BROOKHAVEN
NATIONAL LABORATORY

Addendum to the Closeout Report Waste Concentration Facility (Bldg. 811 – Area of Concern 10) and Surrounding Area

June 14, 2019

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Executive Summary

Radiological contamination was identified in surface soil (i.e., three isolated areas of approximately 129 square-feet [ft^2], 317 ft^2 and 751 ft^2) along the fence line just north of the former Brookhaven National Laboratory (BNL) Waste Concentration Facility during radiological walkover surveys performed in 2016 as part of the Building 811 Project, as documented in the *Revised Closeout Report, Waste Concentration Facility (Bldg 811 – Area of Concern 10) and Surrounding Area,* (Building 811 Closeout Report) (BNL, January 2017). Analytical results for soil samples collected in these areas in 2016 indicate that the primary detected radionuclide was cesium-137 (Cs-137); however, one sample did contain detectable concentrations of cobalt-60 (Co-60). The following scope of work was completed in 2018 to address these three isolated areas of radiological contamination in surface soil:

- Excavation of soil contamination above site cleanup goals;
- Completion of a Final Status Survey (FSS) of a *Multi-Agency Radiological Survey and Site Investigation Manual* (MARSSIM) Class 1 survey unit (SU-3) to ensure site cleanup objectives were met;
- Characterization, transportation and disposal of excavated soil; and
- Site restoration.

Soil remediation and the subsequent FSS were performed in accordance with the *Record of Decision – Operable Unit I and Radiologically Contaminated Soils (Including Areas of Concern 6, 8, 10, 16, 17, and 18,)* (BNL, 1999*)* (OU I ROD) and the *Addendum to the Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC 10) and Surrounding Area* (PWGC, May 2018) (WCF FSP/QAPP Addendum).

Approximately 22 cubic yards of excavated soil were loaded into 7-cubic yard supersacks. A 3-foot long steel I-beam and concrete rubble associated with the removed fence were loaded into B-12 containers. Five supersacks and their associated overpacks, as well as two B-12 containers, were transported to BNL's Waste Management Facility for temporary storage, and subsequently shipped to Energy Solutions of Clive, Utah for disposal.

The following summarizes the as-left conditions for this project and how they satisfy the requirements of the OU I ROD:

- The results of the final status radiological walkover survey of SU-3 exhibited count rates below 21,500 counts per minute (cpm). As specified in Table 4-2 of the *Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC10) and Surrounding Area* (PWGC, August 2015), the 21,500 cpm count rate was determined to approximate a Cs-137 concentration of 15 picocuries per gram (pCi/g) (i.e., the screening

limit) in soil when using the uncollimated sodium iodide (NaI) gamma scintillation detector.

- The maximum Cs-137 and radium-226 (Ra-226) concentrations detected in surface soil and core samples collected after the completion of remediation are 15.5 pCi/g and 0.851 pCi/g, respectively. Strontium (Sr)-90 concentrations were below Minimum Detectable Concentrations (MDC). The as-left maximum concentrations are well below the site cleanup values (Cs-137 = 23 pCi/g, Sr-90 = 15 pCi/g and Ra-226 = 5 pCi/g).
- The maximum concentrations of additional radionuclides evaluated in surface soil composite samples, including tritium, gamma emitters (i.e., Co-60 and europium-152 [Eu-152]), and alpha emitters (isotopes of uranium and plutonium) are below the established site cleanup criteria specified in Table 3-1 of the *Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC10) and Surrounding Area* (PWGC, August 2015)
- As documented in the Building 811 Closeout Report, the results of the dose assessment performed during the Building 811 Project are well below the limits established in the OU I ROD, including the dose based soil cleanup objective of 15 millirem/year (mrem/yr) above background and the New York State Department of Environmental Conservation (NYSDEC) cleanup guideline of 10 mrem/yr from Technical and Administrative Guidance Memorandum (TAGM) 4003, which was adopted as an As-Low-As-Reasonably-Achievable (ALARA) goal. In accordance with the WCF FSP/QAPP Addendum, an additional dose assessment following the remediation documented in this addendum was not performed.
- Site restoration included backfilling excavated areas to original grade and the installation of temporary fencing to delineate the Waste Concentration Facility from the adjacent Collider Accelerator Department metal storage area.

The BNL Land Use Controls Fact Sheet was updated to reflect the as-left site conditions. No radiological soil contamination postings are required for this area. A Land Use and Institutional Controls (LUIC) point-of-contact sign is posted nearby. Brookhaven Science Associates (BSA) will perform surveillance and maintenance activities. In addition to maintaining institutional controls for the area, BSA will ensure that routine inspections are performed. The U.S. Department of Energy (DOE) will ensure enforcement of all institutional controls.

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Appendices

A. Purpose

The purpose of this addendum to the *Revised Closeout Report, Waste Concentration Facility (Bldg 811 – Area of Concern 10) and Surrounding Area,* (Building 811 Closeout Report) (BNL, January 2017) is to document the actions completed to address radiological contamination in surface soil located along the fence line just north of the former Brookhaven National Laboratory (BNL) Building 811, which separates the Waste Concentration Facility (Area of Concern [AOC] 10) from the former Collider Accelerator Department metal storage area (**Figure B-1**). This addendum documents the following scope of work:

- Excavation of soil contaminated above site cleanup goals;
- Completion of a Final Status Survey (FSS);
- Characterization, transportation and disposal of excavated soil; and
- Site restoration.

This scope of work was completed by the BNL Environmental Protection Division (EPD), EPD task order subcontractors, the BNL Facilities and Operations Directorate (F&O) and the BNL Radiological Control Division (RCD). Soil remediation and the subsequent FSS were performed in accordance with the *Record of Decision – Operable Unit I and Radiologically Contaminated Soils (Including Areas of Concern 6, 8, 10, 16, 17, and 18)* (BNL, 1999) (OU I ROD) and the *Addendum to the Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC 10) and Surrounding Area* (PWGC, May 2018), referred to herein as the WCF FSP/QAPP Addendum.

B. Background

As documented in the Building 811 Closeout Report (BNL, January 2017), Decontamination and Dismantlement (D&D) of Building 810 (Waste Transfer Facility) and Building 811 (Waste Concentration Facility), the removal of the associated structures and piping, and the subsequent final status survey (FSS) and independent verification (IV) were completed between July 2014 and September 2016, referred to herein as the Building 811 Project. During the Building 811 Project, radiological contamination was identified in three isolated areas of approximately 129 square-feet (ft^2), 317 ft^2 and 751 ft^2 along the fence line just north of the former Waste Concentration Facility. Count rates of greater than 21,500 counts per minute (cpm) were recorded in these areas using an uncollimated sodium iodide (NaI) gamma scintillation detector during the final status radiological walkover survey. Based on the radiological walkover survey and limited excavation activities along the fence line, the contaminated soil appeared to be shallow (i.e., less than 2 feet below ground surface [bgs]). Analytical results for soil samples collected in these

areas in 2016 indicate that the primary detected radionuclide was cesium-137 (Cs-137); however, one sample did contain detectable concentrations of cobalt-60 (Co-60). Due to insufficient funds for additional remediation activities at the time of the Building 811 Project, these areas with elevated levels of radiologically contaminated soil were placed under institutional controls and added to the Land Use and Institutional Controls (LUIC) contaminated soil map. These areas are illustrated on **Figure B-1**.

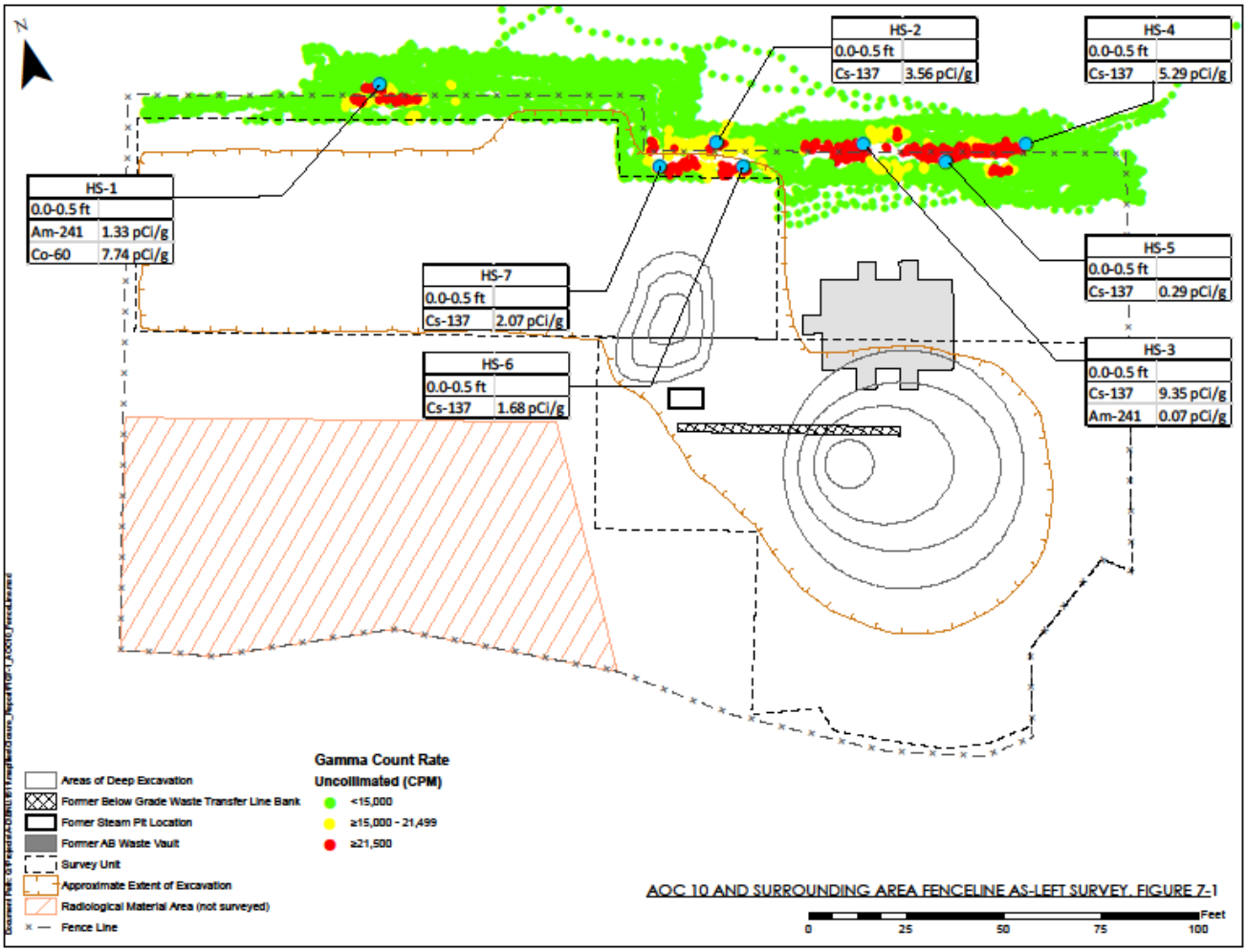

Figure B-1 – 2016 Building 811 Project Fence Line Survey and ISOCS Soil Sample Results

Photograph 1 – Project area, view to west

C. Remedial Activities

Mobilization and site preparation were initiated on July 16, 2018, which included removing fence posts and associated concrete, mowing/clearing vegetation, as well as staging excavation equipment and project waste containers. A general area that encompassed the three isolated areas of surface soil contamination (i.e., approximately 129 ft^2, 317 ft^2 and 751 ft^2) was previously delineated with a radiological boundary. A BNL RCD Technician further delineated the three isolated areas of surface soil contamination by performing an initial radiological walkover survey with an uncollimated NaI detector and marking the areas measured above 21,500 cpm with spray paint. Excavation of the isolated areas of surface soil contamination was performed between July 17 and July 19, 2018. In accordance with the WCF FSP/QAPP Addendum, soil was removed in approximate one-foot lifts with a backhoe until radiological surveys using an uncollimated NaI showed that gamma radiation levels in remediated areas were less than 21,500 cpm. As further discussed in **Section D.2**, spot remediation was performed on August 27, 2018 to address a single surface soil sample location where elevated Cs-137 was detected in a surface soil grab sample. A total of 22 cubic yards of soil were excavated.

Photograph 2 – Remediation of isolated area of surface soil contamination

As further discussed in Section E., excavated soil was loaded into 7-cubic yard supersacks. A 3-foot long steel I-beam and concrete rubble associated with the removed fence were loaded into two B-12 containers.

D. Final Status Survey (FSS) and Sampling Plan

After completing remediation of the areas of surface soil contamination, walkover surveys were performed, and soil samples were collected and analyzed as specified below.

As discussed in Sections 2.1 and 3.2 of the Building 811 Closeout Report, the radionuclides of concern for Building 811 and the surrounding area, based on exposure potential, were Cs-137, radium-226 (Ra-226), and strontium-90 (Sr-90); and their respective site cleanup values are 23 picocuries per gram (pCi/g), 5 pCi/g and 15 pCi/g. Although less likely to be present, additional radionuclides were evaluated and include tritium, gamma emitters (i.e., Co-60 and europium-152 [Eu-152]), and alpha emitters (isotopes of uranium and plutonium).

D.1 Final Status Survey Design

In accordance with the WCF FSP/QAPP Addendum, a FSS was performed following the principles of the *Multi-Agency Radiological Survey and Site Investigation Manual* (MARSSIM). As illustrated on **Figure D-1**, a Class 1 survey unit (SU-3) was established, which contained the three distinct areas where surface soil contamination was remediated. These three areas comprise approximately 1,197 ft^2, or about 28% of the total survey unit (4,305 ft^2).

On July 20 and July 28, 2018, a 100% gamma walkover scan of SU-3 was performed by a RCD Technician using an unshielded 2" x 2" NaI scintillation detector (Ludlum 44-10 probe) coupled to a count rate meter (Ludlum Model 2221) and an ERG 105G Real GPS Data Logger System. A 100% scan is defined as walking at 0.5 meters/second and moving the probe in a serpentine motion. The RCD Technician followed 1-meter-wide lanes over the entire survey unit.

Photograph 3 – Final status radiological walkover survey of remediated area

In accordance with the WCF FSP/QAPP Addendum, a random-start triangular grid pattern was established to determine 20 surface soil sample locations (0-6 inches bgs) within SU-3, as shown on **Figure D-2**. Surface samples were collected on July 31, 2018. A grab sample was collected from each of the 20 locations and analyzed for gamma emitters by gamma spectroscopy (including Cs-137 and Ra-226) and for Sr-90. Four surface soil composite samples were analyzed by alpha spectroscopy for alpha emitters (Uranium-235 [U-235], Uranium-238 [U-238], Plutonium-238 [Pu-238], Plutonium-239/240 [Pu-239/240]), and for tritium. In accordance with the WCF FSP/QAPP Addendum, each of the four composite samples were collected by combining soil from five of the surface soil sample locations (e.g., Composite 1 = SU-3-1 through SU-3-5, Composite 2 = SU-3-6 through SU-3-10, etc.). A fixed-point one-minute measurement with an unshielded 2" x 2" NaI scintillation detector was taken at each of the 20 surface soil sample locations. Grab and composite soil samples were analyzed at GEL Laboratories of Charleston, South Carolina (GEL).

Photograph 4 – Surface soil composite sample preparation

A Geoprobe was utilized to collect a core soil sample (0 – 8 feet bgs) in the approximate center of each of the three discrete areas of contamination within SU-3 on July 31, 2018, as shown on **Figure D-2**. In accordance with the WCF FSP/QAPP Addendum, the three core samples were analyzed in 2-foot sections (i.e., 4 samples per core location) for Cs-137 utilizing onsite gamma spectroscopy. Each core sample was also analyzed at GEL for gamma emitters by gamma spectroscopy (including Cs-137 and Ra-226) and for Sr-90. When Cs-137 was detected in a core soil sample at a concentration greater than 7 pCi/g (about 1/3 of the Derived Concentration Guideline Limit [DCGL]) utilizing onsite gamma spectroscopy, then the specific sample was also analyzed by GEL for alpha emitters (U-235/238, Pu-238, Pu-239/240) and tritium.

As specified in the WCF FSP/QAPP Addendum, soil samples were collected in accordance with BNL EPD standard operating procedures.

D.2 Final Status Survey and Sampling Results

The results of the final status radiological walkover survey of SU-3 performed on July 20 and 28, 2018 exhibited count rates below 21,500 cpm, as shown on **Figure D-3**. As specified in Table 4-2 of the *Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC10) and Surrounding Area* (BNL, August 2015), the 21,500 cpm count rate was determined to approximate a Cs-137 concentration of 15 pCi/G in soil when using the uncollimated NaI gamma scintillation detector.

Results of the fixed-point one-minute measurements taken with the NaI probe at each of the surface soil sample locations ranged from 5,371 cpm at SU-3-11 to 20,793 cpm at SU-3-1. Surface soil grab sample results for Cs-137 were all below the associated site cleanup criteria of 23 pCi/g (ranging from below detection limits to 10.4 pCi/g) with the exception of SU-3-1, which had a concentration of 50.5 pCi/g. Ra-226 concentrations ranged from 0.322 pCi/g to 0.851 pCi/g, well below the associated site cleanup criteria of 5 pCi/g. Sr-90 concentrations were below detection limits in all surface soil grab samples. As previously discussed in **Section C**, subsequent spot remediation was performed at SU-3-1 on August 27, 2018. Upon completion of the spot remediation, a second surface soil grab sample (SU-3-1-R) was collected at the location on August 28, 2018, which was analyzed for gamma emitters by gamma spectroscopy (including Cs-137 and Ra-226) and for Sr-90 at GEL. Analytical results for SU-3-1-R were reported as follows: Cs-137 was detected at a concentration of 8.01 pCi/g; Ra-226 was detected at a concentration of 0.514; and the Sr-90 result was below the detection limit. Since the final results indicate that radionuclides of concern were less than their associated site cleanup criteria in surface soil grab samples, per MARSSIM, the survey unit does not require analysis using the sign test or the elevated measurement comparison. The analytical results for surface soil grab samples are summarized in **Table D-1**, and the associated GEL data sheets are provided in **Appendix A.**

For the surface soil composite samples, alpha emitters (U-235, U-238, Pu-238, Pu-239/240) and tritium were reported at concentrations less than detection limits, with the exception of a U-238 detections of 0.444 pCi/g and 1.11 pCi/g in Composite 1 and Composite 4, respectively. These detections are below the established site cleanup criteria of 4.7 pCi/g specified in Table 3-1 of the *Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC10) and Surrounding Area (*PWGC, August 2015). The analytical results for composite soil samples are summarized in **Table D-2**, and the associated GEL data sheets are provided in **Appendix A**. In accordance with the WCF FSP/QAPP Addendum, there were five sub-samples (i.e., increments) for each of the surface soil composite samples. In accordance with MARSSIM, a modified

investigation level (MIL) was determined by dividing the derived concentration guidance level (DCGL) by the square root of the number of increments. The MIL is then compared to the minimum detectable concentration (MDC) for each radionuclide to ensure that the level of detection is acceptable. As shown in **Table D-3**, the MDC is less than the MIL for each analyzed contaminant in the composite samples.

Onsite ISOCS results for core samples were all below 7 pCi/g with the exception of the 0-2 feet bgs sample interval at Core 3, which indicated a Cs-137 result of 12 pCi/g. In accordance with the WCF FSP/QAPP Addendum, this specific sample was also analyzed by GEL for alpha emitters (U-235/238, Pu-238, Pu-239/240) and tritium, in addition to gamma emitters by gamma spectroscopy (including Cs-137 and Ra-226) and Sr-90. Offsite analysis by GEL indicated a Cs-137 concentration of 15.5 pCi/g in the Core 3, 0-2 feet bgs sample, which is below the established site cleanup goal of 23 pCi/g. The reported concentration of Ra-226 is 0.500, which is well below the established site cleanup goal of 5 pCi/g. The reported concentration of U-235/238 is 0.552 pCi/g, well below the associated site cleanup goal of 4.6 pCi/g. Sr-90, Pu-239, Pu-239/240 and tritium were reported below detection limits in the Core 3, 0-2 feet bgs sample. Cs-137, Ra-226 and Sr-90 were all reported by GEL at concentrations below their established cleanup goals in the remaining core samples. The offsite analytical results for core samples are summarized in **Table D-4**, and the associated data sheets are provided in **Appendix A**. Onsite ISOCS results for core samples are provided in **Appendix B**.

D.3 Final Status Survey Conclusion

As indicated above, the results of the FSS following the remediation of the three isolated areas of radiological contamination in surface soil demonstrates conformance to the site cleanup goals established for the project.

As documented in the *Revised Closeout Report, Waste Concentration Facility (Bldg 811 – Area of Concern 10) and Surrounding Area,* (Building 811 Closeout Report) (BNL, January 2017), the results of the dose assessment performed during the Building 811 Project are well below the limits established in the OU I ROD, including the dose based soil cleanup objective of 15 mrem/yr above background and the NYSDEC cleanup guideline of 10 millirem/year (mrem/yr) from TAGM 4003, which was adopted as an ALARA goal. In accordance with the WCF FSP/QAPP Addendum, an additional dose assessment following the remediation documented in this addendum was not performed.

E. Waste Management

Waste characterization, packaging, handling and storage were performed in accordance with BNL EPD's waste management procedures. A total of approximately 22 cubic yards of excavated soil

were placed into five 7-cubic yard supersacks provided by Strategic Packaging Systems, LLC (SPS Packaging Bags). Per Strategic Packaging Systems, LLC, the SPS Packaging Bags have a 20,000-pound capacity; and were manufactured with an 18-mil woven and coated polypropylene fabric outer shell and a 10-ounce geotextile, non-woven felt liner on the inner surface for puncture protection. In addition, an inner packaging bag was installed inside each 7-cubic yard supersack prior to loading. Per Strategic Packaging Systems, LLC., the inner packaging bags were manufactured with 12-mil woven and coated polypropylene. Although the SPS Packaging Bags inspected prior to use and were not loaded to capacity, two of the five bags failed along their zipper seams. As a result, each of the five SPS Packaging Bags was subsequently loaded into a designated 7-cubic yard polypropylene overpack provided by SPS.

A 3-foot long steel I-beam and concrete rubble associated with the fence that were removed, as well as used geotextile fabric, were loaded into two B-12 containers manufactured by Container Products Corporation (CPS).

Waste verification sampling was performed for disposal and the sample was analyzed by GEL for comparison to Energy Solutions' waste acceptance criteria (WAC). The waste verification sample was also analyzed for Sr-90, U-235/238, Pu-238/239/240/241, polychlorinated biphenyls, mercury, lead, gamma spectroscopy and full TCLP. According to the waste characterization results, the waste shipped met the WAC of Energy Solutions of Clive, Utah. Waste verification results, which are summarized in **Table E1** and **Table E2**, were submitted to BNL's Waste Management Division.

The five supersacks/overpacks and two B-12 containers were transported to BNL's Waste Management Facility for temporary storage on October 3, 2018, and were subsequently shipped via two trucks to Energy Solutions of Clive, Utah for disposal on November 15, 2018. Waste manifests are provided in **Appendix C**.

Photograph 5 – Excavated soil packaged in SPS Packaging Bags

Waste minimization and pollution prevention methods employed during remediation and characterization activities included excavation of soil in as small a lift as possible to minimize excavation of soil below cleanup goals, size reduction of fence concrete, and judicious use of consumables (e.g., PPE).

F. Site Restoration

Excavated areas were backfilled to original grade on October 4, 2018, using stockpiled soils generated during construction of the National Synchrotron Light Source II. This backfill source was evaluated and utilized during the Building 811 Project, as documented in Section 3.4 of the *Revised Closeout Report, Waste Concentration Facility (Bldg 811 – Area of Concern 10) and Surrounding Area,* (Building 811 Closeout Report) (BNL, January 2017). In addition, temporary fencing was installed on October 5, 2018 to delineate the Waste Concentration Facility from the former Collider Accelerator Department metal storage area.

Photograph 6 – Backfilled remediated areas

G. Performance Standards & Quality Control

Physical inspections were conducted on both incoming and outgoing waste containers. Radiological surveys were performed on outgoing containers. Inspections were also conducted on excavations and storm water control measures during excavation operations. Field sampling procedures were reviewed periodically.

Quality Assurance/Quality Control (QA/QC) samples were collected in accordance with the WCF FSP/QAPP Addendum. Field duplicates and equipment blanks were collected at a frequency of one per twenty soil samples and analyzed for the radiological contaminants of concern. QA/QC results are summarized in **Table G1** .

Data validation was performed for a minimum of 5% of the end-point sampling data. The data results obtained from the contract analytical laboratory (GEL Laboratories LLC) underwent a systematic data validation performed by BNL to provide assurance that the data is adequate for its intended use (i.e., in assessing the effectiveness of remedial activities). The validation was performed by personnel who have had appropriate training and/or experience in performing data validation for the radiological analyses.

Validation was performed in accordance with BNL EM-SOP-204, Radiochemical Data Verification, EM-SOP-209, Radiochemical Data Validation, and EM-SOP-210, Radiochemical

Data Usability. The validation checklists are provided in **Appendix D**.

The conclusion of the data validation was that the sample data is sufficient for the intended use.

H. Operation and Maintenance Activities

The BNL Land Use Controls Fact Sheet was updated to reflect the as-left site conditions. No radiological soil contamination postings are required for this area. An LUIC point-of-contact sign is posted nearby. Brookhaven Science Associates (BSA) will perform surveillance and maintenance activities. In addition to maintaining institutional controls for the area, BSA will ensure that routine inspections are performed. DOE will ensure enforcement of all institutional controls.

I. Summary of Project Costs

The remediation and characterization of SU-3, which included the three isolated areas of surface soil contamination located along the fence line just north of the former BNL Building 811 cost approximately $225,000 to complete. The clean-up costs included the following details:

Engineering and Planning	$15,000
Remediation and Characterization	$160,000
Waste Transportation and Disposal	$50,000
Total Cost	$225,000

J. References

A comprehensive list of references is provided in the *Revised Closeout Report, Waste Concentration Facility (Bldg 811 – Area of Concern 10) and Surrounding Area,* (Building 811 Closeout Report) (BNL, January 2017). Additional references associated with this addendum are provided below:

BNL, 2017. *Revised Closeout Report, Waste Concentration Facility (Bldg 811 – Area of Concern 10) and Surrounding Area,* (Building 811 Closeout Report), January 2017.

PWGC, 2018. *Addendum to the Field Sampling Plan/Quality Assurance Project Plan, Waste Concentration Facility (AOC 10) and Surrounding Area,* PWGC, May 2018.

FIGURES

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SURVEY UNIT 3

Former Waste Concentration Facility Soil Excavation
Brookhaven National Laboratory

0 10 20 30 40 Feet

Project:	BNL1803
Date:	8/31/2018
Designed by:	MBM
Drawn by:	TS
Approved by:	MBM
Figure No:	D-1

Document Path: W:\Projects\A-D\BNL\1803\mapfiles\FIGD-1_Survey-Unit-3.mxd

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SURVEY UNIT 3 SOIL SAMPLE LOCATIONS

Former Waste Concentration Facility Soil Excavation
Brookhaven National Laboratory

0 10 20 30 40 Feet

Project:	BNL1803
Date:	10/10/2018
Designed by:	MBM
Drawn by:	TS
Approved by:	MBM
Figure No:	D-2

Document Path: W:\Projects\A-D\BNL\1803\mapfiles\FIG5-2_Survey-Unit-3_Soil-Sample-Locations.mxd

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FINAL STATUS SURVEY

Former Waste Concentration Facility Soil Excavation
Brookhaven National Laboratory

0 10 20 30 40 Feet

Project:	BNL1803
Date:	5/14/2019
Designed by:	MBM
Drawn by:	TS
Approved by:	MBM
Figure No:	D-3

Document Path: W:\Projects\A-D\BNL\1803\mapfiles\FIGD-3_Final Status Survey_.mxd

TABLES

Former Building 811 Soil Remediation

Table D-1: Survey Unit 3 - Surface Soil Grab Sample Results (COC# 39987/40141)

Sample Name	Sample ID	Sample Date	Sample Depth from Excavation Grade (ft)	One Minute Fixed Gamma Count Rate Uncollimated (CPM)	Americium-241 (pCi/g)		Beryllium-7 (pCi/g)		Cesium-134 (pCi/g)		Cesium-137 (pCi/g)		Cobalt-57 (pCi/g)		Cobalt-60 (pCi/g)		Europium-152 (pCi/g)		Europium-154 (pCi/g)		Europium-155 (pCi/g)		Manganese-54 (pCi/g)		Radium-226 (pCi/g)		Strontium-90 (pCi/g)		Sodium-22 (pCi/g)		Zinc-65 (pCi/g)	
					Result	Q	Result	Q	Result	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q
811-SU-3-1	39987-001	7/31/2018	0.0-0.5	20,793	0.113	U	0.566	U-DL	0.0431	UI	50.5		0.00449	U-DL	0.170	J	0.0454	U	-0.023	U	0.0819	U	-0.00116	U	0.538	J	0.106	U	-0.00859	U	0.0122	U
811-SU-3-1R	40141-001	8/28/2018	0.0-0.5	NM	-0.0103	U	-0.091	U	0.0156	U	8.01		0.00977	U	0.0335	J-UI	-0.0176	U	0.00968	U	0.00933	U	0.0128	U	0.514	J	1.75	U	0.00358	U	-0.00789	U
811-SU-3-2	39987-002	7/31/2018	0.0-0.5	7,917	0.0766	U	-0.0179	U	0.0564	UI	0.0707	J	-0.00937	U	-0.00338	U	-0.0206	U	0.0163	U	0.0783	U	0.00697	U	0.597	J	-0.515	U	0.00337	U	0.000479	U
811-SU-3-3	39987-003	7/31/2018	0.0-0.5	8,041	-0.0367	U	0.0556	U	0.0817	UI	0.390	J	0.0115	U-DL	-0.0105	U	-0.0128	U	0.0284	U	0.128	J-UI	-0.0047	U	0.851	J	0.018	U	0.0116	U	-0.0169	U
811-SU-3-4	39987-004	7/31/2018	0.0-0.5	7,926	-0.0336	U	0.00169	U	0.0138	U	3.21		-0.00166	U	0.0167	U	-0.00831	U	-0.0152	U	0.0133	U	0.0137	U	0.505	J	-0.778	U	-0.00413	U	0.016	U
811-SU-3-5	39987-005	7/31/2018	0.0-0.5	6,534	0.176	J-UI	0.0679	U	0.040	UI	1.08	J	-0.00559	U	0.0115	U	-0.000755	U	0.0269	U	0.0899	J-UI	0.00561	U	0.535	J	0.154	U	0.00992	U	-0.015	U
811-SU-3-6	39987-007	7/31/2018	0.0-0.5	6,847	0.00547	U	-0.117	U-DL	0.0502	UI	2.95		-0.0123	U-DL	-0.00432	U	0.0217	U	0.00762	U	0.0185	U	0.0316	U	0.535	J	-0.507	U	-0.00341	U	-0.0186	U
811-SU-3-7	39987-008	7/31/2018	0.0-0.5	6,189	-0.0529	U	0.165	U	0.0485	UI	1.33	J	0.00491	U-DL	0.0221	U	-0.0457	U	0.011	U	0.0573	U	-0.00104	U	0.729	J	1.37	U	0.00428	U	0.0379	U
811-SU-3-8	39987-009	7/31/2018	0.0-0.5	6,016	0.218	U	0.0354	U	0.0146	U	1.68	J	0.0054	U	0.0149	U	-0.0331	U	0.000456	U	0.019	U	0.0136	U	0.422	J	0.0455	U	-0.000343	U	0.00408	U
811-SU-3-9	39987-010	7/31/2018	0.0-0.5	6,459	0.0155	U	-0.0941	U	0.0291	U	2.58		-0.00359	U	0.012	U	0.00096	U	0.0185	U	0.0257	U	0.00846	U	0.568	J	0.185	U	0.0067	U	-0.00391	U
811-SU-3-10	39987-011	7/31/2018	0.0-0.5	6,519	0.0105	U	0.0436	U	0.0146	U	1.10	J	0.00307	U	0.00209	U	0.0313	U	-0.0209	U	0.0615	U	0.0101	U	0.366	J	-0.515	U	-0.00696	U	-0.0183	U
811-SU-3-11	39987-013	7/31/2018	0.0-0.5	5,371	-0.00591	U	0.00978	U	0.0308	J-UI	0.180	J	-0.00342	U	-0.0055	U	0.00504	U	-0.00185	U	0.0117	U	0.0243	J-UI	0.322	J	0.710	U	-0.00113	U	0.0115	U
811-SU-3-12	39987-014	7/31/2018	0.0-0.5	5,612	-0.00611	U	0.0762	U	0.0451	UI	0.930	J	-0.000412	U	0.00456	U	0.00985	U	-0.00822	U	0.022	U	0.0244	J-UI	0.366	J	0.659	U	-0.00305	U	0.000666	U
811-SU-3-13	39987-015	7/31/2018	0.0-0.5	5,570	-0.00656	U	-0.0111	U	0.0069	U	0.303	J	-0.000236	U	-0.000785	U	-0.00446	U	-0.0115	U	0.0619	J-UI	0.0186	J-UI	0.461	J	-0.107	U	-0.00389	U	0.0061	U
811-SU-3-14	39987-016	7/31/2018	0.0-0.5	7,374	-0.0144	U	0.0367	U	0.0327	J-UI	0.856	J	0.00176	U	0.00705	U	0.00711	U	0.0176	U	0.0999	J-UI	0.0163	U	0.452	J	0.106	U	0.00661	U	0.0112	U
811-SU-3-15	39987-017	7/31/2018	0.0-0.5	9,631	-0.00869	U	0.252	U	0.0647	UI	3.80		0.00522	U	0.0366	J	-0.0231	U	-0.0103	U	0.144	J-UI	0.00758	U	0.722	J	0.442	U	-0.00348	U	0.0239	U
811-SU-3-16	39987-019	7/31/2018	0.0-0.5	13,890	0.113	J-UI	-0.0336	U-DL	0.0329	J-UI	10.4		0.0034	U	0.00575	U	-0.0153	U	-0.00112	U	0.0423	U	0.00408	U	0.590	J	-0.293	U	-0.000296	U	-0.00627	U
811-SU-3-17	39987-020	7/31/2018	0.0-0.5	7,890	-0.0167	U	-0.000365	U	0.032	J-UI	3.19		0.0015	U	0.00141	U	0.007	U	0.00642	U	0.0592	J-UI	0.0103	U	0.722	J	-0.0823	U	0.00201	U	0.0101	U
811-SU-3-18	39987-021	7/31/2018	0.0-0.5	6,743	0.0559	J-UI	-0.0403	U	0.0251	U-DL	0.717	J	0.024	UI	0.00652	U	-0.0161	U	-0.00506	U	0.151	J-UI	0.0243	U	0.492	J	-0.0602	U	-0.00178	U	-0.0292	U
811-SU-3-19	39987-022	7/31/2018	0.0-0.5	6,851	0.0293	U	0.361		0.0579	UI	0.822	J	-0.00358	U-DL	0.00339	U	-0.00457	U	-0.035	U	0.126	J-UI	0.0201	U	0.511	J	0.776	U	-0.0135	U	-0.00522	U
811-SU-3-20	39987-023	7/31/2018	0.0-0.5	7,233	0.131	U	0.0865	U	0.0268	U	0.398	J	-0.000594	U	-0.00269	U	0.0152	U	-0.0317	U	0.0246	U	0.00104	U	0.522	J	-0.0339	U	-0.0111	U	-0.00661	U

Notes:

DL - Failed required detection limit.

J - Value is estimated; the result was greater than the MDA but less than the required detection limit

NM-Not Measured

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

pCi/g - Picocuries per gram

Former Building 811 Soil Remediation Table D-2: Survey Unit 3 - Surface Soil Composite Sample Results (COC# 39987)														
Sample Name	Sample ID	Sample Date	Sample Depth from Excavation Grade (ft)	One Minute Fixed Gamma Count Rate Uncollimated (CPM)	Plutonium-238 (pCi/g)		Plutonium 239/240 (pCi/g)		Uranium-235/236 (pCi/g)		Uranium-238 (pCi/g)		Tritium (pCi/g)	
					Result	Q	Result	Q	Result	Q	Results	Q	Results	Q
Composite 1	39987-006	7/31/2018	0.0-0.5	NM	-0.0819	U	0.137	U	0.00	U	0.444	J	-30.1	U
Composite 2	39987-012	7/31/2018	0.0-0.5	NM	0.169	U	0.232	U	-0.0488	U	-0.0132	U	-42.3	U
Composite 3	39987-018	7/31/2018	0.0-0.5	NM	0.442	U	-0.0483	U	0.0765	U	0.498	U	-33.1	U
Composite 4	39987-024	7/31/2018	0.0-0.5	NM	0.552	U	0.376	U	0.044	U	1.11		-95.3	U

Notes:

DL - Failed required detection limit.

J - Value is estimated; the result was greater than the MDA but less than the required detection limit

NM - Not Measured

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

pCi/g - Picocuries per gram

Former Building 811 Soil Remediation Table D-3: Survey Unit 3 - Modified Investigation Level for Soil Composite Samples				
Contaminant	**DCGLw (pCi/g)**	**MDC (pCi/g)**	**MIL (pCi/g)**	**Ratio of MDC to MIL**
Tritium	1010	262	452	0.58
Uranium-235	4.6	0.56	2.1	0.27
Uranium-238	4.7	0.75	2.1	0.36
Plutonium-238	57	0.85	26	0.03
Plutonium-239/240	35	0.89	16	0.06

Notes:

DCGL - Derived Concentration Guidance Level

MDL - Minimum Detectable Concentration

MIL - Modified Investigation Level

NR-Not Reported

pCi/g - Picocuries per gram

Former Building 811 Soil Remediation

Table D-4: Survey Unit 3 - Core Sample Results (COC# 39984)

Sample Name	Sample ID	Sample Date	Sample Depth from Excavation Grade (ft)	Americium-241 (pCi/g)		Beryllium-7 (pCi/g)		Cesium-134 (pCi/g)		Cesium-137 (pCi/g)		Cobalt-57 (pCi/g)		Cobalt-60 (pCi/g)		Europium-152 (pCi/g)		Europium-154 (pCi/g)		Europium-155 (pCi/g)		Manganese-54 (pCi/g)		Plutonium-238 (pCi/g)		Plutonium-239/240 (pCi/g)		Radium-226 (pCi/g)		Strontium-90 (pCi/g)		Sodium-22 (pCi/g)		Tritium (pCi/g)		Uranium-235/236 (pCi/g)		Uranium-238 (pCi/g)		Zinc-65 (pCi/g)	
				Result	Q	Result	Q	Result	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q
811-GP-01-2018	39984-001	7/31/2018	0.0-2.0	-0.00148	U	-0.0779	U	0.0594	UI	0.00376	U	0.00347	U	0.000262	U	0.0266	U	0.0194	U	0.00544	U	0.0138	U	NA		NA		0.634	J	0.019	U	0.00637	U	NA		NA		NA		-0.00434	U
811-GP-01-2018	39984-002	7/31/2018	2.0-4.0	0.0472	U	0.0495	U	0.022	U	0.00315	U	-0.00319	U	0.00502	U	-0.00167	U	-0.00145	U	0.0194	U	0.012	U	NA		NA		0.487	J	0.833	U	-0.00083	U	NA		NA		NA		-0.00155	U
811-GP-01-2018	39984-003	7/31/2018	4.0-6.0	0.000401	U	-0.00868	U	0.0167	U	-0.00504	U	-0.000623	U	0.00108	U	0.00233	U	0.017	U	0.0288	U	0.0185	J-UI	NA		NA		0.383	J	-0.115	U	0.00374	U	NA		NA		NA		0.0288	U
811-GP-01-2018	39984-004	7/31/2018	6.0-8.0	0.0584	U	-0.0574	U	0.033	J-UI	0.0241	J-UI	-0.00331	U	0.0425	J	0.00147	U	-0.0214	U	0.0255	U	0.0198	J-UI	NA		NA		0.321	J	-0.0625	U	-0.00735	U	NA		NA		NA		0.00836	U
811-GP-02-2018	39984-005	7/31/2018	0.0-2.0	0.171	J-UI	-0.00837	U	0.0662	UI	0.145	J	-0.00316	U	0.00579	U	-0.0143	U	-0.0527	U	0.0539	U	0.0266	J-UI	NA		NA		0.710	J	0.178	U	-0.0187	U	NA		NA		NA		-0.00481	U
811-GP-02-2018	39984-006	7/31/2018	2.0-4.0	0.000751	U	-0.0259	U	0.0478	UI	0.0131	U	-0.000369	U	-0.00515	U	-0.0311	U	0.0019	U	0.0732	J-UI	0.00581	U	NA		NA		0.468	J	-0.159	U	-0.002	U	NA		NA		NA		-0.0173	U
811-GP-02-2018	39984-007	7/31/2018	4.0-6.0	-0.0219	U	-0.0195	U	0.0349	J-UI	0.283	J	-0.00691	U	-0.00226	U	-0.0252	U	0.0186	U	0.0314	U	0.00787	U	NA		NA		0.478	J	-0.156	U	0.00627	U	NA		NA		NA		0.0128	U
811-GP-02-2018	39984-008	7/31/2018	6.0-8.0	-0.00677	U	0.129	U	0.0232	U	0.00636	U	0.00168	U	0.00453	U	-0.0053	U	0.0219	U	0.00627	U	-0.00647	U	NA		NA		0.353	J	0.612	U	0.00828	U	NA		NA		NA		0.011	U
811-GP-03-2018	39984-009	7/31/2018	0.0-2.0	-0.0281	U	-0.0767	U-DL	0.0563	UI	15.5		0.00153	U	-0.00173	U	0.00378	U	0.00426	U	0.0445	U	0.0108	U	-0.108	U	0.0206	U	0.500	J	0.428	U	0.00135	U	20.6	U	0.552	J	0.560	U	-0.0018	U
811-GP-03-2018	39984-010	7/31/2018	2.0-4.0	-0.0159	U	0.0144	U	0.0313	J-UI	0.00913	U	-0.000609	U	0.00459	U	-0.0047	U	0.00899	U	0.0238	U	0.0177	J-UI	NA		NA		0.379	J	-0.778	U	0.00316	U	NA		NA		NA		-0.0111	U
811-GP-03-2018	39984-011	7/31/2018	4.0-6.0	0.0171	U	0.0328	U	0.0232	J-UI	0.137	J	0.00126	U	0.00226	U	-0.00805	U	-0.0092	U	0.0576	U	0.000425	U	NA		NA		0.417	J	-0.201	U	-0.00538	U	NA		NA		NA		0.0165	U
811-GP-03-2018	39984-012	7/31/2018	6.0-8.0	-0.00938	U	0.0148	U	0.0117	U	-0.000652	U	0.00018	U	-0.00105	U	0.00208	U	0.00309	U	0.0198	U	0.00941	U	NA		NA		0.334	J	0.234	U	0.00075	U	NA		NA		NA		0.0116	U

Notes:

DL - Failed required detection limit.

J - Value is estimated; the result was greater than the MDA but less than the required detection limit

NA-Not Analyzed

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

pCi/g - Picocuries per gram

Former Building 811 Soil Remediation Table E-1: Survey Unit 3 - Waste Characterization Metal Results (COC# 40085)																		
Sample ID	Sample Name	Sample Date	Mercury (ug/L)		Arsenic (ug/L)		Barium (ug/L)		Cadmium (ug/L)		Chromium (ug/L)		Lead (ug/L)		Selenium (ug/L)		Silver (ug/L)	
			Result	Q	Result	Q	Result	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q
456413001	40085-001	7/25/18	2.00	U	300	U	272		50.0	U	50.0	U	100	U	115	J	250	U

Notes:

DL - Failed required detection limit.

J - Value is estimated; the result was greater than the MDA but less than the required detection limit

NA-Not Analyzed

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

Former Building 811 Soil Remediation

Table E-2: Survey Unit 3 - Waste Characterization Radiological Results (COC# 40085)

Sample ID	Sample Name	Sample Date	Americium-241 (pCi/g)		Beryllium-7 (pCi/g)		Cesium-134 (pCi/g)		Cesium-137 (pCi/g)		Cobalt-57 (pCi/g)		Cobalt-60 (pCi/g)		Europium-152 (pCi/g)		Europium-154 (pCi/g)		Europium-155 (pCi/g)		Manganese-54 (pCi/g)		Plutonium-238 (pCi/g)		Plutonium-239/240 (pCi/g)		Radium-226 (pCi/g)		Strontium-90 (pCi/g)		Sodium-22 (pCi/g)		Tritium (pCi/g)		Uranium-235/236 (pCi/g)		Uranium-238 (pCi/g)		Zinc-65 (pCi/g)	
			Result	Q	Result	Q	Result	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q
456413001	40085-001	7/25/18	0.02	U	0.08	U-DL	0.0443	UI	8.320		-0.0082	U	0.0215	U	-0.00707	U	-0.0063	U	0.0675	U	0.000224	U	0.368	U	0.158	U	NA		0.0087	U	-0.00202	U	NA		0.428	U	0.949		0.0142	U

Notes:

DL - Failed required detection limit.

J - Value is estimated; the result was greater than the MDA but less than the required detection limit

NA-Not Analyzed

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

pCi/g - Picocuries per gram

Former Building 811 Soil Remediation

Table G-1: Survey Unit 3 - QA/QC Sample Results (COC# 39984/39987)

Sample ID	Sample Name	Sample Date	QA/QC Type	Americium-241 (pCi/g)		Beryllium-7 (pCi/g)		Cesium-134 (pCi/g)		Cesium-137 (pCi/g)		Cobalt-57 (pCi/g)		Cobalt-60 (pCi/g)		Europium-152 (pCi/g)		Europium-154 (pCi/g)		Europium-155 (pCi/g)		Manganese-54 (pCi/g)		Plutonium-238 (pCi/g)		Plutonium-239/240 (pCi/g)		Radium-226 (pCi/g)		Strontium-90 (pCi/g)		Sodium-22 (pCi/g)		Tritium (pCi/g)		Uranium-235/236 (pCi/g)		Uranium-238 (pCi/g)		Zinc-65 (pCi/g)	
				Result	Q	Result	Q	Result	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q	Results	Q
39987-025	BD-1	7/31/18	Blind Duplicate	-0.011	U	-0.0438	U	0.274	U	0.103	J	-0.0027	U	-0.00802	U	-0.0134	U	0.0188	U	0.0105	U	0.0032	U	NA		NA		0.276	J	-0.276	U	0.0066	U	NA		NA		NA		-0.0027	U
39987-026	EB-1	7/31/18	Equipment Blank	-3.36	U	-2.93	U	-0.795	U	-0.492	U	0.113	U	0.511	U	0.287	U	-1.72	U	2.18	U	0.564	U	0.0161	U	-0.101	U	0.0798	U	0.207	U	-0.619	U	7.13	U	-0.0751	U	0.0439	U	-0.351	U
39984-013	BD-1	7/31/18	Blind Duplicate	0.0141	U	-0.019	U	0.019	J-UI	-0.0022	U	-0.0036	U	0.00493	U	-0.0058	U	0.0253	U	0.0392	U	0.0031	U	0.215	U	0.160	U	0.299	J	-0.0128	U	0.0088	U	NA		0.167	U	0.338	U	-0.0157	U
39984-014	EB-1	7/31/18	Equipment Blank	-8.72	U	1.35	U	1.27	U	0.177	U	-0.346	U	-1.45	U	-2.9	U	2.26	U	-1.45	U	-0.013	U	0.582	U	-0.0171	U	0.435	J	-0.268	U	0.795	U	146	U	0.110	U	0.0464	U	-2.2	U

Notes:

DL - Failed required detection limit.

J - Value is estimated; the result was greater than the MDA but less than the required detection limit

NA-Not Analyzed

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

Q- Qualifier

U - Analyte was analyzed for, but not detected above the MDA.

UI - Uncertain identification for gamma spectroscopy.

pCi/g - Picocuries per gram

APPENDIX A

Page 1 of 2

BROOKHAVEN NATIONAL LABORATORY

P.O. # _____

Chain of Custody No. 39987

Requires EDD ☑

SAMPLING CHAIN OF CUSTODY 456288

Analysis Requested By	Sampling Contractor	Analytical Laboratory
Name: W. Dorsch	Name: EPD Field Sampling Team	Name: GEL
Life No: 21133 Ext. 5186	Contact: R. Lagattolla	Address: 2040 Savage Rd.
Acct. No: 20802/23139 Dept: ES	Phone: 631 344 7129	City: Charleston St: SC Zip: 29407
Email Reports To:	Email/Fax: rlagattolla@bnl.gov	Contact: E. Kent
1 W. Dorsch	Sampler: R. Metz, J. Milligan	Phone: 843-556-8171
2 B. Howe		Email/Fax:
Project Name:	Project Manager:	Field Engineer:
811LYB	W. Dorsch	R. Lagattolla

Comments: SPDES TAT for EDD Please Provide all analysis possible 14 TAT Ra226 OK to report late

Type			Sample Information					Additional Sample Information					Analysis Requested										
UID	Smp	Coll	Site ID/Bldg/Life #	Depth/RWP	Date	Time	Matrix	Name/Description	Cont. Vol./Units	Cont. Type	# of Cont.	Preservative	Alpha/Beta	Tritium	Gamma Remediation RA 326	Strontium 90	524.2	624	Nuclide-specific Alpha	PCBs	Metals	U 235/238	Pu 238/239/240
001	E	G	811-SU-3-1	0.0-0.5	7/31/18	0945	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
002	E	G	811-SU-3-2	0.0-0.5		0947	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
003	E	G	811-SU-3-3	0.0-0.5		0949	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
004	E	G	811-SU-3-4	0.0-0.5		0951	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
005	E	G	811-SU-3-5	0.0-0.5		0953	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
006	E	C	Composite 1	0.0-0.5		0955	S	Composite 1 (SU-3-1, 2, 3, 4, 5)	16oz	P	1	----		X								X	X
007	E	G	811-SU-3-6	0.0-0.5		1000	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
008	E	G	811-SU-3-7	0.0-0.5		1002	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
009	E	G	811-SU-3-8	0.0-0.5		1004	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
010	E	G	811-SU-3-9	0.0-0.5		1006	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
011	E	G	811-SU-3-10	0.0-0.5		1008	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
012	E	C	Composite 2	0.0-0.5		1010	S	Composite 2 (SU-3-6, 7, 8, 9, 10)	16oz	P	1	----		X								X	X
013	E	G	811-SU-3-11	0.0-0.5		1100	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
014	E	G	811-SU-3-12	0.0-0.5		1102	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							

1 Relinquished By/Date/Time	2 Relinquished By/Date/Time	3 Relinquished By/Date/Time
Print R. Metz 8/1/18	Print	Print
Signature Robert Metz 1330	Signature	Signature
1 Received By/Date/Time	2 Received By/Date/Time	3 Received By/Date/Time
Print C Tarplin 8/2/18	Print	Print
Signature 855	Signature	Signature

Contractor Lab Sample Disposal:
☐ Return To Client ☑ Disposal by Lab
☐ Archive For _____ Months

Data Package: ☑ Full ☐ Summary

Turn-Around Time Required:
☐ Rush (1 Day) ☑ 14 Days ☐ 30 Days
☐ 7 Days ☐ Other ( )

BNL F 3101F (rev. 6/13)

Distribution WHITE (1) - Stays with Sample YELLOW (2) - Returned to Client with Report PINK (3) - Lab or Other GOLDENROD (4) - Field Copy - (Sampler)

Page 2 of 2

BROOKHAVEN NATIONAL LABORATORY

P.O. # _____

Chain of Custody No. 39987

Requires EDD ☑

SAMPLING CHAIN OF CUSTODY 456288

Analysis Requested By	Sampling Contractor	Analytical Laboratory
Name: W. Dorsch	Name: EPD Field Sampling Team	Name: GEL
Life No: 21133 Ext: 5186	Contact: R. Lagattolla	Address: 2040 Savage Rd.
Acct. No: 20802/23139 Dept: ES	Phone: 631 344 7129	City: Charleston St: SC Zip: 29407
Email Reports To:	Email/Fax: rlagattolla@bnl.gov	Contact: E. Kent
W. Dorsch	Sampler: R. Metz, J. Milligan	Phone: 843-556-8171
2B. Howe		Email/Fax:
Project Name:	Project Manager:	Field Engineer:
811LYB	W. Dorsch	R. Lagattolla

Comments: SPDES TAT for EDD Please provide all analysis possible w/ 14DT, Ra 226 O.K. To Report Late

Type			Sample Information					Additional Sample Information					Analysis Requested										
UID	Smp	Coll	Site ID/Bldg/Life #	Depth/RWP	Date	Time	Matrix	Name/Description	Cont. Vol/Units	Cont. Type	# of Cont.	Preservative	Alpha/Beta	Tritium	Gamma Remediation Ra 226	Strontium 90	524.2	624	Nuclide-specific Alpha	PCBs	Metals	U 235/238	Pu 238/239/240
015	E	G	811-SU-3-13	0.0-0.5	7/31/18	1104	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
016	E	G	811-SU-3-14	0.0-0.5		1106	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
017	E	G	811-SU-3-15	0.0-0.5		1108	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
018	E	C	Composite 3	0.0-0.5		1110	S	Composite 3 (SU-3-11, 12, 13, 14, 15)	16oz	P	1	----		X								X	X
019	E	G	811-SU-3-16	0.0-0.5		1112	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
020	E	G	811-SU-3-17	0.0-0.5		1114	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
021	E	G	811-SU-3-18	0.0-0.5		1116	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
022	E	G	811-SU-3-19	0.0-0.5		1118	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
023	E	G	811-SU-3-20	0.0-0.5		1120	S	Bldg. 811 soil grab	16oz	P	1	----			X	X							
024	E	C	Composite 4	0.0-0.5		1122	S	Composite 4 (SU-3-16, 17, 18, 19, 20)	16oz	P	1	----		X								X	X
025	E	G	BD-1	0		0000	s	Blind Duplicate	16oz	P	1	----			X	X							
026	E	G	EB-1	0		0730	w	Equipment Blank	4L	P	1	HNO3			X	X						X	X
026	E	G	EB-1	0	↓	↓	w	Equipment Blank	250ml	AG	1	----		X									

1 Relinquished By/Date/Time	2 Relinquished By/Date/Time	3 Relinquished By/Date/Time
Print R. Metz 8/1/18	Print	Print
Signature [signature] 1330	Signature	Signature
1 Received By/Date/Time	2 Received By/Date/Time	3 Received By/Date/Time
Print C Tarplin 8/2/18	Print	Print
Signature [signature] 855	Signature	Signature

Contractor Lab Sample Disposal:
☐ Return To Client ☑ Disposal by Lab
☐ Archive For ____ Months

Data Package: ☑ Full ☐ Summary

Turn-Around Time Required:
☐ Rush (1 Day) ☑ 14 Days ☐ 30 Days
☐ 7 Days ☐ Other ( )

BNL F 3101F (rev. 6/13)

Distribution WHITE (1) - Stays with Sample YELLOW (2) - Returned to Client with Report PINK (3) - Lab or Other GOLDENROD (4) - Field Copy - (Sampler)

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-001	Project:	BRKL00700
Sample ID:	456288001	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 09:45	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-1
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.538	+/-0.292	0.257	1.00	pCi/g			MXR1	08/24/18	0949	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.113	+/-0.210	0.395	4.00	pCi/g			RXF2	08/09/18	1058	1788713	2
Beryllium-7	U-DL	0.566	+/-0.607	0.977	0.300	pCi/g							
Cesium-134	UI	0.0431	+/-0.0358	0.0404	0.040	pCi/g							
Cesium-137		50.5	+/-0.411	0.0626	2.30	pCi/g							
Cobalt-57	U-DL	0.00449	+/-0.0262	0.0466	0.020	pCi/g							
Cobalt-60	J	0.170	+/-0.0358	0.0302	0.300	pCi/g							
Europium-152	U	0.0454	+/-0.135	0.246	4.80	pCi/g							
Europium-154	U	-0.023	+/-0.0518	0.0916	17.0	pCi/g							
Europium-155	U	0.0819	+/-0.103	0.187	0.300	pCi/g							
Manganese-54	U	-0.00116	+/-0.0172	0.0324	0.050	pCi/g							
Sodium-22	U	-0.00859	+/-0.0182	0.032	0.050	pCi/g							
Zinc-65	U	0.0122	+/-0.0473	0.0796	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.106	+/-0.637	1.17	2.00	pCi/g			KSD1	08/08/18	0910	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			95.5	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-001	Project:	BRKL00700
Sample ID:	456288001	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-1
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-002	Project:	BRKL00700
Sample ID:	456288002	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 09:47	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-2
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.597	+/-0.154	0.101	1.00	pCi/g			MXR1	08/24/18	0949	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0766	+/-0.0871	0.155	4.00	pCi/g			RXF2	08/09/18	1102	1788713	2
Beryllium-7	U	-0.0179	+/-0.141	0.232	0.300	pCi/g							
Cesium-134	UI	0.0564	+/-0.0275	0.0376	0.040	pCi/g							
Cesium-137	J	0.0707	+/-0.0358	0.0328	2.30	pCi/g							
Cobalt-57	U	-0.00937	+/-0.0104	0.0199	0.020	pCi/g							
Cobalt-60	U	-0.00338	+/-0.0194	0.0317	0.300	pCi/g							
Europium-152	U	-0.0206	+/-0.0392	0.0717	4.80	pCi/g							
Europium-154	U	0.0163	+/-0.0473	0.094	17.0	pCi/g							
Europium-155	U	0.0783	+/-0.0534	0.0946	0.300	pCi/g							
Manganese-54	U	0.00697	+/-0.0147	0.028	0.050	pCi/g							
Sodium-22	U	0.00337	+/-0.0168	0.0329	0.050	pCi/g							
Zinc-65	U	0.000479	+/-0.0341	0.0586	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.515	+/-0.367	0.826	2.00	pCi/g			KSD1	08/08/18	0739	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			90.7	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-002
Sample ID: 456288002

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-2
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-003	Project:	BRKL00700
Sample ID:	456288003	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 09:49	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-3
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.851	+/-0.166	0.0931	1.00	pCi/g			MXR1	08/24/18	0950	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0367	+/-0.117	0.198	4.00	pCi/g			RXF2	08/09/18	1103	1788713	2
Beryllium-7	U	0.0556	+/-0.140	0.260	0.300	pCi/g							
Cesium-134	UI	0.0817	+/-0.0343	0.0444	0.040	pCi/g							
Cesium-137	J	0.390	+/-0.0534	0.0357	2.30	pCi/g							
Cobalt-57	U-DL	0.0115	+/-0.0118	0.0218	0.020	pCi/g							
Cobalt-60	U	-0.0105	+/-0.0162	0.0274	0.300	pCi/g							
Europium-152	U	-0.0128	+/-0.0443	0.0805	4.80	pCi/g							
Europium-154	U	0.0284	+/-0.0455	0.0904	17.0	pCi/g							
Europium-155	J-UI	0.128	+/-0.107	0.0881	0.300	pCi/g							
Manganese-54	U	-0.0047	+/-0.020	0.032	0.050	pCi/g							
Sodium-22	U	0.0116	+/-0.0156	0.0316	0.050	pCi/g							
Zinc-65	U	-0.0169	+/-0.0389	0.0591	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.018	+/-0.713	1.37	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			85.9	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-003
Sample ID: 456288003

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-3
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-004	Project:	BRKL00700
Sample ID:	456288004	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 09:51	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-4
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.505	+/-0.231	0.141	1.00	pCi/g			MXR1	08/24/18	0950	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0336	+/-0.0557	0.104	4.00	pCi/g			RXF2	08/09/18	1103	1788713	2
Beryllium-7	U	0.00169	+/-0.158	0.284	0.300	pCi/g							
Cesium-134	U	0.0138	+/-0.0256	0.031	0.040	pCi/g							
Cesium-137		3.21	+/-0.089	0.0277	2.30	pCi/g							
Cobalt-57	U	-0.00166	+/-0.00953	0.0159	0.020	pCi/g							
Cobalt-60	U	0.0167	+/-0.0188	0.0334	0.300	pCi/g							
Europium-152	U	-0.00831	+/-0.040	0.0735	4.80	pCi/g							
Europium-154	U	-0.0152	+/-0.0427	0.0757	17.0	pCi/g							
Europium-155	U	0.0133	+/-0.0359	0.0666	0.300	pCi/g							
Manganese-54	U	0.0137	+/-0.0203	0.0235	0.050	pCi/g							
Sodium-22	U	-0.00413	+/-0.0152	0.0271	0.050	pCi/g							
Zinc-65	U	0.016	+/-0.0283	0.0504	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.778	+/-0.750	1.50	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			83.5	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-004	Project:	BRKL00700
Sample ID:	456288004	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-4
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-005	Project:	BRKL00700
Sample ID:	456288005	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 09:53	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-5
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.535	+/-0.165	0.133	1.00	pCi/g			MXR1	08/24/18	0955	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	J-UI	0.176	+/-0.120	0.0912	4.00	pCi/g			RXF2	08/09/18	1104	1788713	2
Beryllium-7	U	0.0679	+/-0.157	0.290	0.300	pCi/g							
Cesium-134	UI	0.040	+/-0.0329	0.0396	0.040	pCi/g							
Cesium-137	J	1.08	+/-0.0722	0.0319	2.30	pCi/g							
Cobalt-57	U	-0.00559	+/-0.0105	0.0182	0.020	pCi/g							
Cobalt-60	U	0.0115	+/-0.0184	0.0364	0.300	pCi/g							
Europium-152	U	-0.000755	+/-0.0428	0.0788	4.80	pCi/g							
Europium-154	U	0.0269	+/-0.0554	0.107	17.0	pCi/g							
Europium-155	J-UI	0.0899	+/-0.0784	0.0728	0.300	pCi/g							
Manganese-54	U	0.00561	+/-0.0149	0.0291	0.050	pCi/g							
Sodium-22	U	0.00992	+/-0.0196	0.0378	0.050	pCi/g							
Zinc-65	U	-0.015	+/-0.0394	0.0605	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.154	+/-0.461	0.856	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			93.1	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-005
Sample ID: 456288005

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-5
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-006	Project:	BRKL00700
Sample ID:	456288006	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 09:55	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	Composite 1
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Solid "Dry Weight Corrected"													
Plutonium-238	U	-0.0819	+/-0.293	0.599	6.60	pCi/g			BXA4	08/06/18	2248	1788987	1
Plutonium-239/240	U	0.137	+/-0.200	0.325	4.00	pCi/g							
Alphaspec U-235, U-238 "Dry Weight Corrected"													
Uranium-235/236	U	0.00	+/-0.192	0.286	0.900	pCi/g			BXA4	08/07/18	0856	1788988	2
Uranium-238	J	0.444	+/-0.403	0.370	0.900	pCi/g							
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Solid "As Received"													
Tritium	U	-30.1	+/-105	196	500	pCi/g			MXH8	08/06/18	1124	1788846	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	EPA 906.0 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-236 Tracer	Alphaspec Pu, Solid "Dry Weight Corrected"			89.9	(15%-125%)
Uranium-232 Tracer	Alphaspec U-235, U-238 "Dry Weight Corrected"			81.1	(15%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-007	Project:	BRKL00700
Sample ID:	456288007	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 10:00	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-6
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.535	+/-0.168	0.154	1.00	pCi/g			MXR1	08/24/18	0956	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.00547	+/-0.134	0.252	4.00	pCi/g			RXF2	08/09/18	1104	1788713	2
Beryllium-7	U-DL	-0.117	+/-0.198	0.345	0.300	pCi/g							
Cesium-134	UI	0.0502	+/-0.0321	0.050	0.040	pCi/g							
Cesium-137		2.95	+/-0.108	0.038	2.30	pCi/g							
Cobalt-57	U-DL	-0.0123	+/-0.0135	0.0231	0.020	pCi/g							
Cobalt-60	U	-0.00432	+/-0.019	0.0347	0.300	pCi/g							
Europium-152	U	0.0217	+/-0.0568	0.107	4.80	pCi/g							
Europium-154	U	0.00762	+/-0.0595	0.112	17.0	pCi/g							
Europium-155	U	0.0185	+/-0.0574	0.105	0.300	pCi/g							
Manganese-54	U	0.0316	+/-0.0281	0.0347	0.050	pCi/g							
Sodium-22	U	-0.00341	+/-0.0219	0.0399	0.050	pCi/g							
Zinc-65	U	-0.0186	+/-0.0482	0.0747	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.507	+/-0.638	1.33	2.00	pCi/g			KSD1	08/10/18	0649	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			78.8	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-007
Sample ID: 456288007

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-6
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-008	Project:	BRKL00700
Sample ID:	456288008	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 10:02	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-7
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.729	+/-0.170	0.108	1.00	pCi/g			MXR1	08/24/18	1046	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0529	+/-0.0685	0.110	4.00	pCi/g			RXF2	08/09/18	1105	1788713	2
Beryllium-7	U	0.165	+/-0.154	0.292	0.300	pCi/g							
Cesium-134	UI	0.0485	+/-0.0216	0.0375	0.040	pCi/g							
Cesium-137	J	1.33	+/-0.0778	0.0288	2.30	pCi/g							
Cobalt-57	U-DL	0.00491	+/-0.0104	0.0204	0.020	pCi/g							
Cobalt-60	U	0.0221	+/-0.0161	0.0336	0.300	pCi/g							
Europium-152	U	-0.0457	+/-0.0489	0.0805	4.80	pCi/g							
Europium-154	U	0.011	+/-0.0518	0.0868	17.0	pCi/g							
Europium-155	U	0.0573	+/-0.0761	0.079	0.300	pCi/g							
Manganese-54	U	-0.00104	+/-0.0158	0.0294	0.050	pCi/g							
Sodium-22	U	0.00428	+/-0.0183	0.0307	0.050	pCi/g							
Zinc-65	U	0.0379	+/-0.0342	0.0643	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	1.37	+/-0.911	1.40	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			103	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-008
Sample ID: 456288008

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-7
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-009	Project:	BRKL00700
Sample ID:	456288009	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 10:04	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-8
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.422	+/-0.142	0.126	1.00	pCi/g			MXR1	08/24/18	1048	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0218	+/-0.071	0.135	4.00	pCi/g			RXF2	08/09/18	1105	1788713	2
Beryllium-7	U	0.0354	+/-0.155	0.290	0.300	pCi/g							
Cesium-134	U	0.0146	+/-0.0347	0.0321	0.040	pCi/g							
Cesium-137	J	1.68	+/-0.0814	0.0302	2.30	pCi/g							
Cobalt-57	U	0.0054	+/-0.00962	0.0186	0.020	pCi/g							
Cobalt-60	U	0.0149	+/-0.0178	0.0367	0.300	pCi/g							
Europium-152	U	-0.0331	+/-0.0421	0.0763	4.80	pCi/g							
Europium-154	U	0.000456	+/-0.0567	0.104	17.0	pCi/g							
Europium-155	U	0.019	+/-0.0374	0.0732	0.300	pCi/g							
Manganese-54	U	0.0136	+/-0.0149	0.0308	0.050	pCi/g							
Sodium-22	U	-0.000343	+/-0.0199	0.0362	0.050	pCi/g							
Zinc-65	U	0.00408	+/-0.0413	0.0686	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.0455	+/-0.669	1.27	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			95.5	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-009	Project:	BRKL00700
Sample ID:	456288009	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-8
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-010	Project:	BRKL00700
Sample ID:	456288010	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 10:06	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-9
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.568	+/-0.136	0.109	1.00	pCi/g			MXR1	08/24/18	1048	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0155	+/-0.0401	0.0699	4.00	pCi/g			RXF2	08/09/18	1105	1788713	2
Beryllium-7	U	-0.0941	+/-0.145	0.250	0.300	pCi/g							
Cesium-134	U	0.0291	+/-0.0172	0.031	0.040	pCi/g							
Cesium-137		2.58	+/-0.0874	0.0281	2.30	pCi/g							
Cobalt-57	U	-0.00359	+/-0.00962	0.0168	0.020	pCi/g							
Cobalt-60	U	0.012	+/-0.0144	0.0267	0.300	pCi/g							
Europium-152	U	0.00096	+/-0.0416	0.0762	4.80	pCi/g							
Europium-154	U	0.0185	+/-0.0413	0.0793	17.0	pCi/g							
Europium-155	U	0.0257	+/-0.0393	0.0721	0.300	pCi/g							
Manganese-54	U	0.00846	+/-0.0138	0.0245	0.050	pCi/g							
Sodium-22	U	0.0067	+/-0.0145	0.028	0.050	pCi/g							
Zinc-65	U	-0.00391	+/-0.0322	0.0512	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.185	+/-0.595	1.09	2.00	pCi/g			KSD1	08/08/18	0739	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			97.9	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-010	Project:	BRKL00700
Sample ID:	456288010	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-9
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-011	Project:	BRKL00700
Sample ID:	456288011	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 10:08	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-10
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.366	+/-0.191	0.0936	1.00	pCi/g			MXR1	08/24/18	1049	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0105	+/-0.0644	0.116	4.00	pCi/g			RXF2	08/09/18	1106	1788713	2
Beryllium-7	U	0.0436	+/-0.129	0.244	0.300	pCi/g							
Cesium-134	U	0.0146	+/-0.0166	0.032	0.040	pCi/g							
Cesium-137	J	1.10	+/-0.0661	0.0279	2.30	pCi/g							
Cobalt-57	U	0.00307	+/-0.00954	0.0178	0.020	pCi/g							
Cobalt-60	U	0.00209	+/-0.0154	0.0294	0.300	pCi/g							
Europium-152	U	0.0313	+/-0.0375	0.074	4.80	pCi/g							
Europium-154	U	-0.0209	+/-0.0371	0.0657	17.0	pCi/g							
Europium-155	U	0.0615	+/-0.0921	0.0665	0.300	pCi/g							
Manganese-54	U	0.0101	+/-0.0152	0.0287	0.050	pCi/g							
Sodium-22	U	-0.00696	+/-0.0131	0.0233	0.050	pCi/g							
Zinc-65	U	-0.0183	+/-0.0359	0.0555	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.515	+/-0.581	1.29	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			93.1	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-011
Sample ID: 456288011

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-10
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-012	Project:	BRKL00700
Sample ID:	456288012	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 10:10	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	Composite 2
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Solid "Dry Weight Corrected"													
Plutonium-238	U	0.169	+/-0.216	0.299	6.60	pCi/g			BXA4	08/06/18	2248	1788987	1
Plutonium-239/240	U	0.232	+/-0.269	0.399	4.00	pCi/g							
Alphaspec U-235, U-238 "Dry Weight Corrected"													
Uranium-235/236	U	-0.0488	+/-0.216	0.563	0.900	pCi/g			BXA4	08/07/18	0857	1788988	2
Uranium-238	U	-0.0132	+/-0.305	0.689	0.900	pCi/g							
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Solid "As Received"													
Tritium	U	-42.3	+/-140	262	500	pCi/g			MXH8	08/06/18	1140	1788846	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	EPA 906.0 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-236 Tracer	Alphaspec Pu, Solid "Dry Weight Corrected"			79	(15%-125%)
Uranium-232 Tracer	Alphaspec U-235, U-238 "Dry Weight Corrected"			86.1	(15%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-013	Project:	BRKL00700
Sample ID:	456288013	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:00	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-11
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.322	+/-0.151	0.0847	1.00	pCi/g			MXR1	08/24/18	1051	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00591	+/-0.0433	0.0781	4.00	pCi/g			RXF2	08/09/18	1106	1788713	2
Beryllium-7	U	0.00978	+/-0.0777	0.152	0.300	pCi/g							
Cesium-134	J-UI	0.0308	+/-0.0225	0.0234	0.040	pCi/g							
Cesium-137	J	0.180	+/-0.0294	0.022	2.30	pCi/g							
Cobalt-57	U	-0.00342	+/-0.00693	0.0128	0.020	pCi/g							
Cobalt-60	U	-0.0055	+/-0.00969	0.0163	0.300	pCi/g							
Europium-152	U	0.00504	+/-0.029	0.052	4.80	pCi/g							
Europium-154	U	-0.00185	+/-0.0361	0.058	17.0	pCi/g							
Europium-155	U	0.0117	+/-0.0299	0.0579	0.300	pCi/g							
Manganese-54	J-UI	0.0243	+/-0.0167	0.0171	0.050	pCi/g							
Sodium-22	U	-0.00113	+/-0.0126	0.0202	0.050	pCi/g							
Zinc-65	U	0.0115	+/-0.0252	0.0439	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.710	+/-0.853	1.44	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			85.9	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-013
Sample ID: 456288013

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-11
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-014	Project:	BRKL00700
Sample ID:	456288014	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:02	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-12
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.366	+/-0.154	0.0989	1.00	pCi/g			MXR1	08/24/18	1051	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00611	+/-0.047	0.0914	4.00	pCi/g			RXF2	08/09/18	1107	1788713	2
Beryllium-7	U	0.0762	+/-0.0894	0.181	0.300	pCi/g							
Cesium-134	UI	0.0451	+/-0.0261	0.0286	0.040	pCi/g							
Cesium-137	J	0.930	+/-0.0488	0.0197	2.30	pCi/g							
Cobalt-57	U	-0.000412	+/-0.00705	0.0133	0.020	pCi/g							
Cobalt-60	U	0.00456	+/-0.0109	0.0222	0.300	pCi/g							
Europium-152	U	0.00985	+/-0.0317	0.0578	4.80	pCi/g							
Europium-154	U	-0.00822	+/-0.0288	0.0547	17.0	pCi/g							
Europium-155	U	0.022	+/-0.0284	0.0561	0.300	pCi/g							
Manganese-54	J-UI	0.0244	+/-0.0174	0.0167	0.050	pCi/g							
Sodium-22	U	-0.00305	+/-0.0101	0.0192	0.050	pCi/g							
Zinc-65	U	0.000666	+/-0.0274	0.0444	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.659	+/-1.10	1.92	2.00	pCi/g			KSD1	08/07/18	1733	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			62.1	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-014
Sample ID: 456288014

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-12
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-015	Project:	BRKL00700
Sample ID:	456288015	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:04	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-13
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.461	+/-0.113	0.101	1.00	pCi/g			MXR1	08/24/18	1057	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00656	+/-0.0103	0.017	4.00	pCi/g			RXF2	08/09/18	1901	1788713	2
Beryllium-7	U	-0.0111	+/-0.0535	0.101	0.300	pCi/g							
Cesium-134	U	0.0069	+/-0.0115	0.0157	0.040	pCi/g							
Cesium-137	J	0.303	+/-0.0239	0.0146	2.30	pCi/g							
Cobalt-57	U	-0.000236	+/-0.0036	0.007	0.020	pCi/g							
Cobalt-60	U	-0.000785	+/-0.00645	0.012	0.300	pCi/g							
Europium-152	U	-0.00446	+/-0.0174	0.0303	4.80	pCi/g							
Europium-154	U	-0.0115	+/-0.0214	0.0381	17.0	pCi/g							
Europium-155	J-UI	0.0619	+/-0.0347	0.0255	0.300	pCi/g							
Manganese-54	J-UI	0.0186	+/-0.0114	0.0124	0.050	pCi/g							
Sodium-22	U	-0.00389	+/-0.00756	0.0135	0.050	pCi/g							
Zinc-65	U	0.0061	+/-0.0177	0.0302	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.107	+/-0.484	0.999	2.00	pCi/g			KSD1	08/07/18	1732	1788749	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			103	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462 Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-015	Project:	BRKL00700
Sample ID:	456288015	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-13
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-016	Project:	BRKL00700
Sample ID:	456288016	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:06	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-14
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.452	+/-0.153	0.102	1.00	pCi/g			MXR1	08/24/18	1058	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0144	+/-0.0794	0.143	4.00	pCi/g			RXF2	08/09/18	1902	1788713	2
Beryllium-7	U	0.0367	+/-0.0964	0.180	0.300	pCi/g							
Cesium-134	J-UI	0.0327	+/-0.0166	0.0245	0.040	pCi/g							
Cesium-137	J	0.856	+/-0.0454	0.0193	2.30	pCi/g							
Cobalt-57	U	0.00176	+/-0.00706	0.0132	0.020	pCi/g							
Cobalt-60	U	0.00705	+/-0.0107	0.0208	0.300	pCi/g							
Europium-152	U	0.00711	+/-0.0285	0.0521	4.80	pCi/g							
Europium-154	U	0.0176	+/-0.0315	0.0604	17.0	pCi/g							
Europium-155	J-UI	0.0999	+/-0.0752	0.053	0.300	pCi/g							
Manganese-54	U	0.0163	+/-0.00872	0.0177	0.050	pCi/g							
Sodium-22	U	0.00661	+/-0.0111	0.0214	0.050	pCi/g							
Zinc-65	U	0.0112	+/-0.0241	0.0412	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.106	+/-0.399	0.746	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-016	Project:	BRKL00700
Sample ID:	456288016	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-14
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-017	Project:	BRKL00700
Sample ID:	456288017	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:08	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-15
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.722	+/-0.143	0.0916	1.00	pCi/g			MXR1	08/24/18	1058	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00869	+/-0.0238	0.0459	4.00	pCi/g			RXF2	08/09/18	1902	1788713	2
Beryllium-7	U	0.252	+/-0.244	0.285	0.300	pCi/g							
Cesium-134	UI	0.0647	+/-0.0356	0.0365	0.040	pCi/g							
Cesium-137		3.80	+/-0.0984	0.0304	2.30	pCi/g							
Cobalt-57	U	0.00522	+/-0.00873	0.0165	0.020	pCi/g							
Cobalt-60	J	0.0366	+/-0.0278	0.0242	0.300	pCi/g							
Europium-152	U	-0.0231	+/-0.0429	0.0796	4.80	pCi/g							
Europium-154	U	-0.0103	+/-0.0427	0.0774	17.0	pCi/g							
Europium-155	J-UI	0.144	+/-0.0734	0.061	0.300	pCi/g							
Manganese-54	U	0.00758	+/-0.0154	0.0282	0.050	pCi/g							
Sodium-22	U	-0.00348	+/-0.015	0.0273	0.050	pCi/g							
Zinc-65	U	0.0239	+/-0.0345	0.0607	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.442	+/-0.475	0.787	2.00	pCi/g			KSD1	08/08/18	0737	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			107	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-017
Sample ID: 456288017

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-15
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-018	Project:	BRKL00700
Sample ID:	456288018	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:10	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	Composite 3
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Solid "Dry Weight Corrected"													
Plutonium-238	U	0.442	+/-0.432	0.662	6.60	pCi/g			BXA4	08/06/18	2248	1788987	1
Plutonium-239/240	U	-0.0483	+/-0.201	0.471	4.00	pCi/g							
Alphaspec U-235, U-238 "Dry Weight Corrected"													
Uranium-235/236	U	0.0765	+/-0.287	0.482	0.900	pCi/g			BXA4	08/07/18	0857	1788988	2
Uranium-238	U	0.498	+/-0.523	0.750	0.900	pCi/g							
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Solid "As Received"													
Tritium	U	-33.1	+/-127	238	500	pCi/g			MXH8	08/06/18	1156	1788846	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	EPA 906.0 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-236 Tracer	Alphaspec Pu, Solid "Dry Weight Corrected"			65.7	(15%-125%)
Uranium-232 Tracer	Alphaspec U-235, U-238 "Dry Weight Corrected"			91.2	(15%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-019	Project:	BRKL00700
Sample ID:	456288019	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:12	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-16
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.590	+/-0.204	0.133	1.00	pCi/g			MXR1	08/24/18	1059	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	J-UI	0.113	+/-0.0923	0.101	4.00	pCi/g			RXF2	08/09/18	1902	1788713	2
Beryllium-7	U-DL	-0.0336	+/-0.181	0.313	0.300	pCi/g							
Cesium-134	J-UI	0.0329	+/-0.0252	0.0266	0.040	pCi/g							
Cesium-137		10.4	+/-0.119	0.0251	2.30	pCi/g							
Cobalt-57	U	0.0034	+/-0.00979	0.0187	0.020	pCi/g							
Cobalt-60	U	0.00575	+/-0.0107	0.0201	0.300	pCi/g							
Europium-152	U	-0.0153	+/-0.0479	0.0848	4.80	pCi/g							
Europium-154	U	-0.00112	+/-0.0314	0.0563	17.0	pCi/g							
Europium-155	U	0.0423	+/-0.059	0.0714	0.300	pCi/g							
Manganese-54	U	0.00408	+/-0.0114	0.0212	0.050	pCi/g							
Sodium-22	U	-0.000296	+/-0.0111	0.0198	0.050	pCi/g							
Zinc-65	U	-0.00627	+/-0.0238	0.0368	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.293	+/-0.510	1.11	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462 Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-019	Project:	BRKL00700
Sample ID:	456288019	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-16
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-020	Project:	BRKL00700
Sample ID:	456288020	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:14	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-17
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.722	+/-0.248	0.163	1.00	pCi/g			MXR1	08/24/18	1101	1790738	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0167	+/-0.0378	0.0571	4.00	pCi/g			RXF2	08/09/18	1903	1788713	2
Beryllium-7	U	-0.000365	+/-0.108	0.191	0.300	pCi/g							
Cesium-134	J-UI	0.032	+/-0.0201	0.0172	0.040	pCi/g							
Cesium-137		3.19	+/-0.0639	0.0187	2.30	pCi/g							
Cobalt-57	U	0.0015	+/-0.00664	0.0128	0.020	pCi/g							
Cobalt-60	U	0.00141	+/-0.00909	0.0168	0.300	pCi/g							
Europium-152	U	0.007	+/-0.0296	0.0541	4.80	pCi/g							
Europium-154	U	0.00642	+/-0.0271	0.0503	17.0	pCi/g							
Europium-155	J-UI	0.0592	+/-0.0483	0.0511	0.300	pCi/g							
Manganese-54	U	0.0103	+/-0.013	0.0144	0.050	pCi/g							
Sodium-22	U	0.00201	+/-0.00952	0.0176	0.050	pCi/g							
Zinc-65	U	0.0101	+/-0.021	0.0355	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.0823	+/-0.501	1.00	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1530	1788645

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			103	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-020	Project:	BRKL00700
Sample ID:	456288020	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-17
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-021	Project:	BRKL00700
Sample ID:	456288021	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:16	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-18
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.492	+/-0.148	0.101	1.00	pCi/g			MXR1	08/24/18	1119	1790740	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	J-UI	0.0559	+/-0.0522	0.0537	4.00	pCi/g			RXF2	08/09/18	1055	1788721	2
Beryllium-7	U	-0.0403	+/-0.154	0.280	0.300	pCi/g							
Cesium-134	U-DL	0.0251	+/-0.0362	0.0436	0.040	pCi/g							
Cesium-137	J	0.717	+/-0.058	0.0387	2.30	pCi/g							
Cobalt-57	UI	0.024	+/-0.017	0.0173	0.020	pCi/g							
Cobalt-60	U	0.00652	+/-0.0203	0.0391	0.300	pCi/g							
Europium-152	U	-0.0161	+/-0.0433	0.0768	4.80	pCi/g							
Europium-154	U	-0.00506	+/-0.0564	0.104	17.0	pCi/g							
Europium-155	J-UI	0.151	+/-0.120	0.0671	0.300	pCi/g							
Manganese-54	U	0.0243	+/-0.0213	0.0337	0.050	pCi/g							
Sodium-22	U	-0.00178	+/-0.0199	0.0367	0.050	pCi/g							
Zinc-65	U	-0.0292	+/-0.0468	0.071	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.0602	+/-0.671	1.30	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1526	1788646

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			107	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-021
Sample ID: 456288021

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: 811-SU-3-18
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-022	Project:	BRKL00700
Sample ID:	456288022	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:18	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-19
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.511	+/-0.162	0.118	1.00	pCi/g			MXR1	08/24/18	1139	1790740	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0293	+/-0.112	0.172	4.00	pCi/g			RXF2	08/09/18	1055	1788721	2
Beryllium-7		0.361	+/-0.216	0.235	0.300	pCi/g							
Cesium-134	UI	0.0579	+/-0.0295	0.039	0.040	pCi/g							
Cesium-137	J	0.822	+/-0.0544	0.0269	2.30	pCi/g							
Cobalt-57	U-DL	-0.00358	+/-0.0115	0.020	0.020	pCi/g							
Cobalt-60	U	0.00339	+/-0.0133	0.027	0.300	pCi/g							
Europium-152	U	-0.00457	+/-0.0469	0.0782	4.80	pCi/g							
Europium-154	U	-0.035	+/-0.0608	0.0893	17.0	pCi/g							
Europium-155	J-UI	0.126	+/-0.0914	0.0804	0.300	pCi/g							
Manganese-54	U	0.0201	+/-0.0233	0.0263	0.050	pCi/g							
Sodium-22	U	-0.0135	+/-0.0213	0.0309	0.050	pCi/g							
Zinc-65	U	-0.00522	+/-0.0369	0.061	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.776	+/-1.11	1.90	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1526	1788646

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			88.3	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-022	Project:	BRKL00700
Sample ID:	456288022	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-19
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-023	Project:	BRKL00700
Sample ID:	456288023	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:20	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	811-SU-3-20
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.552	+/-0.101	0.0739	1.00	pCi/g			MXR1	08/24/18	1140	1790740	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.131	+/-0.151	0.137	4.00	pCi/g			RXF2	08/09/18	1056	1788721	2
Beryllium-7	U	0.0865	+/-0.111	0.220	0.300	pCi/g							
Cesium-134	U	0.0268	+/-0.0267	0.0344	0.040	pCi/g							
Cesium-137	J	0.398	+/-0.0419	0.0246	2.30	pCi/g							
Cobalt-57	U	-0.000594	+/-0.00977	0.0179	0.020	pCi/g							
Cobalt-60	U	-0.00269	+/-0.0119	0.0224	0.300	pCi/g							
Europium-152	U	0.0152	+/-0.0358	0.0675	4.80	pCi/g							
Europium-154	U	-0.0317	+/-0.0413	0.0717	17.0	pCi/g							
Europium-155	U	0.0246	+/-0.0388	0.0743	0.300	pCi/g							
Manganese-54	U	0.00104	+/-0.0143	0.026	0.050	pCi/g							
Sodium-22	U	-0.0111	+/-0.0145	0.0252	0.050	pCi/g							
Zinc-65	U	-0.00661	+/-0.0268	0.0442	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.0339	+/-0.344	0.686	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1526	1788646

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			105	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462 Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-023	Project:	BRKL00700
Sample ID:	456288023	Client ID:	BRKL007 39987
		Samp Recv.:	
		Client Desc.:	811-SU-3-20
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-024	Project:	BRKL00700
Sample ID:	456288024	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 11:22	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	Composite 4
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Solid "Dry Weight Corrected"													
Plutonium-238	U	0.552	+/-0.693	0.849	6.60	pCi/g			BXA4	08/08/18	0846	1788987	1
Plutonium-239/240	U	0.376	+/-0.622	0.894	4.00	pCi/g							
Alphaspec U-235, U-238 "Dry Weight Corrected"													
Uranium-235/236	U	0.044	+/-0.244	0.469	0.900	pCi/g			BXA4	08/07/18	0857	1788988	2
Uranium-238		1.11	+/-0.573	0.418	0.900	pCi/g							
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Solid "As Received"													
Tritium	U	-95.3	+/-128	251	500	pCi/g			MXH8	08/06/18	1213	1788846	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1526	1788646

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	EPA 906.0 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-236 Tracer	Alphaspec Pu, Solid "Dry Weight Corrected"			99.8	(15%-125%)
Uranium-232 Tracer	Alphaspec U-235, U-238 "Dry Weight Corrected"			101	(15%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-025	Project:	BRKL00700
Sample ID:	456288025	Client ID:	BRKL007
Matrix:	S	COC:	39987
Collect Date:	31-JUL-18 00:00	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	BD-1
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.276	+/-0.083	0.145	1.00	pCi/g			MXR1	08/24/18	1140	1790740	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.011	+/-0.0634	0.127	4.00	pCi/g			RXF2	08/09/18	1056	1788721	2
Beryllium-7	U	-0.0438	+/-0.0847	0.157	0.300	pCi/g							
Cesium-134	U	0.0274	+/-0.0214	0.0275	0.040	pCi/g							
Cesium-137	J	0.103	+/-0.025	0.0204	2.30	pCi/g							
Cobalt-57	U	-0.00268	+/-0.00708	0.0133	0.020	pCi/g							
Cobalt-60	U	-0.00802	+/-0.0121	0.0214	0.300	pCi/g							
Europium-152	U	-0.0134	+/-0.0268	0.0486	4.80	pCi/g							
Europium-154	U	0.0188	+/-0.0307	0.0655	17.0	pCi/g							
Europium-155	U	0.0105	+/-0.0313	0.0615	0.300	pCi/g							
Manganese-54	U	0.00317	+/-0.0109	0.0209	0.050	pCi/g							
Sodium-22	U	0.00662	+/-0.0108	0.0231	0.050	pCi/g							
Zinc-65	U	-0.00268	+/-0.0258	0.0439	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.276	+/-0.346	0.808	2.00	pCi/g			KSD1	08/07/18	1615	1788750	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXB7	08/02/18	1526	1788646

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			105	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-025
Sample ID: 456288025

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: BD-1
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:
DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39987-026	Project:	BRKL00700
Sample ID:	456288026	Client ID:	BRKL007
Matrix:	W	COC:	39987
Collect Date:	31-JUL-18 07:30	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	EB-1
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Liquid "As Received"													
Plutonium-238	U	0.0161	+/-0.130	0.264	0.700	pCi/L			BXA4	08/06/18	2339	1788989	1
Plutonium-239/240	U	-0.101	+/-0.109	0.333	6.00	pCi/L							
Alphaspec U, Liquid "As Received"													
Uranium-235/236	U	-0.0751	+/-0.227	0.637	26.0	pCi/L			BXA4	08/07/18	0856	1788990	2
Uranium-238	U	0.0439	+/-0.244	0.468	26.0	pCi/L							
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Liquid Remediation Standard "As Received"													
Americium-241	U	-3.36	+/-11.1	17.3	25.0	pCi/L			BSW1	08/08/18	1849	1789015	3
Beryllium-7	U	-2.93	+/-8.60	15.1	60.0	pCi/L							
Cesium-134	U	-0.795	+/-1.19	1.97	5.00	pCi/L							
Cesium-137	U	-0.492	+/-1.01	1.74	12.0	pCi/L							
Cobalt-57	U	0.113	+/-1.00	1.69	5.00	pCi/L							
Cobalt-60	U	0.511	+/-0.964	1.94	22.0	pCi/L							
Europium-152	U	0.287	+/-2.93	5.33	84.0	pCi/L							
Europium-154	U	-1.72	+/-5.32	4.82	57.0	pCi/L							
Europium-155	U	2.18	+/-4.20	7.27	359	pCi/L							
Manganese-54	U	0.564	+/-1.09	2.01	6.00	pCi/L							
Sodium-22	U	-0.619	+/-1.87	1.69	7.00	pCi/L							
Zinc-65	U	-0.351	+/-2.00	3.71	15.0	pCi/L							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, liquid "As Received"													
Strontium-90	U	0.207	+/-0.445	0.787	0.800	pCi/L			KSD1	08/06/18	1506	1788973	4
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Liquid "As Received"													
Tritium	U	7.13	+/-148	284	500	pCi/L			MXH8	08/03/18	1015	1788843	5
Rad Radium-226													
Lucas Cell, Ra226, Liquid "As Received"													
Radium-226	U	0.0798	+/-0.156	0.305	1.00	pCi/L			PCW	08/09/18	0955	1788981	6

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: August 30, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39987-026
Sample ID: 456288026

Project: BRKL00700
Client ID: BRKL007
39987
Samp Recv.:
Client Desc.: EB-1
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	EPA 901.1	
4	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
5	EPA 906.0 Modified	
6	EPA 903.1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-236 Tracer	Alphaspec Pu, Liquid "As Received"			84.7	(15%-125%)
Uranium-232 Tracer	Alphaspec U, Liquid "As Received"			90	(15%-125%)
Strontium Carrier	GFPC, Sr90, liquid "As Received"			81.1	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

Page 1 of 1

BROOKHAVEN NATIONAL LABORATORY

P.O. # _____

Chain of Custody No. 40141

Requires EDD

SAMPLING CHAIN OF CUSTODY

458430

Analysis Requested By	Sampling Contractor	Analytical Laboratory
Name: W. Dorsch	Name: EPD Field Sampling Team	Name: GEL
Life No: 21133 Ext. 5186	Contact: R. Lagattolla	Address: 2040 Savage Rd.
Acct. No: 20802/23139 Dept: ES	Phone: 631 344 7129	City: Charleston St: SC Zip: 29407
Email Reports To:	Email/Fax: rlagattolla@bnl.gov	Contact: Edith Kent
1 W. Dorsch	Sampler: R. Mella	Phone: 843-556-8171
2 R. Howe		Email/Fax:
Project Name:	Project Manager:	Field Engineer:
811LYB	W. Dorsch	R. Lagattolla

Comments:

Please send all available data with 7Day TAT, and Sr-90 14day TAT. **Ra226 when available**

Type UiD	Smp	Coll	Sample Information: Site ID/Bldg/Life #	Depth/RWP	Date	Time	Matrix	Additional Sample Information: Name/Description	Cont. Vol./Units	Cont. Type	# of Cont.	Preservative	Analysis Requested: Alpha/Beta	Tritium	Gamma Remidaition	Strontium 90	Ra226	624	Nuclide-specific Alpha	PCBs	Metals		
001	E	G	811-SU-3-1-R	0.0-0.5	8/28/18	1330	S	Building 811 Soil	16OZ	P	1	---			X	X	X						

1 Relinquished By/Date/Time		2 Relinquished By/Date/Time	3 Relinquished By/Date/Time
Print R. Mella	8/28/18	Print	Print
Signature	1400	Signature	Signature
1 Received By/Date/Time		2 Received By/Date/Time	3 Received By/Date/Time
Print SBOONE	8/29/18	Print	Print
Signature	900	Signature	Signature

Contractor Lab Sample Disposal:
- ☐ Return To Client
- ☒ Disposal by Lab
- ☐ Archive For _____ Months

Data Package: ☒ Full ☐ Summary

Turn-Around Time Required:
- ☐ Rush (1 Day)
- ☐ 14 Days
- ☐ 30 Days
- ☒ 7 Days
- ☒ Other (see comments)

BNL F 3101F (rev. 6/13) Distribution WHITE (1) - Stays with Sample YELLOW (2) - Returned to Client with Report PINK (3) - Lab or Other GOLDENROD (4) - Field Copy - (Sampler)

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: September 21, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. Robert F. Howe
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	40141-001	Project:	BRKL00700
Sample ID:	458430001	Client ID:	BRKL007
Matrix:	S	COC:	40141
Collect Date:	28-AUG-18 13:30	Samp Recv.:	
Receive Date:	29-AUG-18 09:00	Client Desc.:	811-SU-3-1-R
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.514	+/-0.148	0.133	1.00	pCi/g			MXR1	09/21/18	0551	1798961	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0103	+/-0.0927	0.168	4.00	pCi/g			MXR1	08/31/18	1122	1798257	2
Beryllium-7	U	-0.091	+/-0.143	0.249	0.300	pCi/g							
Cesium-134	U	0.0156	+/-0.0119	0.0216	0.040	pCi/g							
Cesium-137		8.01	+/-0.106	0.0213	2.30	pCi/g							
Cobalt-57	U	0.00977	+/-0.0097	0.0191	0.020	pCi/g							
Cobalt-60	J-UI	0.0335	+/-0.0154	0.0169	0.300	pCi/g							
Europium-152	U	-0.0176	+/-0.0427	0.0766	4.80	pCi/g							
Europium-154	U	0.00968	+/-0.0303	0.0506	17.0	pCi/g							
Europium-155	U	0.00933	+/-0.0415	0.0814	0.300	pCi/g							
Manganese-54	U	0.0128	+/-0.00985	0.0179	0.050	pCi/g							
Sodium-22	U	0.00358	+/-0.0106	0.0178	0.050	pCi/g							
Zinc-65	U	-0.00789	+/-0.0215	0.0335	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	1.75	+/-1.19	1.85	2.00	pCi/g			LXB3	09/04/18	1415	1798282	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	CXC1	08/30/18	1059	1798227

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			92.3	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: September 21, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. Robert F. Howe
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	40141-001	Project:	BRKL00700
Sample ID:	458430001	Client ID:	BRKL007
			40141
		Samp Recv.:	
		Client Desc.:	811-SU-3-1-R
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

Geoprobes 811

Page 1 of 2

BROOKHAVEN NATIONAL LABORATORY

P.O. #

Chain of Custody No. 39984

Requires EDD ☑

SAMPLING CHAIN OF CUSTODY 456300

Analysis Requested By	Sampling Contractor	Analytical Laboratory
Name: W. Dorsch	Name: EPD Field Sampling Team	Name: GEL
Life: No 21133 Ext: 5186	Contact: R. Lagattolla	Address: 2040 Savage Rd
Acct. No 20802/23139 Dept: ES	Phone: 631 344 7129	City: Charleston St: SC Zip: 29407
Email Reports To:	Email/Fax: rlagattolla@bnl.gov	Contact: E. Kent
W. Dorsch	Sampler: R. Metz, J. Milligan	Phone: 843-556-8171
B. Howe		Email/Fax:
Project Name:	Project Manager:	Field Engineer:
811LYB	W. Dorsch	R. Lagattolla

Comments: SPDES TAT for EDD -009 Additional Analysis per B. Howe. OK to report RA 226 Late

UiD	Smp	Coll	Site ID/Bldg/Life #	Depth/RWP	Date	Time	Matrix	Name/Description	Cont. Vol./Units	Cont. Type	# of Cont.	Preservative	Alpha/Beta	Tritium	Gamma Remediation, RA 226	Strontium 90	524.2	624	Nuclide-specific Alpha	PCBs	Metals	U 235/238	Pu 238/239/240
001	E	C	811-GP-01-2018	0.0-2.0	7/31/18	1320	S	Bldg. 811 Geoprobe soil cores (0.0ft-2.0ft) With MS/MSD	16oz	P	1	----			x	x							
002	E	C	811-GP-01-2018	2.0-4.0	↓	1325	S	Bldg. 811 Geoprobe soil cores (2.0ft-4.0ft)	16oz	P	1	----			x	x							
003	E	C	811-GP-01-2018	4.0-6.0		1355	S	Bldg. 811 Geoprobe soil cores (4.0ft-6.0ft)	16oz	P	1	----			x	x							
004	E	C	811-GP-01-2018	6.0-8.0		1400	S	Bldg. 811 Geoprobe soil cores (6.0ft-8.0ft)	16oz	P	1	----			x	x							
005	E	C	811-GP-02-2018	0.0-2.0		1405	S	Bldg. 811 Geoprobe soil cores (0.0ft-2.0ft)	16oz	P	1	----			x	x							
006	E	C	811-GP-02-2018	2.0-4.0		1410	S	Bldg. 811 Geoprobe soil cores (2.0ft-4.0ft)	16oz	P	1	----			x	x							
007	E	C	811-GP-02-2018	4.0-6.0		1415	S	Bldg. 811 Geoprobe soil cores (4.0ft-6.0ft)	16oz	P	1	----			x	x							
008	E	C	811-GP-02-2018	6.0-8.0		1420	S	Bldg. 811 Geoprobe soil cores (6.0ft-8.0ft)	16oz	P	1	----			x	x							
009	E	C	811-GP-03-2018	0.0-2.0		1425	S	Bldg. 811 Geoprobe soil cores (0.0ft-2.0ft)	16oz	P	1	----		X	x	x						X	X
010	E	C	811-GP-03-2018	2.0-4.0		1430	S	Bldg. 811 Geoprobe soil cores (2.0ft-4.0ft)	16oz	P	1	----			x	x							
011	E	C	811-GP-03-2018	4.0-6.0		1435	S	Bldg. 811 Geoprobe soil cores (4.0ft-6.0ft)	16oz	P	1	----			x	x							
012	E	C	811-GP-03-2018	6.0-8.0		1440	S	Bldg. 811 Geoprobe soil cores (6.0ft-8.0ft)	16oz	P	1	----			x	x							
013	E	C	BD-1	0		0000	S	Blind Duplicate	16oz	P	1	----			x	x							
014	E	C	EB-1	0	↓	0730	W	Equipment Blank	4L	P	1	HNO3			x	x						x	x

1 Relinquished By/Date/Time	2 Relinquished By/Date/Time	3 Relinquished By/Date/Time
Print: R. Metz 8/1/18	Print: Tyler Rogers 8/6/18	Print: Jim Milligan 8/6/18
Signature: Robert Metz 1512	Signature: [signature] 14:30	Signature: [signature] 1515
1 Received By/Date/Time	**2 Received By/Date/Time**	**3 Received By/Date/Time**
Print: Tyler Rogers 8/1/18	Print: Jim Milligan 8/6/18	Print: SBOONC 8/8/18
Signature: [signature] 15:15	Signature: [signature] 1420	Signature: [signature] 920

Contractor Lab Sample Disposal: ☐ Return To Client ☑ Disposal by Lab ☐ Archive For ____ Months

Data Package: ☑ Full ☐ Summary

Turn-Around Time Required: ☐ Rush (1 Day) ☑ 14 Days ☐ 30 Days ☐ 7 Days ☐ Other ( )

BNL F 3101F (rev. 6/13)

Distribution WHITE (1) - Stays with Sample YELLOW (2) - Returned to Client with Report PINK (3) - Lab or Other GOLDENROD (4) - Field Copy - (Sampler)

Page 2 of 2

BROOKHAVEN NATIONAL LABORATORY

P.O. # _____

Chain of Custody No. 39984

Requires EDD ☑

SAMPLING CHAIN OF CUSTODY 456300

Analysis Requested By	Sampling Contractor	Analytical Laboratory
Name: W. Dorsch	Name: EPD Field Sampling Team	Name: GEL
Life No: 21133 Ext. 5186	Contact: R. Lagattolla	Address: 2040 Savage Rd.
Acct. No: 20802/23139 Dept: ES	Phone: 631 344 7129	City: Charleston St: SC Zip: 29407
Email Reports To:	Email/Fax: rlagattolla@bnl.gov	Contact: E. Kent
1 W. Dorsch	Sampler: R. Metz, J. Milligan	Phone: 843-556-8171
2 B. Howe		Email/Fax:
Project Name:	**Project Manager:**	**Field Engineer:**
811LYB	W. Dorsch	R. Lagattolla

Comments: SPDES TAT for EDD

Type			Sample Information					Additional Sample Information					Analysis Requested										
UID	Smp	Coll	Site ID/Bldg/Life #	Depth/RWP	Date	Time	Matrix	Name/Description	Cont. Vol./Units	Cont. Type	# of Cons	Preservative	Alpha/Beta	Tritium	Gamma Remediation + 421	Strontium 90	524.2	624	Nuclide-specific Alpha	PCBs	Metals	U 235/238	Pu 238/239/240
015	E	G	EB-1	0	7/31/18	0730	W	Equipment Blank	250ml	AG	1	----		X									

1 Relinquished By/Date/Time		2 Relinquished By/Date/Time		3 Relinquished By/Date/Time	
Print	R. Metz 8/1/18	Print	Tyler Nelms 8/6/18	Print	Jim Milligan 8/6/18
Signature	1512	Signature	14:30	Signature	1515
1 Received By/Date/Time		**2 Received By/Date/Time**		**3 Received By/Date/Time**	
Print	T Royster 8/1/18	Print	Jim Milligan 8/6/18	Print	SBOONE 8/8/18
Signature	15:15	Signature	1430	Signature	

Contractor Lab Sample Disposal:
☐ Return To Client ☑ Disposal by Lab
☐ Archive For _____ Months

Data Package: ☑ Full ☐ Summary

Turn-Around Time Required:
☐ Rush (1 Day) ☑ 14 Days ☐ 30 Days
☐ 7 Days ☐ Other ( )

BNL F 3101F (rev. 6/13) Distribution WHITE (1) - Stays with Sample YELLOW (2) - Returned to Client with Report PINK (3) - Lab or Other GOLDENROD (4) - Field Copy - (Sampler)

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-001	Project:	BRKL00700
Sample ID:	456300002	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 13:20	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-01-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.634	+/-0.153	0.0902	1.00	pCi/g			RXF2	08/30/18	0552	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00148	+/-0.0364	0.0647	4.00	pCi/g			RXF2	08/10/18	1116	1790490	2
Beryllium-7	U	-0.0779	+/-0.102	0.180	0.300	pCi/g							
Cesium-134	UI	0.0594	+/-0.0271	0.0354	0.040	pCi/g							
Cesium-137	U	0.00376	+/-0.0152	0.0252	2.30	pCi/g							
Cobalt-57	U	0.00347	+/-0.0092	0.0164	0.020	pCi/g							
Cobalt-60	U	0.000262	+/-0.0118	0.0225	0.300	pCi/g							
Europium-152	U	0.0266	+/-0.0328	0.0625	4.80	pCi/g							
Europium-154	U	0.0194	+/-0.0356	0.0708	17.0	pCi/g							
Europium-155	U	0.00544	+/-0.035	0.0652	0.300	pCi/g							
Manganese-54	U	0.0138	+/-0.0136	0.0261	0.050	pCi/g							
Sodium-22	U	0.00637	+/-0.0125	0.0247	0.050	pCi/g							
Zinc-65	U	-0.00434	+/-0.0293	0.0478	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.019	+/-0.490	0.943	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			103	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-001	Project:	BRKL00700
Sample ID:	456300002	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-01-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-002	Project:	BRKL00700
Sample ID:	456300003	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 13:25	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-01-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.487	+/-0.105	0.084	1.00	pCi/g			RXF2	08/30/18	0552	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0472	+/-0.0487	0.102	4.00	pCi/g			RXF2	08/10/18	1117	1790490	2
Beryllium-7	U	0.0495	+/-0.0918	0.182	0.300	pCi/g							
Cesium-134	U	0.022	+/-0.0132	0.0276	0.040	pCi/g							
Cesium-137	U	0.00315	+/-0.0106	0.0203	2.30	pCi/g							
Cobalt-57	U	-0.00319	+/-0.00771	0.0144	0.020	pCi/g							
Cobalt-60	U	0.00502	+/-0.0111	0.0225	0.300	pCi/g							
Europium-152	U	-0.00167	+/-0.0281	0.0548	4.80	pCi/g							
Europium-154	U	-0.00145	+/-0.0324	0.0618	17.0	pCi/g							
Europium-155	U	0.0194	+/-0.033	0.0652	0.300	pCi/g							
Manganese-54	U	0.012	+/-0.0174	0.0171	0.050	pCi/g							
Sodium-22	U	-0.00083	+/-0.0113	0.0216	0.050	pCi/g							
Zinc-65	U	-0.00155	+/-0.0281	0.047	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.833	+/-0.916	1.53	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
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	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-002	Project:	BRKL00700
Sample ID:	456300003	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-01-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-003	Project:	BRKL00700
Sample ID:	456300004	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 13:55	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-01-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.383	+/-0.128	0.0766	1.00	pCi/g			RXF2	08/30/18	0553	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.000401	+/-0.0431	0.0791	4.00	pCi/g			RXF2	08/10/18	1117	1790490	2
Beryllium-7	U	-0.00868	+/-0.0795	0.153	0.300	pCi/g							
Cesium-134	U	0.0167	+/-0.0118	0.0231	0.040	pCi/g							
Cesium-137	U	-0.00504	+/-0.0114	0.0189	2.30	pCi/g							
Cobalt-57	U	-0.000623	+/-0.00702	0.0133	0.020	pCi/g							
Cobalt-60	U	0.00108	+/-0.0106	0.0197	0.300	pCi/g							
Europium-152	U	0.00233	+/-0.0256	0.0507	4.80	pCi/g							
Europium-154	U	0.017	+/-0.0293	0.0581	17.0	pCi/g							
Europium-155	U	0.0288	+/-0.0289	0.0578	0.300	pCi/g							
Manganese-54	J-UI	0.0185	+/-0.0156	0.017	0.050	pCi/g							
Sodium-22	U	0.00374	+/-0.0107	0.0205	0.050	pCi/g							
Zinc-65	U	0.0288	+/-0.0296	0.0367	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.115	+/-0.339	0.725	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			105	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-003	Project:	BRKL00700
Sample ID:	456300004	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-01-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-004	Project:	BRKL00700
Sample ID:	456300005	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:00	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-01-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.321	+/-0.120	0.0817	1.00	pCi/g			RXF2	08/30/18	0553	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0584	+/-0.0724	0.139	4.00	pCi/g			RXF2	08/10/18	1117	1790490	2
Beryllium-7	U	-0.0574	+/-0.0903	0.165	0.300	pCi/g							
Cesium-134	J-UI	0.033	+/-0.0232	0.0247	0.040	pCi/g							
Cesium-137	J-UI	0.0241	+/-0.0196	0.0194	2.30	pCi/g							
Cobalt-57	U	-0.00331	+/-0.0079	0.0146	0.020	pCi/g							
Cobalt-60	J	0.0425	+/-0.0225	0.0224	0.300	pCi/g							
Europium-152	U	0.00147	+/-0.0298	0.0527	4.80	pCi/g							
Europium-154	U	-0.0214	+/-0.0438	0.0655	17.0	pCi/g							
Europium-155	U	0.0255	+/-0.0321	0.0636	0.300	pCi/g							
Manganese-54	J-UI	0.0198	+/-0.0174	0.0195	0.050	pCi/g							
Sodium-22	U	-0.00735	+/-0.0154	0.0231	0.050	pCi/g							
Zinc-65	U	0.00836	+/-0.0248	0.0485	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.0625	+/-0.509	1.03	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			105	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
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	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-004	Project:	BRKL00700
Sample ID:	456300005	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-01-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-005	Project:	BRKL00700
Sample ID:	456300006	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:05	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-02-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.710	+/-0.117	0.0787	1.00	pCi/g			RXF2	08/30/18	0553	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	J-UI	0.171	+/-0.134	0.159	4.00	pCi/g			RXF2	08/10/18	1118	1790490	2
Beryllium-7	U	-0.00837	+/-0.110	0.207	0.300	pCi/g							
Cesium-134	UI	0.0662	+/-0.0332	0.0343	0.040	pCi/g							
Cesium-137	J	0.145	+/-0.0435	0.0266	2.30	pCi/g							
Cobalt-57	U	-0.00316	+/-0.00956	0.0177	0.020	pCi/g							
Cobalt-60	U	0.00579	+/-0.0129	0.0264	0.300	pCi/g							
Europium-152	U	-0.0143	+/-0.0345	0.0654	4.80	pCi/g							
Europium-154	U	-0.0527	+/-0.0403	0.0649	17.0	pCi/g							
Europium-155	U	0.0539	+/-0.0395	0.0796	0.300	pCi/g							
Manganese-54	J-UI	0.0266	+/-0.0194	0.0225	0.050	pCi/g							
Sodium-22	U	-0.0187	+/-0.0141	0.0227	0.050	pCi/g							
Zinc-65	U	-0.00481	+/-0.0306	0.051	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.178	+/-0.526	0.967	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			97.9	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-005	Project:	BRKL00700
Sample ID:	456300006	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-02-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-006	Project:	BRKL00700
Sample ID:	456300007	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:10	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-02-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.468	+/-0.113	0.0609	1.00	pCi/g			RXF2	08/30/18	0554	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.000751	+/-0.0188	0.0346	4.00	pCi/g			RXF2	08/10/18	1118	1790490	2
Beryllium-7	U	-0.0259	+/-0.102	0.189	0.300	pCi/g							
Cesium-134	UI	0.0478	+/-0.0224	0.0328	0.040	pCi/g							
Cesium-137	U	0.0131	+/-0.0249	0.0256	2.30	pCi/g							
Cobalt-57	U	-0.000369	+/-0.00729	0.0137	0.020	pCi/g							
Cobalt-60	U	-0.00515	+/-0.0151	0.0269	0.300	pCi/g							
Europium-152	U	-0.0311	+/-0.032	0.0578	4.80	pCi/g							
Europium-154	U	0.0019	+/-0.0403	0.0765	17.0	pCi/g							
Europium-155	J-UI	0.0732	+/-0.0698	0.0534	0.300	pCi/g							
Manganese-54	U	0.00581	+/-0.0142	0.0281	0.050	pCi/g							
Sodium-22	U	-0.002	+/-0.0145	0.0267	0.050	pCi/g							
Zinc-65	U	-0.0173	+/-0.0352	0.0535	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.159	+/-0.799	1.53	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-006	Project:	BRKL00700
Sample ID:	456300007	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-02-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-007	Project:	BRKL00700
Sample ID:	456300008	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:15	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-02-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.478	+/-0.116	0.0899	1.00	pCi/g			RXF2	08/30/18	0554	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0219	+/-0.0709	0.147	4.00	pCi/g			RXF2	08/10/18	1118	1790490	2
Beryllium-7	U	-0.0195	+/-0.104	0.193	0.300	pCi/g							
Cesium-134	J-UI	0.0349	+/-0.0154	0.0338	0.040	pCi/g							
Cesium-137	J	0.283	+/-0.0323	0.0237	2.30	pCi/g							
Cobalt-57	U	-0.00691	+/-0.00784	0.0147	0.020	pCi/g							
Cobalt-60	U	-0.00226	+/-0.0144	0.0273	0.300	pCi/g							
Europium-152	U	-0.0252	+/-0.0367	0.0603	4.80	pCi/g							
Europium-154	U	0.0186	+/-0.0437	0.087	17.0	pCi/g							
Europium-155	U	0.0314	+/-0.0321	0.0665	0.300	pCi/g							
Manganese-54	U	0.00787	+/-0.0129	0.0257	0.050	pCi/g							
Sodium-22	U	0.00627	+/-0.0153	0.0305	0.050	pCi/g							
Zinc-65	U	0.0128	+/-0.0332	0.0565	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.156	+/-0.364	0.781	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-007	Project:	BRKL00700
Sample ID:	456300008	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-02-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-008	Project:	BRKL00700
Sample ID:	456300009	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:20	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-02-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.353	+/-0.112	0.0987	1.00	pCi/g			RXF2	08/30/18	0554	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00677	+/-0.0629	0.128	4.00	pCi/g			RXF2	08/10/18	1119	1790490	2
Beryllium-7	U	0.129	+/-0.0896	0.192	0.300	pCi/g							
Cesium-134	U	0.0232	+/-0.0188	0.0288	0.040	pCi/g							
Cesium-137	U	0.00636	+/-0.0118	0.0214	2.30	pCi/g							
Cobalt-57	U	0.00168	+/-0.00763	0.0149	0.020	pCi/g							
Cobalt-60	U	0.00453	+/-0.013	0.026	0.300	pCi/g							
Europium-152	U	-0.0053	+/-0.0292	0.0542	4.80	pCi/g							
Europium-154	U	0.0219	+/-0.0367	0.0755	17.0	pCi/g							
Europium-155	U	0.00627	+/-0.0308	0.0609	0.300	pCi/g							
Manganese-54	U	-0.00647	+/-0.0111	0.0207	0.050	pCi/g							
Sodium-22	U	0.00828	+/-0.013	0.0268	0.050	pCi/g							
Zinc-65	U	0.011	+/-0.0312	0.055	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.612	+/-0.671	1.12	2.00	pCi/g			KSD1	08/14/18	0721	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			105	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-008	Project:	BRKL00700
Sample ID:	456300009	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-02-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-009	Project:	BRKL00700
Sample ID:	456300010	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:25	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-03-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Solid "Dry Weight Corrected"													
Plutonium-238	U	-0.108	+/-0.152	0.499	6.60	pCi/g			MXS2	09/01/18	1108	1796137	1
Plutonium-239/240	U	0.0206	+/-0.235	0.498	4.00	pCi/g							
Alphaspec U-235, U-238 "Dry Weight Corrected"													
Uranium-235/236	J	0.552	+/-0.494	0.537	0.900	pCi/g			MXS2	09/01/18	1510	1796140	2
Uranium-238	U	0.560	+/-0.499	0.674	0.900	pCi/g							
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.500	+/-0.231	0.157	1.00	pCi/g			RXF2	08/30/18	0555	1790737	3
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0281	+/-0.0524	0.0922	4.00	pCi/g			RXF2	08/10/18	1633	1790490	4
Beryllium-7	U-DL	-0.0767	+/-0.187	0.321	0.300	pCi/g							
Cesium-134	UI	0.0563	+/-0.026	0.0221	0.040	pCi/g							
Cesium-137		15.5	+/-0.125	0.022	2.30	pCi/g							
Cobalt-57	U	0.00153	+/-0.00914	0.0173	0.020	pCi/g							
Cobalt-60	U	-0.00173	+/-0.00831	0.0147	0.300	pCi/g							
Europium-152	U	0.00378	+/-0.0472	0.0839	4.80	pCi/g							
Europium-154	U	0.00426	+/-0.0262	0.0474	17.0	pCi/g							
Europium-155	U	0.0445	+/-0.0651	0.0678	0.300	pCi/g							
Manganese-54	U	0.0108	+/-0.0131	0.0164	0.050	pCi/g							
Sodium-22	U	0.00135	+/-0.0092	0.0166	0.050	pCi/g							
Zinc-65	U	-0.0018	+/-0.0209	0.0328	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.428	+/-0.718	1.25	2.00	pCi/g			KSD1	08/13/18	1526	1791254	5
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Solid "As Received"													
Tritium	U	20.6	+/-28.4	48.6	500	pCi/g			MXH8	08/25/18	0145	1796008	6

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-009	Project:	BRKL00700
Sample ID:	456300010	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-03-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	DOE HASL 300, 4.5.2.3/Ga-01-R	
4	DOE HASL 300, 4.5.2.3/Ga-01-R	
5	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
6	EPA 906.0 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-242 Tracer	Alphaspec Pu, Solid "Dry Weight Corrected"			85.4	(15%-125%)
Uranium-232 Tracer	Alphaspec U-235, U-238 "Dry Weight Corrected"			91.6	(15%-125%)
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			95.5	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor	Lc/LC: Critical Level
DL: Detection Limit	PF: Prep Factor
MDA: Minimum Detectable Activity	RL: Reporting Limit
MDC: Minimum Detectable Concentration	SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-010	Project:	BRKL00700
Sample ID:	456300011	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:30	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-03-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.379	+/-0.0988	0.0741	1.00	pCi/g			RXF2	08/30/18	0615	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.0159	+/-0.0256	0.0377	4.00	pCi/g			RXF2	08/10/18	1634	1790490	2
Beryllium-7	U	0.0144	+/-0.0523	0.0926	0.300	pCi/g							
Cesium-134	J-UI	0.0313	+/-0.0132	0.0149	0.040	pCi/g							
Cesium-137	U	0.00913	+/-0.0115	0.0111	2.30	pCi/g							
Cobalt-57	U	-0.000609	+/-0.00397	0.00786	0.020	pCi/g							
Cobalt-60	U	0.00459	+/-0.00658	0.0127	0.300	pCi/g							
Europium-152	U	-0.0047	+/-0.0159	0.0294	4.80	pCi/g							
Europium-154	U	0.00899	+/-0.020	0.0376	17.0	pCi/g							
Europium-155	U	0.0238	+/-0.0294	0.032	0.300	pCi/g							
Manganese-54	J-UI	0.0177	+/-0.00957	0.0109	0.050	pCi/g							
Sodium-22	U	0.00316	+/-0.00703	0.0132	0.050	pCi/g							
Zinc-65	U	-0.0111	+/-0.0156	0.0238	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.778	+/-0.645	1.40	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			103	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-010	Project:	BRKL00700
Sample ID:	456300011	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-03-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-011	Project:	BRKL00700
Sample ID:	456300012	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:35	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-03-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.417	+/-0.146	0.0912	1.00	pCi/g			RXF2	08/30/18	0616	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0171	+/-0.0449	0.0812	4.00	pCi/g			RXF2	08/10/18	1705	1790490	2
Beryllium-7	U	0.0328	+/-0.0557	0.105	0.300	pCi/g							
Cesium-134	J-UI	0.0232	+/-0.0145	0.0158	0.040	pCi/g							
Cesium-137	J	0.137	+/-0.0209	0.0129	2.30	pCi/g							
Cobalt-57	U	0.00126	+/-0.00472	0.00871	0.020	pCi/g							
Cobalt-60	U	0.00226	+/-0.0089	0.0144	0.300	pCi/g							
Europium-152	U	-0.00805	+/-0.020	0.0328	4.80	pCi/g							
Europium-154	U	-0.0092	+/-0.0204	0.0356	17.0	pCi/g							
Europium-155	J-UI	0.0576	+/-0.0479	0.0376	0.300	pCi/g							
Manganese-54	U	0.000425	+/-0.00649	0.0122	0.050	pCi/g							
Sodium-22	U	-0.00538	+/-0.00737	0.0125	0.050	pCi/g							
Zinc-65	U	0.0165	+/-0.0234	0.0279	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.201	+/-0.713	1.42	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-011	Project:	BRKL00700
Sample ID:	456300012	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-03-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-012	Project:	BRKL00700
Sample ID:	456300013	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 14:40	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	811-GP-03-2018
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.334	+/-0.103	0.088	1.00	pCi/g			RXF2	08/30/18	0617	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	-0.00938	+/-0.00902	0.014	4.00	pCi/g			RXF2	08/10/18	1705	1790490	2
Beryllium-7	U	0.0148	+/-0.0435	0.0841	0.300	pCi/g							
Cesium-134	U	0.0117	+/-0.012	0.0123	0.040	pCi/g							
Cesium-137	U	-0.000652	+/-0.0056	0.0103	2.30	pCi/g							
Cobalt-57	U	0.00018	+/-0.00299	0.00582	0.020	pCi/g							
Cobalt-60	U	-0.00105	+/-0.00591	0.0108	0.300	pCi/g							
Europium-152	U	0.00208	+/-0.014	0.025	4.80	pCi/g							
Europium-154	U	0.00309	+/-0.0174	0.0327	17.0	pCi/g							
Europium-155	U	0.0198	+/-0.0263	0.022	0.300	pCi/g							
Manganese-54	U	0.00941	+/-0.00824	0.00983	0.050	pCi/g							
Sodium-22	U	0.00075	+/-0.00609	0.0114	0.050	pCi/g							
Zinc-65	U	0.0116	+/-0.0133	0.0238	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	0.234	+/-0.635	1.14	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			107	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-012	Project:	BRKL00700
Sample ID:	456300013	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	811-GP-03-2018
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-013	Project:	BRKL00700
Sample ID:	456300014	Client ID:	BRKL007
Matrix:	S	COC:	39984
Collect Date:	31-JUL-18 00:00	Samp Recv.:	
Receive Date:	08-AUG-18 09:20	Client Desc.:	BD-1
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Gamma Spec Analysis													
Gamma, Ra226, Solid "Dry Weight Corrected"													
Radium-226	J	0.299	+/-0.113	0.103	1.00	pCi/g			RXF2	08/30/18	0617	1790737	1
Gammaspec, Gamma, Solid (Long List) Remediation "Dry Weight Corrected"													
Americium-241	U	0.0141	+/-0.0407	0.0791	4.00	pCi/g			RXF2	08/10/18	1706	1790490	2
Beryllium-7	U	-0.019	+/-0.0661	0.118	0.300	pCi/g							
Cesium-134	J-UI	0.019	+/-0.0126	0.0171	0.040	pCi/g							
Cesium-137	U	-0.00222	+/-0.00729	0.0136	2.30	pCi/g							
Cobalt-57	U	-0.00362	+/-0.00645	0.00915	0.020	pCi/g							
Cobalt-60	U	0.00493	+/-0.00795	0.0151	0.300	pCi/g							
Europium-152	U	-0.00583	+/-0.0204	0.0374	4.80	pCi/g							
Europium-154	U	0.0253	+/-0.0247	0.048	17.0	pCi/g							
Europium-155	U	0.0392	+/-0.0411	0.0402	0.300	pCi/g							
Manganese-54	U	0.00311	+/-0.0119	0.015	0.050	pCi/g							
Sodium-22	U	0.00876	+/-0.00868	0.0169	0.050	pCi/g							
Zinc-65	U	-0.0157	+/-0.0184	0.0262	0.500	pCi/g							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, solid "Dry Weight Corrected"													
Strontium-90	U	-0.0128	+/-0.389	0.769	2.00	pCi/g			KSD1	08/13/18	1526	1791254	3

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
Dry Soil Prep	Dry Soil Prep GL-RAD-A-021	MPK1	08/08/18	1143	1790436

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE HASL 300, 4.5.2.3/Ga-01-R	
2	DOE HASL 300, 4.5.2.3/Ga-01-R	
3	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Strontium Carrier	GFPC, Sr90, solid "Dry Weight Corrected"			100	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-013	Project:	BRKL00700
Sample ID:	456300014	Client ID:	BRKL007
			39984
		Samp Recv.:	
		Client Desc.:	BD-1
		Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

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Certificate of Analysis

Report Date: September 6, 2018

Company :	Brookhaven National Laboratory
Address :	Building 462
	Upton, New York 11973--5000
Contact:	Mr. John Burke
Project:	Hazardous & Radiochemical Analytical Services - Full

Client Sample ID:	39984-014	Project:	BRKL00700
Sample ID:	456300001	Client ID:	BRKL007
Matrix:	W	COC:	39984
Collect Date:	31-JUL-18 07:30	Samp Recv.:	
Receive Date:	02-AUG-18 08:55	Client Desc.:	EB-1
Collector:	Client	Vol. Recv.:	

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method
Rad Alpha Spec Analysis													
Alphaspec Pu, Liquid "As Received"													
Plutonium-238	U	0.582	+/-0.513	0.600	0.700	pCi/L			BXA4	08/16/18	1632	1790607	1
Plutonium-239/240	U	-0.0171	+/-0.257	0.600	6.00	pCi/L							
Alphaspec U, Liquid "As Received"													
Uranium-235/236	U	0.110	+/-0.310	0.331	26.0	pCi/L			BXA4	08/11/18	1248	1790610	2
Uranium-238	U	0.0464	+/-0.258	0.494	26.0	pCi/L							
Rad Gamma Spec Analysis													
Gammaspec, Gamma, Liquid Remediation Standard "As Received"													
Americium-241	U	-8.72	+/-10.7	17.1	25.0	pCi/L			MXR1	08/09/18	1904	1790652	3
Beryllium-7	U	1.35	+/-9.93	18.0	60.0	pCi/L							
Cesium-134	U	1.27	+/-1.37	2.64	5.00	pCi/L							
Cesium-137	U	0.177	+/-1.26	2.26	12.0	pCi/L							
Cobalt-57	U	-0.346	+/-1.12	2.01	5.00	pCi/L							
Cobalt-60	U	-1.45	+/-2.27	2.42	22.0	pCi/L							
Europium-152	U	-2.9	+/-3.76	6.41	84.0	pCi/L							
Europium-154	U	2.26	+/-3.60	6.75	57.0	pCi/L							
Europium-155	U	-1.45	+/-5.24	8.48	359	pCi/L							
Manganese-54	U	-0.013	+/-1.20	2.13	6.00	pCi/L							
Sodium-22	U	0.795	+/-1.27	2.38	7.00	pCi/L							
Zinc-65	U	-2.2	+/-2.55	4.41	15.0	pCi/L							
Rad Gas Flow Proportional Counting													
GFPC, Sr90, liquid "As Received"													
Strontium-90	U	-0.268	+/-0.376	0.786	0.800	pCi/L			LXB3	08/14/18	1417	1791253	4
Rad Liquid Scintillation Analysis													
LSC, Tritium Dist, Liquid "As Received"													
Tritium	U	146	+/-197	334	500	pCi/L			MXH8	08/10/18	2349	1791145	5
Rad Radium-226													
Lucas Cell, Ra226, Liquid "As Received"													
Radium-226	J	0.435	+/-0.270	0.320	1.00	pCi/L			PCW	08/13/18	0915	1789948	6

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Certificate of Analysis

Report Date: September 6, 2018

Company : Brookhaven National Laboratory
Address : Building 462

Upton, New York 11973--5000
Contact: Mr. John Burke
Project: Hazardous & Radiochemical Analytical Services - Full

Client Sample ID: 39984-014
Sample ID: 456300001

Project: BRKL00700
Client ID: BRKL007
39984
Samp Recv.:
Client Desc.: EB-1
Vol. Recv.:

Parameter	Qualifier	Result	Uncertainty	MDC	RL	Units	PF	DF	Analyst	Date	Time	Batch	Method

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	DOE EML HASL-300, Pu-11-RC Modified	
2	DOE EML HASL-300, U-02-RC Modified	
3	EPA 901.1	
4	EPA 905.0 Modified/DOE RP501 Rev. 1 Modified	
5	EPA 906.0 Modified	
6	EPA 903.1 Modified	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
Plutonium-236 Tracer	Alphaspec Pu, Liquid "As Received"			67.6	(15%-125%)
Uranium-232 Tracer	Alphaspec U, Liquid "As Received"			80.9	(15%-125%)
Strontium Carrier	GFPC, Sr90, liquid "As Received"			88.3	(25%-125%)

Notes:
Counting Uncertainty is calculated at the 95% confidence level (1.96-sigma).

Column headers are defined as follows:

DF: Dilution Factor
DL: Detection Limit
MDA: Minimum Detectable Activity
MDC: Minimum Detectable Concentration
Lc/LC: Critical Level
PF: Prep Factor
RL: Reporting Limit
SQL: Sample Quantitation Limit

APPENDIX B

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On : 8/4/2018 9:44:52 AM

Sample Title : 001 0' to 2'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 8.200E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 9:34:49 AM

Live Time : 600.0 seconds
Real Time : 601.0 seconds

Dead Time : 0.16 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 001 0' to 2'
Peak Analysis Performed on: 8/4/2018 9:44:51 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	645-	655	648.45	185.81	0.43	6.35E+001	32.53	4.18E+002
2	2114-	2133	2122.43	608.42	1.60	1.58E+002	18.07	6.33E+001
3	3165-	3185	3174.07	910.11	2.17	9.16E+001	14.20	4.74E+001
4	3370-	3383	3376.19	968.11	1.15	4.09E+001	10.66	3.71E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 001 0' to 2'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 9:44:51 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	185.81	1.0581E-001	51.25		
2	608.42	2.6285E-001	11.46	Tol.	BI-214
3	910.11	1.5271E-001	15.49		
4	968.11	6.8237E-002	26.05	Tol.	AC-228

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On : 8/4/2018 10:56:01 AM

Sample Title : 002 2' to 4'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 7.940E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 10:45:58 AM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.16 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 002 2' to 4'
Peak Analysis Performed on: 8/4/2018 10:56:00 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	2023-	2042	2030.62	582.09	1.47	1.20E+002	16.82	6.06E+001
2	2114-	2132	2122.28	608.38	1.45	1.68E+002	17.09	4.77E+001
3	3370-	3384	3376.59	968.23	0.67	3.70E+001	10.54	3.80E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 002 2' to 4'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 10:56:00 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	582.09	2.0069E-001	13.97		
2	608.38	2.8048E-001	10.16	Tol.	BI-214
3	968.23	6.1592E-002	28.53	Tol.	AC-228

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On : 8/4/2018 11:27:35 AM

Sample Title : 003 4' to 6'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 7.820E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 11:17:31 AM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.15 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 003 4' to 6'
Peak Analysis Performed on: 8/4/2018 11:27:33 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	258-	265	260.91	74.74	0.65	7.35E+001	38.78	4.72E+002
2	2024-	2039	2030.94	582.18	1.47	9.17E+001	14.66	5.23E+001
3	2115-	2133	2122.29	608.38	1.14	1.52E+002	17.00	5.25E+001
4	3168-	3181	3174.05	910.11	0.44	4.01E+001	10.28	3.49E+001
5	3369-	3382	3375.92	968.04	0.29	3.28E+001	9.79	3.32E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 003 4' to 6'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 11:27:33 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	74.74	1.2257E-001	52.74		
2	582.18	1.5282E-001	15.99		
3	608.38	2.5256E-001	11.22	Tol.	BI-214
4	910.11	6.6828E-002	25.63		
5	968.04	5.4659E-002	29.85	Tol.	AC-228

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On	:	8/4/2018 11:47:20 AM
Sample Title	:	004 6' to 8'
Sample Description	:	811 Soils 500ml Jar
Sample Identification	:	ISOCS
Sample Type	:	
Sample Geometry	:	500ml Jar
Peak Locate Threshold	:	3.00
Peak Locate Range (in channels)	:	100 - 8000
Peak Area Range (in channels)	:	100 - 8000
Identification Energy Tolerance	:	1.000 keV
Sample Size	:	7.720E+002 gram
Sample Taken On	:	8/4/2018 12:00:00 AM
Acquisition Started	:	8/4/2018 11:37:18 AM
Live Time	:	600.0 seconds
Real Time	:	600.9 seconds
Dead Time	:	0.15 %

Energy Calibration Used Done On	:	5/20/2014
Efficiency Calibration Used Done On	:	4/23/2013
Efficiency ID	:	500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 004 6' to 8'
Peak Analysis Performed on: 8/4/2018 11:47:19 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	1220-	1235	1225.89	351.34	1.52	1.66E+002	22.43	1.27E+002
2	2022-	2042	2030.62	582.09	1.43	1.04E+002	17.67	7.54E+001
3	2112-	2131	2122.33	608.39	1.36	1.46E+002	17.66	6.16E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 004 6' to 8'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 11:47:19 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	351.34	2.7639E-001	13.52	Tol.	PB-214
2	582.09	1.7266E-001	17.06		
3	608.39	2.4395E-001	12.06	Tol.	BI-214

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On	:	8/4/2018 10:09:12 AM
Sample Title	:	005 0' to 2'
Sample Description	:	811 Soils 500ml Jar
Sample Identification	:	ISOCS
Sample Type	:	
Sample Geometry	:	500ml Jar
Peak Locate Threshold	:	3.00
Peak Locate Range (in channels)	:	100 - 8000
Peak Area Range (in channels)	:	100 - 8000
Identification Energy Tolerance	:	1.000 keV
Sample Size	:	8.080E+002 gram
Sample Taken On	:	8/4/2018 12:00:00 AM
Acquisition Started	:	8/4/2018 9:59:09 AM
Live Time	:	600.0 seconds
Real Time	:	601.0 seconds
Dead Time	:	0.16 %

Energy Calibration Used Done On	:	5/20/2014
Efficiency Calibration Used Done On	:	4/23/2013
Efficiency ID	:	500ML_BOTT

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On : 8/4/2018 12:07:14 PM

Sample Title : 006 2' to 4'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 7.700E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 11:57:11 AM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.15 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 006 2' to 4'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 12:07:12 PM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

	Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
	1	77.06	1.3925E-001	46.22		
m	2	241.28	1.1011E-001	20.70		
	3	351.28	2.9603E-001	12.76	Tol.	PB-214
	4	582.24	1.8929E-001	15.38		
	5	608.35	1.8541E-001	13.88	Tol.	BI-214
	6	868.19	2.1190E-002	44.47		
	7	909.93	1.4937E-001	14.15		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 005 0' to 2'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 10:09:11 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	77.13	2.5298E-001	28.32		
2	351.32	3.9580E-001	10.04	Tol.	PB-214
3	582.28	1.6849E-001	16.83		
4	608.38	2.8684E-001	10.79	Tol.	BI-214
5	910.08	1.5726E-001	14.02		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On : 8/4/2018 12:07:14 PM

Sample Title : 006 2' to 4'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 7.700E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 11:57:11 AM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.15 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 006 2' to 4'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 12:07:12 PM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

	Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
	1	77.06	1.3925E-001	46.22		
m	2	241.28	1.1011E-001	20.70		
	3	351.28	2.9603E-001	12.76	Tol.	PB-214
	4	582.24	1.8929E-001	15.38		
	5	608.35	1.8541E-001	13.88	Tol.	BI-214
	6	868.19	2.1190E-002	44.47		
	7	909.93	1.4937E-001	14.15		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On : 8/4/2018 12:22:58 PM

Sample Title : 007 4' to 6'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 8.060E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 12:12:54 PM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.15 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** PEAK ANALYSIS REPORT *****
****

Detector Name: 4502
Sample Title: 007 4' to 6'
Peak Analysis Performed on: 8/4/2018 12:22:56 PM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	318-	328	323.22	92.59	0.42	7.30E+001	45.12	6.91E+002
2	1024-	1034	1028.02	294.61	0.47	5.79E+001	21.44	1.68E+002
3	2115-	2134	2122.42	608.42	1.28	1.63E+002	17.77	5.70E+001
4	2299-	2313	2304.95	660.77	0.45	3.92E+001	12.13	5.18E+001
5	3165-	3184	3173.83	910.05	1.75	1.03E+002	14.20	4.37E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** NUCLIDE IDENTIFICATION REPORT *****
****

Sample Title: 007 4' to 6'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr
GA-67	0.944	93.31*	39.20	3.48187E-008	2.18318E-008	err
		300.22	16.80			
CS-137	0.884	661.65*	85.12	3.53543E-008	1.11488E-008	err

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.
ISOCS/LabSOCS/Coinc. Corr. Warning/error code = 537199883
COIERR INTERNALISOCSERROR = Internal ISOCS error.
May be an invalid geometry or corrupt file.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty
GA-67	0.944	3.481866E-008	2.183180E-008
CS-137	0.884	3.535429E-008	1.114877E-008

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 12:22:56 PM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
2	294.61	9.6453E-002	37.05	Tol.	PB-214
3	608.42	2.7162E-001	10.90	Tol.	BI-214
5	910.05	1.7224E-001	13.75		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On	:	8/4/2018 10:28:44 AM
Sample Title	:	008 6' to 8'
Sample Description	:	811 Soils 500ml Jar
Sample Identification	:	ISOCS
Sample Type	:	
Sample Geometry	:	500ml Jar
Peak Locate Threshold	:	3.00
Peak Locate Range (in channels)	:	100 - 8000
Peak Area Range (in channels)	:	100 - 8000
Identification Energy Tolerance	:	1.000 keV
Sample Size	:	6.420E+002 gram
Sample Taken On	:	8/4/2018 12:00:00 AM
Acquisition Started	:	8/4/2018 10:18:42 AM
Live Time	:	600.0 seconds
Real Time	:	600.9 seconds
Dead Time	:	0.15 %

Energy Calibration Used Done On	:	5/20/2014
Efficiency Calibration Used Done On	:	4/23/2013
Efficiency ID	:	500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 008 6' to 8'
Peak Analysis Performed on: 8/4/2018 10:28:43 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	2023	2041	2030.85	582.16	0.61	1.24E+002	16.54	5.79E+001
2	2116	2134	2122.39	608.41	1.95	1.29E+002	16.48	5.44E+001
3	4795	4810	4802.07	1377.42	0.49	8.01E+000	5.03	8.99E+000

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 008 6' to 8'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 10:28:43 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	582.16	2.0688E-001	13.33		
2	608.41	2.1431E-001	12.82	Tol.	BI-214
3	1377.42	1.3344E-002	62.88		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On : 8/4/2018 9:23:41 AM

12 pCi/g Cs 137

Sample Title : 009 0' to 2'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 7.480E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 9:13:35 AM

Live Time : 600.0 seconds
Real Time : 602.0 seconds

Dead Time : 0.33 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 009 0' to 2'
Peak Analysis Performed on: 8/4/2018 9:23:38 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	108-	115	112.14	32.11	0.85	3.66E+002	44.64	5.41E+002
2	2114-	2133	2121.91	608.27	0.97	1.60E+002	24.39	1.61E+002
3	2292-	2318	2305.44	660.91	2.10	1.24E+004	113.22	1.56E+002
4	3896-	3909	3902.30	1119.11	0.53	1.79E+001	8.71	3.01E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 009 0' to 2'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr
CS-137	0.917	661.65*	85.12	1.20164E-005	7.30865E-007	miss

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty
CS-137	0.917	1.201645E-005	7.308648E-007

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 9:23:38 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	32.11	6.1059E-001	12.18		
2	608.27	2.6611E-001	15.28		
4	1119.11	2.9896E-002	48.57		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On : 8/4/2018 7:36:58 AM

Sample Title : 010 2' to 4'
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 8.380E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 7:26:55 AM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.15 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 010 2' to 4'
Peak Analysis Performed on: 8/4/2018 7:36:57 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	265-	272	269.47	77.19	0.64	7.36E+001	39.75	5.00E+002

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 010 2' to 4'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 7:36:57 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	77.19	1.2268E-001	54.01		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On	:	8/4/2018 11:10:22 AM
Sample Title	:	011 4' to 6'
Sample Description	:	811 Soils 500ml Jar
Sample Identification	:	ISOCS
Sample Type	:	
Sample Geometry	:	500ml Jar
Peak Locate Threshold	:	3.00
Peak Locate Range (in channels)	:	100 - 8000
Peak Area Range (in channels)	:	100 - 8000
Identification Energy Tolerance	:	1.000 keV
Sample Size	:	7.700E+002 gram
Sample Taken On	:	8/4/2018 12:00:00 AM
Acquisition Started	:	8/4/2018 11:00:16 AM
Live Time	:	600.0 seconds
Real Time	:	600.9 seconds
Dead Time	:	0.15 %

Energy Calibration Used Done On	:	5/20/2014
Efficiency Calibration Used Done On	:	4/23/2013
Efficiency ID	:	500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 011 4' to 6'
Peak Analysis Performed on: 8/4/2018 11:10:18 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
m	1	825-	852	844.05	241.87	1.07	7.46E+001	23.26	2.23E+002
	2	1221-	1234	1225.33	351.18	1.35	1.38E+002	20.11	1.09E+002
	3	2114-	2133	2122.21	608.36	0.94	1.21E+002	17.64	7.12E+001
	4	2296-	2315	2305.41	660.91	1.25	9.11E+001	15.60	6.19E+001
	5	3165-	3185	3173.84	910.05	1.53	6.94E+001	11.95	3.16E+001
	6	3894-	3908	3901.29	1118.82	0.46	5.15E+001	9.96	2.45E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 011 4' to 6'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr
CS-137	0.915	661.65*	85.12	8.60822E-008	1.56181E-008	miss

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty
CS-137	0.915	8.608218E-008	1.561812E-008

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 11:10:18 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

	Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
m	1	241.87	1.2437E-001	31.17		
	2	351.18	2.2933E-001	14.62	Tol.	PB-214
	3	608.36	2.0131E-001	14.60	Tol.	BI-214
	5	910.05	1.1568E-001	17.21		
	6	1118.82	8.5899E-002	19.33		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** G A M M A S P E C T R U M A N A L Y S I S *****
****

Filename: 4502

Report Generated On	:	8/4/2018 12:41:32 PM
Sample Title	:	012 6' to 8'
Sample Description	:	811 Soils 500ml Jar
Sample Identification	:	ISOCS
Sample Type	:	
Sample Geometry	:	500ml Jar
Peak Locate Threshold	:	3.00
Peak Locate Range (in channels)	:	100 - 8000
Peak Area Range (in channels)	:	100 - 8000
Identification Energy Tolerance	:	1.000 keV
Sample Size	:	8.360E+002 gram
Sample Taken On	:	8/4/2018 12:00:00 AM
Acquisition Started	:	8/4/2018 12:31:29 PM
Live Time	:	600.0 seconds
Real Time	:	600.9 seconds
Dead Time	:	0.15 %

Energy Calibration Used Done On	:	5/20/2014
Efficiency Calibration Used Done On	:	4/23/2013
Efficiency ID	:	500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 012 6' to 8'
Peak Analysis Performed on: 8/4/2018 12:41:31 PM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	1774	1784	1778.86	509.89	0.60	4.50E+001	13.37	6.80E+001
2	2113	2131	2122.21	608.36	1.83	1.44E+002	16.70	5.22E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 012 6' to 8'
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 12:41:31 PM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	509.89	7.4936E-002	29.73		
2	608.36	2.3962E-001	11.61	Tol.	BI-214

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** GAMMA SPECTRUM ANALYSIS *****
****

Filename: 4502

Report Generated On : 8/4/2018 7:49:24 AM

Sample Title : 013
Sample Description : 811 Soils 500ml Jar
Sample Identification : ISOCS
Sample Type :
Sample Geometry : 500ml Jar

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 100 - 8000
Peak Area Range (in channels) : 100 - 8000
Identification Energy Tolerance : 1.000 keV

Sample Size : 6.100E+002 gram

Sample Taken On : 8/4/2018 12:00:00 AM
Acquisition Started : 8/4/2018 7:39:21 AM

Live Time : 600.0 seconds
Real Time : 600.9 seconds

Dead Time : 0.15 %

Energy Calibration Used Done On : 5/20/2014
Efficiency Calibration Used Done On : 4/23/2013
Efficiency ID : 500ML_BOTT

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 4502
Sample Title: 013
Peak Analysis Performed on: 8/4/2018 7:49:22 AM
Peak Analysis From Channel: 100
Peak Analysis To Channel: 8000

	Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
M	1	3149-	3184	3155.22	904.70	1.79	1.40E+001	5.04	2.08E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: 013
Nuclide Library Used: C:\GENIE2K\CAMFILES\Waste Mngt.NLB

ISOCS Geom. \GENIE2K\...\SIMPLE_CYLINDER\500mlsludgebottle.geo

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (uCi/gram)	Activity Uncertainty	Coinc Corr

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 1.000 sigma
Coincidence correction performed.
free = No coincidence correction required.
miss = Nuclide energy was not found in the coincidence library.
err = Error in coincidence correction calculation.

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (uCi/gram)	Wt mean Activity Uncertainty

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 1.000 sigma

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 8/4/2018 7:49:22 AM
Peak Locate From Channel: 100
Peak Locate To Channel: 8000

	Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
M	1	904.70	2.3330E-002	36.00		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 1.000 sigma

APPENDIX C

FORM 540 — **EnergySolutions, LLC**

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
SHIPPING PAPER

1. EMERGENCY TELEPHONE NUMBER (Include Area Code): (631) 344-2222

ORGANIZATION: Brookhaven National Laboratory

2. IS THIS AN "EXCLUSIVE USE" SHIPMENT? ☐ YES ☑ NO

3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST =====> 3

4. DOES EPA REGULATED WASTE REQUIRING A MANIFEST ACCOMPANY THIS SHIPMENT? ☐ YES ☑ NO
If "Yes," provide Manifest Number =====>

EPA MANIFEST NUMBER

5. SHIPPER -- NAME AND FACILITY
Brookhaven National Laboratory
for the Department of Energy
Bldg. 860
Upton, NY 11973

Utah Generator Site Access Permit No.: 0112 001 215

SHIPMENT NUMBER: 7314-08-0020

CONTACT: Michael F. Clancy

SHIPPER I.D. NUMBER: 7314-08-0020
☐ COLLECTOR
☐ PROCESSOR
☑ GENERATOR TYPE (Specify)

TELEPHONE NUMBER (Include Area Code): (631) 344-7651

6. CARRIER – Name and Address
RSB Logistics
2425 South 4th Street
Paducah, KY 42003
Truck # - 50216
Trailer # - 48214

EPA I.D. NUMBER: WAR000012005

SHIPPING DATE: 11/15/2018

CONTACT: Ronda Darnell

TELEPHONE (Include Area Code): (270) 444-6604

SIGNATURE – *Authorized carrier acknowledging waste receipt*: William F Reed

DATE: 11-15-2018

7. FORM 540 AND 540A — PAGE 1 OF 1 PAGE(S)
FORM 541 AND 541A — 2 PAGE(S)
FORM 542 AND 542A — None PAGE(S)
ADDITIONAL INFORMATION — None PAGE(S)

8. MANIFEST NUMBER (Use this number on all continuation pages): 7314-08-0020

9. CONSIGNEE - Name and Facility
EnergySolutions, LLC
Clive Disposal Site (Bulk Waste Facility)
Interstate 80, Exit 49
Clive, UT 84029

CONTACT: Security Department

TELEPHONE (Include Area Code): (801)649-2175

SIGNATURE – *Authorized consignee acknowledging waste receipt*

DATE

10. CERTIFICATION
This is to certify that the herein-named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. This also certifies that the materials are classified, packaged, marked, and labeled and are in proper condition for transportation and disposal as described in accordance with the requirements of 10 CFR Parts 20 and 61, or equivalent state regulations.

AUTHORIZED SIGNATURE: [signature]

TITLE: Shipper

DATE: 11/15/18

11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (Including proper shipping name, hazard class, UN ID number, and any additional information)	12. DOT LABEL "RADIOACTIVE"	13. TRANSPORT INDEX	14. PHYSICAL AND CHEMICAL FORM	15. INDIVIDUAL RADIONUCLIDES			16. TOTAL PACKAGE ACTIVITY MBq	16. TOTAL PACKAGE ACTIVITY mCi	17. LSA/SCO CLASS	18. TOTAL WEIGHT OR VOLUME (Use appropriate units)	19. IDENTIFICATION NUMBER OF PACKAGE
DOT Non-Regulated Material STRONG-TIGHT POLYFIBER SACK	NA	NA	Solid Metal Oxide	Cs-137	Ra-226	U-238	2.0609E+00	5.5700E-02	NA	12668 LBS; 189 FT3	R57670
DOT Non-Regulated Material STRONG-TIGHT POLYFIBER SACK	NA	NA	Solid Metal Oxide	Cs-137	Ra-226	U-238	2.3539E+00	6.3620E-02	NA	14460 LBS; 189 FT3	R57671
DOT Non-Regulated Material STRONG-TIGHT POLYFIBER SACK	NA	NA	Solid Metal Oxide	Cs-137	Ra-226	U-238	2.0609E+00	5.5700E-02	NA	12660 LBS; 189 FT3	R57673

FOR CONSIGNEE USE ONLY

____ Record Waste Description Inadequate
____ Contamination or Leakage Detected
____ Unexpected Exposure Rates Detected
____ Labels, Markings, etc. Inadequate
____ Container Integrity Inadequate
____ Other
____ No Violations Detected on this Shipment

20. TERMS AND CONDITIONS

A. HAZARDOUS MATERIALS: Generator represents & warrants that Waste Material __ is (or) ✓ is not a hazardous waste as defined in 40 CFR 261. Where the material is a hazardous waste, this shipment is also accompanied by a separate and completed hazardous waste manifest, along with the appropriate land-disposal restriction notice and/or certification as required by 40 CFR 268.1.

B. TITLE: Upon acceptance at the disposal site by EnergySolutions, LLC, and all appropriate regulatory authorities, title to the Waste Material which conforms to Generator's representations herein shall thereupon transfer from Generator and be vested in EnergySolutions, LLC

C. WASTE MATERIAL: Generator represents and warrants that all data set forth in this (UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST) are true and correct in all respects and in accordance with all applicable governmental laws, rules, regulations and EnergySolutions LLC's facility license.

D. INDEMNIFICATION: Generator agrees to indemnify EnergySolutions, LLC, its officers, employees and agents against all losses and liability whatsoever if such losses or liability results from the failure of the Waste Material to conform in all material respects to the data supplied on the (UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST,) or if this shipment fails to meet the standards prescribed by the Department of Transportation or any governmental agency having jurisdiction over such matters.

FORM 540 (03-06)

Reviewed By [signature] (of Brookhaven Science Associates) 11/15/18 Date

on behalf of the U.S. Department of Energy at Brookhaven National Laboratory

FORM 541 — EnergySolutions, LLC

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

CONTAINER AND WASTE DESCRIPTION

Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer and Disposal of Radioactive Waste

1. MANIFEST TOTALS

NUMBER OF PACKAGES/ DISPOSAL CONTAINERS	NET WASTE VOLUME	NET WASTE WEIGHT
3	m3 11.2134	kg 17897.8489
	ft3 396.0000	ton 19.7290

SPECIAL NUCLEAR MATERIAL (grams)

U-233	U-235	Pu	Total
NP	NP	NP	NP

ACTIVITY

	ALL NUCLIDES	TRITIUM	C-14	Tc-99	I-129	SOURCE (kg)	
MBq	6.4757E+00	NP	NP	NP	NP	(kg)	5.0000E-02
mCi	1.7502E-01	NP	NP	NP	NP	(tons)	5.5116E-05

2. MANIFEST NUMBER: 7314-08-0020

3. PAGE 1 OF 2 PAGE(S)

4. SHIPPER NAME: Brookhaven National Laboratory

SHIPMENT ID NUMBER: 7314-08-0020

DISPOSAL CONTAINER DESCRIPTION / WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER

5. CONTAINER IDENTIFICATION NUMBER/ GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1 & Note 1A)	7. VOLUME (m3) / (ft3)	8. WASTE AND CONTAINER WEIGHT (kg) / (ton)	9. SURFACE RADIATION LEVEL (mSv/hr) / (mrem/hr)	10. SURFACE CONTAMINATION (MBq/100 cm2) / (dpm/100cm2) ALPHA	10. SURFACE CONTAMINATION BETA-GAMMA	11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER (m3) / (FT3)	13. SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3)	14. CHEMICAL DESCRIPTION: CHEMICAL FORM/ CHELATING AGENT	WEIGHT % CHELATING AGENT IF > 0.1%	15. RADIOLOGICAL DESCRIPTION: RADIONUCLIDES	pCi/gm	MBq	mCi	16. WASTE CLASSIFICATION AS-Class A Stable AU-Class A Unstable B-Class B C-Class C
R57670/7314-08	19 STRONG-TIGHT POLYFIBER SACK	5.3519	5746.1085	1.0000E-03	<0.0000	<0.0000	22-H	3.5679	NA	NONE/NP	NP	Cs-137	8.26869E+00	1.7427E+00	4.7100E-02	AU
												Ra-226	5.60024E-01	1.1803E-01	3.1900E-03	
		189.0000	6.3340	1.0000E-01	<20.0000	<1000.0000		126.0000				U-238 [1.5912E-02 kg]	9.49759E-01	2.0017E-01	5.4100E-03	
												Subtotal		2.0609E+00	5.5700E-02	
												Total Source [1.5912E-02 kg]		2.0609E+00	5.5700E-02	
R57671/7314-08	19 STRONG-TIGHT POLYFIBER SACK	5.3519	6558.9461	1.0000E-03	<0.0000	<0.0000	22-H	4.0776	NA	NONE/NP	NP	Cs-137	8.26546E+00	1.9906E+00	5.3800E-02	AU
												Ra-226	5.59224E-01	1.3468E-01	3.6400E-03	
		189.0000	7.2300	1.0000E-01	<20.0000	<1000.0000		144.0000				U-238 [1.8177E-02 kg]	9.49452E-01	2.2866E-01	6.1800E-03	
												Subtotal		2.3539E+00	6.3620E-02	
												Total Source [1.8177E-02 kg]		2.3539E+00	6.3620E-02	
R57673/7314-08	19 STRONG-TIGHT POLYFIBER SACK	5.3519	5742.4798	1.0000E-03	<0.0000	<0.0000	22-H	3.5679	NA	NONE/NP	NP	Cs-137	8.27397E+00	1.7427E+00	4.7100E-02	AU
												Ra-226	5.60381E-01	1.1803E-01	3.1900E-03	
		189.0000	6.3300	1.0000E-01	<20.0000	<1000.0000		126.0000				U-238 [1.5912E-02 kg]	9.50364E-01	2.0017E-01	5.4100E-03	
												Subtotal		2.0609E+00	5.5700E-02	
												Total Source [1.5912E-02 kg]		2.0609E+00	5.5700E-02	

Note 1: Container Description Codes. For containers/ waste requiring disposal in approved structural over-packs the numerical code must be followed by "-OP."

1. Wooden Box or Crate
2. Metal Box
3. Plastic Drum or Pail
4. Metal Drum or Pail
5. Metal Tank or Liner
6. Concrete Tank or Liner
7. Polyethlene Tank or Liner
8. Fiberglass Tank or Liner
9. Demineralizer
10. Gas Cylinder
11. Bulk, Unpackaged Waste
12. Unpackaged Components
13. High Integrity Container
19. Other. Describe in Item 6, or additional page

Note 1A: Bulk Packaging Description Codes. (Choose one code as may be applicable.)

A Gondola
B Intermodal
C End-Dump
D Roll-off
E Seavan

NOTE 2: Waste Descriptor Codes. (Choose up to three which predominate by volume.)

20. Charcoal
21. Incinerator Ash
22. Soil
23. Gas
24. Oil
25. Aqueous Liquid
26. Filter Media
27. Mechanical Filter
28. EPA or State Hazardous
29. Demolition Rubble
30. Cation Ion-exchange Media
31. Anion Ion-exchange Media
32. Mixed Bed Ion-exchange Media
33. Contaminated Equipment
34. Organic Liquid (except oil)
35. Glassware or Labware
36. Sealed Source/Device
37. Paint or Plating
38. Evaporator Bottoms/Sludges/ Concentrates
39. Compactible Trash
40. Noncompactible Trash
41. Animal Carcass
42. Biological Material (except animal carcass)
43. Activated Material
59. Other. Describe in item 11, or additional page

NOTE 2A: Specific Waste Descriptions (Choose all applicable codes.)

G Dewatered
H Solid
I Combustible
J Non-combustible
K Air Filtration Filters
L Asbestos

Note3: Solidification and Stabilization Media Codes. (Choose up to three which predominate by volume.) For media meeting disposal site structural stability requirements, the numerical code must be followed by "-S." and the media vendor and brand name must also be identified in Item 13. Code 100=NONE REQUIRED.

Solidification

90. Cement
91. Concrete (encapsulation)
92. Bitumen
93. Vinyl Chloride
94. Vinyl Ester Styrene
99. Other. Describe in item 13, or additional page
100. None Required.

FORM 541 (03-06)

FORM 541A

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

CONTAINER AND WASTE DESCRIPTION (CONTINUATION)

EnergySolutions, LLC

2. MANIFEST NUMBER 7314-08-0020

3. PAGE 2 OF 2 PAGE(S)

DISPOSAL CONTAINER DESCRIPTION							WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER							16. WASTE CLASSIFICATION AS-Class A Stable AU-Class A Unstable B-Class B C-Class C
							PHYSICAL DESCRIPTION			14. CHEMICAL DESCRIPTION		15. RADIOLOGICAL DESCRIPTION		
5. CONTAINER IDENTIFICATION NUMBER/ GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1 & Note 1A)	7. VOLUME (m3) / (ft3)	8. WASTE AND CONTAINER WEIGHT (kg) / (ton)	9. SURFACE RADIATION LEVEL (mSv/hr) / (mrem/hr)	10. SURFACE CONTAMINATION (MBq/100 cm2) / (dpm/100cm2)		11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER (m3) / (FT3)	13. SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3)	CHEMICAL FORM/ CHELATING AGENT	WEIGHT % CHELATING AGENT IF > 0.1%	INDIVIDUAL RADIONUCLIDES AND ACTIVITY (MBq) AND CONTAINER TOTAL; OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT			
					ALPHA	BETA-GAMMA						RADIONUCLIDES	pCi/gm	MBq	mCi
Shipment Totals		**16.0557**	**18047.5344**									**Source [5.0000E-02 kg]**		**6.4757E+00**	**1.7502E-01**
		567.0000	**19.8940**												

FORM 541A (03-06)

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
ISOTOPES REPORT

For Manifest # 7314-08-0020
EnergySolutions, LLC

Isotope	Total Activity (MBq)	(mCi)	(Ci)
Cs-137	5.4760E+00	1.4800E-01	1.4800E-04
Ra-226	3.7074E-01	1.0020E-02	1.0020E-05
U-238	6.2900E-01	1.7000E-02	1.7000E-05

FORM 540 EnergySolutions, LLC

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

SHIPPING PAPER

1. EMERGENCY TELEPHONE NUMBER *(Include Area Code)*
(631) 344-2222

ORGANIZATION
Brookhaven National Laboratory

2. IS THIS AN "EXCLUSIVE USE" SHIPMENT?
☐ YES
☑ NO

3. TOTAL NUMBER OF PACKAGES IDENTIFIED ON THIS MANIFEST =====> 4

4. DOES EPA REGULATED WASTE REQUIRING A MANIFEST ACCOMPANY THIS SHIPMENT?
☐ YES
☑ NO
If "Yes," provide Manifest Number =====>

EPA MANIFEST NUMBER

5. SHIPPER -- NAME AND FACILITY
Brookhaven National Laboratory
for the Department of Energy
Bldg. 860
Upton, NY 11973

SHIPPER I.D. NUMBER
7314-08-0021
☐ COLLECTOR
☐ PROCESSOR
☑ GENERATOR TYPE *(Specify)*

Utah Generator Site Access Permit No.
0112 001 215

SHIPMENT NUMBER
7314-08-0021

CONTACT
Glen Todzia

TELEPHONE NUMBER (Include Area Code)
(631) 344-7488

6. CARRIER -- Name and Address
RSB Logistics
2425 South 4th Street
Paducah, KY 42003

EPA I.D. NUMBER
WAR000012005

SHIPPING DATE
11/15/2018

CONTACT
Ronda Darnell

TELEPHONE (Include Area Code)
(270) 444-6604

SIGNATURE -- *Authorized carrier acknowledging waste receipt*

DATE

7. FORM 540 AND 540A — PAGE 1 OF 1 PAGE(S)
FORM 541 AND 541A — 2 PAGE(S)
FORM 542 AND 542A — None PAGE(S)
ADDITIONAL INFORMATION — None PAGE(S)

8. MANIFEST NUMBER
(Use this number on all continuation pages)
7314-08-0021

9. CONSIGNEE - Name and Facility
EnergySolutions, LLC
Clive Disposal Site (Bulk Waste Facility)
Interstate 80, Exit 49
Clive, UT 84029

CONTACT
Security Department

TELEPHONE (Include Area Code)
(801)649-2175

SIGNATURE -- *Authorized consignee acknowledging waste receipt*

DATE

10. CERTIFICATION

This is to certify that the herein-named materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. This also certifies that the materials are classified, packaged, marked, and labeled and are in proper condition for transportation and disposal as described in accordance with the requirements of 10 CFR Parts 20 and 61, or equivalent state regulations.

AUTHORIZED SIGNATURE | TITLE | DATE

11. U.S. DEPARTMENT OF TRANSPORTATION DESCRIPTION (Including proper shipping name, hazard class, UN ID number, and any additional information)	12. DOT LABEL "RADIOACTIVE"	13. TRANSPORT INDEX	14. PHYSICAL AND CHEMICAL FORM	15. INDIVIDUAL RADIONUCLIDES			16. TOTAL PACKAGE ACTIVITY MBq	mCi	17. LSA/SCO CLASS	18. TOTAL WEIGHT OR VOLUME (Use appropriate units)	19. IDENTIFICATION NUMBER OF PACKAGE
DOT Non-Regulated Material STRONG-TIGHT POLYFIBER SACK	**NA**	**NA**	**Solid Metal Oxide**	Cs-137	Ra-226	U-238	**1.9995E+00**	**5.4040E-02**	**NA**	**12300 LBS; 189 FT3**	**R57672**
DOT Non-Regulated Material STRONG-TIGHT POLYFIBER SACK	**NA**	**NA**	**Solid Metal Oxide**	Cs-137	Ra-226	U-238	**1.4219E+00**	**3.8430E-02**	**NA**	**8760 LBS; 189 FT3**	**R57674**
DOT Non-Regulated Material Metal Box	**NA**	**NA**	**Solid Metal Oxide**	Cs-137	Ra-226	U-238	**4.5480E-01**	**1.2292E-02**	**NA**	**3320 LBS; 48 FT3**	**R57675**
DOT Non-Regulated Material Metal Box	**NA**	**NA**	**Solid Metal Oxide**	Cs-137	Ra-226	U-238	**2.5419E-01**	**6.8700E-03**	**NA**	**2100 LBS; 48 FT3**	**R57676**

FOR CONSIGNEE USE ONLY

____ Record Waste Description Inadequate
____ Contamination or Leakage Detected
____ Unexpected Exposure Rates Detected
____ Labels, Markings, etc. Inadequate
____ Container Integrity Inadequate
____ Other
____ No Violations Detected on this Shipment

20. TERMS AND CONDITIONS

A. HAZARDOUS MATERIALS: Generator represents & warrants that Waste Material __ is (or) Ü is not a hazardous waste as defined in 40 CFR 261. Where the material is a hazardous waste, this shipment is also accompanied by a separate and completed hazardous waste manifest, along with the appropriate land-disposal restriction notice and/or certification as required by 40 CFR 268.1.

B. TITLE: Upon acceptance at the disposal site by EnergySolutions, LLC, and all appropriate regulatory authorities, title to the Waste Material which conforms to Generator's representations herein shall thereupon transfer from Generator and be vested in EnergySolutions, LLC

C. WASTE MATERIAL: Generator represents and warrants that all data set forth in this (UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST) are true and correct in all respects and in accordance with all applicable governmental laws, rules, regulations and EnergySolutions LLC's facility license.

D. INDEMNIFICATION: Generator agrees to indemnify EnergySolutions, LLC, its officers, employees and agents against all losses and liability whatsoever if such losses or liability results from the failure of the Waste Material to conform in all material respects to the data supplied on the (UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST,) or if this shipment fails to meet the standards prescribed by the Department of Transportation or any governmental agency having jurisdiction over such matters.

FORM 541 EnergySolutions, LLC

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

CONTAINER AND WASTE DESCRIPTION

Additional Nuclear Regulatory Commission (NRC) Requirements for Control, Transfer and Disposal of Radioactive Waste

1. MANIFEST TOTALS

NUMBER OF PACKAGES/ DISPOSAL CONTAINERS	NET WASTE VOLUME	NET WASTE WEIGHT	SPECIAL NUCLEAR MATERIAL (grams) U-233	U-235	Pu	Total
4	m3 6.4847	kg 11411.0241	NP	NP	NP	NP
	ft3 229.0000	ton 12.5785				

ACTIVITY	ALL NUCLIDES	TRITIUM	C-14	Tc-99	I-129	SOURCE (kg)	
MBq	4.1304E+00	NP	NP	NP	NP	(kg)	3.1874E-02
mCi	1.1163E-01	NP	NP	NP	NP	(tons)	3.5135E-05

2. MANIFEST NUMBER 7314-08-0021

3. PAGE 1 OF 2 PAGE(S)

4. SHIPPER NAME Brookhaven National Laboratory

SHIPMENT ID NUMBER 7314-08-0021

DISPOSAL CONTAINER DESCRIPTION							WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER							16. WASTE CLASSIFICATION AS-Class A Stable AU-Class A Unstable B-Class B C-Class C
5. CONTAINER IDENTIFICATION NUMBER/ GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1 & Note 1A)	7. VOLUME (m3) / (ft3)	8. WASTE AND CONTAINER WEIGHT (kg) / (ton)	9. SURFACE RADIATION LEVEL (mSv/hr) / (mrem/hr)	10. SURFACE CONTAMINATION (MBq/100 cm2) / (dpm/100cm2) ALPHA	BETA-GAMMA	PHYSICAL DESCRIPTION 11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER (m3) / (FT3)	13. SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3)	14. CHEMICAL DESCRIPTION CHEMICAL FORM/ CHELATING AGENT	WEIGHT % CHELATING AGENT IF > 0.1%	15. RADIOLOGICAL DESCRIPTION INDIVIDUAL RADIONUCLIDES AND ACTIVITY (MBq) AND CONTAINER TOTAL; OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT RADIONUCLIDES	pCi/gm	MBq	mCi	
R57672/7314-08	19 STRONG-TIGHT POLYFIBER SACK	5.3519	5579.1865	1.0000E-03	<0.0000	<0.0000	22-H	3.4547	89 - WASTE LOCK 770	NONE/NP	1	Cs-137	8.26512E+00	1.6909E+00	4.5700E-02	AU
		189.0000	6.1500	1.0000E-01	<20.0000	<1000.0000		122.0000				Ra-226	5.58845E-01	1.1433E-01	3.0900E-03	
												U-238 [1.5441E-02 kg]	9.49494E-01	1.9425E-01	5.2500E-03	
												Subtotal		1.9995E+00	5.4040E-02	
												Total		1.9995E+00	5.4040E-02	
												Source [1.5441E-02 kg]				
R57674/7314-08	19 STRONG-TIGHT POLYFIBER SACK	5.3519	3973.4694	1.0000E-03	<0.0000	<0.0000	22-H	2.4636	89 - WASTE LOCK 770	NONE/NP	1	Cs-137	8.28331E+00	1.2025E+00	3.2500E-02	AU
		189.0000	4.3800	1.0000E-01	<20.0000	<1000.0000		87.0000				Ra-226	5.60716E-01	8.1400E-02	2.2000E-03	
												U-238 [1.0971E-02 kg]	9.50669E-01	1.3801E-01	3.7300E-03	
												Subtotal		1.4219E+00	3.8430E-02	
												Total		1.4219E+00	3.8430E-02	
												Source [1.0971E-02 kg]				
R57675/7314-08	2	1.3592	1505.9268	1.0000E-03	<0.0000	<0.0000	59-Concrete-H	0.2832	NA	NONE/NP	NP	Cs-137	8.28331E+00	3.8480E-01	1.0400E-02	AU
		48.0000	1.6600	1.0000E-01	<20.0000	<1000.0000		10.0000				Ra-226	5.59123E-01	2.5974E-02	7.0200E-04	
												U-238 [3.5000E-03 kg]	9.47802E-01	4.4030E-02	1.1900E-03	
												Subtotal		4.5480E-01	1.2292E-02	
												Total		4.5480E-01	1.2292E-02	
												Source [3.5000E-03 kg]				

Note 1: Container Description Codes. For containers/ waste requiring disposal in approved structural over-packs the numerical code must be followed by "-OP."

1. Wooden Box or Crate
2. Metal Box
3. Plastic Drum or Pail
4. Metal Drum or Pail
5. Metal Tank or Liner
6. Concrete Tank or Liner
7. Polyethlene Tank or Liner
8. Fiberglass Tank or Liner
9. Demineralizer
10. Gas Cylinder
11. Bulk, Unpackaged Waste
12. Unpackaged Components
13. High Integrity Container
19. Other. Describe in Item 6, or additional page

Note 1A: Bulk Packaging Description Codes. (Choose one code as may be applicable.)

A Gondola
B Intermodal
C End-Dump
D Roll-off
E Seavan

NOTE 2: Waste Descriptor Codes. (Choose up to three which predominate by volume.)

20. Charcoal
21. Incinerator Ash
22. Soil
23. Gas
24. Oil
25. Aqueous Liquid
26. Filter Media
27. Mechanical Filter
28. EPA or State Hazardous
29. Demolition Rubble
30. Cation Ion-exchange Media
31. Anion Ion-exchange Media
32. Mixed Bed Ion-exchange Media
33. Contaminated Equipment
34. Organic Liquid (except oil)
35. Glassware or Labware
36. Sealed Source/Device
37. Paint or Plating
38. Evaporator Bottoms/Sludges/ Concentrates
39. Compactible Trash
40. Noncompactible Trash
41. Animal Carcass
42. Biological Material (except animal carcass)
43. Activated Material
59. Other. Describe in item 11, or additional page

NOTE 2A: Specific Waste Descriptions (Choose all applicable codes.)

G Dewatered
H Solid
I Combustible
J Non-combustible
K Air Filtration Filters
L Asbestos

Note3: Solidification and Stabilization Media Codes. (Choose up to three which predominate by volume.) For media meeting disposal site structural stability requirements, the numerical code must be followed by "-S." and the media vendor and brand name must also be identified in Item 13. Code 100=NONE REQUIRED.

Solidification
90. Cement
91. Concrete (encapsulation)
92. Bitumen
93. Vinyl Chloride
94. Vinyl Ester Styrene
99. Other. Describe in item 13, or additional page
100. None Required.

FORM 541A

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST

CONTAINER AND WASTE DESCRIPTION (CONTINUATION)

EnergySolutions, LLC

2. MANIFEST NUMBER 7314-08-0021

3. PAGE 2 OF 2 PAGE(S)

DISPOSAL CONTAINER DESCRIPTION							WASTE DESCRIPTION FOR EACH WASTE TYPE IN CONTAINER								16. WASTE CLASSIFICATION AS-Class A Stable AU-Class A Unstable B-Class B C-Class C
							PHYSICAL DESCRIPTION			14. CHEMICAL DESCRIPTION		15. RADIOLOGICAL DESCRIPTION			
5. CONTAINER IDENTIFICATION NUMBER/ GENERATOR ID NUMBER(S)	6. CONTAINER DESCRIPTION (See Note 1 & Note 1A)	7. VOLUME (m3) / (ft3)	8. WASTE AND CONTAINER WEIGHT (kg) / (ton)	9. SURFACE RADIATION LEVEL (mSv/hr) / (mrem/hr)	10. SURFACE CONTAMINATION (MBq/100 cm2) / (dpm/100cm2) ALPHA	BETA-GAMMA	11. WASTE DESCRIPTOR (See Note 2 & Note 2A)	12. APPROXIMATE WASTE VOLUME(S) IN CONTAINER (m3) / (FT3)	13. SOLIDIFICATION OR STABILIZATION MEDIA (See Note 3)	CHEMICAL FORM/ CHELATING AGENT	WEIGHT % CHELATING AGENT IF > 0.1%	INDIVIDUAL RADIONUCLIDES AND ACTIVITY (MBq) AND CONTAINER TOTAL; OR CONTAINER TOTAL ACTIVITY AND RADIONUCLIDE PERCENT				
												RADIONUCLIDES	pCi/gm	MBq	mCi	
R57676/7314-08	2	1.3592	952.5440	1.0000E-03	<0.0000	<0.0000	59-Concrete,METAL, 39-H	0.2832	NA	NONE/NP	NP	Cs-137	8.26916E+00	2.1497E-01	5.8100E-03	AU
												Ra-226	5.59342E-01	1.4541E-02	3.9300E-04	
		48.0000	1.0500	1.0000E-01	<20.0000	<1000.0000		10.0000				U-238 [1.9618E-03 kg]	9.49316E-01	2.4679E-02	6.6700E-04	
												Subtotal		2.5419E-01	6.8700E-03	
												Total		2.5419E-01	6.8700E-03	
												Source [1.9618E-03 kg]				
Shipment Totals		13.4222	12011.1267									Source [3.1874E-02 kg]		4.1304E+00	1.1163E-01	
		474.0000	13.2400													

FORM 541A (03-06)

UNIFORM LOW-LEVEL RADIOACTIVE WASTE MANIFEST
ISOTOPES REPORT

For Manifest # 7314-08-0021
EnergySolutions, LLC

Isotope	Total Activity (MBq)	(mCi)	(Ci)
Cs-137	**3.4932E+00**	**9.4410E-02**	**9.4410E-05**
Ra-226	**2.3625E-01**	**6.3850E-03**	**6.3850E-06**
U-238	**4.0097E-01**	**1.0837E-02**	**1.0837E-05**

APPENDIX D

Brookhaven National Laboratory
Radiochemical Analytical Data Package Verification Checklist

Project	Bldg 810/811 Soils			
Sampling Contractor	PWG Grosser / EPD Field Sampling			
Analytical Laboratory	General Engineering Labs			
Analytical Method	DOE HASL 300 / EPA 905/906			
Sample Delivery Group	45630001			
COC No./Sample IDs	39984 / 001-015			
Date Sampled	7/31/18			
Parameter(s)	Gamma Scan, Sr-90, U-235/236, Pu-239/240, H-3			
	Satisfactory	**Unsatisfactory**	**NA**	**Comment**
Sample IDs	X			Equipment Blank mis-labeled by BNL
Detection Limits (CRDL)	X			
Duplicates	X			
Matrix Spike (MS/MSD)	X			
MS/MSD Recoveries	X			
Field Blanks	X			
Equipment Blanks	X			
Method Blanks	X			Sample #9, U-235/236 MDA < MB < RL
Chain-of-Custody Forms	X			
Field Sampling Logs			X	
Holding Times	X			
Nonconformance			X	
Other			X	

Reviewed by _____ Date _____
Project Manager

Attachment 1

BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management

Site Brookhaven National Laboratory Project Name 810/811 Soils

Contract Laboratory General Engineering Labs Project Manager Bob Howe

Sample Delivery Group (SDG) 45630000 Sampling Date (Month/Year) 7/18

Type of Analyses/Special Request:

BNL Sample ID	Lab ID		BNL Sample ID	Lab ID
39984-009	456300010			

Laboratory QC Samples:

Number of Samples Analyzed 15 Total Number of Analyses 87 (41 QC analyses)

MS = Matrix Spike
MSD = Matrix Spike Duplicate
Dup = Matrix Duplicate (replicate)
RE = Reanalysis

Data Reviewer C Schaefer, CHP Date 10/2/18

QA Review by C Schaefer, CHP Date 10/2/18

Data Validation Management (if applicable) N/A Date

EM Manager.Approval N/A Date

Contractual violations found? Yes ____ No X Not Applicable ____

Attach, as necessary, the following Sample Delivery Group (SDF) information:

I. Data Qualifier and Sub Qualifier Definitions
II. Laboratory Case Narratives, Telephone Logs and Correspondence
III. Qualified Sample Results (Form 1's)
IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
V. Standardized Data Validation Comments

Deliverable:

Analyte:	GS	Sr-90	Pu/n	H-3
Case Narrative	X	X	X	X
Chain-of-Custody Records/Traffic Reports/Tracking Records	X	X	X	X
BNL Sample Identifiers and Unique Laboratory ID	X	X	X	X
Initial Calibration / Efficiency Determination	X	X	X	X
Daily Efficiency Check /Continuing Calibration Verification Results	X	X	X	X
Minimum Detectable Concentration Results and a Hand Calculation	X	X	X	X
Daily Background Results	X	X	X	X
Method Blank Results	X	X	X	X
Matrix Spike/Matrix Spike Duplicates Results	X	X	X	X
Gravimetric Standard / Chemical Tracer Results	N/A	X	X	N/A
Duplicate/Replicate Results	X	X	X	X
Laboratory Control Sample (LCS) Results	X	X	X	X
LCS Control Charts	X	X	X	X
Self Absorption Factors (Sr 90, alpha spec., gross alpha and gross beta)	N/A	X	N/A	N/A
Percent Completeness Report	O	O	O	O
Turn Around Time Documents (COC and Case Narrative)	X	X	X	X
Run Log	X	X	X	X
Sample Raw Data	X	X	X	X
Preparation Log Bench sheets	X	X	X	X
Percent Solids Calculations / Bench sheets	X	X	X	X
Legible Pages	X	X	X	X
Pages in Package Numbered and in Sequence	X	X	X	X

a/b = gross alpha/gross beta
GS = gamma scan
H3 = Tritium
Np-237 = neptunium-237
NR = Not Required
0 = Not included and/or Not Complete
Pu-240 = plutonium-240, Pu-242 = plutonium-242
Ra-228 = radium-228
RS = Provided as a Resubmission
Th-230 = thorium-230
U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238
Tc-99 = technetium-99
Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90
X = Included in original data package

Questions:

1. Deliverables

   All data deliverables, as expected, were found in the package and sent through resubmissions.

   Yes X No _____ Comments:

   a. The following are expected deliverables that were not found in the data package:

   b. The following deliverables were found to have problems or contain errors, as provided in the data package:

   c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:

   d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

2. Holding Times/Preservations

   a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

   Yes X No _____ Comments:

3. Tentatively Identified Radionuclides

   a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

   Yes X No _____ Comments:

   b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

   Yes X No _____ Comments:

4. Contract Required Detection Limits

   a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

   Yes X No _____ Comments:

5. Background and Laboratory Quality Control Samples

a. The required summary forms/information were provided and information was present to determine that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No _____ Comments:

b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No _____ Comments:

6. Contamination and Background Stability Quality Control

a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No _____ Comments:

b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit.

Yes _____ No X Comments: Result for U-235/236 Method Blank > MDA but < Reporting Limit.

c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes X No _____ Comments: Equipment Blanks submitted.

7. Gravimetric Standard / Chemical Tracer

a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had measured recoveries within the required control limits.

Yes X No _____ Comments:

8. Accuracy Statements

a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No _____ Comments:

b. Laboratory control charts were provided in the package.

Yes X No _____ Comments:

c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes X No _____ Comments:

f. The matrix (pre-digest) spike frequency requirement was met.

Yes X No _____ Comments:

g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes X No _____ Comments:

9. Precision Statement

a. The matrix (pre-digest) duplicate frequency was met.

Yes X No _____ Comments:

b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No _____ Comments: 26.7% RPD for Ra-226. Okay.

c. This package contained a field duplicate.

Yes X No _____ Comments:

d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No _____ Comments:

10. Self-Absorption Factors

a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X No _____ Comments: Self absorption factors for Gas Flow (Sr-90) reviewed. Okay.

11. Analytical Methods

a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X No _____ Comments:

12. Turnaround Time

a. The turnaround time specified on the chain-of-custody record of 14 days was met.

Yes X No _____ Comments: Exception: Ra-226 due to Radon in-growth time required per procedure. Okay.

13. Completeness

a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X No _____ Comments:

14. Calculations and Transcription

a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X No _____ Comments: Verified ^{137}Cs result for sample 39984-009. Okay.

b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X No _____ Comments: Verified ^{90}Sr result for sample 39984-009. Okay.

15. System Performance

a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X No _____ Comments:

16. Contract Requirements

a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X No _____ Comments:

17. Additional Comments

All supporting QC data is satisfactory.

C Schaefer, CHP

10/2/18

BROOKHAVEN NATIONAL LABORATORY

Data Usability Summary Report

Project:	Bldg 810/811 Soils
Sampling Contractor:	PW Grasser / EPD Field Sampling
Analytical Laboratory:	General Engineering Labs
Analytical Method and/or Parameter:	DOE HASL 300 / EPA 905/906
Sample Delivery Group:	456300001
Chain-of-Custody (COC) No. / Sample IDs:	39984 / 001-015
Date Sampled:	7/31/18
Parameter(s):	Gamma Scan, Sr-90, U-235/236, Pu, H-3

SAMPLE ID	*DATA USABILITY QUALIFIERS*	*EXPLANATION FOR QUALIFIERS*
39984 001-015	No Qualifiers	N/A

Summary: Data useable as reported by GEL.

Reviewed by: C Arthofer, CHP Date: 10/2/18
Subject Matter Expert

Reviewed by: _____ Date: _____
Project Manager

Brookhaven National Laboratory
Radiochemical Analytical Data Package Verification Checklist

Project	Bldg 810/811 Soils			
Sampling Contractor	EPD Sampling			
Analytical Laboratory	General Engineering Labs			
Analytical Method	DOE HASL 300 / EPA 905/906			
Sample Delivery Group	45628800			
COC No./Sample IDs	39987 / 001 - 026			
Date Sampled	7/31/18			
Parameter(s)	Gamma Scan, Sr-90, Uranium, Plutonium, H-3			
	Satisfactory	**Unsatisfactory**	**NA**	**Comment**
Sample IDs	X			
Detection Limits (CRDL)	X			Co-57 + Be-7 did not meet RDL due to limited volume
Duplicates	X			
Matrix Spike (MS/MSD)	X			
MS/MSD Recoveries	X			
Field Blanks	X			
Equipment Blanks	X			
Method Blanks	X			Liquid Sr90 > MDC; Sample results < MDC.
Chain-of-Custody Forms	X			
Field Sampling Logs			X	
Holding Times	X			
Nonconformance			X	
Other			X	

Reviewed by _____ Date _____
Project Manager

Attachment 1

BNL RADIOCHEMICAL VALIDATION REPORT

Project No. N/A Program Waste Management

Site Brookhaven National Laboratory Project Name 810/811 Soils

Contract Laboratory General Engineering Labs Project Manager Bob Howe

Sample Delivery Group (SDG) 456288 00 Sampling Date (Month/Year) 7/18

Type of Analyses/Special Request:

BNL Sample ID	Lab ID		BNL Sample ID	Lab ID
39987-001	456288001			
-019	456288019			

Laboratory QC Samples:

Number of Samples Analyzed 26 Total Number of Analyses 130 (54 QC analyses)

MS = Matrix Spike
MSD = Matrix Spike Duplicate
Dup = Matrix Duplicate (replicate)
RE = Reanalysis

Data Reviewer C Schaefer, CHP Date 10/3/18

QA Review by C Schaefer, CHP Date 10/3/18

Data Validation Management (if applicable) N/A Date

EM Manager.Approval N/A Date

Contractual violations found? Yes ____ No X Not Applicable ____

Attach, as necessary, the following Sample Delivery Group (SDF) information:

I. Data Qualifier and Sub Qualifier Definitions
II. Laboratory Case Narratives, Telephone Logs and Correspondence
III. Qualified Sample Results (Form 1's)
IV. Laboratory Matrix QC Summary Forms (Forms 5A and 6)
V. Standardized Data Validation Comments

Deliverable:

Analyte:	GS	Sr-90	Pu/U	H-3
Case Narrative	X	X	X	X
Chain-of-Custody Records/Traffic Reports/Tracking Records	X	X	X	X
BNL Sample Identifiers and Unique Laboratory ID	X	X	X	X
Initial Calibration / Efficiency Determination	X	X	X	X
Daily Efficiency Check /Continuing Calibration Verification Results	X	X	X	X
Minimum Detectable Concentration Results and a Hand Calculation	X	X	X	X
Daily Background Results	X	X	X	X
Method Blank Results	X	X	X	X
Matrix Spike/Matrix Spike Duplicates Results	X	X	X	X
Gravimetric Standard / Chemical Tracer Results	N/A	X	X	N/A
Duplicate/Replicate Results	X	X	X	X
Laboratory Control Sample (LCS) Results	X	X	X	X
LCS Control Charts	X	X	X	X
Self Absorption Factors (Sr 90, alpha spec., gross alpha and gross beta)	X	X	X	X
Percent Completeness Report	O	O	O	O
Turn Around Time Documents (COC and Case Narrative)	X	X	X	X
Run Log	X	X	X	X
Sample Raw Data	X	X	X	X
Preparation Log Bench sheets	X	X	X	X
Percent Solids Calculations / Bench sheets	X	X	X	X
Legible Pages	X	X	X	X
Pages in Package Numbered and in Sequence	X	X	X	X

a/b = gross alpha/gross beta
GS = gamma scan
H3 = Tritium
Np-237 = neptunium-237
NR = Not Required
0 = Not included and/or Not Complete
Pu-240 = plutonium-240, Pu-242 = plutonium-242
Ra-228 = radium-228
RS = Provided as a Resubmission
Th-230 = thorium-230
U-233 = uranium-233, U-234 = uranium-234, U-235 = uranium-235, U-236 = uranium-236, U-238 = uranium-238
Tc-99 = technetium-99
Sr-89 = Strontium-89, Sr-89/90 = Strontium-89/90, Sr-90 = Strontium-90
X = Included in original data package

Questions:

1. Deliverables

   All data deliverables, as expected, were found in the package and sent through resubmissions.

   Yes X No _____ Comments:

   a. The following are expected deliverables that were not found in the data package:

   b. The following deliverables were found to have problems or contain errors, as provided in the data package:

   c. The following are expected deliverables that were initially not in the data package, but were provided as a resubmission:

   d. The following deliverables were initially found to have problems or contain errors; corrected information was provided in the laboratory resubmission:

2. Holding Times/Preservations

   a. Samples were prepared and analyzed within holding times specified by the project guidelines. The holding time is based on the date of sample collection to the date of analysis, with modifications for preservatives as necessary.

   Yes X No _____ Comments:

3. Tentatively Identified Radionuclides

   a. All tentatively identified radionuclides have been identified and assigned a data qualifier.

   Yes X No _____ Comments:

   b. Sample identification met all spectral line energy and percent of major peaks accounted for requirements.

   Yes X No _____ Comments:

4. Contract Required Detection Limits

   a. The MDCs for all results that are at or near background levels were less than or equal to the contract required detection limits (CRDL).

   Yes X No _____ Comments:

5. Background and Laboratory Quality Control Samples

a. The required summary forms/information were provided and information was present to determine that initial calibration and geometry met guidelines (correlation, number of calibration standards, distribution range of standards, peak shape, spectral lines for gamma, etc.) or method criteria.

Yes X No _____ Comments:

b. The continuing calibration standard (CCV) efficiency analyses were reported as required and had recoveries reported to be within the specified control limits.

Yes X No _____ Comments:

6. Contamination and Background Stability Quality Control

a. Preparation/method blank was prepared and analyzed at the specified frequency. Background determinations were performed.

Yes X No _____ Comments:

b. All analytes in the blank and background were below the minimum detectable concentration (i.e., detection limit.

Yes _____ No X Comments: Sr-90 method Blank > MDC, but all (liquid) Sample results < MDC. Okay.

c. The package contained other types of blanks submitted to the laboratory with the field samples.

Yes X No _____ Comments: Equipment Blanks submitted.

7. Gravimetric Standard / Chemical Tracer

a. Gravimetric standards / chemical tracers were analyzed at the specified frequency and had measured recoveries within the required control limits.

Yes X No _____ Comments:

8. Accuracy Statements

a. Spike/laboratory control samples (LCS) analyses were performed with each sample batch and for each matrix in the data package.

Yes X No _____ Comments:

b. Laboratory control charts were provided in the package.

Yes X No _____ Comments:

c. Spike/laboratory control sample (LCS) analyses were reported to be within control limits (75-125%).

Yes X No _____ Comments:

f. The matrix (pre-digest) spike frequency requirement was met.

Yes X No _____ Comments:

g. Matrix spike recoveries were within the specified control limits (75 - 125%).

Yes X No _____ Comments:

9. Precision Statement

a. The matrix (pre-digest) duplicate frequency was met.

Yes X No _____ Comments:

b. Matrix (pre-digest) duplicate differences were within specified control limits (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No _____ Comments:

c. This package contained a field duplicate.

Yes X No _____ Comments:

d. All field duplicate results met criteria (aqueous: 20% RPD or the RER less than 2.0 for results less than five times the MDC; soil: 35% RPD or the RER less than 2.0 for results less than five times the MDC).

Yes X No _____ Comments:

10. Self-Absorption Factors

a. Self-absorption factors were generated for alpha and beta determinations. Solids content in samples did not exceed 100 mg total.

Yes X No _____ Comments: Self absorption reviewed. Okay.

11. Analytical Methods

a. The analytical methods used were as specified on the chain-of-custody, the BNL QAPP.

Yes X No _____ Comments:

12. Turnaround Time

a. The turnaround time specified on the chain-of-custody record of _____ days was met.

Yes X No _____ Comments:

13. Completeness

a. The percent of data completeness for all radionuclides and methods were greater than 90%.

Yes X No _____ Comments:

14. Calculations and Transcription

a. Correct contract/method calculations (i.e. curve generation, sample quantitation, etc.) were performed.

Yes X No _____ Comments: Verified ^{137}Cs and ^{90}Sr results for samples 001 and 019. Okay.

b. Raw data was transcribed accurately to sample and QC summary sheets.

Yes X No _____ Comments:

15. System Performance

a. The instrumental and analytical systems used in the analysis of these samples maintained an acceptable level of performance throughout this case.

Yes X No _____ Comments:

16. Contract Requirements

a. All contract requirements were met by the laboratory in the preparation and analysis of the samples in the package.

Yes X No _____ Comments:

17. Additional Comments

Supporting QC data is satisfactory.

C Schaefer, CHP

10/3/18

BROOKHAVEN NATIONAL LABORATORY

Data Usability Summary Report

Project:	Bldg 810/811 Soils
Sampling Contractor:	EPD Field Sampling
Analytical Laboratory:	General Engineering Labs
Analytical Method and/or Parameter:	DOE HASL 300 / EPA 905/906
Sample Delivery Group:	45628800
Chain-of-Custody (COC) No. / Sample IDs:	39987 / 001-026
Date Sampled:	7/31/18
Parameter(s):	Gamma Scan, Sr-90, Plutonium, Uranium, H-3

SAMPLE ID	*DATA USABILITY QUALIFIERS*	*EXPLANATION FOR QUALIFIERS*
39987 001-026	No Qualifiers	N/A

Summary: Data useable as reported by GEL.

Reviewed by: C Schaefer, CAP Date: 10/3/18
Subject Matter Expert

Reviewed by: _____ Date: _____
Project Manager