soil screening results, laboratory analytical results, and observations made in the test pits, were used to estimate the depth of IL exceedances. These depth estimates were then used to interpolate the depth of IL exceedances for the remainder of the site. The lateral extent and depths of IL exceedances (excavation limits) are shown on Figure 2 and Figure 3. Maximum depths of IL exceedances were 5.0 to greater than 6.5 feet bgs in the following areas:

- 6.5 feet bgs (or greater) between Pile 3 and Pit 2 at Test Pit 24
- 6 feet bgs near Borrow Area South at Test Pit 23
- 5 ft bgs west of the Crusher/Stockpile Area at Test Pits 4 and 5
- 5 to 6 feet bgs between Pit 1 and Pile 6 at Test Pits 11 and 13

The ground surface elevations, the lateral extent (outer boundary) of Ra-226 above the IL, the depths of IL exceedances (including the mine features that were characterized in 2007) and the interpolated depths in

other areas of the site, were used to estimate the volume of mine waste with Ra-226 concentrations above the IL (6.6 pCi/g). The volume was estimated to be 8.1 million cubic yards.

CONCLUSION

The overall goal to characterize the materials between site features and estimate the lateral and vertical extent of mine waste with Ra-226 greater than the IL of 6.1 pCi/g was completed. The IL exceedances are generally contained within the permit boundary, except for the access road and small areas south of Shale Pile 1, south of Pit 1, around the West Shaft Area, and north of Pit 1. The depth of impacts throughout the site was characterized from 24 test pits and was measured from 0.5 feet to approximately 6.5 feet bgs. This information along with the results of the 2007 Materials Characterization were used to estimate the volume of mine waste at 8.1 million cubic yards.

ATTACHMENTS

Figure 1 – Site Layout
Figure 2 – Excavation Limits
Figure 3 – Excavation Limits (no contours)
Attachment A – Supplemental Radiologic Characterization, St. Anthony Mine Site

REFERENCES

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

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

Stantec Consulting Services Inc.

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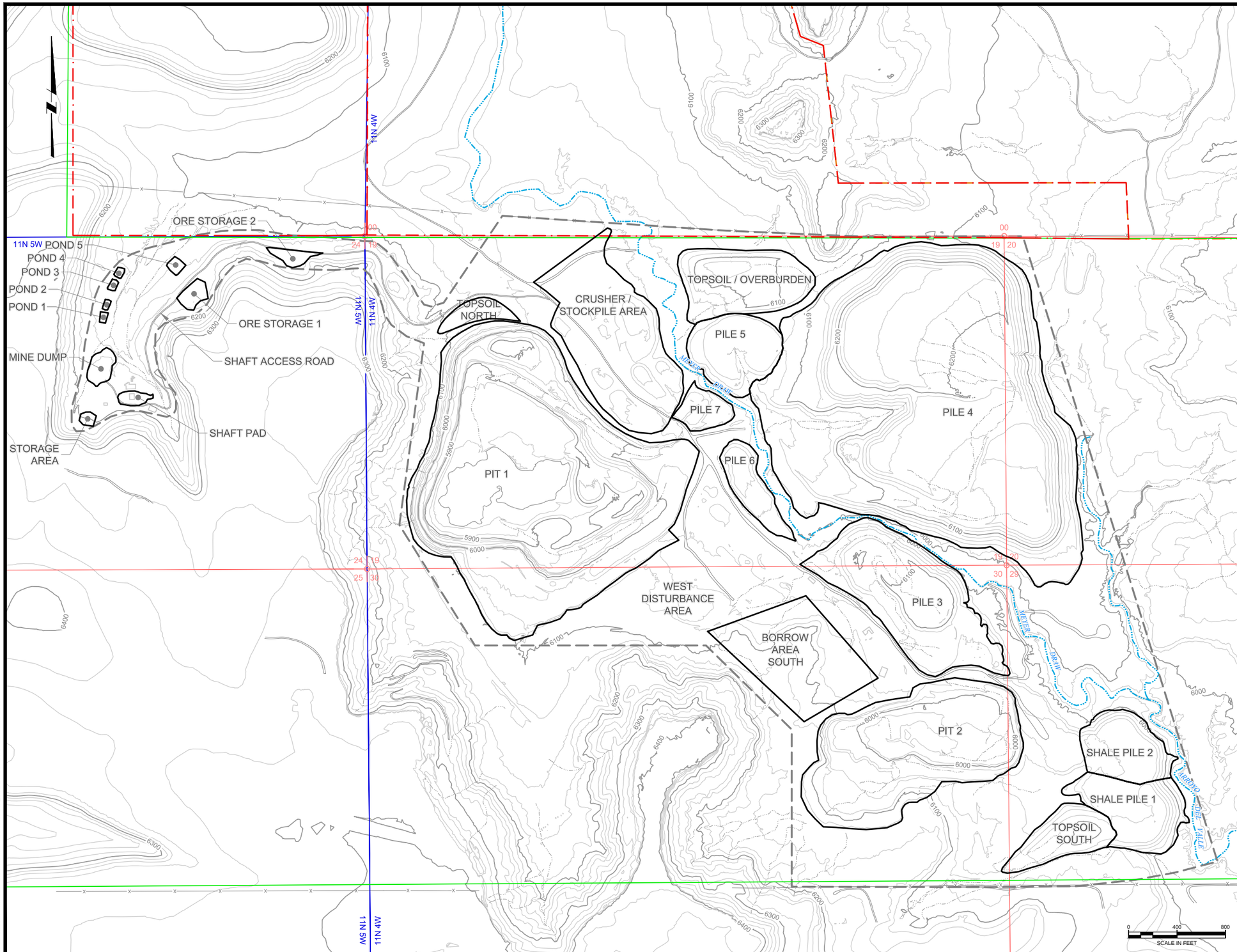
ATTACHMENTS

FIGURES



LEGEND:

- EXISTING GROUND SURFACE CONTOUR & ELEVATION, FEET
- DRAINS
- ARROYO
- EXISTING ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC AND POWER POLES
- TOWNSHIP LINE AND NUMBER
- SECTION LINE AND NUMBER
- CEBOLLETA LAND GRANT
- PARCEL - LOBO PARTNERS,LLC
- PARCEL - UNITED NUCLEAR CORP (UNC)
- UNC MINE PERMIT BOUNDARY
- FACILITY OUTLINES

DESIGNED K REED
CHECKED B VAN
APPROVED T LEESON

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UNITED NUCLEAR CORPERATION AND ST. ANTHONY MINE
CIBOLA COUNTY, NEW MEXICO

SITE LAYOUT

FIGURE
1
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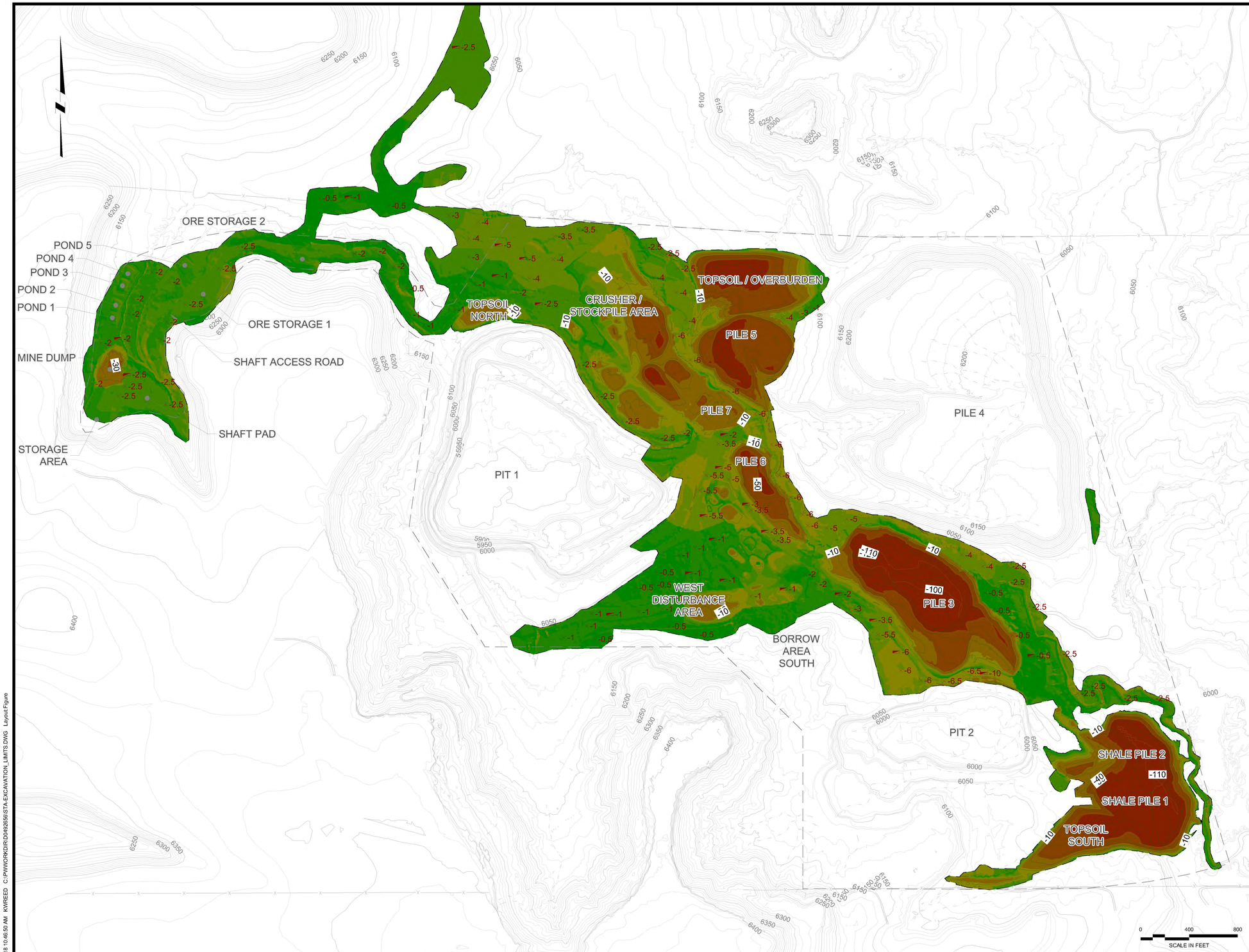

LEGEND:

- 6100 — EXISTING GROUND SURFACE CONTOUR & ELEVATION, FEET
- DRAINS
- ARROYO
- EXISTING ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC AND POWER POLES
- UNC MINE PERMIT BOUNDARY
- -1.5 — TEST PIT AND EXCAVATION DEPTH (STANTEC, 2018)

Excavation Depths

NUMBER	COLOR	MINIMUM DEPTH (FT)	MAXIMUM DEPTH (FT)
1		-138.9	-52.8
2		-52.8	-27.3
3		-27.3	-12.0
4		-12.0	-5.8
5		-5.8	-3.1
6		-3.1	-1.9
7		-1.9	-0.5
8		-0.5	34653465.0

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CIBOLA COUNTY, NEW MEXICO

EXCAVATION LIMITS

FIGURE
2
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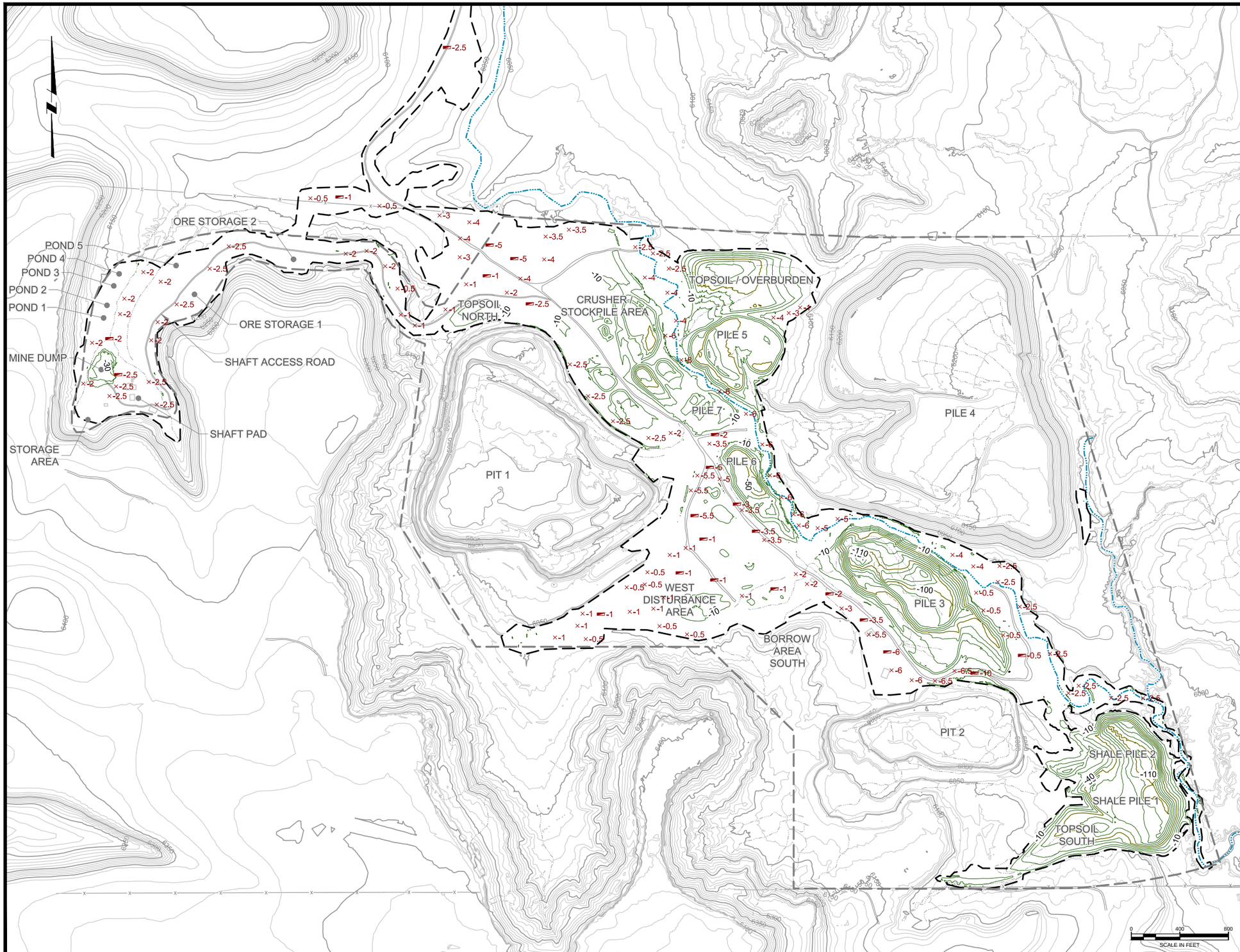

LEGEND:

- EXISTING GROUND SURFACE CONTOUR & ELEVATION, FEET
- EXCAVATION DEPTH CONTOUR & ELEVATION, FEET
- DRAINS
- ARROYO
- EXISTING ROAD
- EXISTING FENCE
- EXISTING OVERHEAD ELECTRIC AND POWER POLES
- UNC MINE PERMIT BOUNDARY
- LIMITS OF EXCAVATION
- -1.5 TEST PIT AND EXCAVATION DEPTH (FT) (STANTEC, 2018)
- -2.5 EXCAVATION DEPTH (FT)

DESIGNED K REED

CHECKED B VAN

APPROVED T LEESON

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UNITED NUCLEAR CORPERATION AND ST. ANTHONY MINE
CIBOLA COUNTY, NEW MEXICO

EXCAVATION LIMITS

FIGURE 3

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SUPPLEMENTAL RADIOLOGIC CHARACTERIZATION
AVM ENVIRONMENTAL SERVICES, INC.

Supplemental Radiologic Characterization
St. Anthony Mine Site
Seboyeta, New Mexico

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August 13, 2018

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Figure 6 St. Anthony Mine Site Supplemental Radiologic Characterization Access Road Lateral Extent of Ra-226 Contamination

Appendices

Appendix A St. Anthony Mine Site Gamma Survey Data
Appendix B Subsurface Contamination Field Investigation Documentation
Appendix C St. Anthony Mine Site Correlation Data
Appendix D Radiologic Instrument Calibration and Operational Function Check Documentation

1.0 Introduction and Background

This report provides the framework and results of the Supplemental Radiologic Characterization that was conducted at the St. Anthony Mine Site (Site) near Seboyeta, New Mexico. The methods and procedures used were consistent with Section 4 of the February 23, 2018 Supplemental Investigation Work Plan (Work Plan) and the applicable survey methods described in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, EPA 2000a). The purpose of this Supplemental Radiological Characterization was to delineate the radiologic contamination boundary based upon an appropriate Investigation Level (IL), and to characterize the Site by performing radiological surveys and collecting soil samples in the areas between the mine features, as shown in Figure 4 of the Work Plan. Site features were characterized in 2007, as described in the *Materials Characterization Report, Saint Anthony Mine Site* (MWH, 2007b). The following sections describe the strategy, methods and procedures that were used and the results of the Supplemental Radiological Characterization of the Site.

The Site was an open pit and underground shaft uranium mine located on the Cebolleta Land Grant located in Cibola County, approximately 4.6 miles southeast of Seboyeta, New Mexico. The Site is in a remote, sparsely populated area with limited access. The location of the Site is shown in Figure 1. United Nuclear Corporation (UNC) operated the Site from 1975 to 1981, pursuant to a mineral lease with the Cebolleta Land Grant, the current owner of the surface and mineral rights. The original lease covered approximately 2,560 acres. This lease was obtained on February 10, 1964 and surrendered by a Release of Mineral Lease dated October 24, 1988.

The Site includes underground workings consisting of one shaft, approximately eight vent shafts that are sealed at the surface, two open pits (one containing a pond), seven large piles of non-economical mine materials with some revegetation, numerous smaller piles of non-economical mine materials, and three topsoil piles. No perennial streams occur within the Site, but an ephemeral stream or arroyo (Meyer Gulch) passes through the Site. The layout of the Site is shown in Figure 4 of the Work Plan and shows the site features and the UNC mine permit boundary (permit boundary). The actively mined area encompasses approximately 430 acres and includes site roads and the other disturbed areas along with the features previously characterized.

2.0 Previous Characterization

As discussed above, only the 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 Western Shaft Area. Gamma exposure rate surveys and soil sampling were conducted during the 2007 Material Characterization. The gamma exposure rate surveys included exposure rate measurements performed at one meter above the ground surface. The areas between the site features were not radiologically characterized during the 2007 Material Characterization. Additionally, the lateral extent of radiologic contamination at the Site was not identified in the 2007 Materials Characterization. A Ra-226 background level of 1.6 pCi/g for the Site was established during the 2007 Materials Characterization.

3.0 Objective of the Supplemental Characterization

The Site is a former uranium mine therefore the surface and subsurface soil is expected to be impacted by radionuclides associated with the uranium decay series, with Ra-226 being the primary Constituent of Concern (COC). Current and anticipated land use surrounding the Site is grazing and wildlife habitat, which is the designated post-mining land use supported by the land owner. Even though an IL based on risk-based cleanup criteria for a ranching scenario would be appropriate for the site characterization, Radiation Cleanup Criteria specified in the March 2016 *Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico* (NMMMD, 2016) by the State of New Mexico Mining and Mineral Division (NMMMD) and New Mexico Environment Department (NMED) was used for the IL as a conservative measure. The Ra-226 cleanup criteria of 5.0 pCi/g above the background level in land averaged over 100 square meters in surface soil (top six inches) specified in the Joint Guidance are taken from the UMTRCA (40 CFR 192), which are based on an unrestricted land use exposure scenario. A 6.6 pCi/g Ra-226 IL (5.0 pCi/g plus 1.6 pCi/g background level) is used for the Site Characterization.

The objective of this Supplemental Radiological Characterization was to delineate the radiologic contamination boundary corresponding to the Ra-226 IL and radiologic characterization of the areas between the site features to estimate surface and subsurface Ra-226 soil concentrations. The objective included a site-specific correlation to convert the results of the supplemental characterization gamma radiation scan surveys in counts per minute (cpm) to Ra-226 soil concentration (pCi/g). An additional objective was to perform a cross-calibration and correlation of exposure rate survey equipment to convert and normalize the 2007 Material Characterization exposure rate measurements to direct gamma radiation levels to cpm and equivalent of Ra-226 surface soil concentrations to normalize the data consistent with the supplemental characterization data and the Ra-226 soil concentration IL.

4.0 Field Investigation

Field investigations for the Supplemental Radiologic Characterization were conducted consistent with the Work Plan during the period March 19, 2018 to May 12, 2018. The supplemental characterization areas and the site features previously characterized are shown in Figure 4 of the Work Plan. The field investigation included, both static gamma radiologic survey measurements and Global Positioning System (GPS) based gamma scan surveys, along with ex-situ and in-situ soil screening, and soil sampling and analysis. The geo-located gamma scans were conducted to provide Ra-226 concentration level estimates in surface soil and to determine the radiologic contamination boundary relative to the IL. Ex-situ gamma radiation soil screening and in-situ gamma radiation level measurements were performed to provide real-time information to estimate subsurface contamination depth. Subsurface soil sampling and analysis was performed to confirm subsurface contamination depth estimated by field ex-situ gamma radiation soil screening. Additionally, gamma radiation static surveys (cpm), exposure rate (µR/hr) measurements, and surface soil samples and analysis were performed at selected locations for the site-specific correlation.

4.1 Investigation Level

The 6.6 pCi/g Ra-226 IL for the Supplemental Radiological Characterization specified in the Work Plan is presented in terms of Ra-226 mass activity concentration and is expressed in units of activity per unit mass of soil, pCi/g. The direct gamma radiation surveys using a NaI scintillation detector provide radiation levels in counts per unit time, generally obtained as cpm. A gamma radiation level cpm equivalent to the IL from a site-specific correlation is useful to guide the field gamma scan activities and estimate the survey boundary relative to the lateral extent of contamination. As discussed in the Work Plan, a site-specific correlation was not available during the field activities for making decisions. As specified in the Work Plan, a correlation between direct gamma radiation levels in cpm and Ra-226 soil concentrations in pCi/g at a similar uranium mine site was used to determine the cpm of approximately 25,000 equating to 6.6 pCi/g Ra-226 in surface soil. However, a 22,500 cpm gamma radiation level was used for a conservative measure and to provide a safety margin for a real time estimate of lateral extent of surface soil contamination during the field gamma scan activities. As discussed in section 4.3 below, a site-specific correlation was developed to convert the gamma scan survey results in cpm to surface soil Ra-226 concentration.

4.2 Gamma Radiation Survey

Direct gamma radiation surveys, gamma exposure rate surveys, ex-situ and in-situ gamma radiation soil screening, and soil sampling and analysis were used for the supplemental radiologic characterization of the Site as described in the Work Plan. The instrumentation configuration for direct gamma radiation level measurements during this characterization consisted of 2x2 NaI scintillation detectors (Eberline SPA-3 and Ludlum 44-10) for detection of gamma radiation, coupled to a scaler/rate meter (Ludlum 2221 or Ludlum 2241). This instrument configuration is used widely for this type of survey and is recommended by the MARSSIM. The scaler/rate meters were interfaced with a sub-meter accurate Differential Global Positioning System (DGPS) with surveying software and a data logger controller for electronically recording the gamma radiation levels to the corresponding location coordinates. The coordinate system that was used for this work was the State Plane Coordinate System (NAD83, New Mexico West, US Feet). The direct gamma radiation surveys using a NaI scintillation detector provide radiation levels in counts per unit time, generally obtained as cpm. A Ludlum Model 19 µR Meter was used for gamma exposure rate (µR/hr) measurements.

DGPS based systematic gamma radiation scan surveys using bare detectors were performed at the Site to determine the lateral extent of Ra-226 in surface soil during this Supplemental Radiological Characterization. The field gamma scan activities began on March 19, 2018. Although bare detectors do not avoid any lateral gamma radiation shine, the bare detectors have a significantly larger field of view and provide a larger scan coverage for an efficient lateral extent of contamination assessment for larger areas. Since the Site encompasses a large area with varying types of terrain, the Site scan area was divided into 26 zones for management and organization of the field gamma scan activities. The gamma scan surveys were performed consistent with AVM SOP-3, included in the Work Plan, to provide a 20 percent coverage of the ground surfaces. Based on a conservative field of view (FOV) of at least six feet diameter for a bare detector for Ra-226 gamma radiations, a 20% coverage would require a scanning

transect spacing of 30 feet. The 30-feet spaced geo-projected transects for each area were digitally created using mapping software and loaded on the field data logger/controller. The gamma scan survey was performed by scanning along these transects with a bare detector at 12 inches above the ground surface at a scan rate of about three feet per second, with a data collection time interval of one and two seconds, depending upon the scaler/ratemeter used. Technicians walked along these transects with the gamma scan survey instruments for the gamma scans in accordance with AVM SOP-3.

The gamma scan survey was conducted by first scanning the areas between site features within the permit boundary, as shown in Figure 4 of the Work Plan, to determine if the radiologic contamination boundary based on the IL cpm is contained within the permit boundary, or if any contamination has migrated beyond the permit boundary. The geo-located gamma scan data includes the gamma scan point ID, date and time, location coordinates, and gamma cpm. The scan data was exported from the data logger, mapped using a mapping software, arranged in color coded ranges, and then reviewed to determine the areas that exceeded the IL cpm. The color-coded range was structured to include the cpm equivalent to the Ra-226 6.6 pCi/g screening level, as discussed previously.

Based on the review of the scan data, additional step-out gamma scans were conducted within and outside the permit boundary identified during field investigation, such as North Wash Area, Arroyo bed and the Access Road, until gamma radiation levels below the IL were detected. The field gamma scan activities were completed on May 12, 2018. The supplemental characterization gamma scan survey included approximately 154,000 gamma scan data points within a total of approximately 370 acres at the Site. The gamma scan data were exported from the scan system data logger into Excel files. The detector cpm were converted into equivalent estimated surface soil Ra-226 concentration in pCi/g using the site-specific correlation for the bare detector as discussed in Section 4.5. A typical gamma scan data export from the scan system data logger is shown in Table 1. Gamma scan data for all the gamma scan surveys during this supplemental characterization are provided in spreadsheet files on a compact disc included in Appendix A. Figure 1 and Figure 2 show the extent of gamma scan at the Site and results in cpm from a 2x2 NaI detector. As shown in Figure 1, the gamma scan surveys included the areas of potential surface contamination that were discussed in UNC's June 15, 2018 response to the NMMMDs April 17, 2018 comments on the Work Plan.

4.3 Test Pits and Ex-Situ Gamma Radiation Soil Screening

Test pit trench excavations and on-site ex-situ gamma radiation soil screening were performed from April 16 through April 19, 2018. These methods were used to define the vertical extent of subsurface contamination at the Site. The ex-situ gamma radiation soil screening was conducted in accordance with the AVM SOP-4 included in the 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 as discussed in AVM SOP-4 included in the Work Plan. 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 reference soil with the same concentration as the IL of 6.6 pCi/g was prepared as described in Appendix B and was used for soil screening at the Site.

An estimated Ra-226 soil concentration was created using a correlation from a similar uranium mine site to show the ranges of Ra-226 concentrations by mapping the geo-located gamma scan data using a color ramp, as shown in Figure 3. Also shown in Figure 3, a total of 24 locations were selected for subsurface assessment in areas with an estimated Ra-226 concentration level above 10 pCi/g at the surface, and where Ra-226 contamination was considered likely to be deeper than one foot below ground surface (bgs). No locations were selected in periphery areas where Ra-226 contamination was low and considered likely to be only in surface soils.

A track excavator was used to excavate trenches at each test pit location for subsurface soil sample collection. The trench was excavated at approximately one-foot depth intervals. At each interval, a subsurface soil sample was collected from the base of the excavation for ex-situ soil screening. The excavation continued until the on-site ex-situ soil screening indicated that Ra-226 concentrations of the soils samples were below the 6.6 pCi/g IL. The test pit excavation geotechnical logs along with the field soil screening forms are included in Appendix B. The test pit subsurface soil screening data is summarized in Table 2. The subsurface soil samples above or below the 6.6 pCi/g IL are shown in Table 2 based on the field soil screening results.

Although the primary objective of the ex-situ gamma radiation soil screening was to determine the Ra-226 concentrations above or below the 6.6 pCi/g IL, Ra-226 concentrations were estimated in all test pit excavation subsurface soil samples screened. During the set up of the soil screening system prior to mobilizing in the field, a calibration/correlation of the ex-situ soil screening system was performed using the 6.6 pCi/g reference soil sample, a 100 pCi/g reference soil sample and a background soil sample. This correlation is included in Appendix B. The estimated Ra-226 concentration in the borehole samples determined using this correlation are included in Table 2.

For the test pit subsurface soil investigation, 44 samples out of a total of 57 borehole subsurface soil samples screened onsite were sent to the off-site vendor laboratory, ALS, Inc. in Fort Collins, CO (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. The 44 samples sent to the laboratory included at least one sample from each test pit excavation that screened at a Ra-226 concentration below the IL. Also, 10% (5 samples) of the samples sent to the lab were split in the field and sent to the lab for QA/QC duplicates. The laboratory results reports are included in Appendix B and are summarized in Table 2. As shown in Table 2, the estimated Ra-226 levels by on-site ex-situ soil screening are consistent with the laboratory Ra-226 results, specifically in regard to determining the depth of Ra-226 levels above or below the IL, except for two samples. The first sample, SB-TP04-05, taken at a depth of five feet, from Test Pit 04, had an estimated Ra-226 concentration of 7.3 pCi/g, while the laboratory reported concentration was 4.9 pCi/g. In sample SB-TP04-06, which was collected at a depth of six feet, both the ex-situ field soil screening and laboratory results were below the IL. As a result, for a conservative measure, a six-foot Ra-226 contamination level depth will be used at this location for subsurface contamination assessment. The

second sample, SB-TP12-04, taken at a depth of four feet from Test Pit 12, had an estimated Ra-226 concentration at 2.9 pCi/g, while the laboratory reported concentration was 16.0 pCi/g. Sample SB-TP12-03, which was taken at a shallower depth of three feet, had an estimated Ra-226 concentration of 6.2 pCi/g, while the laboratory reported concentration was 2.3 pCi/g, a lower concentration than SB-TP12-04. Generally, the contamination level decreased with depth, not increased. Therefore, Ra-226 contamination at or above the IL at this location is likely extend to three feet bgs. Based on the field soil screening and the laboratory sample results, the depth of Ra-226 concentrations above the 6.6 pCi/g IL at each test pit location is summarized in Table 3 and shown in Figure 3.

4.4 Site-Specific Gamma Radiation Level to Surface Soil Ra-226 Correlation

A site-specific correlation was developed for both collimated and bare 2x2 NaI detectors, consistent with AVM SOP-2 that was included in the Work Plan. The correlation was developed to convert gamma radiation levels in cpm for the detector to surface soil Ra-226 concentration in pCi/g. Although a collimated detector was not used for gamma surveys during this supplemental characterization, the data were collected and a correlation was developed for a 0.5-inch thick collimated detector for future use at the Site. Correlation locations were identified and investigated to ensure that the Ra-226 contamination distribution was limited to the surface soil, and that there was not a source of significant lateral gamma radiation shine. Prior to collecting the correlation surface soil samples at each location, one-minute static gamma measurements using detectors at 12 inches above the ground surface and a gamma exposure rate (µR/hr) measurement from 1 meter above ground surface using a calibrated µR meter were taken. The µR measurements were taken at each location to convert the 2007 Materials Characterization gamma exposure rate survey results to a Ra-226 concentration. The 14 correlation sample locations are shown in Figure 4. The correlation field gamma radiation level survey field forms and soil sampling logs are included in Appendix C.

The correlation soil samples were sent to ALS for Ra-226 analysis using EPA Method 901.1 (modified for soil matrix). Initially, ALS sieved out the +0.25-inch (rocks and pebbles) fraction from the samples during sample preparation and took an aliquot for gamma spectroscopy analysis, rather than processing the entire sample (i.e., all particles). Eight samples with noticeable rocks and pebbles greater than 0.25 inches were re-submitted to ALS for sample preparation and analysis including all of the sample material. The laboratory results report is included in Appendix C. The correlation data, gamma radiation levels, exposure rate measurements and laboratory Ra-226 analytical results of the soil samples are summarized in Table 4. Three linear regressions between the co-located soil sample Ra-226 and gamma radiation levels were performed for the correlations: 1) Bare 2x2 NaI detector cpm at 12 inches above the ground surface, 2) 0.5-inch thick lead collimated 2x2 NaI detector cpm at 12 inches above the ground surface, and 3) Ludlum 19 exposure rate µR/hr measurements at one meter above the ground surface. Data from location SA-COR-011 was not included in the correlation regression because it was determined to be an outlier due to a significantly elevated gamma radiation level and potential lateral gamma shine interference from scattered waste ore rocks and berms around this location. All three correlations with regression analysis summaries are included in Appendix C, and the regression equations are summarized as follow:

- **2x2 NaI Bare Detector:**

  Ra-226 pCi/g = (cpm x 0.0005 pCi/g/cpm, slope) - 5.51, intercept or constant, with an $R^2 = 0.98$, and results into approximately 24,200 cpm equivalent to the 6.6 pCi/g surface soil Ra-226 IL.

- **0.5 inch thick lead collimated 2x2 NaI Detector:**

  Ra-226 pCi/g = (cpm x 0.0015 pCi/g/cpm, slope) - 5.21, intercept or constant, with an $R^2 = 0.90$, and results into approximately 7,870 cpm equivalent to the 6.6 pCi/g surface soil Ra-226 IL.

- **Exposure Rate (µR/hr) Meter:**

  Ra-226 pCi/g = (µR/hr x 0.49 pCi/g/µR/hr, slope) - 5.10, intercept or constant, with an $R^2 = 0.90$, and results into approximately 24 µR/hr equivalent to the 6.6 pCi/g surface soil Ra-226 IL.

This site specific correlation for the bare detector is comparable to the correlation (pCi/g = cpm x 0.0005 - 6.14) from a similar uranium mine site that was used to guide the field gamma scan activities as discussed in Section 4.1 As discussed above, this correlation was developed to predict Ra-226 concentrations only in surface soil (0" to 6" depth). The correlation used a survey geometry consisting of a 2x2 NaI detector held at 12 inches above the ground surface and a scan rate of about three feet per second. This correlation may over estimate Ra-226 in surface soil in areas with Ra-226 contamination deeper than six inches, such as waste ore rock piles and backfill areas. Also, the correlation may over estimate Ra-226 levels in areas with significant lateral gamma radiation shine, such as areas near waste piles.

4.5 Ra-226 Investigation Level Contamination Boundary

The radiation level data in cpm collected during this Supplemental Radiological Characterization was converted to the equivalent estimated Ra-226 pCi/g concentration using the regression equation for bare 2x2 detectors, as described above and shown in Figure 5 and Figure 6. The data were structured in the maps into ranges of pCi/g and set to a color ramp. The 6.6 pCi/g Ra-226 IL contamination boundary was delineated using the color ramped ranges as a guide, as shown in Figure 5 for the Site and Figure 6 for the Site Access Road.

A total of 421 surface gamma exposure rate measurements in µR/hr at one meter above the ground surface were made during the 2007 Materials Characterization. The 2007 gamma exposure rate measurements are summarized in Table 3 and shown on Figure 3 of the *Materials Characterization Report*. These gamma exposure rates at one meter above the ground surface in µR/hr were converted to estimated surface soil Ra-226 in pCi/g using the site specific gamma exposure rate to surface soil Ra-226 correlation (pCi/g = µR/hr x 0.19 - 5.10) discussed in Section 4.4 above, and included in Appendix C. The 2007 Materials Characterization gamma survey measurements are shown on Figure 5 and Figure 6, and included in Appendix A.

As shown in Figure 5, the contamination boundary at the IL is contained within the permit boundary on the east side of the Site, south of the shale piles and Pit 2, and west of Pit 2 and Borrow Area South. There is a small area south of Shale Pile 1 just outside the permit boundary above the IL, which is a road leading to a monitoring well. The contamination level above the IL in the arroyo bed appears to cease at the southern permit boundary. The contamination boundary south of Pit 1 extends just outside the permit boundary. However, as indicated in the UNC's June 15, 2018 response to the State of New Mexico Energy, Mineral and Natural Resource Departments April 17, 2018 comments on the Work Plan, the area south of Pit 1 is not within the permit boundary because it was not mined or operated by UNC, and records indicate that an underground mine was operated in that area by another entity. Therefore, the contamination boundary south of Pit 1 is delineated at the permit boundary.

The IL contamination boundary near the West Shaft Area is mostly just inside or at the permit boundary with some small isolated areas just outside of the permit boundary east and southeast of Ore Storage 1, south of the Shaft Pad, east of the Mine Dump, Pond 1 area. The contamination boundary extends outside the permit boundary in areas northeast of the West Shaft Area and an area near the entrance gate. The contamination boundary north of the Crusher Stockpile area is contained inside the permit boundary. The contamination boundary north of the Topsoil/Overburden and Pile 4 areas is well inside the permit boundary. Overall, the IL contamination boundary at the Site is mostly within the permit boundary, but extends slightly outside permit boundary in a few locations, as discussed above. As shown in Figure 6, the Site Access Road contains Ra-226 levels in soil above the IL, and is likely to extend at a minimum to the road shoulders. Contamination above the IL appears to have migrated east of the Site Access Road near the entrance to the Site.

5.0 Soil Sampling and Analysis

Surface soil correlation samples and subsurface soil samples from the test pit excavations for onsite ex-situ gamma radiation soil screening were collected consistent with AVM-SOP-5, included in the Work Plan. Field QA/QC duplicate samples were split at a frequency of 10% of the total number of soil samples collected. A total of 71 surface and subsurface soil samples were collected during the supplemental characterization. Field sampling equipment used for soil sampling, which included: stainless steel scoops, bowls, spoons, and hand auger barrels, were decontaminated between sample locations. The soil sampling equipment decontamination was conducted by brushing off loose visible soil, washing the equipment with a detergent/water solution and rinsing with distilled water. Track excavator buckets were cleaned by removing any loose, visible soil. Any soils generated from the excavation of test pits created were put back into the excavations from which the soil came. All equipment decontamination water/rinsate was poured on top of excess soil from the test pits. Personal protection equipment (PPE), such as gloves, were brushed off and scanned for residual contamination and disposed of as solid waste.

Subsurface soil samples were analyzed by on-site ex-situ gamma radiation soil screening (AVM SOP-4) to estimate Ra-226 concentrations. A completed Chain-of-Custody (COC) along with the surface soil samples and confirmatory subsurface soil samples were placed in labeled Ziploc bags, and packaged in five gallon buckets with sealed lids and shipped to ALS for Ra-226 analysis. The soil samples were analyzed for Ra-226 with a reporting limit of 0.5 pCi/g, using EPA Method 901.1 (modified for soil matrix). The laboratory completed COCs are included with the analytical results reports in appropriate appendices to this report.

6. 0 Quality Assurance and Quality Control Measures

Quality Assurance/Quality Control (QA/QC) measures as specified in the Work Plan were implemented during the Supplemental Radiological Characterization to ensure that decisions are made based on data of acceptable quality. All radiologic survey instruments, including personnel and vehicle contamination friskers, have been calibrated annually, as specified in AVM SOP-1. Additionally, operational functions checks were performed on all radiologic instruments daily prior to use in accordance with AVM SOP-1. The calibration and function check documents are included in Appendix D. During this Supplemental Radiological Characterization, no instruments were found to be out of calibration or inoperable as indicated by the operational function checks. The instrument background measurements for bare 2x2 NaI detectors during daily operational function checks were less than 10,000 cpm as shown in Appendix D. The bare detector field of view (FOV) at 12 inches above the ground surface is conservatively assumed at an area of six feet diameter. The 2x2 NaI detector response factor is determined to be 0.0006 pCi/g/cpm from the linear regression for the site-specific correlation included in Appendix C. Based on the above detector parameters, the Ra-226 minimum detectable concentrations (MDCs) for scan survey at scan speed of three feet per second calculated MARSSIM guidance as shown in AVM SOP-1 were less than 1.0 pCi/g, significantly less than 50% of the 6.6 pCi/g IL. The ex-situ soil gamma radiation screening system was calibrated prior to mobilization in the field and daily operational function checks were performed prior to use. The calibration and function check documentation are included in Appendix D. 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, as shown in AVM SOP-4, was less than 0.8 pCi/g, significantly less than the 6.6 pCi/g IL. The MDCs during the supplemental characterization met the QA objective.

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 appropriate summary tables.

Tables

Table 1
Typical Gamma Scan Data Exported From the Scan System Data Logger

ID	Time	Northing(1) (feet)	Easting(1) (feet)	MSL Elevation (feet)	CPM 2x2 NaI Detector	Ra-226 pCi/g	Zone_ID
1	3/29/2018 9:40:21	1514268	2881680	6051.796	17401	3.19	Pit_1
2	3/29/2018 9:40:23	1514265	2881675	6051.789	17141	3.06	Pit_1
3	3/29/2018 9:40:25	1514261	2881669	6051.904	18457	3.72	Pit_1
4	3/29/2018 9:40:27	1514257	2881663	6052.176	17774	3.38	Pit_1
5	3/29/2018 9:40:29	1514252	2881657	6052.058	17937	3.46	Pit_1
6	3/29/2018 9:40:31	1514246	2881652	6052.019	18383	3.68	Pit_1
7	3/29/2018 9:40:33	1514241	2881647	6051.927	18223	3.60	Pit_1
8	3/29/2018 9:40:35	1514237	2881640	6051.986	18429	3.70	Pit_1
9	3/29/2018 9:40:37	1514232	2881634	6052.166	17831	3.41	Pit_1
10	3/29/2018 9:40:39	1514227	2881628	6051.953	18942	3.96	Pit_1
11	3/29/2018 9:40:41	1514222	2881621	6052.009	18395	3.69	Pit_1
12	3/29/2018 9:40:43	1514216	2881615	6052.035	18316	3.65	Pit_1
13	3/29/2018 9:40:45	1514211	2881609	6052.127	19453	4.22	Pit_1
14	3/29/2018 9:40:47	1514207	2881602	6052.029	19185	4.08	Pit_1
15	3/29/2018 9:40:49	1514202	2881595	6051.878	19125	4.05	Pit_1
16	3/29/2018 9:40:51	1514197	2881589	6052.038	18106	3.54	Pit_1
17	3/29/2018 9:40:53	1514194	2881583	6051.845	18761	3.87	Pit_1
18	3/29/2018 9:40:55	1514192	2881580	6051.769	18926	3.95	Pit_1
19	3/29/2018 9:41:06	1514188	2881575	6051.819	17473	3.23	Pit_1
20	3/29/2018 9:41:08	1514184	2881569	6052.068	17936	3.46	Pit_1
21	3/29/2018 9:41:10	1514179	2881562	6051.842	17904	3.44	Pit_1
22	3/29/2018 9:41:12	1514174	2881555	6051.888	17817	3.40	Pit_1
23	3/29/2018 9:41:14	1514168	2881549	6051.956	18075	3.53	Pit_1
24	3/29/2018 9:41:16	1514163	2881543	6051.812	18881	3.93	Pit_1
25	3/29/2018 9:41:18	1514157	2881537	6051.848	19111	4.05	Pit_1
26	3/29/2018 9:41:20	1514152	2881531	6051.694	19098	4.04	Pit_1
27	3/29/2018 9:41:22	1514146	2881525	6051.779	18165	3.57	Pit_1
28	3/29/2018 9:41:24	1514141	2881520	6051.678	17647	3.31	Pit_1
29	3/29/2018 9:41:26	1514135	2881514	6051.704	16679	2.83	Pit_1
30	3/29/2018 9:41:28	1514130	2881507	6051.723	17441	3.21	Pit_1
31	3/29/2018 9:41:30	1514126	2881501	6051.553	17220	3.10	Pit_1
32	3/29/2018 9:41:32	1514121	2881494	6051.543	17687	3.33	Pit_1
33	3/29/2018 9:41:34	1514117	2881487	6051.796	18375	3.68	Pit_1
34	3/29/2018 9:41:36	1514112	2881479	6051.746	18552	3.77	Pit_1
35	3/29/2018 9:41:38	1514108	2881473	6051.779	18808	3.89	Pit_1
36	3/29/2018 9:41:40	1514103	2881466	6051.609	17910	3.45	Pit_1
37	3/29/2018 9:41:42	1514099	2881459	6051.618	18145	3.56	Pit_1
38	3/29/2018 9:41:44	1514095	2881452	6051.366	18277	3.63	Pit_1
39	3/29/2018 9:41:46	1514090	2881445	6051.353	18827	3.90	Pit_1
40	3/29/2018 9:41:48	1514085	2881438	6051.714	17861	3.42	Pit_1

(1) Projection: NAD 1983, New Mexico West, Feet.

Table 2
St. Anthony Mine Site Test Pits Subsurface Soil Sample Field Gamma Radiation Screening Summary

Sample Data					Field Soil Screening Data				Laboratory Data			
Test Pit ID	Soil Sample ID	Northing[1] (feet)	Easting[1] (feet)	Date	6.6 pCi/g SSL Reference Soil CPM	Soil Sample CPM	Comments	Estimated Ra-226 pCi/g	Sample Sent to Lab	Ra-226 pCi/g	Error Estimate pCi/g	MDC pCi/g
01	SB-TP01-01 (@ 1.1 ft)	1,519,977.7	2,879,801.1	4/19/2018	628	734	**>SSL**	**7.2**	Y	9.20	1.20	0.50
	SB-TP01-02 (@ 2.5 ft)			4/19/2018		286	**<SSL**	**1.7**	Y	1.26	0.30	0.50
02	SB-TP02-01 (@ 1.1 ft)	1,518,527.1	2,880,209.9	4/19/2018	628	2325	**>SSL**	**26.8**	Y	35.40	4.20	0.60
	SB-TP02-02 (@ 2.5 ft)			4/19/2018		383	**<SSL**	**2.9**	Y	1.38	0.32	0.51
03	SB-TP03-01 (@ 1.0 ft)	1,517,294.7	2,879,324.8	4/16/2018	667	243	**<SSL**	**1.2**	Y	1.61	0.35	0.48
04	SB-TP04-03 (@ 3.0 ft)	1,516,898.8	2,880,561.8	4/16/2018	667	3587	**>SSL**	**42.3**	N	-	-	-
	SB-TP04-05 (@ 5.0 ft)			4/16/2018		741	**>SSL**	**7.3**	Y	4.87	0.69	0.44
	SB-TP04-06 (@ 6.0 ft)			4/16/2018		457	**<SSL**	**3.8**	Y	2.79	0.39	0.33
05	SB-TP05-01 (@ 1.0 ft)	1,516,786.8	2,880,764.9	4/16/2018	667	1864	**>SSL**	**21.1**	N	-	-	-
	SB-TP05-02 (@ 2.0 ft)			4/16/2018		2286	**>SSL**	**26.3**	N	-	-	-
	SB-TP05-03 (@ 3.0 ft)			4/16/2018		2574	**>SSL**	**29.8**	N	-	-	-
	SB-TP05-04 (@ 4.0 ft)			4/16/2018		2750	**>SSL**	**32.0**	N	-	-	-
	SB-TP05-05 (@ 5.0 ft)			4/16/2018		496	**<SSL**	**4.3**	Y	0.65	0.19	0.34
06	SB-TP06-01 (@ 1.0 ft)	1,516,646.2	2,880,538.3	4/16/2018	667	402	**<SSL**	**3.1**	Y	4.79	0.71	0.67
07	SB-TP07-01 (@ 1.0 ft)	1,516,414.4	2,880,892.5	4/16/2018	667	2295	**>SSL**	**26.4**	y	29.30	3.50	0.90
	SB-TP07-201 Field QA/QC Dup of SB-TP07-01								Y	27.80	3.40	1.10
	SB-TP07-02 (@ 2.5 ft)			4/16/2018		244	**<SSL**	**1.2**	Y	0.69	0.18	0.31

(1) Projection: NAD 1983, New Mexico West, Feet.

Table 2 (Continued)
St. Anthony Mine Site Test Pits Subsurface Soil Sample Field Gamma Radiation Screening Summary

Sample Data					Field Soil Screening Data				Laboratory Data			
Test Pit ID	Soil Sample ID	Northing[1] (feet)	Easting[1] (feet)	Date	6.6 pCi/g SSL Reference Soil CPM	Soil Sample CPM	Comments	Estimated Ra-226 pCi/g	Sample Sent to Lab	Ra-226 pCi/g	Error Estimate pCi/g	MDC pCi/g
08	SB-TP08-01 (@ 1.0 ft)	1,516,128.0	2,877,428.9	4/16/2018	667	733	**>SSL**	**7.2**	Y	15.30	1.90	0.70
	SB-TP08-02 (@ 2.1 ft)			4/16/2018		210	**<SSL**	**0.8**	Y	0.92	0.25	0.40
	SB-TP08-03 (@ 3.0 ft)			4/16/2018		211	**<SSL**	**0.8**	N	-	-	-
09	SB-TP09-01 (@ 1.0 ft)	1,515,831.1	2,877,501.9	4/16/2018	667	2108	**>SSL**	**24.1**	N	-	-	-
	SB-TP09-02 (@ 2.5 ft)			4/16/2018		267	**<SSL**	**1.5**	Y	1.54	0.32	0.47
	SB-TP09-03 (@ 3.5 ft)			4/16/2018		266	**<SSL**	**1.4**	Y	-	-	-
10	SB-TP10-01 (@ 1.0 ft)	1,515,336.8	2,882,418.7	4/18/2018	628	974	**>SSL**	**10.2**	Y	15.10	1.80	0.50
	SB-TP10-201, Field QA/QC Dup of SB-TP10-01								Y	8.10	1.10	0.60
	SB-TP10-02 (@ 2.0 ft)			4/18/2018		450	**<SSL**	**3.7**	Y	5.03	0.70	0.58
11	SB-TP11-01 (@ 1.0 ft)	1,515,067.3	2,882,375.8	4/18/2018	628	533	**<SSL**	**4.7**	N	-	-	-
	SB-TP11-02 (@ 2.1 ft)			4/18/2018		2674	**>SSL**	**31.1**	N	-	-	-
	SB-TP11-03 (@ 3.0 ft)			4/18/2018		1879	**>SSL**	**21.3**	N	-	-	-
	SB-TP11-04 (@ 4.0 ft)			4/18/2018		2284	**>SSL**	**26.3**	Y	21.70	2.70	0.90
	SB-TP11-05 (@ 5.0 ft)			4/18/2018		599	**<SSL**	**5.5**	Y	4.30	0.61	0.44
12	SB-TP12-02 (@ 2.0 ft)	1,514,764.1	2,882,599.4	4/18/2018	628	1197	**>SSL**	**12.9**	N	-	-	-
	SB-TP12-03 (@ 3.0 ft)			4/18/2018		653	**≈SSL**	**6.2**	Y	2.25	0.42	0.52
	SB-TP12-04 (@ 4.0 ft)			4/18/2018		387	**<SSL**	**2.9**	Y	16.00	2.00	0.60
13	SB-TP13-04 (@ 4.0 ft)	1,514,669.1	2,882,250.3	4/18/2018	628	3255	**>SSL**	**38.2**	N	-	-	-
	SB-TP13-05 (@ 5.0 ft)			4/18/2018		1605	**>SSL**	**17.9**	Y	12.60	1.60	0.80
	SB-TP13-06 (@ 5.5 ft)			4/18/2018		792	**>SSL**	**7.9**	Y	6.93	0.95	0.58
14	SB-TP14-02 (@ 2.0 ft)	1,514,540.5	2,882,755.6	4/18/2018	628	1452	**>SSL**	**16.0**	Y	16.40	2.00	0.50
	SB-TP14-202, Field QA/QC Dup of SB-TP14-02								Y	14.40	1.80	0.80
	SB-TP14-03 (@ 3.5 ft)			4/18/2018		393	**<SSL**	**3.0**	Y	2.08	0.39	0.46

(1) Projection: NAD 1983, New Mexico West, Feet.

Table 2 (Continued)
St. Anthony Mine Site Test Pits Subsurface Soil Sample Field Gamma Radiation Screening Summary

Sample Data					Field Soil Screening Data				Laboratory Data			
Test Pit ID	Soil Sample ID	Northing[1] (feet)	Easting[1] (feet)	Date	6.6 pCi/g SSL Reference Soil CPM	Soil Sample CPM	Comments	Estimated Ra-226 pCi/g	Sample Sent to Lab	Ra-226 pCi/g	Error Estimate pCi/g	MDC pCi/g
15	SB-TP15-01 (@ 1.1 ft)	1,514,476.2	2,882,323.8	4/18/2018	628	247	**<SSL**	**1.2**	Y	1.04	0.24	0.36
	SB-TP15-02 (@ 2.0 ft)			4/18/2018		253	**<SSL**	**1.3**	Y	0.76	0.25	0.45
16	SB-TP16-01 (@ 1.0 ft)	1,514,197.5	2,882,127.8	4/18/2018	628	242	**<SSL**	**1.1**	Y	0.77	0.25	0.41
	SB-TP16-02 (@ 2.0 ft)			4/18/2018		247	**<SSL**	**1.2**	Y	0.87	0.24	0.43
17	SB-TP17-01 (@ 1.2 ft)	1,514,139.3	2,882,412.6	4/18/2018	628	275	**<SSL**	**1.6**	Y	1.42	0.24	0.35
	SB-TP17-02 (@ 2.1 ft)			4/18/2018		236	**<SSL**	**1.1**	Y	0.91	0.26	0.41
18	SB-TP18-01 (@ 1.0 ft)	1,514,065.8	2,882,908.7	4/18/2018	628	330	**<SSL**	**2.2**	Y	1.02	0.24	0.35
	SB-TP18-02 (@ 2.1 ft)			4/18/2018		276	**<SSL**	**1.6**	Y	0.94	0.27	0.50
19	SB-TP19-01 (@ 1.3 ft)	1,514,025.5	2,883,361.9	4/18/2018	628	1918	**>SSL**	**21.8**	Y	29.00	3.60	0.90
	SB-TP19-201, Field QA/QC Dup of SB-TP19-01								Y	26.80	3.30	0.70
	SB-TP19-02 (@ 2.3 ft)			4/18/2018		265	**<SSL**	**1.4**	Y	0.90	0.24	0.42
20	SB-TP20-01 (@ 1.0 ft)	1,513,518.0	2,884,947.0	4/19/2018	628	272	**<SSL**	**1.5**	Y	1.60	0.38	0.58
	SB-TP20-02 (@ 2.0 ft)			4/19/2018		268	**<SSL**	**1.5**	Y	1.32	0.32	0.50
	SB-TP10-202, Field QA/QC Dup of SB-TP20-02								Y	1.26	0.34	0.61
21	SB-TP21-01 (@ 1.0 ft)	1,513,857.6	2,881,478.5	4/18/2018	628	291	**<SSL**	**1.7**	Y	1.35	0.30	0.43
	SB-TP21-02 (@ 2.0 ft)			4/18/2018		254	**<SSL**	**1.3**	Y	0.78	0.22	0.37
22	SB-TP22-03 (@ 3.1 ft)	1,513,810.0	2,883,645.0	4/19/2018	628	683	**≈SSL**	**6.6**	Y	6.63	0.38	0.50
	SB-TP22-07 (@ 7.5 ft)			4/19/2018		296	**<SSL**	**1.8**	Y	1.97	0.35	0.42
23	SB-TP23-04 (@ 4.0 ft)	1,513,547.0	2,883,838.0	4/19/2018	628	2870	**>SSL**	**33.5**	Y	31.20	3.80	0.90
	SB-TP23-06 (@ 6.0 ft)			4/19/2018		486	**<SSL**	**4.1**	Y	2.26	0.40	0.48
24	SB-TP24-05 (@ 5.5 ft)	1,513,371.5	2,884,557.1	4/19/2018	628	3463	**>SSL**	**40.8**	Y	30.00	0.80	0.50
	SB-TP24-06 (@ 6.5 ft)			4/19/2018		2693	**>SSL**	**31.3**	Y	55.50	6.60	0.50

(1) Projection: NAD 1983, New Mexico West, Feet.

Table 3
St. Anthony Mine Site Test Pit Subsurface Ra-226 Contamination Depth Summary

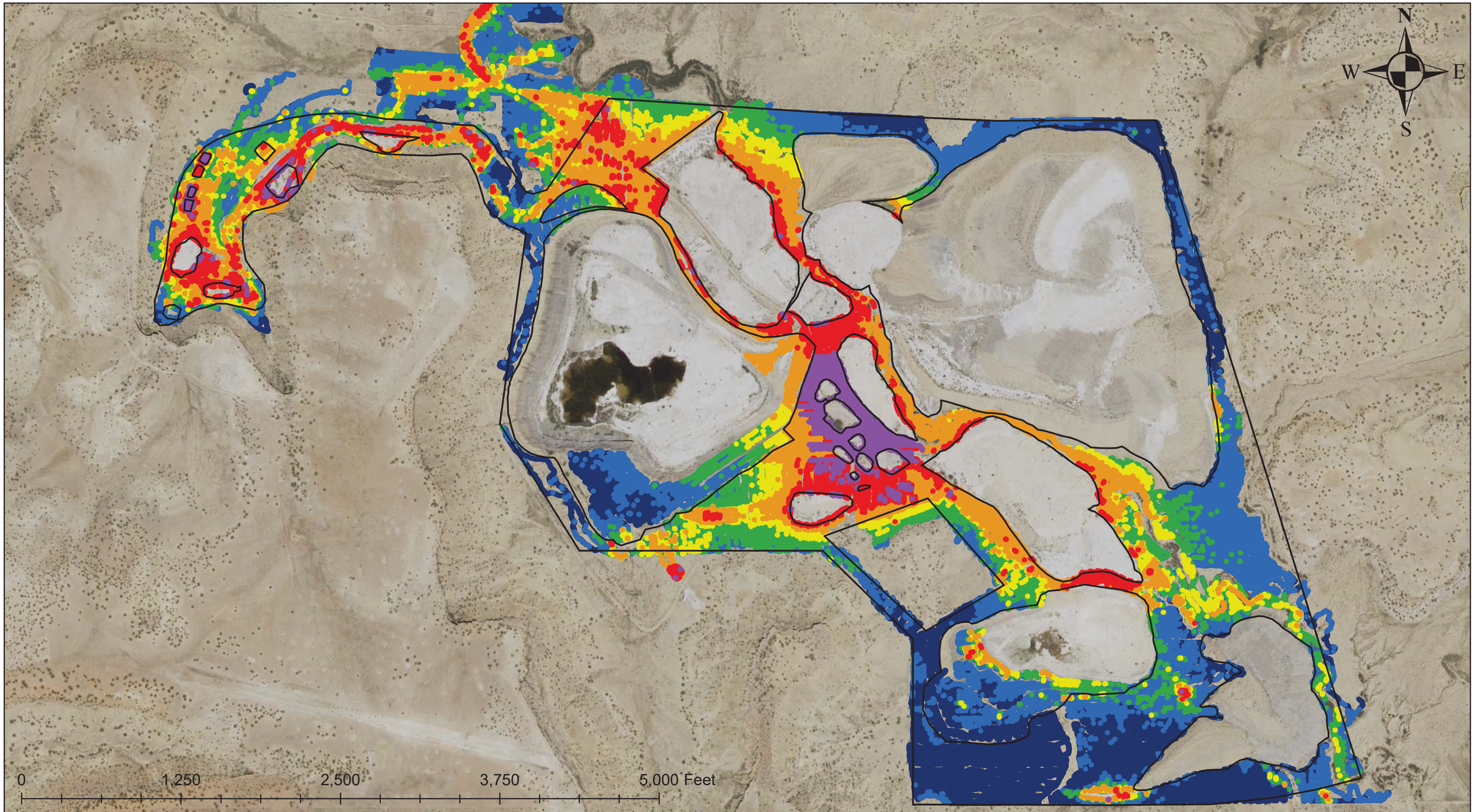
Test Pit ID	Test Pit Location Coordinates (1) (Feet)		Date	Depth of Subsurface Ra-226 Contamination >SSL (Feet)
	Northing	Easting		
1	1,519,977.7	2,879,801.1	4/19/2018	**2.5**
2	1,518,527.1	2,880,209.9	4/19/2018	**2.5**
3	1,517,294.7	2,879,324.8	4/16/2018	**1.0**
4	1,516,898.8	2,880,561.8	4/16/2018	**6.0**
5	1,516,786.8	2,880,764.9	4/16/2018	**5.0**
6	1,516,646.2	2,880,538.3	4/16/2018	**1.0**
7	1,516,414.4	2,880,892.5	4/16/2018	**2.5**
8	1,516,128.0	2,877,428.9	4/16/2018	**2.1**
9	1,515,831.1	2,877,501.9	4/16/2018	**2.5**
10	1,515,336.8	2,882,418.7	4/18/2018	**2.0**
11	1,515,067.3	2,882,375.8	4/18/2018	**5.0**
12	1,514,764.1	2,882,599.4	4/18/2018	**3.0**
13	1,514,669.1	2,882,250.3	4/18/2018	**6.0**
14	1,514,540.5	2,882,755.6	4/18/2018	**3.5**
15	1,514,476.2	2,882,323.8	4/18/2018	**1.1**
16	1,514,197.5	2,882,127.8	4/18/2018	**<1.0**
17	1,514,139.3	2,882,412.6	4/18/2018	**<1.0**
18	1,514,065.8	2,882,908.7	4/18/2018	**1.0**
19	1,514,025.5	2,883,361.9	4/18/2018	**2.3**
20	1,513,518.0	2,884,947.0	4/19/2018	**<1.0**
21	1,513,857.6	2,881,478.5	4/18/2018	**<1.0**
22	1,513,810.0	2,883,645.0	4/19/2018	**3.1**
23	1,513,547.0	2,883,838.0	4/19/2018	**6.0**
24	1,513,371.5	2,884,557.1	4/19/2018	**>6.5**

(1) Projection: NAD 1983, New Mexico West, U.S. Feet.

Table 4
St. Anthony Mine Site Gamma Radiation Level to Ra-226 Correlation Data Summary

Surface Soil Sample ID	Exposure Rate µR/hr	2x2 NaI 0.5-Inch Lead Collimated Detector		2x2 NaI Bare Detector		Soil Sample Ra-226 Laboratory Analysis pCi/g (EPA Method 901.1 Modified)		
		CPM	Avg. CPM	CPM	Avg. CPM	Ra-226	Uncertainty	MDC
SA-COR-001	10	3324 3383 3381	3363	9937 10077 10013	10009	0.85	0.27	0.45
SA-COR-002	11	3165 3070 3238	3158	10406 10441 10425	10424	0.83	0.20	0.28
SA-COR-003	95	25600	25742	84039	83615	43.9	5.3	0.9
SA-COR-003 Field QA/QC Duplicate		25894 25731		83117 83689		41.1	4.9	0.8
SA-COR-004	70	22796	22008	68362	66156	25.3	3.1	0.9
SA-COR-004 Lab QA/QC Duplicate		20739 22490		64884 65222		34.7	4.1	0.6
SA-COR-005	20	7439 6924 7043	7135	19346 19412 19769	19509	6.36	0.86	0.55
SA-COR-006	12	3124	3234	11405	11428	0.75	0.22	0.40
SA-COR-006 Field QA/QC Duplicate		3328 3251		11685 11194		0.74	0.27	0.44
SA-COR-007	15	4991 5241 5096	5109	14131 14174 14372	14226	2.73	0.45	0.48
SA-COR-008	20	6881 6849 7065	6932	20219 20268 20155	20214	5.17	0.73	0.47
SA-COR-009	70	26362 26596 26725	26561	64037 64428 63871	64112	29.7	3.5	0.60
SA-COR-010	25	8515 8672 8635	8607	22943 23060 22997	23000	6.78	0.92	0.50
SA-COR-011	110	35912 36235 35798	35982	99965 96941 98212	98373	69.2	8.2	1.0
SA-COR-012	30	7748	7975	25242	25382	6.63	0.87	0.47
SA-COR-012 Lab QA/QC Duplicate		8050 8126		25514 25390		5.91	0.82	0.51
SA-COR-013	25	8293 8192 8199	8228	21581 21295 21891	21589	5.45	0.74	0.46
SA-COR-014	12	4358 4412 4496	4422	11945 11972 11970	11962	1.25	0.27	0.41

Figures

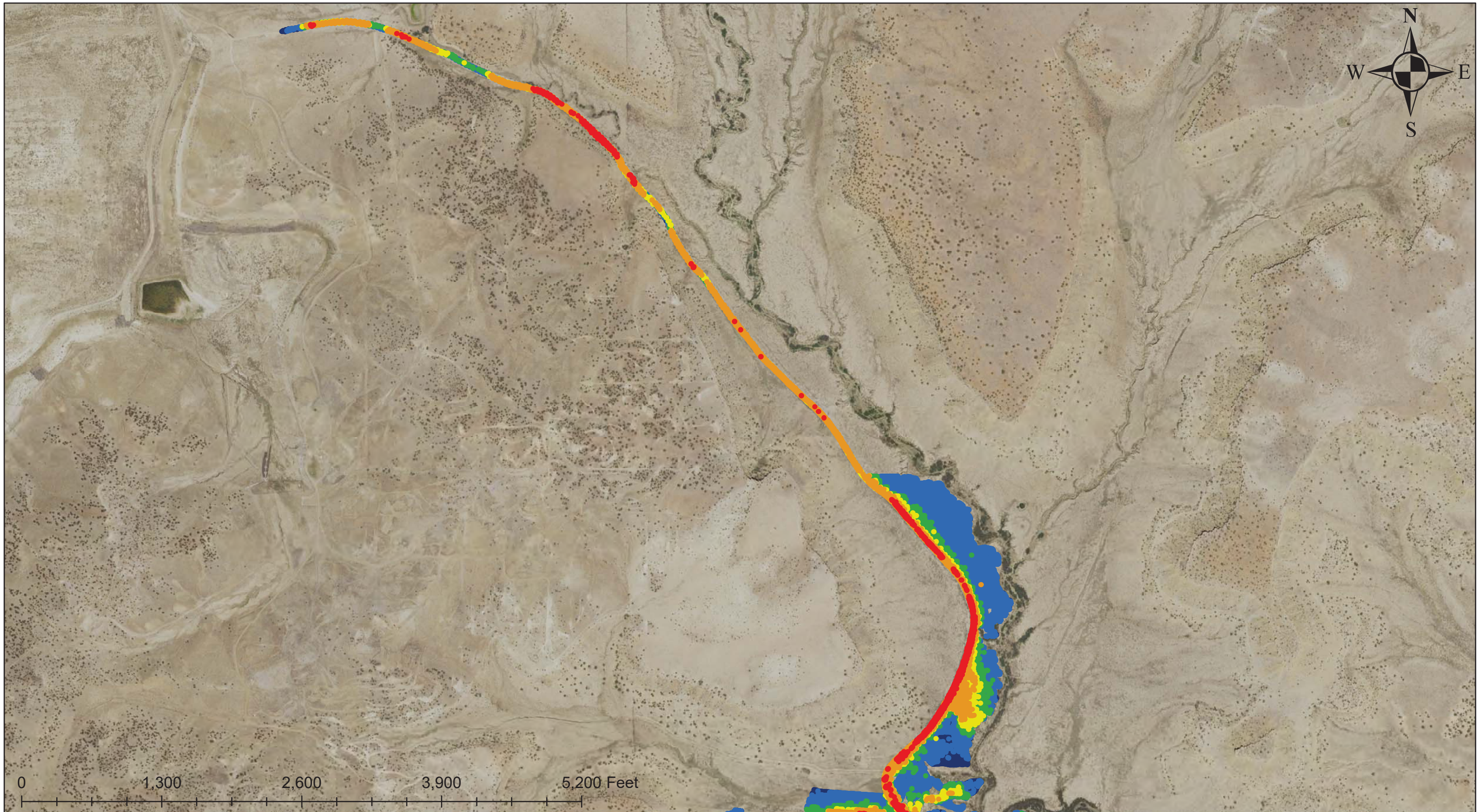


AVM Environmental Services, Inc.

Figure 1
St. Anthony Mine Site Supplemental Radiologic Characterization
Gamma Radiation Level Scan

Legend

- <15,000 cpm
- 15,001 - 20,000 cpm
- 20,001 - 25,000 cpm
- 25,001 - 32,000 cpm
- 32,001 - 62,000 cpm
- 62,001 - 212,000 cpm
- >212,000 cpm

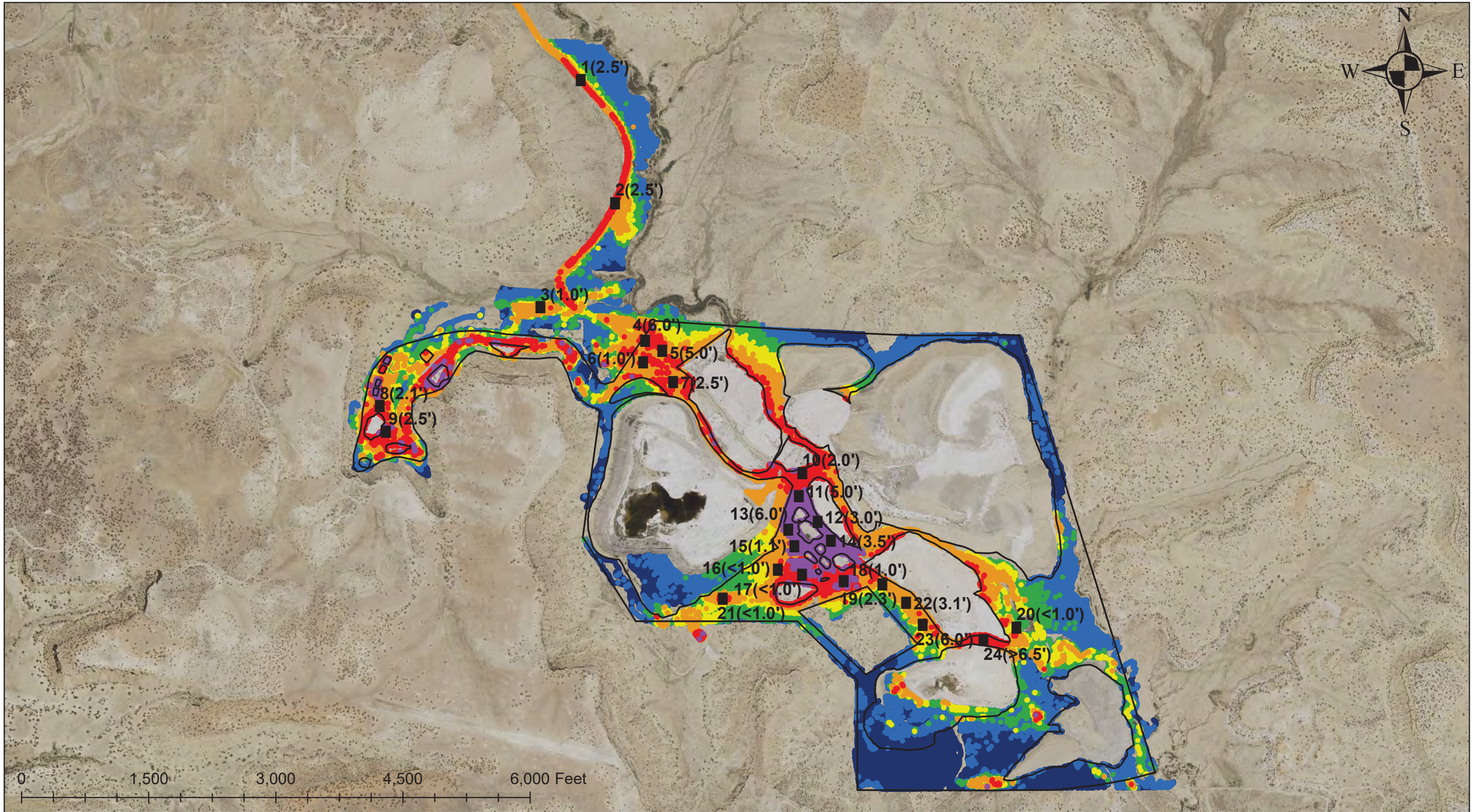


AVM Environmental Services, Inc.

Figure 2
St. Anthony Mine Site Access Road
Supplemental Radiologic Characterization
Gamma Radiation Level Scan

Legend

- <15,000 cpm
- 15,001 - 20,000 cpm
- 20,001 - 25,000 cpm
- 25,001 - 32,000 cpm
- 32,001 - 62,000 cpm
- 62,001 - 212,000 cpm
- >212,000 cpm

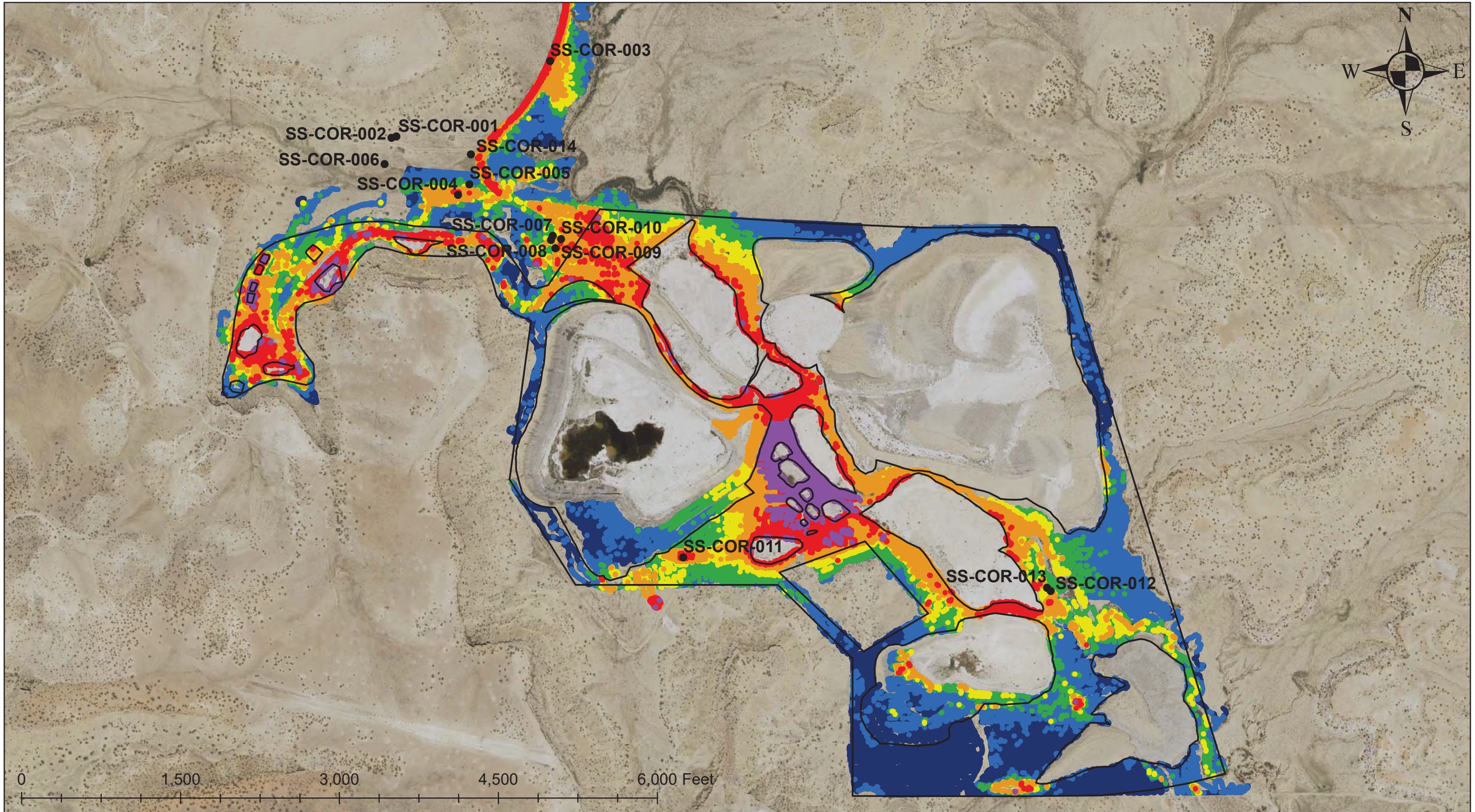


AVM Environmental Services, Inc.

Figure 3
St. Anthony Mine Site Supplemental Radiologic Characterization
Subsurface Investigation Test Pit Locations

Legend

- Test Pit Location - ID(contamination depth)
- <15,000 cpm (bkg) (1.6 pCi/g)
- 15,001 - 20,000 cpm (1.7 - 4.0 pCi/g)
- 20,001 - 25,000 cpm (4.1 - 6.6 pCi/g)
- 25,001 - 32,000 cpm (6.7 - 10.0 pCi/g)
- 32,001 - 62,000 cpm (10.1 - 25.0 pCi/g)
- 62,001 - 212,000 cpm (25.1 - 100.0 pCi/g)
- >212,000 cpm (>100 pCi/g)

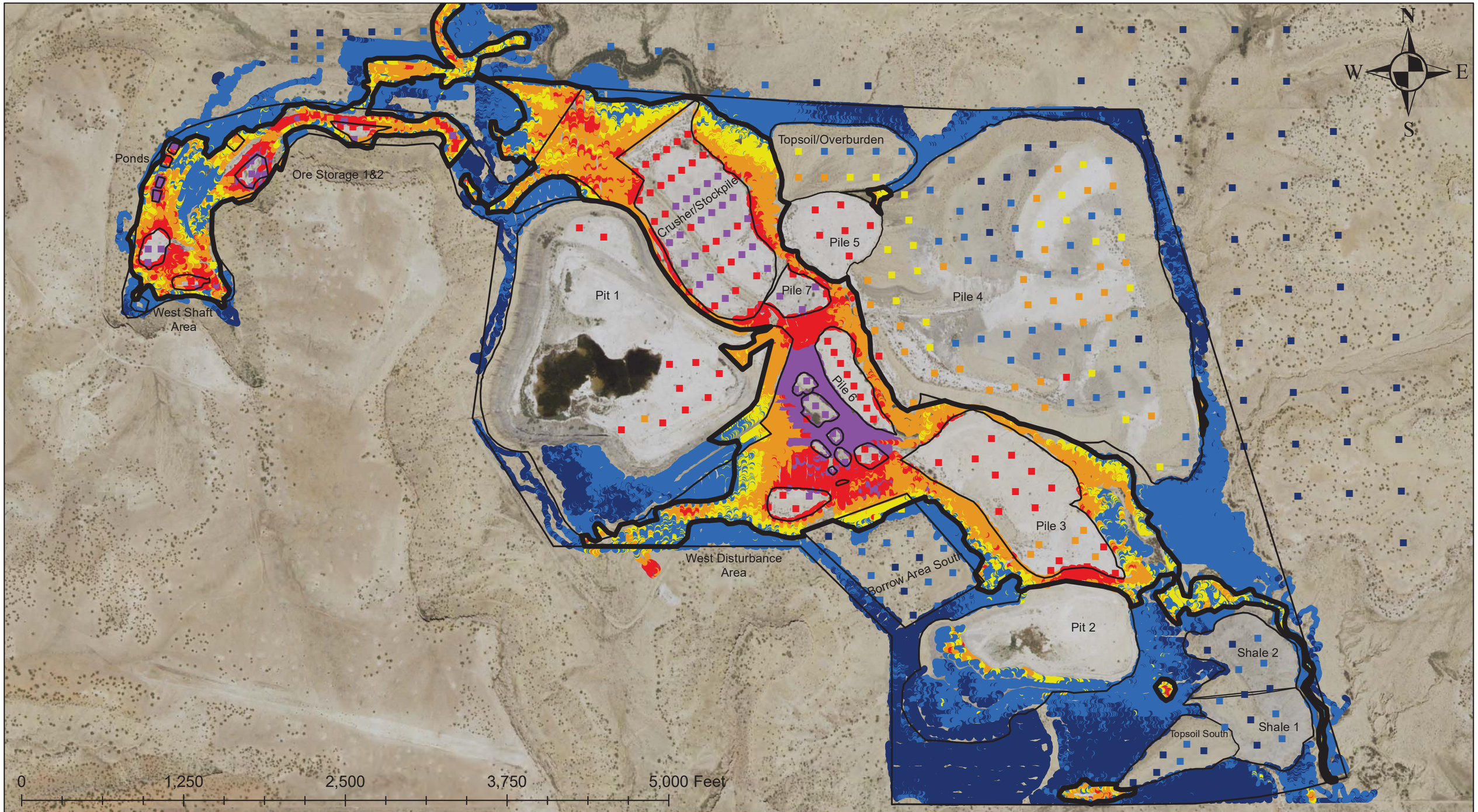


Environmental Services, Inc.

Figure 4
St. Anthony Mine Site Supplemental Radiologic Characterization
Correlation Sampling Locations

Legend

- Correlation Sample Location
- <15,000 cpm
- 15,001 - 20,000 cpm
- 20,001 - 25,000 cpm
- 25,001 - 32,000 cpm
- 32,001 - 62,000 cpm
- 62,001 - 212,000 cpm
- >212,000 cpm



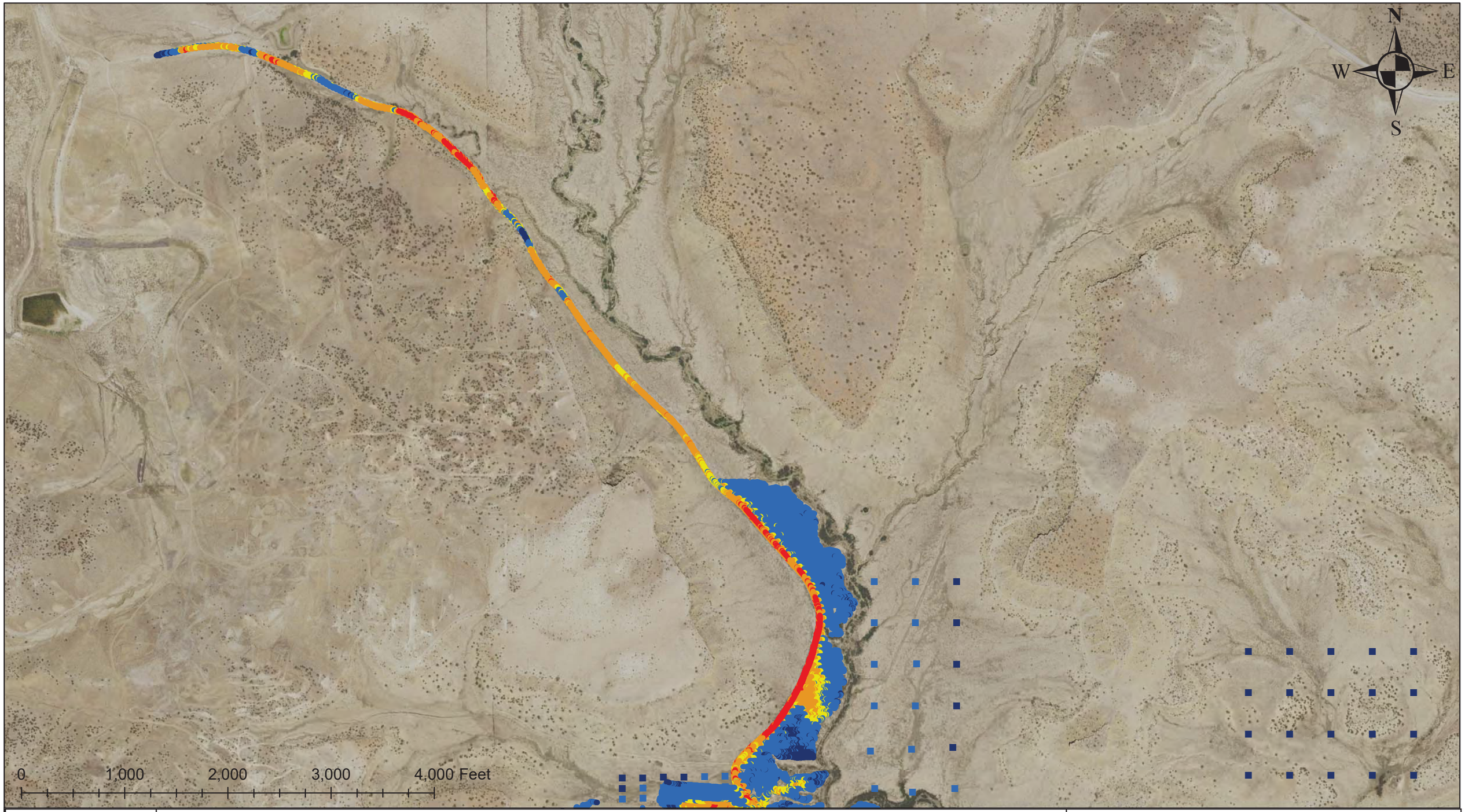
AVM Environmental Services, Inc.

Figure 5
St. Anthony Mine Site Supplemental Radiologic Characterization
Lateral Extent of Ra-226 Contamination

Legend

Ra-226 pCi/g

- <1.6 pCi/g
- 1.61 - 6.6 pCi/g
- 6.61 - 10.0 pCi/g
- 10.1 - 25.0 pCi/g
- 25.1 - 100.0 pCi/g
- >100 pCi/g
- 2007 MC Survey Point
- Boundary above the 6.6 pCi/g Ra-226 Investigation Level



AVM Environmental Services, Inc.

Figure 6
St. Anthony Mine Site Access Road Supplemental Radiologic Characterization
Lateral Extent of Ra-226 Contamination

Legend

Ra-226 pCi/g

- <1.6 pCi/g
- 1.61 - 6.6 pCi/g
- 6.61 - 10.0 pCi/g
- 10.1 - 25.0 pCi/g
- 25.1 - 100.0 pCi/g
- >100 pCi/g
- 2007 MC Survey Point

Appendices

Appendix A
St. Anthony Mine Site Gamma Survey Data
(2007 Materials Characterization Surface Gamma Survey Data & Supplemental Characterization Gamma Scan Data Electronic File Compact Disc)

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Background and Borrow Areas		
Background Reference Area		
BCKA L1-1	11	0.3
BCKA L1-2	11	0.3
BCKA L1-3	11	0.3
BCKA L1-4	13	1.3
BCKA L1-5	14	1.8
BCKA L1-6	17	3.2
BCKA L2-1	13	1.3
BCKA L2-2	15	2.3
BCKA L2-3	17	3.2
BCKA L2-4	16	2.7
BCKA L2-5	18	3.7
BCKA L2-6	18	3.7
BCKA L3-1	21	5.2
BCKA L3-2	19	4.2
BCKA L3-3	19	4.2
BCKA L3-4	21	5.2
BCKA L3-5	21	5.2
BCKA L3-6	21	5.2
Mean	**16**	**3.0**
Minimum	**11**	**0.3**
Maximum	**21**	**5.2**
Borrow Area South		
BA3 L1-1	11	0.3
BA3 L1-2	26	7.6
BA3 L1-3	26	7.6
BA3 L1-4	25	7.2
BA3 L2-1	17	3.2
BA3 L2-2	16	2.7
BA3 L2-3	16	2.7
BA3 L2-4	16	2.7
BA3 L3-1	17	3.2
BA3 L3-2	13	1.3
BA3 L3-3	13	1.3
BA3 L3-4	15	2.3
BA3 L4-1	14	1.8
BA3 L4-2	13	1.3
BA3 L4-3	14	1.8
BA3 L4-4	17	3.2
BA3 L5-1	11	0.3
BA3 L5-2	14	1.8
Mean	**16**	**2.9**
Minimum	**11**	**0.3**
Maximum	**26**	**7.6**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Lobo Tract Area		
L-1	16	2.7
L-2	7	<0.2
L-3	13	1.3
L-4	15	2.3
L-5	13	1.3
L-6	12	0.8
L-7	12	0.8
L-8	10	<0.2
L-9	11	0.3
L-10	15	2.3
L-11	15	2.3
L-12	15	2.3
L-13	15	2.3
L-14	15	2.3
L-15	17	3.2
L-16	16	2.7
L-17	15	2.3
L-18	14	1.8
L-19	14	1.8
L-20	15	2.3
L-21	14	1.8
Mean	**14**	**1.9**
Minimum	**7**	**0.3**
Maximum	**17**	**3.2**
Former Borrow Areas		
Area 1		
BA1 L1-1	9	<0.2
BA1 L1-2	11	0.3
BA1 L1-3	11	0.3
BA1 L1-4	13	1.3
BA1 L1-5	11	0.3
BA1 L2-1	10	<0.2
BA1 L2-2	9	<0.2
BA1 L2-3	11	0.3
BA1 L2-4	8	<0.2
BA1 L2-5	11	0.3
BA1 L3-1	10	<0.2
BA1 L3-2	9	<0.2
BA1 L3-3	11	0.3
BA1 L3-4	8	<0.2
BA1 L3-5	12	0.8
BA1 L4-1	11	0.3
BA1 L4-2	8	<0.2
BA1 L4-3	10	<0.2

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
BA1 L4-4	11	0.3
BA1 L4-5	9	<0.2
BA1 L5-1	12	0.8
BA1 L5-2	9	<0.2
BA1 L5-3	9	<0.2
BA1 L5-4	10	<0.2
BA1 L5-5	11	0.3
Area 2		
BA2 L1-1	10	<0.2
BA2 L1-2	9	<0.2
BA2 L1-3	10	<0.2
BA2 L1-4	9	<0.2
BA2 L2-1	13	1.3
BA2 L2-2	10	<0.2
BA2 L2-3	11	0.3
BA2 L2-4	8	<0.2
BA2 L3-1	8	<0.2
BA2 L3-2	11	0.3
BA2 L3-3	9	<0.2
BA2 L4-1	10	<0.2
BA2 L4-2	9	<0.2
BA2 L4-3	10	<0.2
BA2 L5-1	9	<0.2
BA2 L5-2	9	<0.2
BA2 L5-3	9	<0.2
BA2 L5-4	10	<0.2
BA2 L6-1	11	0.3
BA2 L6-2	11	0.3
BA2 L6-3	10	<0.2
BA2 L6-4	9	<0.2
BA2 L7-1	11	0.3
BA2 L7-2	9	<0.2
BA2 L7-3	9	<0.2
BA2 L7-4	13	1.3
BA2 L8-1	9	<0.2
BA2 L8-2	8	<0.2
BA2 L8-3	9	<0.2
BA2 L9-1	9	<0.2
Mean	**10**	**0.5**
Minimum	**8**	**0.3**
Maximum	**13**	**1.3**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Soil Stockpiles		
Shale 1		
S1 L1-1	14	1.8
S1 L1-2	13	1.3
S1 L1-3	16	2.7
S1 L2-1	13	1.3
S1 L2-2	14	1.8
S1 L3-1	14	1.8
Mean	**14**	**1.8**
Minimum	**13**	**1.3**
Maximum	**16**	**2.7**
Shale 2		
S2 L1-1	11	0.3
S2 L1-2	12	0.8
S2 L1-3	14	1.8
S2 L2-1	14	1.8
S2 L2-2	19	4.2
S2 L3-2	12	0.8
S2 L3-3	13	1.3
Mean	**14**	**1.6**
Minimum	**11**	**0.3**
Maximum	**19**	**4.2**
Topsoil Pile South		
TS-110	12	0.8
TS-111	13	1.3
TS-112	12	0.8
TS-113	15	2.3
TS-267	13	1.3
TS-268	14	1.8
Mean	**13**	**1.4**
Minimum	**12**	**0.8**
Maximum	**15**	**2.3**
Top Soil Pile North		
TS L2-1	16	2.7
TS L2-2	19	4.2
TS L2-3	22	5.7
RSP TPL	18	3.7
Mean	**19**	**4.1**
Minimum	**19**	**2.7**
Maximum	**20**	**5.7**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Topsoil/Overburden Pile		
TS OB L1-1	25	7.2
TS OB L1-2	23	6.2
TS OB L1-3	22	5.7
TS OB L1-4	20	4.7
TS OB L1-5	16	2.7
TS OB L2-1	34	11.6
TS OB L2-2	34	11.6
TS OB L2-3	30	9.6
TS OB L2-4	25	7.2
Mean	**25**	**7.4**
Minimum	**16**	**2.7**
Maximum	**34**	**11.6**
FL Area		
FL-264	51	19.9
FL-265	46	17.4
FL-266	31	10.1
Mine Area Non-Economic Materials Piles		
Pile 3		
P3	60	24.3
P3 NE 117	105	46.4
P3 NW 116	70	29.2
P3 SE 115	65	26.8
P3 SW 114	65	26.8
P3-278	75	31.7
P3-279	36	12.5
P3-280	46	17.4
P3-281	65	26.8
P3-282	60	24.3
P3-283	46	17.4
P3-284	62	25.3
P3-286	70	29.2
P3-287	98	42.9
P3-288	165	75.8
P3-289	125	56.2
P3-290	80	34.1
P3-291	105	46.4
P3-292	105	46.4
P3-293	135	61.1
Mean	**82**	**35.0**
Minimum	**36**	**12.5**
Maximum	**165**	**75.8**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags	EquivalenSurface Soil Estimated Ra-226, pCi/g (1)
Pile 4		
P4 L10-1	46	17.4
P4 L10-2	47	17.9
P4 L10-3	50	19.4
P4 L10-4	65	26.8
P4 L10-5	28	8.6
P4 L10-6	15	2.3
P4 L10-7	15	2.3
P4 L1-1	14	1.8
P4 L11-1	35	12.1
P4 L11-2	23	6.2
P4 L11-3	17	3.2
P4 L11-4	15	2.3
P4 L11-5	15	2.3
P4 L1-2	13	1.3
P4 L12-1	29	9.1
P4 L12-2	45	17.0
P4 L1-3	13	1.3
P4 L13-1	16	2.7
P4 L14-1	30	9.6
P4 L14-2	18	3.7
P4 L2-1	25	7.2
P4 L2-2	18	3.7
P4 L2-3	13	1.3
P4 L2-4	13	1.3
P4 L2-5	13	1.3
P4 L2-6	35	12.1
P4 L2-7	25	7.2
P4 L2-8	16	2.7
P4 L3-1	25	7.2
P4 L3-2	14	1.8
P4 L3-3	13	1.3
P4 L3-4	14	1.8
P4 L3-5	35	12.1
P4 L3-6	30	9.6
P4 L3-7	40	14.5
P4 L3-8	43	16.0
P4 L4-1	28	8.6
P4 L4-10	15	2.3
P4 L4-2	24	6.7
P4 L4-3	19	4.2
P4 L4-4	14	1.8
P4 L4-5	13	1.3
P4 L4-6	15	2.3
P4 L4-7	30	9.6

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags	EquivalenSurface Soil Estimated Ra-226, pCi/g (1)
P4 L4-8	24	6.7
P4 L4-9	21	5.2
P4 L5-1	36	12.5
P4 L5-10	27	8.1
P4 L5-11	25	7.2
P4 L5-2	27	8.1
P4 L5-3	30	9.6
P4 L5-4	31	10.1
P4 L5-5	17	3.2
P4 L5-6	14	1.8
P4 L5-7	18	3.7
P4 L5-8	55	21.9
P4 L5-9	17	3.2
P4 L6-1	60	24.3
P4 L6-2	26	7.6
P4 L6-4	22	5.7
P4 L6-5	18	3.7
P4 L6-6	34	11.6
P4 L6-7	40	14.5
P4 L7-1	55	21.9
P4 L7-2	38	13.5
P4 L7-3	24	6.7
P4 L7-4	42	15.5
P4 L7-4	55	21.9
P4 L7-5	58	23.3
P4 L7-6	60	24.3
P4 L7-7	41	15.0
P4 L7-8	26	7.6
P4 L8-1	65	26.8
P4 L8-10	32	10.6
P4 L8-11	16	2.7
P4 L8-2	45	17.0
P4 L8-3	30	9.6
P4 L8-4	21	5.2
P4 L8-5	19	4.2
P4 L8-6	19	4.2
P4 L8-7	18	3.7
P4 L8-8	20	4.7
P4 L8-9	55	21.9

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
P4 L9-1	34	11.6
P4 L9-2	32	10.6
P4 L9-3	17	3.2
P4 L9-4	16	2.7
P4 L9-5	17	3.2
P4 L9-6	17	3.2
P4 L9-7	16	2.7
P4 L9-8	13	1.3
SW P-4	50	19.4
Mean	**28**	**8.6**
Minimum	**13**	**1.3**
Maximum	**65**	**26.8**
Pile 5		
P5 L1-1	180	83.1
P5 L1-2	105	46.4
P5 L2-1	180	83.1
P5 L2-2	170	78.2
P5 L2-3	125	56.2
P5 L3-1	125	56.2
Mean	**148**	**67.2**
Minimum	**105**	**46.4**
Maximum	**180**	**83.1**
Pile 6		
P6-234	80	34.1
P6-235	85	36.6
P6-236	100	43.9
P6-237	95	41.5
P6-238	95	41.5
P6-239	70	29.2
P6-240	115	51.3
P6-241	70	29.2
Mean	**89**	**38.4**
Minimum	**70**	**29.2**
Maximum	**115**	**51.3**
Pile 7		
P7-229	135	61.1
P7-230	230	107.6
P7-231	130	58.6
P7-232	245	115.0
P7-233	600	288.9
Mean	**268**	**126.2**
Minimum	**130**	**58.6**
Maximum	**600**	**288.9**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
West Disturbance Area		
WDA-242	300	141.9
WDA-243	300	141.9
WDA-244	440	210.5
WDA-245	290	137.0
WDA-246	235	110.1
WDA-247	245	115.0
WDA-248	105	46.4
WDA-249	190	88.0
WDA-250	235	110.1
WDA-251	295	139.5
WDA-252	370	176.2
WDA-253	165	75.8
WDA-254	210	97.8
WDA-255	140	63.5
WDA-256	170	78.2
WDA-257	280	132.1
WDA-258	185	85.6
WDA-259	190	88.0
WDA-260	250	117.4
WDA-261	150	68.4
WDA-262	170	78.2
Mean	**234**	**109.6**
Minimum	**105**	**46.4**
Maximum	**440**	**210.5**
Crusher/Stockpile Area		
CSA L1-1	75	31.7
CSA L1-2	65	26.8
CSA L1-3	79	33.6
CSA L1-4	75	31.7
CSA L1-5	85	36.6
CSA L1-6	105	46.4
CSA L2-1	190	88.0
CSA L2-2	105	46.4
CSA L2-3	175	80.7
CSA L2-4	195	90.5
CSA L2-5	195	90.5
CSA L2-6	205	95.4
CSA L2-7	140	63.5
CSA L3-1	135	61.1
CSA L3-2	120	53.7
CSA L3-3	220	102.7
CSA L3-4	320	151.7
CSA L3-5	220	102.7
CSA L3-6	240	112.5

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
CSA L3-7	265	124.8
CSA L4-1	280	132.1
CSA L4-2	490	235.0
CSA L4-3	175	80.7
CSA L4-4	215	100.3
CSA L4-5	800	386.9
CSA L4-6	350	166.4
CSA L4-7	330	156.6
CSA L5-1	250	117.4
CSA L5-2	330	156.6
CSA L5-3	200	92.9
CSA L5-4	175	80.7
CSA L5-5	410	195.8
CSA L5-6	210	97.8
CSA L5-7	220	102.7
CSA L6-1	95	41.5
CSA L6-2	240	112.5
CSA L6-3	240	112.5
CSA L6-4	160	73.3
CSA L6-5	125	56.2
CSA L6-6	215	100.3
CSA L6-7	245	115.0
CSA L7-1	155	70.9
CSA L7-2	450	215.4
CSA L7-3	155	70.9
CSA L7-4	180	83.1
CSA L7-5	235	110.1
CSA L8-1	80	34.1
CSA L8-2	180	83.1
CSA L8-3	100	43.9
Mean	**214**	**99.9**
Minimum	**65**	**26.8**
Maximum	**800**	**386.9**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Open Pit 1		
Pit1-165	95	41.5
Pit1-166	85	36.6
Pit1-167	70	29.2
Pit1-168	70	29.2
Pit1-169	62	25.3
Pit1-170	80	34.1
Pit1-171	70	29.2
Pit1-172	60	24.3
Pit1-173	80	34.1
Pit1-174	79	33.6
Pit1-175	138	62.5
Mean	**81**	**34.5**
Minimum	**60**	**24.3**
Maximum	**138**	**62.5**
Western Shaft Area		
Mine Dump		
MD-1	140	63.5
MD-2	225	105.2
MD-3	230	107.6
MD-4	215	100.3
MD-6	140	63.5
Mean	**190**	**88.0**
Minimum	**140**	**63.5**
Maximum	**230**	**107.6**
Shaft Pad		
SP-1	70	29.2
SP-2	70	29.2
SP-3	50	19.4
Mean	**63**	**25.9**
Minimum	**50**	**19.4**
Maximum	**70**	**29.2**
Storage Area		
SA-1	15	2.3
SA-2	15	2.3
Mean	**15**	2.3

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Shaft Area Ponds		
SP1-1 (Pond 1)	300	141.9
SP2-2 (Pond 2)	260	122.3
SPM-6 (between Ponds 2 & 3)	22	5.7
SP3-3 (Pond 3)	95	41.5
SP4-4 (Pond 4)	390	186.0
P5-1 (Pond 5)	9	<0.2
P5-2 (Pond 5)	24	6.7
Mean	**157**	**84.0**
Minimum	**9**	**5.7**
Maximum	**390**	**186.0**
Ore Storage Areas		
OS1-1	225	105.2
OS1-2	180	83.1
OS1-3	255	119.9
OS1-4	215	100.3
OS1-5	240	112.5
OS1-6	380	181.1
OS2-1	60	24.3
OS2-2	70	29.2
OS2-3	70	29.2
OS2-4	125	56.2
OS2-5	500	239.9
OS2-6	50	19.4
Mean	**198**	**91.7**
Minimum	**50**	**19.4**
Maximum	**500**	**239.9**

Summary of 2017 Material Characterization Gamma Radiation Survey Results		
Location ID	**Gamma Exposure Rate (uR/hr) Measurements @ 1-meter ags**	**EquivalenSurface Soil Estimated Ra-226, pCi/g (1)**
Shaft Area Access Road		
AR-01	24	6.7
AR-02	23	6.2
AR-03	30	9.6
AR-04	18	3.7
AR-05	17	3.2
AR-06	70	29.2
AR-07	270	127.2
AR-08	80	34.1
AR-10	49	18.9
AR-11	60	24.3
AR-12	43	16.0
AR-13	65	26.8
AR-14	75	31.7
AR-15	240	112.5
AR-16	35	12.1
AR-17	75	31.7
AR-18	135	61.1
AR-19	135	61.1
AR-20	125	56.2
AR-21	36	12.5
AR-22	140	63.5
AR-23	100	43.9
AR-24	100	43.9
AR-25	60	24.3
AR-26	30	9.6
AR-27	22	5.7
AR-28	20	4.7
AR-29	22	5.7
AR-30	33	11.1
AR-31	40	14.5
AR-32	24	6.7
AR-33	17	3.2
AR-34	75	31.7
Mean	**69**	**28.9**
Minimum	**17**	**3.2**
Maximum	**270**	**127.2**

Notes:
(1) Surface soil Ra-226 in pCi/g estimated from site-specific surface gamma exposure rate (uR/hr) to surface soil Ra-226 Correlation [pCi/g Ra-226 = (0.49 x uR/hr)-5.10] for Ludlum Model 19 Micro R Meter

Appendix B
Subsurface Contamination Field Investigation Documentation

(Ex-Situ Gamma Soil Screening Reference soil Preparation
Field Soil Sample Gamma Radiation Screening Forms
Test Pit Geotechnical Field Sample Data Sheet
Ex-Situ Soil Screening Gamma Radiation Level to Ra-226 Correlation
Test Pit Subsurface Sample Laboratory Analytical Result Reports)

AVM Environmental Services, Inc.
Ra-226 Reference Soil Preparation for St. Anthony Gamma Radiation Soil Screening

The Ra-226 reference soil was prepared by local matrix soil from background area and 200 pCi/g PTW reference soil previously prepared for NECR PDS in 2013 using the Department of Energy's New Brunswick Laboratory (NBL) CRM 3-B (3.90% U_3O_8 with Ra to U weight ratio of 3.38E-07) . The reference soil was prepared to calibrate the gamma radiation soil screening system for St. Anthony Site gamma soil screening for pit test during supplemental characterization. The gamma soil screening system will be utilized to determine if the subsurface soil sample is above or below the 6.6 pCi/g screening level. The matrix blending provides additional compensation for local background. The 200 pCi/g reference soil was diluted and mixed with the local matrix to bring the reference soil concentrations to 6.6 pCi/gm of Ra-226, slightly less than 6.0 pCi/g screening level to be conservative in soil screening.

115 grams of 200 pCi/g Reference Soil	= 23,000 pCi
4,000 grams of Matrix Soil (@1.0 pCi/g)	= 4,000 pCi
4,115 grams Total	= 27,000 pCi

Reference Soil Ra-226 concentration = 6.6 pCi/g (April 14, 2018)

The reference and matrix soil was weighed using the Ohaus LS2000 electronic balance.

AVM Envir[illegible]ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 S#290802 **Detector** L-44-20 S#295573
Instrument Calibration Date: 8-1-17 **, Instrument Function Check Performed:** ✓
Survey Area/Unit Decsription St Anthony test Pit Soil Screening

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts, CP5M	Weight Corrected CP5M	CPM	Ref Soil Comparision	Comments
4-16-18	Blank	–	363		73		
"	6.6 pCi/g Ref Soil	3000	3334		667		
"	SB-TP7-01 4-16-18 @ 927	3000	11490	–	2295	>	
"	SB-TP7-02 4-16-18 @ 936	3000	1218	–	244	<	Sample Cut
"	SB-TP05-01 4-16-18 @ 1016	3000	9320	–	1864	>	
"	SB-TP05-02 4-16-18 @ 1025	3000	11430	–	2286	>	
"	SB-TP05-03 4-16-18 @ 1030	3000	12870	–	2574	>	
"	SB-TP05-04 4-16-18 @ 1038	3000	13750	–	2750	>	
"	SBTP05-05 4-16-18 @ 1052	3000	2480	–	496	<	Sample Cut
"	SBTP04-01 4-16-18 @ 1116	3000	7805	–	1561	>	
"	SBTP04-03 4-16-18 @ 1117	3000	17935	–	3587	>	
"	SBTP04-05 4-16-18 @ 1125	3000	3706	–	741	>	
"	SBTP04-06 4-16-18 @ 1140	3000	2284	–	457	<	
"	SB-TP06-01 4-16-18 @ 1204	3000	2010	–	402	<	Sample Cut
"	SB-TP09-03 4-16-18 @ 1400	3000	1331	–	266	<	

Technician Signature [signature], Reviewed by [signature]

AVM Enviro[illegible]ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 S#290802, **Detector** L44-20 S#295573
Instrument Calibration Date: 8-1-17, **Instrument Function Check Performed:** ✓
Survey Area/Unit Decsription St Anthony Test Pit Soil Screening

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts, CP5M	Weight Corrected CP5M	CPM	Ref Soil Comparision	Comments
4-16-18	SB-TP09-02 4-16-18 @1350	3000	1337	-	267	<	Sample Cut
4-16-18	SB-TP09-01 4-16-18 @1340	3000	10540	-	2108	>	
4-16-18	SB-TP08-03 4-16-18 @1440	3000	1058	-	212	<	
"	SB-TP08-02 4-16-18 @1435	3000	1051	-	210	<	Sample Cut
"	SB-TP08-01 4-16-18 @1430	3000	3666	-	733	≈	Sample Cut
"	SB-TP03-01 4-16-18 @1605	3000	1217	-	243	<	
4-17-18	Blank	-	392	-	78		
4-17-18	6.6 pCi/g Ref Soil	3000	3306	-	662		Did not dig pits or Soil Screen due to high winds
4-18-18	Blank	-	406	-	81		
"	6.6 pCi/g Ref Soil	3000	3141	-	628		
"	SB-TP10-01 4-18-18 @848	3000	4870	-	974	>	Sample Cut
"	SB-TP10-02 4-18-18 @900	3000	2250	-	450	<	Sample Cut
"	SB-TP11-02 4-18-18 @920	3000	13370		2674	>	
"	SB-TP13-04 4-18-18 @1000	3000	16275		3255	>	
"	SB-TP11-01 4-18-18 @911	3000	2665		533	<	

Technician Signature [signature], Reviewed by [signature]

AVM Envir[illegible]ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 S#290802, **Detector** L44-20 S#295573
Instrument Calibration Date: 8-1-17, **Instrument Function Check Performed:** ✓
Survey Area/Unit Decsription St. Anthony Test Pit Soil Screening

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts, CP5M	Weight Corrected CP5M	CPM	Ref Soil Comparision	Comments
4-18-18	SB-TP13-06 4-18-18 @1022	3000	3961	-	792	>	Sample Cut
"	SB-TP13-05 4-18-18 @1011	3000	8025	-	1605	>	Sample Cut
"	SB-TP15-02 4-18-18 @1040	3000	1265	-	253	<	Sample Cut
"	SB-TP15-01 4-18-18 @1036	3000	1234	-	247	<	Sample Cut
"	SB-TP11-03 4-18-18 @1111	3000	9395	-	1879	>	
"	SB-TP11-04 4-18-18 @1116	3000	11420	-	2284	>	Sample Cut
"	SB-TP11-05 4-18-18 @1134	3000	2995	-	599	<	Sample Cut
"	SB-TP12-03 4-18-18 @1226	3000	3266	-	653	≈	Sample Cut
"	SB-TP12-04 4-18-18 @1235	3000	1937	-	387	<	Sample Cut
"	SB-TP12-02 4-18-18 @1219	3000	5985	-	1197	>	
"	SB-TP14-03 4-18-18 @1400	3000	1964	-	393	<	Sample Cut
"	SB-TP14-02 4-18-18 @1350	3000	7259	-	1452	>	Sample Cut
"	SB-TP21-01 4-18-18 @1445	3000	1455	-	291	<	Sample Cut
"	SB-TP21-02 4-18-18 @1450	3000	1269	-	254	<	Sample Cut
"	SB-TP16-01 4-18-18 @1510	3000	1207	-	242	<	Sample Cut

Technician Signature [signature], Reviewed by [signature]

AVM Envir[illegible]ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 S#290802, **Detector** L44-20 SH295573
Instrument Calibration Date: 8-1-17, **Instrument Function Check Performed:** ✓
Survey Area/Unit Decsription St. Anthony test Ref Soil Screening

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts, CP5M	Weight Corrected CP5M	CPM	Ref Soil Comparision	Comments
4-18-18	SB-TP16-02 4-18-18 @1515	3000	1235	-	247	<	Sample Cut
"	SB-TP17-01 4-18-18 @1530	3000	1377	-	275	<	Sample Cut
"	SB-TP17-02 4-18-18 @1535	3000	1179	-	236	<	Sample Cut
"	SB-TP18-01 4-18-18 @1550	3000	1413	-	330	<	Sample Cut
"	SB-TP18-02 4-18-18 @1555	3000	1379	-	276	<	Sample Cut
"	SB-TP19-01 4-18-18 @1605	3000	9590	-	1918	>	Sample Cut
"	SB-TP19-02 4-18-18 @1610	3000	1324	-	265	<	Sample Cut
4-19-18	Blank	-	360	-	72		
"	6.6 pCi/g Ref Soil	3000	3139	-	628		
"	SB-TP22-07 4-19-18 @925	3000	1409	-	296	<	Sample Cut
"	SB-TP22-03 4-19-18 @900	3000	3413	-	683	≈	Sample Cut
"	SB-TP23-06 4-19-18 @1020	3000	2431	-	486	<	Sample Cut
"	SB-TP23-04 4-19-18 @1010	3000	14350	-	2870	>	Sample Cut
"	SB-TP24-06 4-19-18 @1117	3000	17315	-	3463	>	Sample Cut
"	SB-TP24-05 4-19-18 @1106	3000	13465	-	2693	>	Sample Cut

Technician Signature [illegible], Reviewed by [illegible]

AVM Envir ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 S#290302, **Detector** L44-20 S# 295573
Instrument Calibration Date: 8-1-17, **Instrument Function Check Performed:** ✓
Survey Area/Unit Decsription St. Anthony test Pit Soil Screening

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts, CP5M	Weight Corrected CP5M	CPM	Ref Soil Comparision	Comments
4-19-18	SB-TP20-02 4-19-18 @1140	3000	1342	-	268	<	Sample Cut
4-19-18	SB-TP20-01 4-19-18 @1133	3000	1358	-	272	<	Sample Cut
"	SB-TP02-02 4-19-18 @1240	3000	1913	-	383	<	Sample Cut
"	SB-TP02-01 4-19-18 @1235	3000	11625	-	2325	>	Sample Cut
"	SB-TP01-02 4-19-18 @1310	3000	1430	-	286	<	Sample Cut
"	SB-TP01-01 4-19-18 @1300	3000	3670	-	734	>	Sample Cut

Technician Signature [signature], Reviewed by [signature]

Test Pit ID: 1

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

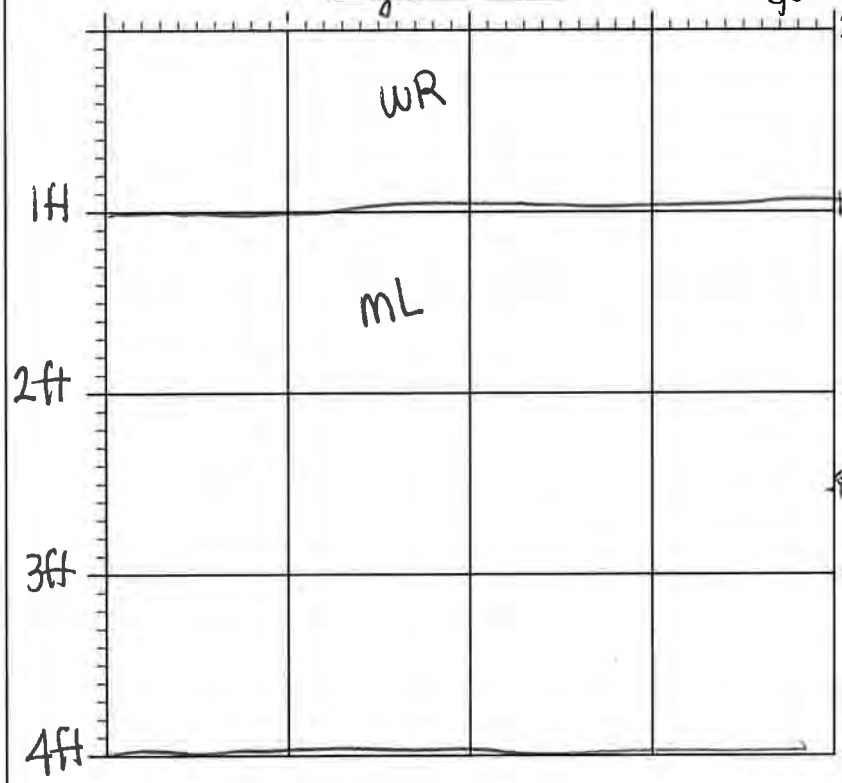
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: NW-SE
PIT FACE LOGGED: yes

DATE: 4-19-18
FIELD ENGINEER: Breanna Van

NORTHING: 1519977.7
EASTING: 2879801.1

gamma scan (cpm)



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP01-01	1.1 ft	13:00	S
SB-TP01-02	2.5 ft	13:10	S
SB-TP01-04	4 ft	13:15	S

clean

Pit Width: 4 ft
Pit Length: 10 ft
Pit Depth: 4 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel. Sand & cobbles. Light gray, loose, dry. (30% cobbles, 40% gravel, 30% sand)
ML	Native	Silt. Light brown/red color. Med. dense. dry (5% sand, 95% silt)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*samples sent to lab

Test Pit ID: 2

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

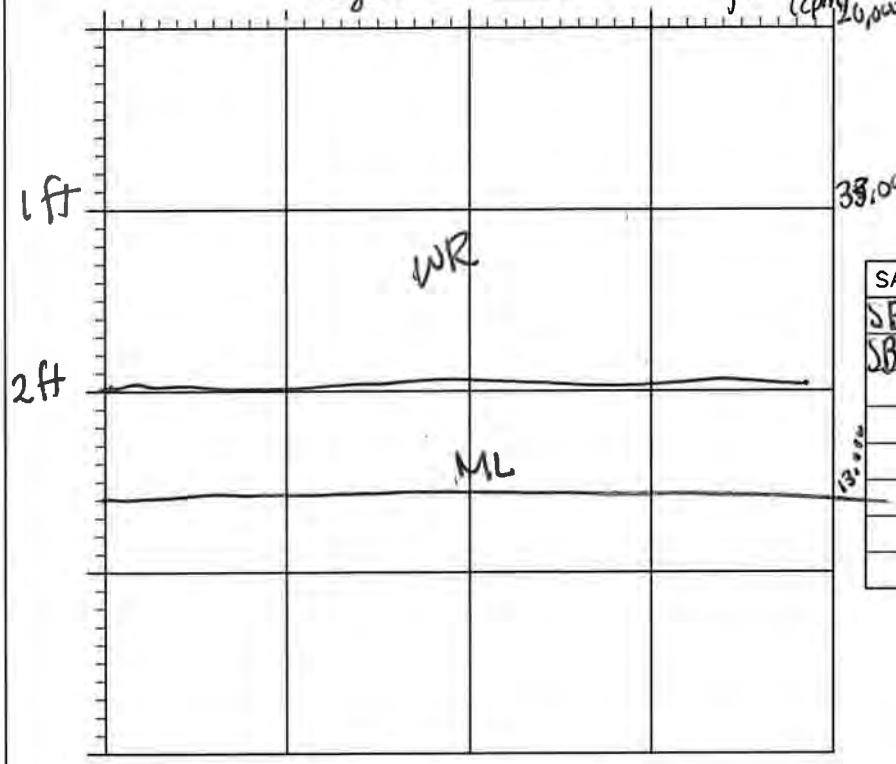
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4.19.18
FIELD ENGINEER: Breanna
gamma scan van
(cpm) 20,000

NORTHING: 1518527.1
EASTING: 2880209.9

TEST PIT LOG



LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP02-01	1.1 ft	12:35	S ★
SB-TP02-02	2.5ft	12:40	S ★ clean

Pit Width: 4ft
Pit Length: 9ft
Pit Depth: 2.5ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	well graded gravel. Sand & cobbles. Light gray. Loose, dry (20% cobbles, 45% gravel, 35% sand)
ML	Native	Silt. Light brown/red. Medium dense - loose. Dry. (5% sand, 95% silt) plant matter

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

★ samples sent to lab

Test Pit ID: TP03

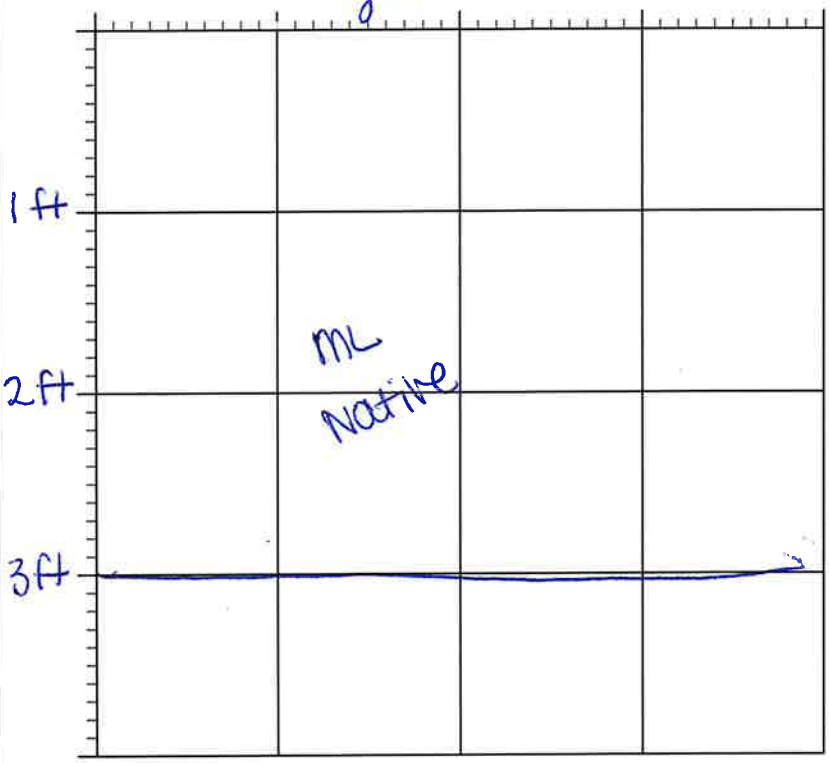
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: E-W
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Breanna Van

NORTHING: 1517294.7
EASTING: 2879324.8



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP03-01	1ft	16:05	S	*
SB-TP03-02	2ft	16:10	S	
SB-TP03-03	3ft	16:15	S	

Pit Width: 2.5ft
Pit Length: 8.5ft
Pit Depth: 3ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Red/brown silt, some sand + some plant materials such as roots. <5% sand, 95% silt. Medium dense, dry

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*: samples sent to lab

Test Pit ID: TP04

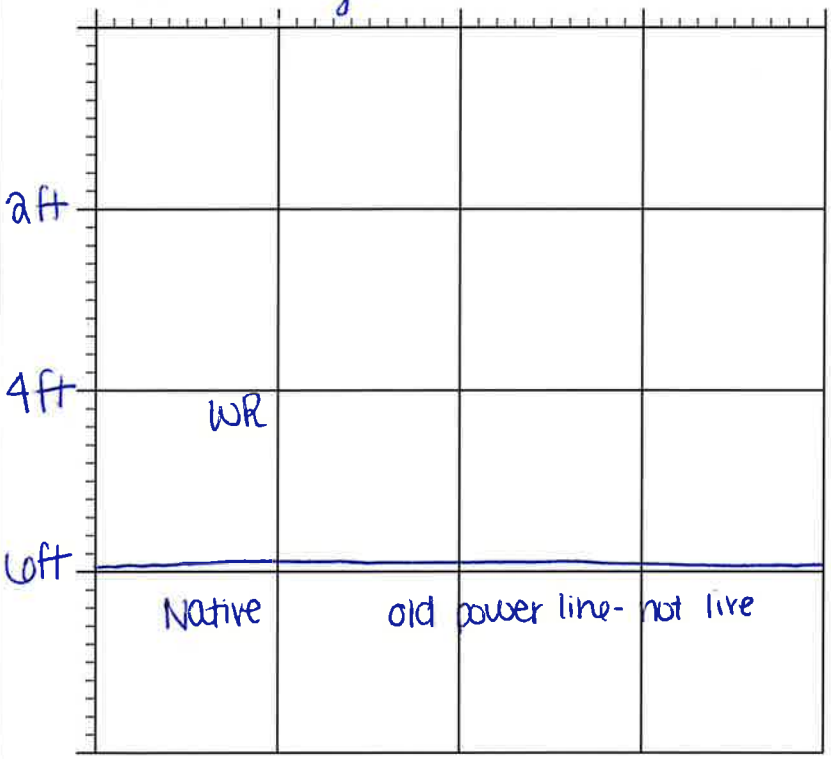
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Bleanna Van

NORTHING: 1516898.8
EASTING: 2880561.8



TEST PIT LOG

LEGEND

- - - - - SOIL HORIZON
- - - - - HORIZON CONTRACT
▽ GROUNDWATER LEVEL
⊠ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP04-01	1.2ft	11:15	S	
~~SB-TP04-02~~				
SB-TP04-03	3ft	11:20	S	
SB-TP04-05	5ft	11:30	S	*
SB-TP04-06	6ft	11:47	S	*

Pit Width: 2.5ft
Pit Length: 12ft
Pit Depth: 6ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	well graded gravel with sand and cobbles. loose, dry, light gray. waste rock material 40% g, 30% sand, 25% cobbles, 5% fine
ML	Native	silt. Red/brown to dark brown. medium dense, dry. 95% silt 5% sand

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

* samples to send to lab

Test Pit ID: TP-05

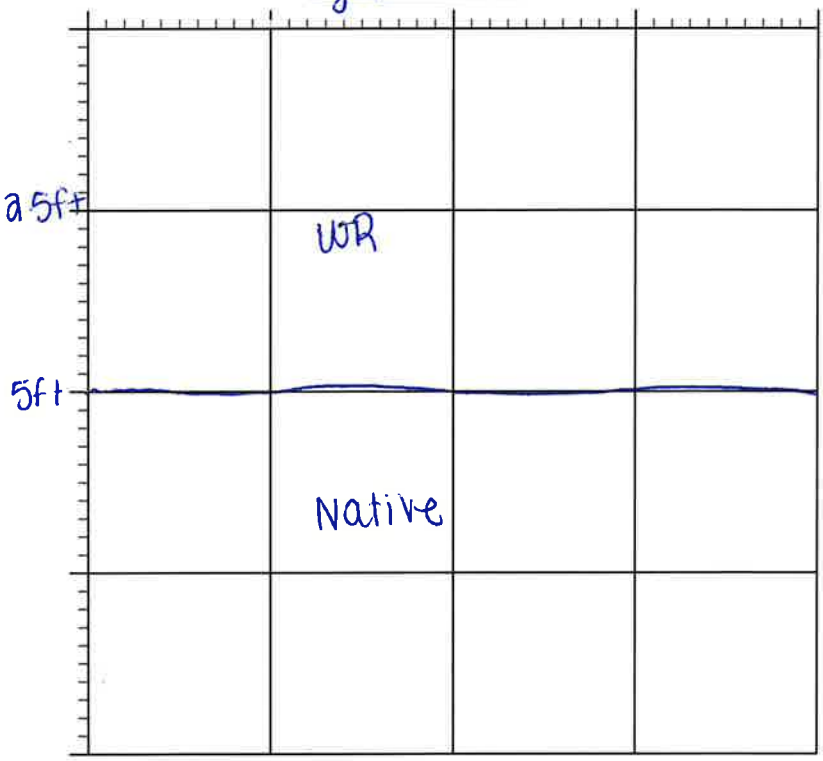
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Breanna Van

NORTHING: 15167786.8
EASTING: 2880764.9



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP05-01	1ft	10:20	S	
SB-TP05-02	2ft	10:25	S	
SB-TP05-03	3ft	10:30	S	
SB-TP05-04	4ft	10:38	S	*
SB-TP05-05	5ft	10:52	S	*

Pit Width: 5ft
Pit Length: 11ft.
Pit Depth: 5.25ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel with sand. Some cobbles. (35g; 30cobble, 30sand, 5fine) Light gray, loose, dry. waste rock material
5ft		
ML	Native	Silt. Red/brown. 95% silt 5% sand. Some roots, plant material Dry medium dense

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*: sample sent to lab

Test Pit ID: TP06

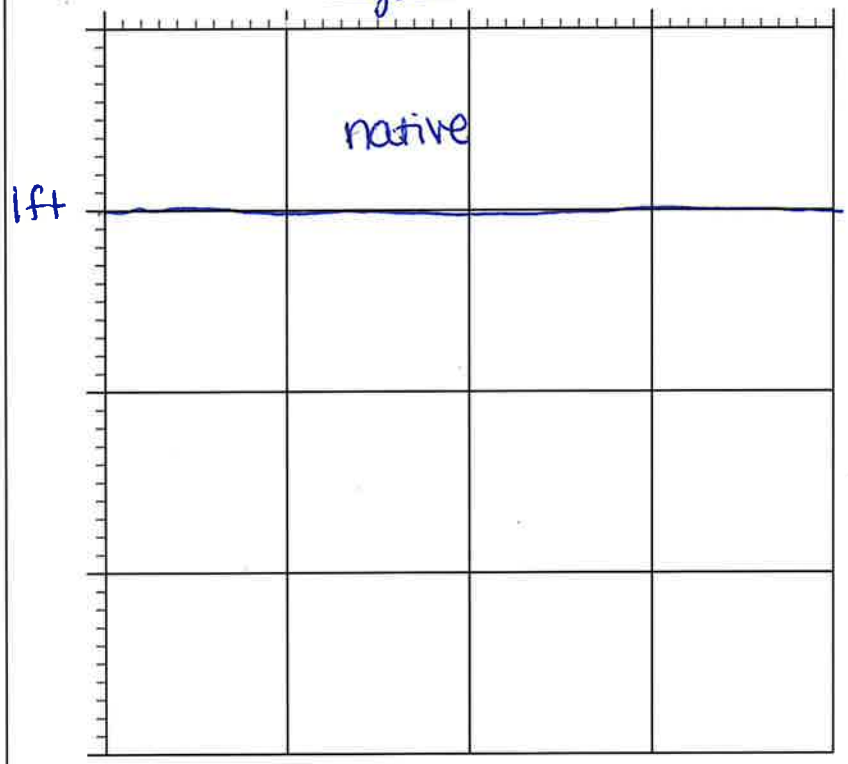
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Breanna Van

NORTHING: 151064462
EASTING: 2880938.3



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP0601	1ft	12:04	S *

Pit Width: 2.5ft
Pit Length: 5ft
Pit Depth: 1ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	native soil	Silt with trace cobbles. Dark brown in color 90% silt 5% sand 5% cobbles

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*: sample sent to lab

Test Pit ID: 7

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

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Breanna Vern

NORTHING: 1516414.4
EASTING: 2880892.5

0 ft
1 ft.
2 ft.
2.5ft
3 ft

gray, hot material

red/brown native soil

TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP7-D1	1 ft	9:27	S	* QC & MS/MSD
SB-TP7-02	2.5 ft	9:30	S	*

Pit Width: 2.5 ft
Pit Length: 9 ft
Pit Depth: 3 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	well graded gravel (GW) (60% G, 35% S, 5% F) with sand, loose, dry, light gray.
2.5ft		
ML	Native	Silt. Red/brown in color. 95% silt 5% sand. Some plant material

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*: sample sent to lab

Test Pit ID: TP08

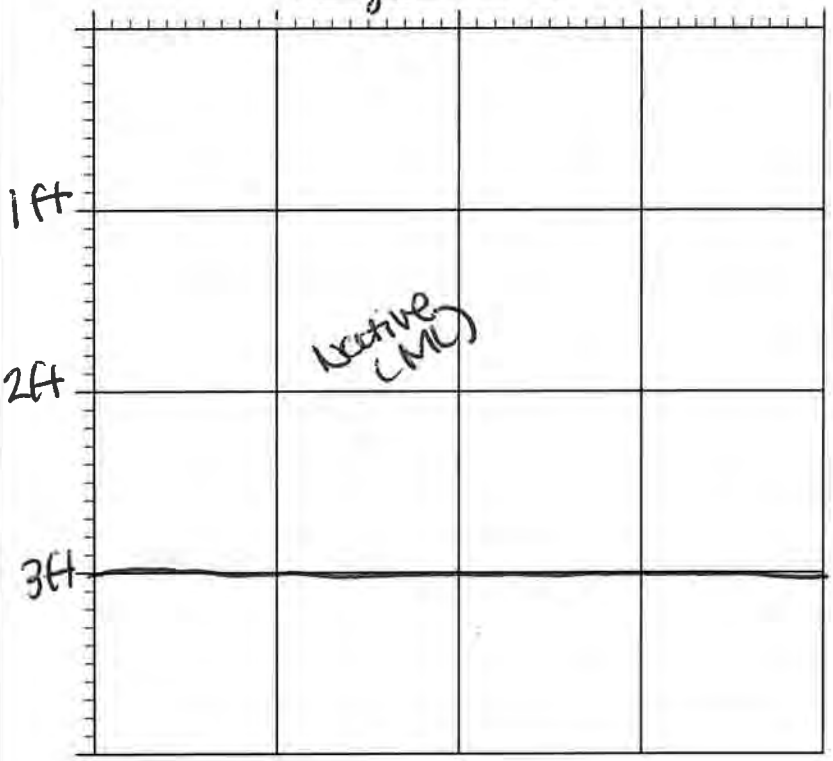
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: E-W
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Breanna Van

NORTHING: 1516128.0
EASTING: 2877428.9



TEST PIT LOG

LEGEND

- ----- SOIL HORIZON
- ----- HORIZON CONTRACT
- ▽ GROUNDWATER LEVEL
- ⊠ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP08-01	1ft	14:30	S	*
SB-TP08-02	~~1ft~~ 2.1ft	14:35	S	*
SB-TP08-03	3ft	14:40	S	

Pit Width: 2.5ft
Pit Length: 10ft
Pit Depth: 3ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Silt. Some sand, few cobbles. Red/brown color Medium dense, dry. Cobbles (<5%) sand (5%) silt (90%)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*: samples sent to lab

Test Pit ID: ~~TP04~~ TP09

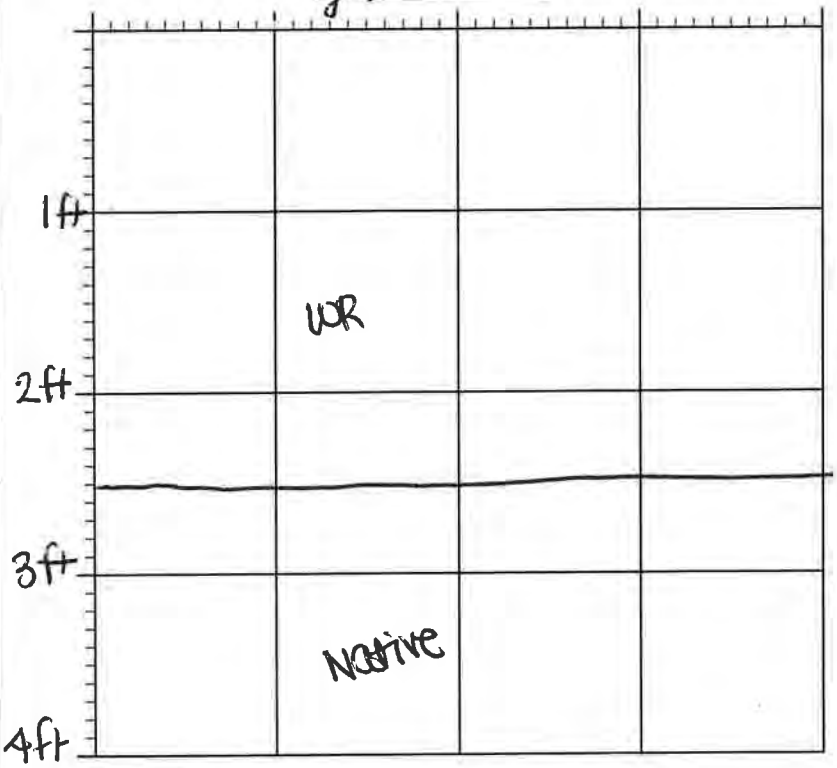
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: NW-SE
PIT FACE LOGGED: yes

DATE: 4-16-18
FIELD ENGINEER: Breanna Van

NORTHING: 1515831.1
EASTING: 2877561.9



TEST PIT LOG

LEGEND

----- SOIL HORIZON
----- HORIZON CONTRACT
▽ GROUNDWATER LEVEL
⊠ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP09-01	1ft	1340	S
SB-TP09-02	2.5ft	1350	S *
SB-TP09-03	3.5ft	~~0340~~ 14:00	S *

Pit Width: 2.5ft
Pit Length: 12 ft
Pit Depth: 4ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel (GW) w/ sand and cobbles. Loose, dry, light gray. cobbles (10%) gravel (50%) sand (35%). fine (5%)
ML	Native	Silt. some sand & cobbles. Dark gray/brown in color. Medium dense, dry. cobbles (5) sand (10) silt (85)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

* samples sent to lab

Test Pit ID: 10

Sheet NO.: TP-

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

GENERAL LOCATION:

PIT TREND: E-W

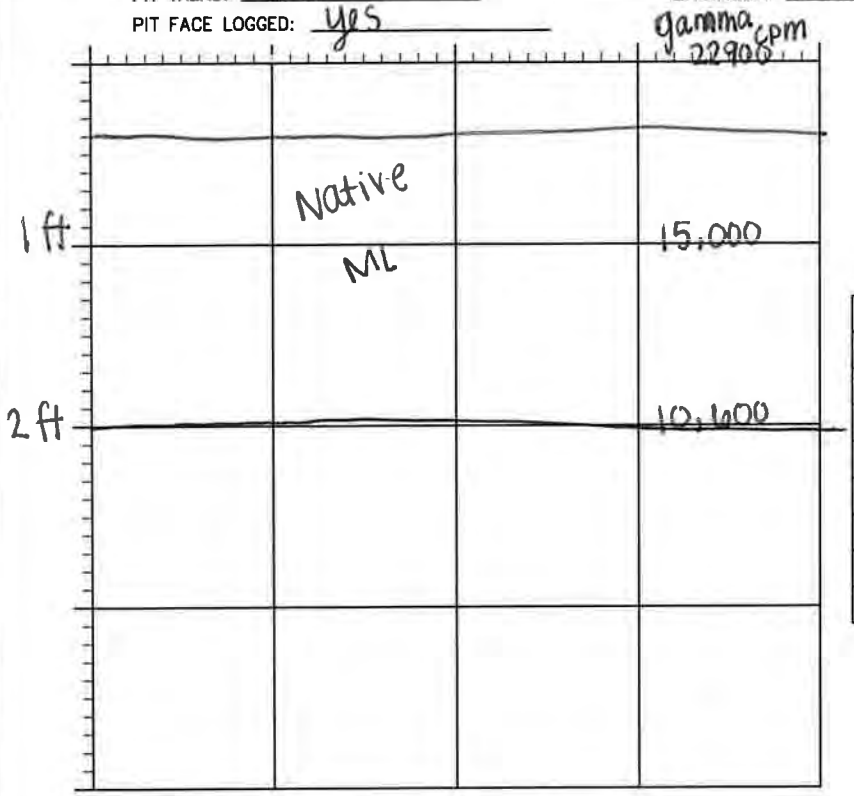
PIT FACE LOGGED: yes

DATE: 4-18-18

FIELD ENGINEER: Breanna Van

NORTHING: 15153368

EASTING: 2882418.7



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP10-01	1 ft	8:48	S
SB-TP10-02	2 ft	9:00	S

SB-TP10-201 * dup

clean *

Pit Width: 2.5 ft

Pit Length: 8 ft

Pit Depth: 2 ft

GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Dark brown/red silt. 95% silt, 5% sand. Moderatley dense

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*: samples sent to lab

Test Pit ID: 11

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

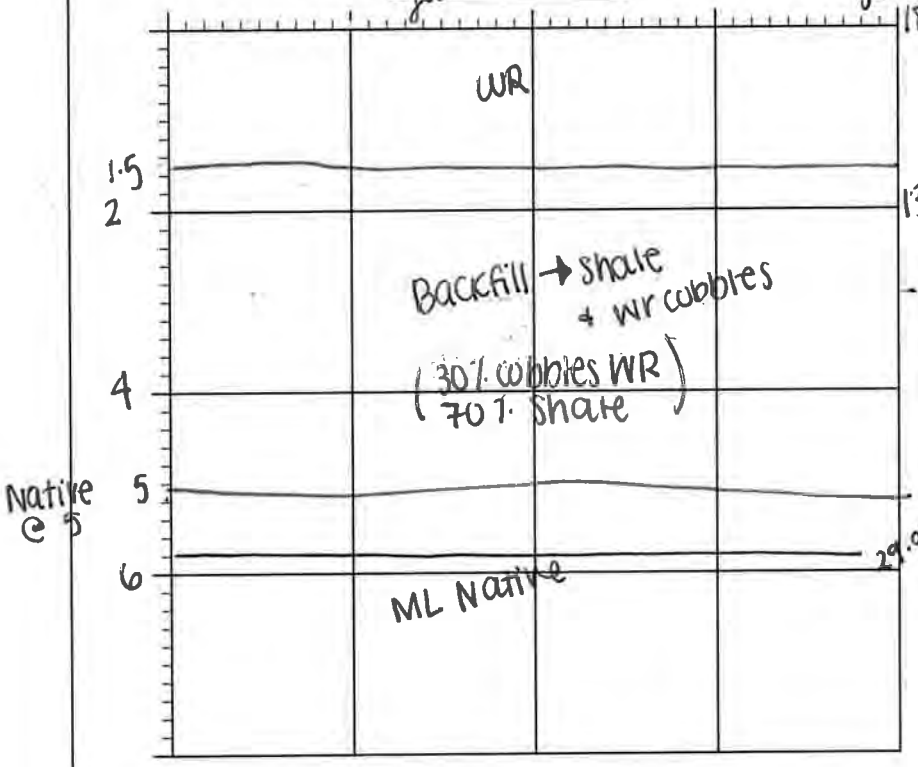
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: E-W
PIT FACE LOGGED: yes

DATE: 4.18.18
FIELD ENGINEER: Breanna Vun

NORTHING: 1515067.3
EASTING: 2882375.8

gamma scan (cpm)



LEGEND

- ----- SOIL HORIZON
- ------ HORIZON CONTRACT
- ▽ GROUNDWATER LEVEL
- ⊠ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP11-01	1 ft	9:11	S	
SB-TP11-02	2 ft	9:20	S	
SB-TP11-03	3 ft	11:11	S	
SB-TP11-04	4 ft	11:16	S	★
SB-TP11-05	5 ft	11:34	S	★
SB-TP11-06	5.7 ft	11:45	S	

Pit Width: 2.5 ft
Pit Length: 7.5 ft
Pit Depth: 5.7 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel with sand & cobbles (10% cobbles, 50% gravel, 30% sand, 10% fines) loose, dry, light gray
	shale	Dark brown / black shale. <5% sand 95% silt Medium dense.
ML	Native	Light brown/red. Dry. Medium dense. <5% sand 95% silt. Silt

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

Black shale @ 1.5 ft. Rocks / cobbles. Same shale as in pit? → most likely backfill - not insitu
Native @ 5 ft.

★: samples sent to lab

Test Pit ID: 12

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

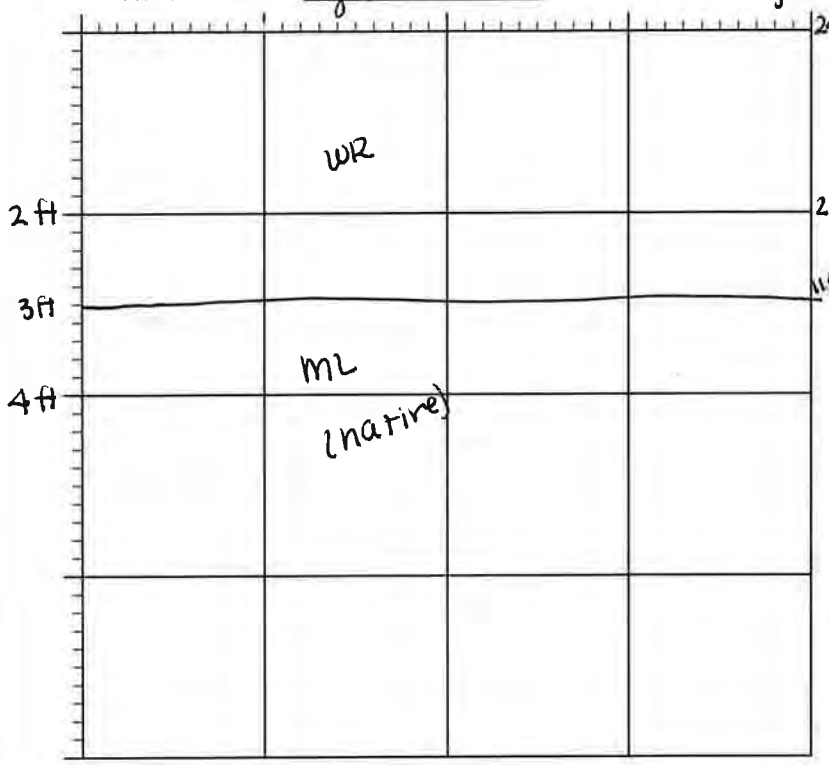
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: E-W
PIT FACE LOGGED: yes

DATE: 4-18-18
FIELD ENGINEER: Breanna Van

NORTHING: 1914764.1
EASTING: 2882599.4

gamma scan (cpm)



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP12-01	1 ft	12:05	S	
SB-TP12-02	2 ft	12:19	S	
SB-TP12-03	3 ft	12:26	S	*
SB-TP12-04	4 ft	12:35	S	*

Pit Width: 4.5 ft
Pit Length: 9 ft
Pit Depth: 4 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel w/ sand & cobbles. White, loose, dry. (10% cobbles, 50% gravel, 40% sand)
ML	Native	Silt. Brown/red color. Dry, medium dense. (5% gravel, 5% sand, 90% silt)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

* Samples sent to lab

Test Pit ID: 13

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

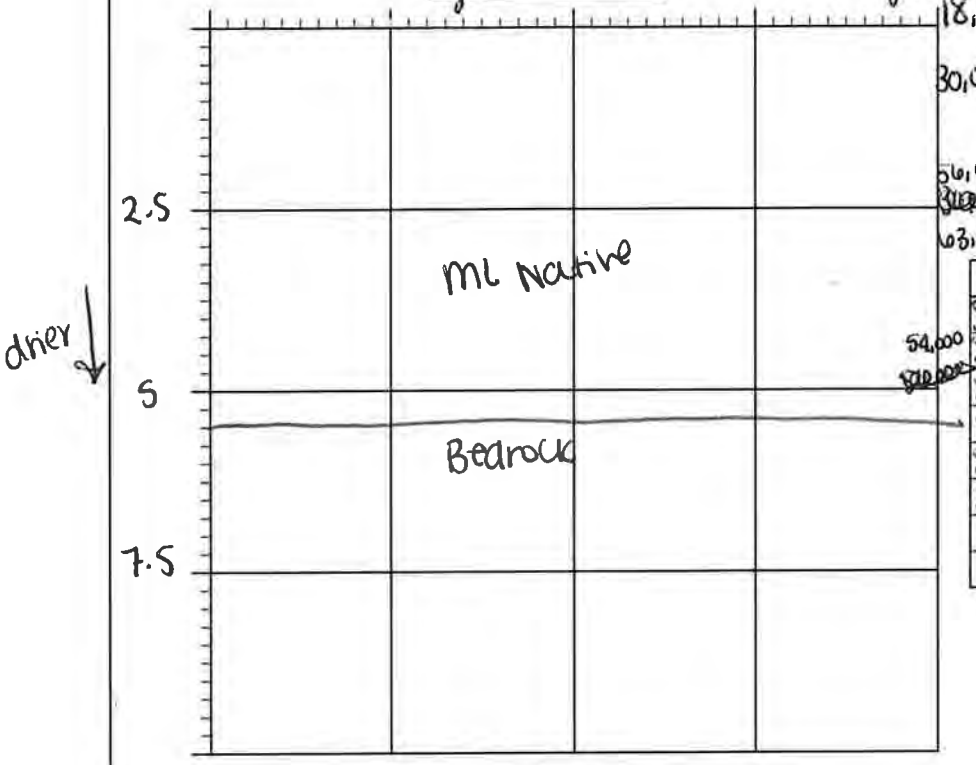
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4-18-18
FIELD ENGINEER: Breanna Vain

NORTHING: 15146069.1
EASTING: 2882250.3

gamma scan (cpm)
18,000
30,000
56,000
63,000
54,000



LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP13-01	1ft	9:40	S	
SB-TP13-02	2ft	9:44	S	
SB-TP13-03	3ft	9:51	S	
SB-TP13-04	4ft	10:00	S	
SB-TP13-05	5.[illegible] ft	10:11	S	*
SB-TP13-06	5.5 ft	10:22	S	* just above

Pit Width: 2.5 ft
Pit Length: 9 ft
Pit Depth: 5.5 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Silt. 95% Silt 5% sand, plant material. Moist. Medium dense Medium/dark brown
		Sandstone bedrock @ 5.5 ft. Light gray, uniform grains, medium-coarse grains

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

Hit bedrock at 5.5 ft

*: samples sent to lab

Test Pit ID: 14

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

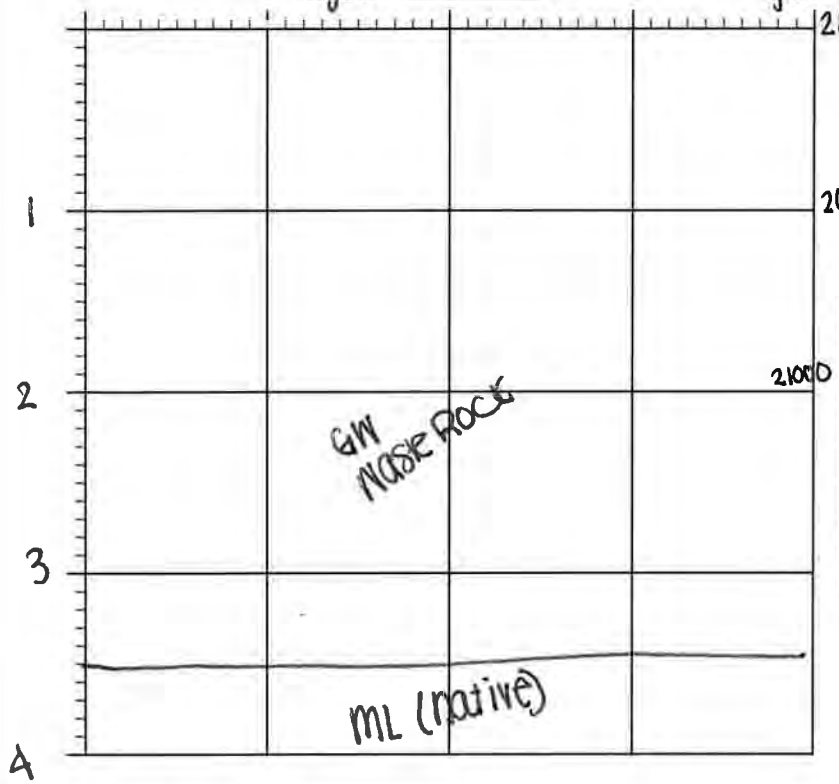
Sheet NO.: TP- [illegible]

GENERAL LOCATION: _____ DATE: 4.18.18 NORTHING: 1514540.5

PIT TREND: EW FIELD ENGINEER: Breanna Van EASTING: 2882755.6

PIT FACE LOGGED: yes

gamma scan (cpm)



TEST PIT LOG

native @ 3.5ft

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP14-01	1.1 ft	13:45	S	
SB-TP14-02	2 ft	13:50	S	*
SB-TP14-03	3.5 ft	14:00	S	*

need dup + MSMD

clean

Pit Width: 3.5ft
Pit Length: 8 ft
Pit Depth: 3.5ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel w/ sand & cobbles. Light gray. Medium dense & dry. (30% cobbles, 40% gravel, 30% sand). Possibly in-situ. Fractures
ML	Native	Dark brown. Dense. <5% sand, 95% silt. Silt

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

*: samples sent to lab

Test Pit ID: 15

Sheet NO.: TP-

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

GENERAL LOCATION:

PIT TREND: E-W

PIT FACE LOGGED: yes

DATE: 4-18-18

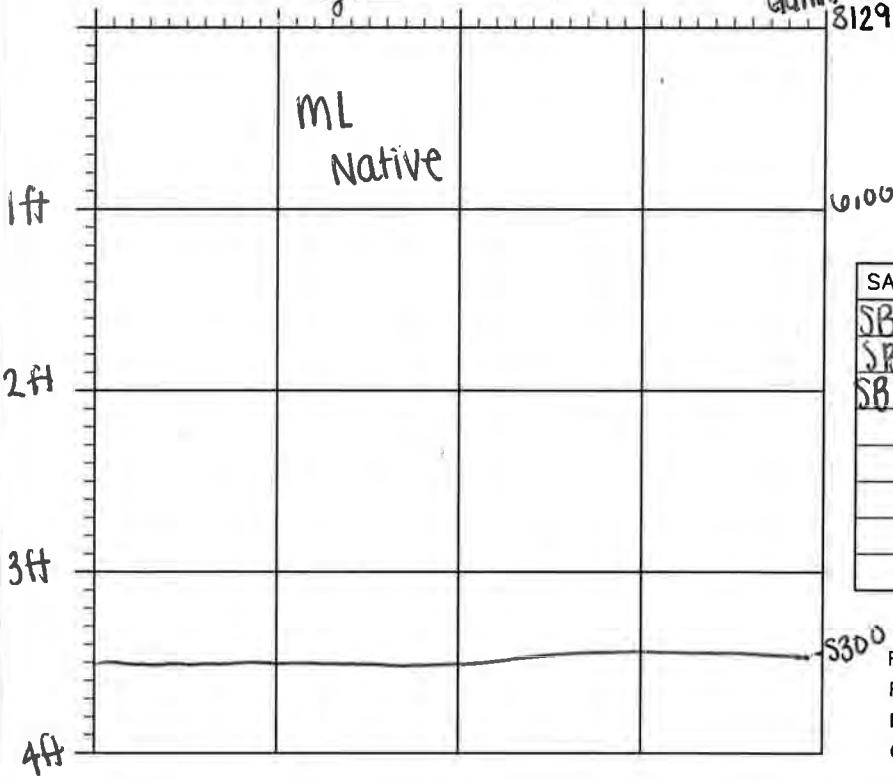
FIELD ENGINEER: Breanna Van

NORTHING: 1514476.2

EASTING: 2882323.8

Gamma (cpm) 8129

TEST PIT LOG



LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP15-01	1.1 ft	10:36	S	*
SB-TP15-02	2 ft	10:40	S	* clean
SB-TP15-03	3.5 ft	10:47	S	

Pit Width: 3 ft

Pit Length: 10 ft

Pit Depth: 3.5 ft

GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Light brown. Silt. Medium dense. Dry. 5% sand, 95% silt. Some small plant matter (roots)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*. samples sent to lab

Test Pit ID: 116

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

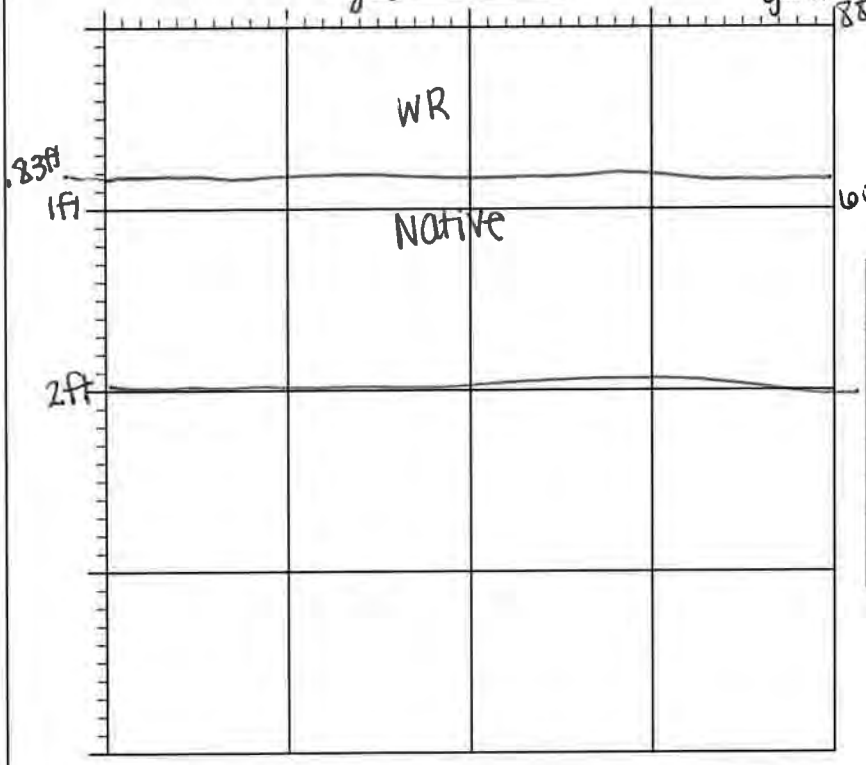
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4.18.18
FIELD ENGINEER: Breanna Van

NORTHING: 1514197.5
EASTING: 2882127.8

gamma scan (cpm)



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP16-01	1ft	15:10	S	* clean
SB-TP1602	2ft	15:15	S	*

Pit Width: 4ft
Pit Length: 9ft
Pit Depth: 2ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SW	WR	Sand with gravel & cobbles. Light gray, medium dense, dry (10% cobble, 60% sand, 30% gravel)
ML	Native	Silt. Light brown/red. Medium dense, dry. (5% sand, 95% silt)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

Native @ 10 in

*: samples sent to lab

Test Pit ID: 17

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

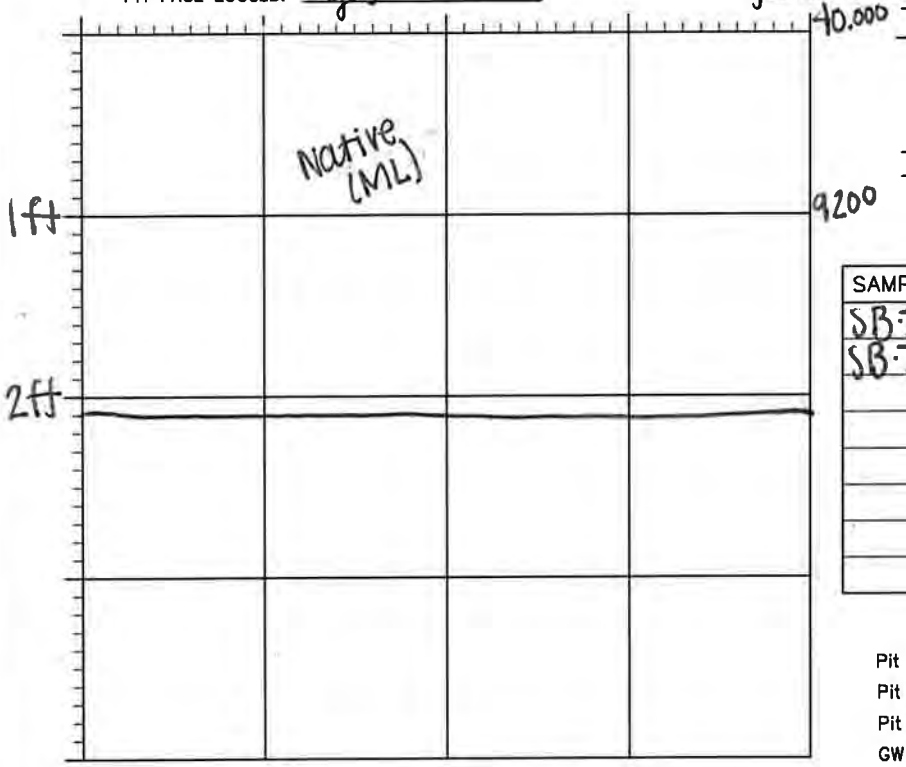
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: NW-SE
PIT FACE LOGGED: yes

DATE: 4.18.18
FIELD ENGINEER: Breanna Van

NORTHING: 1514139.3
EASTING: 2882412.6

gamma scan (cpm)



TEST PIT LOG

LEGEND

- ----- SOIL HORIZON
- ----- HORIZON CONTRACT
- ▽ GROUNDWATER LEVEL
- ⊠ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP17-01	1.2ft	15:30	S
SB-TP17-02	2.1ft	15:35	S

Pit Width: 4ft
Pit Length: 10ft
Pit Depth: 2.1ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Silt. Some sand & gravel. Some plant matter. Light brown. Loose, dry. (<5% gravel, <5% sand, 90% silt)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

* samples sent to lab

Test Pit ID: 18

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

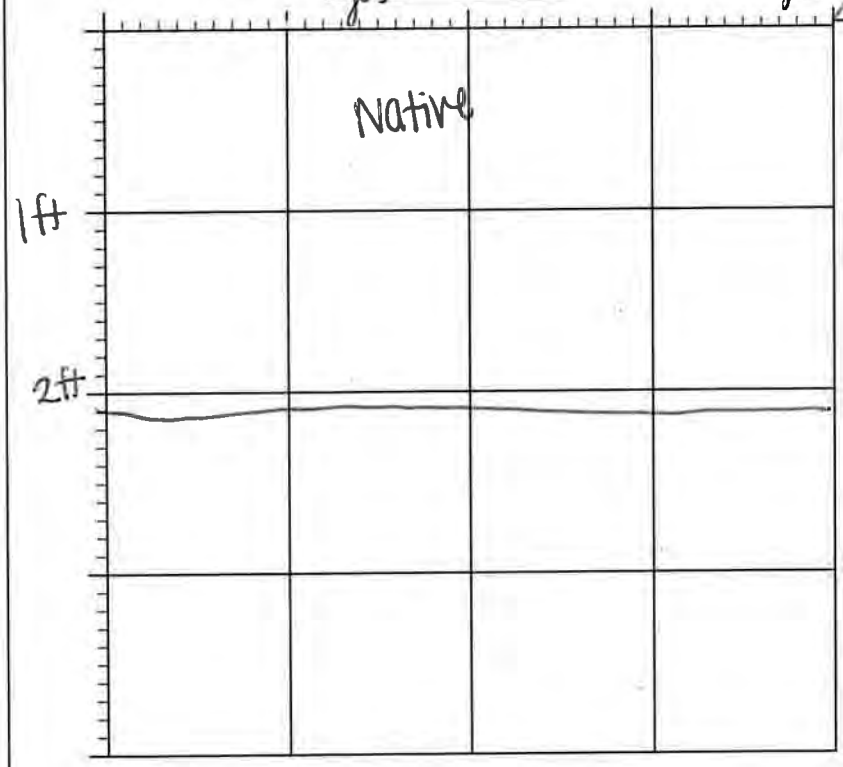
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4.18.18
FIELD ENGINEER: Breanna Van

NORTHING: 1514065.8
EASTING: 2882908.7

gamma scan (cpm)
47,000



TEST PIT LOG

LEGEND

- ----- SOIL HORIZON
- 13,000 ----- HORIZON CONTRACT
- ▽ GROUNDWATER LEVEL
- ☒ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP18-01	1ft	15:50	S *
SB-TP18-02	2.1ft	15:55	S *

Pit Width: 4ft
Pit Length: 7.5ft
Pit Depth: 2.1ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Silt w/ some sand. Light brown. Loose, dry. (5% sand, 95% silt) some plant matter

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*samples sent to lab

Test Pit ID: 19

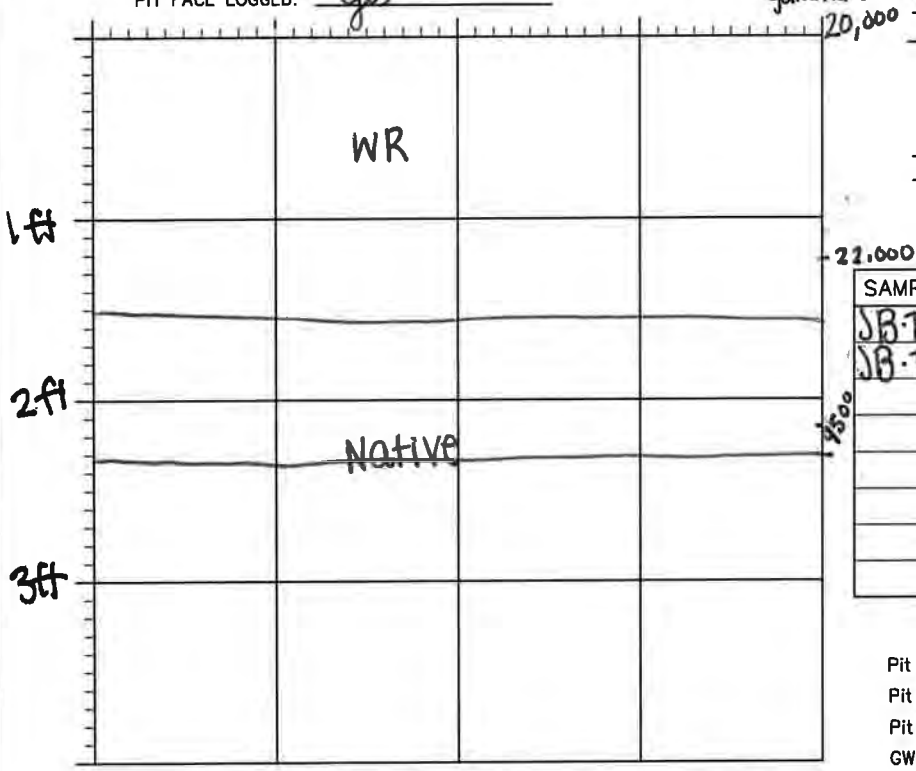
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP- _____

GENERAL LOCATION: _____
PIT TREND: E-W
PIT FACE LOGGED: yes

DATE: 4-18-18
FIELD ENGINEER: Breanna Van
gamma scan (cpm)

NORTHING: 1514025.5
EASTING: 2883361.9



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
JB-TP19-01	1.3ft	16:05	S	* QC
JB-TP19-02	2.3ft	16:10	S	*

Pit Width: 4ft
Pit Length: 9ft
Pit Depth: 2.3ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
SW	WR	Wellgraded sand w/gravel & cobbles. Light gray. Loose, dry. (15% cobbles, 30% gravel, 55% sand)
ML	Native	Silt w/sand & gravel. Some plant matter (roots) Light brown/red. (<5% gravel, <5% sand, 90% silt)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT- _____

*: samples sent to lab

Test Pit ID: 20

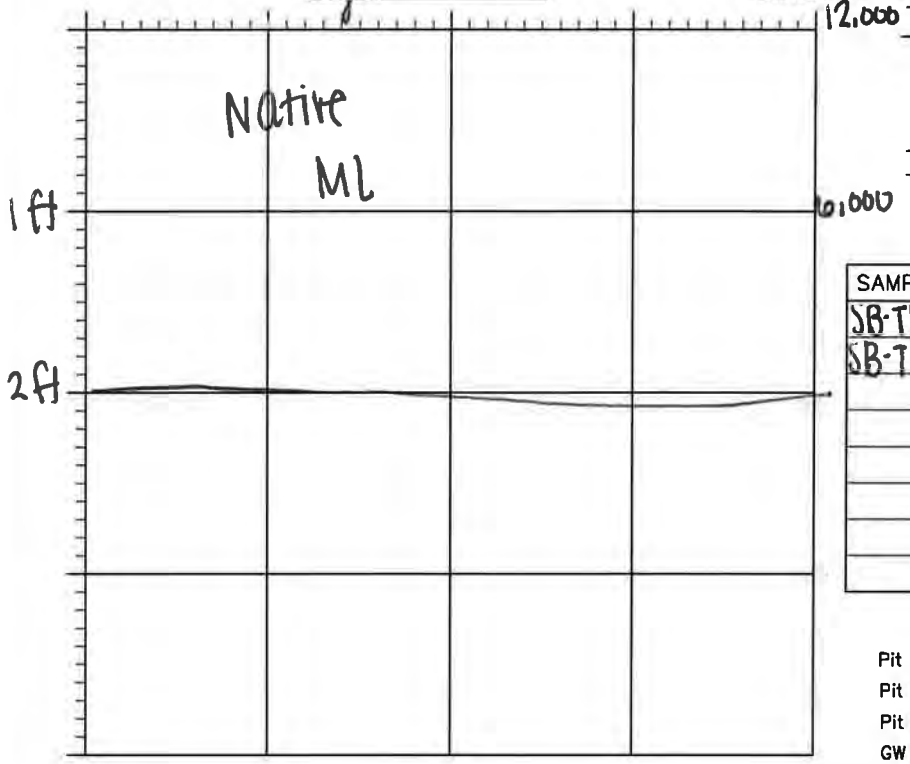
ST. ANTHONY FIELD SAMPLE DATA SHEET (FSDS)
GEOTECHNICAL TEST PIT LOGGING

Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4-19-18
FIELD ENGINEER: Breanna Van

NORTHING: 1513518
EASTING: 2884947



LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE
SB-TP20-01	1 ft	11:33	S *
SB-TP20-02	2 ft	11:40	S * QC MS/MSD

Pit Width: 4 ft
Pit Length: 11 ft
Pit Depth: 2 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
ML	Native	Dark brown. Silt. Some plant matter. (5% gravel, 10% sand, 85% silt) loose, dry

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

20 has been moved. Original location was inaccessible.

*: samples sent to lab

Test Pit ID: 21

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

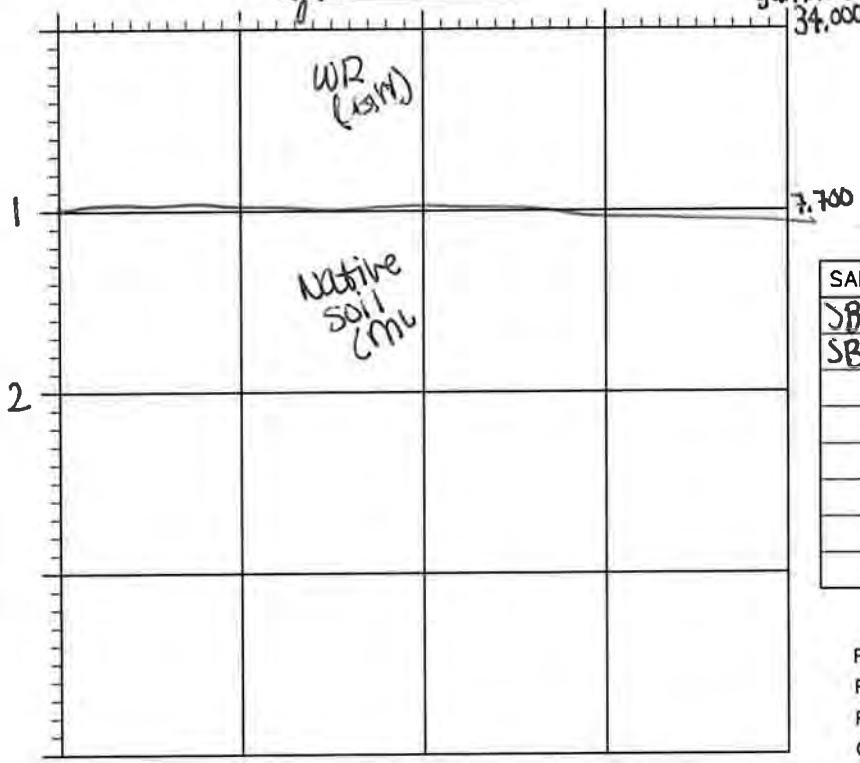
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: N-S
PIT FACE LOGGED: yes

DATE: 4.18.18
FIELD ENGINEER: Brechna Vah

NORTHING: 1913857.6
EASTING: 2881478.5

gammascan (cpm)



TEST PIT LOG

LEGEND

- - - - - SOIL HORIZON
- - - - - HORIZON CONTRACT
▽ GROUNDWATER LEVEL
⊠ SAMPLE

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP21-01	1ft	14:45	S	*
SB-TP21-02	2ft	14:50	S	*

Pit Width: 3.5ft
Pit Length: 3.5ft
Pit Depth: 2ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Light gray waste rock Gravel w/ sand & some cobbles med. dense, dry (10% cobble, 50% gravel, 40% sand)
ML	native	Light brown/red. Silt. (5% sand, 95% silt) medium dense. Dry

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

* samples sent to lab

Test Pit ID: 22

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

Sheet NO.: TP-

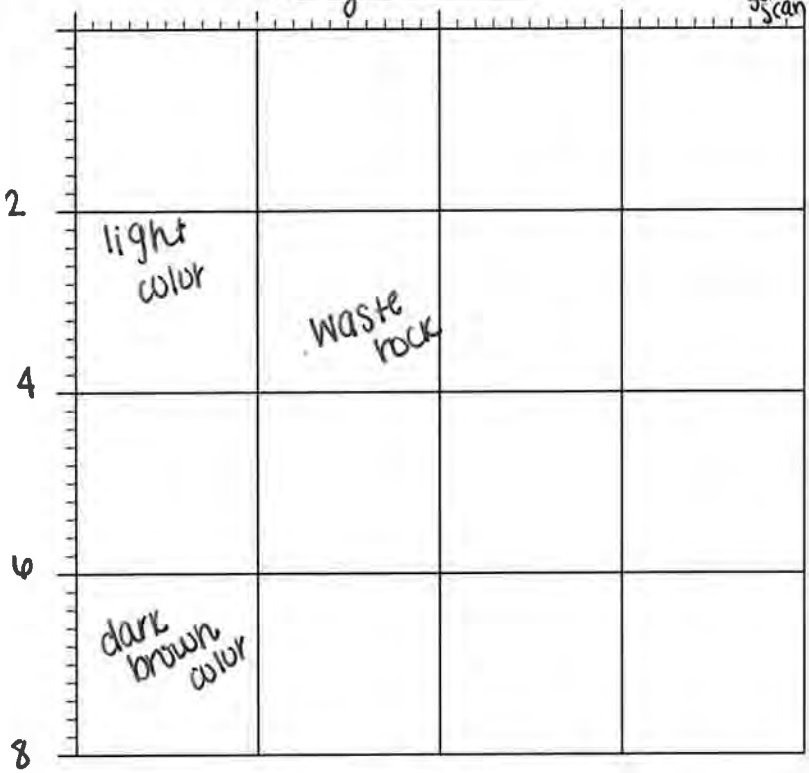
GENERAL LOCATION:
PIT TREND: E-W
PIT FACE LOGGED: yes

DATE: 4-19-18
FIELD ENGINEER: Breanna Van

NORTHING: 1513810.0
EASTING: 2883645.0

gamma scan (cpm) 10,000

TEST PIT LOG



LEGEND

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

12,000
12,000

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP22-01	1 ft	8:50	S	
SB-TP22-02	2 ft	8:55	S	
SB-TP22-03	3.1 ft	9:00	S	* Just above
SB-TP22-07	7.5 ft	9:25	S	*clean

Pit Width: 4.5 ft
Pit Length: 14 ft
Pit Depth: 7.5 ft
GW Depth: N/A

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel with sand & cobbles. Light gray / yellow. Loose, dry. (cobbles 30%, gravel 40%, sand 30%)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

Went down 7.5 ft still only waste rock. Backhoe can't safely go any deeper. Last sample clean

*: samples sent to lab

Test Pit ID: 23

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

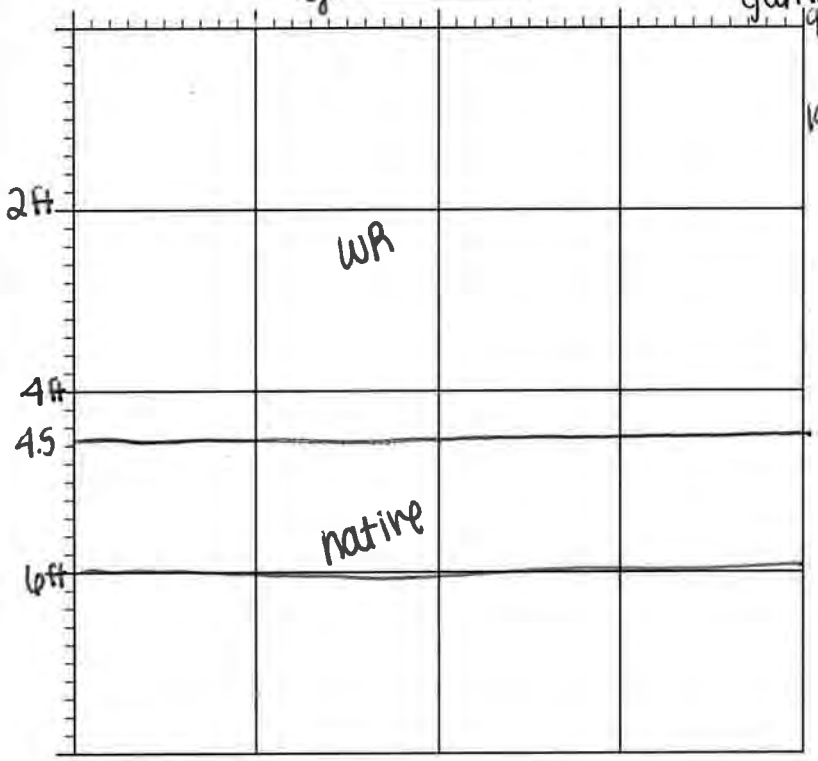
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: NE-SW
PIT FACE LOGGED: yes

DATE: 4-19-18
FIELD ENGINEER: Breanna Van

NORTHING: 1513547
EASTING: 2883838

gamma scan (cpm)
9,000
19,000



TEST PIT LOG

LEGEND

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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP23-01	1.1 ft	9:48	S	
SB-TP23-02	2 ft	9:55	S	
SB-TP23-04	4 ft	10:10	S	*
SB-TP23-06	6 ft	10:20	S	* clean

Pit Width: 4 ft
Pit Length: 16 ft
Pit Depth: 6 ft
GW Depth: Na

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	well-graded gravel w/ sand & cobbles. Light gray. loose, dry. (cobbles 20%, gravel 45%, sand 35%)
ML	Native	silt. Dark brown. medium dense, dry. (5% sand, 95% silt)

SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

Location was on berm → moved back from edge

* samples sent to lab

Test Pit ID: 24

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

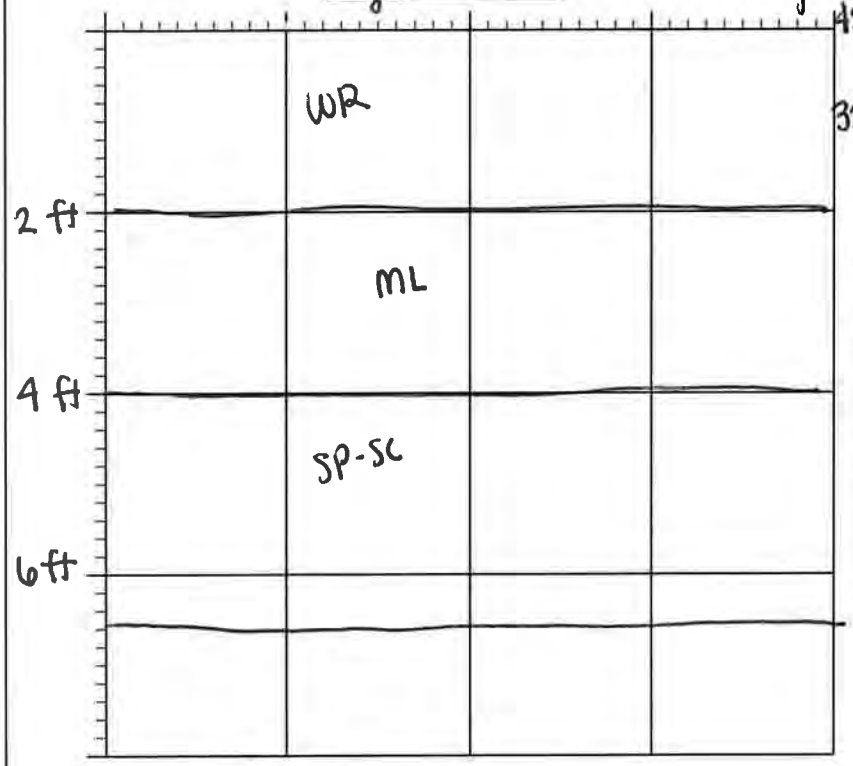
Sheet NO.: TP-

GENERAL LOCATION:
PIT TREND: NE SW
PIT FACE LOGGED: yes

DATE: 4-19-18
FIELD ENGINEER: Breanna Van

NORTHING: 1513371.5
EASTING: 2884557.1

gamma scan (cpm)



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

SAMPLE No.	DEPTH	TIME	TYPE	
SB-TP24-01	1ft	10:35	S	
SB-TP24-02	1.9ft	10:40	S	
SB-TP24-04	4.2ft	11:00	S	
SB-TP24-05	5.5ft	11:06	S	*
SB-TP24-06	6.5ft	11:17	S	*

* well above limit

Pit Width: 4.5 ft
Pit Length: 10.5 ft
Pit Depth: 6.5 ft
GW Depth: NA

USCS SYMBOL	SOIL UNIT	SOIL DESCRIPTION AND EXCAVATION NOTES
GW	WR	Well graded gravel w/ sand & cobbles. Light gray, loose, dry. (30% cobbles, 40% gravel, 30% sand)
ML		Silt. Some plant matter. Dark green color. Medium dense uniform grains. dry to moist. <5% sand 50% silt, 45% clay @ 2ft
SP-SC		Sand w/ clay & gravel. Brown. Uniform grains mostly. loose. dry. (5% gravel, 90% sand, 5% silt). Greenish tint @ 4ft

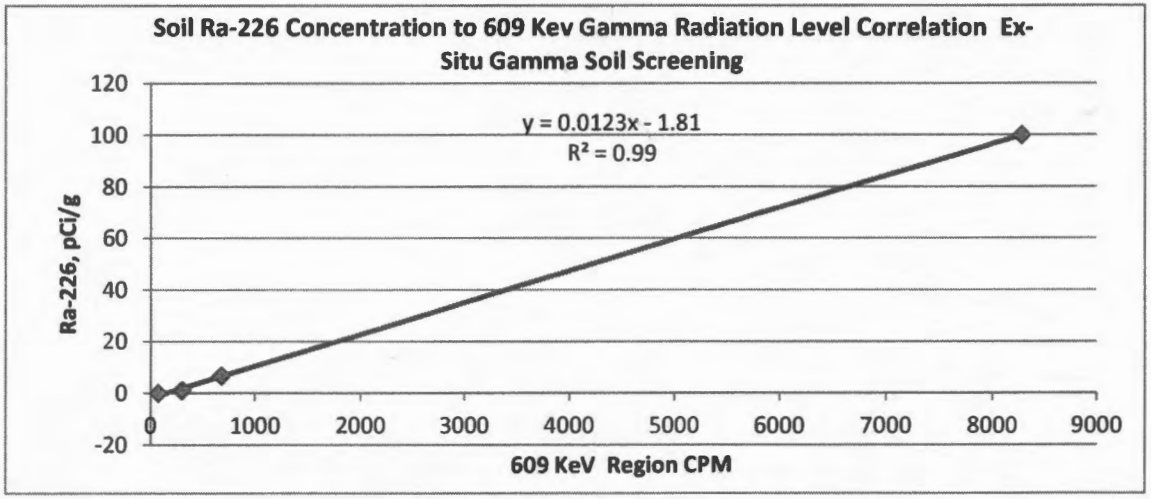
SPECIAL NOTES:

Corresponding GT FSDS Sheet No.: GT-

*samples sent to lab

AVM Environmental Services
Ex-Situ Soil Screening Gamma Radiation Level to Ra-226 Correlation
St Anthony Mine Site Test Pit Investigation

Reference Soil ID	Date	Ra-226 pCi/g	Wt gms	609 KeV CP5Min Gross (3x3 NaI Detector)	CPM
Blank	4/14/2018	0	-	389	78
BKG Soil	4/14//18	1	3000	1522	304
SA Ref Soil	4/14//18	6.6	3000	3392	678
NECR PTW Ref Soil	4/14//18	100	3000	41400	8280



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999887918
R Square	0.999775848
Adjusted R Square	0.999663772
Standard Error	0.895185294
Observations	4

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	7148.517287	7148.517287	8920.518403	0.000112082
Residual	2	1.602713422	0.801356711		
Total	3	7150.12			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.80557978	0.541028323	-3.33731101	0.079258065	-4.13343677	0.522277213	-4.13343677	0.522277213
X Variable 1	0.01229282	0.000130154	94.44849604	0.000112082	0.011732814	0.012852827	0.011732814	0.012852827

AVM Envi. ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 (#290800), Detector L 44-20 (# 295573)
Instrument Calibration Date: 04-14-2018, Instrument Function Check Performed: Y
Survey Area/Unit Decsription Correlation / Calibration data

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts	Weight Corrected Counts	CPM	Estimated Ra-226 pCi/g	Comments
4-14-18	Blank	–	389	–	78	Ø	
4-14-18	St. Anthony Background Soil	3000	1522	–	304	1.0	
4-14-18	St. Anthony 6.6 pCi/g Reference Soil	3000	3392	–	678	6.6	
4-14-18	100 pCi/g Reference Soil	3000	41400	–	8280	100	

Technician Signature [signature], Reviewed by [signature]

Gamma Spectroscopy

Case Narrative

Stantec

St. Anthony Geotechnical Investigation – 233001076

Work Order Number: 1804523

1. The following report consists of analytical results for 10 soil samples received by ALS on 04/24/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 05/02/2018 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 05/23/2018 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 05/23/2018.

4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

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. The requested detection was not met for samples 1804523-1, -2, -5, -6, -9, and -10. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an “M3” qualifier on the final reports.

8. 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	5/24/18
Pik Yee Yuen Radiochemistry Primary Data Reviewer	Date
	5/29/18
Radiochemistry Final Data Reviewer	Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1804523
Client Name: Stantec
Client Project Name: St. Anthony Geotechnical Investigation
Client Project Number: 233001076
Client PO Number: 233001076

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SB-TP19-01	1804523-1		SOIL	18-Apr-18	16:05
SB-TP19-201	1804523-2		SOIL	18-Apr-18	16:05
SB-TP19-02	1804523-3		SOIL	18-Apr-18	16:10
SB-TP10-01	1804523-4		SOIL	18-Apr-18	8:48
SB-TP10-201	1804523-5		SOIL	18-Apr-18	8:48
SB-TP10-02	1804523-6		SOIL	18-Apr-18	9:00
SB-TP15-01	1804523-7		SOIL	18-Apr-18	10:36
SB-TP15-02	1804523-8		SOIL	18-Apr-18	10:40
SB-TP13-05	1804523-9		SOIL	18-Apr-18	10:11
SB-TP13-06	1804523-10		SOIL	18-Apr-18	10:22

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 202r6

WORKORDER #	1804523				
PAGE	1 of 1				
DISPOSAL	By Lab or Return to Client				

		SAMPLER	Breanna Van	DATE	4-19-18
PROJECT NAME	St. Anthony	SITE ID	St. Anthony	TURNAROUND	Standard
PROJECT No.	233001076	EDD FORMAT			
		PURCHASE ORDER			
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec		
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis		
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150		
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525		
PHONE	970-871-4361	PHONE	970-212-2749		
FAX		FAX			
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com		

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC	Ra 226 (901.1 modified)
1	SB-TP19-01	S	4-18-18	16:05	1	NA		✓
2	SB-TP19-201	S	4-18-18	16:05	1	NA		✓
3	SB-TP19-02	S	4-18-18	16:10	1	NA		✓
4	SB-TP10-01	S	4-18-18	8:48	1	NA		✓
5	SB-TP10-201	S	4-18-18	8:48	1	NA		✓
6	SB-TP10-02	S	4-18-18	9:00	1	NA		✓
7	SB-TP15-01	S	4-18-18	10:36	1	NA		✓
8	SB-TP15-02	S	4-18-18	10:40	1	NA		✓
9	SB-TP13-05	S	4-18-18	10:11	1	NA		✓
10	SB-TP13-06	S	4-18-18	10:22	1	NA		✓

BAS

*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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY				
RECEIVED BY	[illegible]	Nick Jostes	4/23/18	12:05
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Stantec Workorder No: 1804523

Project Manager: LS Initials: NB Date: 4/24/18

1. Does this project require any special handling in addition to standard ALS procedures?		YES	NO
2. Are custody seals on shipping containers intact?	NONE	YES	NO
3. Are Custody seals on sample containers intact?	NONE	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		YES	NO
5. Are the COC and bottle labels complete and legible?		YES	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	NO
7. Were airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
10. Is there sufficient sample for the requested analyses?		YES	NO
11. Were all samples placed in the proper containers for the requested analyses?		YES	NO
12. Are all samples within holding times for the requested analyses?		YES	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		YES	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____> green pea	N/A	YES	NO
15. Do any water samples contain sediment? Amount of sediment: ____ dusting ____ moderate ____heavy	N/A	YES	NO
16. Were the samples shipped on ice?		YES	NO
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY	YES	NO

Cooler #:	1							
Temperature (°C):	Amb							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	10							
Background µR/hr reading:	9							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 4/26/18

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

Form 201r25.xls
(02/12/2018)

1804523

FROM: (303) 506-9177
van

3325 s timberline rd
ste 150
Fort Collins CO 80525
US

SHIP DATE: 20APR18
ACTWGT: 30.00 LB
CAD: 006993641/SSFE1904
DIMMED: 12 X 12 X 12 IN

TO

ALS GROUP
225 COMMERCE DR

FORT COLLINS CO 80524 (US)

(281) 776-5300 REF:
INV:
PO: DEPT:

10-0
AMB

FedEx Ground

1 of 5

TRK# **7806 0754 0542**

MASTER

80/m

80524

9622 0019 0 (000 000 0000) 0 00 7806 0754 0542

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180502-1MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180611d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0 +/- 0.23	0.42	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180502-1LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180626d10

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	462 +/- 54	2	468.3	98.6	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP15-01
Lab ID: 1804523-7DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 198 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180624d08

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
13982-63-3	Ra-226	1.04 +/- 0.24	0.36		1.17 +/- 0.27	0.38		0.351	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

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

Abbreviations:

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

Data Package ID: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP19-01
Lab ID: 1804523-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 225 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180915d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	29.0 +/- 3.6	0.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP19-201
Lab ID: 1804523-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 228 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180710d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	26.8 +/- 3.3	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP19-02
Lab ID: 1804523-3
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 224 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180610d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.90 +/- 0.24	0.42	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP10-01
Lab ID: 1804523-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 213 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180625d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	15.1 +/- 1.8	0.5	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP10-201
Lab ID: 1804523-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 214 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180722d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	8.1 +/- 1.1	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP10-02
Lab ID: 1804523-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 215 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180704d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	5.03 +/- 0.70	0.58	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP15-01
Lab ID: 1804523-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 196 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180567d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.04 +/- 0.24	0.36	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP15-01
Lab ID: 1804523-7DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 198 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180624d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.17 +/- 0.27	0.38	0.5	NA	

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.
LT - Result is less than Requested MDC, greater than sample specific MDC.
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 halflives.
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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP15-02
Lab ID: 1804523-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 205 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181120d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.76 +/- 0.25	0.45	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP13-05
Lab ID: 1804523-9
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 185 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180916d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	12.6 +/- 1.6	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804523
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP13-06
Lab ID: 1804523-10
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-1
QCBatchID: GS180502-1-1
Run ID: GS180502-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 184 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180711d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	6.93 +/- 0.95	0.58	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804523-1*

Gamma Spectroscopy

Case Narrative

Stantec

St. Anthony Geotechnical Investigation – 233001076

Work Order Number: 1804521

1. The following report consists of analytical results for 11 soil samples received by ALS on 04/24/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 05/02/2018 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 05/23/2018 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 05/23/2018.

4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

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. The requested detection was not met for samples 1804521-1, -1DUP, -2, -8, and -10. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an “M3” qualifier on the final reports.

8. 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 — 5/24/18

Pik Yee Yuen — Date

Radiochemistry Primary Data Reviewer

5/29/18

Radiochemistry Final Data Reviewer — Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1804521
Client Name: Stantec
Client Project Name: St. Anthony Geotechnical Investigation
Client Project Number: 233001076
Client PO Number: 233001076

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SB-TP07-01	1804521-1		SOIL	16-Apr-18	9:27
SB-TP07-201	1804521-2		SOIL	16-Apr-18	9:27
SB-TP07-02	1804521-4		SOIL	16-Apr-18	9:36
SB-TP05-05	1804521-5		SOIL	16-Apr-18	10:52
SB-TP04-05	1804521-6		SOIL	16-Apr-18	11:30
SB-TP04-06	1804521-7		SOIL	16-Apr-18	11:47
SB-TP06-01	1804521-8		SOIL	16-Apr-18	12:04
SB-TP09-02	1804521-9		SOIL	16-Apr-18	13:50
SB-TP08-01	1804521-10		SOIL	16-Apr-18	14:30
SB-TP08-02	1804521-11		SOIL	16-Apr-18	14:35
SB-TP03-01	1804521-12		SOIL	16-Apr-18	16:05

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 202r6

WORKORDER # 1804521

PAGE 1 of 2

PROJECT NAME	St. Anthony	SAMPLER	Breanna Van
PROJECT No.	233001076	SITE ID	St. Anthony
		EDD FORMAT	
		PURCHASE ORDER	
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525
PHONE	970-871-4361	PHONE	970-212-2749
FAX		FAX	
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com

DATE 4·17·2018
TURNAROUND Standard
DISPOSAL By Lab or Return to Client

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC	Pu-226 (8011 modified)
1	SB-TP07-01	S	4·16·18	9:27	1	NA		✓
2	SB-TP07-201	S	4·16·18	9:27	1	NA		✓
1 3	SB-TP07-01 MSD/MS	S	4·16·18	9:27	1	NA		✓
4	SB-TP07-02	S	4·16·18	9:36	1	NA		✓
5	SB-TP05-05	S	4·16·18	10:52	1	NA		✓
6	SB-TP04-05	S	4·16·18	11:30	1	NA		✓
7	SB-TP04-06	S	4·16·18	11:47	1	NA		✓
8	SB-TP06-01	S	4·16·18	12:04	1	NA		✓
9	SB-TP09-02	S	4·16·18	13:50	1	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:

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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY	Breanna Van	Breanna Van	4/17/18	12:07
RECEIVED BY		KELI-JEAN SMITH	4/24/18	12:05
RELINQUISHED BY				
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 202r6

WORKORDER #	1804521				
PAGE	2 of 2				
DISPOSAL	By Lab or Return to Client				

		SAMPLER	Breanna Van	DATE	4·17·2018
PROJECT NAME	St. Anthony	SITE ID	St. Anthony	TURNAROUND	Standard
PROJECT No.	233001076	EDD FORMAT			
		PURCHASE ORDER			
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec		
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis		
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150		
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525		
PHONE	970-871-4361	PHONE	970-212-2749		
FAX		FAX			
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com		

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC	Ra 226 (901.1 modified)
10	SB-TP08-01	S	4·16·18	14:30	1	NA		✓
11	SB-TP08-02	S	4·16·18	14:35	1	NA		✓
12	SB-TP03-01	S	4·16·18	16:05	1	NA		✓
		S				NA		
		S				NA		
		S				NA		
		S				NA		
		S				NA		
		S				NA		
		S				NA		

BV

*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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY	Breanna Van	Breanna Van	4/17/18	12:07
RECEIVED BY		KELI-JEAN SMI	4.24.18	1205
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

5 of 27

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: STANTEC Workorder No: 1804521

Project Manager: LRS Initials: KZ Date: 4.24.18

1.	Does this project require any special handling in addition to standard ALS procedures?		YES	NO
2.	Are custody seals on shipping containers intact?	NONE	YES	NO
3.	Are Custody seals on sample containers intact?	NONE	YES	NO
4.	Is there a COC (Chain-of-Custody) present or other representative documents?		YES	NO
5.	Are the COC and bottle labels complete and legible?		YES	NO
6.	Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	NO
7.	Were airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
8.	Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	NO
9.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
10.	Is there sufficient sample for the requested analyses?		YES	NO
11.	Were all samples placed in the proper containers for the requested analyses?		YES	NO
12.	Are all samples within holding times for the requested analyses?		YES	NO
13.	Were all sample containers received intact? (not broken or leaking, etc.)		YES	NO
14.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	N/A	YES	NO
15.	Do any water samples contain sediment? Amount of sediment: ____ dusting ____ moderate ____ heavy	N/A	YES	NO
16.	Were the samples shipped on ice?		YES	NO
17.	Were cooler temperatures measured at 0.1-6.0°C?	RAD ONLY	YES	NO

IR gun used*:	#1	#3	#4
Cooler #:	1		
Temperature (°C):	AMB		
No. of custody seals on cooler:	0		
DOT Survey/ Acceptance Information — External µR/hr reading:	10		
Background µR/hr reading:	7		

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 4/26/18

Form 201r25.xls
(02/12/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

1804521

FROM: (303) 506-9179
van

3325 s timberline rd
ste 150
Fort Collins CO 80525
US

SHIP DATE: 20APR18
ACTWGT: 30.00 LB
CAD: 006993641/SSFE1904
DIMMED: 12 X 12 X 21 IN

TO

ALS GROUP
225 COMMERCE DR

10-0

FORT COLLINS CO 80524 (US)

(281) 776-5300 REF:
INV:
PO: DEPT:

AMR

FedEx Ground

G

5 of 5

MPS# 7806 0754 0586

Mstr# 7806 0754 0542

9@m

80524

9622 0019 0 (000 000 0000) 0 00 7806 0754 0586

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180502-3MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180566d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	-0.10 +/- 0.16	0.32	0.5	NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP
U
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180502-3LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180623d08

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	449 +/- 53	2	468.3	95.9	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP07-01
Lab ID: 1804521-1DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 239 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180702d02

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
13982-63-3	Ra-226	29.3 +/- 3.5	0.9	M3	27.8 +/- 3.3	0.7	M3	0.296	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

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

Abbreviations:

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

Data Package ID: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP07-01
Lab ID: 1804521-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 235 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180720d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	29.3 +/- 3.5	0.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP07-01
Lab ID: 1804521-1DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 239 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180702d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	27.8 +/- 3.3	0.7	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.
LT - Result is less than Requested MDC, greater than sample specific MDC.
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 halflives.
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: *GSS1804521-1*

Date Printed: Thursday, May 24, 2018

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP07-201
Lab ID: 1804521-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 237 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181118d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	27.8 +/- 3.4	1.1	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP07-02
Lab ID: 1804521-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 220 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180565d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.69 +/- 0.18	0.31	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP05-05
Lab ID: 1804521-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 220 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180622d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.65 +/- 0.19	0.34	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP04-05
Lab ID: 1804521-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 247 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180609d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	4.87 +/- 0.69	0.44	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP04-06
Lab ID: 1804521-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180624d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	2.79 +/- 0.39	0.33	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP06-01
Lab ID: 1804521-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 195 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180914d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	4.79 +/- 0.71	0.67	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP09-02
Lab ID: 1804521-9
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 206 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180709d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.54 +/- 0.32	0.47	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP08-01
Lab ID: 1804521-10
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 220 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180721d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	15.3 +/- 1.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP08-02
Lab ID: 1804521-11
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 198 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180703d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.92 +/- 0.25	0.40	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804521
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP03-01
Lab ID: 1804521-12
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 16-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 204 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181119d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.61 +/- 0.35	0.48	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804521-1*

Gamma Spectroscopy

Case Narrative

Stantec

St. Anthony Geotechnical Investigation – 233001076

Work Order Number: 1804517

1. The following report consists of analytical results for nine soil samples received by ALS on 04/24/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 05/02/2018 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 05/23/2018 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 05/23/2018.

4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

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 or greater 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 where the sample density is less than the calibration density, and low for results where sample density is greater than the calibration density. 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 was not met for samples 18004517-3, -5, -6, and -8. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an "M3" qualifier on the final reports.

9. 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 — 5/24/18
Pik Yee Yuen — Date
Radiochemistry Primary Data Reviewer

5/29/18
Radiochemistry Final Data Reviewer — Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1804517
Client Name: Stantec
Client Project Name: St. Anthony Geotechnical Investigation
Client Project Number: 233001076
Client PO Number: 233001076

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SB-TP21-01	1804517-1		SOIL	18-Apr-18	14:45
SB-TP21-02	1804517-2		SOIL	18-Apr-18	14:50
SB-TP11-04	1804517-3		SOIL	18-Apr-18	11:16
SB-TP11-05	1804517-4		SOIL	18-Apr-18	11:34
SB-TP12-03	1804517-5		SOIL	18-Apr-18	12:26
SB-TP12-04	1804517-6		SOIL	18-Apr-18	12:35
SB-TP14-02	1804517-7		SOIL	18-Apr-18	13:50
SB-TP14-202	1804517-8		SOIL	18-Apr-18	13:50
SB-TP14-03	1804517-10		SOIL	18-Apr-18	14:00

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 202r6

WORKORDER # 1804517

PAGE 1 of 1

		SAMPLER	Breanna Van
PROJECT NAME	St. Anthony	SITE ID	St. Anthony
PROJECT No.	233001076	EDD FORMAT	
		PURCHASE ORDER	
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525
PHONE	970-871-4361	PHONE	970-212-2749
FAX		FAX	
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com

DATE 4-19-18
TURNAROUND Standard
DISPOSAL By Lab or Return to Client

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles Bags	Pres.	QC	Ra 226/modified
1	SB-TP21-01	S	4-18-18	14:45	1	NA		✓
2	SB-TP21-02	S	4-18-18	14:50	1	NA		✓
3	SB-TP11-04	S	4-18-18	11:16	1	NA		✓
4	SB-TP11-05	S	4-18-18	11:34	1	NA		✓
5	SB-TP12-03	S	4-18-18	12:26	1	NA		✓
6	SB-TP12-04	S	4-18-18	12:35	1	NA		✓
7	SB-TP14-02	S	4-18-18	13:50	1	NA		✓
8	SB-TP14-202	S	4-18-18	13:50	1	NA		✓
9	SB-TP14-02 MS/MSD	S	4-18-18	13:50	1	NA		✓
10	SB-TP14-03	S	4-18-18	14:00	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)

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY				
RECEIVED BY		KELI-JEAN SMITH	4-24-18	1205
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: 1804517

Project Manager: LRS Initials: KZ Date: 4-24-18

1.	Does this project require any special handling in addition to standard ALS procedures?		YES	NO
2.	Are custody seals on shipping containers intact?	NONE	YES	NO
3.	Are Custody seals on sample containers intact?	NONE	YES	NO
4.	Is there a COC (Chain-of-Custody) present or other representative documents?		YES	NO
5.	Are the COC and bottle labels complete and legible?		YES	NO
6.	Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	NO
7.	Were airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
8.	Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	NO
9.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
10.	Is there sufficient sample for the requested analyses?		YES	NO
11.	Were all samples placed in the proper containers for the requested analyses?		YES	NO
12.	Are all samples within holding times for the requested analyses?		YES	NO
13.	Were all sample containers received intact? (not broken or leaking, etc.)		YES	NO
14.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____> green pea	N/A	YES	NO
15.	Do any water samples contain sediment? Amount of sediment: ____ dusting ____ moderate ____heavy	Amount N/A	YES	NO
16.	Were the samples shipped on ice?		YES	NO
17.	Were cooler temperatures measured at 0.1-6.0°C?	RAD ONLY	YES	NO

IR gun used*:	#1	#3	#4
Cooler #:	1		
Temperature (°C):	AMB		
No. of custody seals on cooler:	0		
External µR/hr reading:	10		
Background µR/hr reading:	9		

DOT Survey/ Acceptance Information

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 4/26/18

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

Form 201r25.xls
(02/12/2018)

FROM:
van (303) 506-9177

3325 s timberline rd
ste 150
Fort Collins CO 80525
US

SHIP DATE: 20APR18
ACTWGT: 30.00 LB
CAD: 006993641/SSFE1904
DIMMED: 12 X 12 X 12 IN

1804517

TO

ALS GROUP
225 COMMERCE DR

FORT COLLINS CO 80524 (US)
(281) 776-5300
INV:
PO: REF:
DEPT:

10-0

FedEx Ground

4 of 5
MPS# 7806 0754 0575
Mstr# 7806 0754 0542

80524

9622 0019 0 (000 000 0000) 0 00 7806 0754 0575

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180502-3MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180566d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	-0.10 +/- 0.16	0.32	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180502-3LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180623d08

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	449 +/- 53	2	468.3	95.9	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP21-01
Lab ID: 1804517-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 220 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180719d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.35 +/- 0.30	0.43	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP21-02
Lab ID: 1804517-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 212 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180701d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.78 +/- 0.22	0.37	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP11-04
Lab ID: 1804517-3
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 250 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181117d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	21.7 +/- 2.7	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP11-05
Lab ID: 1804517-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 192 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180564d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	4.30 +/- 0.61	0.44	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP12-03
Lab ID: 1804517-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 180 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180621d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	2.25 +/- 0.42	0.52	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP12-04
Lab ID: 1804517-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 245 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180608d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	16.0 +/- 2.0	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP14-02
Lab ID: 1804517-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 249 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180623d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	16.4 +/- 2.0	0.5	0.5	NA	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP14-202
Lab ID: 1804517-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 245 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180913d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	14.4 +/- 1.8	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804517
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP14-03
Lab ID: 1804517-10
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 23-May-18

Prep Batch: GS180502-3
QCBatchID: GS180502-3-1
Run ID: GS180502-3A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 189 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180708d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	2.08 +/- 0.39	0.46	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804517-1*

Gamma Spectroscopy

Case Narrative

Stantec

St. Anthony Geotechnical Investigation – 233001076

Work Order Number: 1804515

1. The following report consists of analytical results for 10 soil samples received by ALS on 04/24/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 04/30/2018 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 05/21/2018 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 05/21/2018.

4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

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 greater 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 low 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 met for samples 1804515-1, -2, -3, and -6. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an "M3" qualifier on the final report.

9. 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 — 5/23/18

Pik Yee Yuen — Date

Radiochemistry Primary Data Reviewer

5/29/18

Radiochemistry Final Data Reviewer — Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1804515
Client Name: Stantec
Client Project Name: St. Anthony Geotechnical Investigation
Client Project Number: 233001076
Client PO Number: 233001076

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SB-TP02-01	1804515-1		SOIL	19-Apr-18	12:35
SB-TP02-02	1804515-2		SOIL	19-Apr-18	12:40
SB-TP01-01	1804515-3		SOIL	19-Apr-18	13:00
SB-TP01-02	1804515-4		SOIL	19-Apr-18	13:10
SB-TP18-01	1804515-5		SOIL	18-Apr-18	15:50
SB-TP18-02	1804515-6		SOIL	18-Apr-18	15:55
SB-TP17-01	1804515-7		SOIL	18-Apr-18	15:30
SB-TP17-02	1804515-8		SOIL	18-Apr-18	15:35
SB-TP16-01	1804515-9		SOIL	18-Apr-18	15:10
SB-TP16-02	1804515-10		SOIL	18-Apr-18	15:15

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 202r6

WORKORDER #	1804515				
PAGE	1 of 1				
DISPOSAL	By Lab or Return to Client				

		SAMPLER	Breanna Van	DATE	4-19-18
PROJECT NAME	St. Anthony	SITE ID	St. Anthony	TURNAROUND	Standard
PROJECT No.	233001076	EDD FORMAT			
		PURCHASE ORDER			
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec		
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis		
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150		
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525		
PHONE	970-871-4361	PHONE	970-212-2749		
FAX		FAX			
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com		

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles Bags	Pres.	QC	Ra 226 (901.1 modified)
1	SB-TP02-01	S	4-19-18	12:35	1	NA		✓
2	SB-TP02-02	S	4-19-18	12:40	1	NA		✓
3	SB-TP01-01	S	4-19-18	13:00	1	NA		✓
4	SB-TP01-02	S	4-19-18	13:10	1	NA		✓
5	SB-TP18-01	S	4-18-18	15:50	1	NA		✓
6	SB-TP18-02	S	4-18-18	15:55	1	NA		✓
7	SB-TP17-01	S	4-18-18	15:30	1	NA		✓
8	SB-TP17-02	S	4-18-18	15:35	1	NA		✓
9	SB-TP16-01	S	4-18-18	15:10	1	NA		✓
10	SB-TP16-02	S	4-18-18	15:15	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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY				
RECEIVED BY		KELI-JEAN SMITH	4-24-18	1205
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: STANTEC Workorder No: 1804515

Project Manager: LKS Initials: [illegible] Date: 4-26-18

1. Does this project require any special handling in addition to standard ALS procedures?			YES	NO
2. Are custody seals on shipping containers intact?	NONE		YES	NO
3. Are Custody seals on sample containers intact?	NONE		YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?			YES	NO
5. Are the COC and bottle labels complete and legible?			YES	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)			YES	NO
7. Were airbills / shipping documents present and/or removable?	DROP OFF		YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A		YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	N/A		YES	NO
10. Is there sufficient sample for the requested analyses?			YES	NO
11. Were all samples placed in the proper containers for the requested analyses?			YES	NO
12. Are all samples within holding times for the requested analyses?			YES	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)			YES	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____> green pea	N/A		YES	NO
15. Do any water samples contain sediment? Amount of sediment: ____ dusting ____ moderate ____heavy	N/A	Amount	YES	NO
16. Were the samples shipped on ice?			YES	NO
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY		YES	NO

Cooler #:	1							
Temperature (°C):	AMB							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	11							
Background µR/hr reading:	9							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 4/26/18

Form 201r25.xls
(02/12/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

1804515

FROM: (303) 506-9177
van

3325 s timberline rd
ste 150
Fort Collins CO 80525
US

SHIP DATE: 20APR18
ACTWGT: 30.00 LB
CAD: 006993641/SSFE1904
DIMMED: 12 X 12 X 12 IN

TO

ALS GROUP
225 COMMERCE DR

FORT COLLINS CO 80524 (US)

(281) 776-5300 REF:
INV:
PO: DEPT:

11-0
AMB

FedEx Ground

G

9 @ 1M

3 of 5

MPS# 7806 0754 0564

Mstr# 7806 0754 0542

80524

9622 0019 0 (000 000 0000) 0 00 7806 0754 0564

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180501-1MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180903d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.04 +/- 0.18	0.33	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180501-1LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180700d07

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	455 +/- 53	3	468.3	97.1	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP02-01
Lab ID: 1804515-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 239 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180612d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	35.4 +/- 4.2	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP02-02
Lab ID: 1804515-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 205 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180708d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.38 +/- 0.32	0.51	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP01-01
Lab ID: 1804515-3
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 253 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180690d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	9.2 +/- 1.2	0.5	0.5	NA	M3,G

Comments:

Qualifiers/Flags:

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

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP01-02
Lab ID: 1804515-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 206 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180902d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.26 +/- 0.30	0.50	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP18-01
Lab ID: 1804515-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 215 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180699d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.02 +/- 0.24	0.35	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP18-02
Lab ID: 1804515-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 214 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180599d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.94 +/- 0.27	0.50	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP17-01
Lab ID: 1804515-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 221 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180613d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.42 +/- 0.24	0.35	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP17-02
Lab ID: 1804515-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 212 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181111d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.91 +/- 0.26	0.41	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP16-01
Lab ID: 1804515-9
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 211 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180709d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.77 +/- 0.25	0.41	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804515
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP16-02
Lab ID: 1804515-10
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 213 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180691d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.87 +/- 0.24	0.43	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804515-1*

Gamma Spectroscopy

Case Narrative

Stantec

St. Anthony Geotechnical Investigation – 233001076

Work Order Number: 1804514

1. The following report consists of analytical results for nine soil samples received by ALS on 04/24/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 04/30/2018 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 05/21/2018 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 05/21/2018.

4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

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 met for samples 1804514-1, -2, -2DUP, -4, -7, -8, and -9. The reported activity exceeds the achieved MDC. Results are submitted without further qualification. The results are flagged with an "M3" qualifier on the final report.

9. 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 — 5/23/18
Pik Yee Yuen — Date
Radiochemistry Primary Data Reviewer

5/29/18
Radiochemistry Final Data Reviewer — Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1804514
Client Name: Stantec
Client Project Name: St. Anthony Geotechnical Investigation
Client Project Number: 233001076
Client PO Number: 233001076

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SB-TP20-01	1804514-1		SOIL	19-Apr-18	11:33
SB-TP20-02	1804514-2		SOIL	19-Apr-18	11:40
SB-TP20-202	1804514-4		SOIL	19-Apr-18	11:40
SB-TP22-03	1804514-5		SOIL	19-Apr-18	9:00
SB-TP22-07	1804514-6		SOIL	19-Apr-18	9:25
SB-TP24-06	1804514-7		SOIL	19-Apr-18	11:17
SB-TP24-05	1804514-8		SOIL	19-Apr-18	11:06
SB-TP23-04	1804514-9		SOIL	19-Apr-18	10:10
SB-TP23-06	1804514-10		SOIL	19-Apr-18	10:20

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 202r6

WORKORDER #	1804514
PAGE	1 of 1
DISPOSAL	By Lab or Return to Client

		SAMPLER	Breanna Van
		DATE	4-19-18
		TURNAROUND	Standard
PROJECT NAME	St. Anthony	SITE ID	St. Anthony
PROJECT No.	233001076	EDD FORMAT	
		PURCHASE ORDER	
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525
PHONE	970-871-4361	PHONE	970-212-2749
FAX		FAX	
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com

Ra 226/901.1 modified

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# ~~Bottles~~ Bags	Pres.	QC	
1	SB-TP20-01	S	4-19-18	11:33	1	NA		✓
2	SB-TP20-02	S	4-19-18	11:40	1	NA		✓
~~3~~ 2	SB-TP20-02 MSMSD	S	4-19-18	11:40	1	NA		✓
4	SB-TP20-202	S	4-19-18	11:40	1	NA		✓
5	SB-TP22-03	S	4-19-18	9:00	1	NA		✓
6	SB-TP22-07	S	4-19-18	9:25	1	NA		✓
7	SB-TP24-06	S	4-19-18	11:17	1	NA		✓
8	SB-TP24-05	S	4-19-18	11:06	1	NA		✓
9	SB-TP23-04	S	4-19-18	10:10	1	NA		✓
10	SB-TP23-06	S	4-19-18	10:20	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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY				
RECEIVED BY		KELI-JEAN SMITH	4.24.18	1205
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: STANTEC Workorder No: 1804514

Project Manager: LRS Initials: KJ Date: 4-24-18

1.	Does this project require any special handling in addition to standard ALS procedures?		YES	NO
2.	Are custody seals on shipping containers intact?	NONE	YES	NO
3.	Are Custody seals on sample containers intact?	NONE	YES	NO
4.	Is there a COC (Chain-of-Custody) present or other representative documents?		YES	NO
5.	Are the COC and bottle labels complete and legible?		YES	NO
6.	Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	NO
7.	Were airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
8.	Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	NO
9.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
10.	Is there sufficient sample for the requested analyses?		YES	NO
11.	Were all samples placed in the proper containers for the requested analyses?		YES	NO
12.	Are all samples within holding times for the requested analyses?		YES	NO
13.	Were all sample containers received intact? (not broken or leaking, etc.)		YES	NO
14.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____> green pea	N/A	YES	NO
15.	Do any water samples contain sediment? Amount of sediment: ____ dusting ____ moderate ____heavy	N/A	YES	NO
16.	Were the samples shipped on ice?		YES	NO
17.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY	YES	NO

Cooler #:	1						
Temperature (°C):	AMB						
No. of custody seals on cooler:	0						
DOT Survey/ Acceptance Information — External µR/hr reading:	10						
Background µR/hr reading:	9						

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 4/24/18

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

Form 201r25.xls
(02/12/2018)

FROM:
vsn (303) 506-9177

3325 s timberline rd
ste 150
Fort Collins CO 80525
US

SHIP DATE: 20APR18
ACTWGT: 30.00 LB
CAD: 006993641/SSFE1904
DIMMED: 12 X 12 X 12 IN

TO

1804514

ALS GROUP
225 COMMERCE DR

10-0

FORT COLLINS CO 80524
(281) 776-5300
INV:
PO:
REF:
DEPT:

AMB

FedEx
Ground
G

9@1m

2 of 5
MPS# 7806 0754 0553
Mstr# 7806 0754 0542

80524

9622 0019 0 (000 000 0000) 0 00 7806 0754 0553

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180501-1MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180903d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.04 +/- 0.18	0.33	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180501-1LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 29-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180700d07

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	455 +/- 53	3	468.3	97.1	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP20-02
Lab ID: 1804514-2DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 190 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180900d03

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
13982-63-3	Ra-226	1.32 +/- 0.32	0.54	M3,G	1.09 +/- 0.31	0.52	M3	0.504	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

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

Abbreviations:

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

Data Package ID: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP20-01
Lab ID: 1804514-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 167 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180706d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.60 +/- 0.38	0.58	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP20-02
Lab ID: 1804514-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 183 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180688d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.32 +/- 0.32	0.54	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP20-02
Lab ID: 1804514-2DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 190 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180900d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.09 +/- 0.31	0.52	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.
LT - Result is less than Requested MDC, greater than sample specific MDC.
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 halflives.
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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP20-202
Lab ID: 1804514-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 189 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180597d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.26 +/- 0.34	0.61	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP22-03
Lab ID: 1804514-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 230 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180611d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	6.63 +/- 0.85	0.38	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP22-07
Lab ID: 1804514-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 223 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180698d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.97 +/- 0.35	0.42	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP24-06
Lab ID: 1804514-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 211 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180707d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	55.5 +/- 6.6	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 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP24-05
Lab ID: 1804514-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 225 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180689d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	30.0 +/- 3.6	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP23-04
Lab ID: 1804514-9
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 245 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180901d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	31.2 +/- 3.8	0.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1804514
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SB-TP23-06
Lab ID: 1804514-10
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 19-Apr-18
Date Prepared: 29-Apr-18
Date Analyzed: 21-May-18

Prep Batch: GS180501-1
QCBatchID: GS180501-1-1
Run ID: GS180501-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 218 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180598d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	2.26 +/- 0.40	0.48	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1804514-1*

Appendix C
St. Anthony Mine Site Correlation Data
(Gamma Radiation Level to Ra-226 Correlation Regression Analysis
Static Gamma Radiation Survey Field Forms for Correlations
Field Soil Sample Log Forms
Correlation Soil Sample Laboratory Analytical Result Reports)

AVM Environmental Services, Inc.
Gamma Radiation Survey @ St. Anthony Mine Site
Static Gamma Radiation Survey Field Form For Correlation

Instrumentation : Scaler/Ratemeter L2221 S#290801, Detector SPA-3 #33

Instrument Calibration Date: 8-1-17, Instrument Daily Function Check Performed: ✓

Survey Area/Unit Decsription St. Anthony Correlation

Survey Date	Survey Point & Soil Sample ID/Description	Survey Point Coordinate (State Plain, NAD 1983)		Gamma Rad Level (cpm) SPA-3, SR# 408522-33		uR/hr	Comments/Notes
		Northing (ft)	Easting (ft)	Lead Collimated	Bare		
5-7-18	SS-COR-001	1517823.1	2878759.2	3324 3383 3381	9937 10077 10013	10	
"	SS-COR-002	1517808.0	2878713.9	3165 3070 3238	10406 10441 10425	11	
"	SS-COR-003	1518535.2	2880210.2	25600 25894 25731	84039 83117 83689	95	Dark grey material in bottom half of Sample layer
"	SS-COR-004	1517269.8	2879341.7	22796 20739 22490	68362 64884 65222	70	
"	SS-COR-005	1517373.8	2879448.8	7439 6924 7043	19346 19412 19769	20	
"	SS-COR-006	1517565.3	2878649.3	3124 3328 3251	11405 11685 11194	12	
"	SS-COR-007	1516883.8	2880235.5	4991 5241 5096	14131 14174 14372	15	
"	SS-COR-008	1516845.4	2880218.5	6881 6849 7065	20219 20268 20155	20	
"	SS-COR-009	1516767.1	2880261.7	26362 26596 26725	64037 64428 63871	70	
"	SS-COR-010	1516856.0	2880315.2	8515 8672 8635	22943 23060 22997	25	

Technician Signature [signature], Reviewed by [signature]

AVM Environmental Services, Inc.
Gamma Radiation Survey @ St. Anthony Mine Site
Static Gamma Radiation Survey Field Form For Correlation

Instrumentation : Scaler/Ratemeter L2221 S#290801, Detector SPA-3 #33

Instrument Calibration Date: 8-1-17, Instrument Daily Function Check Performed: ✓

Survey Area/Unit Decsription St. Anthony Correlation

Survey Date	Survey Point & Soil Sample ID/Description	Survey Point Coordinate (State Plain, NAD 1983)		Gamma Rad Level (cpm) SPA-3, SR# 408522-33		uR/hr	Comments/Notes
		Northing (ft)	Easting (ft)	Lead Collimated	Bare		
5-7-18	SS-COR-011	1513846.9	2881467.5	35912 36235 35798	99965 96941 98212	110	Scattered Waste Rock & berms nearby
"	SS-COR-012	1513530.4	2884936.9	7748 8050 8126	25242 25514 25390	30	
"	SS-COR-013	1513563.9	2884900.3	8293 8192 8199	21581 21295 21891	25	
"	SS-COR-014	1517657.2	2879464.5	4358 4412 4496	11945 11972 11970	12	

Technician Signature [signature], Reviewed by [signature]

AVM Environmental Services, Inc.
Field Soil Sample Log Form
St. Anthony Mine Site

Sample ID	Sample Date and Time	Sample Location (Coordinates)	Sample collection method/container/preservative	Analysis	Sample Type/Description	Comments/Notes	Sample Tech
SS-COR-001	5-7-18 @838	y1517823.1 x2878759.2	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-002	5-7-18 @852	y1517808.0 x2878713.9	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-003	5-7-18 @915	y1518535.2 x2880210.2	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab	Field QA/QC Dup SS COR-203 5-7-18 @0930	VP
SS-COR-004	5-7-18 @955	y1517269.8 x2879341.7	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-005	5-7-18 @1035	y1517373.8 x2879448.8	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-006	5-7-18 @1105	y1517565.3 x2878649.3	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab	Field QA/QC Dup SS-COR-206 5-7-18 @1120	VP
SS-COR-007	5-7-18 @1155	y1516883.8 x2880235.5	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-008	5-7-18 @1205	y1516845.4 x2880218.5	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-009	5-7-18 @1225	y1516767.1 x2880261.7	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-010	5-7-18 @1235	y1516856.0 x2880315.2	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-011	5-7-18 @1325	y1513846.9 x2881467.5	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-012	5-7-18 @1410	y1513530.4 x2884936.9	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP

Please include other applicable information, such as sampling activity/event, COC#, sampling depth, soil description, sample sub-location, etc in sample description or comments/notes

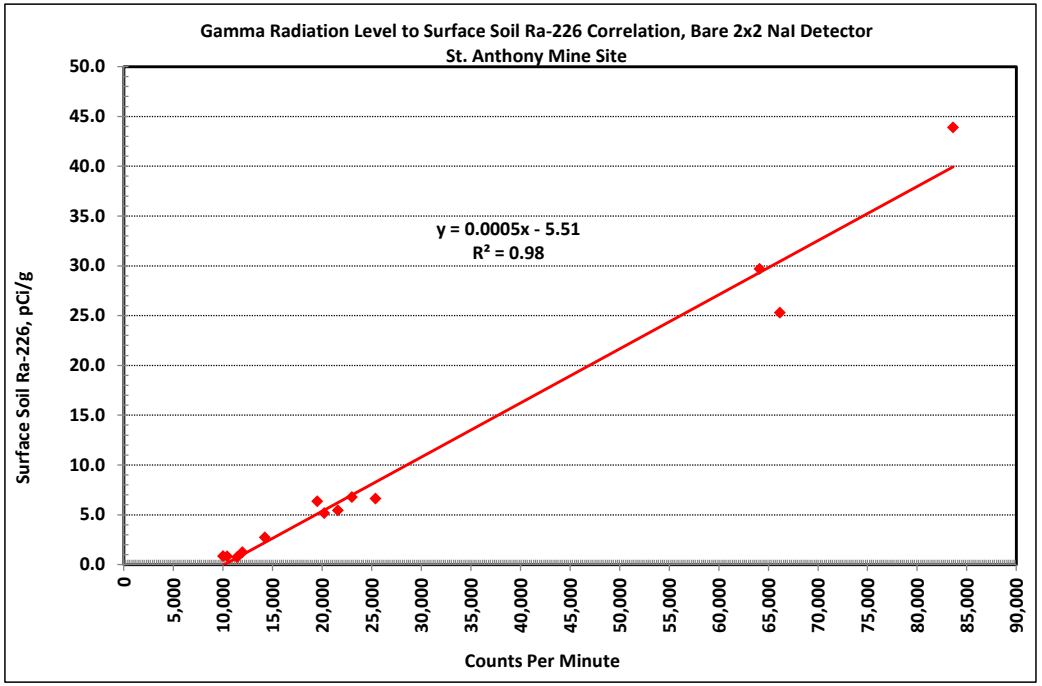
AVM Environmental Services, Inc.
Field Soil Sample Log Form
St. Anthony Mine Site

Sample ID	Sample Date and Time	Sample Location (Coordinates)	Sample collection method/container/preservative	Analysis	Sample Type/Description	Comments/Notes	Sample Tech
SS-COR-013	5-7-18 @1420	y 1513563.9 x 2884900.3	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP
SS-COR-014	5-7-18 @1535	y 1517657.2 x 2879464.5	Hand Auger/Hand Spade Plastic Bag No Preservative	Ra-226	Correlation Surface Soil/Grab		VP

Please include other applicable information, such as sampling activity/event, COC#, sampling depth, soil description, sample sub-location, etc in sample description or comments/notes

Gamma Radiation Level to Soil Ra-226 Concentration Correlation
St. Anthony Mine Site
2x2 NaI Bare Detector (SPA-3)

Surface Soil Sample ID	2x2 NaI Bare Detector CPM	Ra-226 pCi/g	Predicted Ra-226 pCi/g	e	e^2
SA-COR-001	10009	0.85	-0.51	1.36	1.84
SA-COR-002	10424	0.83	-0.30	1.13	1.27
SA-COR-003	83615	43.90	36.30	7.60	57.80
SA-COR-004	66156	25.30	27.57	-2.27	5.14
SA-COR-005	19509	6.36	4.24	2.12	4.48
SA-COR-006	11428	0.75	0.20	0.55	0.30
SA-COR-007	14226	2.73	1.60	1.13	1.27
SA-COR-008	20214	5.17	4.60	0.57	0.33
SA-COR-009	64112	29.70	26.55	3.15	9.95
SA-COR-010	23000	6.78	5.99	0.79	0.62
SA-COR-012	25382	6.63	7.18	-0.55	0.30
SA-COR-013	21589	5.45	5.28	0.17	0.03
SA-COR-014	11962	1.25	0.47	0.78	0.61
			Mean	1.27	6.46



REGRESSION SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.988945607
R Square	0.978013413
Adjusted R Square	0.976014633
Standard Error	2.111552191
Observations	13

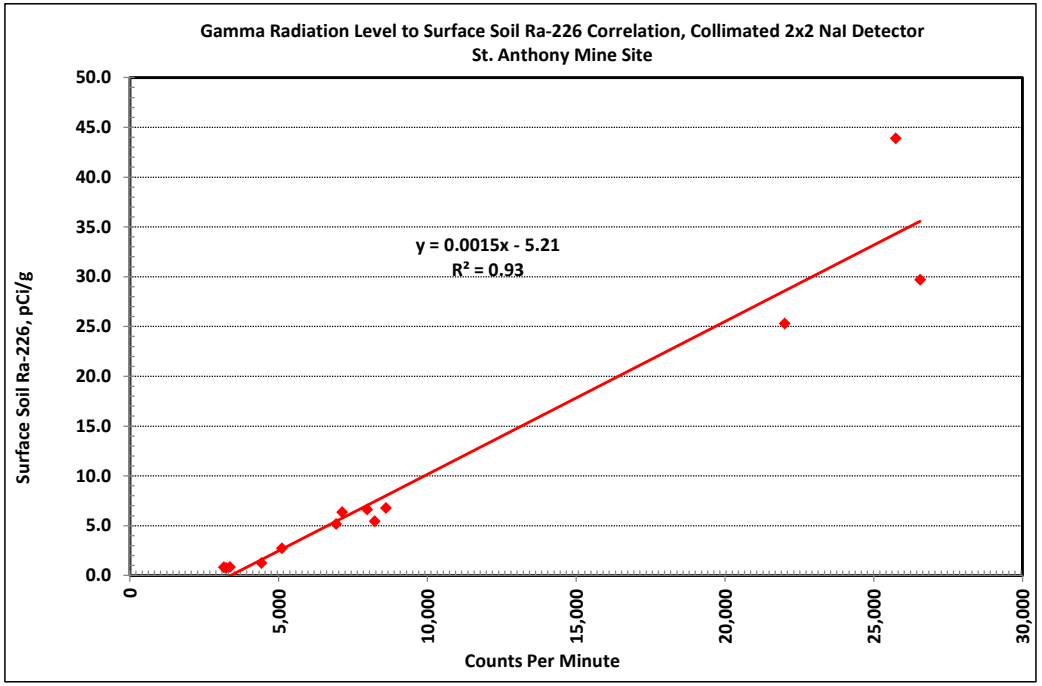
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2181.64119	2181.64119	489.3050341	1.80856E-10
Residual	11	49.04517922	4.458652656		
Total	12	2230.686369			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-5.512824494	0.928968951	-5.934347414	9.81159E-05	-7.557471369	-3.46817762	-7.557471369	-3.46817762
X Variable 1	0.000543377	2.45647E-05	22.12024037	1.80856E-10	0.00048931	0.000597443	0.00048931	0.000597443

Gamma Radiation Level to Soil Ra-226 Concentration Correlation
St. Anthony Mine Site
0.5 Inch Thick Lead Collimated 2x2 NaI Detector (SPA-3)

Surface Soil Sample ID	2x2 NaI Bare Detector CPM	Ra-226 pCi/g	Predicted Ra-226 pCi/g	e	e^2
SA-COR-001	3363	0.85	-0.17	1.02	1.03
SA-COR-002	3158	0.83	-0.47	1.30	1.70
SA-COR-003	25742	43.90	33.40	10.50	110.20
SA-COR-004	22008	25.30	27.80	-2.50	6.26
SA-COR-005	7135	6.36	5.49	0.87	0.75
SA-COR-006	3234	0.75	-0.36	1.11	1.23
SA-COR-007	5109	2.73	2.45	0.28	0.08
SA-COR-008	6932	5.17	5.19	-0.02	0.00
SA-COR-009	26561	29.70	34.63	-4.93	24.32
SA-COR-010	8607	6.78	7.70	-0.92	0.85
SA-COR-012	7975	6.63	6.75	-0.12	0.01
SA-COR-013	8228	5.45	7.13	-1.68	2.83
SA-COR-014	4422	1.25	1.42	-0.17	0.03
			Mean	0.36	11.48



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.966609815
R Square	0.934334535
Adjusted R Square	0.928364948
Standard Error	3.649147559
Observations	13

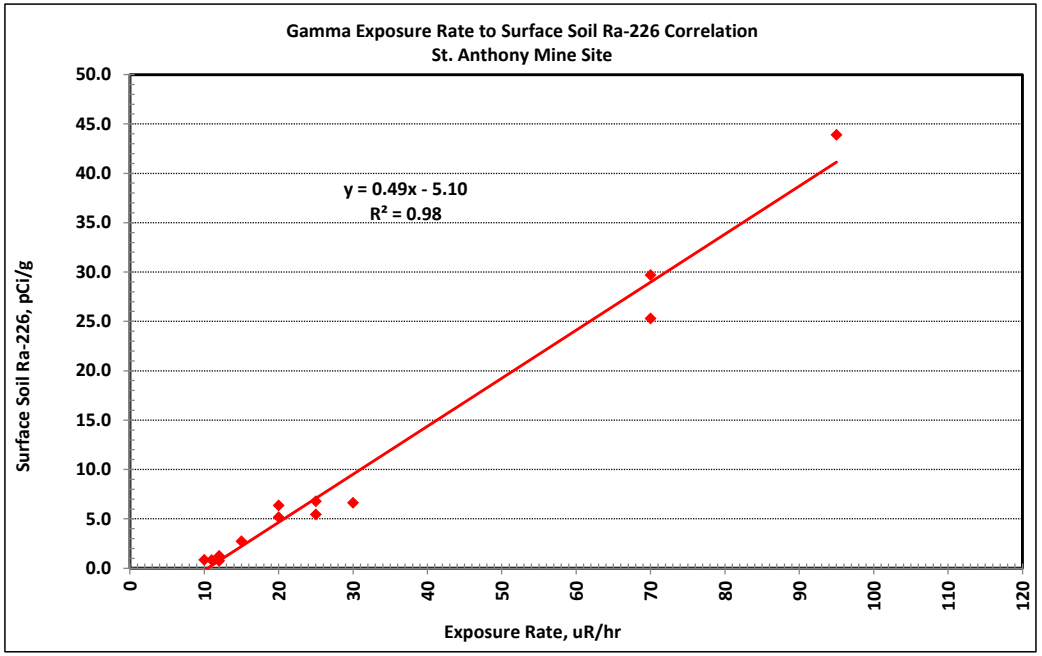
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2084.207312	2084.207312	156.5157566	7.57125E-08
Residual	11	146.479057	13.31627791		
Total	12	2230.686369			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-5.206105492	1.608752692	-3.236112995	0.007928568	-8.746946291	-1.665264693	-8.746946291	-1.665264693
X Variable 1	0.00153524	0.000122715	12.51062575	7.57125E-08	0.001265146	0.001805334	0.001265146	0.001805334

Gamma Exposure Rate to Soil Ra-226 Concentration Correlation
St. Anthony Mine Site
Ludlum 19 Micro R meter

Surface Soil Sample ID	Exposure Rate Ludlum 19	Ra-226 pCi/g	Predicted Ra-226 pCi/g	e	e^2
SA-COR-001	10	0.85	-0.2	1.05	1.10
SA-COR-002	11	0.83	0.3	0.54	0.29
SA-COR-003	95	43.90	41.5	2.45	6.00
SA-COR-004	70	25.30	29.2	-3.90	15.21
SA-COR-005	20	6.36	4.7	1.66	2.76
SA-COR-006	12	0.75	0.8	-0.03	0.00
SA-COR-007	15	2.73	2.3	0.48	0.23
SA-COR-008	20	5.17	4.7	0.47	0.22
SA-COR-009	70	29.70	29.2	0.50	0.25
SA-COR-010	25	6.78	7.2	-0.37	0.14
SA-COR-012	30	6.63	9.6	-2.97	8.82
SA-COR-013	25	5.45	7.2	-1.70	2.89
SA-COR-014	12	1.25	0.8	0.47	0.22
			Mean	-0.10	2.93



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.991471657
R Square	0.983016046
Adjusted R Square	0.981472051
Standard Error	1.855847609
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2192.800495	2192.800495	636.6701629	4.36259E-11
Residual	11	37.88587381	3.444170346		
Total	12	2230.686369			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-5.095319041	0.802456682	-6.349649965	5.4476E-05	-6.861514288	-3.329123794	-6.861514288	-3.329123794
X Variable 1	0.486600356	0.019284802	25.23232377	4.36259E-11	0.444154794	0.529045917	0.444154794	0.529045917

Gamma Spectroscopy

Case Narrative

Stantec Consulting Services

St. Anthony – 233001076

Work Order Number: 1807040

1. The following report consists of analytical results for eight soil samples received by ALS on 07/05/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 07/18/2018 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 08/08/2018 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 08/08/2018.

4. The results for these samples are reported on a "Dry Weight" basis in units of pCi/gram. The samples were not crushed or sieved before can packing.

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. The requested detection limit was not met for samples 1807040-1, -2, -5, -6, and -7DUP. The reported activity for these samples exceeds the achieved MDC. Results are submitted without further qualification. The results are identified with an “M3” qualifier on the final reports.

8. 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.

Jean Anderson Radiochemistry Primary Data Reviewer	8/9/18 Date
Radiochemistry Final Data Reviewer	8/10/18 Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1807040
Client Name: Stantec Consulting Services
Client Project Name: St. Anthony
Client Project Number: 233001076
Client PO Number: 233001076-ALS2

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SS-COR-004	1807040-1		SOIL	07-May-18	9:55
SS-COR-005	1807040-2		SOIL	07-May-18	10:35
SS-COR-007	1807040-3		SOIL	07-May-18	11:55
SS-COR-008	1807040-4		SOIL	07-May-18	12:05
SS-COR-009	1807040-5		SOIL	07-May-18	12:25
SS-COR-010	1807040-6		SOIL	07-May-18	12:35
SS-COR-012	1807040-7		SOIL	07-May-18	14:10
SS-COR-013	1807040-8		SOIL	07-May-18	14:20

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

WORKORDER # 1807040

PAGE 1 of 1

PROJECT NAME	St. Anthony	SITE ID	St. Anthony
PROJECT No.	233001076	EDD FORMAT	
		PURCHASE ORDER	
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525
PHONE	970-871-4361	PHONE	970-212-2749
FAX		FAX	
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com

SAMPLER: Victor
DATE: 7/2/2018
TURNAROUND: Standard
DISPOSAL: By Lab or Return to Client

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles	Pres.	QC	Ra 226 (901.1 modified)
1	SS-COR-004	S	5/7/2018	0955	1	NA		✓
2	SS-COR-005	S	5/7/2018	1035	1	NA		✓
3	SS-COR-007	S	5/7/2018	1155	1	NA		✓
4	SS-COR-008	S	5/7/2018	1205	1	NA		✓
5	SS-COR-009	S	5/7/2018	1225	1	NA		✓
6	SS-COR-010	S	5/7/2018	1235	1	NA		✓
7	SS-COR-012	S	5/7/2018	1410	1	NA		✓
8	SS-COR-013	S	5/7/2018	1420	1	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:

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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY	[signature]	Victor Patel	7-2-18	1100
RECEIVED BY	[signature]	KELI-JEAN SMITH	7-5-18	0920
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: STANTEC Workorder No: 1807040

Project Manager: LRS Initials: KJ Date: 7.5.18

1.	Are airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
2.	Are custody seals on **shipping** containers intact?	NONE	YES	NO
3.	Are custody seals on **sample** containers intact?	NONE	YES	NO
4.	Is there a COC (chain-of-custody) present?		YES	NO
5.	Is the COC in agreement with samples received? (IDs, dates, times, # of samples, # of containers, matrix, requested analyses, etc.)		YES	NO
6.	Are short-hold samples present?		YES	NO
7.	Are all samples within holding times for the requested analyses?		YES	NO
8.	Were all sample containers received intact? (not broken or leaking)		YES	NO
9.	Is there sufficient sample for the requested analyses?		YES	NO
10.	Are all samples in the proper containers for the requested analyses?		YES	NO
11.	Are all aqueous samples preserved correctly, if required? (excluding volatiles)	N/A	YES	NO
12.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
13.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) free of bubbles > 6 mm (1/4 inch) diameter? (i.e. size of green pea)	N/A	YES	NO
14.	Were the samples shipped on ice?		YES	NO
15.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY	YES	NO

Cooler #:	1							
Temperature (°C):	AMB							
No. of custody seals on cooler:	1							
DOT Survey/ Acceptance Information — External µR/hr reading:	14							
Background µR/hr reading:	13							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: **Please provide details here for any NO responses to gray shaded boxes above, or any other issues noted:**

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 7/5/18

Form 201r26.xls
(06/29/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

1807040

ORIGIN ID:GUPA (505) 287-4593
NATVER PATEL

1717 DEL NORTE BLVD.

GRANTS, NM 87020
UNITED STATES US

SHIP DATE: 02JUL18
ACTWGT: 15.00 LB
CAD: 105394318/INET3980
DIMS: 12x12x6 IN

BILL SENDER

TO SAMPLE RECEIVING
ALS ENVIRONMENTAL
225 COMMERCE DRIVE

FORT COLLINS CO 80524
(800) 443-1511 REF:
INV:
PO: DEPT:

14

1

552J293DF/DCA5

FedEx Express

E

J1811180126 01uv

FedEx Ship Manager - Print Your Label(s)

THU - 05 JUL 4:30P
** 2DAY **

TRK# 0201 7726 1326 8831

13 @ 1m

80524
CO-US DEN

ST FTCA

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Lab ID: GS180719-1MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Jul-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181595d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	-0.04 +/- 0.19	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Lab ID: GS180719-1LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 18-Jul-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181110d05

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	463 +/- 54	2	468.3	98.9	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-012
Lab ID: 1807040-7DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 228 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181310d01

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
13982-63-3	Ra-226	6.63 +/- 0.87	0.47		5.91 +/- 0.82	0.51	M3	0.603	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

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

Abbreviations:

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

Data Package ID: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-004
Lab ID: 1807040-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 210 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181309d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	25.3 +/- 3.1	0.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-005
Lab ID: 1807040-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 200 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181276d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	6.36 +/- 0.86	0.55	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-007
Lab ID: 1807040-3
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 232 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181594d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	2.73 +/- 0.45	0.48	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-008
Lab ID: 1807040-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 230 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181113d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	5.17 +/- 0.73	0.47	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-009
Lab ID: 1807040-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 233 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181178d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	29.7 +/- 3.5	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-010
Lab ID: 1807040-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 236 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181806d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	6.78 +/- 0.92	0.64	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-012
Lab ID: 1807040-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 224 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181109d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	6.63 +/- 0.87	0.47	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-012
Lab ID: 1807040-7DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 228 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181310d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	5.91 +/- 0.82	0.51	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.
LT - Result is less than Requested MDC, greater than sample specific MDC.
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 halflives.
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: *GSS1807040-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1807040
Client Name: Stantec Consulting Services
ClientProject ID: St. Anthony 233001076

Field ID: SS-COR-013
Lab ID: 1807040-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 18-Jul-18
Date Analyzed: 08-Aug-18

Prep Batch: GS180719-1
QCBatchID: GS180719-1-1
Run ID: GS180719-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 240 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181277d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	5.45 +/- 0.74	0.46	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1807040-1*

Gamma Spectroscopy

Case Narrative

Stantec

St. Anthony Geotechnical Investigation – 233001076

Work Order Number: 1805265

1. The following report consists of analytical results for 16 soil samples received by ALS on 05/11/2018.

2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 05/25/2018 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 06/15/2018 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 06/15/2018.

4. The results for these samples are reported on a “Dry Weight” basis in units of pCi/gram.

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. Activity concentrations above the calculated MDC are reported in some instances where minimum nuclide identification criteria are not met. Such tentative identifications result when the software attempts to calculate net activity concentrations for analytes where either one or both of the following criteria are not satisfied: the 'diagnostic' peak for a nuclide must be identified above the critical level, or the minimum library peak abundance must be attained. Nuclides not meeting these requirements have been flagged with a "TI" qualifier.

8. There are cases where the sample density is less or greater 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 low for samples 1805265-3 and -4 and biased high for sample 1805265-6. If requested, ALS can perform a transmission spike in order to estimate a magnitude of this bias. The results are reported without further qualification.

9. The requested detection limit for ^{226}Ra was not met for samples 1805265-3, -4, -5, -5DUP, -6, -11, -13, and -15. The reported activity for these samples exceeds the achieved MDC. Results are submitted without further qualification. The results are identified with an "M3" qualifier on the final 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.

Jean Anderson — 6/18/18
Jean Anderson — Date
Radiochemistry Primary Data Reviewer

6/20/18
Radiochemistry Final Data Reviewer — Date

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1805265
Client Name: Stantec
Client Project Name: St. Anthony Geotechnical Investigation
Client Project Number: 233001076
Client PO Number: 233001076

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SS-COR-001	1805265-1		SOIL	07-May-18	8:38
SS-COR-002	1805265-2		SOIL	07-May-18	8:52
SS-COR-003	1805265-3		SOIL	07-May-18	9:15
SS-COR-203	1805265-4		SOIL	07-May-18	9:30
SS-COR-004	1805265-5		SOIL	07-May-18	9:55
SS-COR-005	1805265-6		SOIL	07-May-18	10:35
SS-COR-006	1805265-7		SOIL	07-May-18	11:05
SS-COR-206	1805265-8		SOIL	07-May-18	11:20
SS-COR-007	1805265-9		SOIL	07-May-18	11:55
SS-COR-008	1805265-10		SOIL	07-May-18	12:05
SS-COR-009	1805265-11		SOIL	07-May-18	12:25
SS-COR-010	1805265-12		SOIL	07-May-18	12:35
SS-COR-011	1805265-13		SOIL	07-May-18	13:25
SS-COR-012	1805265-14		SOIL	07-May-18	14:10
SS-COR-013	1805265-15		SOIL	07-May-18	14:20
SS-COR-014	1805265-16		SOIL	07-May-18	15:35

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 202r6

WORKORDER #	1805205				
SAMPLER	Victor Patel	DATE	5-8-18	PAGE	1 of 2
SITE ID	St. Anthony	TURNAROUND	Standard	DISPOSAL	By Lab or Return to Client
EDD FORMAT					
PURCHASE ORDER	233001076-ALS				
BILL TO COMPANY	Stantec				
INVOICE ATTN TO	Melanie Davis				
ADDRESS	3325 S. Timberline Rd Suite 150				
CITY / STATE / ZIP	Fort Collins, CO 80525				
PHONE	970-212-2749				
FAX					
E-MAIL	melanie.davis@stantec.com				

PROJECT NAME	St. Anthony
PROJECT No.	233001076
COMPANY NAME	Stantec
SEND REPORT TO	Toby Leeson
ADDRESS	2103 Resort Dr. Suite 350
CITY / STATE / ZIP	Steamboat, CO 80487
PHONE	970-871-4361
FAX	
E-MAIL	toby.leeson@stantec.com

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles Bdg	Pres.	QC	Ra 226 (901.1 modified)
1	SS-COR-001	S	5-7-18	0838	1	NA		✓
2	SS-COR-002	S	5-7-18	0852	1	NA		✓
3	SS-COR-003	S	5-7-18	0915	1	NA		✓
4	SS-COR-203	S	5-7-18	0930	1	NA		✓
5	SS-COR-004	S	5-7-18	0955	1	NA		✓
6	SS-COR-005	S	5-7-18	1035	1	NA		✓
7	SS-COR-006	S	5-7-18	1105	1	NA		✓
8	SS-COR-206	S	5-7-18	1120	1	NA		✓
9	SS-COR-007	S	5-7-18	1155	1	NA		✓
10	SS-COR-008	S	5-7-18	1205	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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY	[signature]	Victor Patel	5-8-18	1330
RECEIVED BY	[signature]	KELI-JEAN SMITH	5-11-18	1242
RELINQUISHED BY				
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 202r8

WORKORDER #	18052665				
SAMPLER	Victor Patel	DATE	5-8-18	PAGE	2 of 2
PROJECT NAME	St. Anthony	SITE ID	St. Anthony	TURNAROUND	Standard
PROJECT No.	233001076	EDD FORMAT		DISPOSAL	By Lab or Return to Client
		PURCHASE ORDER	233001076-ALS		
COMPANY NAME	Stantec	BILL TO COMPANY	Stantec		
SEND REPORT TO	Toby Leeson	INVOICE ATTN TO	Melanie Davis		
ADDRESS	2103 Resort Dr. Suite 350	ADDRESS	3325 S. Timberline Rd Suite 150		
CITY / STATE / ZIP	Steamboat, CO 80487	CITY / STATE / ZIP	Fort Collins, CO 80525		
PHONE	970-871-4361	PHONE	970-212-2749		
FAX		FAX			
E-MAIL	toby.leeson@stantec.com	E-MAIL	melanie.davis@stantec.com		

Ra 226 (901.1 modified)

Lab ID	Field ID	Matrix	Sample Date	Sample Time	# Bottles Bay	Pres.	QC	Ra 226 (901.1 modified)
11	SS-COR-009	S	5-7-18	1225	1	NA		✓
12	SS-COR-010	S	5-7-18	1235	1	NA		✓
13	SS-COR-011	S	5-7-18	1325	1	NA		✓
14	SS-COR-012	S	5-7-18	1410	1	NA		✓
15	SS-COR-013	S	5-7-18	1420	1	NA		✓
16	SS-COR-014	S	5-7-18	1535	1	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:

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

	SIGNATURE	PRINTED NAME	DATE	TIME
RELINQUISHED BY	[signature]	Victor Patel	5-8-18	1330
RECEIVED BY	[signature]	KELI-JEAN SMITH	5-11-18	1242
RELINQUISHED BY				
RECEIVED BY				
RELINQUISHED BY				
RECEIVED BY				

ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: STANTEC Workorder No: 1805265

Project Manager: LRS Initials: KG Date: 5/1/18

1.	Does this project require any special handling in addition to standard ALS procedures?		YES	NO
2.	Are custody seals on shipping containers intact?	NONE	YES	NO
3.	Are Custody seals on sample containers intact?	NONE	YES	NO
4.	Is there a COC (~~Chain-of-Custody~~) present or other representative documents?		YES	NO
5.	Are the COC and bottle labels complete and legible?		YES	NO
6.	Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	NO
7.	Were airbills / shipping documents present and/or removable?	DROP OFF	YES	NO
8.	Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	NO
9.	Are all aqueous non-preserved samples pH 4-9?	N/A	YES	NO
10.	Is there sufficient sample for the requested analyses?		YES	NO
11.	Were all samples placed in the proper containers for the requested analyses?		YES	NO
12.	Are all samples within holding times for the requested analyses?		YES	NO
13.	Were all sample containers received intact? (not broken or leaking, etc.)		YES	NO
14.	Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	N/A	YES	NO
15.	Do any water samples contain sediment? Amount of sediment: ____ dusting ____ moderate ____ heavy	N/A	YES	NO
16.	Were the samples shipped on ice?		YES	NO
17.	Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #1 #3 #4	RAD ONLY	YES	NO

Cooler #:	1	2						
Temperature (°C):	AmB	AmB						
No. of custody seals on cooler:	0	0						
External µR/hr reading:	12	12						
Background µR/hr reading:	13							

DOT Survey/ Acceptance Information

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

If applicable, was the client contacted? **YES / NO / NA** Contact: [signature] Date/Time: _____

Project Manager Signature / Date: [signature] 5/15/18

Form 201r25.xls
(02/12/2018)

*IR Gun #1, VWR SN 170560549
*IR Gun #3, VWR SN 170647571
*IR Gun #4, Oakton, SN 2372220101-0002

FedEx Ship Manager - Print Your Label(s)

FROM: (505) 287-4593
Victor Patel
AVM Environmental Services, Inc.
1717 Del Norte Blvd.

Grants NM 87020
US

SHIP DATE: 08MAY18
ACTWGT: 27.00 LB
CAD: 105394318/INET3980
DIMMED: 12 X 12 X 14 IN

BILL SENDER

TO Sample Receiving
ALS Environmental
225 Commerce Dr.

FORT COLLINS CO 80524
(800) 443-1511 REF:
INV:
PO: DEPT:

(US) 552.2/782B/DCA5

FedEx. Ground

J181118012601uv

1 of 2
TRK# 7721 8283 0933
MASTER

80524

9622 0019 0 (000 000 0000) 0 00 7721 8283 0933

FedEx Ship Manager - Print Your Label(s)

FROM: (505) 287-4593
Victor Patel
AVM Environmental Services, Inc.
1717 Del Norte Blvd.

Grants NM 87020
US

SHIP DATE: 08MAY18
ACTWGT: 27.00 LB
CAD: 105394318/INET3980
DIMMED: 12 X 12 X 14 IN

BILL SENDER

TO Sample Receiving
ALS Environmental
225 Commerce Dr.

FORT COLLINS CO 80524
(800) 443-1511 REF:
INV:
PO: DEPT:

(US) 552.2/782B/DCA5

FedEx. Ground

J181118012601uv

2 of 2
MPS# 7721 8283 0830
Mstr# 7721 8283 0933

80524

9622 0019 0 (000 000 0000) 0 00 7721 8283 0830

Gamma Spectroscopy Results

PAI 713 Rev 14

Method Blank Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180530-1MB

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 181040d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	-0.01 +/- 0.18	0.35	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

TI - Nuclide identification is tentative.

R - Nuclide has exceeded 8 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Laboratory Control Sample(s)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Lab ID: GS180530-1LCS

Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 25-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes

Final Aliquot: 215 g
Result Units: pCi/g
File Name: 180678d05

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	468 +/- 55	2	468.3	100	85 - 115	P,M3

Comments:

Qualifiers/Flags:

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

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

Data Package ID: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Duplicate Sample Results (DER)

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-004
Lab ID: 1805265-5DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 209 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180731d10

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
13982-63-3	Ra-226	36.0 +/- 4.4	0.9	M3	34.7 +/- 4.1	0.6	M3	0.211	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

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

Abbreviations:

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

Data Package ID: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-001
Lab ID: 1805265-1
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 224 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181285d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.85 +/- 0.27	0.45	0.5	NA	TI

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-002
Lab ID: 1805265-2
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 233 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180676d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.83 +/- 0.20	0.28	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-003
Lab ID: 1805265-3
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 248 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180812d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	43.9 +/- 5.3	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-203
Lab ID: 1805265-4
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 248 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180726d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	41.1 +/- 4.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-004
Lab ID: 1805265-5
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 212 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180717d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	36.0 +/- 4.4	0.9	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Duplicate Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-004
Lab ID: 1805265-5DUP
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 209 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180731d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	34.7 +/- 4.1	0.6	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.
LT - Result is less than Requested MDC, greater than sample specific MDC.
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 halflives.
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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-005
Lab ID: 1805265-6
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 181 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180845d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	8.5 +/- 1.2	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-006
Lab ID: 1805265-7
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 225 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180812d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.75 +/- 0.22	0.40	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-206
Lab ID: 1805265-8
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 223 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181039d03

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.74 +/- 0.27	0.44	0.5	NA	TI

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-007
Lab ID: 1805265-9
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 227 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 181286d04

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	3.09 +/- 0.49	0.46	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-008
Lab ID: 1805265-10
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 228 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180677d05

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	6.76 +/- 0.89	0.46	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-009
Lab ID: 1805265-11
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 232 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180813d07

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	37.4 +/- 4.5	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-010
Lab ID: 1805265-12
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 236 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180727d08

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	9.1 +/- 1.2	0.4	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-011
Lab ID: 1805265-13
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 235 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180718d09

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	69.2 +/- 8.2	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 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-012
Lab ID: 1805265-14
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 219 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180732d10

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	9.5 +/- 1.2	0.4	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-013
Lab ID: 1805265-15
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 232 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180846d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	8.5 +/- 1.1	0.5	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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

Gamma Spectroscopy Results

PAI 713 Rev 14

Sample Results

Lab Name: **ALS -- Fort Collins**
Work Order Number: 1805265
Client Name: Stantec
ClientProject ID: St. Anthony Geotechnical Investigation 233001076

Field ID: SS-COR-014
Lab ID: 1805265-16
Library: RA226.LIB

Sample Matrix: SOIL
Prep SOP: PAI 739 Rev 12
Date Collected: 07-May-18
Date Prepared: 25-May-18
Date Analyzed: 15-Jun-18

Prep Batch: GS180530-1
QCBatchID: GS180530-1-1
Run ID: GS180530-1A
Count Time: 30 minutes
Report Basis: Dry Weight

Final Aliquot: 215 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: 180813d02

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	1.25 +/- 0.27	0.41	0.5	NA	

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.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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 halflives.

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: *GSS1805265-1*

TECHNICAL BULLETIN ADDENDUM

The library used for analysis defines the gamma emission(s) to be used for analysis of each nuclide. If multiple gamma emissions are used for quantification, then a 'NET' quantification emission (or peak) must be defined in the library. This designation provides for the calculation of nuclide activity concentrations and detection limits in the case of non-presence of the nuclide. When the nuclide is not present, or the software is unable to resolve a peak at the library defined 'NET' energy, the software evaluates the 'NET' region of interest ('NET' peak energy +/- 2 keV) by performing a summation of the net counts above the background level. This 'NET' quantification can result in net negative, zero, or positive activity results, and is highly dependent on the spectral distribution in the region of interest of the 'NET' peak. In cases where only the 'NET' peak is found, and the software performs a net quantification, the nuclide result will be flagged with an 'NQ' qualifier on the final reports. This indicates that the nuclide is not detected or supported at any level above the reported MDC. Results are submitted without further qualification.

All nuclides specified in the library of analysis for gamma spectroscopy are evaluated for positive OR tentative identification on the following criteria:

- The individual abundances for the gamma emissions specified for each nuclide are summed to obtain a total nuclide abundance.
- From the total nuclide abundance, a positive identification criterion is set as 75% of this total nuclide abundance.
- For all nuclide peaks that are not net quantified, those peak abundances are summed. The total non-net quantified peak sum is compared to the calculated 75% abundance criterion. If this sum is greater than the 75% criterion, the nuclide is considered to be positively identified at the reported concentration. If the sum is less than the 75% criterion, the nuclide is tentatively identified at the reported concentration. These results will be flagged with a 'TI' qualifier on the final reports to indicate that the 75% abundance criterion was not met.

Appendix D
Radiologic Instrument Calibration and Operational Function Check Documentation

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 Readout (2 points): Ref/Inst 600 / 600 Ref/Inst 990 / 1000

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	38-41		38-41
	x1	40x10	380-420	400		400
	x10	40x100	3800-4200	4000		4000
	x100	40x1K	38K-42K	40000		40000
	x1K	40x10K	380K-420K	400000		400000
Digital Ratemeter	-	40x1	38-42	38-41		38-41
	-	40x10	380-420	394-400		394-400
	-	40x100	3800-4200	3964-4000		3964-4000
	-	40x1K	38K-42K	39k-40k		39k-40k
	-	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	30706		30706
20.0	40000		200 (20 mV)	27K -33K	32190		32190
30.0	40000		300 (30 mV)	27K -33K	31635		31635
40.0	40000		400 (40 mV)	27K -33K	30918		30918
50.0	40000		500 (50 mV)	27K -33K	31244		31244

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) ✓ WIN @ 400 (40.0 mV) ✓

WIN @ 200 (20.0 mV) ✓ WIN @ 500 (50.0 mV) ✓

Date 8-1-17 Calibrated By

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/451652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH			
	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

PULSE AMPLITUDE							
Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%	Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%
1 V	1 V	1 V	0.9 - 1.1	4 V	4.2 V	4.2 V	3.6 - 4.4
100 mV	100 mV	100 mV	90 - 110	400 mV	420 mV	420 mV	360 - 440
10 mV	10 mV	10 mV	9 - 11	40 mV	42 mV	42 mV	36 - 44
1 mV	1 mV	1 mV	0.9 - 1.1	4 mV	4.2 mV	4.2 mV	3.6 - 4.4

PULSE FREQUENCY (PERIOD)			
Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter	Model 1856D	S/N 185641245060600 63	Cal Date 3-Nov 2016		
Oscilloscope	Model GOS-6103	S/N EP832241	Cal Date 2-Feb 2017		
Voltmeter	Model Fluke 83V	S/N 94000441	Cal Date 3-May 2017		

Calibrator William Tinsley William Tinsley Title Calibrator Date 5-July 2017

QC'd By [signature] Title Service Dept QC Date 5 Jul 17

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM SC16-1 12/12/2016 Page 1 of 1

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

AVM Environmental Services Inc.

Scaler/Ratemeter Calibration Form

Model : L2221 S/N: 290801

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

HV Calibration

HV Readout (2 points): Ref/Inst 600 / 600 Ref/Inst 990 / 1000

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	40		40
	x1	40x10	380-420	400		400
	x10	40x100	3800-4200	4000		4000
	x100	40x1K	38K-42K	40k		40k
	x1K	40x10K	380K-420K	400k		400k
Digital Ratemeter	-	40x1	38-42	40-41		40-41
	-	40x10	380-420	390-400		390-400
	-	40x100	3800-4200	3950-4000		3950-4000
	-	40x1K	38K-42K	39k-40k		39k-40k
	-	40x10K	380K-420K	395k-400k		395k-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	30756		30756
20.0	40000		200 (20 mV)	27K -33K	31443		31443
30.0	40000		300 (30 mV)	27K -33K	31128		31128
40.0	40000		400 (40 mV)	27K -33K	30733		30733
50.0	40000		500 (50 mV)	27K -33K	31614		31614

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) ✓ WIN @ 400 (40.0 mV) ✓

WIN @ 200 (20.0 mV) ✓ WIN @ 500 (50.0 mV) ✓

Date 8-1-17 Calibrated By

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/451652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH			
	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

PULSE AMPLITUDE							
Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%	Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%
1 V	1 V	1 V	0.9 - 1.1	4 V	4.2 V	4.2 V	3.6 - 4.4
100 mV	100 mV	100 mV	90 - 110	400 mV	420 mV	420 mV	360 - 440
10 mV	10 mV	10 mV	9 - 11	40 mV	42 mV	42 mV	36 - 44
1 mV	1 mV	1 mV	0.9 - 1.1	4 mV	4.2 mV	4.2 mV	3.6 - 4.4

PULSE FREQUENCY (PERIOD)			
Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter	Model 1856 D	S/N 185641245060600 63	Cal Date 3-Nov 2016		
Oscilloscope	Model GOS-6103	S/N EP832241	Cal Date 2-Feb 2017		
Voltmeter	Model Fluke 83 V	S/N 94000441	Cal Date 3-May 2017		

Calibrator William Tinsley William Tinsley Title Calibrator Date 5-July 2017

QC'd By [signature] Title Service Dept QC Date 5 Jul 17

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM SC16-1 12/12/2016 Page 1 of 1

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

AVM Environmental Services Inc.
Scaler/Ratemeter Calibration Form

Model L2241-2 S/N 287029

Calibration Source Ludlum Model 500 pulser S# 114513

Threshold (input sensitivity), Found at 10 mV Left or Set at 10 mV

Window, In/Out N/A Window N/A mV

Pulser Amplitude Set @ 20 mV

Range/Mode	Calibration Point (Pulser Setting) cpm x multiplier	As Found Reading	Left or Set Reading
Ratemeter	40x1	38-40	38-40
	40x10	395-400	395-400
	40x100	3950-4000	3950-4000
	40x1K	39K-40k	39K-40K
Scaler	40x1	40	40
	40x10	398	398
	40x100	3996	3996
	40x1K	39920	39920

HV Set @ 900 VDC

Date 8-1-17 Calibrated By

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/451652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH			
	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

PULSE AMPLITUDE							
Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%	Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%
1 V	1 V	1 V	0.9 - 1.1	4 V	4.2 V	4.2 V	3.6 - 4.4
100 mV	100 mV	100 mV	90 - 110	400 mV	420 mV	420 mV	360 - 440
10 mV	10 mV	10 mV	9 - 11	40 mV	42 mV	42 mV	36 - 44
1 mV	1 mV	1 mV	0.9 - 1.1	4 mV	4.2 mV	4.2 mV	3.6 - 4.4

PULSE FREQUENCY (PERIOD)			
Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter	Model 1856 D	S/N 185641245060600 63	Cal Date 3-Nov 2016
Oscilloscope	Model GOS-6103	S/N EP832241	Cal Date 2-Feb 2017
Voltmeter	Model Fluke 83 V	S/N 94000441	Cal Date 3-May 2017

Calibrator William Tinsley William Tinsley Title Calibrator Date 5-July 2017

QC'd By [signature] Title Service Dept QC Date 5 July 17

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM SC16-1 12/12/2016 Page 1 of 1

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

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

Scaler/Ratemeter L2221, SR# 68782
Detector SPA-3 # 408522-30

Source: 1% U_3O_8 can, FCS-1 Strength: 1% U_3O_8

Scaler/Ratemeter Threshhold set @ 10 mV, Window IN/OUT Out, Window N/A mV

HV	Reading, CPM (Source)	Reading, CPM (Background)
500	15845	500
550	32625	690
600	54875	1366
650	66884	1767
700	87428	2329
750	92841	2676
800	94979	2856
850	96047	2927
900	96613	2966
950	97669	3037
1000	98213	3168
1050	106392	3193
1100	126990	3529
1150	152407	4014
1200	190378	5648
1250		
1300		
1350		
1400		

HV Set @ 900 VDC (Instrument)

Background reading at designated function check location in AVM office.

Count #	Reading (CPM) Bare	Reading (CPM) Collimated
1	7711	2945
2	7942	2930
3	7940	2907
4	7862	2963
5	7921	2846
Average	7875	2918
FC Range	6300-9450	3502-2334

Count Readings with 1 percent U_3O_8 can directly under collimated detector on designated function check location in AVM office.

Count #	Reading (CPM)
1	96204
2	95976
3	96642
4	96417
5	96616
Average	96371

900 VDC (DVM Fluke 8020B)

Input Sensitivity (THR), mV 10.0

Function Check with 1 percent U_3O_8 ore in can. Can Directly under the detector in the collimator.
Acceptable Function check range is: 77097 to 115645 CPM

Notes:

Date 8/1/2017 By

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

Scaler/Ratemeter L2221 SR # 68782
Detector SPA-3, SR # 408522-30

Source: Grants DOE Cal Pad Strength: _____

Scaler/Ratemeter Threshhold set @ 10.0 mV, Window IN/OUT out, Window N/A mV

HV Set @ 900 VDC (Instrument) 900 VDC (DVM Fluke 8020B)

Count Readings for Calibration Pad GPB (0.0 ± 0.3 pCi/gm Ra-226)

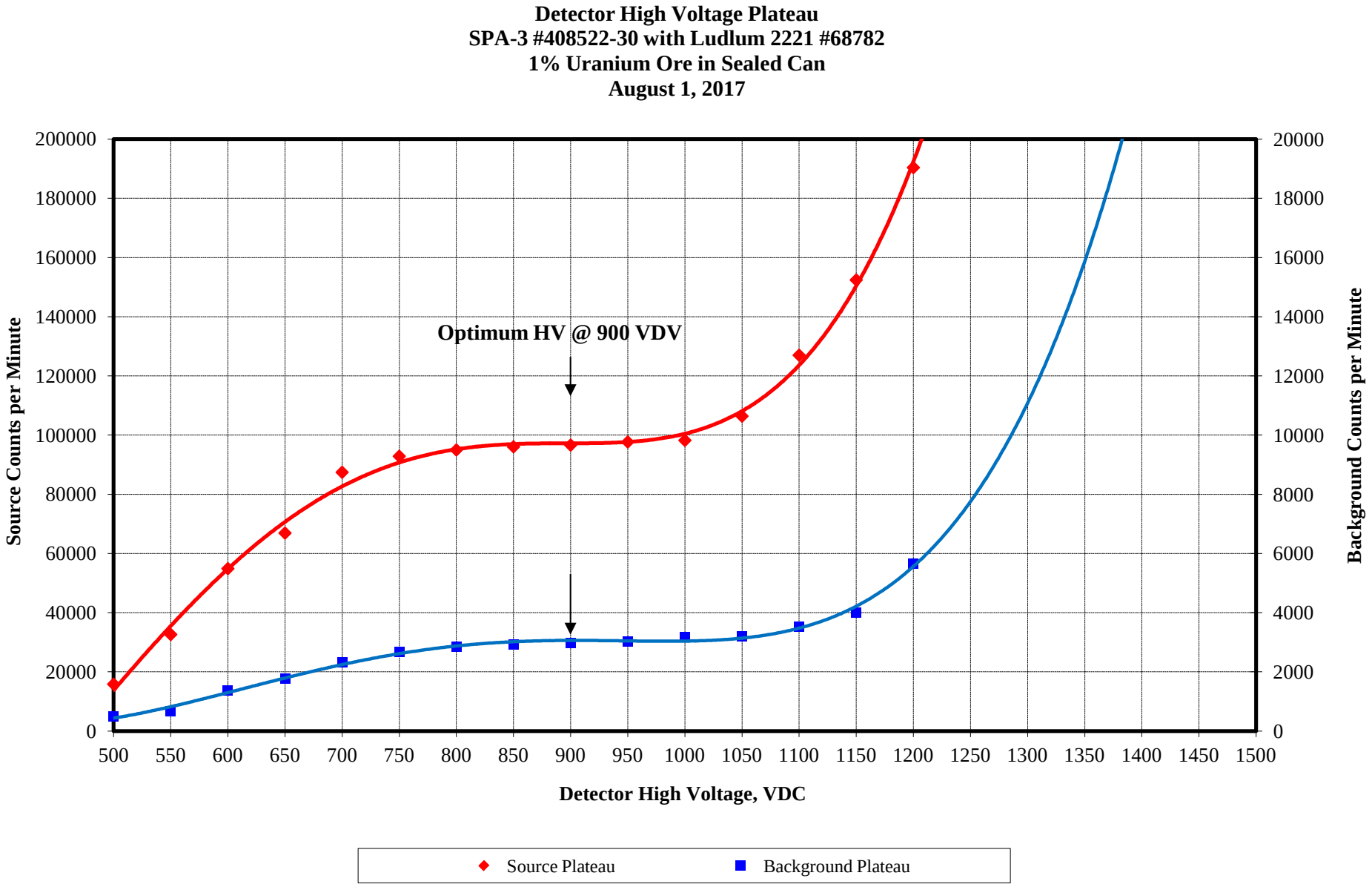
	Bare (Uncollimated)			Collimated	
#1	12708	cpm	#1	2974	cpm
#2	12309	cpm	#2	2971	cpm
#3	12411	cpm	#3	3186	cpm
#4	12303	cpm	#4	2927	cpm
#5	12825	cpm	#5	3064	cpm
BKG Average	12511	cpm	BKG Average	3025	cpm

Count Readings for Calibration Pad GPL (87.78 pCi/gm Ra-226)

	Bare (Uncollimated)			Collimated	
#1	84734	cpm	#1	48841	cpm
#2	85020	cpm	#2	49160	cpm
#3	85869	cpm	#3	48875	cpm
#4	85545	cpm	#4	49129	cpm
#5	84717	cpm	#5	47927	cpm
Gross Average	85,177	cpm	Gross Average	48786	cpm
Net Source Pad	72666	cpm	Net Source Pad	45761	cpm
Eff(net cpm/87.78 pCi/gm	828	cpm/pCi/gm	Eff	521	cpm/pCi/gm

Ludlum 19 # 76248
μR/hr @ 1.0'
= 110 μR/hr
= 1.29×10^{-4} μR/hr / cpm

Date 8/2/17 By _____


Detector High Voltage Plateau
SPA-3 #408522-30 with Ludlum 2221 #68782
1% Uranium Ore in Sealed Can
August 1, 2017
Optimum HV @ 900 VDV
Source Counts per Minute
Background Counts per Minute
Detector High Voltage, VDC
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
Source Plateau
Background Plateau

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

Scaler/Ratemeter L2221 SR# 68782
Detector SPA-3, SR# 408522-33

Source: U_3O_8 in Sealed Can, #FCS-1 Strength: 1% U_3O_8

Scaler/Ratemeter Threshhold set @ 10 mV, Window IN/OUT out, Window ____ mV

HV	Reading, CPM (Source)	Reading, CPM (Background)
500	6261	342
550	18587	709
600	39536	1018
650	58750	1589
700	69883	1950
750	87483	2448
800	93302	2745
850	94895	~~2842~~ 2982
900	96213	2956
950	96180	2970
1000	97187	2994
1050	98962	3022
1100	102048	3216
1150	120218	4258
1200	143302	4520
1250		
1300		
1350		
1400		

HV Set @ 900 VDC (Instrument)

Background reading at designated function check location in AVM office.

Count #	Reading (CPM) Bare	Reading (CPM) Collimated
1	7597	2849
2	7772	2863
3	7890	3013
4	7789	3099
5	7730	2956
Average	7756	2956
FC Range	6204-9307	2365-3547

Count Readings with 1 percent U_3O_8 can directly under collimated detector on designated function check location in AVM office.

Count #	Reading (CPM)
1	95694
2	96571
3	96253
4	95698
5	96118
Average	96067

900 VDC (DVM Fluke 8020B)

Input Sensitivity (THR), mV 10.0

Function Check with 1 percent U_3O_8 ore in can. Can Directly under the detector in the collimator.
Acceptable Function check range is: 76854 to 115,280 CPM

Notes:

Date 8/1/2017 By

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

Scaler/Ratemeter L2221 SR# 68782
Detector SPA-3, SR# 408522-33

Source: Grants DOE Cal Pad. Strength: _____

Scaler/Ratemeter Threshhold set @ 10.0 mV, Window IN/OUT out, Window N/A mV

HV Set @ 900 VDC (Instrument) 900 VDC (DVM Fluke 8020B)

Count Readings for Calibration Pad GPB (0.0 ± 0.3 pCi/gm Ra-226)

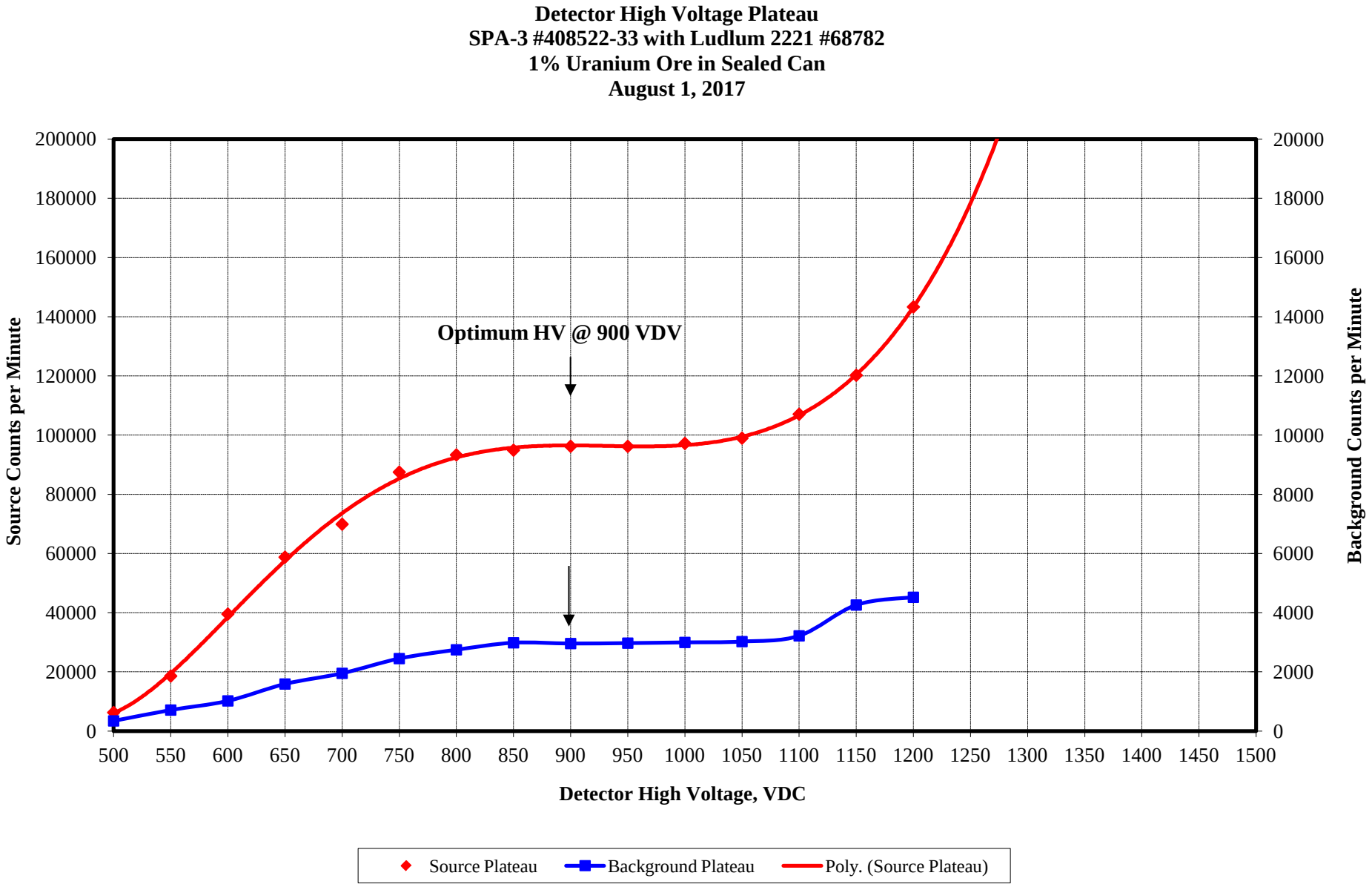
	Bare (Uncollimated)			Collimated	
#1	12431	cpm	#1	2858	cpm
#2	12135	cpm	#2	3101	cpm
#3	11798	cpm	#3	2957	cpm
#4	12120	cpm	#4	3002	cpm
#5	12401	cpm	#5	2981	cpm
BKG Average	12177	cpm	BKG Average	2980	cpm

Count Readings for Calibration Pad GPL (87.78 pCi/gm Ra-226)

	Bare (Uncollimated)			Collimated	
#1	85603	cpm	#1	48752	cpm
#2	84954	cpm	#2	48188	cpm
#3	84970	cpm	#3	47791	cpm
#4	84065	cpm	#4	48653	cpm
#5	84777	cpm	#5	48694	cpm
Gross Average	84874	cpm	Gross Average	48416	cpm
Net Source Pad	72697	cpm	Net Source Pad	45436	cpm
Eff(net cpm/87.78 pCi/gm	828	cpm/pCi/gm	Eff	518	cpm/pCi/gm

Exposure Rate
Ludlum 19 # 7626
@ 1.0'
110 mR/hr
= 1.296 x 10^-4
mR/hr/cpm

Date 8/2/17 By _____


Detector High Voltage Plateau
SPA-3 #408522-33 with Ludlum 2221 #68782
1% Uranium Ore in Sealed Can
August 1, 2017
Optimum HV @ 900 VDV
Source Counts per Minute
Background Counts per Minute
Detector High Voltage, VDC
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
Source Plateau
Background Plateau
Poly. (Source Plateau)

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

Scaler/Ratemeter L2221, SR# 68782
Detector SPA-3, SR# 10071

Source: 1% U_3O_8 in Sealed Can, FCS-1 Strength: 1% U_3O_8 OR

Scaler/Ratemeter Threshhold set @ 100 mV, Window IN/OUT out, Window N/A mV

HV	Reading, CPM (Source)	Reading, CPM (Background)
500	9165	477
550	27944	844
600	45954	1210
650	59667	1631
700	72178	2128
750	84117	2322
800	87565	2483
850	89707	2644
900	90363	2624
950	90191	2648
1000	90456	2740
1050	91634	2802
1100	101193	2964
1150	128133	3444
1200	184347	4950
1250		
1300		
1350		
1400		

HV Set @ 900 VDC (Instrument)

Background reading at designated function check location in AVM office.

Count #	Reading (CPM) Bare	Reading (CPM) Collimated
1	7926	2705
2	7737	2757
3	7935	2728
4	7789	2824
5	7799	2746
Average	7837	2751

FC Range 6270-9405 2201-3302

Count Readings with 1 percent U_3O_8 can directly under collimated detector on designated function check location in AVM office.

Count #	Reading (CPM)
1	90767
2	90490
3	90063
4	90956
5	89788
Average	90413

72330 – 108495

900 VDC (DVM Fluke 8020B)

Input Sensitivity (THR), mV 10.0

Function Check with 1 percent U_3O_8 ore in can. Can Directly under the detector in the collimator.
Acceptable Function check range is: 72330 to 108495 CPM

Notes:

Date 8/1/2017 By

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

Scaler/Ratemeter _____
Detector SPA-3, SR# 10071

Source: Grants DOE cal pad Strength: GPB & GPL

Scaler/Ratemeter Threshhold set @ 10.0 mV, Window IN/OUT out, Window N/A mV

HV Set @ 900 VDC (Instrument) 900 VDC (DVM Fluke 8020B)

Count Readings for Calibration Pad GPB (0.0 ± 0.3 pCi/gm Ra-226)

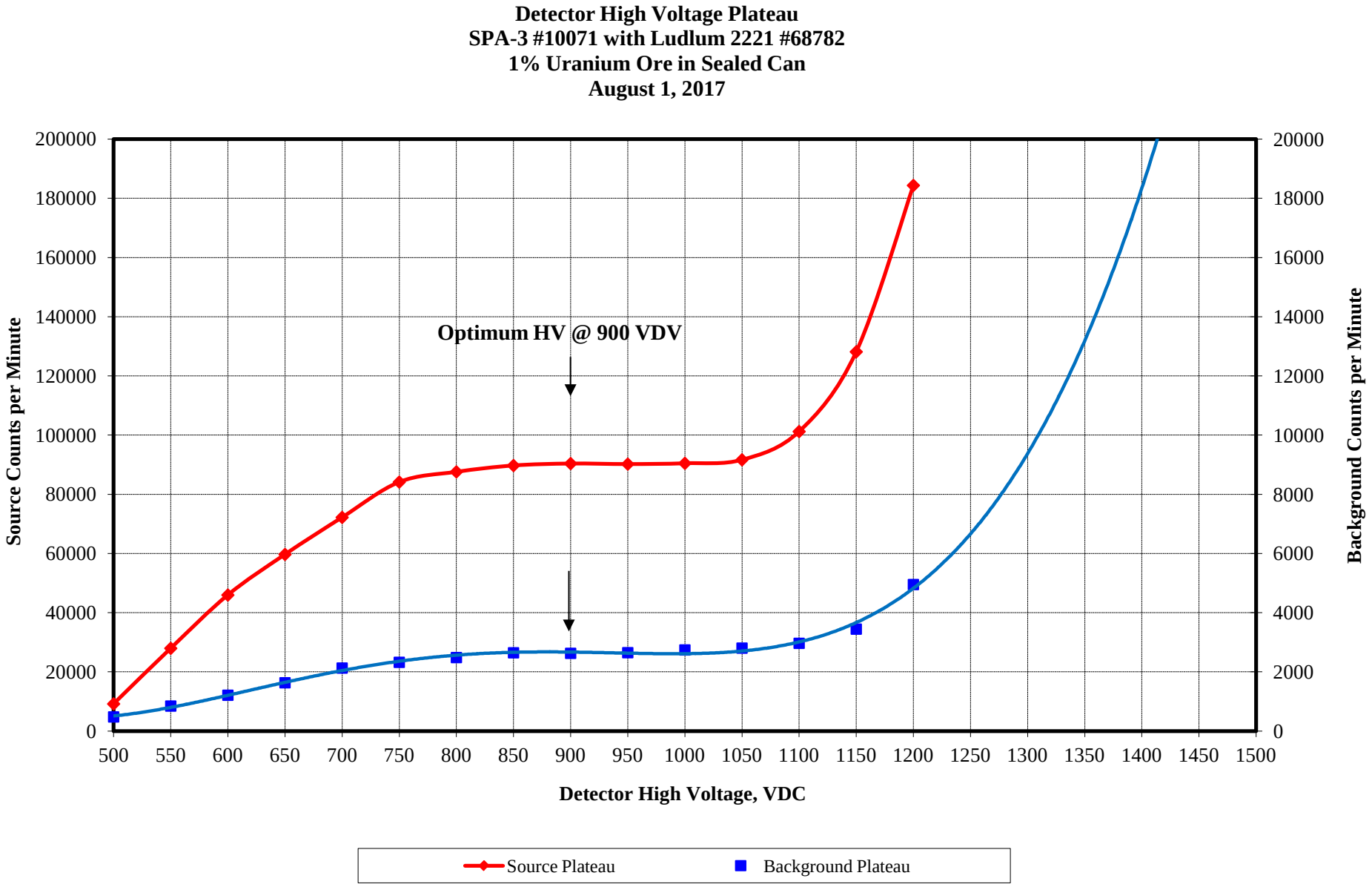
Bare (Uncollimated)		Collimated	
#1	11889 cpm	#1	2930 cpm
#2	11844 cpm	#2	2861 cpm
#3	12203 cpm	#3	2775 cpm
#4	11655 cpm	#4	2740 cpm
#5	12078 cpm	#5	2704 cpm
BKG Average	11934 cpm	BKG Average	2802 cpm

Count Readings for Calibration Pad GPL (87.78 pCi/gm Ra-226)

Bare (Uncollimated)		Collimated	
#1	82822 cpm	#1	46561 cpm
#2	82312 cpm	#2	45525 cpm
#3	82365 cpm	#3	46195 cpm
#4	82446 cpm	#4	46243 cpm
#5	83105 cpm	#5	46296 cpm
Gross Average	82610 cpm	Gross Average	46165 cpm
Net Source Pad	70676 cpm	Net Source Pad	43363 cpm
Eff(net cpm/87.78 pCi/gm	805 cpm/pCi/gm	Eff	494 cpm/pCi/gm

Exposure Rate
Ludlum 19 # 76248
@ 1.0'
= 110 mr/hr
= 1.33 mr/hr/Ci

Date 8/2/17 By [signature]


Detector High Voltage Plateau
SPA-3 #10071 with Ludlum 2221 #68782
1% Uranium Ore in Sealed Can
August 1, 2017
Optimum HV @ 900 VDV
Source Counts per Minute
Background Counts per Minute
Detector High Voltage, VDC
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
Source Plateau
Background Plateau

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 100, At Peak 590

Maximum CPM: 189,640 Background CPM: 7

HV Set @ 590 VDC

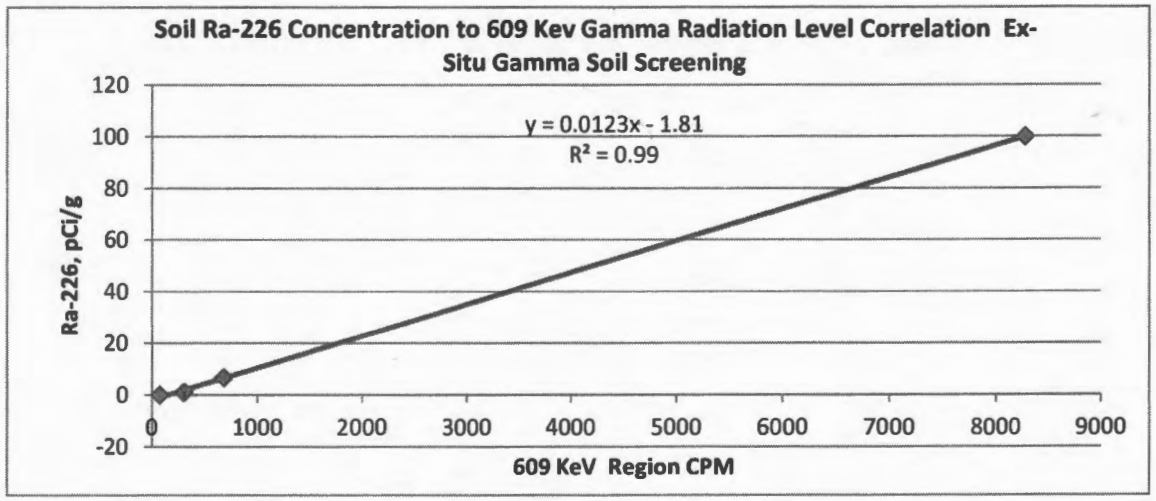
For Bi-214 609.2 KeV Peak (559 - 659 KeV ROI), Set Threshold @ 559, Window @ 100

Calibration Check w 1% U3O8 Ore Check Source: 16157 CPM
Blank 71

Date 04-14-2018 Calibrated By

AVM Environmental Services
Ex-Situ Soil Screening Gamma Radiation Level to Ra-226 Correlation
St Anthony Mine Site Test Pit Investigation

Reference Soil ID	Date	Ra-226 pCi/g	Wt gms	609 KeV CP5Min Gross (3x3 NaI Detector)	CPM
Blank	4/14/2018	0	-	389	78
BKG Soil	4/14//18	1	3000	1522	304
SA Ref Soil	4/14//18	6.6	3000	3392	678
NECR PTW Ref Soil	4/14//18	100	3000	41400	8280



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999887918
R Square	0.999775848
Adjusted R Square	0.999663772
Standard Error	0.895185294
Observations	4

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	7148.517287	7148.517287	8920.518403	0.000112082
Residual	2	1.602713422	0.801356711		
Total	3	7150.12			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.80557978	0.541028323	-3.33731101	0.079258065	-4.13343677	0.522277213	-4.13343677	0.522277213
X Variable 1	0.01229282	0.000130154	94.44849604	0.000112082	0.011732814	0.012852827	0.011732814	0.012852827

AVM Envi. ental Services, Inc.
Field Soil Sample Gamma Radiation Screening Form
St. Anthony Mine Site

Instrumentation : Scaler/Ratemeter L2221 (#290800), Detector L. 44-20 (# 295573)
Instrument Calibration Date: 04-14-2018, Instrument Function Check Performed: Y
Survey Area/Unit Decsription Correlation / Calibration data

Date/Time	Soil Sample ID	Sample Weight Grams	609 (559-669) Kev Gross Counts	Weight Corrected Counts	CPM	Estimated Ra-226 pCi/g	Comments
4-14-18	Blank	–	389	–	78	Ø	
4-14-18	St. Anthony Background Soil	3000	1522	–	304	1.0	
4-14-18	St. Anthony 6.6 pCi/g Reference Soil	3000	3392	–	678	6.6	
4-14-18	100 pCi/g Reference Soil	3000	41400	–	8280	100	

Technician Signature _____, Reviewed by _____

Designer and Manufacturer of Scientific and Industrial Instruments

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314714/451653

Mfr. Ludlum Measurements, Inc. Model 19 Serial No. 76248

Mfr. Model Serial No.

Cal. Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 48 % Alt 707.0 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. 500 / ____ V Ref./Inst. 1200 / ____ 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*
5000	4000 uR/hr	4000	4000
5000	1000 uR/hr	1000	1000
500	400 uR/hr = 73000 cpm	400	400
500	100 uR/hr	100	100
250	200 uR/hr = 37500 cpm	200	200
250	100 uR/hr	100	100
50	7300 cpm	40	40
50	1825 cpm	10	10
25	3750 cpm	20	20
25	937 cpm	5	5

*Uncertainty within ± 10% C.F. within ± 20%

50, 25 Range(s) Calibrated Electronically

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

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/NCSL 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 ☐ 2281CP ☐ 720 ☐ 734 ☑ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 2324/2521
☐ 5717CO ☐ 5719CO ☐ 60846 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☐ 2168CP ☐ S-394 ☐ S-1054 ☐ T10081 ☐ T10082 Neutron Am-241 Be ☐ T-304 Ra-226 ☐ Y96

☐ 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 5 Jul 17

QC'd By [signature] Title Service Dept QC Date 5 Jul 17

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM SC22A 12/12/2016 Page 1 of 1

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

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter: Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	262325
Detector: Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR150851

- [x] Mechanical Check
- [x] F/S Response Check
- [x] Geotropism
- [x] Meter Zeroed
- [x] THR/WIN Operation
- [x] Reset Check
- [x] Audio Check
- [x] Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): [x] 500 V [x] 1000 V [x] 1500 V

Cable Length: [ ] 39-inch [x] 72-inch [ ] Other:

Source Distance: [ ] Contact [x] 6 inches [ ] Other:

Source Geometry: [x] Side [ ] Below [ ] Other:

Threshold: 10 mV

Window:

Barometric Pressure: 24.51 inches Hg

Temperature: 76 °F

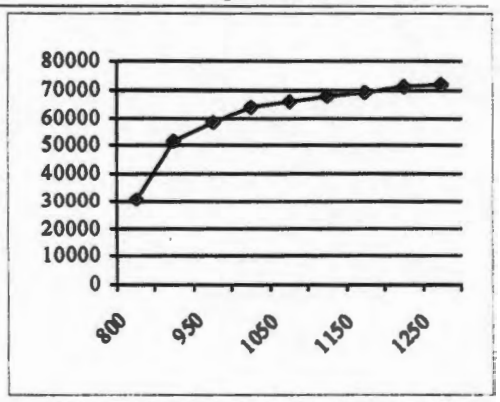
Relative Humidity: 20 %

Instrument found within tolerance: [x] Yes [ ] No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	399130	400
x 1000	100	100	100		100
x 100	400	400	400	39919	400
x 100	100	100	100		100
x 10	400	400	400	3993	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
800	30457	
900	51582	
950	58317	
1000	63521	
1050	65877	
1100	67461	
1150	69361	11131
1200	70973	
1250	71665	

Voltage Plateau



Comments: Scaler count time 1min. Recommended HV = 1150

Reference Instruments and/or Sources:

Ludlum pulser serial number: [ ] 97743 [x] 201932

Fluke multimeter serial number: [ ] 87490128

[ ] Alpha Source: Th-230 sn: 4098-03@12,800dpm/6,520 cpm (1/4/12)

[x] Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

[ ] Beta Source: Tc-99 sn: 4099-03@17,700dpm/11,100cpm(1/4/12)

[ ] Other Source:

Calibrated By: [signature]

Calibration Date: 3-14-18

Calibration Due: 3-14-19

Reviewed By: [signature]

Date: 03/14/18

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

Designer and Manufacturer of Scientific and Industrial Instruments

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Customer: AVM ENVIRONMENTAL SERVICES — ORDER NO. 20314714/451653

Mfr: Ludlum Measurements, Inc. — Model: 19 — Serial No.: 76248

M: — Model: — Serial No.:

Cal. Date: 5-Jul-17 — Cal Due Date: 5-Jul-18 — Cal. Interval: 1 Year — Meterface: 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. — T. 72 °F — RH 48 % — Alt 707.0 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. 500 / ____ V — Ref./Inst. 1200 / ____ 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*
5000	4000 uR/hr	4000	4000
5000	1000 uR/hr	1000	1000
500	400 uR/hr = 73000 cpm	400	400
500	100 uR/hr	100	100
250	200 uR/hr = 37500 cpm	200	200
250	100 uR/hr	100	100
50	7300 cpm	40	40
50	1825 cpm	10	10
25	3750 cpm	20	20
25	937 cpm	5	5

*Uncertainty within ± 10% C.F. within ± 20%

50, 25 Range(s) Calibrated Electronically

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

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/NCSL 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: 5 Jul 17

QC'd By: [signature] — Title: Service Dept QC — Date: 5 Jul 17

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FORM SC22A 12/12/2016 Page 1 of 1

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

www.ludlums.com

of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314714/451653

Mfr. Ludlum Measurements, Inc. Model 19 Serial No. 76248

M. Model Serial No.

Cal. Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Meterface 202-016

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 48 % Alt 707.0 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. 500 / V Ref./Inst. 1200 / 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*
5000	4000 uR/hr	4000	4000
5000	1000 uR/hr	1000	1000
500	400 uR/hr = 73000 cpm	400	400
500	100 uR/hr	100	100
250	200 uR/hr = 37500 cpm	200	200
250	100 uR/hr	100	100
50	7300 cpm	40	40
50	1825 cpm	10	10
25	3750 cpm	20	20
25	937 cpm	5	5

*Uncertainty within ± 10% C.F. within ± 20%

50, 25 Range(s) Calibrated Electronically

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

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/NCSL 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 ☐ 70697 ☐ 73410 ☐ E552 ☐ G112 ☐ 2168CP ☐ S-394 ☐ S-1064 ☐ 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 Title Calibrator Date 5 Jul 17

QC'd By Title Service Dept QC Date 5 Jul 17

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FORM SC22A 12/12/2016 Page 1 of 1

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

Designer and Manufacturer of Scientific and Industrial Instruments

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314714/451653

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

M. Model Serial No.

Cal. Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Meterface X4

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 48 % Alt 707.0 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	2.1	2
X 1000	1000 uR/hr	1.1	1
X 100	200 uR/hr = 35000 cpm	2	2
X 100	100 uR/hr	1	1
X 10	3500 cpm	2	2
X 10	1750 cpm	1	1
x 1	350 cpm	2	2
x 1	175 cpm	1	1

*Uncertainty within ± 10% C.F. within ± 20% X10, X1 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. The calibration system conforms to the requirements of ANSI/NCSL 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 ☐ 60846 ☐ 70697 ☐ 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 5 Jul 17

QC'd By Title Service Dept QC Date 5 Jul 17

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FORM SC22A 12/12/2016 Page 1 of 1

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

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/461652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH

	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

PULSE AMPLITUDE

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

PULSE FREQUENCY (PERIOD)

Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter	Model 1856 D	S/N 185641245066063	Cal Date 3-Nov 2016		
Oscilloscope	Model GDS-6103	S/N EP832241	Cal Date 2-Feb 2017		
Voltmeter	Model Fluke 83V	S/N 94000441	Cal Date 3-May 2017		

Calibrator William Tinsley William Tinsley Title Calibrator Date 5-July 2017

QC'd By [illegible] Title Service Dept QC Date 5 Jul 17

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM SC16-1 12/12/2016 Page 1 of 1

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

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 ± 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 ± 174 (0.00197 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by: [signature]

Calibration Technician: [signature] Q.A. Representative: [signature]

Calibration Date: 3-28-2005 Reviewed Date: 032805

Calculated activity on 3-14-2018
TOBe - 3,199 dpm ± 128 dpm
[signature]

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5411
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

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

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

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

Scaler HV: 900 VDC Scaler Threshold (Input Sensitivity): 10.0 mV

Source Counts: 961 / 1 Mins @ 1.0 cm

Background Counts: 45 / 1 Mins

Net CPM: 916

1% U308

Source CPM	BKG CPM
956	48
940	44
972	45
960	39
980	46
Average 961	45

Eff = Net cpm/source dpm 0.29

Function Check:

Function check source: 1% U308 in Can
Function Check cpm: 3600 cpm
Range 2880-4320 cpm

Comments Active Area = 21 cm²

Date: 3-13-18 Calibrated by: [signature]

AVM Environmental Services Inc.
Scaler/Ratemeter Calibration Form

Model Ludlum 12 S/N 274216

Calibration Source Ludlum Model 500 Pulser S# 114513

Threshold (input sensitivity), Found at 10 mV Left or Set at 10 mV

Window, In/Out N/A Window N/A mV

Pulser Amplitude Set @ 20 mV

Range/Mode	Calibration Point (Pulser Setting) cpm x multiplier	As Found Reading	Left or Set Reading
X1	40x10	400	400
X10	40x100	4000	4000
X 100	40x 1k	40,000	40,000
X 1000	40x 10K	400,000	400,000

HV Set @ 900 VDC

Date 8-1-17 Calibrated By

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
www.ludlums.com

ACCREDITED
CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/451652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH			
	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

PULSE AMPLITUDE							
Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%	Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%
1 V	1 V	1 V	0.9 - 1.1	4 V	4.2 V	4.2 V	3.6 - 4.4
100 mV	100 mV	100 mV	90 - 110	400 mV	420 mV	420 mV	360 - 440
10 mV	10 mV	10 mV	9 - 11	40 mV	42 mV	42 mV	36 - 44
1 mV	1 mV	1 mV	0.9 - 1.1	4 mV	4.2 mV	4.2 mV	3.6 - 4.4

PULSE FREQUENCY (PERIOD)			
Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter	Model 1856 D	S/N 185641245060063	Cal Date 3-Nov 2016
Oscilloscope	Model GOS-6103	S/N EP832241	Cal Date 2-Feb 2017
Voltmeter	Model Fluke 83 V	S/N 94000441	Cal Date 3-May 2017

Calibrator William Tinsley William Tinsley Title Calibrator Date 5-July 2017

QC'd By [signature] Title Service Dept QC Date 5 Jul 17

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FORM SC16-1 12/12/2016 Page 1 of 1

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

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 ± 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 ± 174 (0.00197 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by: [signature]

Calibration Technician: [signature] Q.A. Representative: [signature]

Calibration Date: 3-28-2005 Reviewed Date: 032805

Calculated activity on 3-14-2018
TOBe - 3,199 dpm ± 128 dpm
[signature]

Analytical Services
7021 Pan American Freeway N
Albuquerque, New Mexico 87109-423
(505) 345-3461 Fax (505) 761-541
Toll Free (866) RAD-LABS (723-5227
www.eberlineservices.co

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

Scaler/Ratemeter: L12 S# 274126 HP-210L: ANA-2

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

Scaler HV: 900 VDC Scaler Threshold (Input Sensitivity): 10.0 mV

Source Counts: 1055 / 1 Mins @ 1.0 cm

Background Counts: 43 / 1 Mins

Net CPM: 1012

Eff = Net cpm/source dpm 0.32

	Source CPM	BKG CPM
	1105	41
	1020	48
	1100	37
	1000	44
	1050	45
Average	1055	43

Function Check:

Function check source: 1% U_3O_8 ore in Can
Function Check cpm: 3950 cpm
Range 3160-4740 cpm

Comments Active Area = 21 cm²

Date: 3-13-2018 Calibrated by: [signature]

AVM Environmental Services Inc.
Scaler/Ratemeter Calibration Form

Model Ludlum 12 S/N 274216

Calibration Source Ludlum Model 500 Pulser S# 114513

Threshold (input sensitivity), Found at 10 mV Left or Set at 10 mV

Window, In/Out N/A Window N/A mV

Pulser Amplitude Set @ 20 mV

Range/Mode	Calibration Point (Pulser Setting) cpm x multiplier	As Found Reading	Left or Set Reading
x1	40x10	400	400
x10	40x100	4000	4000
x100	40x1K	40,000	40,000
x1000	40x10K	400,000	400,000

HV Set @ 900 VDC

Date 8-1-17 Calibrated By [signature]

CERTIFICATE OF CALIBRATION

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

www.ludlums.com

CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/451652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

PULSE AMPLITUDE							
Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%	Reference Amplitude	As Found Amplitude Reading	As Left Amplitude Reading	Acceptable Range ± 10%
1 V	1 V	1 V	0.9 - 1.1	4 V	4.2 V	4.2 V	3.6 - 4.4
100 mV	100 mV	100 mV	90 - 110	400 mV	420 mV	420 mV	360 - 440
10 mV	10 mV	10 mV	9 - 11	40 mV	42 mV	42 mV	36 - 44
1 mV	1 mV	1 mV	0.9 - 1.1	4 mV	4.2 mV	4.2 mV	3.6 - 4.4

PULSE FREQUENCY (PERIOD)			
Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter	Model 1856 D	S/N 185641245060600 63	Cal Date 3-Nov 2016
Oscilloscope	Model GOS-6103	S/N EP832241	Cal Date 2-Feb 2017
Voltmeter	Model Fluke 83 V	S/N 94000441	Cal Date 3-May 2017

Calibrator William Tinsley William Tinsley Title Calibrator Date 5-July 2017

QC'd By [signature] Title Service Dept QC Date 5 Jul 17

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

FORM SC10-1 12/12/2016 Page 1 of 1

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

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 ± 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 ± 174 (0.00197 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by: [signature]

Calibration Technician: [signature] Q.A. Representative: [signature]

Calibration Date: 3-28-2005 Reviewed Date: 032805

Calculated activity on 3-14-2018
TOBe - 3,199 dpm ± 128 dpm
[signature]

Analytical Servic
7021 Pan American Freeway
Albuquerque, New Mexico 87109-42
(505) 345-3461 Fax (505) 761-54
Toll Free (866) RAD-LABS (723-521
www.eberlineservices.c

AVM Environmental Services, Inc
Alpha/Beta Counter Calibration

Model: Ludlum 2929/43-10-1, S/N 74084/PR069370
Detector Calibration

Alpha Input Sensitivty: 175
Beta Input Sensitivity: 4
Beta Window: 50

Alpha Source Th-230 DNS-11 S# 1310, 9480 dpm (uncs)
Beta Source Sr-Y-90 DNS-14 S# 5442-05, 3199 dpm
HV Readout: Fluke 8020B Multimeter with detector connected

HV	Alpha CPM	Alpha BKG CPM	Beta CPM	Beta BKG CPM
850				
875				
900				
925				
950	3380	1	1221	43
975	3549	1	1249	49
1000	3581	2	1263	51
1025	3579	2	1262	51
1050	3594	3	1281	55
1075	3648	2	1279	59
1100	3702	3	1309	68
1125	3828	4	1366	84
1150				

HV Set @ 100 VDC

Alpha Source: Th-230 9480 dpm
Alpha Counts 35955 / 10 Minutes
BKG Counts 9 / 10 Minutes

Alpha Eff = $\frac{\text{CPM, Net}}{\text{dpm (Source)}} = \frac{3596}{9480} = 0.379$

Beta Source: Sr-Y-90 3199 dpm
Beta Counts 12585 / 10 Minutes
BKG Counts 531 / 10 Minutes

Beta Eff = $\frac{\text{CPM, Net}}{\text{dpm (Source)}} = \frac{1259}{3199} = 0.393$

Alph FC Range Th-230 #1310: 28674-43146 / 10 min
Beta FC Range Sr-Y-90 #5442-05: 10068-15102 / 10 min
Date: 3-13-18 Tech: [signature]

AVM Environmental Services, Inc
Alpha/Beta Counter Calibration

Model: Ludlum 2929/43-10-1, S/N 74084/PR069370
Scaler Calibration

Scaler Calibration Source: Ludlum 500 Pulser, SR#114513
HV: 1000
Alpha Input Sensitivty set @: 175 mV
Beta Input Sensitivity set @: 4 mV
Beta Window set @ : 50 mV

Scaler Calibration

	Pulse input Sensitivity	Pulser Reference Cal Point CPM	Instrument Reading As Found CPM	Instrument Reading Set or Left at CPM
Alpha Channel Digital Readout	200	40 CPM	40	40
		400 CPM	399	399
		4K CPM	3993	3993
		40K CPM	39997	39997
Beta Channel Digital Readout	25	40 CPM	40	40
		400 CPM	401	401
		4K CPM	4004	4004
		40K CPM	40010	40010

Date: 3-13-18 Tech: [signature]

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 7132
P.O.# 05173

Description of Standard:

Model No. DNS-11 Serial No. S-1310 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 75322-201

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

4,810 ± 144

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

9,480 ± 284 (0.00427 μCi)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by:

Calibration Technician: Art Reust Q.A. Manager: Charlotte McFee

Calibration Date: 6-14-2011 Reviewed Date: 6-14-11

Source Manufacturing Lab
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 761-5413 Fax (505) 761-5416
areust@eberlineservices.com

EBERLINE SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6233
P.O.# 1093

Description of Standard:

Model No. DNS-14 Serial No. 5442-05 Isotope SrY-90

Electroplated on polished Ni disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

3,050 ± 122

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was:

4,370 ± 174 (0.00197 μCi)

The uncertainty of the measurement is 4 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by: [signature]

Calibration Technician: [signature] Q.A. Representative: [signature]

Calibration Date: 3-28-2005 Reviewed Date: 032805

Analytical Services
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 345-3461 Fax (505) 761-5416
Toll Free (866) RAD-LABS (723-5227)
www.eberlineservices.com

on 3/14/18 3199 dpm

www.ludlums.com

CERTIFICATE OF CALIBRATION

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

ACCREDITED
CERT # 4084.01

Model No. / Serial No. 500 / 114513

Customer AVM ENVIRONMENTAL SERVICES ORDER NO. 20314713/451652

Date 5-Jul-17 Cal Due Date 5-Jul-18 Cal. Interval 1 Year Procedure M500, Rev. 5

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

T. 72 °F RH 49 % Alt 707.0 mm Hg ☑ Meter Zeroed ☑ Mechanical Check

CUSTOMER PO N/A

PULSE WIDTH			
	As Found	As Left	Acceptable Range (µs) ± 10%
NEG PULSE	1.7	1.7	1.5 - 1.9
POS PULSE	1.6	1.6	< 2.25

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

PULSE FREQUENCY (PERIOD)			
Pulser Range	As Found Period	As Left Period	Acceptable Range ± 2%
x 10K	6.674	6.674	6.534 - 6.8
x 1K	66.74	66.74	65.34 - 68
x 100	667.4	667.4	653.4 - 680
x 10	6674	6674	6534 - 6800
x 1	66.75	66.75	65.34 - 68
x 0.1	90	90	88.2 - 91.8 Counts

Reference Voltage	As Found Voltage Reading	As Left Voltage Reading	Acceptable Range ± 5%
500 V	500	500	475 - 525
2000 V	1990	1990	1900 - 2100

CPM Reading	As Found cpm Reading	As Left cpm Reading	Acceptable Range ± 10%
MAX	992	992	981 - 999
MIN	0-1	0-1	0 - 1*

* READING OF 0-99 IS ACCEPTABLE FOR INSTRUMENTS WITH A S/N 100000 AND BELOW AND 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. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. ISO/IE 17025:2005(E)

Reference Instruments:

Frequency Counter Model 1856D S/N 185641245060600 63 Cal Date 3-Nov 2016
Oscilloscope Model GOS-6103 S/N EP832241 Cal Date 2-Feb 2017
Voltmeter Model Fluke 83V S/N 94000441 Cal Date 3-May 2017

Operator William Tinsley William Tinsley Title Calibrator Date 5-July 2017
QC'd By [illegible] Title Service Dept QC Date 5 Jul 17

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

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

AVM Environmental Services, Inc.
Scaler/Ratemeter - 2" x 2" NaI Detector Function Check

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

2" x 2" NaI Detector ID: #30, SPA-3

Acceptable background Count (cpm) Range (20%) 6300 to 9450 (Bare)

Acceptable background Count (cpm) Range (20%) 2334 to 3502 (collimated)

Acceptable Source Count (cpm) Range (20%) 77097 to 115645

Date	Scaler/Ratemeter	Physical Check	Cal Due	Battery(1) Volts or OK	HV Volts	THR mV (2)	Window In or OUT(3)	C.C.(4)	BKG Counts cpm	Source Counrts cpm	Within Acceptable Range Y or N	MDC pCi/gm	Tech
3-16-18	L2221 68782	✓	8-1-18	✓	900	10.0	out	1	7894(B) 2880(C)	96244	Y	<1.5	VP
3-20-18	L2221 L68782	✓	8-1-18	✓	900	10.0	out	1	7998(B)	96324	Y	<1.5	MP
3-21-18	L2221 #262325	✓	8-1-18	✓	900	10.0	out	1	8015	96101	Y	<1.5	MP
3-22-18	L2221 #262325	✓	8-1-18	✓	900	10.0	out	1	7938	96485	Y	<1.5	MP
3-23-18	L2221 #262325	✓	8-1-18	✓	901	10.0	out	1	7998	96228	Y	<1.5	MP
3-26-18	L2221 #262325	✓	8-1-18	✓	900	10.0	out	1	8020	96195	Y	<1.5	MP
3-27-18	L2221 #262325	✓	8-1-18	✓	900	10.0	out	1	7899	96334	Y	<1.5	MP
3-28-18	L2221 #262325	✓	8-1-18	✓	901	10.0	out	1	7966	96228	Y	<1.5	MP
3-29-18	L2221 #262325	✓	8-1-18	✓	900	10.0	out	1	7849	96199	Y	<1.5	MP
3-30-18	L2231 #262325	✓	8-1-18	✓	901	10.0	out	1	8005	96419	Y	<1.5	MP
4-4-18	L2221 #290801	✓	8-1-18	✓	900	10.0	out	1	7928	96109	Y	<1.5	MP
5-6-18	L2221 #290801	✓	8-1-18	✓	900	10	out	1	7155	97815	Y	<1.5	VP

Note: (1) Battery Voltage for Ludlum 2221 must be >5.3 volts; (2) Threshhold must be at 10.0 mV; (3) Window Position must be OUT; (4) CC on L2241-2 set at 0.001
For L2241-2 Check HV and Threshold using Ludlum 500 pulser.

AVM Environmental Services, Inc.
Scaler/Ratemeter - 2" x 2" NaI Detector Function Check

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

2" x 2" NaI Detector ID: #33

Acceptable background Count (cpm) Range (20%) 6204 to 9307 (Bare)

Acceptable background Count (cpm) Range (20%) 2365 to 3547 (collimated)

Acceptable Source Count (cpm) Range (20%) 76854 to 115280

Date	Scaler/Ratemeter	Physical Check	Cal Due	Battery(1) Volts or OK	HV Volts	THR mV (2)	Window In or OUT(3)	C.C.(4)	BKG Counts cpm	Source Counrts cpm	Within Acceptable Range Y or N	MDC pCi/gm	Tech
3-16-18	L2221 SN 68782	✓	8-1-18	✓	900	10.0	out	1	7618 B 2920 C	95018	Y	<1.5	VP
3-19-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	16013 B	95281	Y	<1.5	VP
3-20-18	L2221 SN 68782	✓	8-1-18	✓	900	10.0	out	1	8015	95196	Y	<1.5	VP
3-21-18	L2221 SN# 28782	✓	8-1-18	✓	900	10.0	out	1	8098	95319	Y	<1.5	VP
3-22-18	L2221 SN#68782	✓	8-1-18	✓	900	10.0	out	1	7910	95296	Y	<1.5	VP
3-23-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8029	95002	Y	<1.5	VP
3-26-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	7947	95248	Y	<1.5	VP
3-27-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	7904	95411	Y	<1.5	VP
3-28-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8078	95224	Y	<1.5	VP
3-29-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	7877	95224	Y	<1.5	VP
3-30-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8076	95322	Y	<1.5	VP
4-4-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8004	95232	Y	<1.5	VP
4-6-18	L2221 #68782	✓	8-1-18	✓	901	10.0	out	1	7906	95066	Y	<1.5	VP
4-11-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8003	95198	Y	<1.5	VP
4-16-18	L2221 #68782	✓	8-1-18	✓	901	10.0	out	1	8118	95396	Y	<1.5	VP
4-17-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8009	9548	Y	<1.5	VP
4-18-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	7916	95011	Y	<1.5	VP
4-19-18	L2221 #68782	✓	8-1-18	✓	900	10.0	out	1	8117	96199	Y	<1.5	VP

BKG 16-17 B/C

Note: (1) Battery Voltage for Ludlum 2221 must be >5.3 volts; (2) Threshhold must be at 10.0 mV; (3) Window Position must be OUT; (4) CC on L2241-2 set at 0.001
For L2241-2 Check HV and Threshold using Ludlum 500 pulser.

AVM Environmental Services, Inc.
Scaler/Ratemeter - 2" x 2" NaI Detector Function Check

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

2" x 2" NaI Detector ID: #33 SPA-3

Acceptable background Count (cpm) Range (20%) 6204 to 9307 (Bare)

Acceptable background Count (cpm) Range (20%) 2365 to 3547 (collimated)

Acceptable Source Count (cpm) Range (20%) 76854 to 115280

Date	Scaler/Ratemeter	Physical Check	Cal Due	Battery(1) Volts or OK	HV Volts	THR mV (2)	Window In or OUT(3)	C.C.(4)	BKG Counts cpm	Source Counrts cpm	Within Acceptable Range Y or N	MDC pCi/gm	Tech
5-7-18	L2221 #290 801	✓	8-1-18	5.7	900	10	out	—	8179 Bare	98532	y	<1.2	UP
5-9-18	L2241/287 029	✓	8-1-18	OK	900	10	—	—	8090	97400	y	<1.2	up
5-12-18	L2221/#33	✓	8-1-18	OK	900	10	out	—	8124	97428	y	<1.2	up

Note: (1) Battery Voltage for Ludlum 2221 must be >5.3 volts; (2) Threshhold must be at 10.0 mV; (3) Window Position must be OUT; (4) CC on L2241-2 set at 0.001
For L2241-2 Check HV and Threshold using Ludlum 500 pulser.

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

Micro R Meter: Ludlum 19, SR#76248

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

Function Check @ Calibration 110

Acceptable Function Check Reading (uR/hr) Range (20%) 88 to 132

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
3-16-18	✓	7-5-17	✓	10-12	110	Y	7-5-18	VP
3-19-18	✓	7-5-17	✓	9-11	110	Y	7-5-18	VP
3-20-18	✓	7-5-17	✓	10-12	110	Y	7-5-18	VP
3-21-18	✓	7-5-18	✓	10-13	110	Y	7-5-18	VP
3-22-18	✓	7-5-18	✓	10-12	109	Y	7-5-18	VP
3-23-18	✓	7-5-18	✓	10-11	109	Y	7-5-18	VP
3-26-18	✓	7-5-18	✓	10-12	110	Y	7-5-18	VP
3-27-18	✓	7-5-18	✓	10-11	109	Y	7-5-18	VP
3-28-18	✓	7-5-18	✓	10-12	110	Y	7-5-18	VP
3-29-18	✓	7/5/18	✓	9-11	109	Y	7-5-18	VP
3-30-18	✓	7-5-18	✓	10-12	110	Y	7-5-18	VP
4-4-18	✓	7-5-18	✓	9-12	109	Y	7-5-18	VP
4-6-18	✓	7-5-18	✓	10-12	110	Y	7-5-18	VP
4-11-18	✓	7-5-18	✓	10-12	109	Y	7-5-18	VP
4-16-18	✓	7-5-18	✓	10-11	108	Y	7-5-18	VP
4-17-18	✓	7-5-18	✓	10-12	110	Y	7-5-18	VP
4-18-18	✓	7-5-18	✓	9-12	110	Y	7-5-18	VP
4-19-18	✓	7-5-18	✓	10-11	109	Y	7-5-18	VP

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

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

Micro R Meter: Ludlum 19, SR#76248

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

Function Check @ Calibration 115

Acceptable Function Check Reading (uR/hr) Range (20%) 92 to 138

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
3-16-18	✓	7-5-17	✓	10-12	115	Y	7-5-18	UP
4-30-18	✓	7-5-17	✓	9-12	112	Y	7-5-18	ND
5-1-18	✓	7-5-17	✓	10-12	110	Y	7-5-18	ND
5-2-18	✓	7-5-17	✓	10-11	115	Y	7-5-18	ND
5-3-18	✓	7-5-17	✓	10-12	110	Y	7-5-18	ND
5-7-18	✓	7-5-17	✓	9-10	115	Y	7-5-18	UP
5-9-18	✓	7-5-17	✓	10-11	110	Y	7-5-18	ND
5-12-18	✓	7-5-17	✓	10-11	110	Y	7-5-18	ND

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

AVM Environmental Services, Inc.
Ludlum SCA L2221 - 44-20 3x3 NaI Detector Function Check
559 - 659 KeV Gamma Radiation Soil Screening

L2221 #68782

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

Ludlum 44-20 3x3 NaI Detector, #PR295573

Acceptable background Count (cpm) Range (20%) 57 to 85

Acceptable Source Count (cpm) Range (20%) 12926 to 19388

Date	Physical Check	Cal Date	Battery(1) Volts or OK	HV Volts	Threshhold mV (2)	Window mV	Window In/Out	BKG Counts cpm	Source Counrts cpm	Within Acceptable Range Y or N	MDC pCi/gm	Tech
4-16-18	✓	4-14-19	✓	590	559	100	in	73	15876	Y	-	JP
4-17-18	✓	4-14-19	✓	590	559	100	in	78	16218	Y	-	JP
4-18-18	✓	4-14-19	✓	590	559	100	in	81	16070	Y	-	JP
4-19-18	✓	4-14-19	✓	590	559	100	in	72	16114	Y	-	JP

Note: (1) Battery Voltage for Ludlum 2221 must be >5.3 volts; (2) Threshhold must be at 220 mV; (3) Window @ 440, must be IN

AVM Environmental Services, Inc
Scaler/Ratemeter - HP-210L Detector Function Check

Scaler/Ratemeter: L12 S# 274126

HP-210 Detector: ANA-1

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

Acceptable background Count (cpm) Range (20%) 40 to 60

Acceptable Source Count (cpm) Range (20%) 2880 to 4320

Date	Physical Check	Cal date	Battery Volts or OK	HV Volts	BKG Counts cpm	Source Counrts cpm	Within Acceptable Range Y or N	Comments	Tech
3-16-18	✓	3-13-18	✓	900	48	3600	Y		VP
3-19-18	✓	3-13-18	✓	900	51	3600	Y		VP
3-20-18	✓	3-13-18	✓	900	49	3600	Y		VP
3-21-18	✓	3-13-18	✓	900	53	3600	Y		VP
3-22-18	✓	3-13-18	✓	900	51	3600	Y		VP
3-23-18	✓	3-13-18	✓	900	47	3600	Y		VP
3-26-18	✓	3-13-18	✓	900	55	3600	Y		VP
4-6-18	✓	3-13-18	✓	900	49	3600	Y		VP
4-19-18	✓	3-13-18	✓	900	50	3600	Y		VP
4-30-18	✓	3-13-18	✓	900	50	3500	Y		VP
5-1-18	✓	3-13-18	✓	900	42	3600	Y		VP
5-2-18	✓	3-13-18	✓	900	52	3600	Y		VP
5-3-18	✓	3-13-18	✓	900	49	3600	Y		VP
5-7-18	✓	3-13-18	✓	900	48	3600	Y		VP
5-9-18	✓	3-13-18	✓	900	51	3600	Y		VP
5-12-18	✓	3-13-18	✓	900	42	3600	Y		VP

Note: (1) Threshhold must be at 100 mV; (2(C.C. for Eberline ESP scaler must be 1.0+00

AVM Environmental Services, Inc
Scaler/Ratemeter - HP-210L Detector Function Check

Scaler/Ratemeter: L2241-2 (#287029)

HP-210 Detector: ANA-2

Function Check Source ID: 1% U_3O_8 Ore in Sealed can

Acceptable background Count (cpm) Range (20%) 35 to 52

Acceptable Source Count (cpm) Range (20%) 3160 to 4740

Date	Physical Check	Cal date	Battery Volts or OK	HV Volts	BKG Counts cpm	Source Counrts cpm	Within Acceptable Range Y or N	Comments	Tech
3-26-18	✓	3/13/18	OK	900	48	3800	Y		MP
3-27-18	✓	3/13/18	OK	900	52	3850	Y		MP
3-28-18	✓	3/13/18	OK	900	56	3850	Y		MP
3-29-18	✓	3-13/18	OK	900	49	3800	Y		MP
3-30-18	✓	3/13/18	OK	900	51	3800	Y		MP
4-4-18	✓	3-13-18	OK	900	49	3800	Y		MP
4-16-18	✓	3-13-18	OK	900	50	3800	Y		MP
4-17-18	✓	3-13-18	OK	900	60	3800	Y		MP
4-18-18	✓	3-13-18	OK	900	54	3800	Y		MP

Note: (1) Threshhold must be at 100 mV; (2(C.C. for Eberline ESP scaler must be 1.0+00

AVM Environmental Services, Inc
Ludlum 2929 Scaler/43-10-1 Alpha-Beta Counting System Function Check Form

L2929 SR#74084/43-10-1 SR#PR069370

Function Check Source ID: : Th-230 DNS-11 (#1310), 9450 dpm

Acceptable background Count (cp10m) Range (20%) 0 to 11

Acceptable Source Count (cp10m) Range (20%) 28764 to 43146

Date	Physical Check	Cal date	HV Volts	Alpha BKG Counts (CP10M)	Alpha Source Counts (CP10M)	Beta BKG Counts (CP10M)	Beta Source Counts (CP10M)	Within Acceptable Range Y or N	Comments	Tech
3-13-18	✓	3-13-18	1000	3	35955	—	—	Y		mp
3-29-18	✓	3-13-18	1000	2	35435	—	—	Y		mp
4-2-18	✓	3-13-18	1000	1	36176	—	—	Y		mp
4-7-18	✓	3-13-18	1000	1	36478	—	—	Y		mp
4-19-18	✓	3-13-18	1000	2	35228	—	—	Y		mp
4-23-18	✓	3-13-18	1000	3	36101	—	—	Y		mp

Note: (1) Calibration HV set @1000 V