

Attachment Y

Final Status Survey Report #27 Documentation

(UNDER SEPARATE COVER)

FSSR # 27



FINAL

**COLUMBUS CLOSURE PROJECT
CHARACTERIZATION AND FINAL STATUS
SURVEY REPORT FOR THE
JN-1 SOUTH AND EAST GROUNDS**

Revision 1
June 16, 2006

Prepared by

ECC & E2 Closure Services
1425 State Route 142 East
West Jefferson, OH 43162

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Contract Number: DE-AC24-04OH20171

FINAL Characterization and Final Status Report for the JN-1 South and East Grounds

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1.0 Introduction

This report contains the final status surveys (FSS) for the JN-1 south and eastern grounds area located at the Columbus Closure Project (CCP), 1425 State Route 142 East, West Jefferson, OH 43162. The JN-1 south and eastern grounds are an area lying south of the JN-1C and east of the JN-1C and A foundations, continuing to the restricted area fence line. Final status surveys were conducted according to the guidance presented in the *Manual for Conducting Surveys in Support of License Termination*, NUREG/CR-5849 (NUREG/CR-5849) (ORAU, 1992) and the *Radiological Characterization and Final Status Plan for Battelle Columbus Laboratories Decommissioning Project, West Jefferson Site*, DD-97-02 (Final Status Plan) (Battelle, 2000). The final status surveys were conducted in December of 2005 and performed under Work Instruction 2806 (Closure Services, 2004).

The intent of this final status survey report is to provide a complete and unambiguous record of the radiological status of the excavation and release of the JN-1 south and eastern grounds. Sufficient information and data is provided to enable an independent evaluation at some future date of both the survey activities and the reported results for the excavations. Information in this report is also available in referenced technical basis documents, final status survey plans and procedures, and the *Battelle Memorial Institute Columbus Operations, Decommissioning Plan*, DD-93-19 (BMI Decommissioning Plan), and reporting and quality assurance procedures.

To the extent practicable, this final status survey report is presented with minimal information incorporated by reference. This final status survey report has been generated following the comprehensive, annotated outline presented in Chapter 9 of NUREG-5849 (ORAU, 1992).

1.1 Background

On April 16, 1943, BMI, acting through what is now its Battelle Columbus Operations (BCO), entered into Contract No. W-7405-ENG-92 with the Manhattan Engineering District to perform atomic energy research and development (R&D) activities. BCO performed nuclear materials research and development at privately-owned facilities for the Manhattan Engineering District and its successor agencies – the Atomic Energy Commission (AEC), the Energy Research and Development Agency (ERDA), and the Department of Energy (DOE). Research and development continued until 1988 (Battelle, 2003a).

The BCO facilities at the King Avenue Site, Columbus, Ohio, and the West Jefferson North (WJN) and South (WJS) Sites, West Jefferson, Ohio, became partially radiologically contaminated as a result of the R&D activities. Decontamination of the King Avenue and WJS Sites has been completed and activities continue at the WJN site. The DOE, as the successor to the AEC and the Government's earlier work, is the agreed party with predominant liability and responsibility for decontamination and decommissioning (D&D) of the BCO facilities (Battelle, 2003a). The Assistant Secretary for Nuclear Energy of the DOE accepted the decontamination and decommissioning (D&D) of the WJN into the DOE's

Surplus Facilities Management Program as a major project (DOE, 1986). The DOE is the agency funding and managing the cleanup of the WJN (Battelle, 2003a). However, the site is not a DOE-owned facility.

BMI holds U.S. Nuclear Regulatory Commission (NRC) license number SNM-7. BMI has continually operated and conducted D&D activities in full compliance with this NRC license. Decontamination and decommissioning activities under the NRC license have been planned and executed according to the BMI Decommissioning Plan. The BMI Decommissioning Plan for the WJN site does not serve as a declaration to terminate SNM-7, but establishes the criteria for performing D&D activities. The end goal of the BMI Decommissioning Plan is to reach unrestricted use conditions for the site (Battelle, 2003a).

In 2002, the DOE contracted ECC&E2 Closure Services, LLC (Closure Services) to complete the safe removal of the DOE radioactive materials and contamination from the WJN site. Removal of radioactive material will be to levels allowing future use of the site without radiological restrictions as described in the BMI Decommissioning Plan. Closure Services has conducted the characterization and the final status surveys of the JN-1 south and eastern excavation and land areas demonstrating that the area is available for unrestricted release.

2.0 Site Description

Created in 1984, the Battelle Columbus Decommissioning Project (BCDDP) is a remediation project that includes nine buildings at the King Avenue site and five at the WJN site. The WJN site consists of the decontamination and decommissioning of an 11.7 acre property near West Jefferson, Ohio. Three former radiological contaminated structures, Buildings JN-1, JN-2, and JN-3, have been demolished and removed from the site. Building JN-6 was also demolished and removed from the site. Excavation and removal has also been performed of sanitary sewer systems, underground piping, and the filter beds area. Building JN-4 and the WJN Well House are the only remaining structures at the site. Several outfalls, filter beds, and wells also remain at the site. **Figure 1** presents a site map for the CCP.

2.1 Area Description

As shown in **Figure 1**, Building JN-1 was located on the eastern portion of the WJN site. Building JN-1 had nine storm water collection lines running from the east side of the building to the eventual discharge point at the JN-1 Bog area. Excavation activities also included the removal of the eastern portion of the cooling waste line running through the south and east ground of Building JN-1. The east portion of the cooling waste line, the rain water collection piping, and all overburden materials were excavated, removed, and disposed off-site as low level waste. **Figure 2** presents the excavations within the south and eastern portion of the JN-1 yard, along with the excavation of the eastern portion of the cooling waste line.

The JN-1 Bog area final status is presented in a separate report.

Two classifications of areas are used in NUREG-5849 and are termed **affected** or **unaffected**. These classifications are defined as (NRC, 1992):

Affected Areas: Areas that have potential radioactive contamination (based on plant operating history) or known radioactive contamination (based on past or preliminary radiological surveillance). This would normally include areas where radioactive materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in spread of contamination, and where radioactive materials were buried. Areas immediately surrounding or adjacent to locations where radioactive materials were used, stored, or buried are included in this classification because of the potential for inadvertent spread of contamination.

Unaffected Areas: All areas not classified as affected. These areas are not expected to contain residual radioactivity, based on knowledge of site history and previous information.

The JN-1 south and eastern land area and excavations are considered to be affected.

3.0 Decommissioning Activities

3.1 *Decommissioning Objective*

The objective of the final status survey performed on the JN-1 south and east grounds and the excavation is to statistically demonstrate that the remediation of the area is free from residual radioactive contamination making it suitable for unrestricted release. The excavations and grounds are determined to be free of residual radioactive contamination when remaining soil contamination levels are below those presented in DD-93-03, Rev. 0, "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratory Decommissioning Project" (Battelle, 1993A). **Table 1** presents the volumetric release criteria as presented in DD-93-03, Rev. 0.

4.0 Final Status Survey Procedures

Planning and implementation of the final status survey of the excavations adhered to the requirements of the Final Status Survey Plan (Battelle, 2000) and Work Instruction 2806 (CS, 2004)

4.1 Sampling Parameters

Final status soil samples of the JN-1 south and east grounds and excavation were obtained from survey grids. Survey grids were each ten by ten meters, with each grid divided into equal sized quadrants. Final status soil samples were then obtained from each of the grid quadrants. Analyses of samples by gamma spectroscopy were performed by the on-site Radioanalytical Laboratory (RAL).

4.2 Major Contaminants Identified

Characterization and excavation samples taken during the remediation of the JN1 south and east grounds identified Cesium-137 (Cs-137) as the primary radiological contaminant of concern (RCOC). Other radioisotopes present included Cobalt-60 (Co-60), Europium-152 (Eu-152), Eu-154, Americium-241 (Am-241), Strontium-90 (Sr-90), and Plutonium-238 (Pu-238), and Pu-239. Cs-137 is used as a surrogate for the other RCOC present in the soils as it typically accounts for 64 percent of the total isotopic activity. Further, the release criteria set for Cs-137 is considered conservative for the decommissioning activities. The surrogate relationship of Cs-137 to other RCOCs was calculated using data presented in Table 2. Table 2 presents the isotopic quantity and activity concentrations of samples collected from the filter bed area by BMI from March through September 2000. These data are not associated with the excavation of the JN1 south and east grounds. Average activities for the multiple samples were calculated for each RCOC prior to setting the ratios against Cs-137.¹ For each RCOC, the average activity concentration was set as a ratio against the average Cs-137 activity concentration as obtained from previous actions at the filter beds. Cs-137 activity ratios for each RCOC utilized to calculate the RCOCs for the JN1 south and east grounds are presented at the lower portion of Table 2.

4.2.1 Guidelines Established

Table 1 presents the guidelines for residual radioactivity concentrations for soil and solid volumes as applied to the excavation. Criteria for residual radioactivity concentrations in soil are defined in "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratories Decommissioning Project," DD-93-03. (Battelle, 1993). Table 1 values have been generated primarily from various regulatory requirements, technical

¹ Battelle, *Radiological Status of Abandoned Filter Bed Presentation*, http://www.ohio.doe.gov/ccp_scb/, Posted 7/15/2003. Presentation provided by DOE to the CCP website. Page titled "Radioactive Inventory of the Abandoned North Filter Beds & Limit Fractions" contains sampling data obtained from March through September 2000 from the filter beds. Average Cs-137 ratios were utilized to calculate the activity concentrations of the isotopes of concern.

documents, and from soil guidelines generated by computer pathway analyses. Requirements such as those found in DOE Order 5400.5 have been incorporated into the volumetric release criteria. DOE Order 5400.5, Section IV.a.2, provides generic guidelines for residual concentrations of Ra-226, Ra-228, Th-230, and Th-232 that have been incorporated into the volumetric release criteria. Additionally, NRC Guidance has been received by the CCP establishing the soil radioactivity concentration guidelines for Co-60, Sr-90, Cs-137, Ra-226, and Ra-228, and for natural, enriched and depleted uranium.

Table 2 presents data utilized from previous characterization samples collected during the excavation of the backyard of Building JN-1 and the Bog Area during the fall of 2005. These sample data were used to establish a site-specific ratio of Cs-137 to other RCOC. Development of this ratio was necessary in that Sr-90 appeared to occur at a higher concentration than other locations throughout the site. Data presented in the table do not represent the final condition of either area. Samples with a range of activity concentration for Cs-137 were selected in generating the site-specific, or the Bog Area Ratio.

The Bog Area Ratio is used to calculate the activity concentration of individual RCOC other than those detected by the RAL. The Pu-241 activity concentration is calculated by using a ratio of Pu-241 to the sum of Pu-238 and Pu-239, as obtained from the ORIGEN 2.1 derived values. (Battelle, 2003c) The resulting Cs-137 to Pu-241 ratio is 2.8. Using the ratios from **Table 2** and the Cs-137 to Pu-241 ratio of 2.8, the individual concentrations of all RCOCs can be derived. Derived activity concentrations are then applied to the unity rule to determine compliance to Table 1 values. This results in a modified screening criteria of 7.3 pCi/g for Cs-137.

Exposure rates were compared to the 5 microRoentgen per hour ($\mu\text{R/hr}$) above mean background limit listed in DD-97-02, Rev. 0 (Battelle, 2000). Survey measurements are those 1-meter above the ground surface. The calculated mean background exposure rate and the 95 percent confidence intervals used for the CCP open area grounds is $8 \pm 2 \mu\text{R/hr}$. Compliance to the limit is met when the exposure rate survey is less than or equal to the limits of NUREG-5849. Initial compliance screening is met if individual exposure rates are less than or equal to $13 \mu\text{R/hr}$. Further assessment of compliance allows for exposure rates to be averaged of a 100 m^2 grid area to meet the limit of less than or equal to $5 \mu\text{R/hr}$ above background at 1-meter above the ground surface. Additionally, exposure rates over any discrete area may not exceed $5 \mu\text{R/hr}$ above background.

5.0 Equipment and Procedures

5.1 Equipment

Survey instruments sensitive to gamma radiation are used to monitor excavation surfaces for residual radioactive materials. Ludlum Model 44-10 two-inch by two-inch sodium iodide detectors with Eberline ESP-2 meters were used to scan the grounds and excavation. Ludlum Model 19 exposure rate meters were used to obtain microRoentgen per hour measurements.

Instrumentation used in the Onsite Radioanalytical Laboratory (RAL) to support the final status survey included:

- VMS based Canberra Procount data acquisition system in conjunction with high purity germanium detectors for gamma spectroscopy of soil samples.
- Tennelec Model LB5100 Simultaneous Alpha and Beta Gas Proportional Counter to count smear samples

5.2 Scanning Minimum Detectable Activities

Scanning minimum detectable concentrations (MDC_{scan}) is determined to demonstrate that the MDC_{scan} is less than the modified Cs-137 cleanup criteria. The MDC_{scan} is calculated utilizing the methodology described in NUREG-1507 and the background count rate and a default detector response to Cs-137 (NRC, 1998). The equation during the walkover surveys of the CCP incorporates a d' of 1.38 and a surveyor efficiency of 0.5. The ambient background in the area was 11,000 counts per minute (cpm). This background is determined using an un-shielded probe. The following is the calculation of the MDC_{scan} using an un-shielded probe:

$$b_s = (11,000 \text{ cpm}) \times (1 \text{ sec}) \times (1 \text{ min}/60 \text{ sec}) = 183 \text{ counts}$$

$$MDCR = (1.38) \times (\sqrt{183 \text{ counts}}) \times (60 \text{ sec}/1 \text{ min}) = 1120 \text{ cpm}$$

$$MDCR_{surveyor} = 1120 \text{ cpm}/\sqrt{0.5} = 1584 \text{ cpm}$$

$$MDER = 1584 \text{ cpm}/(900 \text{ cpm}/\mu\text{R}/\text{hr}) = 1.76 \mu\text{R}/\text{hr}$$

$$MDC_{scan} = (5 \text{ pCi}/\text{g}) * \frac{1.76 \mu\text{R}/\text{hr}}{1.307 \mu\text{R}/\text{hr}} = 6.73 \text{ pCi}/\text{g}$$

5.3 Procedures

The Characterization Team was formally trained and qualified to applicable procedures prior to the initiation of the characterization and final status surveys. Documentation of training is maintained by CCP Project Records.

The following plans and procedures were utilized for the surveys:

DD-93-19, Rev. 5	Decommissioning Plan, Battelle Memorial Institute Columbus Operations
DD-97-02, Rev. 0	Radiological Characterization and Final Status Plan for BCI DP West Jefferson Site
SC-OP-002, Rev. 0	Facility Post-Decontamination Final Status Survey for Baseline Areas
SC-SP-004.2, Rev. 3	Manual and Mechanical Collection of Surface and Subsurface Soil Samples in Support of Site Characterization
HP-OP-100, Rev. 4	Operation and Calibration of the Eberline Model ESP-2 Survey Meter
WI-2806	Excavation and Trench Sampling and Surveys

6.0 Survey Findings

6.1 Exposure Rate Surveys

The calculated mean background exposure rate at the 95 percent confidence interval used for the CCP open ground surveys at 1-meter is 8 ± 2 $\mu\text{R/hr}$. Individual exposure rate measurements were less than or equal to 13 $\mu\text{R/hr}$ for open grounds. The 1-meter above surface measurements of the area averaged 9.4 $\mu\text{R/hr}$. The minimum measurement at 1-meter was 5 $\mu\text{R/hr}$ and the maximum was 13 $\mu\text{R/hr}$. **Table 3** presents the summary of all sampling and surveys for each area within the JN-1 south and east grounds and the excavation. The exposure rate readings for the area are presented in **Figure 3**.

6.2 Scanning Measurements

Scanning of the JN-1 south and east grounds and excavation was performed using a two inch by two inch sodium iodide detector. Scanning measurements did not exceed the Decision Level Value (DLV) of 18,374 cpm for soil walkover scans. Scanning results for these areas are presented in **Figure 4**.

6.3 Excavation Sampling

Samples of the excavation and ground area were taken at a rate of four per ten by ten meter grid in accordance with Section 6.3.3 of DD-97-02, Rev. 0 (Battelle, 2000). Summary tables of the Cs-137 results in relation to the sample locations are presented in **Figure 5**. Sample results for the excavation are presented as **Table 3**. **Table 3** presents all radionuclides activities and minimum detectable activities of the analyses.

6.4 Radioanalytical Reporting Limits

Most soil samples exhibited low concentrations Cs-137 activity. Utilizing the ratio of Cs-137 to other radionuclides, low concentrations of Cs-137 would indicate even lower concentrations of other gamma emitting radionuclides of concern. As such, gamma emitting radionuclides of concern other than Cs-137 would be less than corresponding Minimum Detectable Activity (MDA). **Table 4** presents the typical MDAs for the gamma-emitting radionuclides of concern.

Compliance to the cleanup criteria presented in **Table 1** is demonstrated through a "fraction of limit." Section 4.2.1 of this report provides a detailed discussion of the "fraction of limit" derivation.

The modified screening criteria of 7.3 pCi/g for Cs-137 is used to evaluate initial compliance to the cleanup levels. Further remediation is typically conducted if reported Cs-137 activity concentrations approach or exceed the modified screening criteria of 7.3 pCi/g. The "fraction of limit" calculation is applied to reported analytical results of samples with Cs-137 activity concentrations greater than 4 pCi/g.

The reported radioanalytical result for the sample collected from the southeast quadrant of grid 103 was 6.63 pCi/g for Cs-137. A sum of ratio calculation was performed as the result exceeded 4 pCi/g for Cs-137. The following table details the sum of ratio calculation.

Analytical Parameter	RL05-4454-4095	
	Result ^a (pCi/g)	Fraction of Limit
Cs-137	4.42	0.29
Co-60	0.01	0.00
Eu-152	0.30	0.01
Eu-154	0.03	0.00
Am-241	0.35	0.01
Sr-90	0.11	0.02
Pu-238 ^b	0.01	0.00
Pu-239 ^b	0.20	0.01
Pu-241 ^c	1.82	0.07
	Sum Fraction of Limit	0.42

^a Activity concentration based on MDA value in absence of positive result

^b Estimated, based on activity concentration of ratio of isotope to Cs-137

^c Pu-241 Origin 2.1 derived value

The following is a summary table of the Cs-137 results for the entire area:

Location	Number of Samples	Average (pCi/g)	Standard Deviation (pCi/g)	Range (pCi/g)	Modified Screening Criteria (pCi/g)
JN-1 South and East Grounds and Excavation	190	0.40	0.64	-0.03 to 6.63	7

7.0 Conclusions

The characterization and final status survey results demonstrate that the radiological endpoint criteria objectives of the NRC-approved Decommissioning Plan have been met for the excavation addressed by this effort. (Battelle, 2003) Reported analytical results for media samples obtained from the excavation are below the residual radioactivity concentrations for soil and solid volumes as presented in **Table 1**.

Remaining soil contamination levels are below those presented in DD-93-03, Rev. 0, "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratory Decommissioning Project" (Battelle, 1993). The decommissioning objective has been satisfied. The final status survey performed on the JN-1 south and east grounds and excavation statistically demonstrates that the remediation of the area was successful and that the excavations are free from residual radioactive contamination making them suitable for unrestricted release.

8.0 References

Battelle, 2003a. "Decommissioning Plan for the Battelle Memorial Institute Columbus Operations," DD-93-19.

Battelle, 2003c. Waste Characterization, Classification, and Shipping Support Technical Basis Document, Rev. 5 for BCLDP West Jefferson Facility, November 2003. Isotopic mixture for Pu-241 is calculated using the values obtained from the ORIGEN2.1-derived data values presented in the technical basis document.

Battelle, 2000. "Radiological Characterization and Final Status Survey Plan for Battelle Columbus Laboratory Decommissioning Project West Jefferson Site," DD-97-02.

Battelle, 1993. "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratories Decommissioning Project," DD-93-03.

ECC&E2 Closure Services, LLC (Closure Services, 2004). Work Instruction 2806, Excavation and Trench Sampling and Survey.

U.S. Department of Energy (DOE), 1990. Finding of No Significant Impact, Decontamination and Decommissioning of the Battelle Columbus Laboratories in Columbus and West Jefferson, Ohio.

U.S. Department of Energy (DOE), 1986. May 29, 1986 memorandum, Voight to Vaughan, approved by Vaughan, June 10, 1986.

U.S. Nuclear Regulatory Commission (NRC), 1998. "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" NUREG-1507.

Oak Ridge Associated Universities (ORAU), 1992. "Manual for Conducting Radiological Surveys in Support of License Termination, Draft Report for Comment" NUREG/CR-5849, ORAU-92/C57, prepared for the Nuclear Regulatory Commission by the Environmental Survey and Assessment Program, Energy/Environmental Systems Division, ORAU, 1992.

Figures

Figure 1
Site Map

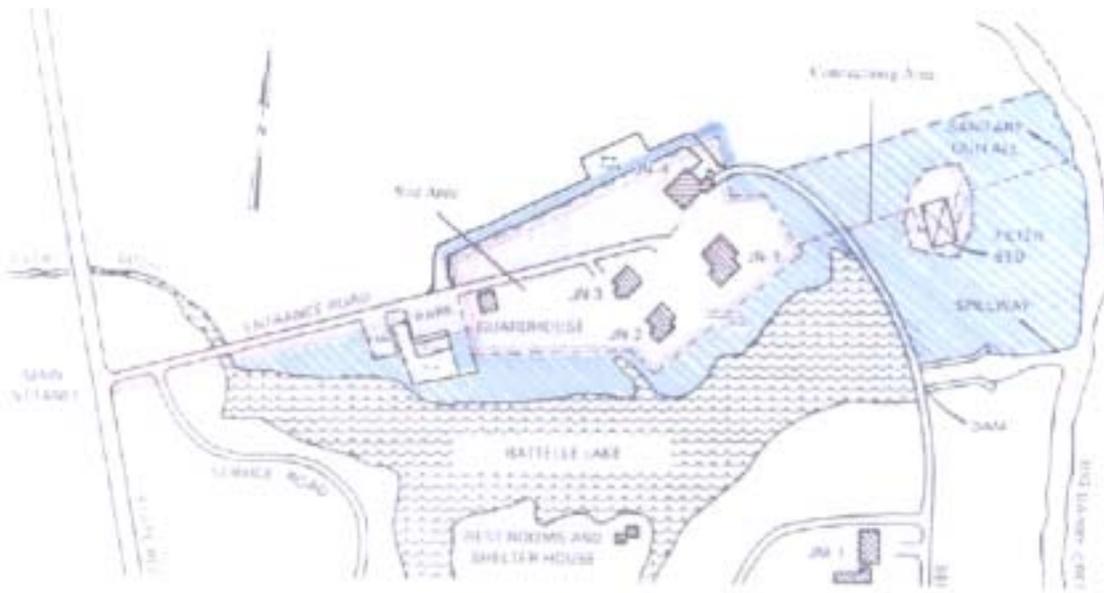
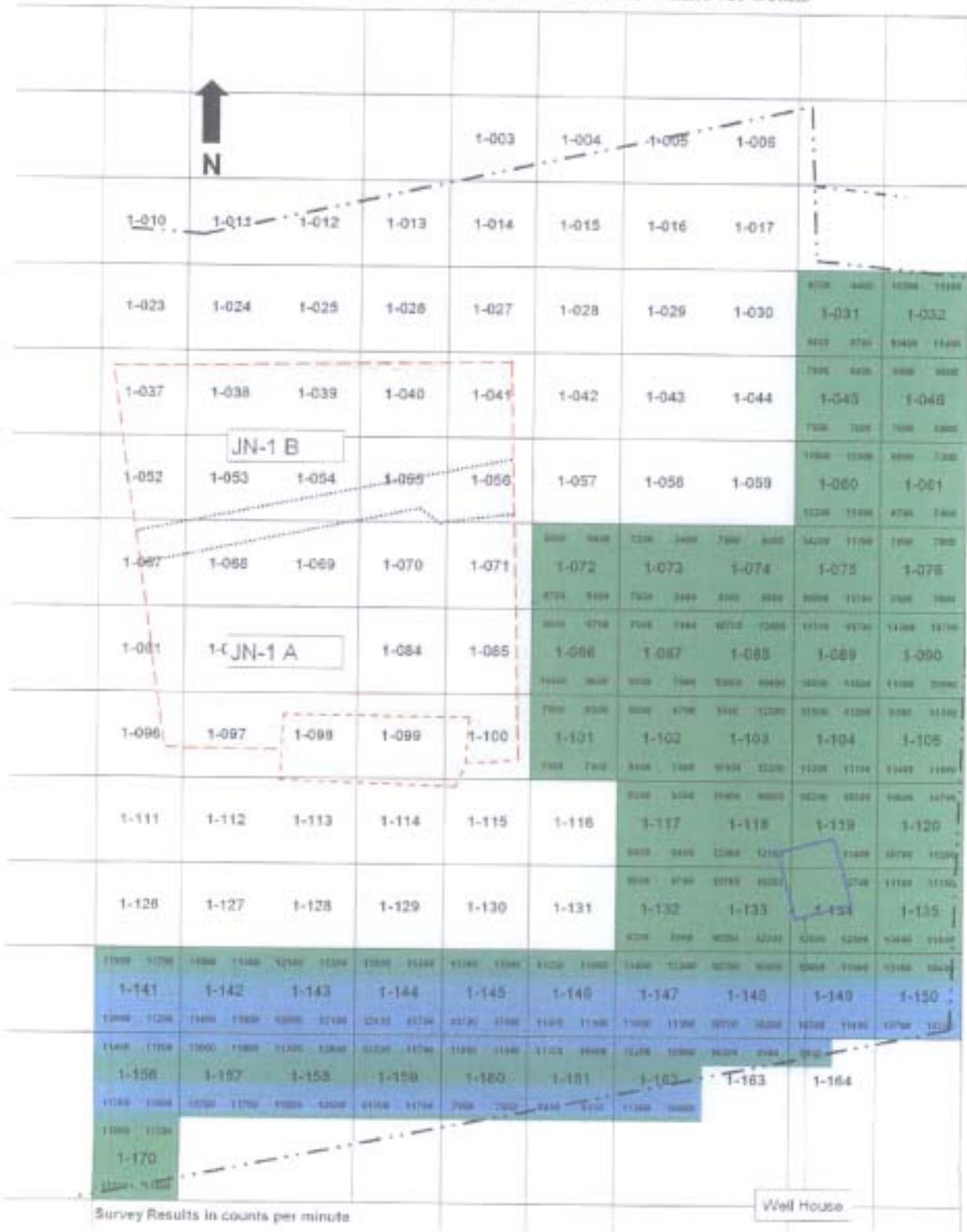


Figure 3
JN-1 South and East Grounds and Excavation Exposure Rates



Figure 4
JN-1 South and East Grounds and Excavation Walkover Scans



Tables

Table 1
BCLDP GUIDELINES FOR RESIDUAL
RADIOACTIVITY CONCENTRATIONS FOR SOIL AND SOLID VOLUMES

Radionuclide ^(a)	King Avenue Concentration (pCi/g) ^(b)	West Jefferson Concentration (pCi/g) ^(b)
Natural Uranium	10 ⁽¹⁾	na ^(c)
Enriched Uranium	30 ⁽¹⁾	30 ⁽¹⁾
Depleted Uranium	35 ⁽¹⁾	35 ⁽¹⁾
Ac-227	19	19
Am-241	na ^(c)	30 ⁽⁴⁾
Am-243	na	30 ⁽⁴⁾
Ce-144	na	2.100
Cm-243	na	0.79
Cm-244	na	1.0
Co-60	8 ⁽²⁾	8 ⁽²⁾
Cs-134	na	33
Cs-137	15 ⁽²⁾	15 ⁽²⁾
C-14	940	940
Eu-152	na	36
Eu-154	na	32
Eu-155	na	1,800
Fe-55	na	2.7E+07
H-3 ^(d)	41,000	38,000
I-129	na	13
Mn-54	na	61
Ni-59	na	1.3E+07
Ni-63	na	4.9E+06
Np-237	na	0.58
Pa-231	18	18
Pb-210	140	na
Pu-238	na	25 ⁽⁴⁾
Pu-239	na	25 ⁽⁴⁾
Pu-240	na	25 ⁽⁴⁾
Pu-241	na	25 ⁽⁴⁾
Pu-242	na	25 ⁽⁴⁾

Radionuclide ^(a)	King Avenue Concentration (pCi/g) ^(b)	West Jefferson Concentration (pCi/g) ^(b)
Ra-226 (0-15 cm of soil)	5 ^(2,3)	na
Ra-226 (>15 cm of soil)	15 ^(2,3)	na
Ra-228	5 ^(2,3)	na
Ru-106	na	180
Sb-125	na	118
Sm-151	na	6,700
Sr-90	5 ⁽²⁾	5 ₍₂₎
Th-228	29	na
Th-230	5 ⁽³⁾	na
Th-232	5 ⁽³⁾	na

Table 1 Notes and References

Notes:

- a. Activity concentrations above natural background concentrations. Where more than one radionuclide is present, the sum of the ratios of the individual radionuclide concentrations to their respective concentration limits shall not exceed 1.
- b. Concentrations for which no specific reference is cited have been derived from RESRAD calculations and are the more restrictive values calculated for soil deposition at a depth of 5 meters.
- c. Indicates that this radionuclide is not expected to be found at the indicated site.
- d. Difference in tritium activity concentrations are due to the difference in depths of the water tables at two sites. The water table depth at King Avenue is deeper than that at West Jefferson.

References:

1. Options 1 and 2 of the Branch Technical Position, "Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations" (46 FR 52061, October 23, 1981).
2. NRC Memorandum, "Acceptable Cleanup Criteria and Practices for Decontamination and Decommissioning (License No. SNM-7)" dated April 17, 1992, to Harley L. Toy, License Coordinator and Manager, Nuclear Sciences, Battelle Memorial Institute from J.W.N. Hickey, Chief, Fuel Cycle Safety Branch, Division of Industrial and Medical Nuclear Safety, Office of Nuclear Material Safety and Safeguards.
3. DOE Order 5400.5, "Radiation Protection of the Public and the Environment".
4. NRC Policy and Guidance Directive FC83-23, "Termination of Byproduct, Source, and Special Nuclear Material Licenses".

Table 2
Bag Area Cesium-137 Surrogate Analysis Data & Modified Cs-137 Screening Criteria

Sample #	pCi/g Cs-137	Fraction Cs-137 Lim	pCi/g Co-60	Fraction Co-60 Lim	pCi/g Eu-152	Fraction Eu-152 Lim	pCi/g Eu-154	Fraction Eu-154 Lim	pCi/g Am-241	Fraction Am-241 Lim	pCi/g Sr-90	Fraction Sr-90 Lim	pCi/g Pu-238	Fraction Pu-238 Lim	pCi/g Pu-239	Fraction Pu-239 Lim
RL05-2744	10.50	0.70	0.20	0.03	0.07	0.00	0.06	0.00	0.27	0.01	2.29	0.46	0.10	0.00	0.05	0.00
RL05-2745	16.30	1.09	0.46	0.06	0.07	0.00	0.09	0.00	-0.20	-0.01	1.97	0.39	0.20	0.01	0.17	0.01
RL05-2746	5.52	0.37	0.19	0.02	0.06	0.00	0.03	0.00	0.30	0.01	0.83	0.17	0.12	0.00	0.05	0.00
RL05-2747	6.43	0.43	0.20	0.03	0.10	0.00	0.03	0.00	-0.08	0.00	1.11	0.22	0.05	0.00	0.01	0.00
RL05-2748	18.30	1.22	0.56	0.07	0.14	0.00	0.07	0.00	0.36	0.01	1.34	0.27	0.14	0.01	0.08	0.00
RL05-2750	18.40	1.23	1.30	0.16	0.11	0.00	0.10	0.00	0.09	0.00	10.90	2.18	0.80	0.03	0.38	0.02
RL05-2751	12.90	0.86	0.40	0.05	0.07	0.00	0.03	0.00	-0.10	0.00	1.73	0.35	0.14	0.01	0.09	0.00
RL05-3012	16.10	1.07	0.19	0.02	0.15	0.00	0.09	0.00	-0.04	0.00	9.13	1.83	1.06	0.04	0.32	0.01
RL05-3014	4.40	0.29	0.01	0.00	0.05	0.00	0.04	0.00	-0.19	-0.01	0.91	0.18	0.05	0.00	0.01	0.00
RL05-3015	25.60	1.71	0.70	0.09	0.22	0.01	0.17	0.01	0.42	0.01	13.30	2.66	0.77	0.03	0.32	0.01
RL05-3017	15.70	1.05	0.38	0.05	0.04	0.00	0.02	0.00	-0.33	-0.01	8.15	1.63	0.62	0.02	0.33	0.01
RL05-3294	15.80	1.05	0.45	0.05	0.02	0.00	0.04	0.00	0.28	0.01	2.34	0.47	0.05	0.00	0.08	0.00
RL05-3296	8.10	0.54	0.27	0.03	-0.04	0.00	0.01	0.00	-0.28	-0.01	2.81	0.56	0.03	0.00	0.10	0.00
RL05-3297	43.20	2.88	0.75	0.09	-0.01	0.00	0.09	0.00	0.05	0.00	3.10	0.82	0.08	0.00	0.12	0.00
RL05-3300	19.50	1.30	0.49	0.06	0.03	0.00	0.04	0.00	-0.06	0.00	2.87	0.57	0.07	0.00	0.24	0.01
RL05-4049	19.50	1.30	0.26	0.03	0.11	0.00	0.11	0.00	0.36	0.01	1.22	0.24	0.98	0.04	0.31	0.01
RL05-4084	13.90	0.93	0.58	0.07	0.08	0.00	0.09	0.00	0.28	0.01	2.79	0.56	0.17	0.01	0.13	0.01
RL05-4085	19.90	1.33	0.30	0.04	0.09	0.00	0.11	0.00	0.47	0.02	5.37	1.07	0.36	0.01	0.12	0.00
RL05-4100	7.47	0.50	0.15	0.02	0.05	0.00	0.10	0.00	0.38	0.01	1.44	0.29	0.22	0.01	0.52	0.02
RL05-4101	7.05	0.47	0.04	0.00	-0.10	0.00	0.04	0.00	-0.01	0.00	0.56	0.11	0.54	0.02	0.93	0.04
RL05-4153	7.15	0.48	0.09	0.01	-0.02	0.00	-0.04	0.00	-0.03	0.00	2.24	0.45	0.13	0.01	0.53	0.02
RL05-4158	12.80	0.85	0.45	0.05	0.08	0.00	0.02	0.00	0.17	0.01	10.50	2.10	0.55	0.02	0.28	0.01
RL05-4159	7.56	0.50	0.24	0.03	0.02	0.00	-0.02	0.00	0.19	0.01	10.30	2.06	0.80	0.03	0.23	0.01
RL05-4161	11.00	0.73	0.25	0.03	0.08	0.00	0.08	0.00	0.07	0.00	9.45	1.89	0.77	0.03	0.24	0.01
RL05-4162	19.50	1.30	0.25	0.03	0.10	0.00	0.05	0.00	0.18	0.01	5.28	1.06	0.31	0.01	0.15	0.01
Average	14.50	0.97	0.37	0.05	0.06	0.00	0.06	0.00	0.10	0.00	4.48	0.90	0.36	0.01	0.23	0.01

Limits:	X _i Cs-137 Ratios	Activity (pCi/g) - Cs-137/Ratio	Limit (pCi/g)	Fraction
Cs-137	15 pCi/g	Cs-137	7.30	0.487
Co-60	8 pCi/g	Co-60	0.20	0.026
Eu-152	36 pCi/g	Eu-152	0.10	0.003
Eu-154	32 pCi/g	Eu-154	0.03	0.001
Am-241	30 pCi/g	Am-241	0.09	0.003
Sr-90	5 pCi/g	Sr-90	1.78	0.356
Pu-238	25 pCi/g	Pu-238	0.13	0.006
Pu-239	25 pCi/g	Pu-239	0.09	0.004
Pu-241	25 pCi/g	Pu-241	2.61	0.104
			Sum	0.99

Table 3
 JN-1 South and East Grounds and Excavation Survey and Sampling Results

Grid Location	Sample ID	Collection Date	Field Screen Result (cpm)	Walkover Scan (Results in cpm)	Exposure Rates (Results in μ R/hr)	Cs-137 Content (Results in pCi/g)
1-031 NW	RL05-4232-4601	12/6/2005	7610	8700	5	0.09
1-031 NE	RL05-4233-4602	12/6/2005	7830	8400	6	0.26
1-031 SW	RL05-4234-4603	12/6/2005	7570	9600	7	0.04
1-031 SE	RL05-4235-4604	12/6/2005	7480	8700	7	0.00
1-032 NW	RL05-4236-4605	12/6/2005	7440	10200	7	0.07
1-032 NE	RL05-4237-4606	12/6/2005	7450	11800	5	0.23
1-032 SW	RL05-4238-4607	12/6/2005	7550	10400	7	0.40
1-032 SE	RL05-4239-4608	12/6/2005	7360	11400	6	0.05
1-045 NW	RL05-4210-4578	12/5/2005	7870	7800	7	0.53
1-045 NE	RL05-4211-4579	12/5/2005	8240	8400	6	0.24
1-045 SW	RL05-4212-4580	12/5/2005	7860	7500	8	0.01
1-045 SE	RL05-4213-4581	12/5/2005	7660	7600	7	-0.01
1-046 NW	RL05-4214-4582	12/5/2005	7760	9400	7	0.59
1-046 NE	RL05-4215-4583	12/5/2005	8110	9600	7	-0.01
1-046 SW	RL05-4216-4584	12/5/2005	7940	7600	7	0.09
1-046 SE	RL05-4217-4585	12/5/2005	7960	6800	6	0.01
1-060 NW	RL05-4469-4108	12/1/2005	8010	11900	10	0.47
1-060 NE	RL05-4470-4109	12/1/2005	7770	12600	10	0.54
1-060 SW	RL05-4471-4110	12/1/2005	8040	12200	9	0.18
1-060 SE	RL05-4472-4111	12/1/2005	7700	11600	8	0.08
1-061 NW	RL05-4570-4202	12/5/2005	7740	6600	5	0.15
1-061 NE	RL05-4571-4203	12/5/2005	7750	7200	5	0.02
1-061 SW	RL05-4572-4204	12/5/2005	7590	6700	5	0.57
1-061 SE	RL05-4573-4205	12/5/2005	7590	7400	5	0.57
1-072 NW	RL05-4566-4198	12/5/2005	7340	9500	10	0.65
1-072 NE	RL05-4567-4199	12/5/2005	7500	9400	9	1.40
1-072 SW	RL05-4568-4200	12/5/2005	7450	8700	9	0.62
1-072 SE	RL05-4569-4201	12/5/2005	7670	8400	9	0.90
1-073 NW	RL05-4523-4160	12/3/2005	7690	7200	5	1.82
1-073 NE	RL05-4524-4161	12/3/2005	8040	8400	7	0.73
1-073 SW	RL05-4525-4162	12/3/2005	8030	7800	6	1.32

Grid Location	Sample ID	Collection Date	Field Screen Result (cpm)	Walkover Scan (Results in cpm)	Exposure Rates (Results in μ R/hr)	Cs-137 Content (Results in pCi/g)
1-073 SE	RL05-4526-4163	12/3/2005	8320	8400	8	1.18
1-074 NW	RL05-4527-4164	12/3/2005	7950	7800	8	0.33
1-074 NE	RL05-4528-4165	12/3/2005	8000	8400	8	0.23
1-074 SW	RL05-4529-4166	12/3/2005	8020	9200	8	0.47
1-074 SE	RL05-4530-4167	12/3/2005	8000	8600	7	0.21
1-075 NW	RL05-4473-4112	12/1/2005	7810	14200	9	0.02
1-075 NE	RL05-4474-4113	12/1/2005	7690	11200	9	0.15
1-075 SW	RL05-4475-4114	12/1/2005	7500	10900	8	0.18
1-075 SE	RL05-4476-4115	12/1/2005	7680	11700	8	0.14
1-076 NW	RL05-4206-4574	12/5/2005	7780	7800	8	0.70
1-076 NE	RL05-4207-4575	12/5/2005	8360	7800	8	3.01
1-076 SW	RL05-4208-4576	12/5/2005	7540	7600	8	0.40
1-076 SE	RL05-4209-4577	12/5/2005	7760	7600	8	0.72
1-086 NW	RL05-4562-4194	12/5/2005	7870	9800	10	0.01
1-086 NE	RL05-4563-4195	12/5/2005	8060	8700	8	0.30
1-086 SW	RL05-4564-4196	12/5/2005	8090	10400	10	0.65
1-086 SE	RL05-4565-4197	12/5/2005	8500	9600	10	0.00
1-087 NW	RL05-4531-4168	12/3/2005	7620	7600	5	0.41
1-087 NE	RL05-4532-4169	12/3/2005	7790	7400	5	0.49
1-087 SW	RL05-4533-4170	12/3/2005	7520	8200	6	0.00
1-087 SE	RL05-4534-4171	12/3/2005	7560	7800	6	0.01
1-088 NW	RL05-4344-4012	11/23/2005	7940	10700	10	1.14
1-088 NE	RL05-4345-4013	11/23/2005	7760	12800	11	0.01
1-088 SW	RL05-4346-4014	11/23/2005	8160	10800	12	0.79
1-088 SE	RL05-4347-4015	11/23/2005	8770	10400	12	1.02
1-089 NW	RL05-4348-4016	11/23/2005	8410	11700	11	0.68
1-089 NE	RL05-4349-4017	11/23/2005	8290	10700	10	0.13
1-089 SW	RL05-4350-4018	11/23/2005	9030	14000	12	0.38
1-089 SE	RL05-4351-4019	11/23/2005	8420	11400	12	0.37
1-090 NW	RL05-4352-4020	11/23/2005	8110	14500	11	0.47
1-090 NE	RL05-4353-4021	11/23/2005	8170	10700	10	0.86
1-090 SW	RL05-4354-4022	11/23/2005	8140	11500	11	0.25
1-090 SE	RL05-4355-4023	11/23/2005	7930	10900	11	0.32
1-101 NW	RL05-4558-4190	12/5/2005	7600	7900	8	0.09
1-101 NE	RL05-4559-4191	12/5/2005	7790	8500	8	0.03
1-101 SW	RL05-4560-4192	12/5/2005	7890	7800	8	0.44

Grid Location	Sample ID	Collection Date	Field Screen Result (cpm)	Walkover Scan (Results in cpm)	Exposure Rates (Results in μ R/hr)	Cs-137 Content (Results in pCi/g)
1-101 SE	RL05-4561-4193	12/5/2005	8120	7400	7	0.08
1-102 NW	RL05-4519-4156	12/3/2005	8270	8600	7	-0.02
1-102 NE	RL05-4520-4157	12/3/2005	7300	8700	7	0.14
1-102 SW	RL05-4521-4158	12/3/2005	6990	8300	7	0.30
1-102 SE	RL05-4522-4159	12/3/2005	9460	7800	7	0.09
1-103 NW	RL05-4356-4024	11/23/2005	8000	9300	11	3.12
1-103 NE	RL05-4455-4096	11/30/2005	7670	12300	11	1.95
1-103 SW	RL05-4358-4026	11/23/2005	7430	10100	11	0.67
1-103 SE	RL05-4454-4095	11/30/2005	9040	12200	10	6.63
1-104 NW	RL05-4360-4028	11/23/2005	8540	11900	11	1.31
1-104 NE	RL05-4361-4029	11/23/2005	8560	11200	10	0.56
1-104 SW	RL05-4362-4030	11/23/2005	8160	11200	10	0.81
1-104 SE	RL05-4363-4031	11/23/2005	7950	11100	12	0.22
1-105 NW	RL05-4364-4032	11/23/2005	8210	9200	10	0.28
1-105 NE	RL05-4365-4033	11/23/2005	7940	11100	11	0.26
1-105 SW	RL05-4366-4034	11/23/2005	8380	11400	11	1.97
1-105 SE	RL05-4367-4035	11/23/2005	7990	11600	12	0.70
1-117 NW	RL05-4515-4152	12/6/2005	8920	8300	7	0.23
1-117 NE	RL05-4516-4153	12/3/2005	7870	8300	7	0.03
1-117 SW	RL05-4517-4154	12/3/2005	7990	8400	7	0.38
1-117 SE	RL05-4518-4155	12/3/2005	8010	8400	7	0.69
1-118 NW	RL05-4246-3966	11/19/2005	8110	10400	10	1.17
1-118 NE	RL05-4247-3967	11/19/2005	7960	10900	10	0.74
1-118 SW	RL05-4248-3968	11/19/2005	8200	12300	9	0.52
1-118 SE	RL05-4249-3969	11/19/2005	7580	12100	9	0.74
1-119 NW	RL05-4250-3970	11/19/2005	8420	10200	8	0.38
1-119 NE	RL05-4251-3971	11/19/2005	8500	10500	10	0.28
1-119 SE	RL05-4253-3973	11/19/2005	8630	11400	10	0.17
1-120 NW	RL05-4254-3974	11/19/2005	8390	10600	10	0.23
1-120 NE	RL05-4255-3975	11/19/2005	8330	10700	10	0.61
1-120 SW	RL05-4256-3976	11/19/2005	8890	10700	9	0.69
1-120 SE	RL05-4257-3977	11/19/2005	8580	11200	10	0.23
1-132 NW	RL05-4505-4144	12/3/2005	7870	8600	8	0.94
1-132 NE	RL05-4506-4145	12/3/2005	7810	9700	8	0.62
1-132 SW	RL05-4507-4146	12/3/2005	8090	8200	8	1.45
1-132 SE	RL05-4508-4147	12/3/2005	7800	8600	7	1.20

Grid Location	Sample ID	Collection Date	Field Screen Result (cpm)	Walkover Scan (Results in cpm)	Exposure Rates (Results in μ R/hr)	Cs-137 Content (Results in pCi/g)
1-133 NW	RL05-4265-3978	11/19/2005	8140	10700	9	0.59
1-133 NE	RL05-4266-3979	11/19/2005	8780	10200	10	0.10
1-133 SW	RL05-4267-3980	11/19/2005	8210	10200	10	0.48
1-133 SE	RL05-4268-4267	11/19/2005	8120	12300	10	0.42
1-134 NE	RL05-4269-3982	11/19/2005	8590	12700	10	0.27
1-134 SW	RL05-4270-3983	11/21/2005	8710	12500	11	0.09
1-134 SE	RL05-4271-3984	11/21/2005	8560	12600	10	0.44
1-135 NW	RL05-4272-3985	11/21/2005	8570	11100	10	0.24
1-135 NE	RL05-4273-3986	11/21/2005	8450	11200	10	0.15
1-135 SW	RL05-4274-3987	11/21/2005	8250	10600	9	0.19
1-135 SE	RL05-4275-3988	11/21/2005	8560	11000	10	0.51
1-141 NW	RL05-4385-4036	11/29/2005	8680	11900	12	0.23
1-141 NE	RL05-4386-4037	11/29/2005	8720	11700	12	0.08
1-141 SW	RL05-4387-4038	11/29/2005	8510	12000	12	0.03
1-141 SE	RL05-4388-4039	11/29/2005	8680	11200	11	0.02
1-142 NW	RL05-4389-4040	11/29/2005	8530	11800	11	0.04
1-142 NE	RL05-4390-4041	11/29/2005	8590	11300	12	0.05
1-142 SW	RL05-4391-4042	11/29/2005	8760	11400	12	0.02
1-142 SE	RL05-4392-4043	11/29/2005	8370	11900	11	0.04
1-143 NW	RL05-4393-4044	11/29/2005	8380	12100	12	0.07
1-143 NE	RL05-4394-4045	11/29/2005	8830	11200	12	0.11
1-143 SW	RL05-4395-4046	11/29/2005	8660	12000	11	0.06
1-143 SE	RL05-4396-4047	11/29/2005	8730	12100	11	0.04
1-144 NW	RL05-4397-4048	11/29/2005	8630	11800	12	0.11
1-144 NE	RL05-4398-4049	11/29/2005	8650	11400	11	0.18
1-144 SW	RL05-4399-4050	11/29/2005	8520	12400	12	0.16
1-144 SE	RL05-4400-4051	11/29/2005	8530	11700	10	0.03
1-145 NW	RL05-4401-4052	11/29/2005	8520	11300	12	0.13
1-145 NE	RL05-4402-4053	11/29/2005	8750	11000	11	0.07
1-145 SW	RL05-4403-4054	11/29/2005	9350	10700	11	0.08
1-145 SE	RL05-4404-4055	11/29/2005	8610	11500	11	0.16
1-146 NW	RL05-4405-4056	11/29/2005	8240	11200	11	0.19
1-146 NE	RL05-4406-4057	11/29/2005	8500	11000	11	0.10
1-146 SW	RL05-4407-4058	11/29/2005	8680	11400	11	0.23
1-146 SE	RL05-4408-4059	11/29/2005	8690	11300	11	0.15
1-147 NW	RL05-4409-4060	11/29/2005	8510	11400	11	0.18

Grid Location	Sample ID	Collection Date	Field Screen Result (cpm)	Walkover Scan (Results in cpm)	Exposure Rates (Results in $\mu\text{R/hr}$)	Cs-137 Content (Results in pCi/g)
1-147 NE	RL05-4410-4061	11/29/2005	8590	12200	11	0.16
1-147 SW	RL05-4411-4062	11/29/2005	8330	11000	11	0.10
1-147 SE	RL05-4412-4063	11/29/2005	8460	11100	11	0.10
1-148 NW	RL05-4276-3989	11/21/2005	8010	10700	9	0.13
1-148 NE	RL05-4277-3990	11/21/2005	8240	10500	9	0.15
1-148 SW	RL05-4278-3991	11/21/2005	8540	10700	9	0.06
1-148 SE	RL05-4279-3992	11/21/2005	8260	10200	9	-0.03
1-149 NW	RL05-4280-3993	11/21/2005	8930	10900	10	0.11
1-149 NE	RL05-4281-3994	11/21/2005	8840	11800	11	0.28
1-149 SW	RL05-4282-3995	11/21/2005	8080	10300	10	0.31
1-149 SE	RL05-4283-3996	11/21/2005	7850	11400	10	0.48
1-150 NW	RL05-4284-3997	11/18/2005	8320	10500	10	0.25
1-150 NE	RL05-4285-3998	11/18/2005	8510	10400	10	0.36
1-150 SW	RL05-4286-3999	11/18/2005	7950	10700	10	0.24
1-150 SE	RL05-4287-4000	11/18/2005	8050	10300	9	0.35
1-156 NW	RL05-4421-4064	11/30/2005	10800	11400	11	0.03
1-156 NE	RL05-4422-4065	11/30/2005	8360	11800	11	0.06
1-156 SW	RL05-4423-4066	11/30/2005	8530	11700	12	0.01
1-156 SE	RL05-4424-4067A	11/30/2005	8170	11900	12	0.27
1-157 NW	RL05-4425-4067B	11/30/2005	8030	11600	12	0.18
1-157 NE	RL05-4426-4068	11/30/2005	8130	11900	12	0.10
1-157 SW	RL05-4427-4069	11/30/2005	8390	11700	12	0.13
1-157 SE	RL05-4428-4070	11/30/2005	8130	11700	11	0.36
1-158 NW	RL05-4429-4071	11/30/2005	8040	11300	11	0.24
1-158 NE	RL05-4430-4072	11/30/2005	8150	12600	12	0.24
1-158 SW	RL05-4431-4073	11/30/2005	7980	11800	11	0.35
1-158 SE	RL05-4432-4074	11/30/2005	7910	12500	11	0.28
1-159 NW	RL05-4433-4075	11/30/2005	8050	13200	13	0.23
1-159 NE	RL05-4434-4076	11/30/2005	8140	11700	12	0.26
1-159 SW	RL05-4435-4077	11/30/2005	8160	11000	11	0.40
1-159 SE	RL05-4436-4078	11/30/2005	8000	11700	11	0.27
1-160 NW	RL05-4437-4079	11/30/2005	7860	11000	11	0.02
1-160 NE	RL05-4438-4080	11/30/2005	7820	11400	12	0.19
1-160 SW	RL05-4439-4081	11/30/2005	7590	7900	10	0.38
1-160 SE	RL05-4440-4082	11/30/2005	7490	7950	8	0.02
1-161 NW	RL05-4441-4083	11/30/2005	7950	11300	10	0.02

Grid Location	Sample ID	Collection Date	Field Screen Result (cpm)	Walkover Scan (Results in cpm)	Exposure Rates (Results in $\mu\text{R/hr}$)	Cs-137 Content (Results in pCi/g)
1-161 NE	RL05-4442-4084	11/30/2005	7990	10900	11	0.01
1-161 SW	RL05-4443-4085	11/30/2005	7630	8160	8	0.06
1-161 SE	RL05-4444-4086	11/30/2005	8570	8310	9	0.03
1-162 NW	RL05-4445-4087	11/30/2005	7770	10200	12	0.06
1-162 NE	RL05-4446-4088	11/30/2005	7950	10800	10	0.18
1-162 SW	RL05-4447-4089	11/30/2005	8510	11300	10	0.05
1-162 SE	RL05-4448-4090	11/30/2005	8710	10800	10	0.20
1-163 NW	RL05-4288-4001	11/18/2005	8450	10200	9	0.03
1-163 NE	RL05-4289-4002	11/18/2005	8070	8900	8	0.26
1-164 NW	RL05-4290-4003	11/18/2005	8230	9900	9	0.44
1-170 NW	RL05-4449-4091	11/30/2005	7630	11800	11	0.08
1-170 NE	RL05-4450-4092	11/30/2005	8120	11700	12	0.15
1-170 SW	RL05-4451-4093	11/30/2005	7950	12200	12	0.16
1-170 SE	RL05-4452-4094	11/30/2005	7460	11800	11	0.21

Table 4
MDA of Gamma-Emitting Radionuclides of Concern

Cs-137 MDA (pCi/g)	Co-60 MDA (pCi/g)	Eu-152 MDA (pCi/g)	Eu-154 MDA (pCi/g)	Am-241 MDA (pCi/g)
0.024 +/- 0.013	0.022 +/- 0.012	0.067 +/- 0.030	0.055 +/- 0.039	0.451 +/- 0.30