LMS/MNT/49853

Groundwater Transmission Line Leak Report for the Monticello, Utah, Disposal and Processing Sites

July 2025

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Abbreviations

EPA	U.S. Environmental Protection Agency
GRO	Groundwater Remedy Optimization
GWTB	Groundwater Transfer Building
RPD	relative percent difference
SAP	Sampling and Analysis Plan

1.0 Introduction

1.1 Background

The U.S. Department of Energy Office of Legacy Management owns and operates the Groundwater Remedy Optimization (GRO) system as part of the cleanup remedy for uranium-contaminated groundwater in Operable Unit III of the Monticello Mill Tailings Site, which is a Comprehensive Environmental Response, Compensation, and Liability Act National Priorities List site in Monticello, Utah. The GRO system pumps contaminated groundwater from a shallow alluvial aquifer via eight groundwater extraction wells to a storage tank in the Groundwater Transfer Building (GWTB), after which the contaminated groundwater is pumped approximately 1 mile via a buried 3-inch high-density polyethylene pipeline to an evaporation pond (Pond 4).

On August 7, 2023, a leak was discovered at vault CS-MNT-10, which is connected to the buried groundwater transmission line approximately 1360 feet southeast of the GWTB. The leak resulted in saturated soil approximately 60 feet wide at its widest point and gradually tapered to approximately 3 feet wide at its narrowest point on the adjacent private property, approximately 440 feet downgradient from vault CS-MNT-10, where evidence of the leak ceased to appear (Figure 1).

2.0 Planning

In response to the leak, the *Soil Sampling and Analysis Plan for Groundwater Transmission Line Leak Monticello, Utah, Disposal and Processing Sites* (DOE 2024c**)** (SAP) was developed and implemented to specify the sampling, analytical, and data evaluation requirements necessary to determine if soils were adversely impacted from the leak. The SAP was approved by the Utah Department of Environmental Quality and the U.S. Environmental Protection Agency (EPA). The SAP specified protocols for collecting samples as shown in Figure 1, which included one grab sample from the excavation that was dug to repair the broken pipe (location 0001), composite soil samples from areas near and downgradient of vault CS-MNT-10 (locations 0002 and 0003), and composite soil samples from a background area upgradient of the spill (location 0004). Two composite soil samples were collected at locations 0002 through 0004: 0 to 2 inches below ground surface and 2 to 12 inches below ground surface.

The SAP also specified laboratory analyses to be conducted on the collected samples and provided the basis to assess the analytical results to determine if soils had been adversely affected by the leak. The SAP included the data quality objectives and sampling approach, as well as analytical requirements, quality assurance, and data management requirements. Samples were collected, analyzed, handled, documented, and validated in accordance with the SAP and the *Sampling and Analysis Plan for U. S. Department of Energy Office of Legacy Management Sites* (DOE 2024b).

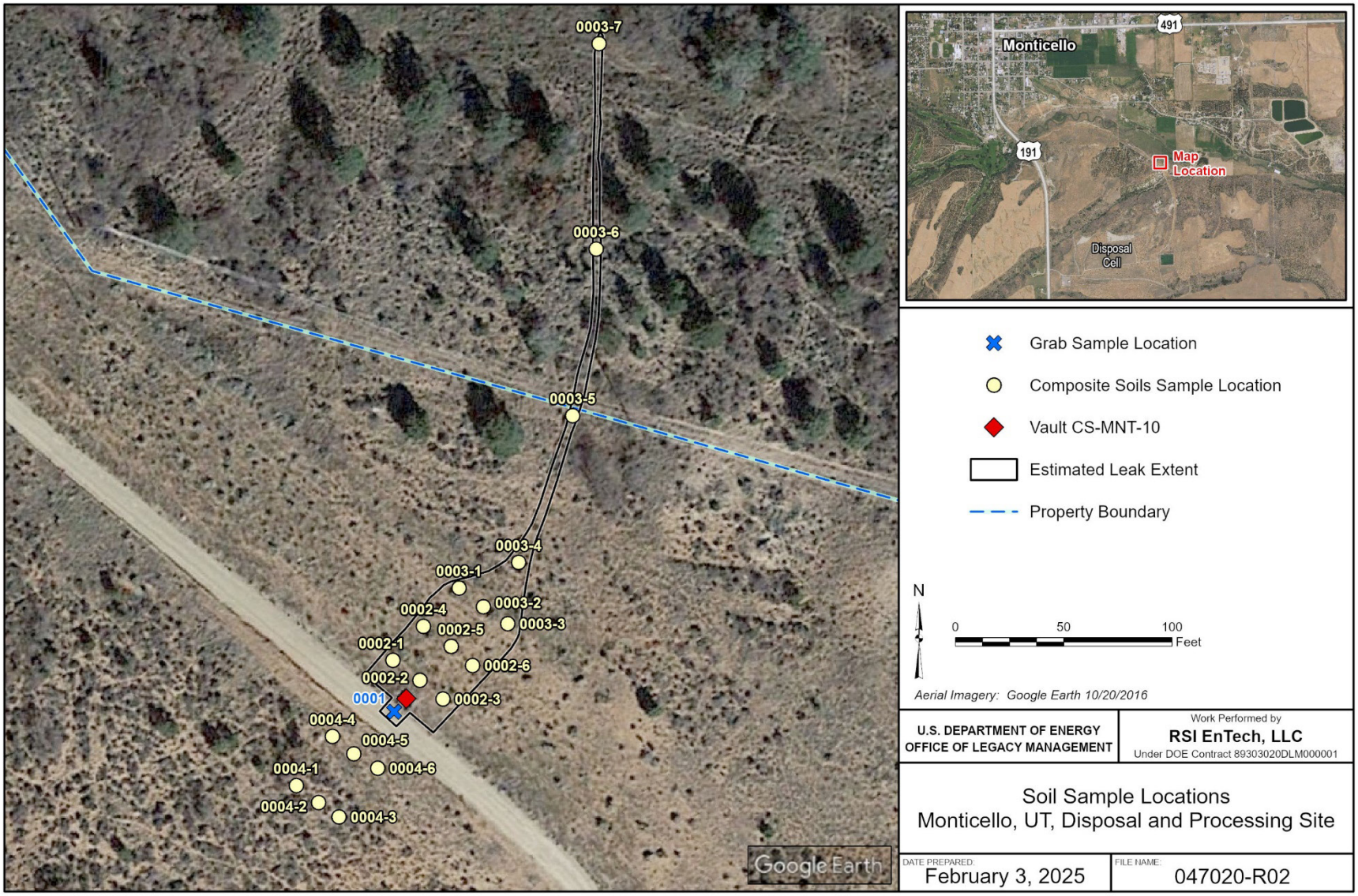

Figure 1. Soil Sample Locations

3.0 Results and Data Assessment

The grab sample location (0001) was collected on October 26, 2023, when the excavation to repair the broken pipe was open, and the composite soil samples (locations 0002, 0003, and 0004) were collected on July 2, 2024. Background samples were collected at location 0004, upgradient from the line leak. A duplicate sample was collected from the 2–12-inch depth interval at location 0003. Table 1 displays the results of the soil sampling and compares the results to background concentrations and benchmarks specified in the SAP. A complete set of soil data is provided in Appendix A. Samples were analyzed by GEL Laboratories, LLC in Charleston, South Carolina, and the data were validated upon receipt from the laboratory (DOE 2024a). A copy of the data validation report is provided in Appendix B.

A comparison of results from potentially impacted areas to background concentrations is displayed in Table 1. The majority of the results are less than the background concentrations; therefore, no additional assessment was needed. For results that exceeded the background concentrations, an additional assessment was conducted. To determine whether a result in Table 1 is significantly different from its associated background sample concentration, a relative percent difference (RPD) was calculated for each result and background pair of data points. A conservative guide of 30% RPD was used to determine if a result was higher than background concentrations (DOE 2025). The 30% RPD is the EPA guidance for assessing laboratory duplicates for soils (different aliquots taken from the same sample during laboratory analysis) (EPA 2017). As a result, it is considered conservative when used to compare field duplicate samples or samples collected from different locations (DOE 2024a).

RPDs greater than 30% in Table 1 are highlighted in red, indicating the result was elevated compared to the background concentration. Results that were highlighted in red were then compared with benchmark values established in the SAP. As shown in Table 1, all results highlighted in red were significantly below their respective benchmarks. Although arsenic concentrations exceeded the benchmark at all locations including background concentrations, the arsenic results did not have RPDs greater than 30% (9.2% to 23.7%) and are considered comparable to background concentrations.

4.0 Conclusions and Recommendations

Numerous RPD values highlighted in red (see Table 1) indicate results were higher than background concentrations; however, the highlighted results were less than the applicable benchmark. Although arsenic results exceeded the benchmark, the RPDs between the arsenic results and background concentrations were less than 30%, which indicates the arsenic concentrations in potentially impacted areas are not significantly different than background concentrations.

Results from this investigation indicate there are no significant impacts to soils from the transmission line leak and no further action is required.

Table 1. Soil Sample Results

Location	Analyte	Result[1]	Background[1]	RPD[2]	Benchmark[1,3]	Depth Interval (inch)
0001	Arsenic	4.17	3.51	17.2	0.68	Grab
	Cesium-137	0.00977 U	0.0845	—	N/A	
	Manganese	546	313	54.2	1,800	
	Molybdenum	0.63	0.298	71.6	4	
	Nitrate as N	8.52	1.51	139.8	130,000	
	Potassium-40	16.4	19.6	—	N/A	
	Radium-226	0.998	1.6	—	N/A	
	Selenium	1.02	1.12	—	390	
	Thorium-232	0.902	1.09	—	N/A	
	Uranium	0.925	1.81	—	16	
	Uranium-233, -234	0.947	1.38	—	300	
	Uranium-235, -236	0.113 U	0.112 U	—		
	Uranium-238	1.11	1.6	—		
	Vanadium	14.2	27.1	—	150	
0002	Arsenic	3.85	3.51	9.2	0.68	0–2
	Arsenic	4.41	3.94	11.3		2–12
	Cesium-137	0.0109 U	0.0845	—	N/A	0–2
	Cesium-137	0.0337 U	0.00604 U	—	N/A	2–12
	Manganese	304	313	—	1,800	0–2
	Manganese	352	266	27.8		2–12
	Molybdenum	0.41	0.298	31.6	4	0–2
	Molybdenum	0.402	0.309	26.2		2–12
	Nitrate as N	1.1	1.51	—	130,000	0–2
	Nitrate as N	0.36 U	0.582	—		2–12
	Potassium-40	17.4	19.6	—	N/A	0–2
	Potassium-40	19.2	17.7	8.1	N/A	2–12
	Radium-226	0.976	1.6	—	N/A	0–2
	Radium-226	0.946	1.33	—	N/A	2–12
	Selenium	1.2	1.12	6.9	390	0–2
	Selenium	1.29	1.21	6.4		2–12
	Thorium-232	0.994	1.09	—	N/A	0–2
	Thorium-232	1.01	1.14	—	N/A	2–12
	Uranium	1.7	1.81	—	16	0–2
	Uranium	0.966	0.592	48.0		2–12
	Uranium-233, -234	1.13	1.38	—	300	0–2
	Uranium-233, -234	0.85	0.953	—		2–12
	Uranium-235, -236	0.115 U	0.112U	—		0–2
	Uranium-235, -236	0.0829 U	0.0716U	—		2–12
	Uranium-238	1.36	1.6	—		0–2
	Uranium-238	1.06	0.928	13.3		2–12
	Vanadium	23.8	27.1	—	150	0–2
	Vanadium	23.9	23.8	0.4		2–12

Table 1. Soil Sample Results (continued)

Location	Analyte	Result[1]	Background[1]	RPD[2]	Benchmark[1,3]	Depth Interval (inch)
0003	Arsenic	3.5	3.51	—	0.68	0–2
	Arsenic	5	3.94	23.7		2–12
	Cesium-137	0.00997 U	0.0845	—	N/A	0–2
	Cesium-137	-0.0016 U	0.00604 U	—	N/A	2–12
	Manganese	349	313	10.9	1,800	0–2
	Manganese	436	266	48.4		2–12
	Molybdenum	0.486	0.298	48.0	4	0–2
	Molybdenum	0.718	0.309	79.6		2–12
	Nitrate as N	1.63	1.51	7.6	130,000	0–2
	Nitrate as N	1.45	0.582	85.4		2–12
	Potassium-40	17.2	19.6	—	N/A	0–2
	Potassium-40	18.2	17.7	2.8	N/A	2–12
	Radium-226	1.33	1.6	—	N/A	0–2
	Radium-226	1.18	1.33	—	N/A	2–12
	Selenium	1.21	1.12	7.7	390	0–2
	Selenium	1.5	1.21	21.4		2–12
	Thorium-232	1.18	1.09	7.9	N/A	0–2
	Thorium-232	0.735	1.14	—	N/A	2–12
	Uranium	1.78	1.81	—	16	0–2
	Uranium	1.56	0.592	90.0		2–12
	Uranium-233, -234	1.52	1.38	9.7	300	0–2
	Uranium-233, -234	0.758	0.953	—		2–12
	Uranium-235, -236	0.128 U	0.112 U	—		0–2
	Uranium-235, -236	−0.0156 U	0.0716 U	—		2–12
	Uranium-238	1.55	1.6	—		0–2
	Uranium-238	0.727	0.928	—		2–12
	Vanadium	23.7	27.1	—	150	0–2
	Vanadium	27.8	23.8	15.5		2–12

Notes:
— = RPD is not calculated if either the result or background concentration is below the detection limit or if the result is less than the background concentration.
[1] Units are in milligrams per kilogram for non-isotopic analytes and picocuries per gram for isotopic analytes. U indicates the result was below the detection limit.
[2] RPD is calculated as RPD = |R – B|/[(R + B)/2], where R is the result and B is the background value.
[3] Benchmarks (except for isotopic uranium) are the lowest value of maximum allowable concentrations in soil protective of plants (Kabata-Pendias and Pendias 2010) or human health regional screening levels in soils (EPA 2023); the benchmark for isotopic uranium is the soil cleanup standard for the Monticello, Utah, Disposal and Processing Sites (DOE 1998).

Abbreviations:
N = nitrogen
N/A = not applicable

5.0 References

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Appendix A

Soil Data

Soil Data

Parameter	Sample Date	Result	Units	Depth Interval (in)	Sample Type	Qualifiers Data/Lab		Detection Limit	Uncertainty
Location 0001									
Arsenic	10/26/2023	4.17	mg/kg	Not applicable, grab sample	F	J		0.358	—
Cesium-137	10/26/2023	0.00977	pCi/g		F	J	HhU		±0.0379
Manganese	10/26/2023	546	mg/kg		F	J		0.209	—
Molybdenum	10/26/2023	0.63	mg/kg		F	J		0.0848	—
Nitrate as Nitrogen	10/26/2023	8.52	mg/kg		F	J	h	0.356	—
Potassium-40	10/26/2023	16.4	pCi/g		F	J	Hh		±2.29
Radium-226	10/26/2023	0.998	pCi/g		F	J	Hh		±0.183
Selenium	10/26/2023	1.02	mg/kg		F	J	BN	0.382	—
Thorium-232	10/26/2023	0.902	pCi/g		F	J	Hh		±0.373
Uranium	10/26/2023	0.925	mg/kg		F	J		0.014	—
Uranium-233,-234	10/26/2023	0.947	pCi/g		F	J	Hh		±0.324
Uranium-235/236	10/26/2023	0.113	pCi/g		F	J	HhU		±0.145
Uranium-238	10/26/2023	1.11	pCi/g		F	J	Hh		±0.339
Vanadium	10/26/2023	14.2	mg/kg		F	J	*	0.104	
Location 0002									
Arsenic	7/2/2024	3.85	mg/kg	0–2	F			0.365	—
Arsenic	7/2/2024	4.41	mg/kg	2–12	F			0.351	—
Cesium-137	7/2/2024	0.0109	pCi/g	0–2	F		U		±0.0345
Cesium-137	7/2/2024	0.0337	pCi/g	2–12	F		U		±0.0313
Manganese	7/2/2024	304	mg/kg	0–2	F	J		0.211	—
Manganese	7/2/2024	352	mg/kg	2–12	F	J		0.198	—
Molybdenum	7/2/2024	0.41	mg/kg	0–2	F			0.0863	—
Molybdenum	7/2/2024	0.402	mg/kg	2–12	F			0.083	—
Nitrate as Nitrogen	7/2/2024	1.1	mg/kg	0–2	F			0.362	—
Nitrate as Nitrogen	7/2/2024	0.36	mg/kg	2–12	F		U	0.360	—
Potassium-40	7/2/2024	17.4	pCi/g	0–2	F				±2.23
Potassium-40	7/2/2024	19.2	pCi/g	2–12	F				±2.88
Radium-226	7/2/2024	0.976	pCi/g	0–2	F				±0.204
Radium-226	7/2/2024	0.946	pCi/g	2–12	F				±0.180

Soil Data (continued)

Parameter	Sample Date	Result	Units	Depth Interval (in)	Sample Type	Qualifiers Data/Lab		Detection Limit	Uncertainty
Selenium	7/2/2024	1.2	mg/kg	0–2	F	J	N	0.388	—
Selenium	7/2/2024	1.29	mg/kg	2–12	F	J	N	0.374	—
Thorium-232	7/2/2024	0.994	pCi/g	0–2	F				±0.334
Thorium-232	7/2/2024	1.01	pCi/g	2–12	F				±0.299
Uranium	7/2/2024	1.7	mg/kg	0–2	F			0.0142	—
Uranium	7/2/2024	0.966	mg/kg	2–12	F			0.0137	—
Uranium-233,-234	7/2/2024	1.13	pCi/g	0–2	F				±0.343
Uranium-233,-234	7/2/2024	0.85	pCi/g	2–12	F				±0.334
Uranium-235/236	7/2/2024	0.115	pCi/g	0–2	F		U		±0.128
Uranium-235/236	7/2/2024	0.0829	pCi/g	2–12	F		U		±0.139
Uranium-238	7/2/2024	1.36	pCi/g	0–2	F				±0.360
Uranium-238	7/2/2024	1.06	pCi/g	2–12	F				±0.363
Vanadium	7/2/2024	23.8	mg/kg	0–2	F	J	*	0.105	—
Vanadium	7/2/2024	23.9	mg/kg	2–12	F	J	*	0.0991	—
Location 0003									
Arsenic	7/2/2024	3.5	mg/kg	0–2	F			0.325	—
Arsenic	7/2/2024	5	mg/kg	2–12	F			0.447	—
Arsenic	7/2/2024	4.17	mg/kg	2–12	D			0.345	—
Cesium-137	7/2/2024	0.00997	pCi/g	0–2	F		U		±0.0336
Cesium-137	7/2/2024	-0.0016	pCi/g	2–12	F		U		±0.0266
Cesium-137	7/2/2024	0.0227	pCi/g	2–12	D		U		±0.0259
Manganese	7/2/2024	349	mg/kg	0–2	F	J		0.208	—
Manganese	7/2/2024	436	mg/kg	2–12	F	J		0.268	—
Manganese	7/2/2024	351	mg/kg	2–12	D	J		0.217	—
Molybdenum	7/2/2024	0.486	mg/kg	0–2	F			0.077	—
Molybdenum	7/2/2024	0.718	mg/kg	2–12	F			0.106	—
Molybdenum	7/2/2024	0.542	mg/kg	2–12	D			0.0817	—
Nitrate as Nitrogen	7/2/2024	1.63	mg/kg	0–2	F			0.358	—
Nitrate as Nitrogen	7/2/2024	1.45	mg/kg	2–12	F			0.454	—
Nitrate as Nitrogen	7/2/2024	0.895	mg/kg	2–12	D		J	0.359	—

Soil Data (continued)

Parameter	Sample Date	Result	Units	Depth Interval (in)	Sample Type	Qualifiers Data/Lab		Detection Limit	Uncertainty
Potassium-40	7/2/2024	17.2	pCi/g	0–2	F				±1.91
Potassium-40	7/2/2024	18.2	pCi/g	2–12	F				±2.06
Potassium-40	7/2/2024	19.6	pCi/g	2–12	D				±2.30
Radium-226	7/2/2024	1.33	pCi/g	0–2	F				±0.208
Radium-226	7/2/2024	1.18	pCi/g	2–12	F				±0.186
Radium-226	7/2/2024	1.34	pCi/g	2–12	D				±0.176
Selenium	7/2/2024	1.21	mg/kg	0–2	F	J	N	0.347	—
Selenium	7/2/2024	1.5	mg/kg	2–12	F	J	N	0.476	—
Selenium	7/2/2024	1.26	mg/kg	2–12	D	J	N	0.368	—
Thorium-232	7/2/2024	1.18	pCi/g	0–2	F				±0.260
Thorium-232	7/2/2024	0.735	pCi/g	2–12	F				±0.289
Thorium-232	7/2/2024	1.22	pCi/g	2–12	D				±0.293
Uranium	7/2/2024	1.78	mg/kg	0–2	F			0.0127	—
Uranium	7/2/2024	1.56	mg/kg	2–12	F			0.0174	—
Uranium	7/2/2024	1.2	mg/kg	2–12	D			0.0135	—
Uranium-233,-234	7/2/2024	1.52	pCi/g	0–2	F				±0.440
Uranium-233,-234	7/2/2024	0.758	pCi/g	2–12	F	J			±0.312
Uranium-233,-234	7/2/2024	0.958	pCi/g	2–12	D				±0.328
Uranium-235/236	7/2/2024	0.128	pCi/g	0–2	F		U		±0.163
Uranium-235/236	7/2/2024	-0.0156	pCi/g	2–12	F		U		±0.0747
Uranium-235/236	7/2/2024	0.132	pCi/g	2–12	D		U		±0.148
Uranium-238	7/2/2024	1.55	pCi/g	0–2	F				±0.437
Uranium-238	7/2/2024	0.727	pCi/g	2–12	F				±0.287
Uranium-238	7/2/2024	1.45	pCi/g	2–12	D				±0.401
Vanadium	7/2/2024	23.7	mg/kg	0–2	F	J	*	0.104	—
Vanadium	7/2/2024	27.8	mg/kg	2–12	F	J	*	0.134	—
Vanadium	7/2/2024	21.4	mg/kg	2–12	D	J	*	0.108	—

Soil Data (continued)

Parameter	Sample Date	Result	Units	Depth Interval (in)	Sample Type	Qualifiers Data/Lab		Detection Limit	Uncertainty
Location 0004									
Arsenic	7/2/2024	3.51	mg/kg	0–2	F			0.321	—
Arsenic	7/2/2024	3.94	mg/kg	2–12	F			0.368	—
Cesium-137	7/2/2024	0.0845	pCi/g	0–2	F	J			±0.0360
Cesium-137	7/2/2024	0.00604	pCi/g	2–12	F		U		±0.0272
Manganese	7/2/2024	313	mg/kg	0–2	F	J		0.182	—
Manganese	7/2/2024	266	mg/kg	2–12	F	J		0.209	—
Molybdenum	7/2/2024	0.298	mg/kg	0–2	F			0.0759	—
Molybdenum	7/2/2024	0.309	mg/kg	2–12	F			0.087	—
Nitrate as Nitrogen	7/2/2024	1.51	mg/kg	0–2	F			0.338	—
Nitrate as Nitrogen	7/2/2024	0.582	mg/kg	2–12	F		J	0.356	—
Potassium-40	7/2/2024	19.6	pCi/g	0–2	F				±2.18
Potassium-40	7/2/2024	17.7	pCi/g	2–12	F				±2.04
Radium-226	7/2/2024	1.6	pCi/g	0–2	F				±0.200
Radium-226	7/2/2024	1.33	pCi/g	2–12	F				±0.193
Selenium	7/2/2024	1.12	mg/kg	0–2	F	J	N	0.341	—
Selenium	7/2/2024	1.21	mg/kg	2–12	F	J	N	0.391	—
Thorium-232	7/2/2024	1.09	pCi/g	0–2	F				±0.217
Thorium-232	7/2/2024	1.14	pCi/g	2–12	F				±0.298
Uranium	7/2/2024	1.81	mg/kg	0–2	F			0.0125	—
Uranium	7/2/2024	0.592	mg/kg	2–12	F			0.0144	—
Uranium-233,-234	7/2/2024	1.38	pCi/g	0–2	F				±0.391
Uranium-233,-234	7/2/2024	0.953	pCi/g	2–12	F				±0.332
Uranium-235/236	7/2/2024	0.112	pCi/g	0–2	F	U			±0.126
Uranium-235/236	7/2/2024	0.0716	pCi/g	2–12	F		U		±0.120
Uranium-238	7/2/2024	1.6	pCi/g	0–2	F				±0.411
Uranium-238	7/2/2024	0.928	pCi/g	2–12	F				±0.312
Vanadium	7/2/2024	27.1	mg/kg	0–2	F	J	*	0.0911	—
Vanadium	7/2/2024	23.8	mg/kg	2–12	F	J	*	0.104	—

Notes:

Data Qualifiers:

F Low-flow sampling method used.

G Possible grout contamination, pH > 9.

Data Qualifiers (continued):
J Estimated value.
L Less than 3 bore volumes purged before sampling.
N TIC.
Q Qualitative result due to sampling technique.
R Unusable result.
U Parameter analyzed but not detected.
X Location undefined.

Lab Qualifiers:
* Replicate analysis not within control limits.
+ Correlation coefficient for MSA < 0.995.
> Result above upper detection limit.
A TIC is a suspected aldol-condensation product.
B Inorganic: Result is between the IDL and CRDL. Organic and radiochemistry: Analyte also found in method blank.
C Pesticide result confirmed by GC-MS.
D Analyte determined in diluted sample.
E Inorganic: Estimated value because of interference, see case narrative. Organic: Analyte exceeded calibration range of the GC-MS.
h Preparation or preservation holding time exceeded.
H Holding time expired, value suspect.
I Increased detection limit due to required dilution.
J Estimated value.
M GFAA duplicate injection precision not met.
N Inorganic or radiochemical: Spike sample recovery not within control limits. Organic: TIC.
P >25% difference in detected pesticide or Aroclor concentrations between two columns.
S Result determined by MSA.
U Parameter analyzed but not detected.
W Postdigestion spike outside control limits while sample absorbance <50% of analytical spike absorbance.
X Laboratory-defined qualifier, see case narrative.
Y Laboratory-defined qualifier, see case narrative.
Z Laboratory-defined qualifier, see case narrative.

Sample Types:
D Duplicate
F Field sample
FR Field sample with replicates
N Not known
R Replicate
S Split sample

Abbreviations:
CRDL = contact required detection limit
GC-MS = gas chromatograph-mass spectrometer
GFAA = graphite furnace atomic absorption
IDL = instrument detection limit
in = inches
mg/kg = milligrams per kilogram
MSA = method of standard addition
pCi/g = picocuries per gram
TIC = tentatively identified compound

Appendix B

Data Validation Report

Data Review and Validation Report

General Information

Task ID:	MNT01-08.2406003
Sample Event:	October 26, 2023, and July 2, 2024
Site(s):	Monticello Soils – Line Leak
Laboratory:	GEL Laboratories, Charleston, South Carolina
Work Order No.:	675060
Analysis:	Metals, Wet Chemistry, Radiochemistry
Validator:	Gretchen Baer
Review Date:	November 26, 2024

This validation was performed according to

- *Environmental Data Validation Procedure* (LMS/PRO/S15870). The procedure was applied at Level 3, Data Validation.
- *Soil SAP for Groundwater Transmission Line Leak Monticello, Disposal and Processing Sites* (LMS/MNT/46277), Section 7.1, Data Validation.

This validation includes the evaluation of data quality indicators (DQIs) associated with the data. DQIs are the quantitative and qualitative descriptors that are used to interpret the degree of acceptability or utility of data. Indicators of data quality include the analysis of laboratory control samples to assess accuracy; duplicates and replicates to assess precision; and interference check samples to assess bias (see attached Data Validation Worksheets). The comparability, completeness, and sensitivity of the data are also evaluated in the sections to follow.

All analyses were successfully completed. The samples were prepared and analyzed using accepted procedures based on methods specified by line item code, which are listed in Table 1.

Table 1. Analytes and Methods

Analyte	Line Item Code	Prep Method	Analytical Method
Uranium Isotopes	ASP-A-025	Dry Soil Prep	HASL-300, U-02-RC Mod
Cs-137, K-40, Ra-226, Th-232	LMR-12	DOE HASL 300	DOE HASL 300
Metals: Mn, V	MET-A-022	SW-846 3050B	SW-846 3050B/6010D
Metals: As, Se Mo, U	MET-A-028	SW-846 3050B	SW-846 3050B/6020B
Nitrate, NO_3	MIS-A-029	SW-846 9056	SW-846 9056

From the Case Narrative: Method SW-846 3050B is not a total digestion technique for most samples. It is a very strong acid digestion that will dissolve almost all elements that could become environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

Data Qualifier Summary

Analytical results were qualified as listed in Table 2. Refer to the sections below for an explanation of the data qualifiers applied.

Table 2. Data Qualifier Summary

Sample Number	Location	Analyte	Flag	Reason
MNT01-08.2406003-001	0001	All	J	Exceeded holding time
MNT01-08.2406003-006	0004	Cesium-137	J	Less than the Determination Limit
All	All	Manganese	J	MS recovery < lower limit
All	All	Selenium	J	MS recovery < lower limit
MNT01-08.2406003-005	0003	Uranium-233/234	J	Less than the Determination Limit
MNT01-08.2406003-006	0004	Uranium-235/236	U	Less than the Decision Level Concentration
All	All	Vanadium	J	Laboratory replicate RPD > 20%

Sample Shipping/Receiving

GEL Laboratories in Charleston, South Carolina, received eight soil samples on July 10, 2024, accompanied by a Chain of Custody (COC) form. (The shipment was received one day late due to a FedEx delay. This did not cause a violation of any preservation or holding time requirements). The COC form was checked to confirm that all samples were listed with sample collection dates and times, and that signatures and dates were present indicating sample relinquishment and receipt. The COC form was complete with no errors or omissions.

Preservation and Holding Times

The sample shipment was received intact with the temperature inside the coolers at 6 °C, which complies with requirements. The samples were received in the correct container types and had been preserved correctly for the requested analyses. Samples were analyzed within the applicable holding times, with the exception of MNT01-08.2406003-001, location ID 0001, which was collected on October 26, 2023. All results for this sample are qualified with a J flag as estimated values.

Detection and Quantitation Limits

The method detection limit (MDL) was reported for all metal and wet chemical analytes as required. The MDL, as defined in 40 CFR 136, is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The practical quantitation limit (PQL) for these analytes is the lowest concentration that can be reliably measured and is defined as 5 times the MDL.

For radiochemical analytes (those measured by radiometric counting) the MDL and PQL are not applicable, and these results are evaluated using the minimum detectable concentration (MDC),

Decision Level Concentration (DLC), and Determination Limit (DL). The MDC is a measure of radiochemical method performance and was calculated and reported as specified in the *Quality Systems Manual*. The DLC is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is estimated as 3 times the one-sigma total propagated uncertainty. Results that are greater than the MDC, but less than the DLC are qualified with a U flag (not detected). The DL for radiochemical results is the lowest concentration that can be reliably measured and is defined as 3 times the MDC. Results not previously U qualified that are less than the DL are qualified with a J flag as estimated values.

The reported MDLs for all metal and wet chemical analytes; and MDCs for radiochemical analytes demonstrate compliance with contractual requirements.

Laboratory Instrument Calibration

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable qualitative and quantitative data for the analytes of interest. Initial calibration verification demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibration verification demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis. Initial and continuing calibration standards must be prepared from independent sources to ensure the validity of the calibration. All laboratory instrument calibrations and calibration verifications were performed correctly in accordance with the cited methods.

Method SW-846 6010D
Calibrations were performed using three calibration standards on July 19, 2024. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than or slightly greater than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks met the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range.

Method SW-846 6020B
Calibrations were performed using two calibration standards on July 23, 2024. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than or slightly greater than 3 times the MDL. Initial and continuing calibration verification checks were made at the required frequency. All calibration checks associated with reported results met the acceptance criteria. Reporting limit verification checks were made at the required frequency to verify the linearity of the calibration curve near the PQL and all results were within the acceptance range. Mass calibration and resolution verifications were performed at the beginning of each analytical run in accordance with the analytical procedure. Internal standard recoveries associated with requested analytes were stable and within acceptable ranges.

Method SW-846 9056
Calibrations were performed June 17, 2024, using six calibration standards. The calibration curve correlation coefficient values were greater than 0.995 and the absolute values of the intercepts were less than 3 times the MDL. Initial and continuing calibration verification checks

were made at the required frequency with all calibration check results within the acceptance criteria.

Radiochemical Analysis

Gamma Spectrometry
The gamma spectrometry efficiency calibration was performed in September 2023 for an energy range of 46 to 1836 kiloelectron volts (keV). Calibration verification was performed on August 2, 2024. A weekly background check was performed on August 1, 2024. All daily calibration and background check results met the acceptance criteria.

Uranium Isotopes
Alpha spectrometry calibrations and instrument backgrounds were performed within a month previous to sample analysis. Calibration standards were counted to obtain a minimum of 10,000 counts per peak. Daily instrument checks met the acceptance criteria. The tracer recoveries met the acceptance criteria of 30 to 110 percent for all samples. The full width at half maximum (FWHM) was reviewed to evaluate the spectral resolution. All internal standard FWHM values were below 100 kiloelectron volts (keV) demonstrating acceptable resolution. All internal standard peaks were within 50 keV of the expected position. The regions of interest (ROIs) for analyte peaks were reviewed. All ROIs were satisfactory and all integrations were performed correctly. Uranium-234 results were corrected for tracer impurity.

Method and Calibration Blanks

Method blanks are analyzed to assess any contamination that may have occurred during sample preparation. Calibration blanks are analyzed to assess instrument contamination prior to and during sample analysis. All method blank and calibration blank results associated with the samples were below the MDL for all analytes. In cases where the blank concentration exceeds the MDL, associated sample results that are greater than the MDL but less than 5 times the blank concentration are qualified with a U flag as not detected.

Inductively Coupled Plasma Interference Check Sample Analysis

Interference check samples are analyzed to verify the instrumental interelement and background correction factors and assess any bias due to interelement interferences. Interference check samples were analyzed at the required frequency with all results meeting the acceptance criteria.

Matrix Spike Analysis

Matrix spikes are aliquots of environmental samples to which a known concentration of an analyte has been added before analysis. Matrix spike and matrix spike duplicate (MS/MSD) samples are used to measure method performance in the sample matrix. The MS/MSD data are not evaluated when the concentration of the unspiked sample is greater than 4 times the spike. The spike recoveries met the acceptance criteria with the following exceptions. The spike recoveries for manganese and selenium were below the acceptance range. The affected results are qualified with a J flag (estimated). (The concentration of manganese in the unspiked sample was greater than 4 times the spike concentration; however, in this case, the unspiked result was significantly greater than the spiked result and the associated sample results are qualified with a J flag as estimated values.)

Laboratory Replicate Analysis

Laboratory replicate analyses are used to determine laboratory precision for each sample matrix. The relative percent difference for non-radiochemical replicate results that are greater than 5 times the PQL should be less than 30 percent for soil samples. For results that are less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the absolute difference between the sample and duplicate results and the sum of the 1-sigma uncertainties) is used to evaluate duplicate results and should be less than 3. The results met the criteria with the exception of the vanadium RPD. The affected results are qualified with a J flag (estimated).

Laboratory Control Samples

Laboratory control samples were analyzed at the correct frequency to provide information on the accuracy of the analytical method and the overall laboratory performance, including sample preparation. All control sample results were acceptable.

Metals Serial Dilution

Serial dilutions were prepared and analyzed for the metals analyses to monitor chemical or physical interferences in the sample matrix. Serial dilution data are evaluated when the concentration of the undiluted sample is greater than 50 times the MDL. The serial dilution results met the acceptance criteria for all analytes.

Completeness

Results were reported in the correct units for all analytes requested using contract-required laboratory qualifiers.

Chromatography Peak Integration

The integration of analyte peaks was reviewed for all ion chromatography data. There were no manual integrations performed for target analytes and all peak integrations were satisfactory.

Electronic Data Deliverable (EDD) File

The EDD file arrived on August 7, 2024. The contents of the file were compared to the requested analyses to ensure all and only the requested data were delivered. The contents of the EDD were manually examined to verify that the sample results accurately reflected the data contained in the sample data package.

Field Duplicate Analysis

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples were collected from location 0003. For non-radiochemical measurements, the relative percent difference for duplicate results that are greater than 5 times the PQL should be less than 30 percent in soil samples. For results less than 5 times the PQL, the range should be no greater than the PQL. For radiochemical measurements, the relative error ratio (the ratio of the

absolute difference between the sample and duplicate results and the sum of the 1 sigma uncertainties) is used to evaluate duplicate results and should be less than 3. All duplicate results met these criteria, demonstrating acceptable precision.

GRETCHEN BAER (Affiliate)

Digitally signed by GRETCHEN BAER (Affiliate)
Date: 2024.11.26 17:36:34 -07'00'

Report Prepared By: _____

Gretchen Baer
Data Validator

General Data Validation Report

Task Code: MNT01-08.2406003 **Lab Code:** GEN **Validator:** Gretchen Baer **Validation Date:** 11-26-2024

Project: Monticello Soils **# Samples:** 8

Analysis Type: [X] General Chemistry [X] Metals [ ] Organics [X] Radiochemistry

Chain of Custody	***Sample***
Present: OK Signed: OK Dated: OK	Integrity: OK Preservation OK Temperature: OK

Check	Summary
Holding Times:	There were 14 analyses performed outside the applicable holding times.
Detection Limits:	The reported detection limits are equal to or below the contract required limits.
Field Duplicates:	There was 1 duplicate evaluated.

Validation Report: Holding Times

26-Nov-2024

Project: Monticello Soils **Task Code:** MNT01-08.2406003 **Lab Code:** GEN

			Holding Times			Criteria			Actual Dates		
Sample ID	Location	Method	Collection to Prep.	Prep. to Analysis	Collection to Analysis	Collection to Prep	Prep to Analysis	Collection to Analysis (Preserved)	Date Sampled	Date Prepared	Date Analyzed
MNT01-08.2406003-001	0001	SW-846 6020	265	6	271	180		180	10/26/2023	7/17/2024	7/23/2024
MNT01-08.2406003-001	0001	DOEHASL3004.5.2.3GA	258	23	281	180	180	180	10/26/2023	7/10/2024	8/2/2024
MNT01-08.2406003-001	0001	SW-846 6010	265	2	267	180	180	180	10/26/2023	7/17/2024	7/19/2024
MNT01-08.2406003-001	0001	SW-846 6020	265	6	271	180		180	10/26/2023	7/17/2024	7/23/2024
MNT01-08.2406003-001	0001	EPA 9056	260	0	260	28	28	28	10/26/2023	7/12/2024	7/12/2024
MNT01-08.2406003-001	0001	DOEHASL3004.5.2.3GA	258	23	281	180	180	180	10/26/2023	7/10/2024	8/2/2024
MNT01-08.2406003-001	0001	DOEHASL3004.5.2.3GA	258	23	281	180	180	180	10/26/2023	7/10/2024	8/2/2024
MNT01-08.2406003-001	0001	SW-846 6020	265	6	271	180		180	10/26/2023	7/17/2024	7/23/2024
MNT01-08.2406003-001	0001	DOEHASL3004.5.2.3GA	258	23	281	180	180	180	10/26/2023	7/10/2024	8/2/2024
MNT01-08.2406003-001	0001	SW-846 6020	265	6	271	180		180	10/26/2023	7/17/2024	7/23/2024
MNT01-08.2406003-001	0001	U-02-RC MODIFIED	258	8	266	180	180		10/26/2023	7/10/2024	7/18/2024
MNT01-08.2406003-001	0001	U-02-RC MODIFIED	258	8	266	180	180		10/26/2023	7/10/2024	7/18/2024
MNT01-08.2406003-001	0001	U-02-RC MODIFIED	258	8	266	180	180		10/26/2023	7/10/2024	7/18/2024
MNT01-08.2406003-001	0001	SW-846 6010	265	2	267	180	180	180	10/26/2023	7/17/2024	7/19/2024

Validation Report: Field Duplicates

26-Nov-2024

Project: Monticello Soils **Task Code:** MNT01-08.2406003 Lab Code: GEN

	Duplicate: MNT01-08.2406003-008				Sample: MNT01-08.2406003-005 0003						
Analyte	**Result**	**Qualifiers**	**Uncert.**	**Dilution**	**Result**	**Qualifiers**	**Uncert.**	**Dilution**	**RPD**	**RER**	**Units**
Arsenic	4.17			2	5.00			2	18.1		mg/kg
Cesium-137	0.0227	U	0.0259	1	-0.00160	U	0.0266	1		1.3	pCi/g
Manganese	351			1	436			1	21.6		mg/kg
Molybdenum	0.542			2	0.718			2	27.9		mg/kg
Nitrate as Nitrogen	0.895	J		1	1.45			1			mg/kg
Potassium-40	19.6		2.30	1	18.2		2.06	1		0.9	pCi/g
Radium-226	1.34		0.176	1	1.18		0.186	1		1.2	pCi/g
Selenium	1.26	N		2	1.50	N		2			mg/kg
Thorium-232	1.22		0.293	1	0.735		0.289	1		2.3	pCi/g
Uranium	1.20			2	1.56			2	26.1		mg/kg
URANIUM-233,-234	0.958		0.328	1	0.758		0.312	1		0.9	pCi/g
Uranium-235/236	0.132	U	0.148	1	-0.0156	U	0.0747	1		1.7	pCi/g
Uranium-238	1.45		0.401	1	0.727		0.287	1		2.9	pCi/g
Vanadium	21.4	*		1	27.8	*		1	26.0		mg/kg

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio

Metals Data Validation Worksheet

26-Nov-2024

Task Code: MNT01-08.2406003 **Project:** Monticello Soils **Lab Code:** GEN

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Arsenic	SW-846 6020	07-23-2024	LCS	92		80	120			
Arsenic	SW-846 6020	07-23-2024	MB							
Arsenic	SW-846 6020	07-23-2024	MS	78		75	125			
Arsenic	SW-846 6020	07-23-2024	MSD		77.1	75	125	0.429	20	
Manganese	SW-846 6010	07-19-2024	LCS	94.7		80	120			
Manganese	SW-846 6010	07-19-2024	MB							
Manganese	SW-846 6010	07-19-2024	MS	-220		75	125			J flag
Manganese	SW-846 6010	07-19-2024	R					19.4	20	
Molybdenum	SW-846 6020	07-23-2024	LCS	103		80	120			
Molybdenum	SW-846 6020	07-23-2024	MB							
Molybdenum	SW-846 6020	07-23-2024	MS	86.1		75	125			

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

Metals Data Validation Worksheet

26-Nov-2024

Task Code: MNT01-08.2406003 **Project:** Monticello Soils **Lab Code:** GEN

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Molybdenum	SW-846 6020	07-23-2024	MSD		79.3	75	125	5.25	20	
Selenium	SW-846 6020	07-23-2024	LCS	87.6		80	120			
Selenium	SW-846 6020	07-23-2024	MB							
Selenium	SW-846 6020	07-23-2024	MS	73		75	125			J flag
Selenium	SW-846 6020	07-23-2024	MS	89.2		75	125			
Selenium	SW-846 6020	07-23-2024	MSD		75.5	75	125	4.33	20	
Uranium	SW-846 6020	07-23-2024	LCS	101		80	120			
Uranium	SW-846 6020	07-23-2024	MB							
Uranium	SW-846 6020	07-23-2024	MS	96.6		75	125			
Uranium	SW-846 6020	07-23-2024	MSD		98.8	75	125	3.62	20	
Vanadium	SW-846 6010	07-19-2024	LCS	93.8		80	120			
Vanadium	SW-846 6010	07-19-2024	MB							

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

Metals Data Validation Worksheet

26-Nov-2024

Task Code: MNT01-08.2406003 **Project:** Monticello Soils **Lab Code:** GEN

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Vanadium	SW-846 6010	07-19-2024	MS	93		75	125			
Vanadium	SW-846 6010	07-19-2024	R					71.6	20	J flag

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

Wet Chemistry Data Validation Worksheet

26-Nov-2024

Task Code: MNT01-08.2406003 **Project:** Monticello Soils **Lab Code:** GEN

Analyte	Method	Analysis Date	QC Type	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	Comments
Nitrate as Nitrogen	EPA 9056	07-12-2024	LCS	98.2		90	110			
Nitrate as Nitrogen	EPA 9056	07-12-2024	MB							
Nitrate as Nitrogen	EPA 9056	07-12-2024	MS	97.2		75	125			
Nitrate as Nitrogen	EPA 9056	07-12-2024	R					9.79	25	

QC Types: LCS: Laboratory Control Sample MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

QC Checks: RPD: Relative Percent Difference

Radiochemistry Data Validation Worksheet

26-Nov-2024

Task Code: MNT01-08.2406003 **Project:** Monticello Soils **Lab Code:** GEN

Sample ID	Analyte	Analysis Date	QC Type	Result Type	Result	Flag	TPU	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	RER	Comments
	Americium-241	08-02-2024	LCS	SC	503		60.4	104		75	125				
	Cesium-137	08-02-2024	LCS	SC	142		11.8	94.6		75	125				
	Cesium-137	08-02-2024	MB	TRG	0.00166	U	0.0121								
	Cesium-137	08-02-2024	R	TRG	-0.00848	HU	0.0307					0			RER=0.7
	Cobalt-60	08-02-2024	LCS	SC	56.4		7.02	97.7		75	125				
	Potassium-40	08-02-2024	LCS	TRG	-0.618	U	1.57								
	Potassium-40	08-02-2024	MB	TRG	-0.0581	U	0.169								
	Potassium-40	08-02-2024	R	TRG	16.5	H	2.05					0.487	20		RER=0.1
	Radium-226	08-02-2024	LCS	TRG	-0.426	U	0.863								
	Radium-226	08-02-2024	MB	TRG	-0.0141	U	0.0240								
	Radium-226	08-02-2024	R	TRG	1.02	H	0.175					1.91	20		RER=0.2
	Thorium-232	08-02-2024	LCS	TRG	0.0959	U	1.69								
	Thorium-232	08-02-2024	MB	TRG	0.0743	U	0.0547								
	Thorium-232	08-02-2024	R	TRG	0.875	H	0.358					3.02	100		RER=0.1
	URANIUM-233,-234	07-18-2024	LCS	TRG	21.4		2.51								
	URANIUM-233,-234	07-18-2024	MB	TRG	0.0656	U	0.120								
	URANIUM-233,-234	07-18-2024	R	TRG	1.11	H	0.338					15.8	20		RER=0.7
	Uranium-235/236	07-18-2024	LCS	TRG	1.49		0.413								
	Uranium-235/236	07-18-2024	MB	TRG	0.0633	U	0.106								
	Uranium-235/236	07-18-2024	R	TRG	0.0538	HU	0.0952					0			RER=0.7
	Uranium-238	07-18-2024	LCS	SC	23.1		2.68	102		75	125				

QC Types: LCS: Laboratory Control Sample LCSD: Laboratory Control Sample Duplicate MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

Result Types: IS: Internal Standard SC: Spike Analyte TRG: Target analyte

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio TPU: Total Propagated Uncertainty

Radiochemistry Data Validation Worksheet

26-Nov-2024

Task Code: MNT01-08.2406003 **Project:** Monticello Soils **Lab Code:** GEN

Sample ID	Analyte	Analysis Date	QC Type	Result Type	Result	Flag	TPU	Spike Recovery	Spike Dup Recovery	Lower Limit	Upper Limit	RPD	RPD Limit	RER	Comments
	Uranium-238	07-18-2024	MB	TRG	0.0718	U	0.0948								
	Uranium-238	07-18-2024	R	TRG	1.05	H	0.325					5.26	20		RER=0.3

QC Types: LCS: Laboratory Control Sample LCSD: Laboratory Control Sample Duplicate MB: Method Blank MS: Matrix Spike MSD: Matrix Spike Duplicate R: Replicate

Result Types: IS: Internal Standard SC: Spike Analyte TRG: Target analyte

QC Checks: RPD: Relative Percent Difference RER: Relative Error Ratio TPU: Total Propagated Uncertainty