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Final Status Survey Report #31-35 Documentation

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FSSR# 31-35



FINAL

**COLUMBUS CLOSURE PROJECT
CHARACTERIZATION AND FINAL STATUS
SURVEY REPORT
JN-3 COOLING WASTE SEWER LINE – EAST SECTION**

Revision 1
June 16, 2006

Prepared by

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

Contract Number: DE-AC24-04OH20171

PSSR # 31-35


**Final Characterization and Final Status Report for
JN-3 Cooling Waste Sewer Line – East Section**

Revision Data Compiled By:



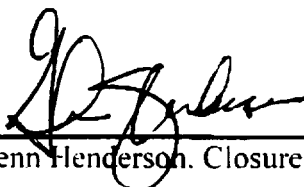
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Contract Number: DE-AC24-04OH20171

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1.0 Introduction

This report contains the final status surveys (FSS) of the east section of the JN-3 Cooling Waste Sewer (CWS) line formerly located at the Columbus Closure Project (CCP), 1425 Plain City/Georgesville Road State Route 142 East, West Jefferson, OH 43162. 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) and the *Radiological Characterization and Final Status Plan for Battelle Columbus Laboratories Decommissioning Project, West Jefferson Site*, DD-97-02 (Final Status Plan) (Battelle, 2000a). The final status surveys were conducted between December 2005 and January of 2006, and performed according to Work Instruction 2806 (Closure Services, 2004).

The intent of this final status survey report is to provide a complete record of the radiological status following the excavation and removal of the east section of the JN-3 CWS line. Sufficient information and data is provided to enable an independent re-creation and evaluation at some future date of both the survey activities and the reported results for the excavation. 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 outline presented in Chapter 9 of NUREG-5849 (ORAU, 1992).

1.1 Background

On April 16, 1943, Battelle Memorial Institute (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, 2003).

The BCO facilities were located at the King Avenue Site in Columbus, Ohio, and the West Jefferson North (WJN) and South (WJS) Sites, in West Jefferson, Ohio. The facilities became partially radiologically contaminated as a result of the R&D activities. Decontamination of the King Avenue Sites has been completed and remedial activities have been completed 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, 2003). The Assistant Secretary for Nuclear Energy of the DOE accepted the

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, 2003). 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. 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, 2003).

The DOE has contracted ECC&E2 Closure Services, LLC (Closure Services) to safely remove DOE radioactive materials and contamination from the WJN site. Removal of radioactive material was to levels allowing future use of the site without radiological restrictions as described in the BMI Decommissioning Plan. Closure Services has conducted characterization and final status surveys of the excavation of the east section of the former JN-3 CWS line to demonstrate that the area is available for unrestricted release for the radioisotopes covered in this report.

2.0 Site Description

Created in 1984, the Battelle Columbus Decommissioning Project (BCLDP) is a remediation project that includes nine buildings at the King Avenue site and five at the West Jefferson Site. In 2003, the DOE changed the name of the BCLDP to the Columbus Closure Project (CCP). The CCP provides final closure of the remaining D&D activities at the WJN site. The WJN site had five permanent structures, including the nuclear research facilities Buildings JN-1, JN-2, JN-3, the security operations Building JN-6, and the Well House. The Well House is the only remaining permanent structure at the site associated with the CCP. Several outfalls, filter beds, and wells have remain at the site.

2.1 Area Description

The east section of the CWS line was connected to the former Building JN-3 cooling tower. The line then ran to an outfall that eventually discharged along the eastern edge of the site. **Figure 1** details the overall layout of the site. **Figure 2** shows the location of the east section of the former CWS line as highlighted in yellow. **Figure 3** details the global positioning satellite (GPS) locations of the east section of the excavation.

3.0 Decommissioning Activities

3.1 Decommissioning Objective

The objective of the final status survey performed on the east section of the former CWS line was to statistically demonstrate that the remediation of the area was successful and that the excavation is suitable for unrestricted release. The excavation is determined to be suitable for unrestricted release 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. Unrestricted release criteria for scanning and exposure rate surveys are discussed in subsequent sections of this report.

3.2 Characterization and Remediation Activities

In August 2000, BMI obtained *in-situ* measurements of the interior of the CWS line for portions of the WJN site. Science & Engineering Associates, Inc. performed the *in-situ* survey under contract to BMI. Measurements from the survey indicated the presence of internal contamination above the residual surface contamination limits for unrestricted release. Based upon the preliminary investigation, the entire CWS line was slated for removal and disposed as low level waste.

Closure Services initiated the final excavation and removal of the CWS line in late December 2005 and completed the excavation the week of January 13, 2006.

Cesium-137 (Cs-137) has been found to be the primary RCOC for excavations performed associated with the remediation of Building JN-3, the origination point of the CWS line. This condition has been consistently encountered throughout the excavation and remediation of the entire WJN site. Specifically, Cs-137 is consistently found at concentrations ranging from 15 to 78.9 times higher than that of Americium-241 (Am-241). This is due to Cs-137 being a major fission product, while Am-241 is generated at a much lesser rate.

Review indicated that activity concentrations of Am-241 exceeded those of Cs-137. This occurred along the section of the CWS line excavation that ran parallel to the fence line of Building JN-4. The ratio of Cs-137 to Am-241 ranged from $6.3E-3$ to $8.2 E-3$, contrary to the ratio consistently encountered throughout the WJN site ranging from 15 to 78.9. The ratios and restricted area of the Am-241 concentrations suggests that the residual radioactive contamination in the east section of the CWS line excavation is not associated with material originating from the Building JN-3 cooling tower or with historical operations uniquely associated with Buildings JN-1, 2, or 3. The unique ratios would suggest that the Am-241 is associated with JN-4, the former Plutonium facility decommissioned and released in the early 1980's.

This report focuses on the mixed fission product contamination uniquely associated with Buildings JN-1, 2, and 3. Specifically, the intent of the design and implementation of the characterization and final status survey was to release the area as established for all other locations at the WJN site. Battelle performed additional characterization of the area surrounding the east section of the JN-3 Cooling Waste Line to determine if Am-241 and plutonium are present and will prepare 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. Residual radioactive contamination is not expected in these areas based on knowledge of site history and previous information.

The excavation of the east section of the former CWS line was conducted in both affected and unaffected areas according to the above definition. The base of the excavation immediately underlying the sanitary line was classified as affected. The sidewalls of the excavation were classified as unaffected.

Excavation of the CWS line began at the connecting point at the former foundation of Building JN-3. Removal then proceeded east along the run of the line. Characterization Technicians sampled and scanned the overburden soils removed as the excavation proceeded. Materials removed immediately adjacent to the sanitary sewer line were segregated and disposed as low level waste. Sanitary sewer line sections were then removed and disposed as low level waste. Characterization Technicians then surveyed the base and sidewalls of the excavation with a Ludlum Model 44-10 two-inch by two-inch sodium iodide detector with Eberline ESP-2 meter. Samples were also collected from the base and sidewalls of the excavation trench to demonstrate compliance to the unrestricted release criteria.

On January 6, 2006, excavation of the east section of the CWS line revealed two clay pipes at approximately 3-feet below the surface grade. The clay pipes traversed the excavation in a north-south direction. The clay pipes were located northeast of the former Building JN-1 High Bay and south of Building JN-4. Characterization Technicians obtained samples of the pipe material for analysis by the Onsite RAL. Review of site

historical drawings and discussions with former site facility personnel determined the pipes to be abandoned roof drain lines. **Table 6** presents the analytical results of samples taken from the pipes.

4.0 Final Status Survey Procedures

Planning and implementation of the final status survey of the excavation affected and unaffected areas of the east section of the former CWS line adhered to the requirements of the Final Status Plan (Battelle, 2000a) and Work Instruction 2806 (Closure Services, 2004).

4.1 Sampling Parameters

Final status soil samples of the east section of the former CWS line excavation trench were taken following completion of the remediation. Sampling was performed according to Work Instruction -2806 (WI-2806), Excavation and Trench Sampling and Surveys. To facilitate the sampling process in the field the trench was physically divided into sections and the samples from the sidewalls and base of the trench were collected in accordance with the requirements of WI - 2806. The Onsite Radioanalytical Laboratory (RAL) performed analysis of the samples by gamma spectroscopy.

4.2 Major Contaminants Identified

The characterization of the east section of the former CWS line excavation identified Cs-137 as the primary radiological contaminant of concern (RCOC). Other RCOCs included Co-60, Eu-152 and 154, Am-241, Sr-90, 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 radioisotopic activity. Further, the release criteria for Cs-137 is considered conservative for the decommissioning activities. **Table 2** includes ratios of individual radionuclides as compared to Cs-137, as well as the analytical results from characterization samples obtained from the Building JN-1 backyard and the Bog Area during the fall of 2005. **Table 2** is a compilation of pre-remedial samples and is not representative of the final condition of the Building JN-1 backyard and the Bog Area.

4.2.1 Guidelines Established

Table 1 presents the guidelines for residual radioactivity concentrations for soil and solid volumes as applied to the excavation and removal of the east section of the CWS line. Criteria for residual radioactivity concentrations in soil are defined in a number of references. DOE Order 5400.5, Section IV.a.2 provides generic guidelines for residual concentrations of Radium-226 (Ra-226), Ra-228, Thorium-230 (Th-230), and Th-232. NRC Guidance provided to the CCP contains soil radioactivity concentration guidelines for Co-60, Sr-90, Cs-137, and Ra-226, and Ra-228, natural, enriched and depleted uranium. **Table 1** values have been generated primarily from various reference technical documents and from soil guidelines generated using computer pathway analyses.

Table 2 presents data utilized from previous characterization samples collected during the excavation of the backyard of Building JN-1 and the Bog Area to establish a site-

specific ratio of Cs-137 to other RCOC. Analytical results from samples of the backyard and Bog Area were obtained during excavation during the fall of 2005, and calculated ratios are presented in Table 2. Sampling data are characterization activities during excavation and are not representative of the final condition of either location. Samples with a range of activity concentrations for Cs-137 were selected in generating the Table 2 Ratio.

The Table 2 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 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. The calculated mean background exposure rate and the 95 percent confidence intervals used for the CCP grounds are $8 \pm 2 \mu\text{R/hr}$. Data collected from trench-like culverts located on Battelle property unassociated with site operations indicate a geometry effect, increasing the exposure rates inside the trenches by up to $5 \mu\text{R/hr}$, creating a exposure rate limit of less than or equal to $18 \mu\text{R/hr}$.

5.0 Equipment and Procedures

5.1 Equipment

A Ludlum Model 44-10 two-inch by two-inch sodium iodide detector with Eberline ESP-2 meter was used to scan the excavation. The Ludlum Model 19 exposure rate meter was used to obtain $\mu\text{R/hr}$ measurements.

Other instrumentation used in the RAL to support the final status survey included:

- A VMS based Canberra Procount data acquisition system in conjunction with high purity germanium detectors for gamma spectroscopy to conduct analysis of bulk soil samples.
- A 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 utilizing the background count rate and a default detector response to Cs-137. 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 for the detector was 9,500 counts per minute (cpm). The following is the calculation of the MDC_{scan} :

$$b_i = (9,500 \text{ cpm}) \times (1 \text{ sec}) \times (1 \text{ min}/60 \text{ sec}) = 158 \text{ counts}$$

$$\text{MDCR} = (1.38) \times (\sqrt{158 \text{ counts}}) \times (60 \text{ sec}/1 \text{ min}) = 1040 \text{ cpm}$$

$$\text{MDCR}_{\text{surveyor}} = 1040 \text{ cpm} / \sqrt{0.5} = 1472 \text{ cpm}$$

$$\text{MDER} = 1472 \text{ cpm} / (900 \text{ cpm}/\mu\text{R/hr}) = 1.63 \mu\text{R/hr}$$

$$\text{MDC}_{\text{scan}} = (5 \text{ pCi/g}) * \frac{1.63 \mu\text{R/hr}}{1.307 \mu\text{R/hr}} = 6.2 \text{ pCi/g}$$

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 BCLDP
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 Excavation Sampling

Samples of the excavation base were taken at an interval of one per linear meter as required by Section 6.3.3 of DD-97-02, Rev. 0. Thirty samples were taken from the sidewalls and 60 samples were obtained from the base of the excavation. The following table lists the number of samples taken from the base and sidewalls of the east section of the CWS line excavation and the Cs-137 concentrations.

Location	Number of Samples	Cs-137 Average (pCi/g)	Cs-137 Standard Deviation (pCi/g)	Cs-137 Modified Screening Criteria (pCi/g)
Excavation Base	66	-1.21E-3	3.17E-3	7.3
Excavation Sidewalls	20	8.97E-3	6.02E-3	7.3

A "fraction of limit" calculation may be performed, to verify the original assumptions, when soil sample results begin to approach detected Cs-137 levels above 4 pCi/g. Further remediation of an area may be conducted when Cs-137 levels begin to consistently approach the modified screening criteria of 7.3 pCi/g. The "fraction of limit" for the east section of the CWS line base and sidewalls was not calculated as the reported activity concentration of the samples was very low. The maximum Cs-137 activity concentrations of soil samples collected from the base and sidewalls of the excavation were 0.033 pCi/g and 0.037 pCi/g, respectively. Both samples were much lower than the modified screening criteria of 7.3 pCi/g for Cs-137.

Tables 3 and 4 present the reported Cs-137 activity concentrations for samples obtained from the excavation of the east section of the CWS line. Table 5 presents the analytical results of samples taken from the sidewalls, "C" soils (base of the excavation trench), the "A" soils, and the "B" soils. "A" soils are those excavated from the ground surface to 3-feet above the former CWS line and are considered unaffected. "B" soils are those excavated from 3-feet to 1-foot above the former CWS line and are considered to be unaffected. "C" soils are those excavated from 1-foot above and 1-foot below the CWS line, and are considered affected.

Analytical results of the two samples collected from the clay pipes encountered during the excavation were below the modified screening criteria for Cs-137. Reported Cs-137 results were 0.068 pCi/g and 0.048 pCi/g, respectively.

6.2 Scanning Measurements

Scanning of the east section of the CWS line excavation was performed in accordance with WI-2806 using a two inch by two inch sodium iodide detector. Results of the survey indicate a uniform distribution of residual radioactivity and did not exceed the DLV of 18,374 cpm. Table 5 presents the results of the scanning survey for the east section of the CWS excavation.

6.3 Overburden Sampling

Forty samples were taken from the overburden removed during the excavation and removal of the east section of the CWS line. The following table summarizes the number of samples obtained from the overburden sampling.

Location	Number of Samples	Cs-137 Average (pCi/g)	Cs-137 Standard Deviation (pCi/g)	Cs-137 Modified Screening Criteria (pCi/g)
Overburden "A" Soils	20	1.15 E-2	4.78 E-3	7.3
Overburden "B" Soils	20	1.41 E-2	4.18 E-3	7.3

The "fraction of limit" for the east section of the CWS line "A" and "B" overburden soils was not calculated as the reported activity concentration of the samples was very low. The maximum Cs-137 activity concentrations of soil samples collected from the "A" soils and the "B" soils was 0.087 pCi/g and 0.061 pCi/g, respectively. Both samples were much lower than the modified screening criteria of 7.3 pCi/g for Cs-137.

6.4 Exposure Rate Surveys

The calculated mean background exposure rate and the 95 percent confidence intervals used for the CCP grounds are 8 ± 2 μ R/hr. The exposure rate readings obtained from the trench of the east section of the CWS line are presented in Table 5. The exposure rate readings were individually compared to the mean background value of 8 ± 2 μ R/hr in order to show compliance with the 5 μ R/hr above background release criterion (grounds exposure rate surveys must be less than or equal to 13 μ R/hr to be compliant). Exposure rates ranged from 5 to 8 μ R/hr, exhibiting an average exposure rate of 5.9 μ R/hr. The minimum measurement of the area was 5 μ R/hr and the maximum measurement was 8 μ R/hr.

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) Specifically, the objective of demonstrating compliance to the unrestricted release of Cs-137 RCOCs surrogate associated with the operations of the WJN site.

8.0 References

- American National Standards Institute (ANSI), 1997. ANSI-N323a. "Radiation Protection Instrumentation Test and Calibration."
- Battelle, 2003. "Decommissioning Plan for the Battelle Memorial Institute Columbus Operations, DD-93-19. Revision 5."
- Battelle, 2000a. "Radiological Characterization and Final Status Survey Plan for Battelle Columbus Laboratory Decommissioning Project West Jefferson Site. DD-97-02."
- Battelle, 1993a. "Surface Release Criteria Technical Basis Document, DD-93-02."
- Battelle, 1993b. "Volumetric Release Criteria Technical Basis Document for Battelle Columbus Laboratories Decommissioning Project. DD-93-03, Revision 0."
- Closure Services, 2004. "Work Instruction 2806. Excavation and Trench Sampling and Surveys."
- DOE, 1990. "Finding of No Significant Impact, Decontamination and Decommissioning of the Battelle Columbus Laboratories in Columbus and West Jefferson, Ohio."
- DOE, 1986. May 29, 1986 memorandum, Voight to Vaughan, approved by Vaughan, June 10, 1986.
- 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

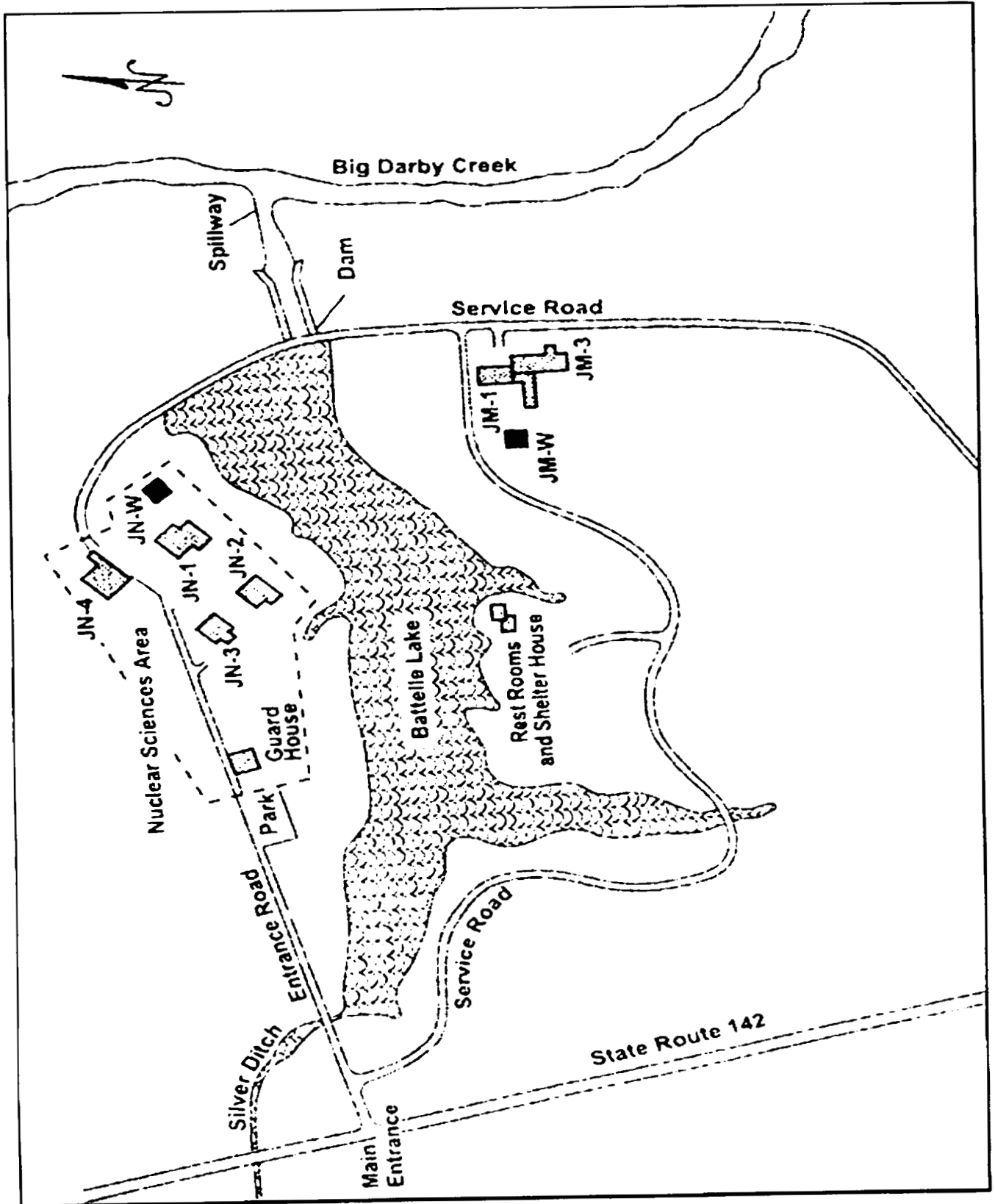
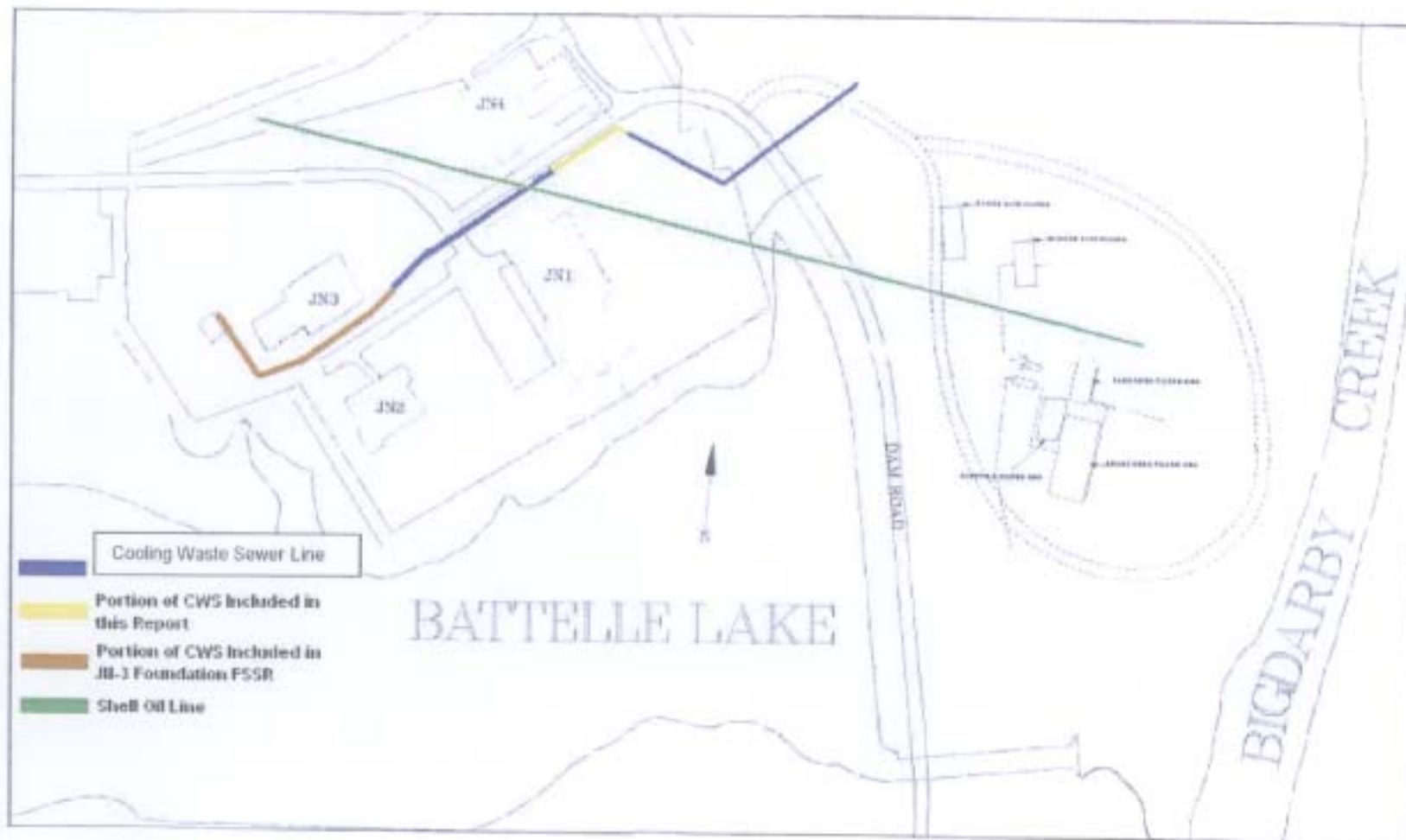


Figure 2, CWS Line Excavation



TABLES

**Table 1
BCLDP Guidelines for Volumetric 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
Am-243	na	30
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	1,900
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
Pu-239	na	25
Pu-240	na	25
Pu-241	na	25
Pu-242	na	25
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

Radionuclide ^(a)	King Avenue Concentration (pCi/g) ^(b)	West Jefferson Concentration (pCi/g) ^(b)
Ru-106	na	180
Sb-125	na	1.100
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".

Table 2, 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	0.05	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	0.36	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	0.06	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	0.62	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	0.11	0.00	0.38	0.01	1.44	0.29	0.22	0.01	0.52	0.02
RL05-4101	7.47	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	0.46	0.13	0.01	0.53	0.02
RL05-4158	12.80	0.85	0.45	0.06	0.09	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 _L Cs-137 Ratios	Activity (pCi/g) - Cs-137 Ratio	Limits (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	Cs/Co-60	35.7	
Eu-154	32 pCi/g	Cs/Eu-152	76.1	0.003
Am-241	30 pCi/g	Cs/Eu-154	225.1	0.001
Sr-90	5 pCi/g	Cs/Am-241	78.9	0.003
Pu-238	25 pCi/g	Cs/Sr-90	4.1	0.366
Pu-239	25 pCi/g	Cs/Pu-238	57.5	0.005
Pu-241	25 pCi/g	Cs/Pu-239	83.1	0.004
		*Cs/Pu-241	2.8	0.104
				Sum
				0.99

Table J
Report of Cs-137 Concentrations (pCi/g) of Samples from Base of Excavation 0 to 100 Feet

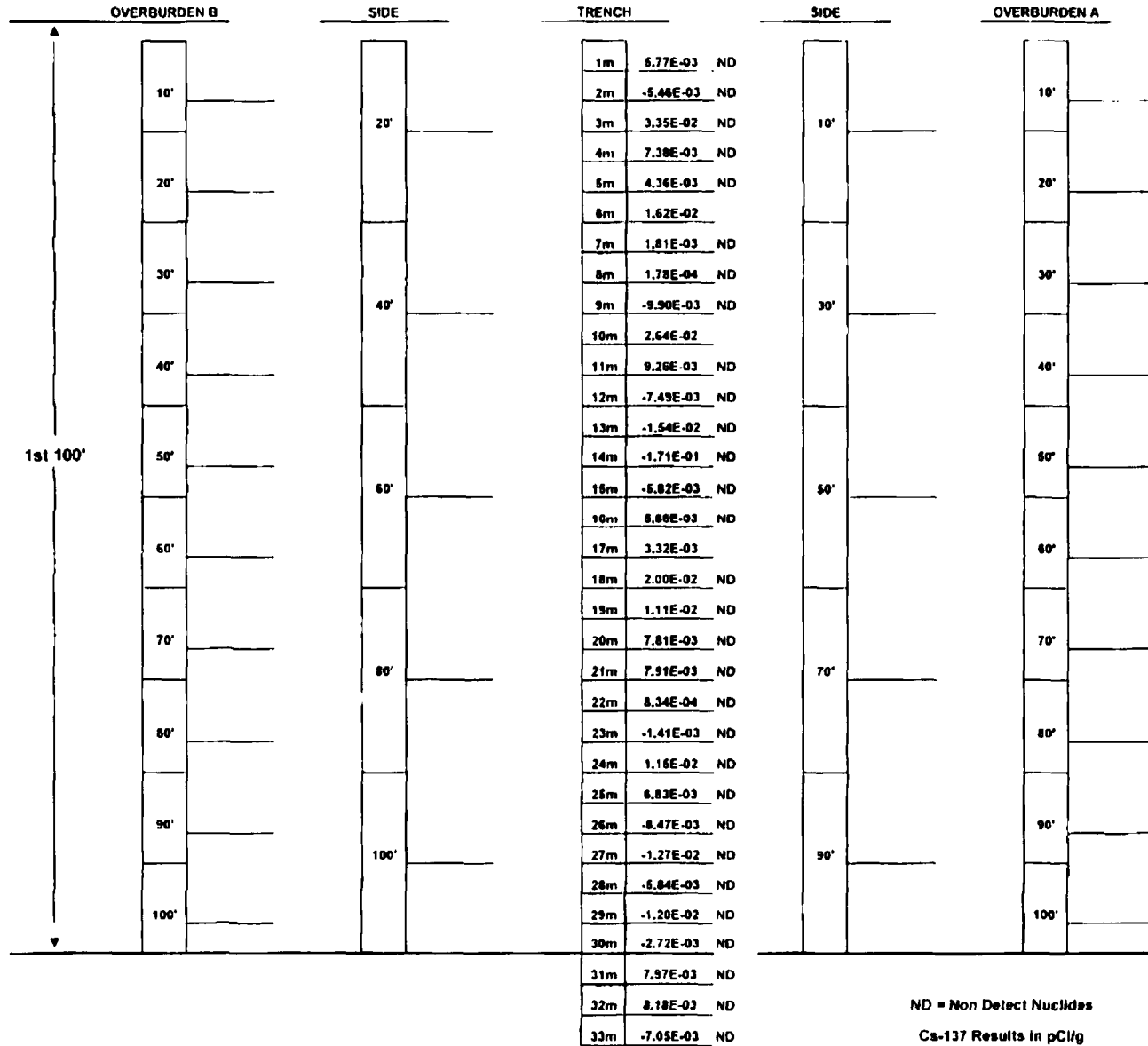


Table 4
Reported Cs-137 Concentrations (pCi/g) of Samples from Base of Excavation 110 to 200 Feet

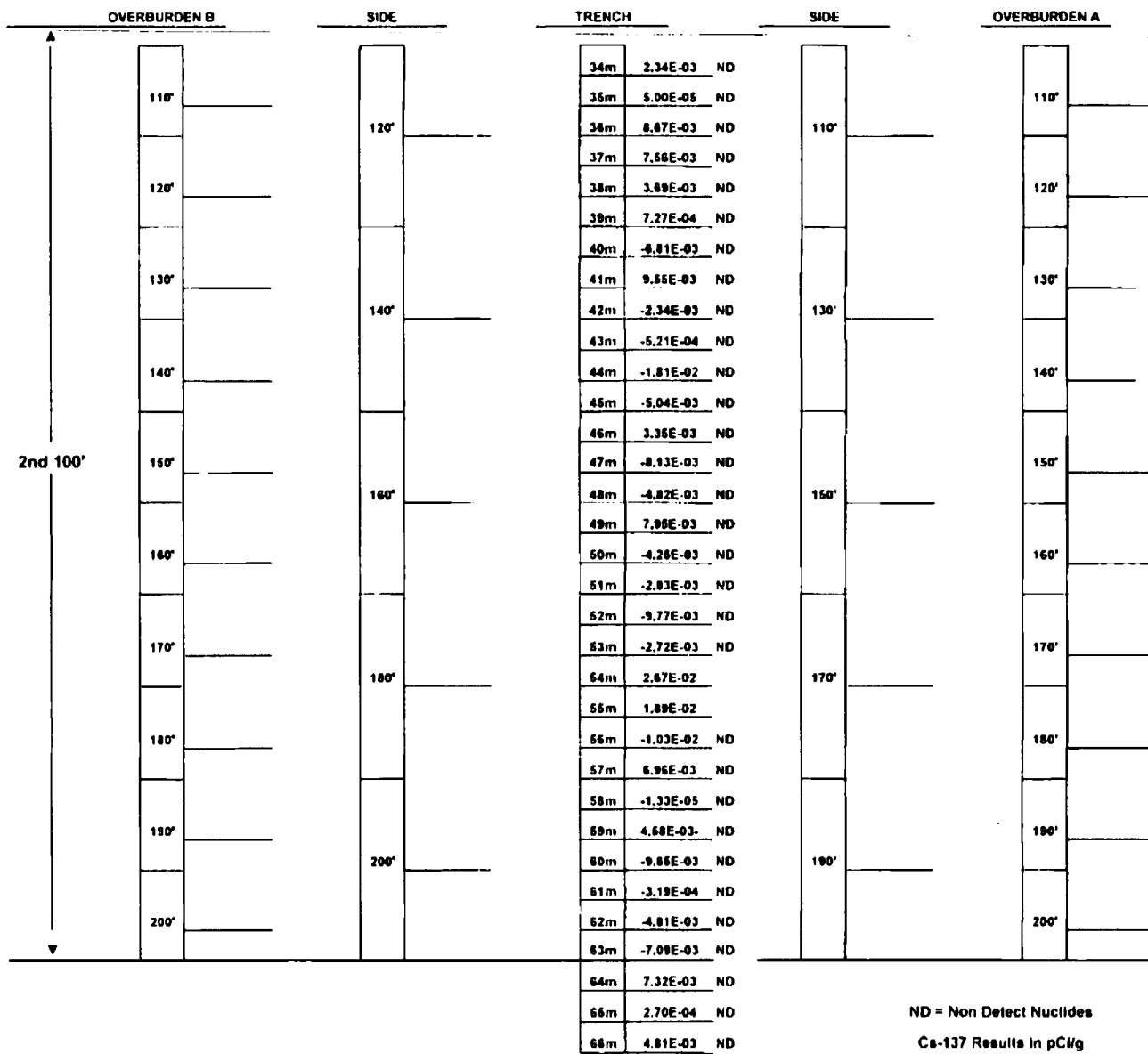


Table 5
Summary Data for Excavation and Removal of East Section CWS Line

Sample Identification Number	Location	Collection Date	Field Screen Result (Kcpm)	Wallover Scan Results (Kcpm)	Exposure Rate Survey (μ R/h)	Cs-137 Activity Concentration (pCi/g)
RL06-0137-4574	B Soil @ 100'	1/9/2006	8.15	N/A	N/A	9.35E-03
RL06-0138-4575	B Soil @ 110'	1/9/2006	7.24	N/A	N/A	-1.03E-02
RL06-0139-4576	B Soil @ 120'	1/9/2006	7.79	N/A	N/A	-5.60E-03
RL06-0140-4577	B Soil @ 130'	1/9/2006	7.65	N/A	N/A	9.05E-03
RL06-0141-4578	B Soil @ 140'	1/9/2006	7.86	N/A	N/A	2.28E-02
RL06-0142-4579	B Soil @ 150'	1/9/2006	7.70	N/A	N/A	2.51E-02
RL06-0143-4580	B Soil @ 160'	1/9/2006	7.70	N/A	N/A	4.38E-02
RL06-0144-4581	B Soil @ 170'	1/9/2006	7.67	N/A	N/A	3.18E-02
RL06-0145-4582	B Soil @ 180'	1/9/2006	7.79	N/A	N/A	-1.41E-02
RL06-0054-4506	B Soil @ 190'	1/5/2006	7.49	N/A	N/A	9.05E-03
RL06-0055-4507	B Soil @ 200'	1/5/2006	7.57	N/A	N/A	2.28E-02
RL06-0402-4808	C Soil @ 1m	1/16/2006	8.10	9.84	6.00	5.77E-03
RL06-0403-4809	C Soil @ 2m	1/16/2006	8.21	9.32	5.00	-5.46E-03
RL06-0404-4810	C Soil @ 3m	1/16/2006	7.90	8.20	5.00	3.35E-02
RL06-0415-4821	C Soil @ 4m	1/16/2006	7.83	9.40	5.00	7.38E-03
RL06-0260-4655	C Soil @ 5m	1/11/2006	7.13	10.70	6.00	4.36E-03
RL06-0261-4656	C Soil @ 6m	1/11/2006	7.48	12.00	6.00	1.62E-02
RL06-0388-4787	C Soil @ 7m	1/13/2006	7.20	11.20	6.00	1.81E-03
RL06-0389-4788	C Soil @ 8m	1/13/2006	7.16	12.20	6.00	1.78E-04
RL06-0390-4789	C Soil @ 9m	1/13/2006	7.35	11.00	5.00	-9.90E-03
RL06-0391-4790	C Soil @ 10m	1/13/2006	6.94	10.50	5.00	2.64E-02
RL06-0392-4791	C Soil @ 11m	1/13/2006	7.30	10.40	6.00	9.26E-03
RL06-0405-4811	C Soil @ 12m	1/16/2006	8.25	11.20	5.00	-7.49E-03
RL06-0406-4812	C Soil @ 13m	1/16/2006	8.82	10.90	5.00	-1.54E-02
RL06-0407-4813	C Soil @ 14m	1/16/2006	9.24	11.00	6.00	-1.71E-01
RL06-0408-4814	C Soil @ 15m	1/16/2006	9.37	12.00	5.00	-5.82E-03
RL06-0409-4815	C Soil @ 16m	1/16/2006	7.85	13.90	6.00	5.86E-03
RL06-0410-4816	C Soil @ 17m	1/16/2006	7.96	12.40	6.00	3.32E-03
RL06-0414-4820	C Soil @ 18m	1/16/2006	7.60	12.60	5.00	2.00E-02

Table 5
Summary Data for Excavation and Removal of East Section CWS Line

Sample Identification Number	Location	Collection Date	Field Screen Result (Kcpm)	Wallover Scan Results (Kcpm)	Exposure Rate Survey ($\mu\text{R/h}$)	Cs-137 Activity Concentration ($\mu\text{Ci/g}$)
RL06-0393-4792	C Soil @ 19m	1/13/2006	8.27	12.70	6.00	1.11E-02
RL06-0394-4793	C Soil @ 20m	1/13/2006	7.45	13.80	7.00	7.81E-03
RL06-0395-4794	C Soil @ 21m	1/13/2006	7.58	12.90	6.00	7.91E-03
RL06-0396-4795	C Soil @ 22m	1/13/2006	7.66	12.80	6.00	8.34E-04
RL06-0397-4796	C Soil @ 23m	1/13/2006	8.97	12.40	7.00	-1.41E-03
RL06-0398-4797	C Soil @ 24m	1/13/2006	7.91	12.30	7.00	1.15E-02
RL06-0411-4817	C Soil @ 25m	1/16/2006	8.52	13.30	5.00	6.83E-03
RL06-0412-4818	C Soil @ 26m	1/16/2006	8.50	13.60	6.00	-8.47E-03
RL06-0413-4819	C Soil @ 27m	1/16/2006	8.55	12.90	6.00	-1.27E-02
RL06-0157-4587	C Soil @ 28m	1/10/2006	8.48	15.30	6.00	-5.84E-03
RL06-0158-4588	C Soil @ 29m	1/10/2006	7.50	13.10	7.00	-1.20E-02
RL06-0159-4589	C Soil @ 30m	1/10/2006	7.94	13.60	6.00	-2.72E-03
RL06-0160-4590	C Soil @ 31m	1/10/2006	7.58	13.00	6.00	7.97E-03
RL06-0161-4591	C Soil @ 32m	1/10/2006	7.60	13.50	7.00	8.18E-03
RL06-0162-4592	C Soil @ 33m	1/10/2006	7.09	14.30	6.00	-7.05E-03
RL06-0163-4593	C Soil @ 34m	1/10/2006	6.98	14.50	6.00	2.34E-03
RL06-0164-4594	C Soil @ 35m	1/10/2006	7.22	16.10	7.00	5.00E-05
RL06-0165-4595	C Soil @ 36m	1/10/2006	7.14	16.40	7.00	8.67E-03
RL06-0166-4596	C Soil @ 37m	1/10/2006	7.27	16.50	8.00	7.56E-03
RL06-0167-4597	C Soil @ 38m	1/10/2006	7.37	15.40	7.00	3.69E-03
RL06-0168-4598	C Soil @ 39m	1/10/2006	7.45	16.90	6.00	7.27E-04
RL06-0169-4599	C Soil @ 40m	1/10/2006	7.90	15.40	6.00	-6.81E-03
RL06-0170-4600	C Soil @ 41m	1/10/2006	7.56	15.20	7.00	-9.55E-03
RL06-0171-4601	C Soil @ 42m	1/10/2006	7.57	14.30	6.00	-2.34E-03
RL06-0172-4602	C Soil @ 43m	1/10/2006	7.73	15.00	6.00	-5.21E-04
RL06-0173-4603	C Soil @ 44m	1/10/2006	7.34	15.30	5.00	-1.81E-02
RL06-0174-4604	C Soil @ 45m	1/10/2006	6.93	14.00	7.00	-5.04E-03
RL06-0175-4605	C Soil @ 46m	1/10/2006	7.21	15.50	6.00	3.35E-03
RL06-0176-4606	C Soil @ 47m	1/10/2006	7.48	15.20	5.00	-8.13E-03

Table 5
Summary Data for Excavation and Removal of East Section CWS Line

Sample Identification Number	Location	Collection Date	Field Screen Result (Kcpm)	Wallover Scan Results (Kcpm)	Exposure Rate Survey (μ R/h)	Cs-137 Activity Concentration (pCi/g)
RL06-0177-4607	C Soil @ 48m	1/10/2006	7.38	15.30	5.00	-4.82E-03
RL06-0178-4608	C Soil @ 49m	1/10/2006	7.53	15.50	5.00	7.95E-03
RL06-0179-4609	C Soil @ 50m	1/10/2006	7.70	13.80	6.00	-4.26E-03
RL06-0180-4610	C Soil @ 51m	1/10/2006	7.11	11.50	6.00	-2.83E-03
RL06-0181-4611	C Soil @ 52m	1/10/2006	7.23	12.90	7.00	-9.77E-03
RL06-0182-4612	C Soil @ 53m	1/10/2006	7.75	13.40	6.00	-2.72E-03
RL06-0183-4613	C Soil @ 54m	1/10/2006	6.85	12.10	6.00	2.67E-02
RL06-0184-4614	C Soil @ 55m	1/10/2006	7.49	12.80	5.00	1.89E-02
RL06-0185-4615	C Soil @ 56m	1/10/2006	8.03	13.00	5.00	-1.03E-02
RL06-0186-4616	C Soil @ 57m	1/10/2006	6.94	14.60	5.00	6.96E-03
RL06-0187-4617	C Soil @ 58m	1/10/2006	7.01	9.92	6.00	-1.33E-05
RL06-0188-4618	C Soil @ 59m	1/10/2006	7.03	11.70	5.00	4.58E-03
RL06-0189-4619	C Soil @ 60m	1/10/2006	6.83	10.40	6.00	-9.65E-03
RL06-0517-4894	Sidewall Soil @ 10'	1/26/2006	7.84	9.78	5.00	1.49E-02
RL06-0518-4895	Sidewall Soil @ 20'	1/26/2006	8.09	11.90	6.00	4.73E-03
RL06-0519-4896	Sidewall Soil @ 30'	1/26/2006	7.79	10.50	6.00	5.85E-03
RL06-0520-4897	Sidewall Soil @ 40'	1/26/2006	7.44	11.10	5.00	-1.31E-02
RL06-0521-4898	Sidewall Soil @ 50'	1/26/2006	9.70	11.00	6.00	-9.12E-03
RL06-0522-4899	Sidewall Soil @ 60'	1/26/2006	8.88	11.40	6.00	3.94E-03
RL06-0523-4900	Sidewall Soil @ 70'	1/26/2006	9.97	11.50	6.00	3.89E-03
RL06-0524-4901	Sidewall Soil @ 80'	1/26/2006	11.70	12.20	6.00	1.71E-02
RL06-0525-4902	Sidewall Soil @ 90'	1/26/2006	9.90	12.60	6.00	7.94E-03
RL06-0526-4903	Sidewall Soil @ 100'	1/26/2006	10.00	11.70	5.00	3.72E-02
RL06-0527-4904	Sidewall Soil @ 110'	1/26/2006	9.50	12.70	6.00	6.24E-03
RL06-0528-4905	Sidewall Soil @ 120'	1/26/2006	10.10	16.10	7.00	3.56E-02
RL06-0530-4906	Sidewall Soil @ 130'	1/26/2006	9.39	16.80	6.00	-7.59E-03
RL06-0531-4907	Sidewall Soil @ 140'	1/26/2006	9.69	15.10	7.00	6.70E-03
RL06-0532-4908	Sidewall Soil @ 150'	1/26/2006	10.50	15.70	6.00	2.21E-02
RL06-0533-4909	Sidewall Soil @ 160'	1/26/2006	11.90	17.10	7.00	-1.85E-02

Table 5
Summary Data for Excavation and Removal of East Section CWS Line

Sample Identification Number	Location	Collection Date	Field Screen Result (Kcpm)	Wallover Scan Results (Kcpm)	Exposure Rate Survey (μ R/h)	Cs-137 Activity Concentration (pCi/g)
RL06-0534-4910	Sidewall Soil @ 170'	1/26/2006	12.00	15.30	6.00	-3.00E-03
RL06-0535-4911	Sidewall Soil @ 180'	1/26/2006	10.70	11.70	7.00	3.38E-02
RL06-0536-4912	Sidewall Soil @ 190'	1/26/2006	11.80	13.20	6.00	-8.05E-03
RL06-0537-4913	Sidewall Soil @ 200'	1/26/2006	11.60	11.70	6.00	-5.79E-03

Table 6

Reported Cs-137 Concentrations (pCi/g) of Samples from (2) Clay Pipes

Sample Identification Number	Location	Collection Date	Field Screen Result (Kcpm)	Wallover Scan Results (Kcpm)	Exposure Rate Survey (μ R/h)	Cs-137 Activity Concentration (pCi/g)
RL06-0081	Clay Pipe @ N.Wall	1/06/2006	N/A	N/A	N/A	-3.18E-02
RL06-0082	Clay Pipe @ S.Wall	1/06/2006	N/A	N/A	N/A	-2.32E-02