APPENDIX A

STANDARD OPERATING PROCEDURES

SOP 1 – SOIL SAMPLING

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the protocol and methods for collecting soil samples for the Marsland Expansion Area preoperational soil sampling program.

2.0 PRECAUTIONS

The following precautions will be observed during sampling:

- All sample containers shall be inspected for cleanliness and flaws prior to use.
- Latex or nitrile gloves shall be worn during sample collection.
- Sample collection equipment shall be decontaminated as described in this document.

3.0 EQUIPMENT AND MATERIALS

The following equipment is required for the collection of soil samples:

- field logbook or equivalent and permanent black pens
- sample containers (plastic one-gallon bags)
- stainless steel spoons, stainless steel mixing bowls
- scoop or shovel
- engineers tape (graduated in centimeter [cm] increments)
- decontamination equipment and supplies
- disposable latex / nitrile gloves
- digital camera

4.0 PROCEDURE

The following procedures will be used for equipment decontamination and soil sample collection.

4.1 SAMPLING LOCATIONS

Soil sampling locations will be determined prior to traveling to the field. Prior to soil sampling the coordinates of each sample location plot will be identified. Sampling plot locations will be initially located using a hand-held GPS device. Sampling locations may be adjusted in the field as necessary for access and to accommodate field conditions. The GPS coordinates of the actual (adjusted) sampling locations will be recorded in the field logbook at the time of sampling.

4.2 Equipment Decontamination Procedures

Sampling equipment will be decontaminated between sample collection points, if the equipment is not disposable, in order to avoid cross contamination between samples. Decontamination equipment may include pump sprayers, spray bottles, deionized water, phosphate free soap solution, scrub brushes, buckets, disposable gloves, paper towels, etc. Field personnel will wear disposable gloves while decontaminating equipment.

The following sampling equipment decontaminated procedures will be followed:

1. Visually inspect sampling equipment for adhered soil; a disposable paper towel or stiff brush will be used to remove any visible material.
2. If visible contamination remains, wash the field equipment with phosphate free soap and water, rinse with distilled water, and air dry or wipe with disposable paper towels.
3. Deposit all disposable items, such as paper towels and disposable gloves, into a garbage bag and dispose of properly.

4.3 Pre-sampling Inspection

1. Inspect the sampling site and ensure that it has not been disturbed.
2. Note in the field logbook any unusual conditions.
3. Take photographs to document sample site conditions and location.

4.4 Soil Sample Collection

The soil sample at each location will consist of the collection of a minimum of 500 grams of soil. Samples will be collected to a depth of 5-cm or 15-cm below the ground surface depending on the sampling type. After collection in the field soil samples will be submitted to Inter-mountain (IML) laboratories to be analyzed for select radionuclides depending on the sample type. The sampling type requirements such as depth and laboratory analysis requirements will be provided in the final report.

4.5 Quality Assurance / Quality Control

Quality assurance and quality control (QA/QC) samples will be collected during soil sampling. QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses. A field duplicate is defined as a second sample (or measurement) from the same location, collected in immediate succession, using identical techniques. Both the primary and field duplicate samples will be homogenized in the mixing bowl and split into separate sample containers. A minimum of one field duplicate will be submitted per 20 primary samples during soil sampling. Data validation testing, including precision analysis testing, will be performed on the primary and duplicate sample laboratory results.

5.0 SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

5.1 SAMPLE CONTAINERS

Proper sample preparation practices will be observed to minimize sample contamination and potential repeat analyses due to anomalous analytical results. Appropriately sized re-sealable freezer plastic bags will be used. The sample bags will be labeled as described in section 5.4.1.

5.2 SAMPLE PRESERVATION

No sample preservation is required for soil samples.

5.3 SAMPLE HOLDING TIMES AND ANALYSES

Sample holding times are established to minimize chemical changes in a sample prior to analysis and/or extraction. A holding time is defined as the maximum allowable time between sample collection and analysis and/or extraction, based on the nature of the analyte of interest and chemical stability factors. There is no holding time for samples to be submitted for Ra-226 analysis. A 180 day holding time is recommended for U-nat and Th-230 analysis. Samples should be sent to the laboratory as soon as possible after collection by hand delivery or a courier service to minimize the possibility of exceeding holding times.

5.4 SAMPLE PREPARATION AND SHIPPING

After collection, samples will be labeled as described in the following section, prepared as described in the previous sections and placed in a cooler for delivery to the laboratory. The coolers will be taped shut and chain of custody (COC) seals will be attached to the outside of the cooler to ensure that the cooler cannot be opened without breaking the seal.

6.0 RECORDS

6.1 FIELD LOGBOOK

All information pertinent to field sampling shall be recorded in a field logbook or equivalent. The field logbook will be a bound book with consecutively numbered pages. All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions. Entries in the logbook will include the following, as applicable:

- date and time of sample collection
- sample identification
- sample location
- sample depth

- physical description of sample (color, texture)
- weather conditions and physical/environmental conditions during field activity
- names of sampling personnel and any visitors
- photograph log
- sampling equipment and method
- information concerning sampling decisions
- field observations
- summary of daily tasks and information concerning sampling changes and scheduling modifications
- signature and date by personnel responsible for observations at bottom of each page

6.2 Sample Chain of Custody

During field sampling activities, traceability of the sample must be maintained from the time the samples are collected until laboratory data are issued. Establishment of traceability of data is crucial for resolving future problems if analytical results are called into question and for minimizing the possibility of sample mix-up. Initial information concerning collection of the samples will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form.

The sampler is responsible for initiating and filling out the COC form. The COC form will be signed by the sampler when samples are relinquished to anyone else. A COC form will be completed for each set of samples collected and will contain the following information:

- sampler's signature and affiliation
- project number
- date and time of collection
- sample identification number
- sample type
- analyses requested (can provide laboratory project quote number)
- number of containers
- signature of persons relinquishing custody, dates, and times
- signature of persons accepting custody, dates, and times
- method of shipment
- shipping air bill number (if the samples are shipped)
- any additional instructions to the laboratory

The person responsible for delivering the samples to the laboratory will sign the COC form, retain a copy of the form, document the method of shipment, and send the original form with the samples. Tetra Tech will maintain a copy of the COC. Upon arrival at the laboratory, the person receiving the samples will sign the COC form and return a copy to the Project Manager. Copies of all COC documentation will be compiled and maintained in the central files. The original COC forms will remain with the samples until the time of final disposition. When returning samples for disposal, the laboratory will send the original COC to Tetra Tech. This COC will then be incorporated into the central files. COC forms will be provided by either the analytical laboratory or Tetra Tech.

6.3 FIELD OBSERVATIONS

The field logbook will contain sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbook will be kept in the field technician's possession or in a secure place during sampling activities. Following sampling, the completed logbook shall be maintained and filed as part of the permanent project record. A scanned copy of the field logbook will be included as an appendix to the final report. Photographs will be taken where possible at each sampling location and a photographic log will be provided as an appendix to the final report.

SOP 2 – MOBILE GAMMA RADIATION SURVEYING

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LIST OF FIGURES

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the protocol and methods for performing a continuous mobile gamma radiation survey in accordance with the Marsland Baseline Radiological Investigation. The methods presented in this SOP include equipment operation, survey techniques, and instrument calibration requirements.

1.1 EQUIPMENT AND MATERIALS

Each mobile gamma survey system consists of:

(1) USB compatible laptop or mobile computer installed with Tetra Tech *ScanSystem* software, *GammaViewer* software and a global mapping software

(1) Standard backpack or ATV (shown on Figure 1)

(2) *USGlobalSat* GPS Receiver with USB Interface

(1) Ludlum 44-10 sodium iodide (NaI) scintillation detector (shown in Figure 2)

(1) Ludlum 2350-1 data logger (shown in Figure 2)

(1) 4 port USB hub

(1) 3-foot Ludlum coaxial cable

(1) RS232 Serial to USB Converter

(1) Ludlum RS232 data cable

Figure 1 Mobile GPS Integrated Gamma Survey System – Backpack (left) and ATV (right)

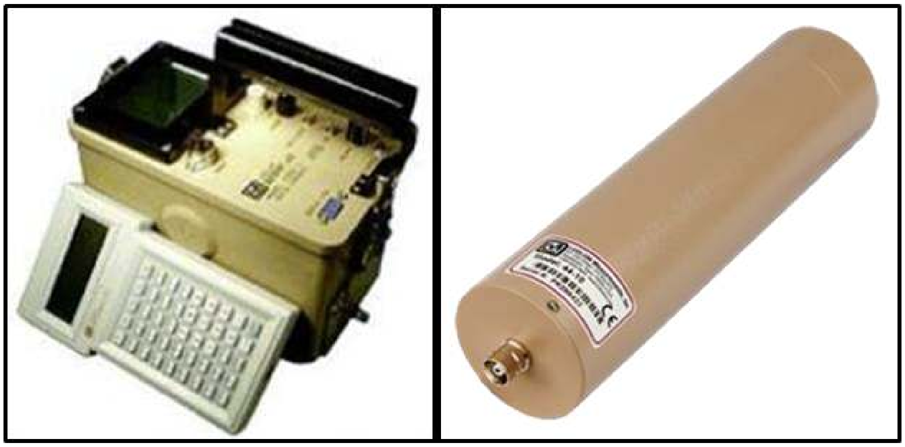

Figure 2 Ludlum 2350-1 Data Logger (left) and Ludlum 44-10 NaI Scintillator

2.0 PROCEDURE

2.1 BACKPACK AND SYSTEM SET UP

Ensure the 2350-1 data logger has sufficient battery voltage, which is defined as greater than 5.6V. If there is less than 5.6V- place four new D-size batteries correctly without allowing the battery to drop directly into the battery compartment. Connect RS232 serial converter to RS232 port on the Ludlum 2350-1 datalogger. Connect GPS receivers and serial converter to the 4-port USB hub and connect the USB hub to field computer. Open “Device Manager” and note which COMM ports have been assigned to respective USB devices.

2.2 SCANSYSTEM SOFTWARE OPERATIONS

ScanSystem software shall be used to record simultaneous GPS location data and gamma exposure rate date. Upon first launching the program, click the “Configure” button, then the “Disable Ports” function. Assign the correct COMM port ID to the Rad and GPS locations. Select “Enable Ports” and close the window. Next click “Start GPS”. Both GPS and gamma exposure rate data should now be displayed in real time on the ScanSystem main screen. A screenshot showing ScanSystem menu is shown in Figure 3.

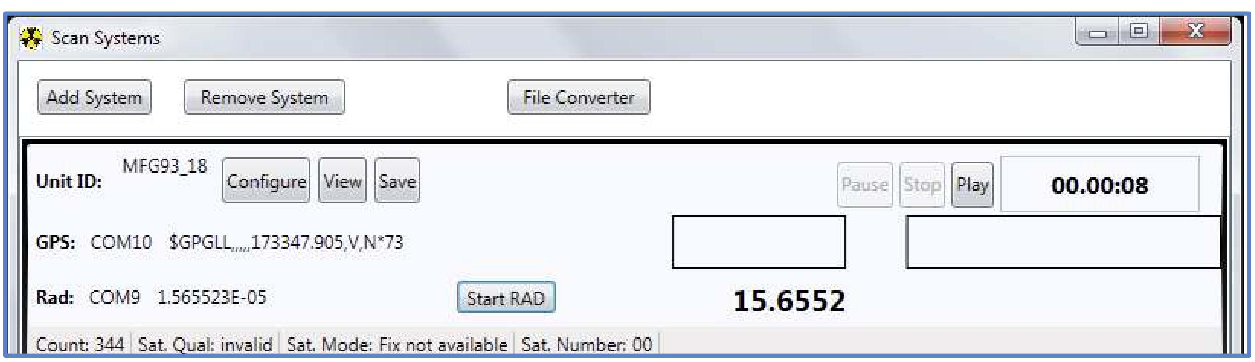

Figure 3 ScanSystem GUI Screenshot

To log data, click the "Play" button. The software will ask if previous data is to be overwritten (Figure 4). To save data, click "Stop" then the "Save" icon, select a directory and name the text file. Warning: if you select "Overwrite Data" by mistake, you should save a new file with a different name in order to avoid erasing the existing scan data file.

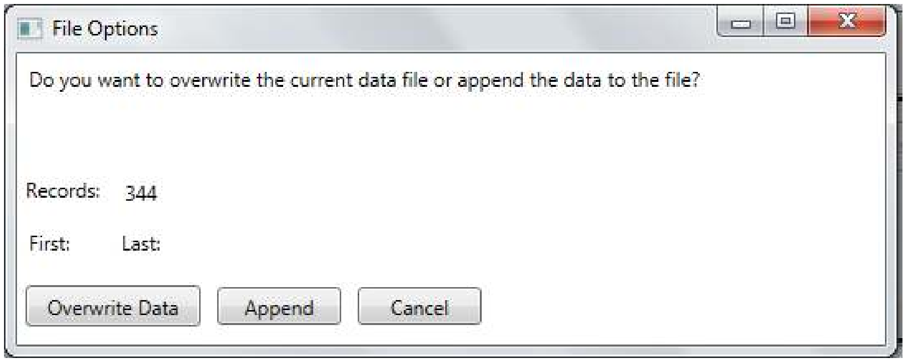

Figure 4 Screenshot of GUI Interface (overwrite screen)

Text file names should include the detector ID, date and time, and project ID. The software will ask if current data is to be cleared from the application at this point (Figure 5). If continuing scanning for the day, do not clear the application. Only clear the application at the beginning of a new scanning day. If you do clear the application by mistake- just save a new file and continue to append to the new file.

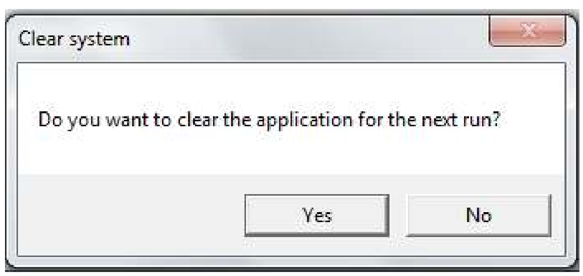

Figure 5 Screenshot of GUI Interface (clear screen)

2.3 Mapping Software Operations

Mapping software can be used to visually guide operators over their pre-defined survey path. It displays current location overlaid on shapefiles. Shapefiles, as long as properly projected, are supported with different software types. WGS84 datum is preferred to avoid confusion. It is highly recommended to use mapping software with pre-entered transect lines, to be viewed on a laptop or handheld GPS device.

2.4 Scan Process

The gamma scan will be conducted on transects spaced 50 meters apart. The gamma detector will be positioned at a height of approximately one meter above the ground surface, whether backpack or ATV mounted. The detector "sees" gamma radiation with relatively good efficiency from a circular area with a radius of approximately one meter when held at a height of one meter.

Scanning will be conducted by traversing the survey unit at a rate of approximately 1-2 miles per hour (one meter per second). Data will be downloaded in gamma viewer at least once per day and the map checked to make sure the required coverage is attained. As necessary, additional transects will be surveyed to attain the coverage in areas of interest.

Care must be taken during scanning to prevent slips, trips and falls as well as contact with biological hazards such as snakes and insects.

3.0 RECORDS

3.1 SURVEY RECORDS

Documenting scanning results and observations from the field is very important (NRC, 2000). Surveys shall be recorded as follows:

- Survey information shall be recorded in the field logbook by field personnel.
- Surveys shall be documented in writing. The person performing the survey is responsible for correct and accurate documentation of survey data.
- Surveys shall be documented as they are performed whenever possible in a clear and legible manner using black or blue ink.
- Indicate survey points or sample locations, as applicable, and record the associated measurements. Provide sufficient detail to adequately describe each specific area surveyed.
- Instrument check records shall be included with the survey records in the field logbook.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

All radiological characterization projects conducted by Tetra Tech incorporate specific data quality assurance and quality control (QA/QC) protocols. In general, QA includes qualitative factors that provide confidence in the results, while QC involves quantitative, field evidence that supports the validity of results. Tetra Tech utilizes quality assurance and quality control methods as data quality indicators that are outlined in NRC (2000). The QA/QC survey procedures used by Tetra Tech are industry accepted techniques that ensure the data collected is of the highest quality and reliability.

4.1 QUALITY ASSURANCE

Calibration refers to the determination and adjustment of the instrument response in a particular radiation field of known intensity (NRC, 2000). Calibration of all radiation detection equipment is the primary method for QA that is used to ensure the data collected is of high quality and reliable. Tetra Tech ensures all instruments used during radiological projects are factory calibrated within 12 months per the manufacturer's recommendation. Scanned copies of calibration documentation for all instruments shall be included as an appendix to the final survey report.

4.2 QUALITY CONTROL

The primary QC method utilized by Tetra Tech includes calibration checks. These checks are measurements performed each time an instrument is used. The specified protocol used on this project involves quantitative calibration checks using a background as well as a known source.

The QC calibration checks that are used include:

- **Daily Checks:** Daily background, field strip, and check source QC measurements that will be conducted in the field at the site. Daily QC measurements will be collected on site at a designated background location selected by field personnel. Control charts are used to present the results.
- **Pre- and Post-survey:** Pre-survey and post-survey background and check source QC measurements that will be performed at a designated location off site. The results are presented in tables, probability plots and histograms.

4.2.1 Daily QC Measurements

Each day prior to performing the gamma radiation survey, instrument comparison QC measurements will be performed for all NaI detectors potentially used to survey the site. Sets of individual background QC measurements will be compared under the same counting geometries. Under the QA program, factory-calibrated instruments must also meet on-site field test criteria. Data developed using any of the field-qualified instruments are then interchangeable, allowing instrument substitution if needed.

- Field Check Results:
    - For normally distributed data, 99 percent of all measurements are expected to fall within ±3 standard deviations from the mean. Background, field strip, and check source standard deviation values are recalculated twice daily throughout the project. Any instrument with a QC measurement result falling outside ±3 standard deviations from the mean of all QC measurements on the field check control chart require investigation. A detector exceeding control limits on any QC check (background or source check) is replaced with a pre-qualified spare detector and sent back to the manufacturer for evaluation, repair, and recalibration.
    - QC measurements, including a background check and a source check, are performed twice daily during the work for each scanning system in use. These checks are performed outdoors at a specified location.

The Ludlum 2350-1 datalogger system employs a calibration factor to internally convert detector counts per minute to exposure rate. The calculated exposure rate, directly proportional to the measured count rate, is transmitted by the data logger to the scanning system portable computer. No record of count rate is retained by the system, but count rates can be calculated using the instrument-specific calibration factors.

Daily count rate variations within these limits are functions of several possible variables, including exact placement of detector systems during daily checks, and recent variations in barometric pressure. Low detector count rates at very low background gamma exposure rates contribute significantly to variability

in count rates. Differences in detector internal characteristics, including minor NaI detector crystal issues or photomultiplier tube optical interface variations, can also affect NaI detector readings.

The data should be compiled and input into control charts and analyzed at the end of each day to identify any anomalies with the data. Control charts are used to monitor performance of the radiation detection instruments. A control chart is a graphical plot of measurement results with respect to time and an example control chart is shown below in Figure 6. A control chart of the daily calibration checks for the duration of the project will be included in the final report.

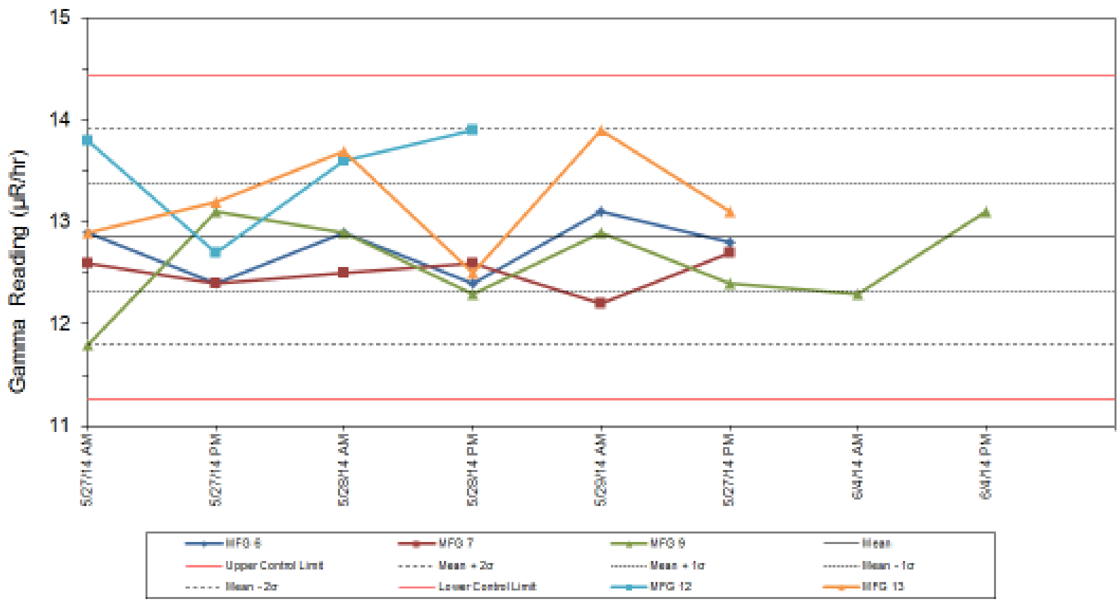

Figure 6 Example of Control Chart

4.2.2 Pre-Survey and Post-Survey QC Measurements

Before and after the gamma survey, field personnel will collect instrument QC measurements at a designated indoor location for each NaI detector that could potentially be utilized for the gamma survey. The purpose of the pre-survey and post-survey QC protocol is to quantify the consistency of readings among the different detection systems. The pre-survey and post-survey calibration checks consist of background and source cesium137 measurements collected at the Tetra Tech office in Fort Collins, Colorado. The average value of the measurements will be compared using the mean, probability plots, and histograms and comparing various statistical measures, such as the Anderson-Darling coefficient and the correlation coefficient (R). An example of this analysis is shown in Figure 7 and Figure 8.

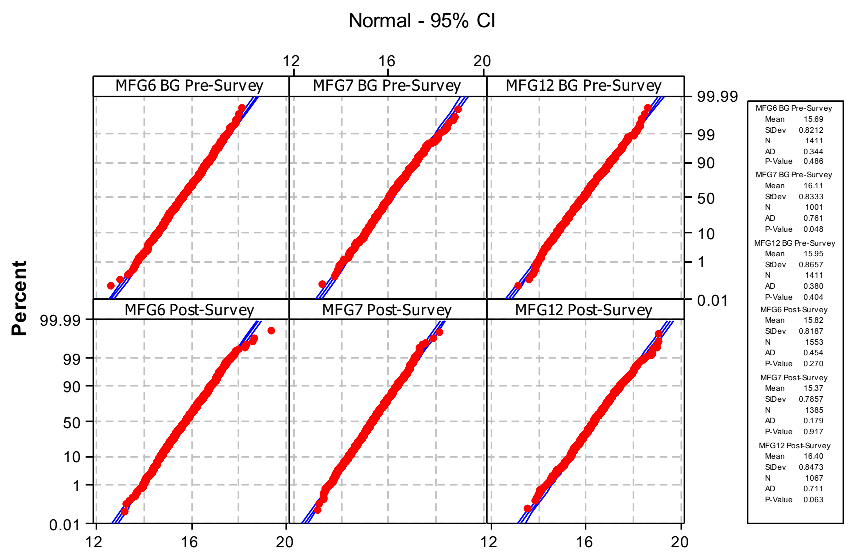

Figure 7 Example of Probability Plot Comparisons

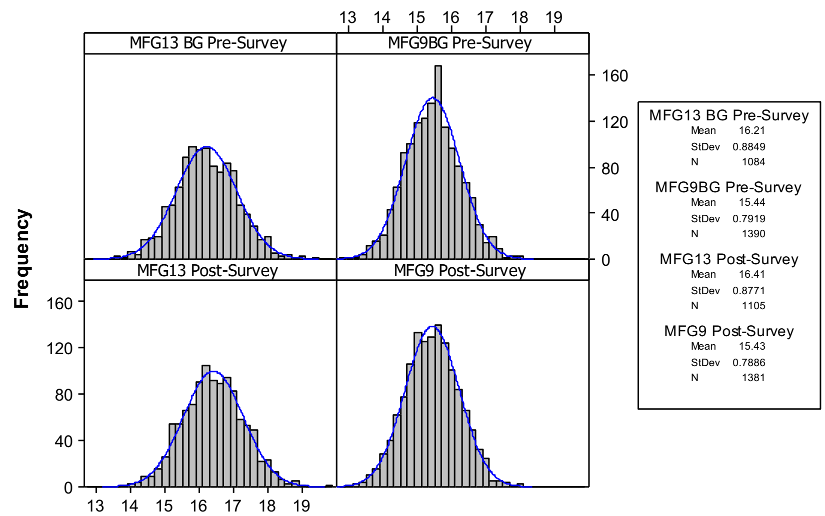

Figure 8 Example of Frequency Histogram Comparisons

5.0 REFERENCES

NRC (U.S. Nuclear Regulatory Commission), 2000. Multi-Agency Radiological Site Survey and Investigation Manual. NUREG-1575, Rev. 1. August 2000 (with 2001 addendum).

SOP 3 – Radiological Instrumentation Cross Calibration and Correlation Standard Operating Procedure

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LIST OF FIGURES

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1.0 PROCEDURE

This Standard Operating Procedure (SOP) describes the protocol and methods for performing soil correlation sampling and HPIC (or equivalent) cross calibration methods as part of the as part of the Marsland Baseline Radiological Investigation. The primary methods presented here follow Johnson et. al (2006) and Whicker et. al (2008).

1.1 EQUIPMENT AND MATERIALS

(1) Mobile Gamma Survey system (SOP 5)

(1) High Pressure Ionization Chamber (HPIC), and/or equivalent (e.g. Bicron Micro-rem meter)

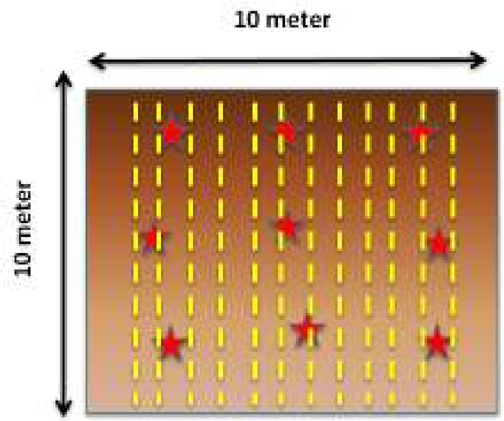
(1) Soil and Sediment Sampling Equipment (SOP 1)

1.2 CORRELATION/CROSS CALIBRATION PLOT LOCATION SELECTION

The locations of correlation/cross calibration plot will be selected by inspection of the gamma radiation survey data following completion of the baseline survey. Plots should be located such that the range of gamma exposure rates at a site is represented. A minimum of 10 correlation plots should be selected, if a large enough range of exposure rates is present additional correlation plots can be selected. Preliminary locations and the corresponding gamma exposure rate, obtained from the survey data, should be recorded to make locating the proposed correlation plot easier. Plots should be selected that have uniform gamma exposure rates over the entire area to be sampled.

1.3 GAMMA/SOIL RADIONUCLIDE CORRELATION METHODS

Correlation soil sampling is conducted by extracting soil aliquots over 100-square meter (m^2) plots (10 x 10 meters), selected as described in the previous section. Figure 1 shows the composite sampling layout. Within each plot, nine soil sub-samples will be collected to a depth of approximately 15 cm, then composited into a single sample representative of the plot. Decontaminated stainless steel bowl and spoon will be used for homogenization of composite samples, and samples will be placed in plastic zip-loc bags. GPS coordinates will be taken at the center of each sampling plot and recorded. Samples are to be analyzed for ^{226}Ra via gamma spectrometry, after radon daughter equilibration. Samples are to be dried and homogenized prior to canning and analysis. The analytical methods and reporting limits for testing ^{226}Ra activity concentrations in soil correlation sampling and other radionuclides are presented in Table 1.



1.

Figure 1 Correlation Plot Soil Sampling Layout

Table 1 Analytical Methods and Reporting Limits for Soil Correlation Sampling

Parameter	Analytical Method by Lab	Reporting Limit	Reported Units
Lead 210	OTW01	1	pCi/g
Potassium 40	E901.1 Mod.	0.2	pCi/g
Radium 226	E901.1 Mod.	0.2	pCi/g
Thorium 230	ACW10	0.2	pCi/g
Uranium	EPA 200.8	0.2	pCi/g

Following methods similar to those described in Johnson et al. (2006), each 100 m^2 soil sampling plot should also be scanned using one of the backpack mounted NaI systems used to scan the site, making sure to obtain uniform coverage over the entire correlation plot as displayed in Figure 1. The average gamma reading of each plot will be plotted against the corresponding average ^{226}Ra soil concentration to determine whether or not a correlation exists. As noted above, locations are selected to include the range of exposure rates found on the site; they are not meant to be spread uniformly over the site.

1.4 Onsite Correlation of NaI vs. Bicron Micro-rem Radiation Detectors

NaI detector systems are useful tools for characterizing gamma exposure rates over large areas. However, gamma exposure rates measured by NaI detectors are only relative measurements, as the response characteristics of NaI detectors are energy dependent. True gamma exposure rates are best measured with a less energy dependent system such as a Bicron micro-rem (µrem) meter or HPIC. Also, unless the same equipment and scanning geometry is used to characterize pre- and post-operational conditions an accurate comparison can only be made if the data has been normalized to a common basis. This is the purpose of performing Bicron/NaI cross-calibration measurements.

To perform Bicron/NaI cross-calibrations, static dose rate measurements will be taken within each of the soil correlation plots as described in the previous section. A minimum of 10 static dose measurements will be recorded over the entire correlation plot; these values will be recorded on field sheets or logbook. The

sensitive volume of the Bicron meter should be held at the same height as the NaI detector, approximately 1-meter from the ground surface. An analysis of the average dose rate and average gamma exposure rate of each correlation plot will be used to establish a normalized cross calibration.

2.0 QUALITY ASSURANCE AND QUALITY CONTROL

To measure the precision of the laboratory analysis methods, field duplicate QC samples will be collected and submitted for analysis to the laboratory. Field duplicates are samples obtained from one location, homogenized and divided into separate containers and treated as separate samples throughout the sample handling and analytical process. Field duplicates will be collected and submitted to the analytical laboratory at a minimum frequency of one duplicate sample for every 20 correlation soil samples. Field duplicate samples will be sent to the laboratory along with primary correlation soil samples.

3.0 REFERENCES

Johnson JA, Meyer HR, Vidyasagar M. 2006. Characterization of Surface Soils at a Former Uranium Mill. Health Physics 90 (Suppl 1): S29-S32, 2006.

Whicker R, Cartier P, Cain J, Milmine K, Griffin M. 2008. Radiological Site Characterizations: Gamma Surveys, Gamma/Radium-226 Correlations, and Related Spatial Analysis Techniques. The Radiation Safety Journal S180. November 2008.

APPENDIX B

SCANNED COPY OF THE FIELD LOGBOOK

MARSLAND

2014 FIELD SAMPLING
LOGBOOK

Forestry Suppliers, Inc.
1-800-647-5368
#49355 Level Book

114-910141

AARON ORRECHUNG P.E.
DAN WORKMAN E.I.T

MONDAY 5/26/14 Memorial Day

- MET AT FORT COLLINS OFFICE @ 0800 MT
- LEFT FORT COLLINS AFTER FIELD PREP @ 0930
- ARRIVED ON-SITE @ MARSLAND 1400 MT

SAFETY MTG

> HYDRATION > WILDLIFE
> HAZARDOUS TERRAIN
> SUN EXPOSURE

NO QA/QC WAS PERFORMED

> SCANNING WAS PERFORMED AT SOUTHERN PERMIT BOUNDARY

LEFT SITE @ 1830

> ARRIVED @ CHADRON @ 1930

> PERFORMED FIELD DO MOB/DATA UNTIL 2200

END OF ENTRIES FOR DAY

TUESDAY, 5/27/14

SAFETY MEETING / TRAINING @ 0630

ARRIVED @ NORTH BUTTE 0800 MT

0800 - 1000 MT TRAINING

PERFORMED QA @ 1000 MT

		1000		PM	
COMP	DETECTOR	BG	CS-137	BG	CS137
1	MFG-13	12.9	213	13.2	210
2	MFG-7	12.6	139	12.4	135
3	MFG-5	13.6	205	14.2	202
4	MFG-12	13.8	210	12.7	205
5	MFG-6	12.9	161	12.4	159
6	MFG9	11.8	187	13.1	186

SCANNED UNTIL 1600 w/ CampCo.

AO/DW CONTINUED UNTIL 1830.

PERFORMED QA @ 1830 HOTEL @ 1930

AO DATA ANALYSIS AT 2200 - 2400

END OF ENTRIES FOR DAY

WEDNESDAY, 5/28/14

SAFETY MEETING @ 0530

ARRIVED @ CROW BUTTE 0700

QA PERFORMED

		AM		PM	
COMP	DET.	BG	CS-137	BG	CS-137
1	MFG 13	13.7	207	12.5	208
2	MFG 7	12.5	136	12.6	136
3	MFG 5	13.2	200	13.5	202
4	MFG 12	13.6	204	13.9	207
5	6	12.9	160	12.4	159
6	MFG9	12.9	187	12.3	187

* SPLIT INTO SCAN TEAMS FOR AFTERNOON
* MET AT LUNCH TO RETRIEVE DATA

END OF ENTRIES FOR PAGE

RW

5/28/14

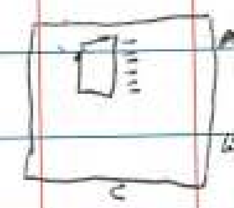
INITIATED AIR MONITORING STATION

ARRIVED @ MAR1 1400

SOIL SAMPLING @ 1420

MAR1 SOIL-01-15 0-15 cm

MAR1 SOIL-01-30 15-30 cm



MAR1 SOIL A-01-5 0-5 cm

MAR1 SOIL B-01-5 0-5 cm

MAR1 SOIL C-01-5 0-5 cm

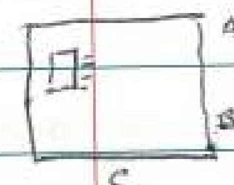
GAMMA NAI & HPIC DATA COLLECTED @ 1451

LEFT @ 1500

ARRIVED @ 1505 @ MAR 2

SOIL SAMPLES COLLECTED @ 1510

GAMMA/HPIC @ 1515



MAR 2 SOIL-01-15 0-15 cm
MAR 2 SOIL-01-30 15-30 cm
MAR 2 SOIL A-5
MAR 2 SOIL B-5 } 0-5 cm
MAR 2 SOIL C-5

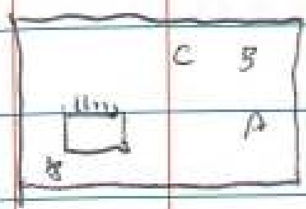
END OF ENTRIES FOR PAGE

5/28/14

ARRIVED @ MAR 4 @ 1530

SOIL SAMPLING @ 1545

HPIC/GAMMA @ 1548-1553



MAR 4 SOIL -01-15 0-15 cm
MAR 4 SOIL -01-30 15-30 cm
MAR 4 SOIL A -01-5 0-5 cm
MAR 4 SOIL B -01-5 0-5 cm
MAR 4 SOIL C -01-5 0-5 cm

ARRIVED @ MAR 3 @ 1600
SOIL SAMPLES COLLECTED @ 1610
HPIC/GAMMA @ 1617-1622

MAR 3 SOIL ~~SOIL~~ -01-15 (Primary) } 0-15 cm
MAR 3 SOIL ~~SOIL~~ -02-15 (Duplicate)
MAR 3 SOIL -01-30 15-30 cm
MAR 3 SOIL A-01-5 } 0-5 cm
MAR 3 SOIL B-01-5
MAR 3 SOIL C-01-5

END OF ENTRIES FOR PAGE

DW

5/28/14

LEFT MAR 3 TO SCAN @ 1630

COMPLETED SCANNING @ 1700

ARRIVED @ MAR 5 @ 1720

SOIL SAMPLING COLLECTED @ 1730

MAR 5 SOIL -01-15 0-15 cm

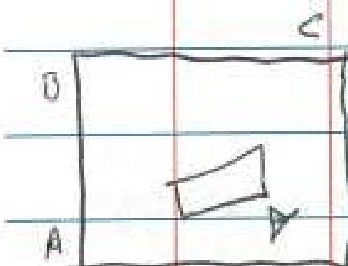
MAR 5 SOIL -01-30 15-30 cm

MAR 5 SOIL A-01-5 (Primary) } 0-5 cm

MAR 5 SOIL A-02-5 (Duplicate)

MAR 5 SOIL B-01-5

MAR 5 SOIL C-01-5



LEFT MAR 5 @ 1800

ARRIVED @ CAMEO @ 1900

HOTEL @ 1930

MISC DATA ANALYSIS (IC)
2030-2330

END OF ENTRIES FOR DAY

DW

THURSDAY, 5/29/14

SAFETY MEETING @ 0600

LEFT HOTEL @ 0630

ARRIVED @ CAMELO SITE 0730

PERFORMED QA @ 0830

COMP	DETECTOR	BG	CS-137	BG	CS-137
1	MFG13	13.9	213	13.1	212
2	MFG 7	12.2	144	12.7	143
3	MFG 5	14.3	209	14.6	209
4	NOT USED ON 5/29 →				
5	MFG 6	13.1	164	12.8	166
6	MFG 9	12.9	195	12.4	194

SPLIT INTO SCANNING TEAM AND SOIL CORRELATION SAMPLING TEAM.

END OF ENTRIES FOR PAGE

5/29/14

SOIL CORRELATION SAMPLING:

CORR ID: SOIL CORR1 0-15 cm

SAMPLE ID: MARSOILCORR1-01-15

DATE: 5/29/14 0930 MT

CORR ID: SOIL CORR 2 0-15 cm

SAMPLE ID: MAR SOIL CORR2-01-15

MAR SOIL CORR2-02-15 (DUP)

DATE: 5/29/14 1000 MT

CORR ID: SOIL CORR 3 0-15 cm

SAMPLE ID: MAR SOIL CORR3-01-15

DATE: 5/29/14 1015 MT

CORR ID: SOIL CORR 4 0-15 cm

SAMPLE ID: MAR SOIL CORR 4-01-15

DATE: 5/29/14 1045 MT

END OF ENTRIES FOR PAGE

5/29/14

SOIL CORRELATION SAMPLING CONT...:

CORR ID: SOIL CORR 5 0-15 cm

SAMPLE ID: MARSOILCORR5-01-15

DATE: 5/29/14 1100

CORR ID: SOIL CORR 6

SAMPLE ID: MARSOILCORR6-01-15

DATE: 5/29/14 1115

CORR ID: SOIL CORR 7

SAMPLE ID: MAR SOIL CORR 7-01-15

DATE: 5/29/14 1200

CORR ID: SOIL CORR 8

SAMPLE ID: MAR SOIL CORR 8-01-15

DATE 5/29/14 1300

CORR ID: SOIL CORR 9

SAMPLE ID: MARSOILCORR9-01-15

DATE: 5/29/14 1315

END OF ENTRIES PER DAY

5/29/14

SOIL CORRELATION SAMPLING CONT...

CORR ID: SOIL CORR 10

SAMPLE ID: MAR SOIL CORR 10-01-15

DATE: 5/29/14 1330

> COMPLETED SOIL CORRELATION SAMPLING @ 1400

> LEFT TO FORT COLLINS @ 1530

ARRIVED TO FORT COLLINS 1930.

END OF ENTRIES PER DAY

6/3/14

600 Left FTC

1200 Arrive Crow Butte

1230 - 1530 Radial
Soil sampling

~70° Cloudy

1600 Arrive Best
Western

6/4/14

0700 - Crow Butte

0740 - Instrument Check

	BG	Cs-137
MFG9	12.3	193
	13.1	194

1115 End Radial Grid
Begin Subsurface
Sampling

1120 CENTER - SUB - 01 - 33
" " - 02 - 33
" " - 01 - 66
" " - 01 - 100

Photo

DW

6/4/13

140 W750 subsurface sampling

W750-SUB-01-33
W750-SUB-01-66
W750-SUB-01-100

1200 N750 sub surface sampling

N750-SUB-01-33
N750-SUB-01-66
N750-SUB-01-100

END OF ENTRIES

DW

6/4/14

1220 S750 sub-surface sampling

1230 E750 sub-surface sampling

Sub-surface sampling complete,

1300 Gamma surveying
1400 Begin Travel to FTC
1800 Arrive FTC

END OF ENTRIES

DW

11|10|2014 MONDAY

FIELD PREP IN FORT COLLINS, CO 0800-1200

> FIELD SUPPLIES
> PRE-SURVEY QC
> PRINT FIELD MAPS
> SAFETY MEETING

LEFT FORT COLLINS @ 1800

ARRIVED IN CHADRON @ 2200

END OF ENTRIES
FOR DAY 11/10/14

11/11/14 TUESDAY

SAFETY MEETING @ 0600

LEFT CHADRON, NE TO MARSLAND 0700

ARRIVED TO SITE @ 0800

- PERFORMED QC CALIBRATION CHECK @ 0830 ON MFG 13

MFG 13	BG	CS-137
AM	14.7	213
PM	14.3	211

INITIATED FIELD SAMPLING @ 0845

AFTER DISCUSSION W/ CAMECO IT WAS CONCLUDED THAT NO SOIL CORRELATION PLOTS WOULD BE PERFORMED.

WEATHER: SNOW ON GROUND

TEMP: 4°F

END OF ENTRIES PER PAGE

11/11/14 TUESDAY

P - PRIMARY [D] - DUPLICATE

ID	QC	ST	γ (μR/hr)
MARSS-01-01	P	0845	15.0
MARSS-02-01	P	0900	14.4
MARSS-03-01	P	0915	14.8
MARSS-04-01	P	0930	14.5
MARSS-04-02	[D]	0930	—
MARSS-05-01	P	0940	12.0
MARSS-06-01	P	0950	14.2
MARSS-07-01	P	1045	11.3
MARSS-08-01	P	1055	13.5
MARSS-09-01	P	1100	11.0
MARSS-10-01	P	1110	13.7
MARSS-10-02	[D]	1110	—

END OF ENTRIES PER DAY

11/11/14 THURSDAY

ID	QC	ST	γ (μS/cm)
MARSS-11-01	P	1120	13.4
MARSS-12-01	P	1125	14.2
MARSS-13-01	P	1130	13.9
MARSS-14-01	P	1145	12.5
MARSS-15-01	P	1200	12.9
MARSS-16-01	P	1245	12.0
MARSS-17-01	P	1310	13.0
MARSS-18-01	P	1330	13.0
MARSS-19-01	P	1345	12.0
MARSS-20-01	P	1400	11.7
MARSS-21-01	P	1410	11.1
MARSS-22-01	P	1420	12.4
MARSS-23-01	P	1430	1/9

END OF ENTRIES
FOR PAGE

11/11/14

COMPLETED SAMPLING @ 1500

LEFT CHADRON @ 1630

ARRIVED IN FT. COLLINS @ 2200

DAN ARRIVED HOME @ 2300

END OF FIELD
ENTRIES FOR
DAY 11/11/14