Waste Site Reclassification Form

Date Submitted: 9/14/06 **Originator:** L. M. Dittmer **Phone:** 372-9664	**Operable Unit(s):** 100-BC-1 **Waste Site ID:** 100-B-26 **Type of Reclassification Action:** Rejected ☐ Closed Out ☐ Interim Closed Out ☐ No Action ☒	**Control Number:** 2006-052 **Lead Agency:** EPA

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, interim closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List of no action, interim closed-out, or closed-out sites will occur at a future date.

Description of current waste site condition:

The 100-B-26 Spillway waste site is a spillway that served as an emergency discharge point for the 132-C-2 outfall in the event that the 100-B-15 river effluent pipelines were blocked, damaged, or undergoing maintenance. Confirmatory sampling was conducted on January 17, 2006. Sampling and evaluation of this site have been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved demonstrating through confirmatory sampling that cleanup goals have been met and proposing the site for reclassification as no action.

Basis for reclassification:

The results of the confirmatory sampling at the 100-B-26 Spillway site demonstrate that residual contaminant concentrations remaining in the soil beneath the riprap are more protective of groundwater and the Columbia River than the risk they would pose if the site was remediated. The site does not have a deep zone; therefore, no deep zone institutional controls are required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-B-26, Spillway* (attached).

D. C. Smith DOE-RL Project Manager	Signature	9/14/06 Date
N/A Ecology Project Manager	Signature	Date
D. A. Faulk EPA Project Manager	Signature	9/18/06 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-26 SPILLWAY

Attachment to Waste Site Reclassification Form 2006-052

September 2006

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-26 SPILLWAY

EXECUTIVE SUMMARY

The 100-B-26 Spillway waste site, part of the 100-BC-1 Operable Unit, is a concrete and riprap spillway that served as an emergency discharge point for the 132-C-2 outfall in the event that the 100-B-15 river effluent pipelines were blocked, damaged, or undergoing maintenance.

Confirmatory sampling of the 100-B-26 waste site was conducted on January 17, 2006. Heavy equipment was used to excavate through the riprap, and the underlying soils were sampled. The sample results indicate that six constituents slightly exceed remedial action goals for the protection of groundwater and the Columbia River. The residual contaminants within the spillway present little risk to human health and the environment compared to the effect remediating the spillway could have on the Columbia River and its shoreline. The results of confirmatory sampling are used to make a reclassification decision for the 100-B-26 site in accordance with the TPA-MP-14 (DOE-RL 1998) process.

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to no action. While the current site conditions do not achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (ROD) (EPA 1999), a no action decision for the 100-B-26 spillway poses less risk to human health and the environment than remediation. These results show that contaminant levels trapped in the soil beneath the riprap are more protective of groundwater and the Columbia River in their present state than they would be if released during remediation. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-26 SPILLWAY

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-B-26 site meets the requirements for a no action decision. The confirmatory sampling results show that contaminant levels remaining in the soil are more protective of groundwater and the Columbia River than the mobilization of contaminants that is possible during remediation of the site. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-B-26 spillway consists of concrete and riprap (large angular rock) sections of spillway (Figure 1). During decommissioning in the 1980s, the concrete spillway walls were collapsed and the structure was covered with clean soil. The concrete portion of the 100-B-26 spillway was disposed of in 2001 as part of a removal action for the 132-C-2 outfall structure (BHI 2002). Typically, effluent cooling water from the 105-C reactor was discharged to the river via the 132-C-2 outfall and the 100-B-15 effluent pipelines. The 100-B-15 effluent pipelines consist of two 54-inch (1.37-m) diameter steel pipes, that currently remain in the Columbia River. The pipelines carried effluent water 500 feet (152 m) from the 132-C-2 outfall into the main current of the river. The upper section of the 100-B-26 spillway (concrete flume) also connected to the 132-C-2 (1904-C) outfall. The lower riprap section of the spillway leads down into the river. In the event that the 100-B-15 river effluent pipelines were blocked, damaged, undergoing maintenance, or otherwise could not accommodate the total flow sent to the 132-C-2 outfall, the 100-B-26 spillway served as an emergency discharge pathway to the river. The riprap section of the spillway remains, with the upper portion covered by clean fill. A rudimentary road crosses the otherwise exposed lower riprap section.

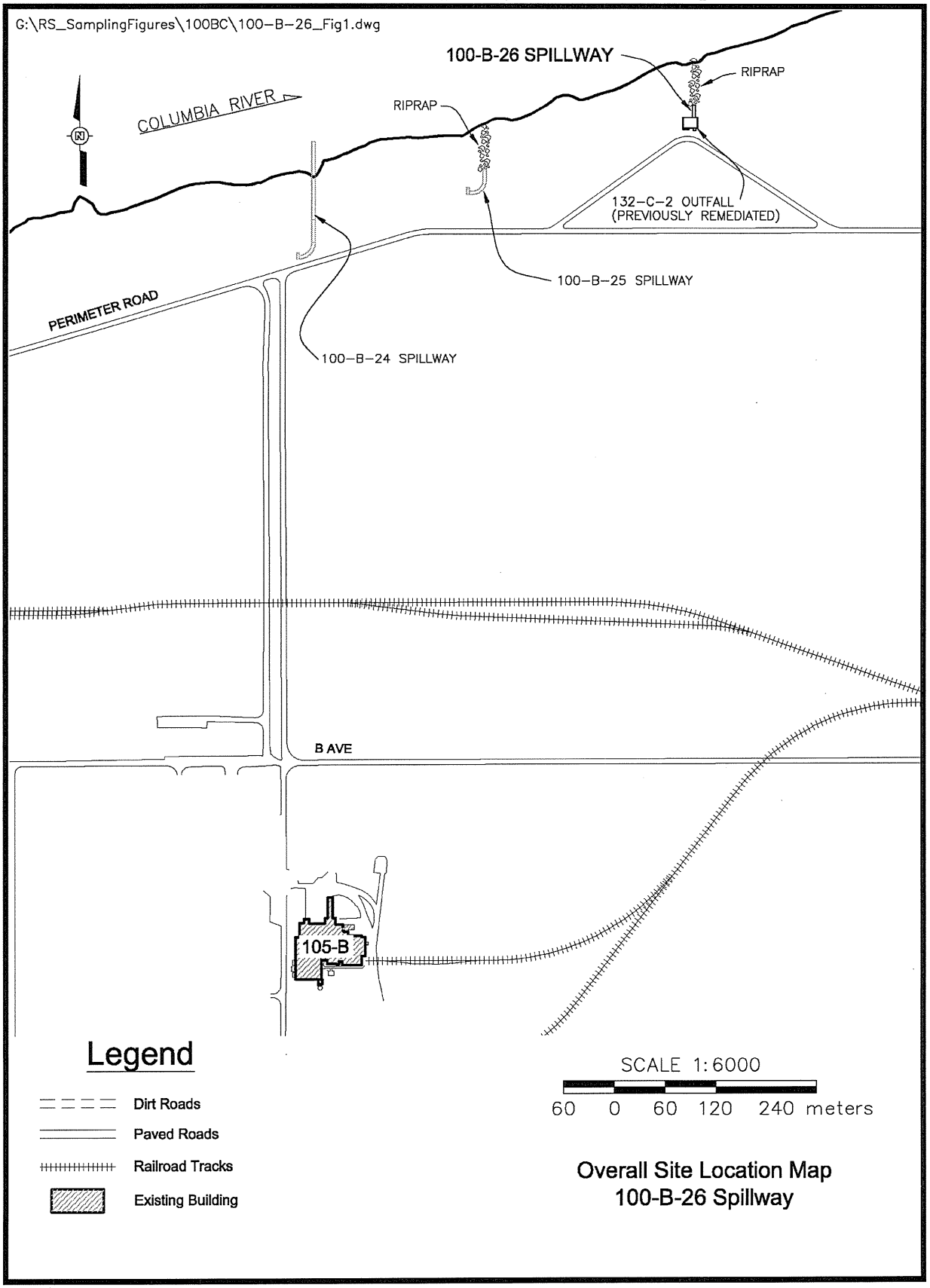
CONFIRMATORY SAMPLING ACTIVITIES

Contaminants of Potential Concern

The contaminants of potential concern (COPCs) for the 100-B-26 site were identified based on COPCs identified for the 132-C-2 outfall (BHI 2002) as follows: americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155, tritium, nickel-63, uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239/240, strontium-90, chromium (total), hexavalent chromium, lead, and mercury. Further consideration of upstream waste sites resulted in the inclusion of polychlorinated biphenyls (PCBs) as a COPC. Although not considered COPCs, confirmatory sample analysis was performed for the expanded list of inductively coupled plasma (ICP) metals to include antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

Field screening with an organic vapor monitor did not detect volatile organic compounds during sampling activities; therefore, volatile organic analysis was not requested.

Figure 1. 100-B-26 Spillway Site Location Map.



Confirmatory Sample Design

A focused sampling design was used to assess whether the 100-B-26 waste site meets the cleanup criteria as specified in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b).

Radiological surveys were performed along the 100-B/C Area shoreline during 2002 and 2003 as part of the 100-B/C Pilot Study (BHI 2005) (Figure 2), which contained survey information for the 100-B-26 spillway.

Three sampling locations were determined for the 100-B-26 site. One sample was selected to be above the rudimentary road that crosses the remaining 100-B-26 spillway (listed in Table 2 as sample location #1), and two samples in the section of riprap that is below the road (listed in Table 2 as sample locations #2 and #3). The sample location above the road was focused on the spillway at the location of the highest LARADS survey results within the spillway footprint. The two samples below (north of) the road were focused by selecting clusters of the highest LARADS survey results within the spillway footprint and above the ordinary high water mark. Heavy equipment was used to excavate through the riprap, exposing the soil below. Three samples and a sample duplicate of the soil underlying the riprap were collected as summarized in Table 1, at the locations listed in Table 1 and shown in Figure 3.

Table 1. Confirmatory Sample Summary for the 100-B-26 Spillway Waste Site.

Sample Location	Sample Media	Sample Number	Coordinate Locations (Field Estimate)	Sample Description	Sample Analysis
#1 South of road	Soil	J10V99	N 145505.8 E 565722.1	Soil immediately underlying riprap	PCB, ICP metals,[a] mercury, hexavalent chromium, GEA, gross alpha, gross beta, Ni-63 scintillation, tritium scintillation, isotopic uranium
#2 North of road	Soil	J10VB1	N 145518.2 E 565726.0	Soil immediately underlying riprap	PCB, ICP metals,[a] mercury, hexavalent chromium, GEA, gross alpha, gross beta, Ni-63 scintillation, tritium scintillation, isotopic uranium
North of road (duplicate of J10VB1)	Soil	J10VB2	N 145518.2 E 565726.0	Soil immediately underlying riprap	PCB, ICP metals,[a] mercury, hexavalent chromium, GEA, gross alpha, gross beta, Ni-63 scintillation, tritium scintillation, isotopic uranium
#3 North of road/closest to river	Soil	J10VB3	N 145526.7 E 565726.0	Soil immediately underlying riprap	PCB, ICP metals,[a] mercury, hexavalent chromium, GEA, gross alpha, gross beta, Ni-63 scintillation, tritium scintillation, isotopic uranium
Equipment blank	Silica sand	J10VB0	N/A	N/A	ICP metals[a] and mercury.

[a] The expanded list of ICP metals will be performed to include antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc in the analytical results package.

Source: *100 BC Burial Grounds/Remaining Sites Field Sampling,* Logbook EFL-1173-7 (WCH 2006a).

bgs = below ground surface
GEA = gamma energy analysis
ICP = inductively coupled plasma
N/A = not applicable
PCB = polychlorinated biphenyl

Figure 2. Results of Radiological Surveys Along the 100-B/C Shoreline.

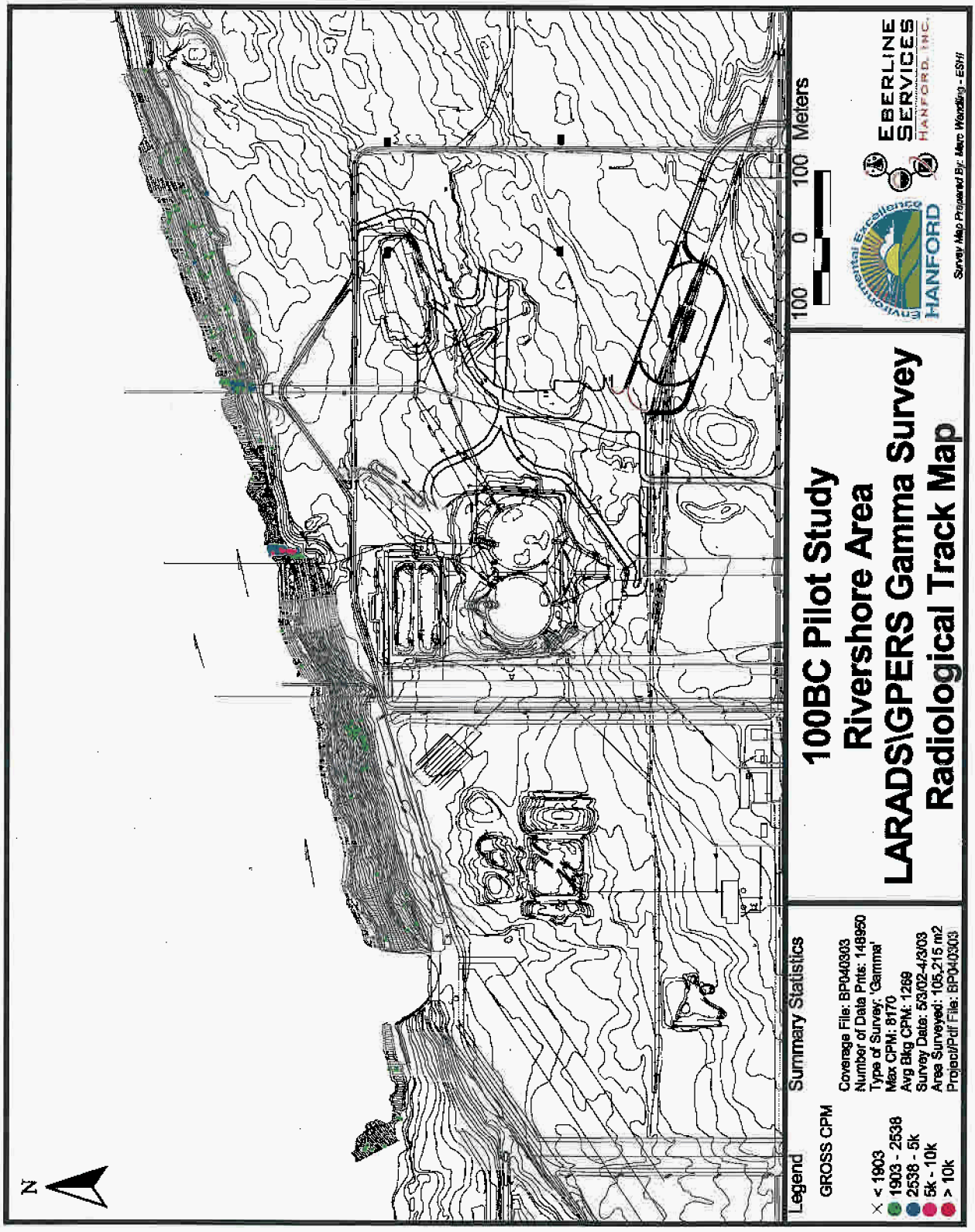
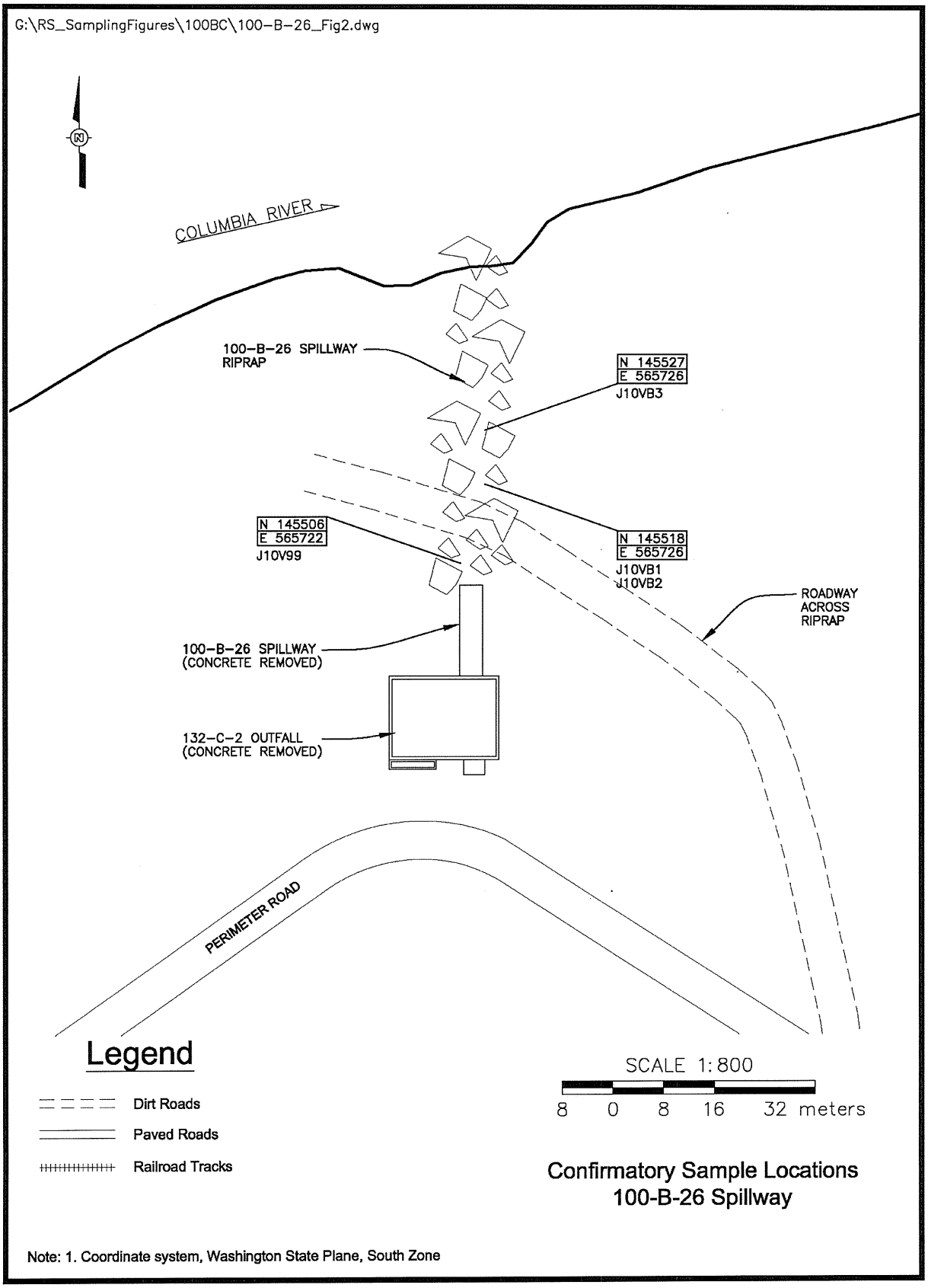


Figure 3. Sampling Locations at the 100-B-26 Spillway Waste Site.



Confirmatory Sampling Results

Confirmatory sampling of the 100-B-26 waste site was performed on January 17, 2006. Samples were analyzed using analytical methods approved by the U.S. Environmental Protection Agency. A comparison of the maximum concentrations of detected COPCs and the site remedial action goals (RAGs) is summarized in Table 2. Contaminants that were not detected by laboratory analysis are excluded from Table 2. Calculated cleanup levels for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not presented in the Model Toxics Control Act Cleanup Levels and Risk Calculations database under *Washington Administrative Code* 173-340-740(3) therefore, these constituents are not considered COPCs. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in the field samples, but are not considered within Table 2 because these isotopes are not related to the operational history of the site. The laboratory-reported results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to submission for inclusion to the Hanford Environmental Information System (HEIS) and are included in Appendix B.

Table 2. Comparison of Maximum Detected Contaminant Concentrations to Action Levels for the 100-B-26 Spillway Waste Site.[a] (2 Pages)

Contaminant of Potential Concern	Maximum Result (pCi/g)	Radionuclide Lookup Values (pCi/g)			Does the Maximum Result Exceed Lookup Values?
		Shallow Zone Lookup Value[b]	Groundwater Protection Lookup Value	River Protection Lookup Value	
Cesium-137	3.14	6.2	1,465	1,465	No
Uranium-233/234	1.44	1.1[c]	1.1[c]	1.1[c]	Yes
Uranium-238	1.18	1.1[c]	1.1[c]	1.1[c]	Yes
Contaminant of Potential Concern	**Maximum Result (mg/kg)**	**Nonradionuclide Remedial Action Goals (mg/kg)**			**Does the Maximum Result Exceed RAGs?**
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection	
Arsenic	5.2 (<BG)	20[d]	20[d]	20[d]	No
Barium	84.7 (<BG)	5600[e]	132[f,g]	224[h]	No
Beryllium	0.44 (<BG)	10.4[i]	1.51[f]	1.51[f]	No
Boron[j]	1.8	16,000[k,e]	320	--[i]	No
Cadmium[m]	0.50 (<BG)	13.9[j]	0.81[f]	0.81[f]	No
Chromium (total)	39.3	80,000	18.5[f]	18.5[f]	Yes
Chromium (hexavalent)	2.0	2.1[i]	4.8	2	Yes
Cobalt	6.4 (<BG)	1,600[k]	32	--[i]	No
Copper	20.2 (<BG)	2,960[k]	59.2	22[f]	No

Table 2. Comparison of Maximum Detected Contaminant Concentrations to Action Levels for the 100-B-26 Spillway Waste Site.[a] (2 Pages)

Contaminant of Potential Concern	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg)			Does the Maximum Result Exceed RAGs?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection	
Lead	17.6	353[o]	10.2[f]	10.2[f]	Yes
Manganese	262 (<BG)	11,200[k]	512[f]	512[f]	No
Mercury	0.02 (<BG)	24[k]	0.33[f]	0.33[f]	No
Molybdenum[j]	0.21	400[k]	8	--[n]	No
Nickel	16.5 (<BG)	1,600[k]	19.1[f]	27.4	No
Selenium[m]	0.51 (<BG)	400[k]	5	1	No
Vanadium	33.7 (<BG)	560[k]	85.1[f]	--[n]	No
Zinc	108	24,000[k]	480	67.8[f]	Yes

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) or calculated per WAC-173-340-720, 730, and 740, Method B, 1996, unless otherwise noted.

[b] Activity corresponding to a single radionuclide 15 mrem/yr exposure as calculated using a generic RESRAD model (DOE-RL 2005b).

[c] The calculated lookup value is below the Hanford Site-specific statistical soil background concentration. The value presented is the Hanford Site-specific statistical soil background concentration.

[d] The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1 of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b).

[e] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), 1996 (Method B for soils) (as presented in the DOE-RL [2005b]). Updated oral reference dose values (as provided in the Integrated Risk Information System) yield Method B direct exposure RAG values of 16,000 mg/kg and 120,000 mg/kg for barium and chromium, respectively.

[f] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

[g] Barium soil cleanup level for groundwater protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule") and WAC 173-340-720(3), 1996 (Method B for groundwater) is 112 mg/kg (as presented in the DOE-RL [2005b]). The updated oral reference dose value (as provided in the Integrated Risk Information System) yields a Method B groundwater cleanup criteria of 7 mg/L, as compared to the more restrictive MCL of 2 mg/L (40 CFR 141). Per WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), the most restrictive updated soil cleanup level for groundwater protection would be 200 mg/kg.

[h] Barium soil cleanup level for river protection calculated from WAC 173-340-740(3)(a)(ii)(A), 1996 ("100 times rule"), a dilution attenuation factor of 2, and WAC 173-340-720(3), 1996 (Method B for groundwater) is 224 mg/kg (as presented in DOE-RL [2005b]). No surface water bioconcentration factor is available for barium and no water quality criteria value exists separate from the drinking water standard; therefore no WAC 173-340-730(3), 1996 (Method B for surface waters) value can be determined.

[i] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) (1996).

[j] No Hanford Site-specific or Washington State background value available.

[k] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B, 1996.

[l] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations database (Ecology 2005), and no bioconcentration factor or water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[m] Hanford Site-specific background is not available; not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[n] No cleanup level is available from the Ecology Cleanup Levels and Risk Calculations tables, and no toxicity values are available to calculate cleanup levels (Ecology 2005).

[o] A WAC 173-340-740(3) (1996) value for lead is not available. This value is based on the *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children* (EPA 1994).

-- = not applicable
BG = background
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

DATA EVALUATION

Uranium-233/234 and uranium-238 were detected above single-radionuclide direct exposure dose-equivalence lookup values. Additionally, total chromium, hexavalent chromium, lead, and zinc were detected at concentrations exceeding soil RAGs for the protection of groundwater and/or the Columbia River. Cesium-137 was detected above the background concentration in the confirmatory samples, but below dose-equivalence lookup values.

The residual constituents within the spillway are present in amounts that are not significantly greater than the RAGs. Remediation to remove the riprap and underlying soils presents the possibility of destabilizing the riverbank and disturbing the existing ecosystem. The potential for releasing contaminated soils and sediments into the river should be avoided. There is a greater risk posed by a removal action at the 100-B-26 site than is posed by leaving the existing soils in place. Therefore, a no action decision is supported for the 100-B-26 spillway.

Nonradionuclide risk requirements for the 100-B-26 site include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, individual contaminant carcinogenic risks of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. These risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background values (Appendix B). All individual hazard quotients were less than 1.0. The cumulative hazard quotient for those constituents above background is 6.4×10^{-2}. Hexavalent chromium is the sole carcinogenic constituent present above background levels. As such, the cumulative carcinogenic risk is equivalent to the individual carcinogenic risk associated with hexavalent chromium (9.5×10^{-7}). This value is below the requirements for individual and cumulative carcinogenic risk.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and analytical data with the sampling and data requirements specified in the site-specific work instruction (WCH 2005). This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e. closeout decisions) (EPA 2000) and completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process.

This DQA was performed in accordance with specific data quality objectives for the site found in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2005). To ensure quality data sets, the *100 Area Remedial Action Sampling and Analysis Plan* data quality assurance requirements, as well as the data validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b), are followed, where appropriate.

A review of the sample design (WCH 2005), the field logbook (WCH 2006a), and applicable analytical data packages has been performed as part of this DQA. Samples were collected at locations selected based on radiological survey results from the 100-B/C Pilot Study.

Data from samples collected at the 100-B-26 waste site were provided by the analytical laboratory in sample delivery group (SDG) K0186. This SDG consists of three field samples (J10V99, J10VB1, and J10VB3) and one field duplicate (J10VB2), submitted for ICP metals, mercury, hexavalent chromium, PCBs, gross alpha, gross beta, gamma energy, nickel-63, tritium, and isotopic uranium analyses. Sample J10V99 had an elevated gross beta detection and was therefore also analyzed for total strontium. An equipment blank (sample J10VB0), submitted for ICP metals and mercury analyses, is also contained within this SDG.

The DQA review for the 100-B-26 waste site found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling. The DQA review for the 100-B-26 waste site concludes that the data reviewed are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of quality control deficiencies. All analytical data were found acceptable for decision-making purposes. The confirmatory sample analytical data are stored in the ENRE project-specific database prior to providing to HEIS and are summarized in Appendix A.

SUMMARY FOR NO ACTION

On January 17, 2006, focused confirmatory samples were collected from the soil beneath the riprap at the 100-B-26 spillway. Residual contamination was identified within the spillway at concentrations that are not significantly greater than the RAGs. This evaluation concluded that a remedial action to remove soils and sediments would result in greater risk to human health and the environment than leaving site soils in place. In accordance with this evaluation, the confirmatory sampling results support a reclassification of the 100-B-26 site to no action.

REFERENCES

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

BHI, 1999, *Cleanup Verification Package for the 116-C-1 Process Effluent Trench*, CVP-98-00006, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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.

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.

BHI, 2002, *Cleanup Verification Package for the 116-B-7, 132-B-6, and 132-C-2 B/C Outfalls*, CVP-2002-00003, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005a, *100-B/C Pilot Project Data Summary for 2003 and 2004,* BHI-01724, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005b, *100 Area Analogous Sites RESRAD Calculations*, 0100X-CA-V0050, Rev. 0, Bechtel Hanford Inc., Richland, Washington.

DOE Order 5400.5, *Radiation Protection of the Public and Environment*, as amended, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1994, *Limited Field Investigation Report for the 100-BC-1 Operable Unit*, DOE/RL-93-06, 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, 2005a, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State,* Publication No. 94-115, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2005, *Cleanup Levels and Risk Calculations (CLARC) Database*, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

ENV-1, *Environmental Monitoring and Management*, Washington Closure Hanford, Richland, Washington.

EPA, 1994, *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1999, *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2000, *Guidance for Data Quality Assessment*, EPA/600/R-96/084, U.S. Environmental Protection Agency, Washington, D.C.

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

WCH, 2005, *Work Instruction for the 100-B-26 Spillway Waste Site*, 0100B-WI-G0011, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2006a, *100 BC Burial Grounds/Remaining Sites Sampling*, Logbook EL-1173-7, Washington Closure Hanford, Richland, Washington.

WCH, 2006b, *Final Validation Package for SDG K0185*, Washington Closure Hanford, Richland, Washington.

APPENDIX A

100-B-26 SPILLWAY SAMPLE RESULTS

Table A-1. 100-B-26 Confirmation Sampling Results. (3 Pages)

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil south of road beneath riprap	J10V99	1/17/06	0.36	U	0.36	3.14		0.12	0.11	U	0.11	0.27	U	0.27	0.36	U	0.36	0.26	U	0.26
Soil north of road beneath riprap	J10VB1	1/17/06	0.32	U	0.32	0.72		0.14	0.14	U	0.14	0.33	U	0.33	0.37	U	0.37	0.29	U	0.29
Duplicate of J10VB1	J10VB2	1/17/06	0.51	U	0.51	0.53		0.13	0.13	U	0.13	0.30	U	0.30	0.38	U	0.38	0.31	U	0.31
Soil closest to river beneath riprap	J10VB3	1/17/06	0.27	U	0.27	1.18		0.14	0.14	U	0.14	0.29	U	0.29	0.34	U	0.34	0.27	U	0.27

Sample Location	HEIS Number	Sample Date	Nickel-63			Potassium-40			Radium-226			Radium-228			Silver 108m			Thorium-228 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil south of road beneath riprap	J10V99	1/17/06	-0.22	U	4.70	16.20		0.91	0.45		0.17	0.80		0.38	0.08	U	0.08	0.48		0.18
Soil north of road beneath riprap	J10VB1	1/17/06	0.47	U	4.60	11.20		1.10	0.46		0.32	1.12		0.41	0.08	U	0.08	1.07		0.20
Duplicate of J10VB1	J10VB2	1/17/06	0.35	U	3.80	11.70		0.78	0.77		0.21	1.41		0.40	0.08	U	0.08	1.34		0.20
Soil closest to river beneath riprap	J10VB3	1/17/06	0.91	U	4.20	9.63		1.30	0.50		0.24	1.10		0.40	0.08	U	0.08	0.77		0.19

Sample Location	HEIS Number	Sample Date	Thorium-232 GEA			Tritium			Uranium-233/234			Uranium-235			Uranium-235 GEA			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil south of road beneath riprap	J10V99	1/17/06	0.80		0.38	-1.66	U	2.80	0.69		0.13	0.08	U	0.16	0.39	U	0.39	0.83		0.13
Soil north of road beneath riprap	J10VB1	1/17/06	1.12		0.41	-0.58	U	2.80	1.44		0.15	0.02	U	0.18	0.46	U	0.46	1.15		0.15
Duplicate of J10VB1	J10VB2	1/17/06	1.41		0.40	-0.40	U	2.70	1.38		0.16	0.03	U	0.20	0.44	U	0.44	1.18		0.16
Soil closest to river beneath riprap	J10VB3	1/17/06	1.10		0.40	0.10	U	2.70	1.02		0.17	0.05	U	0.20	0.40	U	0.40	0.82		0.17

Sample Location	HEIS Number	Sample Date	Uranium-238 GEA			Gross Alpha			Gross Beta			total-Strontium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil south of road beneath riprap	J10V99	1/17/06	12.00	U	12.00	2.57	U	13.00	26.60		6.00	0.29	U	0.31
Soil north of road beneath riprap	J10VB1	1/17/06	13.00	U	13.00	8.15	U	9.20	15.20		9.30			
Duplicate of J10VB1	J10VB2	1/17/06	13.00	U	13.00	14.60		14.00	16.50		9.60			
Soil closest to river beneath riprap	J10VB3	1/17/06	14.00	U	14.00	7.96	U	11.00	18.30		6.50			

Acronyms and notes apply to all of the tables in this appendix.
Note: Data qualified with C are considered acceptable values.
C = blank contamination (inorganic constituents)
GEA= gamma energy analysis
HEIS = Hanford Environmental Information System
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
U = undetected

Table A-1. 100-B-26 Confirmation Sampling Results. (3 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil south of road beneath riprap	J10V99	1/17/06	5200		2.9	0.39	U	0.39	3.1		0.33	75.3	C	0.02	0.32		0.01	1.8	C	0.26	0.11		0.07
Equipment blank	J10VB0	1/17/06	59.1		2.7	0.35	U	0.35	0.30	U	0.3	1.3	C	0.02	0.03		0.01	0.35	C	0.24	0.06	U	0.06
Soil north of road beneath riprap	J10VB1	1/17/06	5560		3.1	0.41	U	0.41	4.7		0.35	74.8	C	0.02	0.36		0.01	0.72	C	0.27	0.29		0.07
Duplicate of J10VB1	J10VB2	1/17/06	7160		3.2	0.43	U	0.43	5.2		0.36	84.7	C	0.02	0.44		0.01	0.82	C	0.29	0.50		0.07
Soil closest to river beneath riprap	J10VB3	1/17/06	4910		3	0.39	U	0.39	3.7		0.33	60.7	C	0.02	0.33		0.01	0.54	C	0.26	0.10		0.07

Sample Location	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil south of road beneath riprap	J10V99	1/17/06	2420	C	1.9	26.4		0.15	5.3		0.12	16.8		0.12	0.22	U	0.22	13300		3.1	11.1		0.3
Equipment blank	J10VB0	1/17/06	29.3	C	1.7	0.22		0.14	0.11	U	0.11	0.11	U	0.11				113		2.8	0.43		0.27
Soil north of road beneath riprap	J10VB1	1/17/06	2310	C	2	29.4		0.16	4.9		0.12	16.8		0.12	0.36		0.23	14800		3.3	12.1		0.31
Duplicate of J10VB1	J10VB2	1/17/06	2550	C	2.1	39.3		0.17	6.4		0.13	20.2		0.13	1.47		0.24	17900		3.4	17.6		0.33
Soil closest to river beneath riprap	J10VB3	1/17/06	1760	C	1.9	22.7		0.16	4.6		0.12	14		0.12	2.0		0.22	13600		3.1	8.6		0.3

Sample Location	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil south of road beneath riprap	J10V99	1/17/06	3430		1.3	262		0.51	0.02	U	0.02	0.15	C	0.13	11.3		0.13	1680		52	0.35	U	0.35
Equipment blank	J10VB0	1/17/06	17.4		1.2	3		0.47	0.02	U	0.02	0.12	U	0.12	0.12	U	0.12	47.8	U	47.8	0.32	U	0.32
Soil north of road beneath riprap	J10VB1	1/17/06	3160		1.4	202		0.54	0.02		0.02	0.14	C	0.13	12.1		0.13	824		54.8	0.51		0.37
Duplicate of J10VB1	J10VB2	1/17/06	4120		1.4	246		0.56	0.02	U	0.02	0.21	C	0.14	16.5		0.14	1070		57.5	0.38	U	0.38
Soil closest to river beneath riprap	J10VB3	1/17/06	3190		1.3	183		0.52	0.02	U	0.02	0.20	C	0.13	12		0.13	863		52.5	0.35	U	0.35

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil south of road beneath riprap	J10V99	1/17/06	560		0.79	0.14	U	0.135	104	C	2.7	28.4		0.09	61.9		0.05
Equipment blank	J10VB0	1/17/06	44.5		0.73	0.12	U	0.124	8.2	C	2.5	0.08	U	0.08	0.71		0.04
Soil north of road beneath riprap	J10VB1	1/17/06	697		0.83	0.14	U	0.142	81.3	C	2.9	24.6		0.09	78.1		0.05
Duplicate of J10VB1	J10VB2	1/17/06	583		0.87	0.15	U	0.149	94.5	C	3	33.7		0.1	108		0.05
Soil closest to river beneath riprap	J10VB3	1/17/06	471		0.8	0.14	U	0.136	64.9	C	2.7	23.5		0.09	54.6		0.05

Table A-1. 100-B-26 Confirmation Sampling Results. (3 Pages)

Constituents	J10V99 Soil south of road beneath riprap Sample date 1/17/06			J10VB1 Soil north of road beneath riprap Sample date 1/17/06			J10VB2 Duplicate of J10VB1 Sample date 1/17/06			J10VB3 Soil closest to the river beneath riprap Sample date 1/17/06		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCBs)												
Aroclor-1016	15	U	15	15	U	15	16	U	16	15	U	15
Aroclor-1221	15	U	15	15	U	15	16	U	16	15	U	15
Aroclor-1232	15	U	15	15	U	15	16	U	16	15	U	15
Aroclor-1242	15	U	15	15	U	15	16	U	16	15	U	15
Aroclor-1248	15	U	15	15	U	15	16	U	16	15	U	15
Aroclor-1254	15	U	15	15	U	15	16	U	16	15	U	15
Aroclor-1260	15	U	15	15	U	15	16	U	16	15	U	15

APPENDIX B

CALCULATION OF HAZARD QUOTIENTS AND EXCESS CARCINOGENIC RISK

CALCULATION COVER SHEET

Project Title 100-B/C Field Remediation **Job No.** 14655
Area 100-B/C
Discipline Environmental ***Calc. No.** 0100B-CA-V0283
Subject 100-B-26 Hazard Quotient and Carcinogenic Risk Calculations
Computer Program Excel **Program No.** Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations 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 Summary = 3 Total = 4	M. W. Perrott 8/24/06	J. M. Capron 8/24/06	S. W. Clark 8/24/06	D. N. Strom D. S. Dechen for DNS per telecon 8/24/06. kaa	

SUMMARY OF REVISION

WCH-DE-018 (04/14/2006) *Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	M.W. Perrott	Date:	8/24/06	Calc. No.:	0100B-CA-V0283	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	J. M. Capron	Date:	8/24/06
Subject:	100-B-26 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk values for the 100-B-26 Spillway site remedial action. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

GIVEN/REFERENCES:

1) DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) EPA, 1994, *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

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

4) WCH, 2006, Waste Site Reclassification Form 2006-052, and Attachment *Remaining Sites Verification Package for the 100-B-26, 1904-C Spillway*, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Calculate an HQ for each noncarcinogenic constituent detected above background and compare it to the individual HQ criterion of <1.0 (DOE-RL 2005).

2) Sum the HQs and compare to the cumulative HQ criterion of <1.0.

3) Calculate an excess cancer risk value for each carcinogenic constituent detected above background and compare it to the individual excess cancer risk criterion of $<1 \times 10^{-6}$ (DOE-RL 2005).

4) Sum the excess cancer risk values and compare to the cumulative cancer risk criterion of $<1 \times 10^{-5}$.

Washington Closure Hanford CALCULATION SHEET

Originator:	M.W. Perrott	Date:	8/24/06	Calc. No.:	0100B-CA-V0283	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	J. M. Capron	Date:	8/24/06
Subject:	100-B-26 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	2 of 3

METHODOLOGY:

Hazard quotient and carcinogenic risk calculations were computed for the 100-B-26 site using the data from WCH (2006). Of the contaminants of potential concern for the site, total chromium, lead, and zinc require the HQ and risk calculations because they were detected above background. Additionally, boron, molybdenum, and hexavalent chromium require the HQ and risk calculations because these analytes were detected and Washington State or Hanford Site background values are not available. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.8 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (calculated in accordance with the noncarcinogen toxic effects in WAC 173-340-740[3]), is 1.1×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criteria is met.

2) After the HQ calculations are completed for the appropriate analytes, the cumulative HQ is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values is 6.4×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the maximum value for hexavalent chromium, the sole carcinogenic constituent, is 2.0 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is 9.5×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criterion is met. The cumulative excess cancer risk is also 9.5×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None
4) List the cumulative excess cancer risk for carcinogens $>1 \times 10^{-5}$: None.

Table 1 shows the results of the calculation for the 100-B-26 Spillway.

Washington Closure Hanford		CALCULATION SHEET					
Originator:	M.W. Perrott	Date:	8/24/06	Calc. No.:	0100B-CA-V0283	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	J. M. Capron	Date:	8/24/06
Subject:	100-B-26 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 3

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-B-26 Waste Site.

Contaminants of Potential Concern[a]	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.8	16,000	1.1E-04	--	--
Chromium, total	39.3	80,000	4.9E-04		
Chromium, hexavalent[c]	2.0	240	8.3E-03	2.1	9.5E-07
Lead[d]	17.6	353	5.0E-02	--	--
Molybdenum	0.21	400	5.3E-04	--	--
Zinc	108	24,000	4.5E-03	--	--
Totals					
Cumulative Hazard Quotient:			**6.4E-02**		
Cumulative Excess Cancer Risk:					**9.5E-07**

Notes:
RAG = remedial action goal
-- = not applicable
[a] = From WCH (2006).
[b] = Value obtained from *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.
[c] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway (WAC) 173-340-750(3), 1996.
[d] = Value for the noncarcinogen RAG obtained from EPA (1994).

CONCLUSION:

This calculation demonstrates that the 100-B-26 Spillway waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).