Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

14-AMRP-0204

JUN 10 2014

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Dear Ms. Hedges:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 100-N-91, 100-N BATTERY DEBRIS, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-022 and supporting, "Remaining Sites Verification Package for the 100-N-91, 100-N Battery Debris," Rev. 0. If you have questions, please contact me or your staff may contact Joanne Chance, of my staff, at (509) 376-0811.

Sincerely,

Mark S. French, Director
River Corridor Division

AMRC:JCC

Attachment

cc w/attach:
N. M. Menard, Ecology
Administrative Record, H6-08

cc w/o attach:
R. D. Cantwell, WCH
S. L. Feaster, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-022

Waste Site Code(s)/Subsite Code(s): 100-N-91

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐
RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-N-91, 100-N Battery Debris waste site, part of the 100-NR-1 Operable Unit, was included in the *Explanation of Significant Differences for the 100-NR-1 and 100-NR-2 Operable Units Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2011) and added to the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County Washington* (100-N Area ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999) as a remove, treat, and dispose site.

The 100-N-91 waste site is approximately 805 m (2,641 ft) southwest of the 100-N-47 Military Artillery Site Solid Waste Site. Based on field observations, the site consisted of an area approximately 0.6 m (2 ft) in diameter of battery debris. The exteriors of the batteries degraded and the contents were mixed into the soil. There was no vegetation growing in the affected area. The Washington State Plane coordinates for the 100-N-91 waste site are N 148183.5, E 571144.7.

The 100-N-91 waste site was recommended for remediation based on a review of the history of the waste site. No confirmatory sampling was recommended or done for this site. The 100-N-91 waste site was remediated by hand digging on November 12, 2013. Less than 1 bank cubic meters (1.3 bank cubic yards) of soil was collected in plastic bags for disposal at the Environmental Restoration Disposal Facility (ERDF). There was no staging pile area or overburden soil stockpile associated with the 100-N-91 waste site excavation. Debris consisting of small dry-cell batteries and pieces of batteries was excavated by hand digging at the 100-N-91 waste site. No other anomalous material or staining was encountered during excavation. The final depth of the 100-N-91 waste site excavation is approximately 0.5 m (1.5 ft) below ground surface.

Cleanup verification soil samples were collected from the 100-N-91 waste site on February 4, 2014, per the *Work Instruction for Verification Sampling of the 100-N-91, 100-N Battery Debris Waste Site*, 0100N-WI-G0071, Rev. 0, Washington Closure Hanford, Richland, Washington (WCH 2014b). Analytical results of those samples indicate the 100-N-91 waste site achieves remedial action objectives (RAOs) and remedial action goals (RAGs) established by the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, DOE/RL-2005-93, Rev. 1, (100-N Area RDR/RDWP), U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2013), and 100-N Area ROD (EPA 1999). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF in the 200 Area of the Hanford Site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

The verification sampling results for the 100-N-91 waste site demonstrate that the waste site meets the RAOs and corresponding RAGs established in the 100-N Area ROD (EPA 1999) and documented in the 100-N Area RDR/RDWP (DOE-RL 2013). The results demonstrate that residual contaminant concentrations do not preclude any future land uses (as bounded by a rural-residential scenario), and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft]). The results also show that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-91, 100-N Battery Debris* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-022

Waste Site Code(s)/Subsite Code(s): 100-N-91

Regulator Comment:

Waste Site Controls:

Engineered Controls: ☐ Yes ☒ No Institutional Controls: ☐ Yes ☒ No O&M Requirements: ☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

J. P. Neath	JPNeath	5/14/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard KIM WELSCH FOR	Kim Welsch	5/14/14
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-91, 100-N BATTERY DEBRIS

Attachment to Waste Site Reclassification Form 2014-022

May 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-91, 100-N BATTERY DEBRIS

EXECUTIVE SUMMARY

The 100-N-91, 100-N Battery Debris waste site, part of the 100-NR-1 Operable Unit, was included in the *Explanation of Significant Differences for the 100-NR-1 and 100-NR-2 Operable Units Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2011) and added to the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-N Area ROD) (EPA 1999) as a remove, treat, and dispose site.

The 100-N-91 waste site is approximately 805 m (2,641 ft) southwest of the 100-N-47 Military Artillery Site Solid Waste Site. Based on field observations, the site consisted of an area approximately 0.6 m (2 ft) in diameter of battery debris. The exteriors of the batteries degraded and the contents were mixed into the soil. There was no vegetation growing in the affected area. The Washington State Plane coordinates for the 100-N-91 waste site are N 148183.5, E 571144.7.

The 100-N-91 waste site was recommended for remediation based on a review of the history of the waste site. No confirmatory sampling was recommended or done for this site. The 100-N-91 waste site was remediated by hand digging on November 12, 2013. Less than 1 bank cubic meter (1.3 bank cubic yards) of soil was collected in plastic bags for disposal at the Environmental Restoration Disposal Facility. There was no staging pile area or overburden soil stockpile associated with the 100-N-91 waste site excavation. Debris consisting of small dry-cell batteries and pieces of batteries was excavated by hand digging at the 100-N-91 waste site. No other anomalous material or staining was encountered during excavation. The final depth of the 100-N-91 waste site excavation is approximately 0.5 m (1.5 ft) below ground surface.

Cleanup verification sampling was conducted on February 4, 2014, per the *Work Instruction for Verification Sampling of the 100-N-91, 100-N Battery Debris Waste Site* (WCH 2014b). A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the 100-N-91 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Remedial Action Goals for the 100-N-91 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15 mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 100-N-91 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPCs below RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotient for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for all sampling areas (2.5×10^{-4}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	Carcinogenic constituents were either not detected or were not detected above background levels.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	Carcinogenic constituents were either not detected or were not detected above background levels.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Radionuclides were not COPCs for the 100-N-91 waste site.	NA
	Attain national primary drinking water standards [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	Radionuclides were not COPCs for the 100-N-91 waste site.	
	Meet drinking water standards for alpha emitters: the most stringent of the 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5 [b].	Radionuclides were not COPCs for the 100-N-91 waste site.	
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].	Radionuclides were not COPCs for the 100-N-91 waste site.	

Table ES-1. Summary of Remedial Action Goals for the 100-N-91 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	The residual concentration of zinc exceeded soil RAGs for groundwater and river protection. However, based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), it is predicted that zinc will not reach groundwater (and thus the Columbia River) within 1,000 years [d].	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).
[c] Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL 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* (BHI 2001).
[d] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentration of zinc is not expected to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the soil-partitioning coefficient of zinc of 30 mL/g). The vadose zone beneath the 100-N-91 waste site is approximately 16 m (52 ft) thick. Therefore, the residual concentration of zinc is predicted to be protective of groundwater and the Columbia River.

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (DOE-RL 2013) and the 100-N Area ROD (EPA 1999).

The verification sample results show that residual contaminant concentrations 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). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure cleanup levels was not observed in shallow zone soils and is concluded not to be present in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the 100-N Area ROD, a comparison against ecological risk screening levels has been made for the 100-N-91 waste site contaminants of potential concern, and other constituents (Appendix A). The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for manganese, vanadium, and zinc. Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340,

"Model Toxics Control Act – Cleanup," were exceeded for boron, vanadium, and zinc. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of manganese and vanadium are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as a part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-91, 100-N BATTERY DEBRIS

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-N-91, 100-N Battery Debris waste site meets the objectives to support a reclassification of this site to Interim Closed Out as established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (100-N Area RDR/RAWP) (DOE-RL 2013) and the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-N Area ROD) (EPA 1999). The results of verification sampling and modeling show that residual soil concentrations 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). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure cleanup levels was not observed in shallow zone soils and is concluded not to be present in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the 100-N Area ROD, a comparison against ecological risk screening levels has been made for the 100-N-91 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for manganese, vanadium, and zinc. Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, vanadium, and zinc. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of manganese and vanadium are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as a part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-N-91, 100-N Battery Debris waste site, part of the 100-NR-1 Operable Unit is approximately 805 m (2,641 ft) southwest of the 100-N-47 Military Artillery Site Solid Waste Site (Figure 1). Based on field observations in the *100-N Area Orphan Sites Evaluation Report* (WCH 2009), the site consisted of an area approximately 0.6 m (2 ft) in diameter of battery debris (Figures 2 and 3). The exteriors of the batteries degraded and the contents were mixed into the soil. There was no vegetation growing in the affected area. The Washington State Plane coordinates for the 100-N-91 waste site are N 148183.5, E 571144.7, as reported in *100-N Area Orphan Sites Evaluation Report* (WCH 2009).

Figure 1. Overall Site Location Map of the 100-N-91 Waste Site.

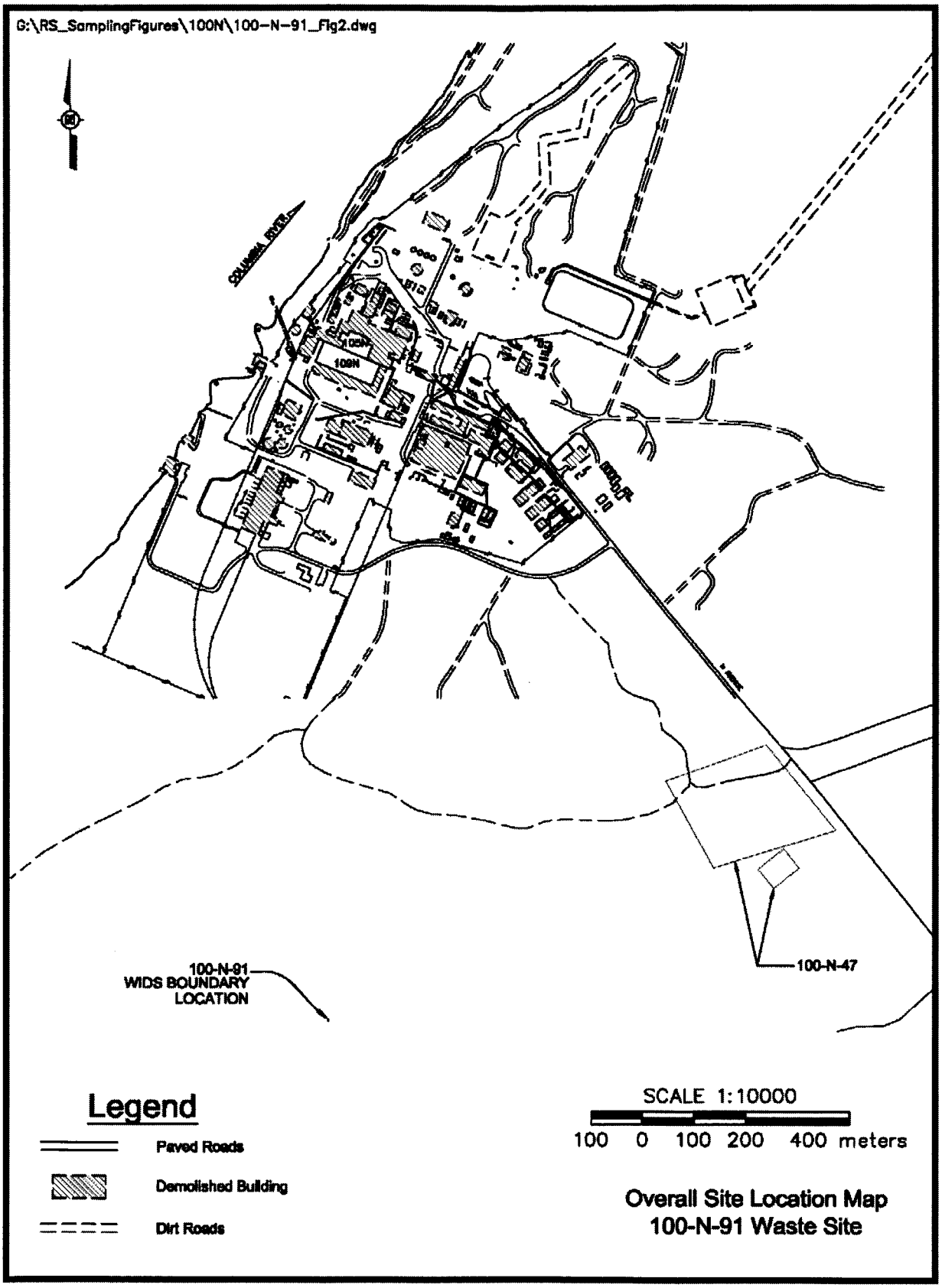

Figure 2. Pre-Remediation Photograph of the 100-N-91 Waste Site.

Figure 3. Close-up Photograph of the100-N-91 Waste Site.

CONIRMATORY SAMPLING SUMMARY

The 100-N-91 waste site was recommended for remediation based on a review of the history of the waste site. No confirmatory sampling was recommended or done for this site. The details are provided in the *100-N-91, 100-N Battery Debris Remove, Treat, and Dispose Report,* which is attached to an interoffice memorandum dated June 10, 2010 (WCH 2010).

REMEDIAL ACTION SUMMARY

The 100-N-91 waste site was remediated by hand digging on November 12, 2013, based on the recommendation of the remove, treat, and dispose report (WCH 2010). Less than 1 bank cubic meters (1.3 bank cubic yards) of soil was collected in plastic bags for disposal at the Environmental Restoration Disposal Facility. There was no staging pile area or overburden soil stockpile associated with the 100-N-91 waste site excavation. Debris consisting of small dry-cell batteries and pieces of batteries was excavated by hand digging at the 100-N-91 waste site. No other anomalous material or staining was encountered during excavation (WCH 2013a).

The final depth of the 100-N-91 waste site excavation is approximately 0.5 m (1.5 ft) (WCH 2013a). Following remediation, a boundary walk-around survey of the 100-N-91 waste site excavation was not performed due to the very small size of the hand-dug excavation. The post-excavation photo (Figure 4) shows the excavation to be a small, circular hole of approximately 0.9 m (3 ft) in diameter resulting in an excavated waste site area of less than 1 m^2 (10.8 ft^2) (WCH 2013a).

Figure 4. Post-Remediation Photograph of the 100-N-91 Waste Site.

Following remediation, the project collected an in-process soil sample on November 13, 2013, to determine if additional soil remediation was necessary at the 100-N-91 waste site prior to initiating verification sampling activities. The sample results indicated that the waste removal was sufficient; therefore, no additional material was removed. The in-process sample data is provided in Appendix B.

VERIFICATION SAMPLING

Verification sampling of the 100-N-91 waste site was conducted on February 4, 2014. Samples were collected to support a determination that residual contaminant concentrations at this site meet the cleanup criteria specified in the 100-N Area RDR/RAWP (DOE-RL 2013) and the 100-N Area ROD (EPA 1999).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 100-N-91 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site. A more detailed discussion of the verification sample design can be found in the *Work Instruction for Verification Sampling of the 100-N-91, 100-N Battery Debris Waste Site* (WCH 2014b).

Contaminants of Potential Concern

The COPCs for the 100-N-91 waste site were based on the nature of the site's debris (i.e., small batteries), the 100-N-91 post-excavation in-process sampling results, and a high mercury result in the waste characterization sample (Table B-2). Zinc was the only COPC that exceeded 100-N RAGs (DOE-RL 2013) for the post-excavation in-process sampling results (Table B-1).

The post-excavation in-process sampling COPCs were inductively coupled plasma (ICP) metals and mercury (WCH 2013b).

For verification sampling, the COPCs were the same as the post-excavation in-process sampling COPCs: ICP metals and mercury (Table 1). The analytical methods that were performed to evaluate the site COPCs are provided in Table 1.

Table 1. 100-N-91 Laboratory Analytical Methods and Contaminants of Potential Concern.

Analysis	Analytical Method	Contaminant of Potential Concern
ICP metals [a]	EPA Method 6010	Metals
Mercury	EPA Method 7471	Mercury

[a] Analysis was performed for the expanded list of ICP metals including antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma

Sample Design and Sampling Activities

One shallow zone decision unit was identified for the 100-N-91 waste site. One focused verification soil sample and a duplicate sample were collected from the waste site decision unit.

All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites* (DOE-RL 2006). All samples were grab samples collected at the predetermined coordinates. Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a). The verification sample summary is provided in Table 2. A verification sample location map is provided in Figure 5.

Table 2. 100-N-91 Waste Site Verification Sample Summary Table.

Sample Location	HEIS Number	Sample Date	Washington State Plane		Sample Analysis
			Northing (m)	Easting (m)	
EXC-1	J1T919	2/4/2014	148184.6	571143.7	ICP metals [a], mercury
Duplicate of EXC-1	J1T920				
Equipment blank	J1T921		NA	NA	ICP metals [a], mercury

Source: Field logbook EL-1652-11 (WCH 2014a).

[a] Analysis for the expanded list of ICP metals was performed to include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable

Figure 5. 100-N-91 Waste Site Verification Sample Location.

Following remediation, the project collected an in-process soil sample on November 13, 2013, to determine if additional soil remediation was necessary at the 100-N-91 waste site prior to initiating verification sampling activities. The sample results indicated that the waste removal was sufficient; therefore, no additional material was removed. The in-process sample data is provided in Appendix B.

VERIFICATION SAMPLING

Verification sampling of the 100-N-91 waste site was conducted on February 4, 2014. Samples were collected to support a determination that residual contaminant concentrations at this site meet the cleanup criteria specified in the 100-N Area RDR/RAWP (DOE-RL 2013) and the 100-N Area ROD (EPA 1999).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 100-N-91 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site. A more detailed discussion of the verification sample design can be found in the *Work Instruction for Verification Sampling of the 100-N-91, 100-N Battery Debris Waste Site* (WCH 2014b).

Contaminants of Potential Concern

The COPCs for the 100-N-91 waste site were based on the nature of the site's debris (i.e., small batteries), the 100-N-91 post-excavation in-process sampling results, and a high mercury result in the waste characterization sample (Table B-2). Zinc was the only COPC that exceeded 100-N RAGs (DOE-RL 2013) for the post-excavation in-process sampling results (Table B-1).

The post-excavation in-process sampling COPCs were inductively coupled plasma (ICP) metals and mercury (WCH 2013b).

For verification sampling, the COPCs were the same as the post-excavation in-process sampling COPCs: ICP metals and mercury (Table 1). The analytical methods that were performed to evaluate the site COPCs are provided in Table 1.

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EPA = U.S. Environmental Protection Agency
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Verification Sample Results

All verification samples were analyzed using EPA-approved analytical methods. A data summary is presented in Appendix C. Evaluation of the data from the 100-N-91 verification samples was performed by direct comparison of the maximum sample results for each COPC against the cleanup criteria.

Comparisons of the results for each COPC from the 100-N-91 waste site against the RAGs are summarized in Table 3. Contaminants that were not detected by laboratory analysis are excluded from the table. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2014) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in the table. The complete laboratory results for all constituents are stored in a Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Attachment 1 of the calculations (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-N-91 waste site achieve the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the 100-N Area ROD (EPA 1999) and documented in the 100-N Area RDR/RAWP (DOE-RL 2013).

Attainment of Nonradionuclide RAGS

Table 3 compares the cleanup verification sample maximum values for the 100-N-91 waste site excavation to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All COPCs were quantified below direct exposure RAGs. All COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of zinc. However, given the soil-partitioning coefficient of zinc of 30 mL/g, zinc would not be expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013). The vadose zone beneath the 100-N-91 waste site is approximately 16 m (52 ft) thick; therefore, the residual concentration of zinc is predicted to be protective of groundwater (and thus the Columbia River).

Three-Part Test for Nonradionuclides

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. However, no statistical samples were used in the 100-N-91 waste site sampling design (WCH 2014b). The verification samples were all focused samples; therefore, the three-part test is not applicable to the data evaluation for the 100-N-91 waste site.

Table 3. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 100-N-91 Waste Site Focused Verification Samples.

COPC	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	3.3 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	63.2 (<BG)	16,000 [c]	200	400	No	--
Boron [d]	1.7	16,000 [c]	320	-- [e]	No	--
Cadmium [f]	0.15 (<BG)	13.9 [g]	0.81 [b]	0.81 [b]	No	--
Chromium	12.5 (<BG)	120,000 [c]	18.5 [b]	18.5 [b]	No	--
Cobalt	5.6 (<BG)	1,600 [c]	32	-- [e]	No	--
Copper	10.8 (<BG)	2,960 [c]	59.2	22.0 [b]	No	--
Lead	9.6 (<BG)	353 [h]	10.2 [b]	10.2 [b]	No	--
Manganese	296 (<BG)	11,200 [c]	512 [b]	-- [e]	No	--
Mercury	0.029 (<BG)	24 [c]	0.33 [b]	0.33 [b]	No	--
Nickel	13.1 (<BG)	1,600 [c]	19.1 [b]	27.4	No	--
Vanadium	32.4 (<BG)	560 [c]	85.1 [b]	-- [e]	No	--
Zinc	146	24,000 [c]	480	67.8 [b]	Yes	Yes [i]

[a] RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2013).

[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100-N Area RDR/RAWP (DOE-RL 2013).

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

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

[e] No parameters (bioconcentration factors or AWQC values) are available from the Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

[f] Hanford Site-specific background not available. Value is Washington State background from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[g] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

[h] Use 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.

[i] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentration of zinc is not expected to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the soil-partitioning coefficient of zinc of 30 mL/g). The vadose zone beneath the 100-N-91 waste site is approximately 16 m (52 ft) thick; therefore, the residual concentration of zinc is predicted to be protective of groundwater and the Columbia River.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. For the 100-N-91 waste site, 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. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 2.5×10^{-4}. There are no detected COPCs that require a carcinogenic risk calculation; therefore, the individual carcinogenic risk requirement of less than 1×10^{-6} is met, and the cumulative carcinogenic risk requirement of less than 1×10^{-5} is met. The 100-N-91 waste site meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100-N Area RDR/RAWP (DOE-RL 2013).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-N-91 waste site included a calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values or for which there is no background value. In addition, the soil-partitioning coefficients for these contaminants must be less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013). Based on this model and a vadose zone of approximately 16 m (52 ft) in thickness, a distribution coefficient of 4.6 mL/g or greater is required to show no predicted migration to groundwater in 1,000 years. The hazard quotient for boron, the only constituent subject to the groundwater protection calculation, is 5.2×10^{-3}, which is less than 1.0. No carcinogenic soil constituents met the criteria for groundwater protection evaluation at the 100-N-91 waste site; therefore, no calculations of excess carcinogenic risk were performed and nonradionuclide risk requirements related to groundwater are met.

Attainment of Radionuclide Direct Exposure RAGs

There were no radionuclide COPCs identified for the 100-N-91 waste site; therefore, no evaluation was conducted.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2014b), the field logbook (WCH 2014a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA is provided in Appendix D.

The DQA for the 100-N-91 waste site established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the WCH project-specific database for data evaluation prior to archival in the HEIS and are summarized in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 100-N-91 waste site has been evaluated in accordance with the 100-N Area ROD (EPA 1999) and the 100-N Area RDR/RAWP (DOE-RL 2013). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at the site meet the RAOs for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-N-91 waste site to Interim Closed Out. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

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WCH, 2009, *100-N Area Orphan Sites Evaluation Report*, OSR-2009-0001, Rev. 0, Washington Closure Hanford, Richland, Washington, pp. 6-28.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-N-91 Waste Site [a].

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Waste Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
Metals (mg/kg)									
	Background								
Boron	--	0.5	--	--	--	--	--	--	1.7
Manganese	512	1,100 [d]	--	1,500	220	450	4,300	4,000	296 (<BG)
Vanadium	85.1	2	--	--	--	--	7.8	280	32.4 (<BG)
Zinc	67.8	86 [d]	200	360	160	120	46	79	146

NOTE: Shaded cells indicate an ecological screening level exceedance.

[a] Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site, which will include a more complete quantitative ecological risk assessment.

[b] Available on the Internet at www.epa.gov/ecotox/ecossl.

[c] Wildlife.

[d] Benchmark replaced by Washington State natural background concentration from Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Publication 94-115, Washington State Department of Ecology, Olympia, Washington.

-- = no value exists
BG = background
EPA = U.S. Environmental Protection Agency
WAC = *Washington Administrative Code*

APPENDIX B

IN-PROCESS AND WASTE CHARACTERIZATION SAMPLE RESULTS

Table B-1. 100-N-91 In-Process Sample Data.

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Location 1	J1T5T1	11/13/2013	148184.6	571143.7	8000		1.6	0.39	U	0.39	3.4		0.68	64.1		0.078	0.23		0.03	1	U	1

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Cadmium			Calcium			Chromium			Cobalt			Copper			Iron		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Location 1	J1T5T1	11/13/2013	148184.6	571143.7	0.22	M	0.04	2850		14.5	11.7		0.06	5.5		0.1	10.3	M	0.22	15100		3.9

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Location 1	J1T5T1	11/13/2013	148184.6	571143.7	6.1		0.28	3830		3.8	282		0.1	0.27	U	0.27	11.6		0.13	1920		42.3

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Selenium			Silicon			Silver			Sodium			Vanadium			Zinc		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Location 1	J1T5T1	11/13/2013	148184.6	571143.7	0.89	U	0.89	274	N	5.8	0.17	U	0.17	134		60.9	31.8		0.1	94.2	M	0.41

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Mercury			Percent Moisture		
			Northing	Easting	mg/kg	Q	PQL	%	Q	PQL
Location 1	J1T5T1	11/13/2013	148184.6	571143.7	0.023	MN	0.01	3.1		0

Acronyms and notes apply to all of the tables in this appendix.

B = estimated
HEIS=Hanford Environmental Information System
M = sample duplicate precision not met.
N = recovery exceeds upper or lower control limits.
PQL = practical quantitation limit
Q = qualifier
U = undetected
WSP = Washington State Plane

Table B-2. 100-N-91 Waste Characterization Sample Data.

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-N-91	J1R5X3	11/20/2012	148183.5	571144.7	7650		14.8	13.6		1.77	17.8		2.95	87.6		1.48	0.304	B	0.591	1.78	B	5.91

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Cadmium			Calcium			Chromium			Cobalt			Copper			Iron		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-N-91	J1R5X3	11/20/2012	148183.5	571144.7	21.6		0.591	2480		295	16.8		0.591	8.16		5.91	240		2.95	16000		59.1

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-N-91	J1R5X3	11/20/2012	148183.5	571144.7	1190		1.48	3230		222	17600		14.8	6.47		5.91	22.9		11.8	1350		1180

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Selenium			Silicon			Silver			Sodium			Vanadium			Zinc		
			Northing	Easting	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-N-91	J1R5X3	11/20/2012	148183.5	571144.7	0.886	U	0.886	890		5.91	0.591	U	0.591	201		148	43.4		7.38	48000		985

Sample Location	HEIS Number	Sample Date	WSP Coordinates (m)		Mercury		
			Northing	Easting	mg/kg	Q	PQL
100-N-91	J1R5X3	11/20/2012	148183.5	571144.7	9.86		1.3

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATIONS

The calculations provided in this appendix are copies of originals that 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. These calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The calculations provided in this appendix include:

100-N-91 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0100N-CA-V0257, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-N-91 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100N-CA-V0259, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculations that are provided in this appendix 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.

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CALCULATION COVER SHEET

Project Title: 100-N Area Field Remediation **Job No. 14655**

Area: 100-N Area

Discipline: Environmental Calculation No: 0100N-CA-V0257

Subject: 100-N-91 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2010

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 = 5 Attachment = 1 Total = 7	N. K. Schiffern N K Schiffern	I. B. Berezovskiy I B Berezovskiy	J. D. Skoglie J D Skoglie	D. F. Obenauer D. F. Obenauer	4/7/14

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	3/18/2014	Calc. No.:	0100N-CA-V0257	Rev.:	0
Project:	100-N Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	3/18/2014
Subject:	100-N-91 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 5	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-N-91 waste site. In accordance with the remedial action goals (RAGs) in the 100-N remedial design report/remedial action work plan (100-N RDR/RAWP) (DOE-RL 2013), 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.

Also, calculate the relative percent difference (RPD) for the primary-duplicate sample pairs from the 100-N-91 waste site verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2006, *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites*, DOE/RL-2005-92, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2013, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, DOE/RL-2005-93, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3) 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.

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

5) WCH, 2014, *Remaining Sites Verification Package for the 100-N-91, 100-N Battery Debris Waste Site*, Attachment to Waste Site Reclassification Form 2014-022, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2013).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2013).

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	3/18/2014	Calc. No.:	0100N-CA-V0257	Rev.:	0
Project:	100-N Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	3/18/2014
Subject:	100-N-91 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 5	

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

5) Use data from Attachment 1 to perform the RPD calculations for primary-split sample pairs, as required.

METHODOLOGY:

The 100-N-91 waste site underwent discrete focused sampling at one location for the purpose of verification sampling. One duplicate sample was also collected. The direct contact hazard quotient and carcinogenic risk calculations for the 100-N-91 waste site were conservatively calculated for the entire waste site using the greatest of the maximum soil sample results from Attachment 1. Of the contaminants of potential concern (COPCs) for this site boron requires HQ and risk calculations because this analyte was detected and a Washington State or Hanford Site background value is not available. Zinc requires HQ and risk calculations because this analyte was detected above a Washington State or Hanford Site background value. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.7 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), produces a HQ value of 1.1×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be 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 2.5×10^{-4}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. No carcinogenic constituents met the criteria for evaluation in direct exposure at the 100-N-91 waste site; therefore, no calculations of excess carcinogenic risk were performed. The requirement of $<1 \times 10^{-6}$ is met.

4) The cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values is zero. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate/split value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDLs are pre-determined values for analytical methods and constituents with cleanup levels as listed in Table 2-1 of the SAP (DOE-RL 2006). Table 2-1 includes nominal TDLs for identified methods based organic analyses. The nominal TDLs are also used in support of the RPD calculation for the methods based analytes. TDLs not included in Table 2-1 are based on the laboratory and/or methods used. Where direct evaluation of the attached sample data showed that a given analyte was not

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Subject:	100-N-91 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 5	

detected in the primary and/or duplicate/split sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

$$RPD = [\ |M-D|/((M+D)/2)]*100$$

where, M = main sample value D = duplicate sample value

When an analyte is detected in the primary or duplicate/split sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) 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. No duplicate samples were collected for the verification sampling of the subject site and one split sample was collected. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2014), as necessary.

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 x 10^{-6}: None
4) List the cumulative excess cancer risk for carcinogens >1 x 10^{-5}: None

Table 1 shows the results of the direct contact hazard quotient calculations.

5) The evaluation of the QA/QC split RPD calculations are performed within the data quality assessment section of the RSVP.

Table 2 shows the results of the RPD calculations for the 100-N-91 waste site.

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Table 1. Direct Contact HQ and Excess Cancer Risk Results for the 100-N-91 Waste Site.

Contaminants of Potential Concern	Maximum Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.7	16,000	1.1E-04	--	--
Zinc	146	1,050,000	1.4E-04	--	--
Totals					
Cumulative Hazard Quotient:			**2.5E-04**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From Attachment 1.

[b] = Value obtained from the 100-N RDR/RAWP (DOE-RL 2013) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

-- = not applicable

RAG = remedial action goal

Table 2. Relative Percent Difference Calculations for the 100-N-91 Waste Site. (2 Pages)

100-N-91 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	8910		1.6	3.3		0.69	63.2		0.080	0.15	BMJ	0.043
Duplicate of J1T919	J1T920	2/4/2014	8710		1.6	1.6		0.69	28.1		0.080	0.065	BJ	0.043

Analysis:

TDL		5	10	2	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	2.3%		76.9%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

100-N-91 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	3220		14.8	12.5		0.061	5.5	X	0.11	10.8		0.23
Duplicate of J1T919	J1T920	2/4/2014	1410		14.8	5.6		0.061	5.6	X	0.11	4.8		0.23

Analysis:

TDL		100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	78.2%	76.2%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Yes - assess further

100-N-91 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	16900		4.0	9.6		0.28	4150		3.9	296	MJ	0.11
Duplicate of J1T919	J1T920	2/4/2014	16800		4.0	8.5		0.28	1770		3.9	243	J	0.11

Analysis:

TDL		5	5	75	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	0.6%		80.4%	19.7%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

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Table 2. Relative Percent Difference Calculations for the 100-N-91 Waste Site. (2 Pages)

100-N-91 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Mercury			Nickel			Potasium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	0.021		0.0061	13.1		0.13	1810		43.1	254	J	6.0
Duplicate of J1T919	J1T920	2/4/2014	0.029		0.0059	5.5		0.13	1870		43.1	127	J	5.9

Analysis:

TDL		0.2	4	400	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD				66.7%
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	Not applicable

100-N-91 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	32.4		0.099	146	MJ	0.42
Duplicate of J1T919	J1T920	2/4/2014	14.6		0.099	113	J	0.42

Analysis:

TDL		2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)
	RPD	75.7%	25.5%
	Difference > 2 TDL?	Not applicable	Not applicable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-N-91 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the 100-N RDR/RAWP (DOE-RL 2013) and SAP (DOE-RL 2006). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 100-N-91 Waste Site Verification Sample Results (Metals and Physicals).

LOCATION	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	8910		1.6	0.40	UJ	0.40	3.3		0.69	63.2		0.080
Duplicate of J1T919	J1T920	2/4/2014	8710		1.6	0.40	UJ	0.40	1.6		0.69	28.1		0.080
Equipment Blank	J1T921	2/4/2014	232		1.5	0.37	UJ	0.37	0.64	U	0.64	2.0		0.074

LOCATION	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	0.035	U	0.035	1.7	B	1.0	0.15	BMJ	0.043	3220		14.8
Duplicate of J1T919	J1T920	2/4/2014	0.035	U	0.035	1.0	U	1.0	0.065	BJ	0.043	1410		14.8
Equipment Blank	J1T921	2/4/2014	0.037	B	0.032	0.95	U	0.95	0.04	UJ	0.040	43.4	B	13.7

LOCATION	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	12.5		0.061	5.5	X	0.11	10.8		0.23	16900		4.0
Duplicate of J1T919	J1T920	2/4/2014	5.6		0.061	5.6	X	0.11	4.8		0.23	16800		4.0
Equipment Blank	J1T921	2/4/2014	0.18	B	0.056	0.15	BX	0.097	0.21	U	0.21	598		3.7

LOCATION	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	9.6		0.28	4150		3.9	296	MJ	0.11	0.021		0.0061
Duplicate of J1T919	J1T920	2/4/2014	8.5		0.28	1770		3.9	243	J	0.11	0.029		0.0059
Equipment Blank	J1T921	2/4/2014	0.31	B	0.26	32.6		3.6	6.4	J	0.097	0.0060	U	0.0060

LOCATION	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	0.27	U	0.27	13.1		0.13	1810		43.1	0.90	U	0.90
Duplicate of J1T919	J1T920	2/4/2014	0.27	U	0.27	5.5		0.13	1870		43.1	0.90	U	0.90
Equipment Blank	J1T921	2/4/2014	0.25	U	0.25	0.18	B	0.12	66.3	B	39.8	0.83	U	0.83

LOCATION	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1T919	2/4/2014	254	J	6.0	0.17	UJ	0.17	141		62.0	32.4		0.099
Duplicate of J1T919	J1T920	2/4/2014	127	J	5.9	0.17	U	0.17	62.0	U	62.0	14.6		0.099
Equipment Blank	J1T921	2/4/2014	112	J	5.5	0.16	U	0.16	57.3	U	57.3	0.63	B	0.091

LOCATION	HEIS Number	Sample Date	Zinc			Percent Moisture (Wet)		
			mg/kg	Q	PQL	%	Q	PQL
EXC-1	J1T919	2/4/2014	146	MJ	0.42	5.8		0.10
Duplicate of J1T919	J1T920	2/4/2014	113	J	0.42	5.7		0.10
Equipment Blank	J1T921	2/4/2014	3.8	J	0.39	0.10	U	0.10

Note: Data qualified with B, J, M, and X are acceptable values.
B = analyte was found in associated method blank as well as the sample
EXC = excavation
HEIS = Hanford Environmental Information system
J = Results less than RL but greater than or equal to the MDL and the concentration is an approximate value.
M = sample duplicate precision not met
PQL = practical quantitation limit
Q = qualifier
U = undetected
X = Serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)

Attachment	1	Sheet No.	1 of 1
Originator	N. K. Schiffern	Date	3/6/2014
Checked	I. B. Berezovskiy	Date	3/6/2014
Calc. No.	0100N-CA-V0257	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-N Field Remediation **Job No. 14655**

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0259

Subject: 100-N-91 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2010

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
	Cover = 1 Sheets = 3 Total = 4	N. K. Schiffern N.K. Schiffern	I. B. Berezovskiy I.B. Berezovskiy	J. D. Skoglie J. D. Skoglie	D. F. Obenauer D.F. Obenauer	4/7/14

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern NQ	Date:	03/18/14	Calc. No.:	0100N-CA-V0259	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	03/18/14
Subject:	100-N-91 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-N-91 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) for the 100-N Area (DOE-RL 2013), 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, 2013, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area,* DOE/RL-2005-93, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) WCH, 2014, *Remaining Sites Verification Package for the 100-N-91, 100-N Battery Debris Waste Site,* Attachment to Waste Site Reclassification Form 2014-022, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate a HQ for each noncarcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (DOE-RL 2013).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (DOE-RL 2013).

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

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Originator:	N. K. Schiffern	Date:	03/18/14	Calc. No.:	0100N-CA-V0259	Rev.:	0
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Subject:	100-N-91 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	2 of 3

METHODOLOGY:

The 100-N-91 waste site is comprised of one decision unit for verification sampling, consisting of the excavation area. The protection of groundwater hazard quotient and carcinogenic risk calculations for the 100-N-91 waste site were conservatively calculated for the entire waste site using the maximum value for each analyte (WCH 2014). Based on the generic site RESRAD model (DOE-RL 2013) and a vadose zone of approximately 16 m (52 ft) thickness, a K_d of 4.6 or greater is required to show no predicted migration to groundwater in 1,000 years. Boron is the only constituent included because it has a K_d of less than 4.6, and no Hanford background value has been established. All other site nonradionuclide COPCs were undetected, quantified below background levels, or have a K_d greater than or equal to 4.6. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (μg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720 (3)(a)(ii)(A), (1996) x 100 x 1 mg/1000 μg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii) (A) (1996). For example, the maximum value for boron of 1.7 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 5.3×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be 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 cumulative HQ for the 100-N-91 waste site is 5.3×10^{-3}. 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, and then multiplied by 1×10^{-6}. There were not any constituents in this calculation that had a carcinogenic RAG associated with it. Therefore, the requirement of $<1 \times 10^{-6}$ is met. Furthermore, the criterion for cumulative excess cancer risk for carcinogens is also met.

4) The soil cleanup RAGs for protection of groundwater are based on the "100 times" provision in WAC 173-340-740(3)(a)(ii)(A). WAC 173-340-740(3)(a)(ii)(A) (1996) provides the "100 times rule" but also states "unless it can be demonstrated that a higher soil concentration is protective of ground water at the site." When the "100 times rule" values are exceeded, RESRAD was used to demonstrate that higher soil concentrations may be protective of groundwater.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	03/18/14	Calc. No.:	0100N-CA-V0259	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	03/18/14
Subject:	100-N-91 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	3 of 3

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 x 10^{-6}: None
4) List the cumulative excess cancer risk for carcinogens >1 x 10^{-5}: None.

Table 1 shows the results of the calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-N-91 Waste Site.

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.7	320	5.3E-03	--	--
Totals					
Cumulative Hazard Quotient:			**5.3E-03**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2014).
[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-N-91 waste site meets the requirements for the hazard quotients and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2013).

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2014b). This DQA was performed in accordance with site-specific data quality objectives found in the *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites* (100-N Area SAP) (DOE-RL 2006).

A review of the sample design (WCH 2014b), the field logbook (WCH 2014a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the 100-N Area SAP (DOE-RL 2006) data assurance requirements and the data validation procedure for chemical analysis (BHI 2000) is used as appropriate. 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). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification data from samples collected at the 100-N-91 waste site was provided by the laboratory in one sample delivery group (SDG), JP0729. SDG JP0729 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-N-91 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MINOR DEFICIENCIES

SDG JP0729

This SDG comprises one focused soil sample (J1T919) and one duplicate sample (J1T920) collected from the 100-N-91 excavation area. These samples were analyzed for inductively coupled plasma (ICP) metals and mercury. In addition, one equipment blank (J1T921) was collected and also analyzed for ICP metals and mercury. SDG JP0729 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP metals analysis, matrix spike recoveries for antimony (53%) and silicon (21%) are outside the quality control (QC) limits. Additionally, the laboratory control sample recovery for silicon (12%) is also outside the QC limits. Third-party validation qualified all antimony and silicon results in SDG JP0729 as estimated with "J" flags.

In the ICP metals analysis, the relative percent differences (RPDs) calculated for cadmium (170%), manganese (109%), and zinc (180%) are above the QC limit. Third-party validation qualified all cadmium, manganese, and zinc results in SDG JP0729 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies in those calculations are reported by SDG in the previous sections.

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2014a), are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

Table D-1. Field Quality Assurance/Quality Control Samples.

Sample Area	Main Sample	Duplicate Sample
100-N-91 Excavation	J1T919	J1T920

Field duplicate samples are 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 sample/duplicate pair(s) for each contaminant of potential concern. The RPDs are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit. The RPDs of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation. Minor deficiencies for the field duplicates are as follows.

The RPDs calculated for barium (76.9%), calcium (78.2%), chromium (76.2%), magnesium (80.4%), silicon (66.7%), and vanadium (75.7%) for the field duplicate sample are above the acceptance criteria (30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit, including undetected analytes. In these cases, a control limit of ±2 times the target detection limit is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. Duplicate evaluations for aluminum, barium, calcium, iron, manganese, silicon, vanadium, and zinc required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-N-91 waste site verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for the 100-N-91 waste site data set concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

The verification sample analytical data are stored in the Washington Closure Hanford project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix C.

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