Cleanup Verification Package for the 600-259 Waste Site

**Prepared for the U.S. Department of Energy
by Washington Closure Hanford**

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EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action for the 600-259 waste site. The 600-259 site is located within the 300-FF-2 Operable Unit in the 300 Area of the Hanford Site in southeastern Washington State. The site was the former site of the Special Waste Form Lysimeter, consisting of commercial reactor isotope waste forms in contact with soils within engineered caissons. The Special Waste Form Lysimeter was used by Pacific Northwest National Laboratory to collect data regarding leaching behavior for target analytes. A Grout Waste Test Facility also operated at the site, designed to test leaching rates of grout-solidified low-level radioactive waste.

Site excavation and waste disposal are complete, and the exposed surfaces and overburden material have been sampled and analyzed to verify attainment of the remedial action goals. Results of the sampling, laboratory analyses, and data evaluations for the 600-259 site indicate that all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met (Table ES-1).

The site meets cleanup standards and has been reclassified as "interim closed out" in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 1998). A copy of the waste site reclassification form is included as Attachment ES-1.

**Table ES-1. Summary of Cleanup Verification Results for the
600-259 Waste Site.**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years. Attain the CERCLA risk range of 10^{-4} to 10^{-6} .	Cesium-137 was detected below its direct exposure dose equivalence lookup value at the Special Waste Form Lysimeter. All other radionuclide COCs were undetected. No radionuclides were detected above background at the Grout Waste Test Facility.	Yes
Direct Exposure – Nonradionuclides	Attain individual COC RAGs.	No nonradionuclide COCs were identified.	NA
Meet Nonradionuclide Risk Requirements	<div>Hazard quotient of <1 for noncarcinogens.</div> <div>Cumulative hazard quotient of <1 for noncarcinogens.</div> <div>Excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.</div> <div>Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.</div>	No nonradionuclide COCs were identified.	NA
Groundwater/River Protection – Radionuclides	<div>Attain single-COC groundwater and river protection RAGs.</div> <div>Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptors/organs.^a</div> <div>Meet drinking water standards for nonuranium alpha emitters: the more stringent of the 15 pCi/L MCL or 1/25th of the derived concentration guide per DOE Order 5400.5.^b</div> <div>Meet total uranium standard of 21.2 pCi/L.^c</div>	Of the radionuclide COCs, only cesium-137 was detected at the Special Waste Form Lysimeter. Cesium-137 is not predicted to reach groundwater or the river within 1,000 years. ^d No radionuclides were detected above background at the Grout Waste Test Facility.	Yes
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	No nonradionuclide COCs were identified.	NA
Supporting Information	600-259 cleanup verification sample location design (Appendix C). ^e 600-259 cleanup verification 95% UCL calculation (Appendix C). ^f		

^a “National Primary Drinking Water Regulations” (40 *Code of Federal Regulations* 141).

^b *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).

^c Based on the isotopic distribution of uranium in the Hanford Site background, the 30 µg/L MCL (65 *Federal Register* 76708) corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

^d Based on the RESRAD model identified in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2004b).

^e 600-259 Waste Site Shallow Zone and Overburden Sampling Plan, 0600X-CA-V0055, Rev. 0, Washington Closure Hanford, Richland, Washington.

^f 600-259 Waste Site Cleanup Verification 95% UCL Calculations, 0600X-CA-V0053, Rev. 0, Washington Closure Hanford, Richland, Washington.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

COC = contaminant of concern

MCL = maximum contaminant level (drinking water standard)

NA = not applicable

RAG = remedial action goal

UCL = upper confidence limit

Attachment ES-1 Waste Site Reclassification Form

<p><u>Date Submitted:</u> 1/24/06</p> <p><u>Originator:</u> R. A. Carlson</p> <p><u>Phone:</u> 373-1440</p>	<p><u>Operable Unit(s):</u> 300-FF-2</p> <p><u>Waste Site ID:</u> 600-259, Special Waste Form Lysimeter and 600-259:1 Grout Waste Test Facility</p> <p><u>Type of Reclassification Action:</u></p> <p>Rejected ☐</p> <p>Closed Out ☐</p> <p>Interim Closed Out ☒</p> <p>No Action ☐</p>	<p><u>Control Number:</u> 2005-051</p> <p><u>Lead Agency:</u> EPA</p>
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This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action, and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at the 600-259 site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the U.S. Department of Energy, Richland Operations Office, in concurrence with the Washington State Department of Ecology. The selected remedial action involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavated materials at the Environmental Restoration Disposal Facility in the 200 Area of the Hanford Site, and (3) backfilling the site with clean overburden and fill material to match the surrounding surface. The excavation and disposal activities have been completed.

Lysimeters at the Grout Waste Test Facility (600-259:1 subsite) were removed in September 1994. Analysis of soil samples collected beneath the former lysimeters at the time of removal indicated that no residual radionuclide contamination existed above background activity levels.

Basis for reclassification:

The 600-259 waste site (including the 600-259:1 subsite) has been remediated to meet the cleanup standards specified in the *Record of Decision for the 300-FF-2 Operable Unit, Hanford Site*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. Remedial actions were performed to support future unrestricted land use and to protect groundwater and the Columbia River. The residual contaminant concentrations achieved for the 600-259 site (and 600-259:1 subsite) do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). This site has no deep zone; therefore, no deep zone institutional controls are required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 600-259 Waste Site* (CVP-2005-00008), Washington Closure Hanford, Richland, Washington.

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CONTENTS

1.0	INTRODUCTION.....	1
2.0	SITE DESCRIPTION AND SUPPORTING INFORMATION.....	2
3.0	REMEDIAL ACTION FIELD ACTIVITIES	2
3.1	EXCAVATION AND DISPOSAL	2
3.2	FIELD SCREENING	4
3.3	BIASED SAMPLING AND ANALYSIS.....	4
3.4	CLEANUP VERIFICATION SAMPLING AND ANALYSIS	4
4.0	CLEANUP VERIFICATION DATA EVALUATION	9
4.1	DATA QUALITY ASSESSMENT PROCESS.....	9
4.2	CONTAMINANTS OF CONCERN 95% UPPER CONFIDENCE LIMIT.....	9
4.3	BIASED SAMPLE RESULTS	10
4.4	SITE-SPECIFIC CLEANUP VERIFICATION MODEL	11
4.5	RESRAD MODELING.....	11
5.0	EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT	11
5.1	DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED....	12
5.1.1	Radionuclides	12
5.1.2	Nonradionuclides	12
5.2	GROUNDWATER REMEDIAL ACTION GOALS ATTAINED	12
5.2.1	Radionuclides	12
5.2.2	Nonradionuclides	13
5.3	COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED	13
5.3.1	Radionuclides	13
5.3.2	Nonradionuclides	13
5.4	WAC 173-340 THREE-PART TEST FOR NONRADIONUCLIDES	13
6.0	STATEMENT OF PROTECTIVENESS	13
7.0	REFERENCES.....	14

APPENDICES

A	SUMMARY OF VERIFICATION SOIL SAMPLING AND ANALYTICAL RESULTS.....	A-i
B	DATA QUALITY ASSESSMENT FOR THE 600-259 WASTE SITE.....	B-i
C	CALCULATION BRIEF EXCERPTS	C-i

FIGURES

1.	Hanford Site Map and Location of the 600-259 Site.....	3
2.	Pre-Remediation Topographic Plan for the 600-259 Site.	5
3.	Post-Remediation Topographic Plan for the 600-259 Site.....	6
4.	Radiological Mapping (Beta) Survey Results for the 600-259 Site.	7
5.	Radiological Mapping (Gamma) Survey Results for the 600-259 Site.....	8

TABLES

1.	Summary of Remedial Action Goals – Unrestricted Land Use.	1
2.	Cleanup Verification Data Set.	10
3.	Maximum Results from Biased Sampling.....	11

ACRONYMS AND ABBREVIATIONS

COC	contaminant of concern
DQA	data quality assessment
ERDF	Environmental Restoration Disposal Facility
ESD	explanation of significant differences
PNNL	Pacific Northwest National Laboratory
RAG	remedial action goal
RAO	remedial action objective
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity dose assessment model
ROD	record of decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	<i>Washington Administrative Code</i>

1.0 INTRODUCTION

The purpose of this cleanup verification package is to document that the 600-259 waste site was remediated in accordance with the *Record of Decision for the 300-FF-2 Operable Unit, Hanford Site* (ROD) (EPA 2001), as modified by the *Explanation of Significant Differences for the 300-FF-2 Operable Unit Interim Record of Decision* (ESD) (EPA 2004). Remedial action objectives (RAOs) and remedial action goals (RAGs) established for the 600-259 site are documented in the ROD (EPA 2001) and the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2004b). The ROD provides the U.S. Department of Energy, Richland Operations Office the authority, guidance, and objectives to conduct this remedial action.

The preferred remedy specified in the ROD (EPA 2001) and conducted for the 600-259 site included (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavated materials at the Environmental Restoration Disposal Facility (ERDF) at the 200 Areas of the Hanford Site, and (3) backfilling the site with clean overburden and fill material to match adjacent grade elevation. Excavation was driven by RAOs for direct exposure, protection of groundwater, and protection of the Columbia River. For the respective points of compliance, RAGs, summarized in Table 1, were established for the contaminants of concern (COCs) in the RDR/RAWP (DOE-RL 2004b) to support unrestricted land use. Preliminary waste site contaminants of potential concern were identified in the *300 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2004a). Following excavation of the site, final COCs were identified in the *Closeout Plan for Waste Site 600-259* (WCH 2005) and are listed in Table 1.

Table 1. Summary of Remedial Action Goals – Unrestricted Land Use.

COC	Direct Exposure RAG (pCi/g)	Soil RAG for Groundwater Protection (pCi/g)	Soil RAG for Columbia River Protection (pCi/g)
Cesium-134	15 mrem/yr (cumulative)	4 mrem/yr (cumulative)	4 mrem/yr (cumulative)
Cesium-137			
Cobalt-60			
Manganese-54			
Technetium-99			
Tritium			

COC = contaminant of concern
RAG = remedial action goal

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

The 600-259 waste site is located in the 300-FF-2 Operable Unit of the 300 Area, west of Route 4 South and southeast of the 618-10 Burial Ground (Figure 1). The site consists of the Special Waste Form Lysimeter, constructed in 1983 as 10 soil-filled caissons (1.8 m [5.9 ft] in diameter by 3 m [10 ft] deep) located concentrically around a central access caisson (3.65 m [12.0 ft] in diameter by 3.65 m [12.0 ft] deep). Each lysimeter was equipped with a gravity drain attached to the central caisson for leachate collection. The central caisson also provided access to the 10 lysimeters through horizontal sample ports. Each of the 10 lysimeters contained a single waste form sample in direct contact with the soil. The waste form samples consisted of commercial reactor waste (isotopes manganese-54, cobalt-60, cesium-134, cesium-137, and technetium-99) solidified in cement, butimen, or vinyl-ester styrene. The Special Waste Form Lysimeter was used to collect information between 1984 and 1992 regarding the leaching behavior of these contaminants. Leachate was collected by Pacific Northwest National Laboratory (PNNL) and disposed off-site. The lysimeters were capped in 1995 to prevent further water intrusion and drained for the last time by PNNL in 1996.

A Grout Waste Test Facility (600-259:1 subsite) also operated at the location of the 600-259 waste site between 1985 and 1989, designed to test leaching rates of grout-solidified low-level radioactive waste. The Grout Waste Test Facility consisted of four lysimeters, two of which were never used. All four of the lysimeters were removed in September 1994. Samples collected beneath the lysimeters after removal indicated that residual contaminant levels were at background levels for radionuclides (Bjorklund 1999).

An active lysimeter facility operated by PNNL (Waste Information Data System site 600-63) is located immediately adjacent to the 600-259 waste site, separated by a fence that divides the two sites.

3.0 REMEDIAL ACTION FIELD ACTIVITIES

3.1 EXCAVATION AND DISPOSAL

Remedial action at the 600-259 site was conducted from September 2004 to July 2005. Excavation of the site included the removal of all caisson structures and radioactive waste forms. Overburden material was segregated and stockpiled for possible use as backfill material pending the results of verification sampling. No anomalies were identified within the bulk soil and debris during remedial activities, and no indications of liquid waste migration beyond the caisson units were observed.

Figure 1. Hanford Site Map and Location of the 600-259 Site.

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Approximately 950 metric tons (1,050 U.S. tons) of material was removed for disposal at the ERDF. Pre- and post-remediation topographic civil survey results for the 600-259 waste site are depicted in Figures 2 and 3.

3.2 FIELD SCREENING

Radiological surveys were performed in June 2005 after excavation operations were substantially complete at the 600-259 waste site to provide an initial assessment of attainment of radiological cleanup levels. The survey results identified residual cesium-137 contamination requiring additional site excavation in July 2005. Following completion of these remedial activities, new surveys were conducted in July 2005, with results provided in Figures 4 and 5. Results of these surveys indicated that residual soil contaminant concentrations met radiological cleanup goals.

3.3 BIASED SAMPLING AND ANALYSIS

Biased samples are typically collected at locations where significant quantities of specific waste streams were unearthed from a common area to help verify the absence of hot spots in the residual soil. At the 600-259 waste site, controlled tests were performed, and the waste forms or leachate were not exposed to soil outside of the engineered test facility. However, per the approved closeout plan (WCH 2005), two biased grab samples were collected beneath the former location of the central access caisson (Figure 3) to increase confidence in the absence of hot spots in residual soils.

3.4 CLEANUP VERIFICATION SAMPLING AND ANALYSIS

Final cleanup verification samples were collected from the excavated area on August 23, 2005, and from the overburden stockpiles on September 21, 2005, to confirm acceptability of residual contaminant concentrations in soil at the 600-259 waste site. Based on the overall footprint of the area and depth of excavation, the 600-259 waste site was classified as one shallow zone decision unit with one overburden decision unit. The final verification samples were submitted to offsite laboratories for analysis using approved U.S. Environmental Protection Agency analytical methods as described in the SAP (DOE-RL 2004a).

Figure 2. Pre-Remediation Topographic Plan for the 600-259 Site.

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Figure 3. Post-Remediation Topographic Plan for the 600-259 Site.

Figure 4. Radiological Mapping (Beta) Survey Results for the 600-259 Site.

CVP-2005-00008
Rev. 0

Figure 5. Radiological Mapping (Gamma) Survey Results for the 600-259 Site.

In accordance with the SAP (DOE-RL 2004a), each verification sample was collected as a composite sample formed by combining soil collected at four random locations within the sampling area (excluding the quality assurance/quality control samples). The sample design methodology and sample location figures are presented in the calculation brief for sample design in Appendix C.

4.0 CLEANUP VERIFICATION DATA EVALUATION

This section presents the evaluation and modeling of the 600-259 waste site cleanup verification data for comparison with the data quality criteria and RAGs.

4.1 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) is performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 600-259 waste site determined that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation also found that the sample design was sufficient to support clean site verification. The cleanup verification sample analytical data are stored in the Hanford Environmental Information System and are summarized in Appendix A. The detailed DQA is presented in Appendix B.

4.2 CONTAMINANTS OF CONCERN 95% UPPER CONFIDENCE LIMIT

The primary statistical calculation to support cleanup verification is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. Prior to calculating the 95% UCL, the individual sample results are reviewed and, as appropriate, adjusted per the SAP (DOE-RL 2004a). This process is summarized below.

- **Radionuclides:** The laboratory-reported value is used in the calculation of the 95% UCL. In cases where the laboratory does not report a value for data qualified with a "U" (i.e., less than the detection limit), half of the minimum detectable activity is used in the calculation of the 95% UCL.
- **Nonradionuclides:** For data flagged with a "U" (i.e., less than detection), a value equal to one-half the practical quantitation limit is used in the calculation of the 95% UCL, consistent with Washington State Department of Ecology regulations (*Washington Administrative Code* [WAC] 173-340-740[7][g]). If greater than half of

the sample results for a given nonradionuclide COC are below detection, the statistical value is set equal to the maximum concentration detected (i.e., versus computing a 95% UCL). No nonradionuclide COCs were identified for the 600-259 waste site.

Statistical calculations are presented in the 600-259 waste site cleanup verification 95% UCL calculation brief (Appendix C). Verification sampling summary statistics (95% UCL values) are listed in Table 2. The columns on the left side of Table 2 are the COCs and the 95% UCL values before subtraction of background. The fourth column of Table 2 presents the statistical background, where values exist, and the last columns present the statistical verification values adjusted for background, if appropriate, which become the cleanup verification data set used for evaluation against RAGs. None of the COCs for the 600-259 site were detected in verification samples, with the exception of cesium-137, which was detected below background in overburden material.

Table 2. Cleanup Verification Data Set.

COC	95% UCL Statistical Values ^a (pCi/g)		Hanford Site Background ^b (pCi/g)	Cleanup Verification Data Set ^c (pCi/g)	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Cesium-134	0.026 (ND)	0.025 (ND)	NA	0.026 (ND)	0.025 (ND)
Cesium-137	0.051 (ND)	0.025	1.1	0.051 (ND)	0 (<BG)
Cobalt-60	0.021 (ND)	0.020 (ND)	0.008	0.021 (ND)	0.012 (ND)
Manganese-54	0.017 (ND)	0.019 (ND)	NA	0.017 (ND)	0.019 (ND)
Technetium-99	-0.0045 (ND)	0.18 (ND)	NA	-0.0045 (ND)	0.18 (ND)
Tritium	-1.92 (ND)	-0.656 (ND)	NA	-1.92 (ND)	-0.656 (ND)

^a Laboratory data, including the minimum detectable activity for the individual cleanup verification samples, are included in Appendix A and the 95% UCL calculation brief in Appendix C.

^b Represents the 90th percentile of the lognormal distribution (DOE-RL 1996).

^c For overburden, anthropogenic background and naturally occurring background is subtracted from all radionuclides. For other decision units (e.g., shallow zone), naturally occurring background (uranium) is subtracted. Refer to the 95% UCL calculation brief in Appendix C for additional details on determination of statistical values.

BG = background

COC = contaminant of concern

NA = not available

ND = not detected (in all samples in the data set)

UCL = upper confidence limit

4.3 BIASED SAMPLE RESULTS

Two biased grab samples were collected beneath the former location of the central access caisson (Figure 3). Statistical analysis (e.g., calculation of a 95% UCL value) is inappropriate for the results of these samples, so evaluation is based on the maximum

detected concentration of each COPC as reported in Table 3. Individual sample results are provided in Appendix A.

Table 3. Maximum Results from Biased Sampling.

Contaminant of concern	Maximum Result (pCi/g)
Cesium-134	ND
Cesium-137	0.038
Cobalt-60	ND
Manganese-54	ND
Technetium-99	ND
Tritium	ND

ND = not detected

4.4 SITE-SPECIFIC CLEANUP VERIFICATION MODEL

A site-specific vadose zone model was not developed for the 600-259 site, as all COCs were either undetected or the cleanup verification data set statistical values were determined to be below statistical background levels, as shown in Table 2.

4.5 RESRAD MODELING

A site-specific RESidual RADioactivity (RESRAD) model was not developed for the 600-259 waste site, as the only radionuclide COC detected was cesium-137. The statistical value for cesium-137 in overburden soil presented in Table 2 was determined to be below the statistical background level as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE-RL 1996). The maximum residual cesium-137 activity detected by biased sampling is below the 15 mrem/yr dose equivalence direct exposure lookup value (DOE-RL 2004b).

5.0 EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT

This section demonstrates that remedial actions at the 600-259 waste site have achieved the RAGs developed to support unrestricted (residential) land use at the 300 Area as established in the ESD (EPA 2004) and documented in the RDR/RAWP (DOE-RL 2004b).

5.1 DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED

5.1.1 Radionuclides

5.1.1.1 Direct Comparison to RAGs. Radionuclide COCs were not detected in statistical cleanup verification samples, with the exception of cesium-137 in overburden material. The statistical concentration of cesium-137 in overburden material is below the statistical anthropogenic background activity, as shown in Table 2. Cesium-137 was detected in biased samples at a maximum activity of 0.038 pCi/g, below the 15 mrem/yr dose equivalence direct exposure lookup value of 6.2 pCi/g (DOE-RL 2004b). No other radionuclide COCs were detected in biased samples.

5.1.1.2 Radionuclide Risk. Radionuclide COCs were either not detected or detected below background levels for the statistical verification data set at the 600-259 waste site. Only cesium-137 was detected in biased samples, below the lookup value (6.2 pCi/g) that satisfies the RAO for cumulative risk (10^{-4} to 10^{-6} under an unrestricted land-use scenario) (DOE-RL 2004b).

5.1.2 Nonradionuclides

5.1.2.1 Direct Comparison to RAGs. No nonradionuclide COCs were identified for the 600-259 waste site.

5.1.2.2 Noncarcinogenic Hazard Quotient RAG Attained. For noncarcinogenic COCs, WAC 173-340-740(5)(a) and (b) specify the evaluation of the hazard quotient. No nonradionuclide COCs were identified for the 600-259 waste site; consequently, hazard quotient values were not calculated.

5.1.2.3 Carcinogenic Risk RAG Attained. For individual nonradionuclide carcinogenic COCs, the WAC 173-340-745(4)(a)(iii) Method B cleanup limits are based on an unrestricted land-use incremental cancer risk of 1×10^{-6} . The cumulative excess cancer risk for all nonradionuclide carcinogenic COCs must also be less than 1×10^{-6} (WAC 173-340). No nonradionuclide COCs were identified for the 600-259 waste site; consequently, excess cancer risk values were not calculated.

5.2 GROUNDWATER REMEDIAL ACTION GOALS ATTAINED

5.2.1 Radionuclides

Radionuclide COCs were not detected in any cleanup verification samples, with the exception of cesium-137 in overburden material and biased shallow zone sampling. The statistical activity of cesium-137 in overburden is below the statistical anthropogenic background activity, as shown in Table 2, and RESRAD modeling predicts that shallow zone cesium-137 will not migrate to groundwater within a 1,000-year period (DOE-RL 2004b).

5.2.2 Nonradionuclides

No nonradionuclide COCs were identified for the 600-259 waste site.

5.3 COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED

5.3.1 Radionuclides

Radionuclide COCs were not detected in any cleanup verification samples, with the exception of cesium-137 in overburden material and biased shallow zone sampling. The statistical activity of cesium-137 in overburden is below the statistical anthropogenic background activity, as shown in Table 2, and RESRAD modeling predicts that shallow zone cesium-137 will not migrate to groundwater (and thus the Columbia River) within a 1,000-year period (DOE-RL 2004b).

5.3.2 Nonradionuclides

No nonradionuclide COCs were identified for the 600-259 waste site.

5.4 WAC 173-340 THREE-PART TEST FOR NONRADIONUCLIDES

The WAC 173-340-740(7)(e) three-part test is applicable to nonradionuclide COCs and consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%. The most restrictive RAG (defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs) is used for the test.

No nonradionuclide COCs were identified for the 600-259 waste site. Consequently, the WAC 173-340-740(e) three-part test was not performed.

6.0 STATEMENT OF PROTECTIVENESS

This cleanup verification package demonstrates that remedial action at the 600-259 waste site has achieved the RAOs and corresponding RAGs established for unrestricted land use in the ROD (EPA 2001), the ESD (EPA 2004), and the RDR/RAWP (DOE-RL 2004b). The contaminated materials from the site have been excavated and disposed at the ERDF. The remaining soil at the 600-259 site has been sampled, analyzed, and evaluated. Results indicate that the site supports future land uses that can be represented (or bounded) by an unrestricted land-use scenario and that residual concentrations throughout this site pose no threat to groundwater or the Columbia River. The 600-259 waste site is verified to be remediated in accordance with

the ROD (EPA 2001) and the ESD (EPA 2004) and may be backfilled. This site has no deep zone; therefore no institutional controls are required.

7.0 REFERENCES

- 40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.
- 65 FR 76708, "National Primary Drinking Water Regulations; Radionuclides; Final Rule," *Federal Register*, Vol. 65, No. 236, p. 76708, December 7, 2000.
- BHI, 2001, *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- Bjorklund, W. J., 1999, *Closure of Waste Site Transfer Post Transition Punchlist Item*, Letter to G. MacFarlan, dated December 1, 1999, Pacific Northwest National Laboratory, Richland, Washington.
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 U.S.C. 9601, et seq.
- DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, U.S. Department of Energy, Washington, D.C.
- DOE-RL, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, DOE/RL-96-12, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 1998, *Tri-Party Agreement Handbook Management Procedures*, RL-TPA-90-0001, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 2004a, *300 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-2001-48, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 2004b, *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, DOE/RL-2001-47, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 2001, *Record of Decision for the 300-FF-2 Operable Unit, Hanford Site*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2004, *Explanation of Significant Differences for the 300-FF-2 Operable Unit Record of Decision*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

WAC 173-340, 1996, "Model Toxics Control Act – Cleanup" *Washington Administrative Code*.

WCH, 2005, *Closeout Plan for Waste Site 600-259*, CCN 123844, Washington Closure Hanford, Richland, Washington.

APPENDIX A

**SUMMARY OF VERIFICATION SOIL SAMPLING
AND ANALYTICAL RESULTS**

Table A-1. 600-259 Shallow Zone Cleanup Verification Data.

Sampling Area	HEIS Number	Sample Date	Cesium-134			Cesium-137			Cobalt-60			Manganese-54		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J03WM5	8/23/05	4.9E-02	U	4.9E-02	3.3E-02	U	3.3E-02	4.1E-02	U	4.1E-02	3.4E-02	U	3.4E-02
Duplicate of J03WM5	J03WM9	8/23/05	5.6E-02	U	5.6E-02	3.9E-02	U	3.9E-02	4.5E-02	U	4.5E-02	3.7E-02	U	3.7E-02
Split of J03WM5	J03WN0	8/23/05	1.78E-02	U	1.69E-02	-4.47E-03	U	1.29E-02	-7.30E-03	U	1.43E-02	5.05E-03	U	1.36E-02
A2	J03WM6	8/23/05	5.1E-02	U	5.1E-02	6.8E-02	U	4.4E-02	3.9E-02	U	3.9E-02	3.2E-02	U	3.2E-02
A3	J03WM7	8/23/05	3.8E-02	U	3.8E-02	2.2E-02	U	2.8E-02	3.3E-02	U	3.3E-02	2.8E-02	U	2.8E-02
A4	J03WM8	8/23/05	3.6E-02	U	3.6E-02	2.7E-02	U	2.7E-02	2.8E-02	U	2.8E-02	2.7E-02	U	2.7E-02
Biased, beneath central caisson	J03X41	8/23/05	4.2E-02	U	4.2E-02	3.6E-02	U	3.6E-02	3.6E-02	U	3.6E-02	3.4E-02	U	3.4E-02
Biased, beneath central caisson	J03X42	8/23/05	3.5E-02	U	3.5E-02	3.8E-02		2.8E-02	2.8E-02	U	2.8E-02	2.6E-02	U	2.6E-02

A-1

Sampling Area	HEIS Number	Sample Date	Technetium-99			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J03WM5	8/23/05	1.E-03	U	3.9E-01	-9.49E-01	UJ	5.2E+00
Duplicate of J03WM5	J03WM9	8/23/05	2.7E-02	U	5.5E-01	-1.61E+00	UJ	5.3E+00
Split of J03WM5	J03WN0	8/23/05	2.75E-01	U	6.35E-01	-1.80E-02	U	3.14E-02
A2	J03WM6	8/23/05	-2.1E-02	U	3.7E-01	-3.02E+00	UJ	5.5E+00
A3	J03WM7	8/23/05	-1.33E-01	U	3.7E-01	-3.19E+00	UJ	5.4E+00
A4	J03WM8	8/23/05	-1.07E-01	U	5.5E-01	-3.38E+00	UJ	5.3E+00
Biased, beneath central caisson	J03X41	8/23/05	-3.8E-02	U	5.7E-01	-1.37E+00	UJ	5.3E+00
Biased, beneath central caisson	J03X42	8/23/05	-1.0E-02	U	5.3E-01	-2.29E+00	UJ	5.2E+00

HEIS = Hanford Environmental Information System
MDA = minimum detectable activity

Q = qualifier
U = undetected

Table A-2. 600-259 Overburden Cleanup Verification Data.

Sampling Area	HEIS Number	Sample Date	Cesium-134			Cesium-137			Cobalt-60			Manganese-54		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J10738	9/21/05	3.8E-02	U	3.8E-02	3.4E-02		3.1E-02	3.3E-02	U	3.3E-02	2.9E-02	U	2.9E-02
Duplicate of J10738	J10742	9/21/05	5.0E-02	U	5.0E-02	4.3E-02	U	4.3E-02	3.6E-02	U	3.6E-02	3.8E-02	U	3.8E-02
Split of J10738	J10795	9/21/05	1.41E-02	U	1.65E-02	1.59E-02	U	1.57E-02	1.32E-02	U	1.65E-02	4.22E-03	U	1.36E-02
A2	J10739	9/21/05	3.0E-02	U	3.0E-02	2.8E-02	U	2.8E-02	2.7E-02	U	2.7E-02	2.6E-02	U	2.6E-02
A3	J10740	9/21/05	5.4E-02	U	5.4E-02	4.3E-02	U	4.3E-02	4.2E-02	U	4.2E-02	4.0E-02	U	4.0E-02
A4	J10741	9/21/05	3.4E-02	U	3.4E-02	3.1E-02	U	3.1E-02	3.4E-02	U	3.4E-02	2.9E-02	U	2.9E-02

Sampling Area	HEIS Number	Sample Date	Technetium-99			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J10738	9/21/05	1.18E-01	U	4.8E-01	3.89E-01	U	5.1E+00
Duplicate of J10738	J10742	9/21/05	2.67E-01	U	6.1E-01	-1.44E+00	U	5.0E+00
Split of J10738	J10795	9/21/05	5.56E-01	U	5.98E-01	-1.54E-02	U	3.07E-02
A2	J10739	9/21/05	1.36E-01	U	4.7E-01	-1.90E+00	U	5.2E+00
A3	J10740	9/21/05	8.2E-02	U	5.5E-01	-7.72E-01	U	4.7E+00
A4	J10741	9/21/05	1.41E-01	U	6.2E-01	-2.51E+00	U	4.7E+00

HEIS = Hanford Environmental Information System
MDA = minimum detectable activity
Q = qualifier
U = undetected

A-2

APPENDIX B
DATA QUALITY ASSESSMENT FOR THE 600-259 WASTE SITE

APPENDIX B

DATA QUALITY ASSESSMENT FOR THE 600-259 WASTE SITE

B1.1 OVERVIEW

This data quality assessment (DQA) was performed in accordance with WCH-EE-01, *Environmental Investigations Procedures*. Specific data quality objectives for the site are found in the *300 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2004a). The DQA is based on the guidelines presented in *Guidance for Data Quality Assessment* (EPA 2000). Statistical tests used in this DQA were performed as specified in the SAP and the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2004b). This DQA involves the scientific and statistical evaluations to determine if the data are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions [EPA 2000]). This DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process.

Prior to performing statistical tests, the field logbook (WCH 2005a) and sample analytical data are reviewed to verify sample dates, times, and location information and to verify that samples were taken in accordance with the sample design. A portion of the cleanup verification sample analytical data are validated for compliance requirements (DOE-RL 2004b). Data evaluation is performed to determine if the laboratory carried out all steps required by the SAP (DOE-RL 2004a) and the laboratory contract governing the conduct of the analysis and reporting of the data. This assessment also examines the available laboratory data to determine what analytes are present or absent in a sample and the degree of overall uncertainty associated with that determination. Data validation is done in accordance with validation procedures (BHI 2000a, 2000b) as part of data evaluation. After data evaluation and validation, the appropriate statistical test is performed on the adjusted raw analytical data (see calculation briefs in Appendix C) to determine statistical values for each contaminant. The cleanup verification sample analytical data are stored in the Hanford Environmental Information System and are summarized in Appendix A.

B1.2 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL MEASURES

All verification samples are subject to laboratory-specific quality assurance (QA) requirements, including instrument procurement, maintenance, calibration, and operation. Additional laboratory quality control (QC) checks are performed as specified by the analytical method, at a rate of once per sample delivery group (SDG), or once for every 20 samples, whichever is more frequent. Laboratory internal QC checks include the following:

- **Laboratory Contamination:** Each analytical batch contains a laboratory (method) blank (material of similar composition as the samples with known/minimal contamination of the analytes of interest) carried through the complete analytical process. The method blank is used to evaluate false-positive results in samples due to contamination during handling at the laboratory.
- **Analytical Accuracy:** Generally, known quantities of representative analytes of interest (matrix spike [MS]) are added to a separate aliquot of a sample from the analytical batch. The recovery percentage of the added MS is used to evaluate analytical accuracy. However, gamma energy analysis, technetium analysis, and the method used for tritium analysis are not amenable to MS techniques. In this case, accuracy is evaluated from recovery of the QC reference sample (e.g., laboratory control spike or blank spike sample).
- **Analytical Precision:** Separate aliquots removed from one or more of the same sample containers (replicate samples) are analyzed for each analytical batch. The replicate sample results (evaluated as relative percent differences [RPDs]) are used to assess analytical precision.
- **QC Reference Samples:** A QC reference sample is prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples provide an independent check on analytical technique, methodology, and quantitation.

Laboratories are also subject to periodic and random assessments of overall performance. These assessments are performed by the Washington Closure Hanford QA group to ensure that the laboratories are performing within laboratory contract requirements.

B1.3 DATA VALIDATION

The final laboratory data package for SDG H3334 (containing all verification samples and analyses) was validated to Level C per WCH-EE-01, Procedure 2.5, "Data Package Validation Process," by a third-party validator. Level C validation procedures are specified in *Data Validation Procedure for Chemical Analysis* (BHI 2000a) and *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b).

Use of level C validation procedures included the review of the following items, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- Laboratory duplicates
- Associated batch laboratory control sample results

- Achievement of required (or contractual) detection limits (RDLs)
- Data package completeness.

The laboratory QA/QC was evaluated for precision, accuracy, completeness, and RDLs pursuant to the SAP (DOE-RL 2004a). The organization performing the data validation reported that, of the data validated, the laboratory met the standards of performance for precision ($\pm 30\%$), accuracy ($\pm 30\%$), and completeness ($>90\%$). Comparison of the RDL with the respective MDA is discussed in Section B1.4.

The only deficiency identified by the validation was the absence of a matrix spike for tritium analysis. The method used for tritium analysis utilizes a solid matrix rather than dissolution within a liquid and is therefore not amenable to spiking with tritium due to its volatility. However, because the SAP-specified matrix spike was not performed, the validation process requalified tritium results as estimates. Additional information is provided in the associated validation reports (WCH 2005b).

B1.4 DATA EVALUATION

The context for assessing the data includes evaluating the sample data using the statistical methodology of the SAP (DOE-RL 2004a) (included in the calculation brief excerpts in Appendix C) and a comparison of analytical results to the parameters specified in the SAP. This section summarizes the results of the comparison and presents an evaluation of the affected data.

B1.4.1 RDL Comparison

Reported analytical detection levels for nondetected analytes were compared to the RDLs specified in the SAP (DOE-RL 2005a). When detected results are obtained, evaluation of detection limits is not performed. The data validation and supplemental data evaluation noted no contaminants of concern (COCs) for which the detection limits (MDA) were above SAP RDLs for nondetected analytes.

B1.4.2 Precision and Accuracy Evaluation

Analytical accuracy and precision were evaluated by examination of the percent recovery and RPD of analytical spikes (laboratory control samples) between the main and duplicate samples. Recoveries of the laboratory control sample were within acceptance criteria. No COCs were detected at more than five times their respective detection limits, so RPD values were not calculated.

B1.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC measures were used to assess potential sources of error and cross-contamination of soil samples that could bias results. Field QA/QC samples included the following:

- Duplicate J03WM9, associated with sample J03WM5
- Split J03WN0, associated with sample J03WM5
- Duplicate J10742, associated with sample J10738
- Split J10795, associated with sample J10738.

All main and QA/QC sample results are presented in Appendix A.

B1.5.1 Field Duplicate Samples

Duplicate samples were collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values more than five times the contractual RDLs for both the main and duplicate samples are compared. Based on these criteria, RPD analysis was not required for the 600-259 waste site verification sample duplicate pairs. The 95% upper confidence limit calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation.

B1.5.2 Field Split Samples

Split samples were collected to provide a relative measure of the degree of variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field main and split samples are evaluated by computing the RPD of the split samples for each COC to determine the usability of the verification data. The U.S. Environmental Protection Agency Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994), is used as an initial test of the data from the splits. Only analytes that had values more than five times the contractual RDL for both the main and split sample were compared. Based on these criteria, RPD analysis was not required for the split pair. The 95% upper confidence limit calculation brief in Appendix C provides details on split pair evaluation and RPD calculation.

B1.6 SUITABILITY OF DATA

The DQA for the 600-259 site determined that the data are of the right type, quality, and quantity to support site cleanup verification decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean

site verification. All analytical data were found to be acceptable for decision-making purposes and acceptable for calculating the required statistical values.

B2.0 REFERENCES

- BHI, 2000a, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- DOE-RL, 2004a, *300 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-2001-48, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 2004b, *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, DOE/RL-2001-47, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.
- EPA, 2000, *Guidance for Data Quality Assessment*, EPA QA/G-9, QA00 Update, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.
- WCH, 2005a, *300-FF-1/2 Analytical Field Services Logbook*, EFL-1395-11, Washington Closure Hanford, Richland, Washington.
- WCH, 2005b, *Data Validation Package - Radiochemistry (SDG No. H3334)*, Washington Closure Hanford, Richland, Washington.
- WCH-EE-01, *Environmental Investigations Procedures*, Washington Closure Hanford, Richland, Washington.

APPENDIX C
CALCULATION BRIEF EXCERPTS

DISCLAIMER FOR CALCULATIONS

The attached calculations have been generated for a specific purpose and task. Use of these calculations by persons who do not have access to all pertinent facts may lead to incorrect conclusions and/or results. Before applying these calculations to your work, the underlying basis, rationale, and other pertinent information relevant to these calculations must be thoroughly reviewed with appropriate Washington Closure Hanford (WCH) officials or other authorized personnel. WCH is not responsible for the use of a calculation not under its direct control.

CALCULATION BRIEFS

The following calculation briefs have been prepared in accordance with WCH-DE-01, *Design Engineering Procedures Manual*, EDPI-4.37-01, "Project Calculations," Washington Closure Hanford, Richland, Washington.

600-259 Waste Site Shallow Zone and Overburden Sampling Design, 0600X-CA-V0055, Rev. 0, Washington Closure Hanford, Richland, Washington.

600-259 Waste Site Cleanup Verification 95% UCL Calculations, 0600X-CA-V0053, Rev. 0, Washington Closure Hanford, Richland, Washington.

NOTE: The calculation briefs referenced in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office repository. Only excerpts of the calculation briefs are included in this appendix.

CALCULATION COVER SHEET

Project Title:	<u>600-259 Waste Site Sample Design</u>	Job No.	<u>14655</u>
Area	<u>600 Area</u>		
Discipline	<u>Environmental Engineering</u>	Calc. No.	<u>0600X-CA-V0055</u>
Subject	<u>600-259 Waste Site Shallow Zone and Overburden Sampling Plan</u>		
Computer Program	<u>Excel</u>	Program No.	<u>Excel 2003</u>

The attached calculations have been generated to document compliance with established cleanup levels. These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sht Calc = 2 Shts Attach1 = 1 Sht Attach2 = 1 Sht Attach3 = 2 Shts Total = 7 Shts	<i>Approved</i> 11/08/05 G. Cruz	<i>Approved</i> 11/08/05 C.A. Bentz	<i>Approved</i> 11/14/05 J.A. Lerch	<i>Approved</i> 11/17/05 M.J. Haass	11/17/05
1	Cover = 1 Sht Calc = 2 Shts Attach1 = 1 Sht Attach2 = 1 Sht Attach3 = 2 Shts Total = 7 Shts	G. Cruz 12/14/05	C.A. Bentz 12/15/05	J.A. Lerch 12/19/05	M.J. Haass	12/19/05
SUMMARY OF REVISIONS						
1	Cover page replace to comply with procedures.					

* Obtain calc no. from DIS

DE01437.03 (12/09/2004)

Washington Closure Hanford

CALCULATION SHEET

Originator G. Cruz Date 11/8/2005 Calc. No. 0600X-CA-V0055 Rev. No. 0
Project 600-259 Waste Site Sample Design Job No. 14655 Checked AB Date 11/09/05
Subject 600-259 Waste Site Shallow Zone and Overburden Sampling Plan Sheet No. 1 of 2

1	Problem:	Calculate and display required sampling nodes in concurrence with 300 Area				
2		SAP DOE/RL-2001-48 Rev. 0 for verification and closure.				
3						
4	Given:	-SAP (DOE/RL-2001-48 Rev. 0) requirements				
5		-Shallow Sampling Area (Surface area of each zone determined from CAD program,				
6		Attachment 3, Sht 1of2, CAD file 3X:110805A, 600-259 Waste Site Shallow Zone Sampling Plan)				
7		-Overburden Sampling Area (Surface area of each zone determined from CAD program,				
8		Attachment 3, Sht 2of2, CAD file 3X:110805B, 600-259 Waste Site Overburden Sampling Plan)				
9						
10						
11						
12						
13						
14	SAP Requirements:					
15		-Develop a 16 node sampling grid for the sampling area				
16	Shallow Zone:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled				
17		to collect clean up verification samples				
18						
19		-Develop a 16 node sampling grid for the sampling area				
20	Overburden:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled				
21		to collect clean up verification samples				
22						
23		-Develop a 16 node sampling grid for the sampling area				
24	Deep Zone:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled				
25		to collect clean up verification samples				
26						
27	Determination of Shallow Zone Sampling Grid:					
28						
29	Shallow Zone Sampling Grid Area determined from Table 3-2, SAP					
30	Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)					
31						
32	Total Area:		299.78	m ²		
33	Area of Decision Subunits (total area 1 subunit)		299.78	m ²		
34						
35	Decision Subunit divided into 4 Sampling Areas:		74.94	m ²		
36						
37	Sampling Areas divided into a 16 node grid (node numbers 1-16):		4.68	m ²		
38						
39	Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)					
40		See Attachment 3, Sht 1of2, 600-259 Waste Site Shallow Zone Sampling Plan,				
41		for Sample Location Table				
42						
43						
44						
45						

CALCULATION SHEET

[illegible]

Washington Closure Hanford

Originator G. Cruz Date 11/8/2005 Calc. No. 0600X-CA-V0055 Rev. No. 0
Project 600-259 Waste Site Sample Design Job No. 14655 Checked CAB Date 11/09/05
Subject 600-259 Waste Site Shallow Zone and Overburden Sampling Plan Sheet No 1 of 1

1 ATTACHMENT 1

2

3 Sample Grid Point Lookup Table.

4

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Default Plan	Sampling Area 1	Sampling Area 2	Sampling Area 3	Sampling Area 4	Sampling Area 5	Sampling Area 6	Sampling Area 7	Sampling Area 8	Sampling Area 9	Sampling Area 10
Closeout	3	6	1	4	5	1	3	3	4	16
Closeout	4	7	11	3	15	15	5	13	10	10
Closeout	16	3	2	7	7	10	11	4	3	14
Closeout	10	15	4	12	1	13	4	8	16	4
Not Sampling	2	14	5	9	13	12	8	2	14	8
Not Sampling	13	10	9	13	2	16	1	12	5	3
Not Sampling	6	1	10	8	14	4	16	5	8	6
Not Sampling	1	9	13	1	10	5	12	1	1	15
Not Sampling	9	12	7	5	6	2	6	7	15	9
Not Sampling	15	16	15	14	16	6	2	15	11	1
Not Sampling	8	13	8	10	12	11	13	14	2	12
Not Sampling	5	2	3	11	4	3	9	10	7	11
Not Sampling	7	11	14	15	11	14	14	6	13	2
Not Sampling	11	4	6	2	9	7	7	11	9	7
Not Sampling	12	8	16	16	3	8	15	9	6	13
Not Sampling	14	5	12	6	8	9	10	16	12	5

23 ** Note: Grid nodes for each sampling area in each waste site should be numbered consistently, e.g., begin numbering
24 the nodes in the northwesternmost node. Then number consecutively left to right.

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Washington Closure Hanford

Originator G. Cruz Date 11/8/2005 Calc. No. 0600X-CA-V0055 Rev. No. 0
Project 600-259 Waste Site Sample Design Job No. 14655 Checked CB Date 11/09/05
Subject 600-259 Waste Site Shallow Zone and Overburden Sampling Plan Sheet No. 1of1

ATTACHMENT 2

Number of Decision Subunits Based on Area.

Site Verification Sampling Frequencies Based on Area.					
Decision Unit ^a	Waste Site Size ^b	Decision Subunits	Blocks ^c	Discrete Samples	Composite Samples
Shallow zone - 0 to 15 ft	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32
Deep Zone - >15 ft	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32
Overburden/layback stockpiles	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32
Staging pile areas (residual soil)	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32

* The shallow zone, deep zone, overburden stockpile, and staging pile areas each represent single decision units. The total number of decision units will vary because individual waste sites may not have a deep zone, overburden stockpile, and/or staging pile areas.

^b Area of exposed surface after excavation or area of stockpile base (as applicable)

^c Decision subunits are divided into four blocks to ensure that random sampling locations are not bunched together in one area

3X:110805B

E 591250

N 121600

SCALE 1:200
2 0 2 4 8 meters

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DOE RICHLAND OPERATIONS OFFICE
RIVER CORRIDOR CLOSURE CONTRACT

NOTES

1. OVERBURDEN NODE AREAS ARE APPROXIMATELY 4.29 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER OF EACH NODE.
3. THE OVERBURDEN CONSISTS OF SAMPLING AREAS A1, A2, A3, & A4 WITHIN DECISION SUBUNIT 1.

LEGEND

CLEAN UP VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	O-A1-3	121588.84	591230.98
		O-A1-4	121587.64	591231.99
		O-A1-10	121594.15	591232.51
		O-A1-16	121593.21	591236.68
	A2	O-A2-3	121596.26	591236.76
		O-A2-6	121599.32	591236.77
		O-A2-7	121597.90	591238.18
		O-A2-15	121601.10	591240.93
	A3	O-A3-1	121605.69	591239.19
		O-A3-2	121604.22	591240.65
		O-A3-4	121601.21	591243.67
		O-A3-11	121605.88	591244.54
	A4	O-A4-3	121608.92	591247.01
		O-A4-4	121607.45	591248.49
		O-A4-7	121610.43	591248.43
		O-A4-12	121610.58	591251.20

Attachment 3 Sheet No. 2 of 2
Originator G. CRUZ Date 11/08/05
Chk'd By cdBaf Date 11/09/05
Calc. No. 0600X-CA-VDSS Rev. No. 0

ATTACHMENT 3

300 AREA
300 AREA REMEDIAL DESIGN
600-259 WASTE SITE
OVERBURDEN SAMPLING PLAN

CALCULATION COVER SHEET

Project Title: 300 Area Field Remediation Job No. 14655
Area: 600
Discipline: Environmental *Calc. No. 0600X-CA-V0053
Subject: 600-259 Waste Site Cleanup Verification 95% UCL Calculations
Computer Program: Excel Program No. Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 4 Total = 5	<i>J. M. Capron</i> 11/01/05 J. M. Capron	<i>T. M. Blakley</i> 11/1/05 T. M. Blakley	<i>L. M. Dittmer</i> 11/2/05 L. M. Dittmer	<i>J. A. Lerch</i> 11/2/05 J. A. Lerch	
SUMMARY OF REVISIONS						

* Obtain calc no. from DIS

DE01437.03 (12/09/2004)

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron
Project 300 Area Field Remediation
Subject 600-259 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/01/05
Job No. 14655

Calc. No. 0600X-CA-V0053
Checked T. M. Blakley

Rev. No. 0
Date 11/01/05
Sheet No. 1 of 4

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site. Also, calculate the relative percent difference (RPD) for each contaminant of concern (COC).

Table of Contents:
Sheets 1 to 2 - Calculation Sheet Summary
Sheet 3 - Calculation Sheet Shallow Zone Sample Data
Sheet 4 - Calculation Sheet Overburden Sample Data

Given/References:
1) Analytical sample results.
2) Lookup values, background values, and remedial action goals (RAGs) are taken from DOE-RL (1996), the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2004b), and Ecology (1996).
3) DOE-RL, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, DOE/RL-96-12, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2004a, *300 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-2001-48, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2004b, *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, DOE/RL-2001-47, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington State Department of Ecology, Olympia, Washington.
7) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-Detection Limit or Below-PQL Values (Censored Data Sets)*, Publication #92-54, Washington State Department of Ecology, Olympia, Washington.
8) Ecology, 1996, *Model Toxics Control Act Cleanup Levels and Risk Calculations (CLARC II)*, Publication #94-145, Washington State Department of Ecology, Olympia, Washington.
9) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.
10) WAC 173-340, 1996, "Model Toxics Control Act-Cleanup," *Washington Administrative Code*.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2004b). Use data from attached worksheets to calculate the 95% UCL and the RPD for each analyte and to perform the WAC 173-340 3-part test for nonradionuclides.

Calculation Description:
The subject calculations were performed on data from soil verification samples from waste site 600-259. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by utilizing the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2004b) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the cleanup verification package (CVP) for this site.

Methodology:
The statistical value calculated to evaluate the effectiveness of cleanup was the 95% UCL. For nonradioactive analytes with > 50% of the data below detection limits, the maximum value for the sample data is used instead of the 95% UCL. All nonradionuclide data reported as being below detection limits are set to 1/2 the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation.

For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data, and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n < 10) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no test for distribution is performed. For nonradionuclide data sets of ten or greater, distributional testing is done using Ecology's MTCStat software (Ecology 1993).

The WAC 173-340 3-part test is performed for nonradionuclide analytes only; no nonradionuclide COCs have been identified for the 600-259 waste site.

The RPD is calculated when both the main value and either the duplicate or split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method. These detection limit requirements are listed in Table 2-1 of the sampling and analysis plan (DOE-RL 2004a). The RPD calculations use the following formula:

$$RPD = \frac{|M-S|}{((M+S)/2)} \times 100$$

where, M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than +/- 30% indicates the data compare favorably. For regulatory splits, a threshold of +/- 35% is used (EPA 1994). If the RPD is greater than +/- 30% (or +/- 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

If regulator split comparison is required, an additional parameter is evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is greater than 5 times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore, the following calculation is performed as part of the evaluation for these two cases involving regulator split data: difference = main - regulator split.

If the difference is greater than +/- 2 times the TDL, then further investigation regarding the usability of the data is performed and presented in the applicable CVP data quality assessment section.

No regulatory split samples were collected for the 600-259 site.

Washington Closure Hanford

CALCULATION SHEET

Originator J. M. Capron
Project 300 Area Field Remediation
Subject 600-259 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/01/05
Job No. 14655

Calc. No. 0600X-CA-V0053
Checked T. M. Blakley

Rev. No. 0
Date 11/01/05
Sheet No. 2 of 4

Summary (continued)

Results:

The results presented in the summary tables that follow are for use in RESRAD dose/risk analysis and the CVP for this site.

Results Summary - Shallow Zone			
Analyte	Result	Qualifier	Units
Cesium-134	2.6E-02	U	pCi/g
Cesium-137	5.1E-02	U	pCi/g
Cobalt-60	2.1E-02	U	pCi/g
Manganese-54	1.7E-02	U	pCi/g
Technetium-99	-4.5E-03	U	pCi/g
Tritium	-1.92E+00	U	pCi/g

Results Summary - Overburden			
Analyte	Result	Qualifier	Units
Cesium-134	2.5E-02	U	pCi/g
Cesium-137	0 (< BG)		pCi/g
Cobalt-60	1.2E-02	U	pCi/g
Manganese-54	1.9E-02	U	pCi/g
Technetium-99	1.8E-01	U	pCi/g
Tritium	-6.56E-01	U	pCi/g

Relative Percent Difference (RPD) Results (Shallow Zone)* QA/QC Analysis		
Analyte	Duplicate Analysis	Split Analysis
Cesium-134		
Cesium-137		
Cobalt-60		
Manganese-54		
Technetium-99		
Tritium		

Relative Percent Difference (RPD) Results (Shallow Zone)* QA/QC Analysis		
Analyte	Duplicate Analysis	Split Analysis
Cesium-134		
Cesium-137		
Cobalt-60		
Manganese-54		
Technetium-99		
Tritium		

*A blank cell indicates that RPD evaluation was not required.
BG = background
QA/QC = quality assurance/quality control
RESRAD = RESidual RADioactivity (dose model)
WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator J. M. Capron
Project 300 Area Field Remediation
Subject 600-259 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/01/05
Job No. 14655

Calc. No. 0600X-CA-V0053
Checked T. M. Blakley

Rev. No. 0
Date 11/01/05
Sheet No. 3 of 4

600-259 Shallow Zone Sample Data

Sampling Area	HEIS Number	Sample Date	Cesium-134			Cesium-137			Cobalt-60			Manganese-54			Technetium-99			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J03WM5	8/23/05	4.9E-02	U	4.9E-02	3.3E-02	U	3.3E-02	4.1E-02	U	4.1E-02	3.4E-02	U	3.4E-02	1.E-03	U	3.9E-01	-9.49E-01	U	5.2E+00
Duplicate of J03WM5	J03WM9	8/23/05	5.6E-02	U	5.6E-02	3.9E-02	U	3.9E-02	4.5E-02	U	4.5E-02	3.7E-02	U	3.7E-02	2.7E-02	U	5.5E-01	-1.61E+00	U	5.3E+00
A2	J03WM6	8/23/05	5.1E-02	U	5.1E-02	6.8E-02	U	4.4E-02	3.9E-02	U	3.9E-02	3.2E-02	U	3.2E-02	-2.1E-02	U	3.7E-01	-3.02E+00	U	5.5E+00
A3	J03WM7	8/23/05	3.8E-02	U	3.8E-02	2.2E-02	U	2.8E-02	3.3E-02	U	3.3E-02	2.8E-02	U	2.8E-02	-1.33E-01	U	3.7E-01	-3.19E+00	U	5.4E+00
A4	J03WM8	8/23/05	3.6E-02	U	3.6E-02	2.7E-02	U	2.7E-02	2.8E-02	U	2.8E-02	2.7E-02	U	2.7E-02	-1.07E-01	U	5.5E-01	-3.38E+00	U	5.3E+00

Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Cesium-134 pCi/g	Cesium-137 pCi/g	Cobalt-60 pCi/g	Manganese-54 pCi/g	Technetium-99 pCi/g	Tritium pCi/g
A1	J03WM5/J03WM9	8/23/05	2.6E-02	1.8E-02	2.2E-02	1.8E-02	1.4E-02	-1.28E+00
A2	J03WM6	8/23/05	2.6E-02	6.8E-02	2.0E-02	1.6E-02	-2.1E-02	-3.02E+00
A3	J03WM7	8/23/05	1.9E-02	2.2E-02	1.7E-02	1.4E-02	-1.33E-01	-3.19E+00
A4	J03WM8	8/23/05	1.8E-02	1.4E-02	1.4E-02	1.4E-02	-1.1E-01	-3.38E+00

Statistical Computations

	Cesium-134	Cesium-137	Cobalt-60	Manganese-54	Technetium-99	Tritium
Statistical value based on	Radionuclide data set. Use nonparametric z-stat	Radionuclide data set. Use nonparametric z-stat	Radionuclide data set. Use nonparametric z-stat	Radionuclide data set. Use nonparametric z-stat	Radionuclide data set. Use nonparametric z-stat	Radionuclide data set. Use nonparametric z-stat
N	4	4	4	4	4	4
% < Detection limit	100%	100%	100%	100%	100%	100%
mean	2.2E-02	3.0E-02	1.8E-02	1.5E-02	-6.2E-02	-2.72E+00
st. dev.	4.E-03	2.5E-02	3.E-03	2.E-03	7.0E-02	9.7E-01
Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	2.6E-02	5.1E-02	2.1E-02	1.7E-02	-4.5E-03	-1.92E+00
max value	5.6E-02	6.8E-02	4.5E-02	3.7E-02	2.7E-02	-9.49E-01
Statistical value	2.6E-02	5.1E-02	2.1E-02	1.7E-02	-4.5E-03	-1.92E+00
Background	NA	NA	NA	NA	NA	NA
Statistical value above background	2.6E-02	5.1E-02	2.1E-02	1.7E-02	-4.5E-03	-1.92E+00

Split/Duplicate Analysis:

Composite Area	HEIS Number	Sample Date	Cesium-134			Cesium-137			Cobalt-60			Manganese-54			Technetium-99			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J03WM5	8/23/05	4.9E-02	U	4.9E-02	3.3E-02	U	3.3E-02	4.1E-02	U	4.1E-02	3.4E-02	U	3.4E-02	1.E-03	U	3.9E-01	-9.49E-01	U	5.2E+00
Duplicate of J03WM5	J03WM9	8/23/05	5.6E-02	U	5.6E-02	3.9E-02	U	3.9E-02	4.5E-02	U	4.5E-02	3.7E-02	U	3.7E-02	2.7E-02	U	5.5E-01	-1.61E+00	U	5.3E+00
Split of J03WM5	J03WN0	8/23/05	1.78E-02	U	1.69E-02	-4.47E-03	U	1.29E-02	-7.30E-03	U	1.43E-02	5.05E-03	U	1.36E-02	2.75E-01	U	6.35E-01	-1.80E-02	U	3.14E-02
TDL			0.1			0.05			15			400								
Duplicate Analysis	Both >MDA?		No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)		
	Both >5xTDL?																			
	RPD																			
Split Analysis	Both >MDA?		No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)		
	Both >5xTDL?																			
	RPD																			

43 BG = background

44 HEIS = Hanford Environmental Information System

45 MDA = minimum detectable activity

46 NA = not applicable

47 Q = qualifier

RAG = remedial action goal

RPD = relative percent difference

TDL = target detection limit

WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator J. M. Capron *JMC*
 Project 300 Area Field Remediation
 Subject 600-259 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/01/05
 Job No. 14655

Calc. No. 0600X-CA-V0053
 Checked T. M. Blakley *TMB*

Rev. No. 0
 Date 11/01/05
 Sheet No. 4 of 4

1 600-259 Overburden Sample Data

Sampling Area	HEIS Number	Sample Date	Cesium-134			Cesium-137			Cobalt-60			Manganese-54			Technetium-99			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J10738	9/21/05	3.8E-02	U	3.8E-02	3.4E-02	U	3.1E-02	3.3E-02	U	3.3E-02	2.9E-02	U	2.9E-02	1.18E-01	U	4.8E-01	3.89E-01	U	5.1E+00
Duplicate of J10738	J10742	9/21/05	5.0E-02	U	5.0E-02	4.3E-02	U	4.3E-02	3.6E-02	U	3.6E-02	3.8E-02	U	3.8E-02	2.67E-01	U	6.1E-01	-1.44E+00	U	5.0E+00
A2	J10739	9/21/05	3.0E-02	U	3.0E-02	2.8E-02	U	2.8E-02	2.7E-02	U	2.7E-02	2.6E-02	U	2.6E-02	1.36E-01	U	4.7E-01	-1.90E+00	U	5.2E+00
A3	J10740	9/21/05	5.4E-02	U	5.4E-02	4.3E-02	U	4.3E-02	4.2E-02	U	4.2E-02	4.0E-02	U	4.0E-02	8.2E-02	U	5.5E-01	-7.72E-01	U	4.7E+00
A4	J10741	9/21/05	3.4E-02	U	3.4E-02	3.1E-02	U	3.1E-02	3.4E-02	U	3.4E-02	2.9E-02	U	2.9E-02	1.41E-01	U	6.2E-01	-2.51E+00	U	4.7E+00

9 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Cesium-134 pCi/g			Cesium-137 pCi/g			Cobalt-60 pCi/g			Manganese-54 pCi/g			Technetium-99 pCi/g			Tritium pCi/g		
A1	J10738/ J10742	9/21/05	2.2E-02			2.8E-02			1.7E-02			1.7E-02			1.93E-01			-5.26E-01		
A2	J10739	9/21/05	1.5E-02			1.4E-02			1.4E-02			1.3E-02			1.36E-01			-1.90E+00		
A3	J10740	9/21/05	2.7E-02			2.2E-02			2.1E-02			2.0E-02			8.2E-02			-7.72E-01		
A4	J10741	9/21/05	1.7E-02			1.6E-02			1.7E-02			1.5E-02			1.41E-01			-2.51E+00		

16 Statistical Computations

	Cesium-134			Cesium-137			Cobalt-60			Manganese-54			Technetium-99			Tritium		
Statistical value based on	Radionuclide data set. Use nonparametric z-stat			Radionuclide data set. Use nonparametric z-stat			Radionuclide data set. Use nonparametric z-stat			Radionuclide data set. Use nonparametric z-stat			Radionuclide data set. Use nonparametric z-stat			Radionuclide data set. Use nonparametric z-stat		
N	4			4			4			4			4			4		
% < Detection limit	100%			75%			100%			100%			100%			100%		
mean	2.0E-02			2.0E-02			1.7E-02			1.6E-02			1.4E-01			-1.43E+00		
st. dev.	5.E-03			6.3E-03			3.E-03			3.E-03			4.5E-02			9.4E-01		
Z-statistic	1.645			1.645			1.645			1.645			1.645			1.645		
95% UCL on mean	2.5E-02			2.5E-02			2.0E-02			1.9E-02			1.8E-01			-6.56E-01		
max value	5.4E-02			4.3E-02			4.2E-02			4.0E-02			2.7E-01			3.89E-01		
Statistical value	2.5E-02			2.5E-02			2.0E-02			1.9E-02			1.8E-01			-6.56E-01		
Background	NA			1.1			0.008			NA			NA			NA		
Statistical value above background	2.5E-02			0 (< BG)			1.2E-02			1.9E-02			1.8E-01			-6.56E-01		

30 Split/Duplicate Analysis:

Composite Area	HEIS Number	Sample Date	Cesium-134			Cesium-137			Cobalt-60			Manganese-54			Technetium-99			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J10738	9/21/05	3.8E-02	U	3.8E-02	3.4E-02	U	3.1E-02	3.3E-02	U	3.3E-02	2.9E-02	U	2.9E-02	1.18E-01	U	4.8E-01	3.89E-01	U	5.1E+00
Duplicate of J10738	J10742	9/21/05	5.0E-02	U	5.0E-02	4.3E-02	U	4.3E-02	3.6E-02	U	3.6E-02	3.8E-02	U	3.8E-02	2.67E-01	U	6.1E-01	-1.44E+00	U	5.0E+00
Split of J10738	J10795	9/21/05	1.41E-02	U	1.65E-02	1.59E-02	U	1.57E-02	1.32E-02	U	1.65E-02	4.22E-03	U	1.36E-02	5.56E-01	U	5.98E-01	-1.54E-02	U	3.07E-02
TDL						0.1			0.05			15			400					
Duplicate Analysis	Both >MDA?		No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)		
	Both >5xTDL?																			
	RPD																			
Split Analysis	Both >MDA?		No-Stop (acceptable)			Yes (continue)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)		
	Both >5xTDL?					No-Stop (acceptable)														
	RPD																			

43 BG = background

44 HEIS = Hanford Environmental Information System

45 MDA = minimum detectable activity

46 NA = not applicable

47 Q = qualifier

RAG = remedial action goal

RPD = relative percent difference

TDL = target detection limit

WAC = Washington Administrative Code

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