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

14-AMRP-0240

JUL 16 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-54, 151-N BUILDING DRYWELL WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-055 and supporting, "Remaining Sites Verification Package for the 100-N-54, 151-N Building Drywell Waste Site," 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.:** 2014-055

Waste Site Code(s)/Subsite Code(s): 100-N-54

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-N-54, 151-N Building Drywell waste site, part of the 100-NR-1 Operable Unit, was 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 candidate site for confirmatory sampling by 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). Confirmatory samples collected in December 2005 from the soil underlying the former drywell exceeded direct exposure remedial action goals (RAGs) for multiple polycyclic aromatic hydrocarbons. Based on the confirmatory sampling results, the 100-N-54 waste site was subsequently recommended for remove, treat, and dispose.

The 100-N-54 waste site consisted of the soil below a former drywell that received discharges from the former 151-N Electrical Substation. The drywell was located immediately south of the 151-N facility, which was a single-story concrete block building that housed switchgear equipment and included a single-level basement for cable spreading. The 100-N-54 drywell was a 1.65-m (5.5-ft)-outer diameter concrete pipe with a steel cover. The drywell received discharges from a service sink and a shallow basement sump in the 151-N Building. The building was demolished and removed in December 2005, including incidental removal of the drywell.

Remedial action at the 100-N-54 waste site was conducted on November 4, 2013, and on March 4 and 5, 2014. The remediation resulted in a total of approximately 426 bank cubic meters (558 bank cubic yards) of soil and debris being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). The excavation extended to a final remediation depth of 3 m (9.8 ft) below ground surface. No overburden pile or waste staging pile area was created. No anomalous material or soil staining was encountered during the waste site remediation. Cleanup verification sampling was performed on January 14, 2014, and on March 5, 2014.

Cleanup verification sampling was conducted to determine if the waste site met the remedial action objectives (RAOs) and RAGs established by the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (100-N Area RDR/RAWP), DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2013), and the 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, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification of Interim Closed Out.

Basis for reclassification:

The verification sampling results for the 100-N-54 waste site demonstrate that the site meets the RAOs and corresponding RAGs established in the 100-N Area RDR/RAWP (DOE-RL 2013) and the 100-N Area ROD (EPA 1999) and support a reclassification to Interim Closed Out. These sampling results established 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. Residual 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-54, 151-N Building Drywell Waste Site* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-055

Waste Site Code(s)/Subsite Code(s): 100-N-54

Regulator comments:

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	J P Neath	6/23/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard KIM WELSCH FOR	Kim Welsch FOR	6/26/14
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-54, 151-N BUILDING DRYWELL WASTE SITE

Attachment to Waste Site Reclassification Form 2014-055

July 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-54, 151-N BUILDING DRYWELL WASTE SITE

EXECUTIVE SUMMARY

The 100-N-54, 151-N Building Drywell waste site, part of the 100-NR-1 Operable Unit, consisted of a drywell removed during demolition of the adjacent 151-N Electrical Substation in December 2005. During site operations, the drywell received discharges from a service sink and floor sump at the 151-N facility. The 100-N-54 waste site was 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 candidate site for confirmatory sampling by 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).

Confirmatory samples were collected from soil underlying the former drywell on December 28, 2005. The confirmatory sample results failed to meet direct exposure remedial action goals (RAGs) for multiple polycyclic aromatic hydrocarbons (PAH); therefore, the site was recommended for remedial action (WCH 2006a).

Remedial action at the 100-N-54 waste site was initially conducted on November 4, 2013. The excavation extended to approximately 2 m (6.6 ft) below ground surface (bgs) resulting in approximately 80 bank cubic meters (BCM) (105 bank cubic yards [BCY] of soil and debris (transite conduit, concrete, and electrical wire) being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). All material was direct loaded from the waste site; therefore, no waste staging pile area was created. No overburden material was removed from the waste site for use as backfill. No anomalous material or staining was observed during remediation.

Following remediation, verification soil sampling was conducted on January 14, 2014. Several PAH and semivolatile organic compounds (SVOCs) were detected above direct exposure RAGs; therefore, additional remediation was conducted on March 4 and 5, 2014. An additional 346 BCM (453 BCY) of soil was removed from the excavation resulting in a final remediation depth of 3 m (9.8 ft) and a total of 426 BCM (558 BCY) of soil and debris being removed and disposed at the ERDF. Replacement verification sampling was conducted on March 5, 2014. A summary of the cleanup evaluation for the soil sampling results against the applicable RAGs is presented in Table ES-1. The results of the verification sampling were used to make reclassification decisions for the 100-N-54 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-54 Waste Site.

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-54 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual direct exposure COPC 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 molybdenum, the only contaminant detected above background levels, is 7.5×10^{-4}, which is <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The hazard quotient for molybdenum, the only contaminant detected above background levels, is 7.5×10^{-4}, which is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	No carcinogenic constituents met the criteria for excess cancer risk evaluation; therefore, no calculations were performed.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.		
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 100-N-54 site.	NA
	Attain National Primary Drinking Water Regulations [a]: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	All individual COPC concentrations are below the groundwater and Columbia River cleanup requirements.	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 Area, 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).

COPC = contaminant of potential concern
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal

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 RAGs 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). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The sampling results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft] deep), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Residual 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.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based in part 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-54 waste site contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* 173-340 were exceeded for vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of manganese and vanadium are below the Hanford Site background values, 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 part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-54, 151-N BUILDING DRYWELL WASTE SITE

STATEMENT OF PROTECTIVENESS

The 100-N-54 waste site cleanup verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives 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 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. Residual 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.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based in part 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-54 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340 were exceeded for vanadium. The U.S. Environmental Protection Agency's (EPA's) ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of manganese and vanadium are below the Hanford Site background values, it is believed that the presence of these constituents does 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 part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-N-54 waste site, part of the 100-NR-1 Operable Unit, consisted of the soil below a former drywell that received discharges from the former 151-N Electrical Substation. The drywell was located immediately south of the 151-N facility, approximately 130 m (430 ft) southeast of the 109-N Building (Figure 1). The 151-N facility was a single-story concrete block building housing switchgear equipment with a single-level basement used for cable spreading. The 100-N-54 drywell was a 1.2-m (4-ft)-inner diameter, 1.65-m (5.5-ft) maximum outer diameter concrete pipe with a steel cover. The drywell received discharges from a service sink and a shallow basement sump in the 151-N Building. The building was demolished and completely removed in December 2005, including incidental removal of the 100-N-54 drywell. Following demolition activities, excavation boundaries were surveyed (Figure 2) and the site was temporarily backfilled.

Figure 1. 100-N-54 Waste Site Location Map.

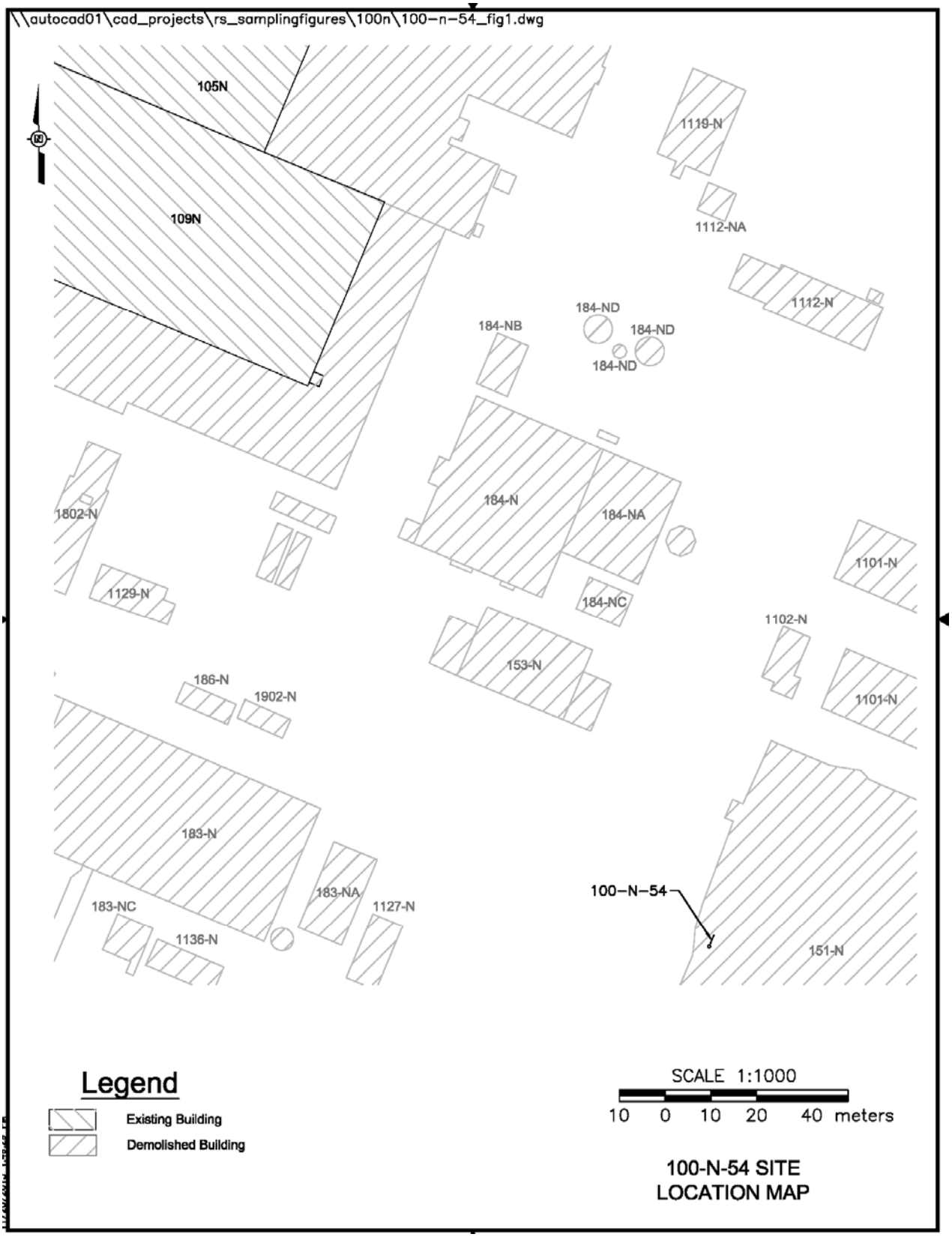
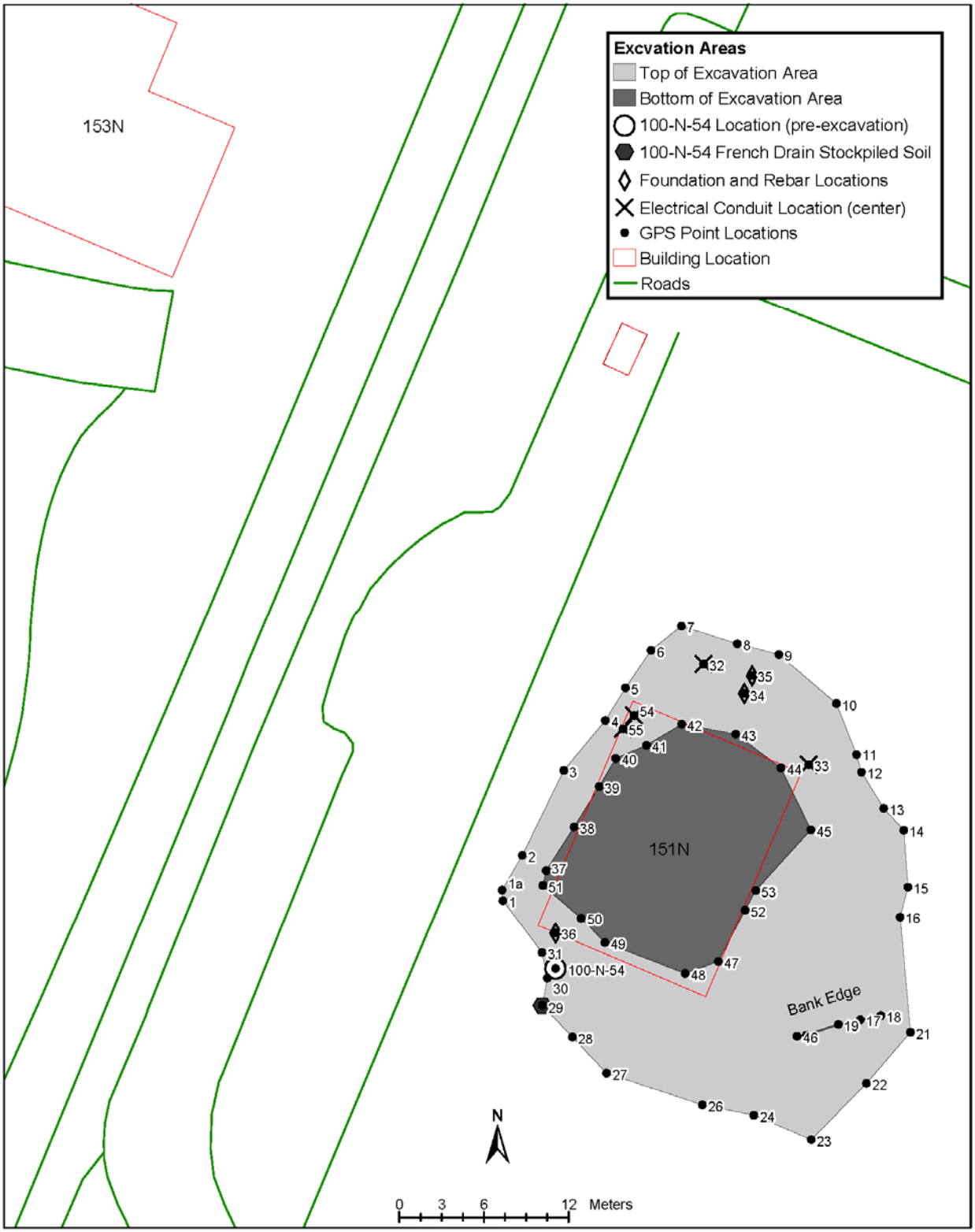


Figure 2. 151-N Demolition Boundary Survey, December 2005.



CONFIRMATORY SAMPLING ACTIVITIES

Contaminants of Potential Concern

The COPCs for confirmatory sampling were identified based on consideration of the wastes potentially discharged to the 100-N-54 drywell. The COPC list identified in the *Sampling and Analysis Instruction to Support Demolition of the 151-N and 153-N Facilities* (WCH 2006c) includes inductively coupled plasma (ICP) metals, mercury, semivolatile organic compounds, and polychlorinated biphenyls (PCBs).

While not considered COPCs, the potential presence of volatile organic compounds (VOCs) was evaluated by field screening with an organic vapor monitor during confirmatory sampling activities. No VOCs were detected at the 100-N-54 site, and no further laboratory analysis was performed. Similarly, field screening for radionuclides was performed using instrumentation capable of detecting alpha, beta, and gamma radiation. No radiological activity was detected above background (WCH 2006b), and no further radionuclide analysis was performed.

Confirmatory Sample Design and Sample Results

Process knowledge and site visit observations were used to develop a post-demolition site-specific sample design for the 100-N-54 waste site (WCH 2006c). Since discharges to the drywell would migrate vertically from the open base of the drywell, focused sampling at the base of the drywell (following removal of the structure) was used to evaluate residual soils. On December 28, 2005, one primary and one duplicate sample were collected from the soil underlying the former drywell. The results exceeded direct exposure RAGs for multiple polycyclic aromatic hydrocarbons (PAH); therefore, the site was recommended for remedial action (WCH 2006a). The confirmatory sampling summary and results are provided in Appendix B.

REMEDIAL ACTION SUMMARY

Remedial action at the 100-N-54 waste site was conducted on November 4, 2013. The excavation extended to approximately 2 m (6.6 ft) below ground surface (bgs) resulting in approximately 80 bank cubic meters (BCM) (105 bank cubic yards [BCY]) of soil and debris (transite conduit, concrete, and electrical wire) being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). Photographs of the waste site during remediation are provided in Figures 3 and 4. Additional remediation was conducted on March 4 and 5, 2014, due to several (PAH) and semivolatile organic compounds (SVOCs) exceeding direct exposure remedial action goals (RAGs). An additional 346 BCM (453 BCY) of soil was removed from the excavation. The final remediation depth was approximately 3 m (9.8 ft) bgs, and a total of 426 BCM (558 BCY) of soil and debris was removed and disposed at the ERDF. All material was direct loaded from the waste site; therefore, no waste staging pile area was created.

Figure 3. Photograph of the 100-N-54 Waste Site at the Start of Remediation (November 4, 2013).

Figure 4. Photograph of the 100-N-54 Waste Site During Remediation (November 4, 2013).

No overburden material was removed from the waste site for use as backfill. No anomalous material or staining was observed during remediation. The post-remediation boundary survey is provided in Figure 5.

One in-process soil sample was collected from the site following remedial action activities. The in-process sample summary and the results are provided in Appendix B.

VERIFICATION SAMPLING ACTIVITIES

Verification soil sampling was conducted on January 14, 2014, per the *Work Instruction for Verification Sampling of the 100-N-54, 151-N Building Drywell* (WCH 2014b). Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100-N Area RDR/RAWP (DOE-RL 2013) and 100-N Area ROD (EPA 1999). Because several PAH and SVOCs were detected above direct exposure RAGs, additional remediation was conducted and replacement samples were collected on March 5, 2014.

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 RAGs for the 100-N-54 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.

Contaminants of Potential Concern

The COPCs for verification sampling at the 100-N-54 waste site were determined based on the confirmatory sampling results (Appendix B). Because copper, lead, aroclor-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected above a RAG in the confirmatory samples, they were retained as site COPCs for verification sampling. Although not considered site COPCs, analysis for mercury was requested, and antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc were included in the expanded list of ICP metals analysis.

No VOCs or radiological activity were detected at the 100-N-54 site during confirmatory sampling; therefore, VOCs and radionuclides were not considered COPCs for verification sampling.

The analytical methods that were performed to evaluate the site COPCs are provided in Table 1.

Figure 5. 100-N-54 Post-Remediation Boundary Survey.

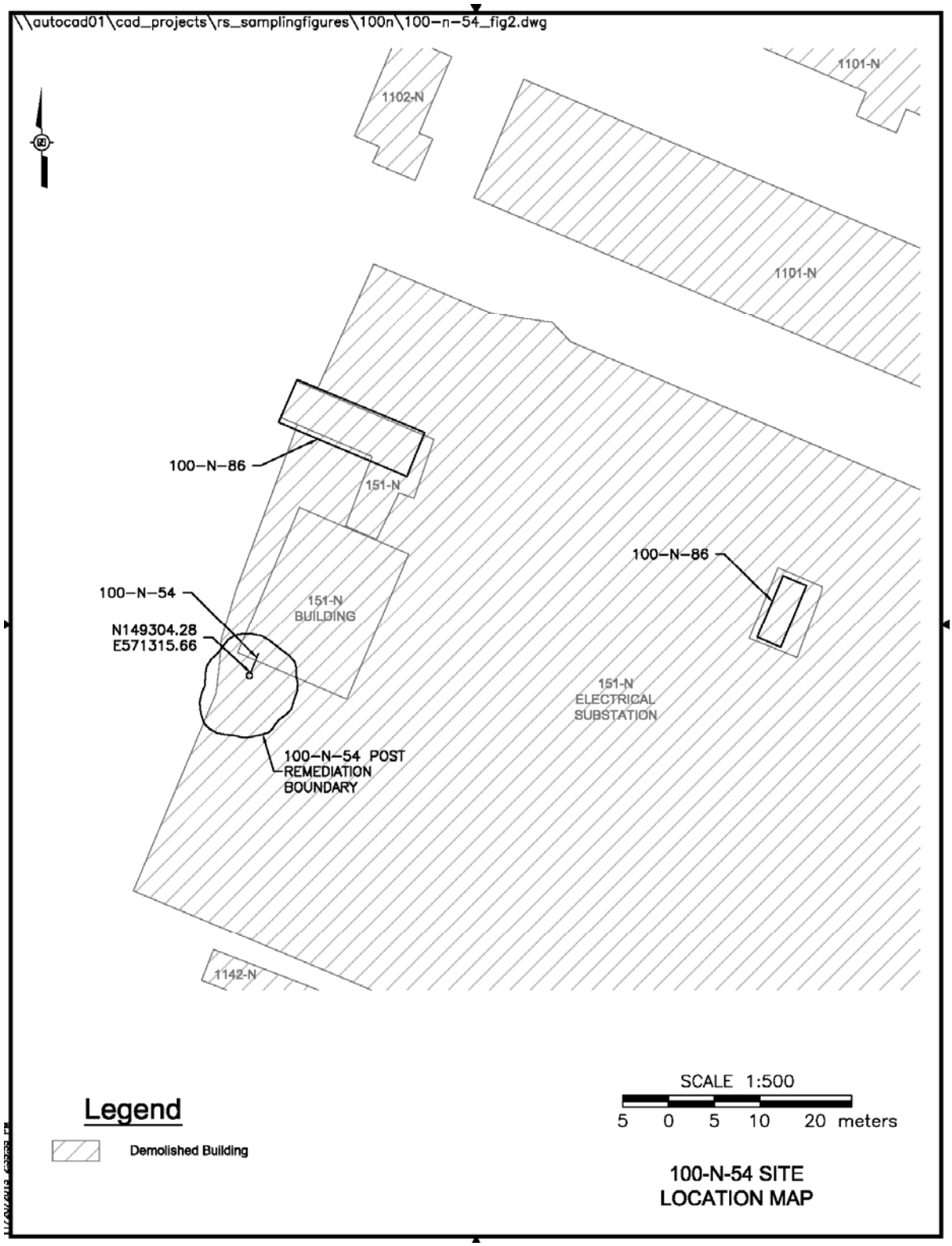


Table 1. Laboratory Analytical Methods for the 100-N-54 Waste Site.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Copper, lead
Mercury – EPA Method 7471	Mercury
PAH – EPA Method 8310	Polycyclic aromatic hydrocarbons
PCBs – EPA Method 8082	Aroclor-1260
SVOA – EPA Method 8270	Carbazole

[a] The expanded list of ICP metals included 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
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis

Verification Sample Design

A focused sample design was used for verification sampling at the 100-N-54 waste site. One discrete focused sample, one duplicate, and one split sample were collected from the waste site at the location where the pipeline from the 151-N Building entered the drywell.

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). 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. Figure 6 shows the overall waste site footprint and the sampling location.

Verification Sample Results

All verification samples were analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 100-N-54 waste site was performed by direct comparison of the maximum sample results for each COPC against the cleanup criteria.

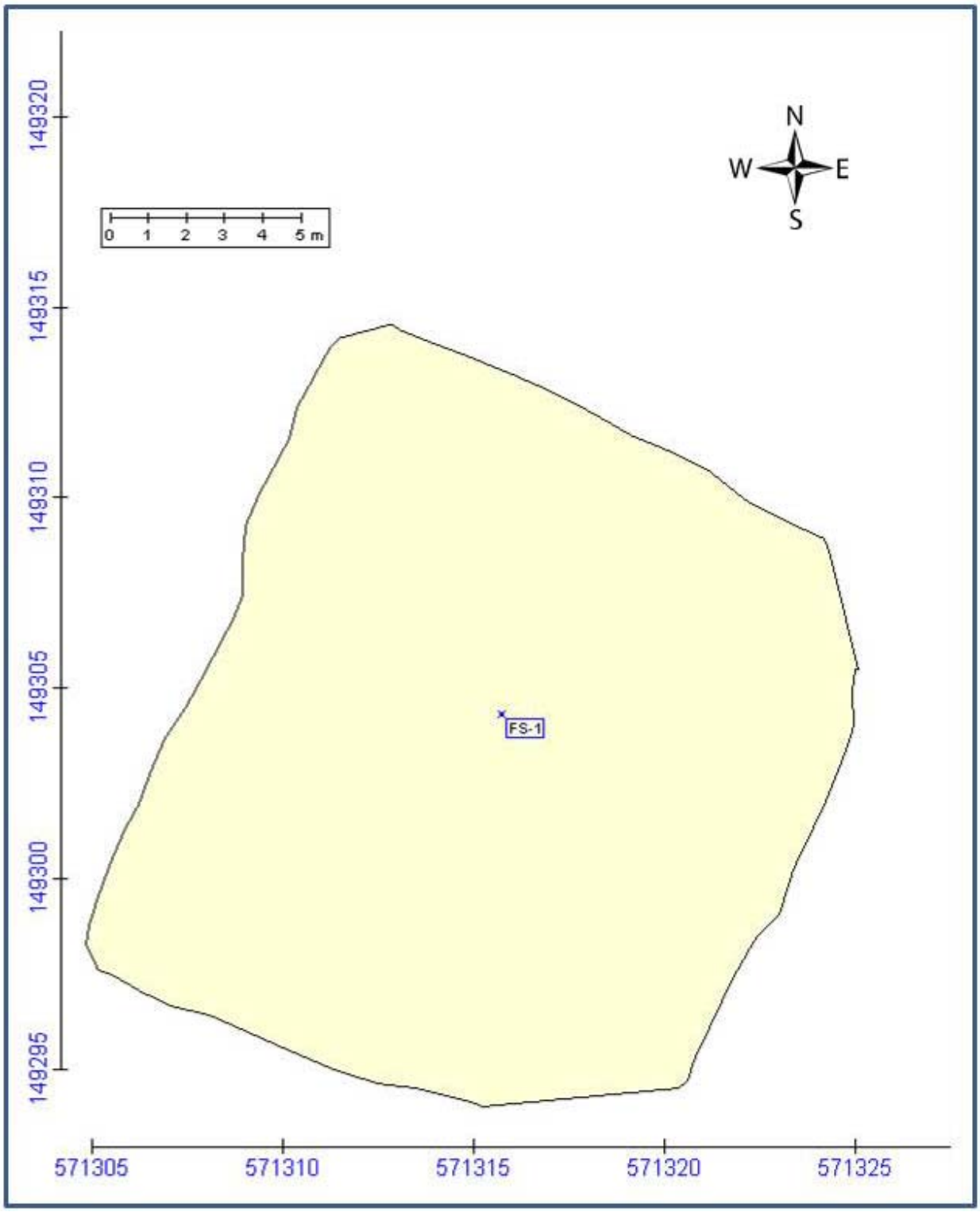
Table 2. 100-N-54 Waste Site Verification Sample Summary Table.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
FS-1 [a]	J1TFC9	149304.3	571315.7	ICP metals [b], mercury, PAH, PCBs, SVOA
Duplicate of FS-1	J1TFD0	149304.3	571315.7	
Split of FS-1	J1TFD1	149304.3	571315.7	

[a] One discrete grab sample was collected at the point where the pipeline from the 151-N Building entered the drywell.
[b] Analysis for the expanded list of ICP metals included 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
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis

Figure 6. 100-N-54 Waste Site Verification Sample Location.



Comparisons of the results for each COPC from the 100-N-54 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 95% upper confidence limit calculations (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-N-54 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 values for the 100-N-54 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, groundwater, and river protection soil RAGs.

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. Because there were no statistical verification samples for the 100-N-54 waste site, this test is not applicable.

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-54 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. The noncarcinogenic hazard quotient for molybdenum, the only constituent subject to the noncarcinogenic calculation, is 7.5×10^{-4}, which is less than 1.0. No carcinogenic constituents met the criteria for evaluation at the 100-N-54 waste site; therefore, no carcinogenic risk calculations were performed. The 100-N-54 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).

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-N-54 Waste Site Verification Samples.

COPC	Maximum Result [b] (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	1.7 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	43.5 (<BG)	16,000	200	400	No	--
Cadmium [d]	0.075 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium	3.3 (<BG)	120,000	18.5 [c]	18.5 [c]	No	--
Cobalt	8.6 (<BG)	1,600	32	-- [f]	No	--
Copper	20.5 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	2.5 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	264 (<BG)	11,200	512 [c]	-- [f]	No	--
Molybdenum [g]	0.30	400	8	-- [f]	No	--
Nickel	7.1 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	56.9 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	39.5 (<BG)	24,000	480	67.8 [c]	No	--

[a] RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2013).
[b] Maximum results as described in the *100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations* (Appendix C).
[c] 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).
[d] Hanford Site-specific background not available. Value is Washington State background from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[e] 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]).
[f] 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]).
[g] No Hanford Site-specific or Washington State background value available.

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

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-N-54 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 RESidual RADioactivity (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 12 m (39 ft) in thickness, a distribution coefficient of 6.1 or greater is required to show no predicted migration to groundwater in 1,000 years. No noncarcinogenic or carcinogenic constituents met the criteria for groundwater protection evaluation at the 100-N-54 waste site; therefore, no hazard quotient or excess carcinogenic risk calculations were performed.

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 for the 100-N-54 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 a WCH project-specific database for data evaluation prior to archival in the HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-N-54 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-54 waste site to Interim Closed Out. Residual 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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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-N-54 Waste Site [a].

Hazardous Substance		2001 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg)							
Manganese	512	1,100 [d]	NA	1,500	220	450	4,300	4,000	264 (<BG)
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	56.9 (<BG)

NOTE: Shaded cells indicate screening values that are exceeded.

[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.

BG = background
EPA = U.S. Environmental Protection Agency
NA = not available
WAC= *Washington Administrative Code*

APPENDIX B

CONFIRMATORY AND IN-PROCESS SAMPLING RESULTS

APPENDIX B

CONFIRMATORY AND IN-PROCESS SAMPLING RESULTS

CONFIRMATORY SAMPLING ACTIVITIES

Confirmatory samples were collected from the soil underlying the former drywell on December 28, 2005. The confirmatory sampling summary is presented in Table B-1. The sample results are presented in Table B-2.

Table B-1. Confirmatory Sample Summary for the 100-N-54 Waste Site.

Sample Location	Sample Media	Sample Number	Coordinate Locations	Depth (Estimate, bgs)	Sample Analysis
Beneath former drywell	Soil	J10W42	N 149304 E 571316	1.2 m (4 ft)	ICP metals, mercury, SVOA, and PCBs
Field duplicate (beneath former drywell)		J10W43			
Equipment blank	Silica sand	J10W41	NA	NA	ICP metals, mercury, SVOA, and PCBs

Source: WCH, 2006, *Miscellaneous Sampling*, Logbook EL-1516-8, Washington Closure Hanford, Richland, Washington.

bgs = below ground surface
ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis

Table B-2. 100-N-54 Confirmatory Sample Results. (3 pages)

Sample Number	Sample Date	Sample Area	Northing	Easting	Antimony			Arsenic			Barium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J10W41	12/28/2005	Equipment blank	NA	NA	0.37	U	0.37	0.315	U	0.315	1.8		0.02
J10W42	12/28/2005	Soil below former drywell	Not recorded	Not recorded	0.465		0.42	1.3		0.36	117		0.02
J10W43	12/28/2005	Duplicate of J10W42	Not recorded	Not recorded	0.315	U	0.315	1.2		0.35	104		0.02

Sample Number	Sample Date	Sample Area	Northing	Easting	Beryllium			Boron			Cadmium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J10W41	12/28/2005	Equipment blank	NA	NA	0.024		0.009	0.25	U	0.25	0.065	U	0.065
J10W42	12/28/2005	Soil below former drywell	Not recorded	Not recorded	0.203		0.01	0.557		0.29	0.35		0.07
J10W43	12/28/2005	Duplicate of J10W42	Not recorded	Not recorded	0.247		0.01	0.578		0.28	0.285		0.07

Sample Number	Sample Date	Sample Area	Northing	Easting	Chromium			Copper			Lead		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J10W41	12/28/2005	Equipment blank	NA	NA	0.179		0.15	0.349		0.11	0.455		0.29
J10W42	12/28/2005	Soil below former drywell	Not recorded	Not recorded	8.8		0.17	54.7		0.13	11.1		0.33
J10W43	12/28/2005	Duplicate of J10W42	Not recorded	Not recorded	4.5		0.16	34.9		0.12	6.3		0.32

Sample Number	Sample Date	Sample Area	Northing	Easting	Lithium			Manganese			Nickel		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J10W41	12/28/2005	Equipment blank	NA	NA	0.249		0.03	8.9		0.02	0.12	U	0.12
J10W42	12/28/2005	Soil below former drywell	Not recorded	Not recorded	3		0.03	287		0.02	12.1		0.14
J10W43	12/28/2005	Duplicate of J10W42	Not recorded	Not recorded	3.2		0.03	302		0.02	6.8		0.13

Sample Number	Sample Date	Sample Area	Northing	Easting	Selenium			Silver			Sodium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J10W41	12/28/2005	Equipment blank	NA	NA	0.333	U	0.333	0.13	U	0.13	6.3		0.16
J10W42	12/28/2005	Soil below former drywell	Not recorded	Not recorded	0.381	U	0.381	0.161		0.15	130		0.18
J10W43	12/28/2005	Duplicate of J10W42	Not recorded	Not recorded	0.37	U	0.37	0.144	U	0.144	154		0.17

Sample Number	Sample Date	Sample Area	Northing	Easting	Thallium			Vanadium			Mercury		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J10W41	12/28/2005	Equipment blank	NA	NA	0.593	U	0.593	0.092		0.08	0.015	U	0.015
J10W42	12/28/2005	Soil below former drywell	Not recorded	Not recorded	0.676	U	0.676	40.5		0.1	0.106		0.02
J10W43	12/28/2005	Duplicate of J10W42	Not recorded	Not recorded	0.658	U	0.658	58.3		0.09	0.229		0.02

Table B-2. 100-N-54 Confirmatory Sample Results. (3 pages)

CONSTITUENT	CLASS	J10W41			J10W42			J10W43		
		Equipment Blank			Underlying Soil			Duplicate of J10W42		
		12/28/200			12/28/2005			12/28/2005		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	13	U	13	15	U	15	15	U	15
Aroclor-1221	PCB	13	U	13	15	U	15	15	U	15
Aroclor-1232	PCB	13	U	13	15	U	15	15	U	15
Aroclor-1242	PCB	13	U	13	15	U	15	15	U	15
Aroclor-1248	PCB	13	U	13	15	U	15	15	U	15
Aroclor-1254	PCB	13	U	13	15	U	15	15	U	15
Aroclor-1260	PCB	13	U	13	43		15	32		15
1,2,4-Trichlorobenzene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
1,2-Dichlorobenzene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
1,3-Dichlorobenzene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
1,4-Dichlorobenzene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2,4,5-Trichlorophenol	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
2,4,6-Trichlorophenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2,4-Dichlorophenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2,4-Dimethylphenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2,4-Dinitrophenol	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
2,4-Dinitrotoluene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2,6-Dinitrotoluene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2-Chloronaphthalene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2-Chlorophenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2-Methylnaphthalene	SVOA	3300	UD	3300	21.818	J	370	2900	UD	2900
2-Methylphenol (cresol, o-)	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
2-Nitroaniline	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
2-Nitrophenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
3,3'-Dichlorobenzidine	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
3+4 Methylphenol (cresol, m+p)	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
3-Nitroaniline	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
4,6-Dinitro-2-methylphenol	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
4-Bromophenylphenyl ether	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
4-Chloro-3-methylphenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
4-Chloroaniline	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
4-Chlorophenylphenyl ether	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
4-Nitroaniline	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
4-Nitrophenol	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
Acenaphthene	SVOA	3300	UD	3300	55.507	J	370	1370.658	JD	2900
Acenaphthylene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Anthracene	SVOA	3300	UD	3300	113.029	J	370	2578.849	JD	2900
Benzo(a)anthracene	SVOA	3300	UD	3300	153.356	J	370	3537.816	D	2900
Benzo(a)pyrene	SVOA	3300	UD	3300	127.433	J	370	2687.839	JD	2900
Benzo(b)fluoranthene	SVOA	3300	UD	3300	79.285	J	370	2336.165	JD	2900
Benzo(ghi)perylene	SVOA	3300	UD	3300	74.57	J	370	1279.397	JD	2900
Benzo(k)fluoranthene	SVOA	3300	UD	3300	110.385	J	370	2010.066	JD	2900
Bis(2-chloro-1-methylethyl)ether	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Bis(2-Chloroethoxy)methane	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Bis(2-chloroethyl) ether	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Bis(2-ethylhexyl) phthalate	SVOA	17145.59	BD	3300	1467.126	B	370	1809.234	JBD	2900

Table B-2. 100-N-54 Confirmatory Sample Results. (3 pages)

CONSTITUENT	CLASS	J10W41			J10W42			J10W43		
		Equipment Blank			Underlying Soil			Duplicate of J10W42		
		12/28/200			12/28/2005			12/28/2005		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Butylbenzylphthalate	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Carbazole	SVOA	3300	UD	3300	41.048	J	370	1065.922	JD	2900
Chrysene	SVOA	3300	UD	3300	181.036	J	370	4153.102	D	2900
Dibenz[a,h]anthracene	SVOA	3300	UD	3300	24.814	J	370	609.036	JD	2900
Dibenzofuran	SVOA	3300	UD	3300	31.193	J	370	531.581	JD	2900
Diethyl phthalate	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Dimethyl phthalate	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Di-n-butylphthalate	SVOA	3300	UD	3300	25.701	JB	370	2900	UD	2900
Di-n-octylphthalate	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Fluoranthene	SVOA	3300	UD	3300	387.365		370	9205.879	D	2900
Fluorene	SVOA	3300	UD	3300	46.632	J	370	1038.021	JD	2900
Hexachlorobenzene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Hexachlorobutadiene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Hexachlorocyclopentadiene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Hexachloroethane	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Indeno(1,2,3-cd)pyrene	SVOA	3300	UD	3300	62.792	J	370	1191.334	JD	2900
Isophorone	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Naphthalene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Nitrobenzene	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
N-Nitroso-di-n-dipropylamine	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
N-Nitrosodiphenylamine	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Pentachlorophenol	SVOA	8300	UD	8300	920	U	920	7300	UD	7300
Phenanthrene	SVOA	3300	UD	3300	348.925	J	370	8328.289	D	2900
Phenol	SVOA	3300	UD	3300	370	U	370	2900	UD	2900
Pyrene	SVOA	3300	UD	3300	391.452		370	9238.574	D	2900

IN-PROCESS SAMPLING ACTIVITIES

One in-process soil sample was collected from the site following remedial action activities. The in-process sample summary is provided in Table B-3; the results are provided in Table B-4.

Table B-3. 100-N-54 Waste Site In-Process Sample Summary Table.

Sample Location	Sample Date	HEIS Sample Number	Washington State Plane		Sample Analysis
			Northing (m)	Easting (m)	
100-N-54	11-5-13	J1T582	N 149303.3	E 571313.8	ICP metals [a], mercury, PAH, PCBs, SVOA

[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
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis

Table B-4. 100-N-54 In-Process Sample Results. (2 pages)

Sample Number	Sample Date	Northing	Easting	Aluminum			Antimony			Arsenic			Barium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	8390	XM	1.5	0.36	U	0.36	5.5	M	0.63	76	XM	0.072

Sample Number	Sample Date	Northing	Easting	Beryllium			Boron			Cadmium			Calcium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	0.27	M	0.031	0.93	U	0.93	0.18	BM	0.039	13900	XMN	13.4

Sample Number	Sample Date	Northing	Easting	Chromium			Cobalt			Copper			Iron		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	13.7	XMN	0.055	7.9	X	0.095	20.4	XM	0.21	21100	X	3.6

Sample Number	Sample Date	Northing	Easting	Lead			Magnesium			Manganese			Molybdenum		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	6.5	M	0.26	6030	XMN	3.5	344	X	0.095	0.39	B	0.25

Sample Number	Sample Date	Northing	Easting	Nickel			Potassium			Selenium			Silicon		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	14.5	XM	0.12	1470	M	39.1	0.82	U	0.82	182	N	5.4

Sample Number	Sample Date	Northing	Easting	Silver			Sodium			Vanadium			Zinc		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	0.15	U	0.15	232		56.2	46.1	X	0.09	68	XN	0.38

Sample Number	Sample Date	Northing	Easting	Mercury			% Moisture (wet sample)		
				mg/kg	Q	PQL	%	Q	PQL
J1T582	11/5/2013	149303.3	571313.8	0.0054	U	0.0054	10.3		0

Table B-4. 100-N-54 In-Process Sample Results. (2 pages)

CONSTITUENT	CLASS	J1T582 11/5/2013		
		ug/kg	Q	PQL
Acenaphthene	PAH	11	U	11
Acenaphthylene	PAH	9.9	U	9.9
Anthracene	PAH	6.5	J	3.4
Benzo(a)anthracene	PAH	23	NX	3.5
Benzo(a)pyrene	PAH	29	X	7.1
Benzo(b)fluoranthene	PAH	26		4.6
Benzo(ghi)perylene	PAH	7.9	UN	7.9
Benzo(k)fluoranthene	PAH	7.4	JX	4.3
Chrysene	PAH	32	JX	5.3
Dibenz[a,h]anthracene	PAH	12	UN	12
Fluoranthene	PAH	67	N	14
Fluorene	PAH	5.8	U	5.8
Indeno(1,2,3-cd)pyrene	PAH	13	U	13
Naphthalene	PAH	13	U	13
Phenanthrene	PAH	34	JNX	13
Pyrene	PAH	71	N	13
Aroclor-1016	PCB	3.1	U	3.1
Aroclor-1221	PCB	8.9	U	8.9
Aroclor-1232	PCB	2.2	U	2.2
Aroclor-1242	PCB	5.2	U	5.2
Aroclor-1248	PCB	5.2	U	5.2
Aroclor-1254	PCB	2.9	U	2.9
Aroclor-1260	PCB	15		2.9
1,2,4-Trichlorobenzene	SVOA	31	U	31
1,2-Dichlorobenzene	SVOA	24	U	24
1,3-Dichlorobenzene	SVOA	13	U	13
1,4-Dichlorobenzene	SVOA	15	U	15
2,4,5-Trichlorophenol	SVOA	11	U	11
2,4,6-Trichlorophenol	SVOA	11	U	11
2,4-Dichlorophenol	SVOA	11	U	11
2,4-Dimethylphenol	SVOA	73	U	73
2,4-Dinitrophenol	SVOA	370	U	370
2,4-Dinitrotoluene	SVOA	73	U	73
2,6-Dinitrotoluene	SVOA	31	U	31
2-Chloronaphthalene	SVOA	11	U	11
2-Chlorophenol	SVOA	23	U	23
2-Methylnaphthalene	SVOA	21	U	21
2-Methylphenol (cresol, o-)	SVOA	14	U	14
2-Nitroaniline	SVOA	55	U	55
2-Nitrophenol	SVOA	11	U	11
3,3'-Dichlorobenzidine	SVOA	100	U	100
3+4 Methylphenol (cresol, m+p)	SVOA	37	U	37
3-Nitroaniline	SVOA	81	U	81
4,6-Dinitro-2-methylphenol	SVOA	370	U	370
4-Bromophenylphenyl ether	SVOA	21	U	21
4-Chloro-3-methylphenol	SVOA	73	U	73
4-Chloroaniline	SVOA	91	U	91
4-Chlorophenylphenyl ether	SVOA	23	U	23

CONSTITUENT	CLASS	J1T582 11/5/2013		
		ug/kg	Q	PQL
4-Nitroaniline	SVOA	80	U	80
4-Nitrophenol	SVOA	110	U	110
Acenaphthene	SVOA	18	J	11
Acenaphthylene	SVOA	19	U	19
Anthracene	SVOA	43	J	19
Benzo(a)anthracene	SVOA	110	J	22
Benzo(a)pyrene	SVOA	91	J	22
Benzo(b)fluoranthene	SVOA	150	JK	29
Benzo(ghi)perylene	SVOA	49	J	18
Benzo(k)fluoranthene	SVOA	44	UK	44
Bis(2-chloro-1-methylethyl)ether	SVOA	25	U	25
Bis(2-Chloroethoxy)methane	SVOA	25	U	25
Bis(2-chloroethyl) ether	SVOA	18	U	18
Bis(2-ethylhexyl) phthalate	SVOA	320	J	51
Butylbenzylphthalate	SVOA	48	U	48
Carbazole	SVOA	40	U	40
Chrysene	SVOA	130	J	30
Dibenz[a,h]anthracene	SVOA	21	U	21
Dibenzofuran	SVOA	22	U	22
Diethylphthalate	SVOA	29	U	29
Dimethyl phthalate	SVOA	160	JB	25
Di-n-butylphthalate	SVOA	32	U	32
Di-n-octylphthalate	SVOA	16	U	16
Fluoranthene	SVOA	250	J	40
Fluorene	SVOA	20	U	20
Hexachlorobenzene	SVOA	32	U	32
Hexachlorobutadiene	SVOA	11	U	11
Hexachlorocyclopentadiene	SVOA	55	U	55
Hexachloroethane	SVOA	24	U	24
Indeno(1,2,3-cd)pyrene	SVOA	24	U	24
Isophorone	SVOA	19	U	19
Naphthalene	SVOA	34	U	34
Nitrobenzene	SVOA	24	U	24
N-Nitroso-di-n-dipropylamine	SVOA	34	U	34
N-Nitrosodiphenylamine	SVOA	23	U	23
Pentachlorophenol	SVOA	370	U	370
Phenanthrene	SVOA	170	J	19
Phenol	SVOA	20	U	20
Pyrene	SVOA	250	J	13

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 file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. These calculations has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The following calculation is provided in this appendix:

100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100N-CA-V0261, 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.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0261

Subject: 100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

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 = 3 Total = 9	J. D. Skoglie	I. B. Berezovskiy	H. M. Sulloway	D. F. Obenauer	6/16/14

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:	J. D. Skoglie	Date:	4/17/2014	Calc. No.:	0100N-CA-V026	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/17/2014
Subject:	100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 5	

PURPOSE:

Using sample data from Attachment 1 provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-N-54 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (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 primary-duplicate and primary-split sample pairs from 100-N-54 waste site verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2006a, *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-54, 151-N Building Drywell Waste Site*, Attachment to Waste Site Reclassification Form 2014-055, Washington Closure Hanford, 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:	J. D. Skoglie	Date:	4/17/2014	Calc. No.:	0100N-CA-V0261	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/17/2014
Subject:	100-N-54 Waste Site Relative Percent Difference (RPD) 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-duplicate sample pairs, as required.

METHODOLOGY:

The 100-N-54 waste site underwent verification focused sampling at four locations including a duplicate and a split sample. The direct contact hazard quotient and carcinogenic risk calculations for the 100-N-54 waste site were conservatively calculated using the maximum results from Attachment 1. Of the contaminants of potential concern (COPCs) and other analytes for this site, molybdenum requires HQ and risk calculations because this analyte was detected and a Washington State or Hanford Site background value is not available. 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 molybdenum is 0.30 mg/kg, divided by the noncarcinogenic RAG value of 400 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 7.5×10^{-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 for COPCs is 7.5×10^{-4}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. There were not any detected analytes with a carcinogenic RAG, therefore, all individual values meet the requirement of $<1 \times 10^{-6}$.

4) After these calculations are completed for the carcinogenic analytes, 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. There were not any detected analytes with a carcinogenic RAG, therefore, this site meets the requirement of $<1 \times 10^{-5}$.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2006a). Other analytes will have their own pre-determined constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/17/2014	Calc. No.:	0100N-CA-V0261	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/17/2014
Subject:	100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 5	

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

When an analyte is detected in the primary-duplicate or primary-split sample pair, 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 sample pair 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. 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 hazard quotient and excess cancer risk calculations for the 100-N-54 waste site.

5) The evaluation of the QA/QC duplicate 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-54 waste site.

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-N-54 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					
Molybdenum	0.30	400	7.5E-04	--	--
Totals					
Cumulative Hazard Quotient:			**7.5E-04**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From Attachment 1.

[b] = Value obtained from the 100-N Area 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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/17/2014	Calc. No.:	0100N-CA-V0261	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/17/2014
Subject:	100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 5	

Table 2. Relative Percent Difference Calculations for the 100-N-54 Waste Site. (2 pages)

Duplicate/Split Analysis - 100-N-54 Waste Site

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	4110	X	1.6	1.5		0.68	43.5		0.079	0.075	B	0.043
Duplicate of J1TFC9	J1TFD0	3/5/14	4850	X	1.6	1.7		0.67	42.2		0.077	0.074	B	0.042
Split of J1TFC9	J1TFD1	3/5/14	3460		6.90	1.26	B	0.507	38.9		0.101	0.487	B	0.101

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	16.5%		3.0%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable
Split 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	17.2%		11.2%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Yes - assess further

Duplicate/Split Analysis - 100-N-54 Waste Site

Sampling Area	Sample Number	Sample Date	Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	4540	X	14.6	3.3		0.060	8.6	X	0.10	14.3	X	0.23
Duplicate of J1TFC9	J1TFD0	3/5/14	4860	X	14.3	3.1		0.059	8.5	X	0.10	20.5	X	0.22
Split of J1TFC9	J1TFD1	3/5/14	4970		8.12	3.62		0.152	9.84	D	0.761	15.2		0.304

Analysis:

TDL					
		100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	6.8%			*35.6%*
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	9.0%			6.1%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

Duplicate/Split Analysis - 100-N-54 Waste Site

Sampling Area	Sample Number	Sample Date	Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	23600	X	3.9	2.5		0.28	3690	X	3.8	263	X	0.10
Duplicate of J1TFC9	J1TFD0	3/5/14	22500	X	3.9	2.4		0.27	3550	X	3.8	264	X	0.10
Split of J1TFC9	J1TFD1	3/5/14	25300		8.12	2.03	BD	1.67	3660		8.63	269		0.203

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	4.8%		3.9%	0.4%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable
Split 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	7.0%		0.8%	2.3%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

B = detected but below the reporting limit
D = dilution
FS = focused sample
J = estimate
MDA = minimal detectable activity
N = recovery exceeds upper or lower control limits
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/17/2014	Calc. No.:	0100N-CA-V0261	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/17/2014
Subject:	100-N-54 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 5	

Table 2. Relative Percent Difference Calculations for the 100-N-54 Waste Site. (2 pages)

Duplicate/Split Analysis - 100-N-54 Waste Site

Sampling Area	Sample Number	Sample Date	Nickel			Potassium			Silicon			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	7.1	X	0.13	528		42.5	198	J	5.9	280		61.2
Duplicate of J1TFC9	J1TFD0	3/5/14	6.9	X	0.12	529		41.6	209	J	5.7	416		59.9
Split of J1TFC9	J1TFD1	3/5/14	6.35		0.152	523		6.50	475	N	1.52	171		7.1

Analysis:

TDL		4	400	2	50
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD			5.4%	39.1%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD			82.3%	
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Yes - assess further

Duplicate/Split Analysis - 100-N-54 Waste Site

Sampling Area	Sample Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	56.9	X	0.097	39.5	X	0.41
Duplicate of J1TFC9	J1TFD0	3/5/14	54.5	X	0.095	38.6	X	0.40
Split of J1TFC9	J1TFD1	3/5/14	71.9	DN	0.507	44.1	D	2.03

Analysis:

TDL		2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)
	RPD	4.3%	2.3%
	Difference > 2 TDL?	Not applicable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)
	RPD	23.3%	11.0%
	Difference > 2 TDL?	Not applicable	Not applicable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-N-54 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2013) and SAP (DOE-RL 2006a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Attachment 1. 100-N-54 Waste Site Verification Sample Results (Metals).

Sample Area	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	4110	X	1.6	0.39	UJ	0.39	1.5		0.68	43.5		0.079	0.034	U	0.034
Duplicate of J1TFC9	J1TFD0	3/5/14	4850	X	1.6	0.39	UJ	0.39	1.7		0.67	42.2		0.077	0.034	U	0.034
Split of J1TFC9	J1TFD1	3/5/14	3460		6.90	1.67	DU	1.67	1.26	B	0.507	38.9		0.101	0.403	B	0.101

Sample Area	Sample Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	1.0	UN	1.0	0.075	B	0.043	4540	X	14.6	3.3		0.060	8.6	X	0.10
Duplicate of J1TFC9	J1TFD0	3/5/14	0.99	U	0.99	0.074	B	0.042	4860	X	14.3	3.1		0.059	8.5	X	0.10
Split of J1TFC9	J1TFD1	3/5/14	1.01	U	1.01	0.487	B	0.101	4970		8.12	3.62		0.152	9.84	D	0.761

Sample Area	Sample Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TFC9	3/5/14	14.3	X	0.23	23600	X	3.9	2.5		0.28	3690	X	3.8	263	X	0.10
Duplicate of J1TFC9	J1TFD0	3/5/14	20.5	X	0.22	22500	X	3.9	2.4		0.27	3550	X	3.8	264	X	0.10
Split of J1TFC9	J1TFD1	3/5/14	15.2		0.304	25300		8.12	2.03	BD	1.67	3660		8.63	269		0.203

Sample Area	Sample Number	Sample Date	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
FS-1	J1TFC9	3/5/14	0.0065	UN	0.0065	0.27	U	0.27	7.1	X	0.13	528		42.5	0.89	U	0.89
Duplicate of J1TFC9	J1TFD0	3/5/14	0.0052	UN	0.0052	0.30	B	0.26	6.9	X	0.12	529		41.6	0.87	U	0.87
Split of J1TFC9	J1TFD1	3/5/14	0.00374	U	0.00374	0.203	U	0.203	6.35		0.152	523		6.50	0.330	DU	0.330

Sample Area	Sample 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
FS-1	J1TFC9	3/5/14	198	J	5.9	0.17	U	0.17	280		61.2	56.9	X	0.097	39.5	X	0.41
Duplicate of J1TFC9	J1TFD0	3/5/14	209	J	5.7	0.16	U	0.16	416		59.9	54.5	X	0.095	38.6	X	0.40
Split of J1TFC9	J1TFD1	3/5/14	475	N	1.52	0.578		0.101	171		7.1	71.9	DN	0.507	44.1	D	2.03

Sample Area	Sample Number	Sample Date	Percent Moisture (wet)		
			%	Q	PQL
FS-1	J1TFC9	3/5/14	5.5		0.10
Duplicate of J1TFC9	J1TFD0	3/5/14	5.3		0.10

Grey cells indicate not applicable or data will not be used.

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

Note: Data qualified with B, C, J and/or X are considered acceptable values.

B = blank contamination (inorganic constituents)

D = reported from a dilution

HEIS = Hanford Environmental Information System

FS = focused sample

J = estimate

MDA = minimal detectable activity

N = recovery exceeds upper or lower control limits

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyls

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

SVOA = semivolatile organic analysis

T = spike and/or spike duplicate sample recovery is outside control limits.

X = serial dilution in the analytical batch indicates that physical and chemical interferences are present

U = undetected

Attachment	1	Sheet No.	1 of 3
Originator	J. D. Skoglie	Date	04/17/14
Checked	I. B. Berezovskiy	Date	04/17/14
Calc. No.	0100N-CA-V0261	Rev. No.	0

Attachment 1. 100-N-54 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	FS-1 - J1TFC9			Duplicate of J1TFC9 - J1TFD0			Split of J1TFC9 - J1TFD1		
		3/5/14			3/5/14			3/5/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.7	UJ	9.7	10	UJ	10	5.25	U	5.25
Acenaphthylene	PAH	8.7	UJ	8.7	9.4	UJ	9.4	5.25	U	5.25
Anthracene	PAH	3.0	UJ	3.0	3.2	UJ	3.2	1.75	UT	1.75
Benzo(a)anthracene	PAH	3.1	UJ	3.1	3.3	UJ	3.3	0.560	U	0.560
Benzo(a)pyrene	PAH	6.2	UJ	6.2	6.7	UJ	6.7	0.560	U	0.560
Benzo(b)fluoranthene	PAH	4.1	UJ	4.1	4.4	UJ	4.4	0.560	U	0.560
Benzo(ghi)perylene	PAH	7.0	UJ	7.0	7.6	UJ	7.6	0.560	U	0.560
Benzo(k)fluoranthene	PAH	3.8	UJ	3.8	4.1	UJ	4.1	0.280	U	0.280
Chrysene	PAH	4.7	UJ	4.7	5.1	UJ	5.1	0.560	U	0.560
Dibenz[a,h]anthracene	PAH	11	UJ	11	12	UJ	12	0.560	U	0.560
Fluoranthene	PAH	13	UJ	13	14	UJ	14	0.560	U	0.560
Fluorene	PAH	5.1	UJ	5.1	5.5	UJ	5.5	5.25	UT	5.25
Indeno(1,2,3-cd)pyrene	PAH	12	UJ	12	13	UJ	13	0.560	U	0.560
Naphthalene	PAH	12	UJ	12	13	UJ	13	5.25	U	5.25
Phenanthrene	PAH	12	UJ	12	13	UJ	13	5.25	U	5.25
Pyrene	PAH	12	UJ	12	13	UJ	13	0.560	U	0.560
Aroclor-1016	PCB	2.8	UJ	2.8	2.9	UJ	2.9	1.17	U	1.17
Aroclor-1221	PCB	8.0	UJ	8.0	8.5	UJ	8.5	1.17	U	1.17
Aroclor-1232	PCB	2.0	UJ	2.0	2.1	UJ	2.1	1.17	U	1.17
Aroclor-1242	PCB	4.7	UJ	4.7	4.9	UJ	4.9	1.17	U	1.17
Aroclor-1248	PCB	4.7	UJ	4.7	4.9	UJ	4.9	1.17	U	1.17
Aroclor-1254	PCB	2.6	UJ	2.6	2.7	UJ	2.7	1.17	U	1.17
Aroclor-1260	PCB	2.6	UJ	2.6	2.7	UJ	2.7	1.17	U	1.17
1,2,4-Trichlorobenzene	SVOA	29	UJ	29	28	UJ	28	105	U	105
1,2-Dichlorobenzene	SVOA	23	UJ	23	22	UJ	22	105	U	105
1,3-Dichlorobenzene	SVOA	12	UJ	12	12	UJ	12	105	U	105
1,4-Dichlorobenzene	SVOA	14	UJ	14	14	UJ	14	105	U	105
2,4,5-Trichlorophenol	SVOA	10	UJ	10	10	UJ	10	105	U	105
2,4,6-Trichlorophenol	SVOA	10	UJ	10	10	UJ	10	105	U	105
2,4-Dichlorophenol	SVOA	10	UJ	10	10	UJ	10	105	U	105
2,4-Dimethylphenol	SVOA	68	UJ	68	67	UJ	67	105	U	105
2,4-Dinitrophenol	SVOA	340	UJ	340	340	UJ	340	105	U	105
2,4-Dinitrotoluene	SVOA	68	UJ	68	67	UJ	67	105	U	105
2,6-Dinitrotoluene	SVOA	29	UJ	29	28	UJ	28	105	U	105
2-Chloronaphthalene	SVOA	10	UJ	10	10	UJ	10	10.5	U	10.5
2-Chlorophenol	SVOA	22	UJ	22	21	UJ	21	105	U	105
2-Methylnaphthalene	SVOA	20	UJ	20	19	UJ	19	10.5	U	10.5
2-Methylphenol (cresol, o-)	SVOA	13	UJ	13	13	UJ	13	105	U	105
2-Nitroaniline	SVOA	52	UJ	52	51	UJ	51	116	U	116
2-Nitrophenol	SVOA	10	UJ	10	10	UJ	10	105	U	105
3,3'-Dichlorobenzidine	SVOA	93	UJ	93	91	UJ	91	105	U	105
3+4 Methylphenol (cresol, m+p)	SVOA	34	UJ	34	34	UJ	34	105	U	105
3-Nitroaniline	SVOA	75	UJ	75	74	UJ	74	105	U	105

Attachment	1	Sheet No.	2 of 3
Originator	J. D. Skoglie	Date	04/17/14
Checked	I. B. Berezovskiy	Date	04/17/14
Calc. No.	0100N-CA-V0261	Rev. No.	0

Attachment 1. 100-N-54 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	FS-1 - J1TFC9			Duplicate of J1TFC9 - J1TFD0			Split of J1TFC9 - J1TFD1		
		3/5/14			3/5/14			3/5/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
4,6-Dinitro-2-methylphenol	SVOA	340	UJ	340	340	UJ	340	105	U	105
4-Bromophenylphenyl ether	SVOA	20	UJ	20	19	UJ	19	105	U	105
4-Chloro-3-methylphenol	SVOA	68	UJ	68	67	UJ	67	140	U	140
4-Chloroaniline	SVOA	84	UJ	84	83	UJ	83	105	U	105
4-Chlorophenylphenyl ether	SVOA	22	UJ	22	21	UJ	21	105	U	105
4-Nitroaniline	SVOA	75	UJ	75	74	UJ	74	105	U	105
4-Nitrophenol	SVOA	100	UJ	100	98	UJ	98	105	U	105
Acenaphthene	SVOA	11	UJ	11	10	UJ	10	10.5	U	10.5
Acenaphthylene	SVOA	18	UJ	18	17	UJ	17	10.5	U	10.5
Anthracene	SVOA	18	UJ	18	17	UJ	17	10.5	U	10.5
Benzo(a)anthracene	SVOA	21	UJ	21	20	UJ	20	10.5	U	10.5
Benzo(a)pyrene	SVOA	21	UJ	21	20	UJ	20	10.5	U	10.5
Benzo(b)fluoranthene	SVOA	27	UJ	27	27	UJ	27	10.5	U	10.5
Benzo(ghi)perylene	SVOA	16	UJ	16	16	UJ	16	10.5	U	10.5
Benzo(k)fluoranthene	SVOA	41	UJ	41	41	UJ	41	10.5	U	10.5
Bis(2-chloro-1-methylethyl)ether	SVOA	24	UJ	24	23	UJ	23			
Bis(2-Chloroethoxy)methane	SVOA	24	UJ	24	23	UJ	23	105	U	105
Bis(2-chloroethyl) ether	SVOA	17	UJ	17	17	UJ	17	105	U	105
Bis(2-chloroisopropyl) ether	SVOA	24	UJ	24	23	UJ	23	105	U	105
Bis(2-ethylhexyl) phthalate	SVOA	47	UJ	47	47	UJ	47	105	U	105
Butylbenzylphthalate	SVOA	44	UJ	44	44	UJ	44	105	U	105
Carbazole	SVOA	37	UJ	37	37	UJ	37	10.5	U	10.5
Chrysene	SVOA	28	UJ	28	27	UJ	27	10.5	U	10.5
Dibenz[a,h]anthracene	SVOA	20	UJ	20	19	UJ	19	10.5	U	10.5
Dibenzofuran	SVOA	21	UJ	21	20	UJ	20	105	U	105
Diethyl phthalate	SVOA	27	UJ	27	26	UJ	26	105	U	105
Dimethyl phthalate	SVOA	24	UJ	24	23	UJ	23	105	U	105
Di-n-butylphthalate	SVOA	30	UJ	30	29	UJ	29	105	U	105
Di-n-octylphthalate	SVOA	15	UJ	15	15	UJ	15	105	U	105
Diphenylamine	SVOA							105	U	105
Fluoranthene	SVOA	37	UJ	37	37	UJ	37	10.5	U	10.5
Fluorene	SVOA	19	UJ	19	18	UJ	18	10.5	U	10.5
Hexachlorobenzene	SVOA	30	UJ	30	29	UJ	29	105	U	105
Hexachlorobutadiene	SVOA	10	UJ	10	10	UJ	10	105	U	105
Hexachlorocyclopentadiene	SVOA	52	UJ	52	51	UJ	51	105	U	105
Hexachloroethane	SVOA	22	UJ	22	22	UJ	22	105	U	105
Indeno(1,2,3-cd)pyrene	SVOA	23	UJ	23	22	UJ	22	10.5	U	10.5
Isophorone	SVOA	18	UJ	18	17	UJ	17	105	U	105
Naphthalene	SVOA	32	UJ	32	31	UJ	31	10.5	U	10.5
Nitrobenzene	SVOA	23	UJ	23	22	UJ	22	105	U	105
N-Nitroso-di-n-dipropylamine	SVOA	32	UJ	32	31	UJ	31	105	U	105
N-Nitrosodiphenylamine	SVOA	22	UJ	22	21	UJ	21			
Pentachlorophenol	SVOA	340	UJ	340	340	UJ	340	105	U	105
Phenanthrene	SVOA	18	UJ	18	17	UJ	17	10.5	U	10.5
Phenol	SVOA	19	UJ	19	18	UJ	18	105	U	105
Pyrene	SVOA	12	UJ	12	12	UJ	12	10.5	U	10.5

Attachment	1	Sheet No.	3 of 3
Originator	J. D. Skoglie	Date	04/17/14
Checked	I. B. Berezovskiy	Date	04/17/14
Calc. No.	0100N-CA-V0261	Rev. No.	0

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. To ensure quality data, the SAP 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-54 waste site were provided by the laboratory in two sample delivery groups (SDGs), SDG JP0751 and SDG XP0055. SDG JP0751 was submitted for third-party validation. All field samples were collected and analyzed per the sample design. However, an equipment blank indicated by the sample design was not taken. The equipment blank sample is used as an indicator of possible contamination from the sampling equipment but is not absolutely needed. The lack of an equipment blank does not impact the field sample data. The data are usable for decision-making purposes.

No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-N-54 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 JP0751

This SDG comprises one focused soil sample (J1TFC9) and a duplicate sample (J1TFD0) collected from the 100-N-54 excavation area. These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and semivolatile organic compounds (SVOCs). SDG JP0751 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, the matrix spike (MS) recoveries for antimony (56%) and silicon (37%) are outside quality control (QC) limits. Additionally, the laboratory control sample (LCS) recovery for silicon (23%) is also outside the QC limits. Third-party validation qualified all antimony and silicon results in SDG JP0751 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the PAH analysis, neither a MS nor matrix spike duplicate (MSD) was prepared due to insufficient sample volume. Third-party validation qualified all PAH results in SDG JP0751 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the PCB analysis, neither a MS nor MSD was prepared due to insufficient sample volume. Third-party validation qualified all PCB results in SDG JP0751 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOC analysis, neither a MS nor MSD was prepared due to insufficient sample volume. Third-party validation qualified all SVOC results in SDG JP0751 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the LCS recovery for 4-chloroanaline (48%) is outside the QC limits. Third-party validation qualified all 4-chloroanaline results in SDG JP0751 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG XP0055

This SDG comprises one focused soil sample (J1TFD1) collected from the 100-N-54 excavation area. This is a field split of sample J1TFC9, which is included in SDG JP0751. The sample was analyzed ICP metals, mercury, PAH, PCBs, and SVOCs. Minor deficiencies are as follows:

In the SVOC analysis, the relative percent difference (RPD) calculated for 2,4-dinitrophenol (42%) between the MS and the MSD is above the QC limit (30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. Results for 2,4-dintirophenol in SDG XP0055 may be considered estimated. Estimated data are usable for decision-making purposes.

In the PAH analysis, MS recoveries for fluorene (90.1%) and anthracene (94.0%) were outside the laboratory acceptance ranges of 50% to 90% and 49% to 91%, respectively. This may indicate a slight high bias for these analytes in the field sample data. The laboratory qualified the associated data with "T" flags due to the potential bias. These recoveries are within the projects QC range but may be considered estimated. High biased or estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for silicon (179%) and vanadium (128%) are outside the QC limits. A post-spike (PS) was evaluated and silicon was found to have also failed those QC limits indicating a matrix interference for silicon. The vanadium PS recovery for vanadium was within the QC limits indicating that the initial MS deficiency was due to an insufficient spiking concentration and not to interference. Silicon is not a regulated compound

and will not impact the evaluation of the 100-D-54 waste site. However, silicon data for SDG XP0055 may be considered estimated. 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	Split Sample
100-N-54 Excavation	J1TFC9	J1TFD0	J1TFD1

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 (COPC). Relative percent differences 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 (TDL). Relative percent differences of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. No major deficiencies in the RPD calculations were found for the duplicate sample.

Field split samples are used to determine systematic differences (bias) between laboratories. A statistical determination of systematic differences would require larger data sets than are presented here. Such a determination is complicated by variability introduced by the natural heterogeneities inherent in field soil samples, and the analytical variability that each individual laboratory experiences. Therefore, when evaluating limited field split data relatively large RPDs are expected. No major deficiencies in the RPD calculations were found for the split sample.

The calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation. Minor deficiencies for the field duplicate and split samples are as follows:

The RPDs calculated for copper (35.6%) and sodium (39.1%) in the field duplicate analysis and silicon (82.3%) in the field split analysis are above the acceptance criteria. 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 TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. In the 100-N-54 data set sodium met the criteria for this check. No additional deficiencies were noted due to the TDL initiated review. A visual inspection of all of the data is also performed. No additional 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-54 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-54 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 a 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.

REFERENCES

BHI, 2000, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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WCH, 2014a, *100-N Field Remediation and Sampling*, Logbook EL-1652-11, pp. 65-66, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *Work Instruction for Verification Sampling of the 100-N-54, 151-N Building Drywell*, 0100N-WI-G0079, Rev. 0, Washington Closure Hanford, Richland, Washington.