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

JUN 19 2014

14-AMRP-0218

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 120-N-4; 1310-N HAZARDOUS WASTE STORAGE AREA; 1310-N NON-HAZARDOUS WASTE PAD; 1310-N WASTE OIL STORAGE PAD WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-024 and supporting, "Remaining Sites Verification Package for the 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste Oil Storage Pad 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

Washington Closure Hanford

176293

JUN 12 2014

U.S. Department of Energy
Richland Operations Office
J. C. Connerly, Contracting Officer
Procurement Services Division
P.O. Box 550, MSIN A7-80
Richland, Washington 99352

Subject: Contract No. DE-AC06-05RL14655
TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 120-N-4; 1310-N HAZARDOUS WASTE STORAGE AREA; 1310-N NON-HAZARDOUS WASTE PAD; 1310-N WASTE OIL STORAGE PAD WASTE SITE, REVISION 0

Dear Ms. Connerly:

Attached is the approved Waste Site Reclassification Form No. 2014-024 and supporting *Remaining Sites Verification Package for the 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste Oil Storage Pad Waste Site*, Rev. 0, for your use and transmittal to the Washington State Department of Ecology.

If you have questions regarding this document, please contact me or call Ms. T. Q. Howell at 372-0162, or send an email to tqhowell@wch-rcc.com.

Sincerely,

R. D. Cantwell, Director
Closure Operations

TQH:djb

Attachments: Waste Site Reclassification Form No. 2014-024 and supporting *Remaining Sites Verification Package for the 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste Oil Storage Pad Waste Site*, Rev. 0

cc: J. C. Chance (RL) A3-04, w/a (4 copies)
R. J. Corey (RL) A5-11, w/o
M. S. French (RL) A6-38, w/o
J. D. Kautzky (RL) A3-04, w/a
C. S. Louie (RL) A3-04, w/o
J. P. Neath (RL) A3-04, w/o
J. P. Shearer (CHPRC) H8-51, w/o

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-024

Waste Site Code(s)/Subsite Code(s): 120-N-4

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 120-N-4, 1310-N Hazardous Waste Storage Area, 1310-N Waste Oil Storage Pad, and 1310-N Non-Hazardous Waste Pad, 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), via 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). The 120-N-4 waste site is located immediately southwest of the 1310-N Facility between the footprint of the former 13-N Building and the 1525-N graveled laydown storage yard.

The 1310-N Hazardous Waste Storage Area was a concrete pad approximately 20 by 25 m (70 by 80 ft), surrounded with a concrete berm and locked chain-link fence. Outside the pad the ground surface was gravel. A small open shed was in the southwest corner of the pad. The site was posted as a Radioactive Materials Area. As of April 12, 2000, the area contained several wrapped objects marked with radioactive warning signs. The unit stored waste held in drums and containers from 1985 to 1989. The pad was later used (as of April 12, 2000) to store lead-lined burial casks and radioactive materials.

The concrete pad comprising the 120-N-4 waste site was removed and disposed to the Environmental Restoration Disposal Facility (ERDF) by the Washington Closure Hanford (WCH) Deactivation, Decommission, Decontamination, and Demolition (D4) Project between December 2008 and February 2009. On December 11, 2008, a 3.8-cm (1.5-in.) feed from the export water line was inadvertently contacted during the removal of the concrete pad at the 1524-N Hazardous Waste Storage Facility. The result was a rupture of the 30-cm (12-in.) export water line and a release of at least 189,270 L (50,000 gal) of raw water onto the surrounding area. Once the water line was turned off the water immediately percolated into the ground. In-process and post-event surface soil radiological field survey results did not find any contamination spread as a result of the water release. A follow-up review of nearby monitoring wells as well as the standard waste site confirmatory sampling was used to ascertain potential impacts/conditions.

The soil underlying the concrete pad was evaluated for residual contamination per a site-specific confirmatory sampling work instruction. Comparison of analytical results from the sampling event with remedial action objectives (RAOs) and remedial action goals (RAGs) indicated the site exceeded direct exposure levels for multiple chemical contaminants. Based on these results, the site was recommended for remove, treat, and dispose (WCH 2009).

During remediation between October 8 and October 10, 2013, 956 bank cubic meters (BCM) of material was directly loaded out for disposal at ERDF. Along with this, <1 BCM of wire and concrete debris were removed. This excavation was approximately 1 m (3.3 ft) deep. No anomalies were discovered.

Cleanup verification sampling was conducted on January 23, 2014. The sampling was performed to determine if the waste site met the 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. 1, 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.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-024

Waste Site Code(s)/Subsite Code(s): 120-N-4

Basis for reclassification:

The verification sampling and modeling results for the 120-N-4 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 and modeling 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. 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 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste Oil Storage Pad* (attached).

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	5/14/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard KIM WELSCH FOR	KIM WELSCH FOR	5/27/14
Ecology Project Manager (printed)	Signature	Date
NA		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 120-N-4; 1310-N HAZARDOUS WASTE STORAGE AREA; 1310-N NON-HAZARDOUS WASTE PAD; 1310-N WASTE OIL STORAGE PAD WASTE SITE

Attachment to Waste Site Reclassification Form 2014-024

June 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 120-N-4; 1310-N HAZARDOUS WASTE STORAGE AREA; 1310-N NON-HAZARDOUS WASTE PAD; 1310-N WASTE OIL STORAGE PAD WASTE SITE

EXECUTIVE SUMMARY

The 120-N-4, 1310-N Hazardous Waste Storage Area, 1310-N Non-Hazardous Waste Pad, and 1310-N Waste Oil Storage Pad, 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) (EPA 1999). The 120-N-4 waste site is located immediately southwest of the 1310-N Facility between the footprint of the former 13-N Building and the 1525-N graveled laydown storage yard.

The 1310-N Hazardous Waste Storage Area was a concrete pad approximately 20 by 25 m (70 by 80 ft), surrounded with a concrete berm and locked chain-link fence. Outside the pad, the ground surface was gravel. A small open shed was in the southwest corner of the pad. The site was posted as a Radioactive Materials Area. As of April 12, 2000, the area contained several wrapped objects marked with radioactive warning signs. The unit stored waste held in drums and containers from 1985 to 1989. The pad was later used (as of April 12, 2000) to store lead-lined burial casks and radioactive materials.

The concrete pad comprising the 120-N-4 waste site was removed and disposed to the Environmental Restoration Disposal Facility (ERDF) by the Washington Closure Hanford (WCH) Deactivation, Decommission, Decontamination, and Demolition (D4) Project between December 2008 and February 2009. On December 11, 2008, a 3.8-cm (1.5-in.) feed from the export water line was inadvertently contacted during the removal of the concrete pad at the 1524-N Hazardous Waste Storage Facility. The result was a rupture of the 30-cm (12-in.) export water line and a release of at least 189,270 L (50,000 gal) of raw water onto the surrounding area. Once the water line was turned off the water immediately percolated in the ground. In-process and post-event surface soil radiological field survey results did not find any contamination spread as a result of the water release.

The soil underlying the concrete pad was evaluated for residual contamination per a site-specific confirmatory sampling work instruction (WCH 2008a). Comparison of analytical results from the sampling event with remedial action objectives (RAOs) and remedial action goals (RAGs) indicated the site exceeded direct exposure levels for multiple chemical contaminants. Based on these results, the site was recommended for remove, treat, and dispose (RTD) (WCH 2009).

Between October 8, 2013, and October 10, 2013, 956 bank cubic meters (BCM) was directly loaded out for disposal at ERDF. Along with this, <1 BCM of wire and concrete debris were removed. This excavation was approximately 1 m (3.3 ft) deep. No anomalies were discovered.

Cleanup verification sampling was conducted on January 23, 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 120-N-4 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 120-N-4 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 120-N-4 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual 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 quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for the 120-N-4 waste site (2.8×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for individual carcinogens is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk (4.1×10^{-8}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 120-N-4 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].		

Table ES-1. Summary of Remedial Action Goals for the 120-N-4 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	The residual concentration of aroclor-1254 and copper exceed soil RAGs for groundwater and/or 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 these constituents 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 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).
[d] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentration of aroclor-1254 and copper are predicted to migrate less than 3 m (10 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [copper] of 22 mL/g). The vadose zone underlying the soil beneath the excavation is approximately 19.5 m (64 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and consequently are protective of the Columbia River.

COPC = contaminant of potential concern
MCL = maximum contaminant level
NA = not applicable
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDR/RAWP= remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results and modeling 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 and modeling 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. 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 120-N-4 waste site was excavated to an approximate maximum depth of 1 m (3.3 ft) below ground surface.

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 120-N-4 waste site contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, molybdenum, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for copper, manganese, vanadium, and zinc. 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, vanadium, and zinc are below the Hanford Site background value, 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 120-N-4; 1310-N HAZARDOUS WASTE STORAGE AREA; 1310-N NON-HAZARDOUS WASTE PAD; 1310-N WASTE OIL STORAGE PAD WASTE SITE

STATEMENT OF PROTECTIVENESS

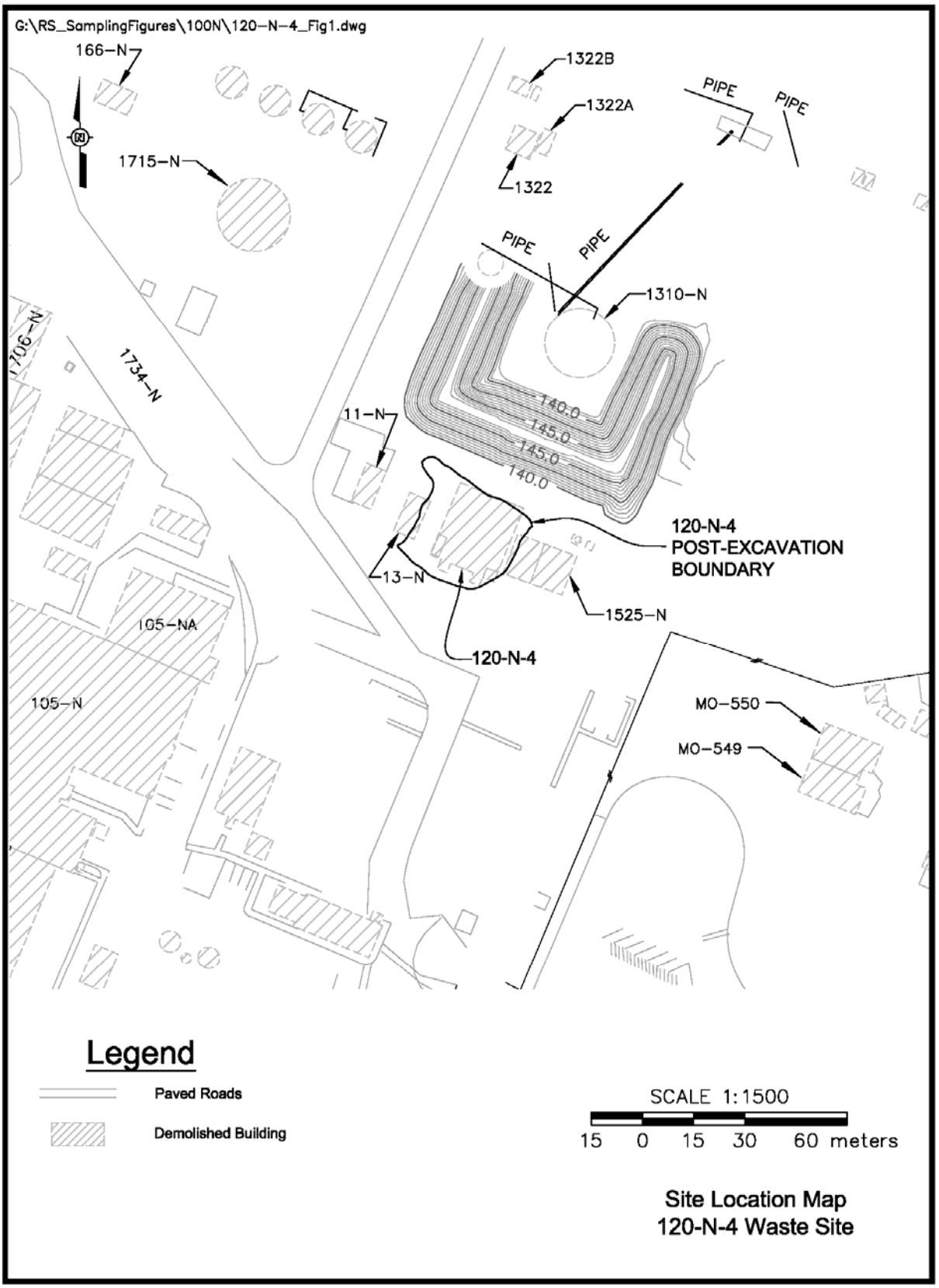
The 120-N-4 waste site cleanup verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (100-N Area RDR/RAWP) (DOE-RL 2013) and the *Interim Action 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 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 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 120-N-4 waste site was excavated to an approximate maximum depth of 1 m (3.3 ft) below ground surface (bgs).

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 120-N-4 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, molybdenum, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for copper, manganese, vanadium, and zinc. 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, vanadium, and zinc are below the Hanford Site background value, 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.

GENERAL SITE INFORMATION AND BACKGROUND

The 120-N-4, 1310-N Hazardous Waste Storage Area, 1310-N Non-Hazardous Waste Pad, and 1310-N Waste Oil Storage Pad waste site was located immediately southwest of the 1310-N Facility between the footprint of the former 13-N Building and the 1525-N graveled laydown storage yard (Figure 1). The unit stored waste held in drums and containers from 1985 to 1989. The site was posted as a Radioactive Materials Area. The pad was later used to store lead-lined burial casks and radioactive materials.

Figure 1. 120-N-4 Waste Site Location Map and Post-Excavation Boundary.



The concrete pad comprising the 120-N-4 waste site (Figure 2) was removed and disposed to the Environmental Restoration Disposal Facility (ERDF) by the Washington Closure Hanford (WCH) Deactivation, Decommission, Decontamination, and Demolition (D4) Project between December 2008 and February 2009. On December 11, 2008, a 3.8-cm (1.5-in.) feed from the export water line was inadvertently contacted during the removal of the concrete pad at the 1524-N Hazardous Waste Storage Facility. (Figures 3 and 4). The result was a rupture of the 30-cm (12-in.) export water line and a release of at least 189,270 L (50,000 gal) of raw water onto the surrounding area. Once the water line was turned off the water immediately percolated into the ground. In-process and post event surface soil radiological field survey results did not find any contamination spread as a result of the water release. A follow-up review of nearby monitoring wells as well as the standard waste site confirmatory sampling was used to ascertain potential impacts/conditions (WCH 2008b).

Figure 2. Waste Oil Storage at the 120-N-4 Site (View to the Northeast).

Figure 3. Berm on the West Side of the 1524-N (120-N-4) Pad Area After Pipe Breach (December 11, 2008).

Figure 4. Aerial Photograph of 120-N-4 Spill from Pipe Breach (April 26, 2008).

The soil underlying the concrete pad was evaluated for residual contamination per a site-specific confirmatory sampling work instruction (WCH 2008a). Comparison of analytical results from the sampling event with remedial action objectives (RAOs) and remedial action goals (RAGs) indicated the site exceeded direct exposure levels for multiple chemical contaminants. Based on these results, the site was recommended for RTD (WCH 2009).

REMEDIAL ACTION SUMMARY

Between October 8 and October 10, 2013, 956 bank cubic meters (BCM) of material from the 120-N-4 site was directly loaded out for disposal at ERDF. Along with this, <1 BCM of wire and concrete debris were removed. This excavation was approximately 1 m (3.3 ft) deep. No anomalies were discovered. Before, during, and after photographs of the 120-N-4 waste site remediation are shown in Figures 5 through 7.

Figure 5. Photograph of the 120-N-4 Waste Site Prior to Remediation.

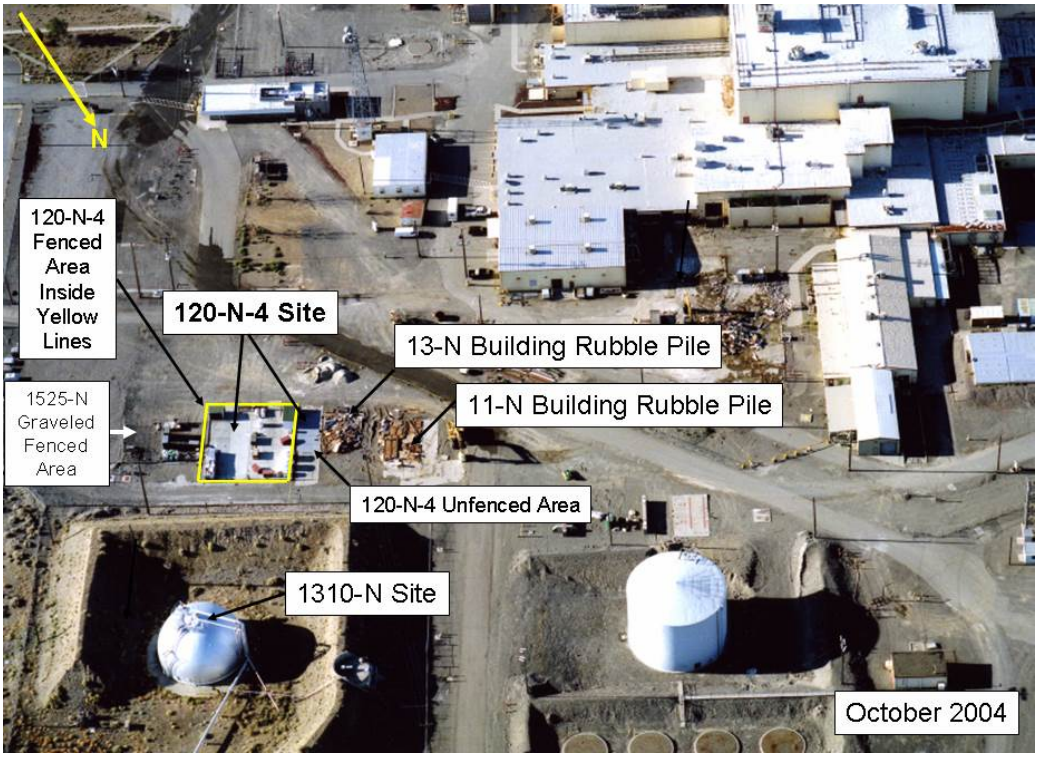
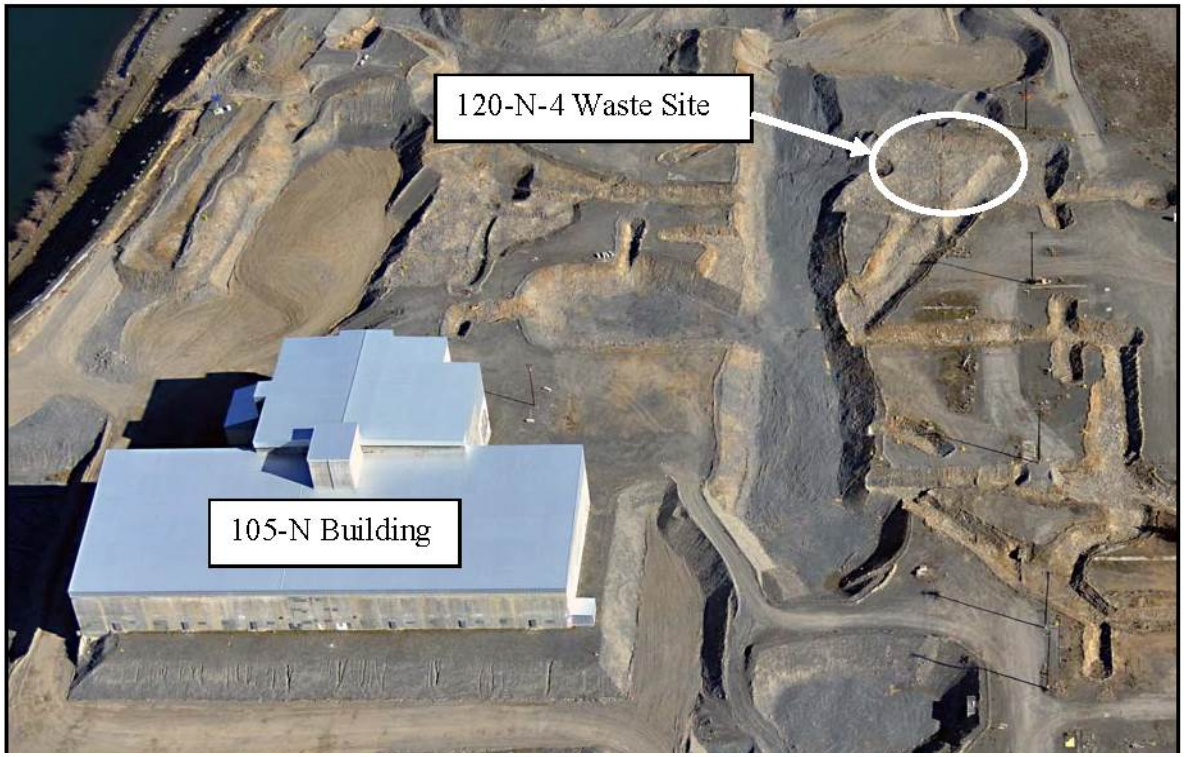


Figure 6. Photograph of the 120-N-4 Waste Site During Remediation (October 2013).

Figure 7. 120-N-4 Waste Site Post-Remediation (Photo Taken on March 12, 2014).



VERIFICATION SAMPLING ACTIVITIES

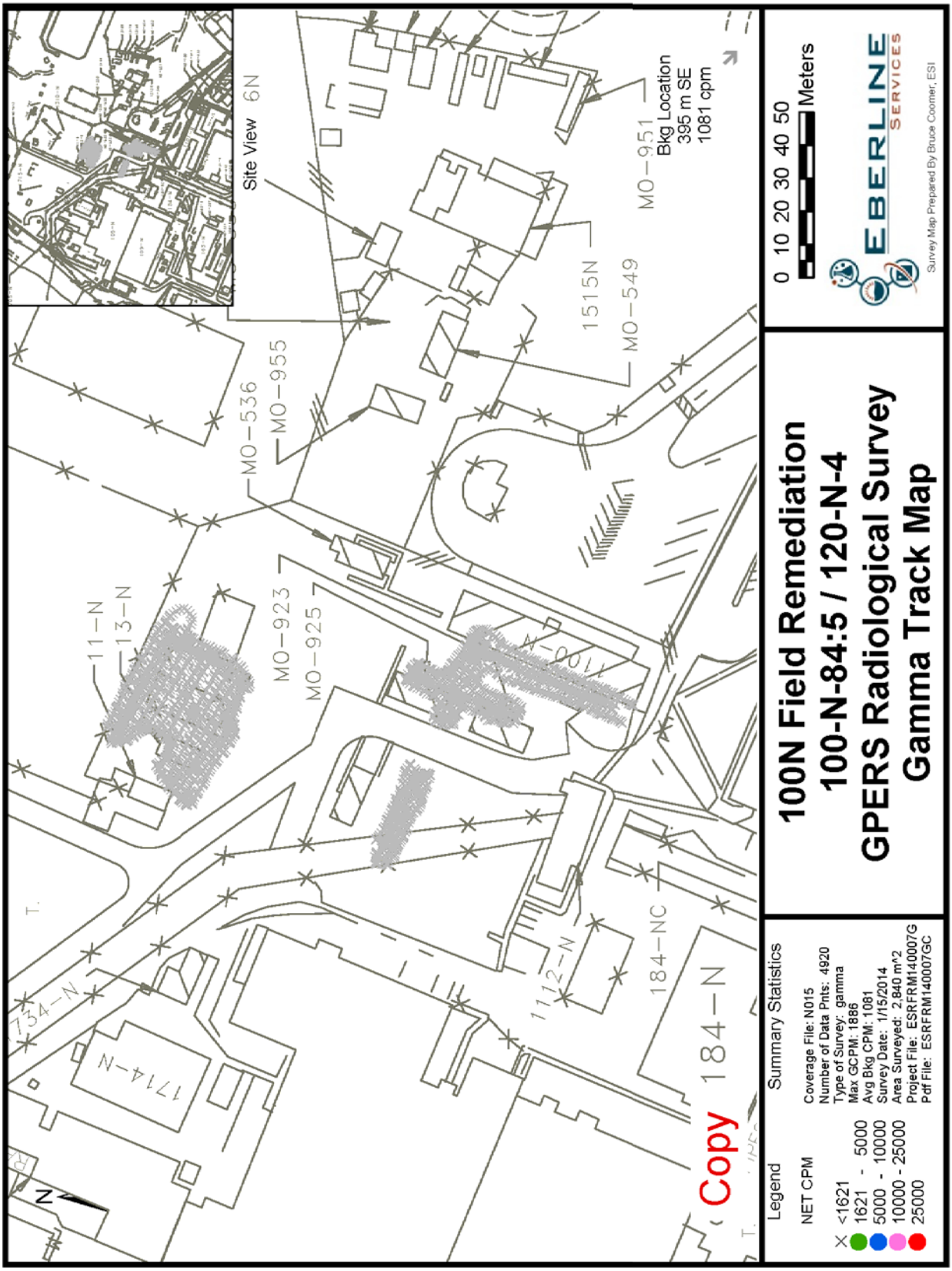
Verification soil sampling was conducted on January 23, 2014, per the *Work Instruction for Verification Sampling of the 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste oil Storage Pad* (WCH 2014b). Sampling was conducted to support a determination that residual 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). The verification sample results are provided in Appendix C.

Contaminants of Potential Concern

The COPCs for the 120-N-4 waste site were developed based on historical information, process knowledge, confirmatory samples, and other available information.

Because all ion chromatography anion and herbicide results in confirmatory samples were either below background or undetected, anions and herbicides were eliminated as COPCs. The COPCs for the 120-N-4 waste site included the expanded list of inductively coupled plasma (ICP) metals, mercury, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), and pesticides. 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. Per the final radiological survey taken (Figure 8) the 120-N-4 waste site is a nonradiological waste site and radionuclides were not included as COPCs.

Figure 8. Final Global Positioning Environmental Radiological Survey (GPERS) for the 120-N-4 Waste Site.



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

Table 1. Laboratory Analytical Methods for the 120-N-4 Waste Site.

Analytical Method	Contaminants of Potential Concern
ICP metals – EPA Method 6010 [a]	Metals
Mercury – EPA Method 7471	Mercury
PAH – EPA Method 8310	Polycyclic aromatic hydrocarbons
PCBs – EPA Method	Polychlorinated biphenyls
Pesticides – EPA Method 8081	Pesticides
TPH – NWTPH-Dx	Total petroleum hydrocarbons

[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
NWTPH = Northwest total petroleum hydrocarbons
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

Verification Sample Design

One shallow zone decision unit was identified for the 120-N-4 waste site. Twelve statistical verification soil samples, one duplicate, and one split sample were collected from the waste site excavation. 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, and the sample locations are shown in Figure 9.

Table 2. 120-N-4 Waste Site Verification Sample Summary Table. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates		Sample Analysis
		Northing (m)	Easting (m)	
EXC-1	J1T816	149546.1	571377.8	ICP metals [a], mercury, PCBs, PAH, pesticides, TPH
EXC-2	J1T817	149553.9	571364.1	
EXC-3	J1T818	149553.9	571373.3	
EXC-4	J1T819	149553.9	571382.3	
EXC-5	J1T820	149553.9	571391.4	
EXC-6	J1T821	149561.8	571367.8	
EXC-7	J1T822	149561.8	571377.8	
EXC-8	J1T823	149561.8	571386.9	
EXC-9	J1T824	149561.8	571396.0	
EXC-10	J1T825	149569.7	571373.2	
EXC-11	J1T826	149569.7	571382.3	
EXC-12	J1T827	149577.6	571368.7	
Duplicate of EXC-4	J1T828	149553.9	571382.3	
Split of EXC-4	J1T830	149553.9	571382.3	

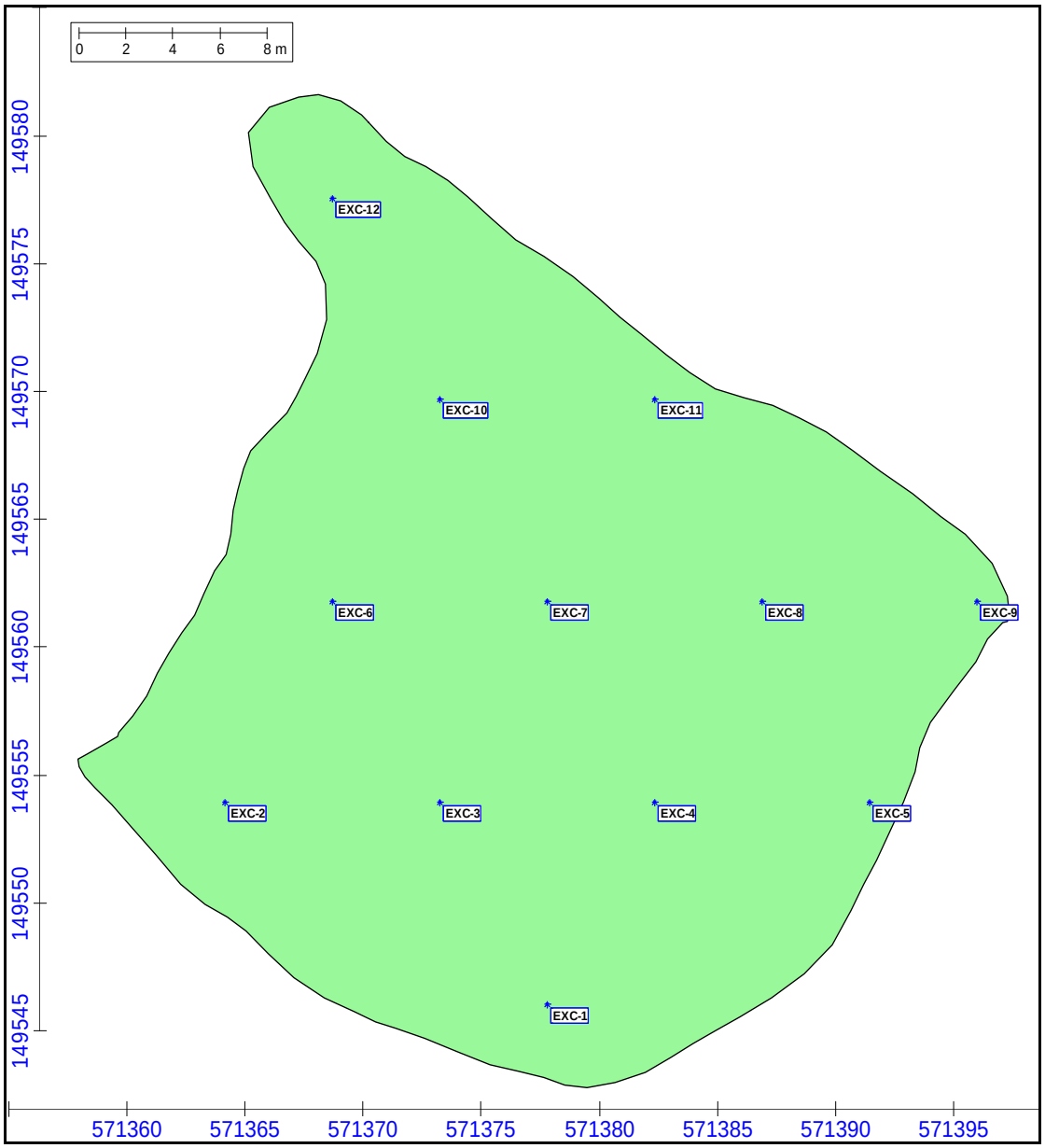
Table 2. 120-N-4 Waste Site Verification Sample Summary Table. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates		Sample Analysis
		Northing (m)	Easting (m)	
Equipment blank	J1T829	NA	NA	ICP metals [a], mercury

[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 in the analytical results package.

GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

Figure 9. Statistical Verification Sample Locations for the 120-N-4 Waste Site.



Verification Sample Results

All verification samples were collected for full protocol laboratory analysis and analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 120-N-4 waste site was performed by direct comparison of the statistical or maximum sample results for each COPC against the cleanup criteria.

The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COPC are computed for the 120-N-4 waste site decision unit as specified by the 100-N Area RDR/RAWP (DOE-RL 2013). The calculations are provided in Appendix C. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for a decision unit, the maximum detected value was used for comparison to RAGs. If no detections for a given COPC were reported in the data set, then no statistical calculation or evaluation was performed for that COPC.

Comparisons of the results for each COPC from the 120-N-4 waste site against the RAGs are summarized in Table 3. Contaminants that were not detected by laboratory analysis are excluded from this 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, Volume I: Human Health Evaluation Manual* (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.

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 120-N-4 Waste Site ExcavationVerification Samples. (2 Pages)

COPC	Statistical or 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	3.9 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	56.4 (<BG)	16,000	200	400	No	--
Beryllium	0.28 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	3.0	16,000	320	-- [f]	No	--
Cadmium [g]	0.25 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium	16.2 (<BG)	120,000	18.5 [c]	18.5 [c]	No	--
Cobalt	8.0 (<BG)	1,600	32	-- [f]	No	--
Copper	29.1	2,960	59.2	22.0 [c]	Yes	Yes [h]
Lead	5.6 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	326 (<BG)	11,200	512 [c]	-- [f]	No	--
Mercury	0.010 (<BG)	24	0.33 [c]	0.33 [c]	No	--
Molybdenum	2.5	400	8	-- [f]	No	--
Nickel	14.1 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	48.7 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	49.3 (<BG)	24,000	480	67.8 [c]	No	--

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 120-N-4 Waste Site ExcavationVerification Samples. (2 Pages)

COPC	Statistical or 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		
Aroclor-1254	0.019	0.5	0.017 [i]	0.017 [i]	Yes	Yes [h]
Benzo(a)anthracene	0.0046	1.37	0.015 [a]	0.015 [a]	No	--
Chrysene	0.0065	137	1.2	0.10 [a]	No	--
Pyrene	0.0140	2,400	48	192	No	--

[a] RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2013), or the 100 Area RDR/RAWP (DOE-RL 2009) where indicated.
[b] Maximum or 95% UCL, depending on data censorship, as described in the *120-N-4 Waste Site Cleanup Verification 95% UCL 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 2.12.1 of the 100-N Area RDR/RAWP (DOE-RL 2013).
[d] 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]).
[e] No Hanford Site-specific or Washington State background value available.
[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] Hanford Site-specific background not available. Value is Washington State background from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[h] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentration of aroclor-1254 and copper are predicted to migrate less than 3 m (10 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [copper] of 22 mL/g). The vadose zone underlying the soil beneath the excavation is approximately 19.5 m (64 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and consequently are protective of the Columbia River.
[i] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
Ecology = Washington State Department of Ecology
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
UCL = upper confidence limit
WAC = *Washington Administrative Code*

The complete laboratory results for all constituents are stored in a WCH project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Attachment 1 of the 95% UCL calculations (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 120-N-4 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 120-N-4 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 aroclor-1254 and copper. However, given the lowest soil-partitioning coefficient (K_d) of these contaminants (copper) of 22 mL/g, none would be expected to migrate more than 3 m (10 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 120-N-4 waste site is approximately 19.5 m (64 ft) thick. Therefore, residual concentrations of aroclor-1254 and copper are predicted to be protective of groundwater (and thus the Columbia River).

Three-Part Test for Nonradionuclides

A RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test, which consists of the following criteria: (1) the cleanup verification 95% UCL value must be less than the cleanup level, (2) no single detection shall exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10% of the data set.

The application of the three-part test for the 120-N-4 waste site is included in the 95% UCL calculations, where half or more of the data set was detected (Appendix C). The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of copper, which fails one or more parts of the three-part test to be protective of groundwater and the Columbia River. However, based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentrations of this constituent are not expected to migrate more than 2.6 m (8.5 ft) vertically within 1,000 years (based on the contaminant with the lowest K_d [copper with a K_d of 22 mL/g]). The vadose zone beneath the 120-N-4 waste site is approximately 19.5 m (64 ft) thick. Based on RESRAD modeling, constituents with a soil-partitioning coefficient of 3.8 mL/g or greater are not predicted to migrate through a vadose zone of this thickness and reach groundwater in 1,000 years. Therefore, the residual concentration of copper are predicted to be protective of groundwater and the Columbia River.

An additional application of the three-part test is included for the statistical data sets that default to the maximum because less than half of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of aroclor-1254, which fails one part of the three-part test. However, based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentrations of aroclor-1254 are predicted to migrate less than 1 m (3.3 ft) vertically within 1,000 years (based on the K_d of 75.6 mL/g). As stated above, the vadose zone beneath the 120-N-4 waste site is approximately 19.5 m (64 ft) thick. Based on RESRAD modeling, constituents with a soil-partitioning coefficient of 3.8 mL/g or greater are not predicted to migrate through a vadose zone of this thickness and reach groundwater in 1,000 years. Therefore, the residual concentrations of aroclor-1254 are predicted to be protective of groundwater and the Columbia River.

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 120-N-4 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 2.8×10^{-2}, which is less than 1.0. The individual carcinogenic risk values for the carcinogenic constituents detected above background are less than 1×10^{-6}, and the cumulative carcinogenic risk value was 4.1×10^{-8}, which is less than 1×10^{-5}. The 120-N-4 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 120-N-4 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 19.5 m (64 ft) in thickness, a K_d of 3.8 or greater is required to show no predicted migration to groundwater in 1,000 years. The noncarcinogenic hazard quotient for boron, the only constituent subject to the noncarcinogenic calculation, is 9.4×10^{-3}, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection evaluation at the 120-N-4 waste site; therefore, no calculations of excess carcinogenic risk were performed. Therefore, nonradionuclide risk requirements related to groundwater are met.

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 120-N-4 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 HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 120-N-4 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 120-N-4 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.

REFERENCES

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

BHI, 2001, *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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

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.

DOE-RL, 2009, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas*, DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2011, *Tri-Party Agreement Handbook Management Procedures*, RL-TPA-90-0001, Rev. 2, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 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.

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

Ecology, 1996, "Model Toxics Control Act – Cleanup," *Washington Administrative Code* (WAC) 173-340, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2014, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

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

EPA, 1989, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1999, *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

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

WCH, 2008a, Uncontaminated Raw Water from Export Water Line Spilled on 12/11/2008 at 1524-N Pad, WCH Spill/Release Checklist, CCN 0595192, Washington Closure Hanford, Richland, Washington.

WCH, 2008b, *Work Instruction for Confirmatory Sampling of the 120-N-4, 1310-N Hazardous Waste Storage Area*, 0100N-WI-G0008, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2009, "120-N-4 Remaining Site for Remedial Action," CCN 144252 to R. A. Carlson from M. L. Proctor, Washington Closure Hanford, Richland, Washington, April 21.

WCH, 2014a, *100N Field Remediation and Sampling*, Logbook EL-1652-11, pp. 40-43, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *Work Instruction for Verification Sampling of the 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste Oil Storage Pad*, 0100N-WI-G0081, Rev. 0, Washington Closure Hanford, Richland, Washington.

WDOH, 1997, *Hanford Guidance for Radiological Cleanup*, WDOH/320-015, Rev. 1, Washington State Department of Health, Olympia, Washington.

APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 120-N-4 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)							
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	3.0
Copper	22.0	100	50	217	70	80	28	49	29.1
Manganese	512	1,100 [d]	NA	1,500	220	450	4,300	4,000	326 (<BG)
Molybdenum	NA	2	NA	7	NA	NA	NA	NA	2.5
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	48.7 (<BG)
Zinc	67.8	86 [d]	200	360	160	120	46	79	49.3 (<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.

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

APPENDIX B

IN-PROCESS SAMPLE DATA

APPENDIX B

IN-PROCESS SAMPLE DATA

In-process samples were collected from the 120-N-4 waste site on January 4, 2013, and October 14, 2013. On January 4, 2013, an excavator was used to pothole the 120-N-4 waste site until previously undisturbed soil was reached. From that pothole one sample was collected from the bottom. October 14, 2013, five samples were collected from the 120-N-4 waste site excavation floor to determine if the contamination had been removed. The in-process soil samples are summarized in Table B-1. The data are presented in Tables B-2 through B-4.

Table B-1. 120-N-4 Waste Characterization and In-Process Sample Summary.

Sample Location Number	Sample Number	Sample Date	Washington State Plane Coordinates		Sample Type and Description
			Northing (m)	Easting (m)	
Potholed	J1R887	1/4/2013	149566.9	571373.3	Silt, sand, gravel, and cobble
1	J1T3V9	10/14/2013	149573.0	571373.9	Silt, sand, gravel, and cobble
2	J1T3W0	10/14/2013	149557.1	571364.5	Silt, sand, gravel, and cobble
3	J1T3W1	10/14/2013	149558.5	571378.8	Silt, sand, gravel, and cobble
4	J1T3W2	10/14/2013	149562.6	571389.8	Silt, sand, gravel, and cobble
5	J1T3W3	10/14/2013	149548.3	571379.9	Silt, sand, gravel, and cobble

Table B-2. 120-N-4 In-Process Sample Summary (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			ICP			ICP			ICP			ICP		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Potholed	J1R887	1/4/13	6850		15.3	1.83	U	1.83	2.78	B	3.05	64.8		1.53
1	J1T3V9	10/14/13							2.7		0.61	31.2	X	0.070
2	J1T3W0	10/14/13							2.2		0.63	72.9	X	0.072
3	J1T3W1	10/14/13							3.0		0.64	79.2	X	0.074
4	J1T3W2	10/14/13							2.7		0.58	47.8	X	0.066
5	J1T3W3	10/14/13							2.9		0.67	56.8	X	0.077

Sample Location	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			ICP			ICP			ICP			ICP		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Potholed	J1R887	1/4/13	0.288	B	0.611	6.11	U	6.11	0.233	B	0.611	10300		305
1	J1T3V9	10/14/13							0.12	B	0.038			
2	J1T3W0	10/14/13							0.25		0.039			
3	J1T3W1	10/14/13							0.21		0.040			
4	J1T3W2	10/14/13							0.14	B	0.036			
5	J1T3W3	10/14/13							0.17	B	0.041			

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron		
			ICP			ICP			ICP			ICP		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Potholed	J1R887	1/4/13	11.2		0.611	7.53		6.11	18.2		3.05	20700		61.1
1	J1T3V9	10/14/13	9.9	X	0.054									
2	J1T3W0	10/14/13	12.3	X	0.055									
3	J1T3W1	10/14/13	11.7	X	0.057									
4	J1T3W2	10/14/13	6.0	X	0.051									
5	J1T3W3	10/14/13	7.2	X	0.058									

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			ICP			ICP			ICP			ICP		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Potholed	J1R887	1/4/13	4.42		1.53	4340		229	291		15.3	0.0102	B	0.0283
1	J1T3V9	10/14/13	2.9		0.25							0.0065	B	0.0062
2	J1T3W0	10/14/13	11.4		0.26							0.0390		0.0066
3	J1T3W1	10/14/13	5.8		0.26							0.0052	U	0.0052
4	J1T3W2	10/14/13	3.7		0.24							0.0060	U	0.0060
5	J1T3W3	10/14/13	5.1		0.27							0.0069	B	0.0051

Sample Location	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			ICP			ICP			ICP			ICP		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Potholed	J1R887	1/4/13	6.11	U	6.11	10.7	B	12.2	945	B	1220	0.916	U	0.916
1	J1T3V9	10/14/13										0.80	U	0.80
2	J1T3W0	10/14/13										0.82	U	0.82
3	J1T3W1	10/14/13										0.84	U	0.84
4	J1T3W2	10/14/13										0.75	U	0.75
5	J1T3W3	10/14/13										0.87	U	0.87

Table B-3. 120-N-4 In-Process Sample Summary (Metals, TPH, and % Moisture).

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			ICP			ICP			ICP			ICP		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Potholed	J1R887	1/4/13	461		6.11	0.611	U	0.611	408		153	55.4		7.64
1	J1T3V9	10/14/13				0.15	U	0.15						
2	J1T3W0	10/14/13				0.15	U	0.15						
3	J1T3W1	10/14/13				0.16	U	0.16						
4	J1T3W2	10/14/13				0.14	U	0.14						
5	J1T3W3	10/14/13				0.16	U	0.16						

Sample Location	HEIS Number	Sample Date	Zinc			TPH - Diesel Range EXT			TPH - Diesel Range			Percent moisture (wet sample)		
			ICP			TPH			TPH			PHYSICAL		
			mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
Potholed	J1R887	1/4/13	45.3		30.5									
1	J1T3V9	10/14/13				3000	J	980	2100	J	670	2.0		0
2	J1T3W0	10/14/13				11000		1000	6600		680	2.6		0
3	J1T3W1	10/14/13				3500	J	1100	2400	J	730	7.7		0
4	J1T3W2	10/14/13				1200	J	1000	1100	J	680	3.0		0
5	J1T3W3	10/14/13				7600		1000	5000		710	7.2		0

Sample Location	HEIS Number	Sample Date	Arsenic			Barium			Cadmium			Chromium		
			TCLP			TCLP			TCLP			TCLP		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Potholed	J1R887	1/4/13	0.0750	U	0.0750	0.141		0.00500	0.0150	U	0.0150	0.00315	B	0.0250

Sample Location	HEIS Number	Sample Date	Lead			Mercury			Selenium			Silver		
			TCLP			TCLP			TCLP			TCLP		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Potholed	J1R887	1/4/13	0.0500	U	0.0500	0.000200	U	0.000200	0.100	U	0.100	0.0300	U	0.0300

Table B-4. 120-N-4 In-Process Sample Summary (Organics).

CONSTITUENT	CLASS	1			2			3			4			5		
		J1T3V9			J1T3W0			J1T3W1			J1T3W2			J1T3W3		
		10/14/13			10/14/13			10/14/13			10/14/13			10/14/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	10	U	10	9.6	U	9.6	11	U	11	10	U	10	10	U	10
Acenaphthylene	PAH	9.1	U	9.1	8.6	U	8.6	9.5	U	9.5	9.2	U	9.2	9.3	UN	9.3
Anthracene	PAH	3.1	U	3.1	2.9	U	2.9	3.2	U	3.2	3.1	U	3.1	3.7	J	3.2
Benzo(a)anthracene	PAH	3.2	U	3.2	3.1	U	3.1	29		3.4	3.2	U	3.2	54		3.3
Benzo(a)pyrene	PAH	6.5	U	6.5	6.1	U	6.1	31		6.7	6.5	U	6.5	36	X	6.6
Benzo(b)fluoranthene	PAH	4.3	U	4.3	4.0	U	4.0	24	X	4.4	4.3	U	4.3	29		4.4
Benzo(ghi)perylene	PAH	7.3	U	7.3	6.9	U	6.9	20	J	7.6	7.3	U	7.3	24	J	7.5
Benzo(k)fluoranthene	PAH	4.0	U	4.0	3.8	U	3.8	9.4	J	4.1	4.0	U	4.0	12	J	4.1
Chrysene	PAH	4.9	U	4.9	4.6	U	4.6	38	J	5.1	4.9	U	4.9	43	X	5.0
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	12	U	12	11	U	11	11	U	11
Fluoranthene	PAH	13	U	13	12	U	12	54	X	14	13	U	13	70		13
Fluorene	PAH	5.4	U	5.4	5.1	U	5.1	5.6	U	5.6	5.4	U	5.4	5.5	U	5.5
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	11	U	11	16	JX	13	12	U	12	23	J	12
Naphthalene	PAH	12	U	12	11	U	11	13	U	13	12	U	12	12	U	12
Phenanthrene	PAH	12	U	12	11	U	11	18	JX	13	12	U	12	12	U	12
Pyrene	PAH	12	U	12	11	U	11	72		13	12	U	12	89		12
Aroclor-1016	PCB	2.8	U	2.8	2.8	U	2.8	3.0	U	3.0	2.7	U	2.7	2.9	U	2.9
Aroclor-1221	PCB	8.2	U	8.2	8.1	U	8.1	8.6	U	8.6	7.9	U	7.9	8.5	U	8.5
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	2.1	U	2.1	2.0	U	2.0	2.1	U	2.1
Aroclor-1242	PCB	4.7	U	4.7	4.7	U	4.7	5.0	U	5.0	4.6	U	4.6	4.9	U	4.9
Aroclor-1248	PCB	4.7	U	4.7	4.7	U	4.7	5.0	U	5.0	4.6	U	4.6	4.9	U	4.9
Aroclor-1254	PCB	2.6	U	2.6	100		2.6	2.8	U	2.8	2.6	U	2.6	5.2	J	2.7
Aroclor-1260	PCB	2.6	U	2.6	2.6	UN	2.6	2.8	U	2.8	2.6	U	2.6	2.7	U	2.7
Aldrin	PEST	0.25	U	0.25	2.5	UD	2.5	0.26	U	0.26	0.24	U	0.24	0.27	U	0.27
Alpha-BHC	PEST	0.21	U	0.21	2.1	UD	2.1	0.22	U	0.22	0.20	U	0.20	0.23	U	0.23
alpha-Chlordane	PEST	0.32	U	0.32	3.2	UD	3.2	0.33	U	0.33	0.31	U	0.31	0.34	U	0.34
Beta-BHC	PEST	0.67	U	0.67	6.5	UD	6.5	0.68	U	0.68	0.64	U	0.64	0.70	U	0.70
Delta-BHC	PEST	0.40	U	0.40	3.9	UD	3.9	0.41	U	0.41	0.38	U	0.38	0.42	U	0.42
4-4'-DDD	PEST	0.55	U	0.55	5.4	UD	5.4	0.56	U	0.56	0.52	U	0.52	0.58	U	0.58
4-4'-DDE	PEST	0.24	U	0.24	2.3	UD	2.3	0.24	U	0.24	0.23	U	0.23	0.25	U	0.25
4-4'-DDT	PEST	0.59	U	0.59	14	JXD	5.8	0.60	U	0.60	0.56	U	0.56	0.62	U	0.62
Dieldrin	PEST	0.21	U	0.21	2.1	UD	2.1	0.21	U	0.21	0.20	U	0.20	0.22	U	0.22
Endosulfan I	PEST	0.18	U	0.18	1.7	UD	1.7	0.18	U	0.18	0.17	U	0.17	0.19	U	0.19
Endosulfan II	PEST	0.29	U	0.29	2.8	UD	2.8	0.29	U	0.29	0.27	U	0.27	0.30	U	0.30
Endosulfan sulfate	PEST	0.28	U	0.28	2.7	UD	2.7	0.28	U	0.28	0.26	U	0.26	0.29	U	0.29
Endrin	PEST	0.31	U	0.31	3.0	UD	3.0	0.31	U	0.31	0.29	U	0.29	0.32	U	0.32
Endrin aldehyde	PEST	0.17	U	0.17	1.7	UD	1.7	0.17	U	0.17	0.16	U	0.16	0.18	U	0.18
Endrin ketone	PEST	0.49	U	0.49	4.8	UD	4.8	0.50	U	0.50	0.47	U	0.47	0.52	U	0.52
Gamma-BHC (Lindane)	PEST	0.47	U	0.47	4.6	UD	4.6	0.47	U	0.47	0.44	U	0.44	0.49	U	0.49
gamma-Chlordane	PEST	0.27	U	0.27	2.6	UD	2.6	0.27	U	0.27	0.25	U	0.25	0.28	U	0.28
Heptachlor	PEST	0.21	U	0.21	2.1	UD	2.1	0.22	U	0.22	0.20	U	0.20	0.23	U	0.23
Heptachlor epoxide	PEST	0.43	U	0.43	4.2	UD	4.2	0.44	U	0.44	0.41	U	0.41	0.45	U	0.45
Methoxychlor	PEST	0.45	U	0.45	4.4	UD	4.4	0.46	U	0.46	0.43	U	0.43	0.48	U	0.48
Toxaphene	PEST	16	U	16	160	UD	160	16	U	16	15	U	15	17	U	17

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATION BRIEF

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 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:

120-N-4 Waste Site Cleanup Verification 95% UCL Calculation, 0100N-CA-V0252, Rev. 0, Washington Closure Hanford, Richland, Washington.

120-N-4 Waste Site Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater, 0100N-CA-V0254, Rev. 0, Washington Closure Hanford, Richland, Washington.

120-N-4 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100N-CA-V0255, 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 Field Remediation **Job No. 14655**

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0252

Subject: 120-N-4 Waste Site Cleanup Verification 95% UCL 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 Sheets = 10 Attm. 1 = 8 Total = 19	N. K. Schiffern N K Schiffern	I. B. Berezovskiy I B Berezovskiy	J. D. Skoglie J D Skoglie	D. F. Obenauer D. F. Obenauer	4/30/14

SUMMARY OF REVISION

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

Washington Closure Hanford **CALCULATION SHEET**

Originator	N. K. Schiffern	**Date**	03/18/14	**Calc. No.**	0100N-CA-V0252
Project	100-N Field Remediation	**Job No.**	14655	**Checked**	I. B. Berezovskiy
Subject	120-N-4 Waste Site Cleanup Verification 95% UCL Calculations			**Rev. No.**	0
				Date	03/18/14
				Sheet No.	1 of 10

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the subject site. Also, perform the *Washington Administrative Code* (WAC) 173-340-740(7)(e) Model Toxics Control Act (MTCA) 3-part test for nonradionuclide analytes and calculate the relative percent difference (RPD) for primary-duplicate sample pairs for each contaminant of potential concern (COPC), as necessary.

Table of Contents:
Sheets 1 to 4 - Calculation Sheet Summary
Sheet 5 to 6 - Calculation Sheet Verification Data - Excavation
Sheet 7- Calculation Sheet Maximum Calculation - Excavation
Sheet 8 to 9 - Ecology Software (MTCAStat) Results
Sheet 10 - Calculation Sheet Duplicate Split Analysis
Attachment 1 - 120-N-4, Verification Sampling Results (8 sheets)

Given/References:
1) Sample Results (Attachment 1).
2) 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.
3) DOE-RL, 2009, Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) 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.
5) Ecology, 1992, Statistical Guidance for Ecology Site Managers, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 1993, Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets), Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) Ecology, 2012, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
8) EPA, 1989, Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D. C.
9) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," Washington Administrative Code.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2013). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).

Calculation Description:
The subject calculations were performed on statistical data from soil verification samples (Attachment 1) from the 120-N-4 waste site. The data were entered into an EXCEL 2010 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2013) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

Methodology:
The 120-N-4 waste site underwent verification sampling at one decision unit: excavation area. Twelve statistical samples (EXC-1 to 12) were collected. Also included in the excavation area were one duplicate and one split sample. Further information is explained in the RSVP for this site.

Analytical results for all sampling locations are summarized in the tables provided on sheets 4 and 5. Further information of the sample data quality is presented in the data quality assessment section of the associated RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern	**Date** 03/18/14	**Calc. No.** 0100N-CA-V0252	**Rev. No.** 0
Project 100-N Field Remediation	**Job No.** 14655	**Checked** I. B. Berezovskiy	**Date** 03/18/14
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations			**Sheet No.** 2 of 10

Summary (continued)

Methodology, continued:

For nonradioactive analytes with ≤50% of the data below detection limits, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection of the sample results (Attachment 1), the maximum detected value for the data set (which includes primary and duplicate samples) is used instead of the 95% UCL, and no further calculations are performed for those data sets. For convenience, these maximum detected values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in (Ecology 2012) 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 COCs/COPCs and are also not included in these calculations.

All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above. For radionuclide data, calculation of the statistics is done using the reported value. In cases where the laboratory does not report a value below the minimum detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets ($n < 10$), the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2013) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting data set treated as uncensored.

The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the 95% UCL exceeds the most stringent cleanup limit for each COPC/COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each COPC/COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each COPC/COC.

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

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

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

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. If the RPD is greater than 30%, further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, 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 result exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern	**Date** 03/04/14	**Calc. No.** 0100N-CA-V0252	**Rev. No.** 0
Project 100-N Field Remediation	**Job No.** 14655	**Checked** I. B. Berezovskiy	**Date** 03/04/14
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations			**Sheet No.** 3 of 10

Summary (continued)

QUALIFIER LIST

B = estimate
D = dilution
EXC = excavation
J = estimate
M = sample duplicate precision not met
N = recovery is outside control limits
U = undetected
X (metal) = serial dilution indicates that physical and chemical interferences are present.

ACRONYM LIST

-- = not applicable
DE = direct exposure
EXC = excavation
GW = groundwater
MTCA = *Model Toxics Control Act*
NA = not applicable
PAH = polycyclic aromatic hudrocarbons
PCB = polychlorinated biphenyls
PEST= pesticides
PQL = practical quantitation limit
Q = qualifier
QA/QC = quality assurance/quality control
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
TDL = target detection limit
UCL = upper confidence limit
WAC = Washington Administrative Code

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern **Date** 03/04/14 **Calc. No.** 0100N-CA-V0252 **Rev. No.** 0
Project 100-N Field Remediation **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 03/04/14
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 10

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the excavation, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Results Summary - Excavation Samples [a]

Analyte	EXC 95% UCL Result	EXC Maximum Result	Units
Arsenic	3.9	--	mg/kg
Barium	56.4	--	mg/kg
Beryllium	0.28	--	mg/kg
Boron	--	3.0	mg/kg
Cadmium	0.25	--	mg/kg
Chromium	16.2	--	mg/kg
Cobalt	8.0	--	mg/kg
Copper	29.1	--	mg/kg
Lead	5.6	--	mg/kg
Manganese	326	--	mg/kg
Mercury	0.010	--	mg/kg
Molybdenum	--	2.5	mg/kg
Nickel	14.1	--	mg/kg
Vanadium	48.7	--	mg/kg
Zinc	49.3	--	mg/kg
Aroclor-1254	--	0.019	mg/kg
Benzo(a)anthracene	--	0.0046	mg/kg
Chrysene	--	0.0065	mg/kg
Pyrene	--	0.0140	mg/kg
3-Part Test Evaluation:	**EX**		
95% UCL or maximum[a] > Cleanup Limit?	YES	YES	
> 10% above Cleanup Limit?	NO	NO	
Any sample > 2x Cleanup Limit?	YES	NO	

[a]The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.

Relative Percent Difference Results and QA/QC Analysis[a]

Analyte	Duplicate Analysis	Split Analysis
Aluminum	0.2%	15.3%
Barium	11.0%	13.2%
Calcium	0.1%	3.3%
Chromium	3.8%	8.8%
Copper	4.4%	6.0%
Iron	3.9%	10.8%
Magnesium	6.5%	0.6%
Manganese	1.2%	9.1%
Silicon	9.5%	96.9%
Vanadium	6.5%	22.3%
Zinc	3.3%	11.0%

[a]RPD listed where result produced, based on criteria. If RPD not required, no value is listed. The significance of the reported RPD values, including values greater than 30% (greater than 35% for splits), is addressed in the data quality assessment section of the RSVP.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-N Field Remediation
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/04/14
Job No. 14655

Calc. No. 0100N-CA-V0252
Checked I. B. Berezovskiy

Rev. No. 0
Date 03/04/14
Sheet No. 5 of 10

120-N-4 Statistical Calculations

Verification Data -Excavation (EXC)

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Arsenic Q	Arsenic PQL	Barium mg/kg	Barium Q	Barium PQL	Beryllium mg/kg	Beryllium Q	Beryllium PQL	Cadmium mg/kg	Cadmium Q	Cadmium PQL	Chromium mg/kg	Chromium Q	Chromium PQL	Cobalt mg/kg	Cobalt Q	Cobalt PQL	Copper mg/kg	Copper Q	Copper PQL	Lead mg/kg	Lead Q	Lead PQL
EXC-4	J1T819	1/23/2014	3.2		0.62	56.4	X	0.072	0.22		0.031	0.17	B	0.039	10.8	X	0.055	5.4	X	0.095	13.8	X	0.21	3.6		0.26
Duplicate of J1T819	J1T828	1/23/2014	3.2		0.61	50.5	X	0.070	0.21		0.031	0.15	B	0.038	10.4	X	0.054	5.6	X	0.093	13.2	X	0.20	3.4		0.25
EXC-1	J1T816	1/23/2014	2.9		0.65	52.0	X	0.075	0.31		0.033	0.16	B	0.040	5.9	X	0.057	9.1	X	0.099	18.4	X	0.21	4.1		0.27
EXC-2	J1T817	1/23/2014	3.1		0.64	38.5	X	0.074	0.23		0.032	0.14	B	0.040	12.3	X	0.057	6.5	X	0.098	16.8	X	0.21	3.3		0.26
EXC-3	J1T818	1/23/2014	3.4		0.67	37.6	X	0.077	0.23		0.033	0.15	B	0.042	11.5	X	0.059	5.9	X	0.10	16.7	X	0.22	3.5		0.27
EXC-5	J1T820	1/23/2014	3.6		0.67	62.9	X	0.077	0.36		0.033	0.16	B	0.041	9.2	X	0.059	9.3	X	0.10	19.9	X	0.22	5.3		0.27
EXC-6	J1T821	1/23/2014	4.2		0.66	42.2	X	0.076	0.24		0.033	0.19	B	0.041	13.1	X	0.058	7.1	X	0.10	18.8	X	0.22	3.8		0.27
EXC-7	J1T822	1/23/2014	2.9		0.67	40.4	X	0.077	0.23		0.034	0.14	B	0.042	10.4	X	0.059	6.1	X	0.10	15.1	X	0.22	3.2		0.27
EXC-8	J1T823	1/23/2014	4.5		0.63	53.8	X	0.072	0.22		0.031	0.14	B	0.039	10.9	X	0.055	5.5	X	0.095	12.5	X	0.21	3.3		0.26
EXC-9	J1T824	1/23/2014	3.8		0.69	52.8	X	0.079	0.31		0.034	0.16	B	0.043	18.1	X	0.060	8.2	X	0.10	17.6	X	0.23	5.3		0.28
EXC-10	J1T825	1/23/2014	2.9		0.65	34.1	X	0.075	0.21		0.032	0.13	B	0.040	9.6	X	0.057	5.8	X	0.098	15.8	X	0.21	3.5		0.27
EXC-11	J1T826	1/23/2014	4.6		0.62	78.4	X	0.072	0.31		0.031	0.60	0	0.039	33.0	X	0.055	9.4	X	0.095	73.2	X	0.21	11.7		0.26
EXC-12	J1T827	1/23/2014	3.3		0.65	43.3	X	0.075	0.25		0.033	0.14	B	0.040	10.7	X	0.057	6.7	X	0.099	17.1	X	0.21	3.6		0.27

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Barium mg/kg	Beryllium mg/kg	Cadmium mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg	Lead mg/kg
EXC-4	J1T819/J1T828	1/23/2014	3.2	53.5	0.22	0.16	10.6	5.5	13.5	3.5
EXC-1	J1T816	1/23/2014	2.9	52.0	0.31	0.16	5.9	9.1	18.4	4.1
EXC-2	J1T817	1/23/2014	3.1	38.5	0.23	0.14	12.3	6.5	16.8	3.3
EXC-3	J1T818	1/23/2014	3.4	37.6	0.23	0.15	11.5	5.9	16.7	3.5
EXC-5	J1T820	1/23/2014	3.6	62.9	0.36	0.16	9.2	9.3	19.9	5.3
EXC-6	J1T821	1/23/2014	4.2	42.2	0.24	0.19	13.1	7.1	18.8	3.8
EXC-7	J1T822	1/23/2014	2.9	40.4	0.23	0.14	10.4	6.1	15.1	3.2
EXC-8	J1T823	1/23/2014	4.5	53.8	0.22	0.14	10.9	5.5	12.5	3.3
EXC-9	J1T824	1/23/2014	3.8	52.8	0.31	0.16	18.1	8.2	17.6	5.3
EXC-10	J1T825	1/23/2014	2.9	34.1	0.21	0.13	9.6	5.8	15.8	3.5
EXC-11	J1T826	1/23/2014	4.6	78.4	0.31	0.60	33.0	9.4	73.2	11.7
EXC-12	J1T827	1/23/2014	3.3	43.3	0.25	0.14	10.7	6.7	17.1	3.6

Statistical Computations

	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
N	12	12	12	12	12	12	12	12
% < Detection limit	0%	0%	0%	0%	0%	0%	0%	0%
Mean	3.5	49.1	0.26	0.19	12.9	7.1	21.3	4.5
Standard deviation	0.62	12.6	0.049	0.13	6.9	1.5	16.5	2.4
95% UCL on mean	3.9	56.4	0.28	0.25	16.2	8.0	29.1	5.6
Maximum value	4.6	78.4	0.36	0.60	33.0	9.4	73.2	11.7
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	0.81 GW & River Protection	18.5 GW & River Protection	32.0 GW Protection	22.0 River Protection	10.2 GW & River Protection
WAC 173-340 3-PART TEST								
95% UCL > Cleanup Limit?	NA	NA	NA	NA	NO	NA	YES	NO
> 10% above Cleanup Limit?	NA	NA	NA	NA	NO	NA	NO	NO
Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NO	NA	YES	NO
WAC 173-340 Compliance?	Because all values are below background (6.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-N Field Remediation
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/04/14
Job No. 14655

Calc. No. 0100N-CA-V0252
Checked I. B. Berezovskiy

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Date 03/04/14
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120-N-4 Statistical Calculations

Verification Data -Excavation (EXC)

Sample Area	Sample Number	Sample Date	Manganese mg/kg	Q	PQL	Mercury mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	252	X	0.095	0.0052	U	0.0052	11.0	X	0.12	36.7	X	0.089	34.3	X	0.38
Duplicate of J1T819	J1T828	1/23/2014	249	X	0.093	0.0063	U	0.0063	13.0	X	0.11	34.4	X	0.087	33.2	X	0.37
EXC-1	J1T816	1/23/2014	353	X	0.099	0.0054	UN	0.0054	9.6	X	0.12	64.8	X	0.093	49.0	X	0.39
EXC-2	J1T817	1/23/2014	256	X	0.098	0.0060	U	0.0060	13.1	X	0.12	39.3	X	0.092	35.9	X	0.39
EXC-3	J1T818	1/23/2014	242	X	0.10	0.029		0.0060	11.4	X	0.12	37.5	X	0.095	35.0	X	0.40
EXC-5	J1T820	1/23/2014	366	X	0.10	0.0070	U	0.0070	12.1	X	0.12	58.5	X	0.095	50.4	X	0.40
EXC-6	J1T821	1/23/2014	267	X	0.10	0.0070	U	0.0070	13.6	X	0.12	37.7	X	0.094	37.9	X	0.40
EXC-7	J1T822	1/23/2014	256	X	0.10	0.0062	B	0.0050	11.0	X	0.12	37.4	X	0.096	34.5	X	0.40
EXC-8	J1T823	1/23/2014	250	X	0.095	0.0057	U	0.0057	11.5	X	0.12	37.5	X	0.090	34.8	X	0.38
EXC-9	J1T824	1/23/2014	300	X	0.10	0.0072	B	0.0059	17.6	X	0.13	52.8	X	0.098	43.5	X	0.41
EXC-10	J1T825	1/23/2014	232	X	0.098	0.0087	B	0.0065	11.1	X	0.12	34.3	X	0.092	32.7	X	0.39
EXC-11	J1T826	1/23/2014	470	X	0.095	0.0075	B	0.0068	19.1	X	0.12	49.5	X	0.089	84.5	X	0.38
EXC-12	J1T827	1/23/2014	269	X	0.099	0.0066	B	0.0049	11.3	X	0.12	41.8	X	0.093	37.4	X	0.39

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Manganese mg/kg	Mercury mg/kg	Nickel mg/kg	Vanadium mg/kg	Zinc mg/kg
EXC-4	J1T819/J1T828	1/23/2014	251	0.0029	12.0	35.6	33.8
EXC-1	J1T816	1/23/2014	353	0.0027	9.6	64.8	49.0
EXC-2	J1T817	1/23/2014	256	0.0030	13.1	39.3	35.9
EXC-3	J1T818	1/23/2014	242	0.029	11.4	37.5	35.0
EXC-5	J1T820	1/23/2014	366	0.0035	12.1	58.5	50.4
EXC-6	J1T821	1/23/2014	267	0.0035	13.6	37.7	37.9
EXC-7	J1T822	1/23/2014	256	0.0062	11.0	37.4	34.5
EXC-8	J1T823	1/23/2014	250	0.0029	11.5	37.5	34.8
EXC-9	J1T824	1/23/2014	300	0.0072	17.6	52.8	43.5
EXC-10	J1T825	1/23/2014	232	0.0087	11.1	34.3	32.7
EXC-11	J1T826	1/23/2014	470	0.0075	19.1	49.5	84.5
EXC-12	J1T827	1/23/2014	269	0.0066	11.3	41.8	37.4

Statistical Computations

	Manganese	Mercury	Nickel	Vanadium	Zinc
95% UCL based on	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
N	12	12	12	12	12
% < Detection limit	0%	50%	0%	0%	0%
Mean	293	0.0070	12.8	43.9	42.4
Standard deviation	70.2	0.0073	2.8	10.0	14.5
95% UCL on mean	326	0.010	14.1	48.7	49.3
Maximum value	470	0.029	19.1	64.8	84.5
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	512 GW Protection	0.33 GW & River Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection
WAC 173-340 3-PART TEST					
95% UCL > Cleanup Limit?	NA	NA	NO	NA	NO
> 10% above Cleanup Limit?	NA	NA	NO	NA	NO
Any sample > 2X Cleanup Limit?	NA	NA	NO	NA	NO
WAC 173-340 Compliance?	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.33 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

Qualifiers are defined on page 3.

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-N Field Remediation
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/04/14
Job No. 14655

Calc. No. 0100N-CA-V0252
Checked I. B. Berezovskiy

Rev. No. 0
Date 03/04/14
Sheet No. 7 of 12

1 **120-N-4 Maximum Calculations**
2 **Verification Data -Excavation (EXC)**

3	Sample	Sample	Sample	Boron			Molybdenum			Benzo(a)anthracene			Chrysene			Pyrene			Aroclor-1254		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-4	J1T819	1/23/2014	0.93	U	0.93	0.25	U	0.25	3.2	U	3.2	4.8	U	4.8	12	U	12	2.6	U	2.6
6	Duplicate of J1T819	J1T828	1/23/2014	0.91	U	0.91	0.24	U	0.24	3.2	U	3.2	4.9	U	4.9	12	U	12	2.6	U	2.6
7	EXC-1	J1T816	1/23/2014	0.97	U	0.97	0.28	B	0.26	3.3	U	3.3	5.1	U	5.1	13	U	13	2.6	U	2.6
8	EXC-2	J1T817	1/23/2014	0.96	U	0.96	0.25	U	0.25	3.2	U	3.2	4.9	U	4.9	12	U	12	2.6	U	2.6
9	EXC-3	J1T818	1/23/2014	0.99	U	0.99	0.26	U	0.26	3.1	U	3.1	6.1	J	4.7	12	U	12	2.5	U	2.5
10	EXC-5	J1T820	1/23/2014	1.1	B	0.99	0.26	U	0.26	3.5	U	3.5	5.3	U	5.3	13	U	13	2.8	U	2.8
11	EXC-6	J1T821	1/23/2014	1.3	B	0.98	0.26	U	0.26	3.1	U	3.1	4.8	U	4.8	12	U	12	2.5	U	2.5
12	EXC-7	J1T822	1/23/2014	1.4	B	1.0	0.26	U	0.26	3.1	U	3.1	4.8	U	4.8	12	U	12	2.6	U	2.6
13	EXC-8	J1T823	1/23/2014	0.93	U	0.93	0.25	U	0.25	3.1	U	3.1	4.7	U	4.7	12	U	12	2.6	U	2.6
14	EXC-9	J1T824	1/23/2014	1.0	U	1.0	0.27	U	0.27	3.5	U	3.5	5.3	U	5.3	13	U	13	2.9	U	2.9
15	EXC-10	J1T825	1/23/2014	0.96	U	0.96	0.26	U	0.26	3.1	U	3.1	4.7	U	4.7	12	U	12	3.3	J	2.4
16	EXC-11	J1T826	1/23/2014	3.0		0.93	2.5		0.25	4.6	J	3.1	6.5	J	4.6	14	J	11	19		2.5
17	EXC-12	J1T827	1/23/2014	0.97	U	0.97	0.26	U	0.26	3.1	U	3.1	4.7	U	4.7	12	U	12	2.7	U	2.7

18 **Statistical Computations**

19		Boron		Molybdenum		Benzo(a)anthracene		Chrysene		Pyrene		Aroclor-1254	
20	% < Detection limit	67%		83%		92%		83%		92%		83%	
21	Maximum value	3.0		2.5		4.6		6.5		14		19	
22	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless otherwise noted**	320	GW Protection	8	GW Protection	15 ug/kg	GW & River Protection	100 ug/kg	River Protection	48000 ug/kg	GW Protection	17 ug/kg	GW & River Protection
23	**3-PART TEST**												
24	Maximum > Cleanup Limit?	NO		NO		NO		NO		NO		YES	
25	> 10% above Cleanup Limit?	NO		NO		NO		NO		NO		NO	
26	Any sample > 2X Cleanup Limit?	NO		NO		NO		NO		NO		NO	
27	**3-Part Test Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	

28 Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-N Field Remediation
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/04/14
Job No. 14655

Calc. No. 0100N-CA-V0252
Checked I. B. Berezovskiy

Rev. No. 0
Date 03/04/14
Sheet No. 8 of 10

Ecology Software (MTCAStat) Results, 120-N-4 Excavation (EXC)

Arsenic 95% UCL Calculation

DATA	ID
3.2	J1T819/J1T828
2.9	J1T816
3.1	J1T817
3.4	J1T818
3.6	J1T820
4.2	J1T821
2.9	J1T822
4.5	J1T823
3.8	J1T824
2.9	J1T825
4.6	J1T826
3.3	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	3.5
Censored		Lognormal mean	3.5
Detection limit or PQL		Std. devn.	0.62
Method detection limit		Median	3.4
TOTAL	12	Min.	2.9
		Max.	4.6

Lognormal distribution? r-squared is: 0.924
Normal distribution? r-squared is: 0.905
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 3.9

Barium 95% UCL Calculation

DATA	ID
53.5	J1T819/J1T828
52.0	J1T816
38.5	J1T817
37.6	J1T818
62.9	J1T820
42.2	J1T821
40.4	J1T822
53.8	J1T823
52.8	J1T824
34.1	J1T825
78.4	J1T826
43.3	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	49.1
Censored		Lognormal mean	49.2
Detection limit or PQL		Std. devn.	12.6
Method detection limit		Median	47.7
TOTAL	12	Min.	34.1
		Max.	78.4

Lognormal distribution? r-squared is: 0.947
Normal distribution? r-squared is: 0.895
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 56.4

Beryllium 95% UCL Calculation

DATA	ID
0.22	J1T819/J1T828
0.31	J1T816
0.23	J1T817
0.23	J1T818
0.36	J1T820
0.24	J1T821
0.23	J1T822
0.22	J1T823
0.31	J1T824
0.21	J1T825
0.31	J1T826
0.25	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	0.26
Censored		Lognormal mean	0.26
Detection limit or PQL		Std. devn.	0.049
Method detection limit		Median	0.24
TOTAL	12	Min.	0.21
		Max.	0.36

Lognormal distribution? r-squared is: 0.868
Normal distribution? r-squared is: 0.843
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.28

Cadmium 95% UCL Calculation

DATA	ID
0.16	J1T819/J1T828
0.16	J1T816
0.14	J1T817
0.15	J1T818
0.16	J1T820
0.19	J1T821
0.14	J1T822
0.14	J1T823
0.16	J1T824
0.13	J1T825
0.60	J1T826
0.14	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	0.19
Censored		Lognormal mean	0.18
Detection limit or PQL		Std. devn.	0.13
Method detection limit		Median	0.16
TOTAL	12	Min.	0.13
		Max.	0.60

Lognormal distribution? r-squared is: 0.513
Normal distribution? r-squared is: 0.399
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.25

Chromium 95% UCL Calculation

DATA	ID
10.6	J1T819/J1T828
5.9	J1T816
12.3	J1T817
11.5	J1T818
9.2	J1T820
13.1	J1T821
10.4	J1T822
10.9	J1T823
18.1	J1T824
9.6	J1T825
33.0	J1T826
10.7	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	12.9
Censored		Lognormal mean	12.9
Detection limit or PQL		Std. devn.	6.9
Method detection limit		Median	10.8
TOTAL	12	Min.	5.9
		Max.	33.0

Lognormal distribution? r-squared is: 0.832
Normal distribution? r-squared is: 0.653
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 16.2

Cobalt 95% UCL Calculation

DATA	ID
5.5	J1T819/J1T828
9.1	J1T816
6.5	J1T817
5.9	J1T818
9.3	J1T820
7.1	J1T821
6.1	J1T822
5.5	J1T823
8.2	J1T824
5.8	J1T825
9.4	J1T826
6.7	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	7.1
Censored		Lognormal mean	7.1
Detection limit or PQL		Std. devn.	1.5
Method detection limit		Median	6.6
TOTAL	12	Min.	5.5
		Max.	9.4

Lognormal distribution? r-squared is: 0.904
Normal distribution? r-squared is: 0.882
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 8.0

Copper 95% UCL Calculation

DATA	ID
13.5	J1T819/J1T828
18.4	J1T816
16.8	J1T817
16.7	J1T818
19.9	J1T820
18.8	J1T821
15.1	J1T822
12.5	J1T823
17.6	J1T824
15.8	J1T825
73.2	J1T826
17.1	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	21.3
Censored		Lognormal mean	20.6
Detection limit or PQL		Std. devn.	16.5
Method detection limit		Median	17.0
TOTAL	12	Min.	12.5
		Max.	73.2

Lognormal distribution? r-squared is: 0.583
Normal distribution? r-squared is: 0.417
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 29.1

Lead 95% UCL Calculation

DATA	ID
3.5	J1T819/J1T828
4.1	J1T816
3.3	J1T817
3.5	J1T818
5.3	J1T820
3.8	J1T821
3.2	J1T822
3.3	J1T823
5.3	J1T824
3.5	J1T825
11.7	J1T826
3.6	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	4.5
Censored		Lognormal mean	4.5
Detection limit or PQL		Std. devn.	2.4
Method detection limit		Median	3.6
TOTAL	12	Min.	3.2
		Max.	11.7

Lognormal distribution? r-squared is: 0.672
Normal distribution? r-squared is: 0.536
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 5.6

Manganese 95% UCL Calculation

DATA	ID
251	J1T819/J1T828
353	J1T816
256	J1T817
242	J1T818
366	J1T820
267	J1T821
256	J1T822
250	J1T823
300	J1T824
232	J1T825
470	J1T826
269	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	293
Censored		Lognormal mean	293
Detection limit or PQL		Std. devn.	70.2
Method detection limit		Median	262
TOTAL	12	Min.	232
		Max.	470

Lognormal distribution? r-squared is: 0.823
Normal distribution? r-squared is: 0.766
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 326

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-N Field Remediation
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/04/14
Job No. 14655

Calc. No. 0100N-CA-V0252
Checked I. B. Berezovskiy

Rev. No. 0
Date 03/04/14
Sheet No. 9 of 10

Ecology Software (MTCAStat) Results, 120-N-4 Excavation (EXC)

Mercury 95% UCL Calculation

DATA	ID
0.00288	J1T819/J1T828
0.0027	J1T816
0.0030	J1T817
0.029	J1T818
0.0035	J1T820
0.0035	J1T821
0.0062	J1T822
0.00285	J1T823
0.0072	J1T824
0.0087	J1T825
0.0075	J1T826
0.0066	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	0.0070
Censored		Lognormal mean	0.0067
Detection limit or PQL		Std. devn.	0.0073
Method detection limit		Median	0.0049
TOTAL	12	Min.	0.0027
		Max.	0.029

Lognormal distribution? r-squared is: 0.835
Normal distribution? r-squared is: 0.560
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.010

Nickel 95% UCL Calculation

DATA	ID
12.0	J1T819/J1T828
9.6	J1T816
13.1	J1T817
11.4	J1T818
12.1	J1T820
13.6	J1T821
11.0	J1T822
11.5	J1T823
17.6	J1T824
11.1	J1T825
19.1	J1T826
11.3	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	12.8
Censored		Lognormal mean	12.8
Detection limit or PQL		Std. devn.	2.8
Method detection limit		Median	11.8
TOTAL	12	Min.	9.6
		Max.	19.1

Lognormal distribution? r-squared is: 0.852
Normal distribution? r-squared is: 0.794
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 14.1

Vanadium 95% UCL Calculation

DATA	ID
35.6	J1T819/J1T828
64.8	J1T816
39.3	J1T817
37.5	J1T818
58.5	J1T820
37.7	J1T821
37.4	J1T822
37.5	J1T823
52.8	J1T824
34.3	J1T825
49.5	J1T826
41.8	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	43.9
Censored		Lognormal mean	43.9
Detection limit or PQL		Std. devn.	10.0
Method detection limit		Median	38.5
TOTAL	12	Min.	34.3
		Max.	64.8

Lognormal distribution? r-squared is: 0.864
Normal distribution? r-squared is: 0.833
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 48.7

Zinc 95% UCL Calculation

DATA	ID
33.8	J1T819/J1T828
49.0	J1T816
35.9	J1T817
35.0	J1T818
50.4	J1T820
37.9	J1T821
34.5	J1T822
34.8	J1T823
43.5	J1T824
32.7	J1T825
84.5	J1T826
37.4	J1T827

Number of samples		Uncensored values	
Uncensored	12	Mean	42.4
Censored		Lognormal mean	42.3
Detection limit or PQL		Std. devn.	14.5
Method detection limit		Median	36.7
TOTAL	12	Min.	32.7
		Max.	84.5

Lognormal distribution? r-squared is: 0.741
Normal distribution? r-squared is: 0.635
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 49.3

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 03/04/14 **Calc. No.** 0100N-CA-V0252 **Rev. No.** 0
Project 100-N Field Remediation **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 03/04/14
Subject 120-N-4 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 10 of 10

Duplicate Split Analysis - 120-N-4 Excavation (EXC)

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	6280	X	1.5	3.2		0.62	56.4	X	0.072	0.22		0.031	0.17	B	0.039	7320	X	13.3	10.8	X	0.055	5.4	X	0.095	13.8	X	0.21
Duplicate of J1T819	J1T828	1/23/2014	6270	X	1.4	3.2		0.61	50.5	X	0.070	0.21		0.031	0.15	B	0.038	7330	X	13.1	10.4	X	0.054	5.6	X	0.093	13.2	X	0.20
Split of J1T819	J1T830	1/23/2014	5390		6.77	3.29		0.497	49.4	0	0.0995	0.515		0.0995	0.10	U	0.10	7080		7.96	11.8		0.149	6.94	D	1.49	13.0		0.298

Analysis:

TDL		5	10	2	0.2	0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD	0.2%		11.0%			0.1%	3.8%		4.4%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)		**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD	15.3%		13.2%			3.3%	8.8%		6.0%
	Difference > 2 TDL?	Yes - assess further	No - acceptable	Yes - assess further	No - acceptable	Not applicable	Yes - assess further	No - acceptable	No - acceptable	No - acceptable

Duplicate Split Analysis - 120-N-4 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Nickel			Potassium			Silicon			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	15700	X	3.6	3.6		0.26	4790	X	3.5	252	X	0.095	11.0	X	0.12	925		38.8	131	NJ	5.4	205		55.8	36.7	X	0.089
Duplicate of J1T819	J1T828	1/23/2014	15100	X	3.5	3.4		0.25	5110	X	3.4	249	X	0.093	13.0	X	0.11	893		38.0	144	NJ	5.2	230		54.7	34.4	X	0.087
Split of J1T819	J1T830	1/23/2014	17500		7.96	3.28	DU	3.28	4760		8.46	276		0.199	12.6		0.149	887		6.37	377	N	1.49	125		6.96	45.9	D	0.995

Analysis:

TDL		5	5	75	5	4	400	2	50	2.5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD	3.9%		6.5%	1.2%			9.5%		6.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**		**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD	10.8%		0.6%	9.1%			*96.9%*		22.3%
	Difference > 2 TDL?	Yes - assess further	Not applicable	No - acceptable	Yes - assess further	No - acceptable	No - acceptable	Yes - assess further	No - acceptable	Yes - assess further

Duplicate Split Analysis - 120-N-4 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	34.3	X	0.38
Duplicate of J1T819	J1T828	1/23/2014	33.2	X	0.37
Split of J1T819	J1T830	1/23/2014	38.3	D	3.98

Analysis:

TDL		1
Duplicate Analysis	Both > PQL?	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**
	RPD	3.3%
	Difference > 2 TDL?	Not applicable
Split Analysis	Both > PQL?	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**
	RPD	11.0%
	Difference > 2 TDL?	Yes - assess further

Qualifiers are defined on page 3.

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	6280	X	1.5	0.36	UJ	0.36	3.2		0.62	56.4	X	0.072	0.22		0.031	0.93	U	0.93
Duplicate of J1T819	J1T828	1/23/2014	6270	X	1.4	0.35	UJ	0.35	3.2		0.61	50.5	X	0.070	0.21		0.031	0.91	U	0.91
EXC-1	J1T816	1/23/2014	5880	X	1.5	0.38	UJ	0.38	2.9		0.65	52.0	X	0.075	0.31		0.033	0.97	U	0.97
EXC-2	J1T817	1/23/2014	6320	X	1.5	0.37	UJ	0.37	3.1		0.64	38.5	X	0.074	0.23		0.032	0.96	U	0.96
EXC-3	J1T818	1/23/2014	6260	X	1.6	0.39	UJ	0.39	3.4		0.67	37.6	X	0.077	0.23		0.033	0.99	U	0.99
EXC-5	J1T820	1/23/2014	7670	X	1.6	0.38	UJ	0.38	3.6		0.67	62.9	X	0.077	0.36		0.033	1.1	B	0.99
EXC-6	J1T821	1/23/2014	6740	X	1.6	0.38	UJ	0.38	4.2		0.66	42.2	X	0.076	0.24		0.033	1.3	B	0.98
EXC-7	J1T822	1/23/2014	5900	X	1.6	0.39	UJ	0.39	2.9		0.67	40.4	X	0.077	0.23		0.034	1.4	B	1.0
EXC-8	J1T823	1/23/2014	6240	X	1.5	0.36	UJ	0.36	4.5		0.63	53.8	X	0.072	0.22		0.031	0.93	U	0.93
EXC-9	J1T824	1/23/2014	7470	X	1.6	0.40	UJ	0.40	3.8		0.69	52.8	X	0.079	0.31		0.034	1.0	U	1.0
EXC-10	J1T825	1/23/2014	6050	X	1.5	0.37	UJ	0.37	2.9		0.65	34.1	X	0.075	0.21		0.032	0.96	U	0.96
EXC-11	J1T826	1/23/2014	7920	X	1.5	0.36	UJ	0.36	4.6		0.62	78.4	X	0.072	0.31		0.031	3.0		0.93
EXC-12	J1T827	1/23/2014	6850	X	1.5	0.38	UJ	0.38	3.3		0.65	43.3	X	0.075	0.25		0.033	0.97	U	0.97
Split of J1T819	J1T830	1/23/2014	5390		6.77	3.28	DU	3.28	3.29		0.497	49.4		0.0995	0.515		0.0995	1.53	B	0.995
Equipment Blank	J1T829	1/23/2014	195	X	1.5	0.37	UJ	0.37	0.65	U	0.65	2.0	X	0.075	0.048	B	0.032	0.96	U	0.96

Sample Location	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	0.17	B	0.039	7320	X	13.3	10.8	X	0.055	5.4	X	0.095	13.8	X	0.21	15700	X	3.6
Duplicate of J1T819	J1T828	1/23/2014	0.15	B	0.038	7330	X	13.1	10.4	X	0.054	5.6	X	0.093	13.2	X	0.2	15100	X	3.5
EXC-1	J1T816	1/23/2014	0.16	B	0.040	5590	X	13.9	5.9	X	0.057	9.1	X	0.099	18.4	X	0.21	25500	X	3.8
EXC-2	J1T817	1/23/2014	0.14	B	0.040	8020	X	13.8	12.3	X	0.057	6.5	X	0.098	16.8	X	0.21	15800	X	3.7
EXC-3	J1T818	1/23/2014	0.15	B	0.042	10200	X	14.3	11.5	X	0.059	5.9	X	0.10	16.7	X	0.22	15600	X	3.9
EXC-5	J1T820	1/23/2014	0.16	B	0.041	9470	X	14.3	9.2	X	0.059	9.3	X	0.10	19.9	X	0.22	24400	X	3.8
EXC-6	J1T821	1/23/2014	0.19	B	0.041	14500	X	14.1	13.1	X	0.058	7.1	X	0.10	18.8	X	0.22	16100	X	3.8
EXC-7	J1T822	1/23/2014	0.14	B	0.042	6190	X	14.3	10.4	X	0.059	6.1	X	0.10	15.1	X	0.22	15900	X	3.9
EXC-8	J1T823	1/23/2014	0.14	B	0.039	6760	X	13.4	10.9	X	0.055	5.5	X	0.095	12.5	X	0.21	16000	X	3.6
EXC-9	J1T824	1/23/2014	0.16	B	0.043	12700	X	14.7	18.1	X	0.060	8.2	X	0.10	17.6	X	0.23	20400	X	4.0
EXC-10	J1T825	1/23/2014	0.13	B	0.040	8720	X	13.9	9.6	X	0.057	5.8	X	0.098	15.8	X	0.21	14600	X	3.7
EXC-11	J1T826	1/23/2014	0.60		0.039	5180	X	13.3	33.0	X	0.055	9.4	X	0.095	73.2	X	0.21	38200	X	3.6
EXC-12	J1T827	1/23/2014	0.14	B	0.040	9340	X	13.9	10.7	X	0.057	6.7	X	0.099	17.1	X	0.21	16700	X	3.8
Split of J1T819	J1T830	1/23/2014	0.10	U	0.0995	7080		7.96	11.8		0.149	6.94	D	1.49	13.0		0.298	17500		7.96
Equipment Blank	J1T829	1/23/2014	0.040	U	0.040	42.6	BX	13.8	0.16	BX	0.057	0.14	BX	0.098	0.27	BX	0.21	569	X	3.7

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

Gray cells indicate not applicable.

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

B = blank contamination (organic constituents) = Estimated (inorganic)

D = dilution

EXC = excavation

HEIS = Hanford Environmental Information System

J = estimated

M = sample duplicate precision not met.

N = recovery is outside the control limits

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

PEST = pesticides

PQL = practical quantitation limit

Q = qualifier

TPH = total petroleum hydrocarbons

U = undetected

X = serial dilution indicates that physical and chemical interferences are present.

Attachment	1	Sheet No.	1 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury			Molybdenum			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	3.6		0.26	4790	X	3.5	252	X	0.095	0.0052	U	0.0052	0.25	U	0.25	11.0	X	0.12
Duplicate of J1T819	J1T828	1/23/2014	3.4		0.25	5110	X	3.4	249	X	0.093	0.0063	U	0.0063	0.24	U	0.24	13.0	X	0.11
EXC-1	J1T816	1/23/2014	4.1		0.27	5360	X	3.7	353	X	0.099	0.0054	UN	0.0054	0.28	B	0.26	9.6	X	0.12
EXC-2	J1T817	1/23/2014	3.3		0.26	4610	X	3.6	256	X	0.098	0.0060	U	0.0060	0.25	U	0.25	13.1	X	0.12
EXC-3	J1T818	1/23/2014	3.5		0.27	4450	X	3.8	242	X	0.10	0.029		0.0060	0.26	U	0.26	11.4	X	0.12
EXC-5	J1T820	1/23/2014	5.3		0.27	5950	X	3.7	366	X	0.10	0.0070	U	0.0070	0.26	U	0.26	12.1	X	0.12
EXC-6	J1T821	1/23/2014	3.8		0.27	4760	X	3.7	267	X	0.10	0.0070	U	0.0070	0.26	U	0.26	13.6	X	0.12
EXC-7	J1T822	1/23/2014	3.2		0.27	4370	X	3.8	256	X	0.10	0.0062	B	0.0050	0.26	U	0.26	11.0	X	0.12
EXC-8	J1T823	1/23/2014	3.3		0.26	4850	X	3.5	250	X	0.095	0.0057	U	0.0057	0.25	U	0.25	11.5	X	0.12
EXC-9	J1T824	1/23/2014	5.3		0.28	5750	X	3.8	300	X	0.10	0.0072	B	0.0059	0.27	U	0.27	17.6	X	0.13
EXC-10	J1T825	1/23/2014	3.5		0.27	4150	X	3.6	232	X	0.098	0.0087	B	0.0065	0.26	U	0.26	11.1	X	0.12
EXC-11	J1T826	1/23/2014	11.7		0.26	4390	X	3.5	470	X	0.095	0.0075	B	0.0068	2.5		0.25	19.1	X	0.12
EXC-12	J1T827	1/23/2014	3.6		0.27	4480	X	3.7	269	X	0.099	0.0066	B	0.0049	0.26	U	0.26	11.3	X	0.12
Split of J1T819	J1T830	1/23/2014	3.28	DU	3.28	4760		8.46	276		0.199	0.00767	B	0.00408	0.406	B	0.199	12.6		0.149
Equipment Blank	J1T829	1/23/2014	0.43	B	0.26	30.8	X	3.6	6.3	X	0.098	0.0055	U	0.0055	0.25	U	0.25	0.17	BX	0.12

Sample Location	HEIS Number	Sample Date	Potassium			Selenium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	925		38.8	0.81	U	0.81	131	NJ	5.4	0.15	U	0.15	205		55.8	36.7	X	0.089
Duplicate of J1T819	J1T828	1/23/2014	893		38.0	0.80	U	0.80	144	NJ	5.2	0.15	U	0.15	230		54.7	34.4	X	0.087
EXC-1	J1T816	1/23/2014	942		40.5	0.85	U	0.85	175	NJ	5.6	0.16	U	0.16	273		58.3	64.8	X	0.093
EXC-2	J1T817	1/23/2014	956		40.1	0.84	U	0.84	175	NJ	5.5	0.16	U	0.16	264		57.7	39.3	X	0.092
EXC-3	J1T818	1/23/2014	910		41.6	0.87	U	0.87	182	NJ	5.7	0.16	U	0.16	217		59.8	37.5	X	0.095
EXC-5	J1T820	1/23/2014	1370		41.5	0.87	U	0.87	184	NJ	5.7	0.16	U	0.16	304		59.7	58.5	X	0.095
EXC-6	J1T821	1/23/2014	996		41.1	0.86	U	0.86	223	NJ	5.7	0.16	U	0.16	230		59.1	37.7	X	0.094
EXC-7	J1T822	1/23/2014	859		41.7	0.87	U	0.87	170	NJ	5.8	0.16	U	0.16	188		60.0	37.4	X	0.096
EXC-8	J1T823	1/23/2014	942		39.1	0.82	U	0.82	157	NJ	5.4	0.15	U	0.15	192		56.3	37.5	X	0.090
EXC-9	J1T824	1/23/2014	1410		42.6	0.89	U	0.89	182	NJ	5.9	0.17	U	0.17	349		61.3	52.8	X	0.098
EXC-10	J1T825	1/23/2014	752		40.3	0.85	U	0.85	176	NJ	5.6	0.16	U	0.16	290		58.0	34.3	X	0.092
EXC-11	J1T826	1/23/2014	1450		38.8	0.81	U	0.81	349	NJ	5.4	0.15	U	0.15	248		55.8	49.5	X	0.089
EXC-12	J1T827	1/23/2014	929		40.5	0.85	U	0.85	282	NJ	5.6	0.16	U	0.16	309		58.2	41.8	X	0.093
Split of J1T819	J1T830	1/23/2014	887		6.37	0.317	DU	0.317	377	N	1.49	0.0995	U	0.0995	125		6.96	45.9	D	0.995
Equipment Blank	J1T829	1/23/2014	54.9	B	40.2	0.84	U	0.84	95.9	NJ	5.5	0.16	U	0.16	57.8	U	57.8	0.62	BX	0.092

Attachment	1	Sheet No.	2 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
EXC-4	J1T819	1/23/2014	34.3	X	0.38
Duplicate of J1T819	J1T828	1/23/2014	33.2	X	0.37
EXC-1	J1T816	1/23/2014	49.0	X	0.39
EXC-2	J1T817	1/23/2014	35.9	X	0.39
EXC-3	J1T818	1/23/2014	35.0	X	0.40
EXC-5	J1T820	1/23/2014	50.4	X	0.40
EXC-6	J1T821	1/23/2014	37.9	X	0.40
EXC-7	J1T822	1/23/2014	34.5	X	0.40
EXC-8	J1T823	1/23/2014	34.8	X	0.38
EXC-9	J1T824	1/23/2014	43.5	X	0.41
EXC-10	J1T825	1/23/2014	32.7	X	0.39
EXC-11	J1T826	1/23/2014	84.5	X	0.38
EXC-12	J1T827	1/23/2014	37.4	X	0.39
Split of J1T819	J1T830	1/23/2014	38.3	D	3.98
Equipment Blank	J1T829	1/23/2014	1.9	XCUJ	0.39

Attachment	1	Sheet No.	3 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (TPH and Physical).

Sample Location	HEIS Number	Sample Date	TPH - Diesel Ext.			TPH- Diesel Range Organics (C10-C28)			TPH- Diesel Range Organics (C10-C20)			TPH - motor oil (high boiling)			% moisture (wet sample)		
			ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
EXC-4	J1T819	1/23/2014	5000	JBU	930	5000	JBU	640							2.0		0.10
Duplicate of J1T819	J1T828	1/23/2014	5000	JBU	1000	5000	JBU	680							1.9		0.10
EXC-1	J1T816	1/23/2014	5000	JBU	1000	5000	JBU	700							5.4		0.10
EXC-2	J1T817	1/23/2014	5000	BU	950	5000	JBU	650							2.5		0.10
EXC-3	J1T818	1/23/2014	5000	JBU	1000	5000	JBU	690							2.3		0.10
EXC-5	J1T820	1/23/2014	5000	JBU	1100	5000	JBU	720							10.9		0.10
EXC-6	J1T821	1/23/2014	5000	JBU	1000	5000	JBU	700							3.0		0.10
EXC-7	J1T822	1/23/2014	5000	JBU	980	5000	JBU	670							1.6		0.10
EXC-8	J1T823	1/23/2014	5000	JBU	980	5000	JBU	670							2.0		0.10
EXC-9	J1T824	1/23/2014	5000	JBU	1100	5000	JBU	750							10.9		0.10
EXC-10	J1T825	1/23/2014	5000	JBU	1000	5000	JBU	690							2.2		0.10
EXC-11	J1T826	1/23/2014	5000	BU	1000	5000	JBU	710							3.9		0.10
EXC-12	J1T827	1/23/2014	5000	JBU	990	5000	JBU	680							2.6		0.10
Split of J1T819	J1T830	1/23/2014							2210	U	2210	3470	J	2210			
Equipment Blank	J1T829	1/23/2014													0.10	U	0.10

Attachment	1	Sheet No.	4 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1T819, EXC-4			J1T828, Duplicate of J1T819			J1T816, EXC-1			J1T817, EXC-2		
		1/23/2014			1/23/2014			1/23/2014			1/23/2014		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.9	U	9.9	10	U	10	10	U	10	10	U	10
Acenaphthylene	PAH	8.9	U	8.9	9.0	U	9.0	9.4	U	9.4	9.1	U	9.1
Anthracene	PAH	3.0	U	3.0	3.1	U	3.1	3.2	U	3.2	3.1	U	3.1
Benzo(a)anthracene	PAH	3.2	U	3.2	3.2	U	3.2	3.3	U	3.3	3.2	U	3.2
Benzo(a)pyrene	PAH	6.4	U	6.4	6.4	U	6.4	6.7	U	6.7	6.5	U	6.5
Benzo(b)fluoranthene	PAH	4.2	U	4.2	4.2	U	4.2	4.4	U	4.4	4.2	U	4.2
Benzo(ghi)perylene	PAH	7.2	U	7.2	7.2	U	7.2	7.5	U	7.5	7.3	U	7.3
Benzo(k)fluoranthene	PAH	3.9	U	3.9	4.0	U	4.0	4.1	U	4.1	4.0	U	4.0
Chrysene	PAH	4.8	U	4.8	4.9	U	4.9	5.1	U	5.1	4.9	U	4.9
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	12	U	12	11	U	11
Fluoranthene	PAH	13	U	13	13	U	13	14	U	14	13	U	13
Fluorene	PAH	5.3	U	5.3	5.3	U	5.3	5.5	U	5.5	5.3	U	5.3
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	12	U	12	13	U	13	12	U	12
Naphthalene	PAH	12	U	12	12	U	12	13	U	13	12	U	12
Phenanthrene	PAH	12	U	12	12	U	12	13	U	13	12	U	12
Pyrene	PAH	12	U	12	12	U	12	13	U	13	12	U	12
Aroclor-1016	PCB	2.8	U	2.8	2.7	U	2.7	2.8	U	2.8	2.8	U	2.8
Aroclor-1221	PCB	8.1	U	8.1	7.9	U	7.9	8.1	U	8.1	8.1	U	8.1
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0
Aroclor-1242	PCB	4.7	U	4.7	4.6	U	4.6	4.7	U	4.7	4.7	U	4.7
Aroclor-1248	PCB	4.7	U	4.7	4.6	U	4.6	4.7	U	4.7	4.7	U	4.7
Aroclor-1254	PCB	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6
Aroclor-1260	PCB	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6
Aldrin	PEST	0.25	U	0.25	0.25	U	0.25	0.26	U	0.26	0.26	U	0.26
Alpha-BHC	PEST	0.21	U	0.21	0.21	U	0.21	0.22	U	0.22	0.22	U	0.22
alpha-Chlordane	PEST	0.32	U	0.32	0.32	U	0.32	0.34	U	0.34	0.33	U	0.33
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.66	U	0.66	0.65	U	0.65	0.69	U	0.69	0.68	U	0.68
Delta-BHC	PEST	0.40	U	0.40	0.39	U	0.39	0.42	U	0.42	0.41	U	0.41
Dichlorodiphenyldichloroethane	PEST	0.54	U	0.54	0.54	U	0.54	0.57	U	0.57	0.56	U	0.56
Dichlorodiphenyldichloroethylene	PEST	0.24	U	0.24	0.23	U	0.23	0.25	U	0.25	0.24	U	0.24
Dichlorodiphenyltrichloroethane	PEST	0.59	U	0.59	0.58	U	0.58	0.62	U	0.62	0.60	U	0.60
Dieldrin	PEST	0.21	U	0.21	0.21	U	0.21	0.22	U	0.22	0.21	U	0.21
Endosulfan I	PEST	0.18	U	0.18	0.17	U	0.17	0.18	U	0.18	0.18	U	0.18
Endosulfan II	PEST	0.29	U	0.29	0.28	U	0.28	0.30	U	0.30	0.29	U	0.29
Endosulfan sulfate	PEST	0.28	U	0.28	0.27	U	0.27	0.29	U	0.29	0.28	U	0.28
Endrin	PEST	0.31	U	0.31	0.30	U	0.30	0.32	U	0.32	0.31	U	0.31
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.18	U	0.18	0.17	U	0.17
Endrin ketone	PEST	0.49	U	0.49	0.48	U	0.48	0.51	U	0.51	0.50	U	0.50
Gamma-BHC (Lindane)	PEST	0.46	U	0.46	0.45	U	0.45	0.49	U	0.49	0.47	U	0.47
gamma-Chlordane	PEST	0.27	U	0.27	0.26	U	0.26	0.28	U	0.28	0.27	U	0.27
Heptachlor	PEST	0.21	U	0.21	0.21	U	0.21	0.22	U	0.22	0.22	U	0.22
Heptachlor epoxide	PEST	0.42	U	0.42	0.42	U	0.42	0.45	U	0.45	0.44	U	0.44
Methoxychlor	PEST	0.45	U	0.45	0.44	U	0.44	0.47	U	0.47	0.46	U	0.46
Toxaphene	PEST	16	UJ	16	15	UJ	15	17	UJ	17	16	UJ	16

Attachment	1	Sheet No.	5 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1T818, EXC-3			J1T820, EXC-5			J1T821, EXC-6			J1T822, EXC-7		
		1/23/2014			1/23/2014			1/23/2014			1/23/2014		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.8	U	9.8	11	U	11	9.8	U	9.8	9.9	U	9.9
Acenaphthylene	PAH	8.8	U	8.8	9.8	U	9.8	8.8	U	8.8	8.9	U	8.9
Anthracene	PAH	3.0	U	3.0	3.3	U	3.3	3.0	U	3.0	3.0	U	3.0
Benzo(a)anthracene	PAH	3.1	U	3.1	3.5	U	3.5	3.1	U	3.1	3.1	U	3.1
Benzo(a)pyrene	PAH	6.3	U	6.3	7.0	U	7.0	6.3	U	6.3	6.3	U	6.3
Benzo(b)fluoranthene	PAH	4.1	U	4.1	4.6	U	4.6	4.1	U	4.1	4.1	U	4.1
Benzo(ghi)perylene	PAH	7.0	U	7.0	7.8	U	7.8	7.1	U	7.1	7.1	U	7.1
Benzo(k)fluoranthene	PAH	3.9	U	3.9	4.3	U	4.3	3.9	U	3.9	3.9	U	3.9
Chrysene	PAH	6.1	J	4.7	5.3	U	5.3	4.8	U	4.8	4.8	U	4.8
Dibenz[a,h]anthracene	PAH	11	U	11	12	U	12	11	U	11	11	U	11
Fluoranthene	PAH	13	U	13	14	U	14	13	U	13	13	U	13
Fluorene	PAH	5.2	U	5.2	5.7	U	5.7	5.2	U	5.2	5.2	U	5.2
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	13	U	13	12	U	12	12	U	12
Naphthalene	PAH	12	U	12	13	U	13	12	U	12	12	U	12
Phenanthrene	PAH	12	U	12	13	U	13	12	U	12	12	U	12
Pyrene	PAH	12	U	12	13	U	13	12	U	12	12	U	12
Aroclor-1016	PCB	2.7	U	2.7	3.0	U	3.0	2.6	U	2.6	2.8	U	2.8
Aroclor-1221	PCB	7.8	U	7.8	8.6	U	8.6	7.6	U	7.6	8.1	U	8.1
Aroclor-1232	PCB	1.9	U	1.9	2.1	U	2.1	1.9	U	1.9	2.0	U	2.0
Aroclor-1242	PCB	4.5	U	4.5	5.0	U	5.0	4.4	U	4.4	4.7	U	4.7
Aroclor-1248	PCB	4.5	U	4.5	5.0	U	5.0	4.4	U	4.4	4.7	U	4.7
Aroclor-1254	PCB	2.5	U	2.5	2.8	U	2.8	2.5	U	2.5	2.6	U	2.6
Aroclor-1260	PCB	2.5	U	2.5	2.8	U	2.8	2.5	U	2.5	2.6	U	2.6
Aldrin	PEST	0.26	U	0.26	0.27	U	0.27	0.24	U	0.24	0.24	U	0.24
Alpha-BHC	PEST	0.22	U	0.22	0.23	U	0.23	0.20	U	0.20	0.21	U	0.21
alpha-Chlordane	PEST	0.33	U	0.33	0.34	U	0.34	0.31	U	0.31	0.31	U	0.31
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.68	U	0.68	0.71	U	0.71	0.63	U	0.63	0.64	U	0.64
Delta-BHC	PEST	0.41	U	0.41	0.43	U	0.43	0.38	U	0.38	0.39	U	0.39
Dichlorodiphenyldichloroethane	PEST	0.56	U	0.56	0.58	U	0.58	0.52	U	0.52	0.53	U	0.53
Dichlorodiphenyldichloroethylene	PEST	0.24	U	0.24	0.25	U	0.25	0.23	U	0.23	0.23	U	0.23
Dichlorodiphenyltrichloroethane	PEST	0.60	U	0.60	0.63	U	0.63	0.56	U	0.56	0.57	U	0.57
Dieldrin	PEST	0.21	U	0.21	0.22	U	0.22	0.20	U	0.20	0.20	U	0.20
Endosulfan I	PEST	0.18	U	0.18	0.19	U	0.19	0.17	U	0.17	0.17	U	0.17
Endosulfan II	PEST	0.29	U	0.29	0.31	U	0.31	0.27	U	0.27	0.28	U	0.28
Endosulfan sulfate	PEST	0.28	U	0.28	0.29	U	0.29	0.26	U	0.26	0.27	U	0.27
Endrin	PEST	0.31	U	0.31	0.33	U	0.33	0.29	U	0.29	0.29	U	0.29
Endrin aldehyde	PEST	0.17	U	0.17	0.18	U	0.18	0.16	U	0.16	0.16	U	0.16
Endrin ketone	PEST	0.50	U	0.50	0.52	U	0.52	0.47	U	0.47	0.47	U	0.47
Gamma-BHC (Lindane)	PEST	0.47	U	0.47	0.49	U	0.49	0.44	U	0.44	0.45	U	0.45
gamma-Chlordane	PEST	0.27	U	0.27	0.28	U	0.28	0.25	U	0.25	0.26	U	0.26
Heptachlor	PEST	0.22	U	0.22	0.23	U	0.23	0.20	U	0.20	0.21	U	0.21
Heptachlor epoxide	PEST	0.43	U	0.43	0.45	U	0.45	0.41	U	0.41	0.41	U	0.41
Methoxychlor	PEST	0.46	U	0.46	0.48	U	0.48	0.43	U	0.43	0.43	U	0.43
Toxaphene	PEST	16	UJ	16	17	UJ	17	15	UJ	15	15	UJ	15

Attachment	1	Sheet No.	6 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1T823, EXC-8			J1T824, EXC-9			J1T825, EXC-10			J1T826, EXC-11		
		1/23/2014 8:20			1/23/2014 8:25			1/23/2014 8:30			1/23/2014 8:35		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.8	U	9.8	11	U	11	9.8	U	9.8	9.6	U	9.6
Acenaphthylene	PAH	8.8	U	8.8	9.9	U	9.9	8.8	U	8.8	8.6	U	8.6
Anthracene	PAH	3.0	U	3.0	3.4	U	3.4	3.0	U	3.0	2.9	U	2.9
Benzo(a)anthracene	PAH	3.1	U	3.1	3.5	U	3.5	3.1	U	3.1	4.6	J	3.1
Benzo(a)pyrene	PAH	6.3	U	6.3	7.1	U	7.1	6.3	U	6.3	6.1	U	6.1
Benzo(b)fluoranthene	PAH	4.1	U	4.1	4.6	U	4.6	4.1	U	4.1	4.0	U	4.0
Benzo(ghi)perylene	PAH	7.0	U	7.0	8.0	U	8.0	7.0	U	7.0	6.9	U	6.9
Benzo(k)fluoranthene	PAH	3.9	U	3.9	4.4	U	4.4	3.8	U	3.8	3.8	U	3.8
Chrysene	PAH	4.7	U	4.7	5.3	U	5.3	4.7	U	4.7	6.5	J	4.6
Dibenz[a,h]anthracene	PAH	11	U	11	12	U	12	11	U	11	11	U	11
Fluoranthene	PAH	13	U	13	14	U	14	13	U	13	12	U	12
Fluorene	PAH	5.2	U	5.2	5.8	U	5.8	5.2	U	5.2	5.1	U	5.1
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	13	U	13	12	U	12	11	U	11
Naphthalene	PAH	12	U	12	13	U	13	12	U	12	11	U	11
Phenanthrene	PAH	12	U	12	13	U	13	12	U	12	11	U	11
Pyrene	PAH	12	U	12	13	U	13	12	U	12	14	J	11
Aroclor-1016	PCB	2.8	U	2.8	3.1	U	3.1	2.6	U	2.6	2.6	U	2.6
Aroclor-1221	PCB	8.0	U	8.0	8.9	U	8.9	7.5	U	7.5	7.6	U	7.6
Aroclor-1232	PCB	2.0	U	2.0	2.2	U	2.2	1.9	U	1.9	1.9	U	1.9
Aroclor-1242	PCB	4.6	U	4.6	5.1	U	5.1	4.3	U	4.3	4.4	U	4.4
Aroclor-1248	PCB	4.6	U	4.6	5.1	U	5.1	4.3	U	4.3	4.4	U	4.4
Aroclor-1254	PCB	2.6	U	2.6	2.9	U	2.9	3.3	J	2.4	19		2.5
Aroclor-1260	PCB	2.6	U	2.6	2.9	U	2.9	2.4	U	2.4	2.5	U	2.5
Aldrin	PEST	0.25	U	0.25	0.26	U	0.26	0.24	U	0.24	0.25	U	0.25
Alpha-BHC	PEST	0.21	U	0.21	0.22	U	0.22	0.21	U	0.21	0.21	U	0.21
alpha-Chlordane	PEST	0.32	U	0.32	0.34	U	0.34	0.31	U	0.31	0.32	U	0.32
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.66	U	0.66	0.69	U	0.69	0.64	U	0.64	0.65	U	0.65
Delta-BHC	PEST	0.40	U	0.40	0.42	U	0.42	0.38	U	0.38	0.39	U	0.39
Dichlorodiphenyldichloroethane	PEST	0.54	U	0.54	0.57	U	0.57	0.52	U	0.52	0.54	U	0.54
Dichlorodiphenyldichloroethylene	PEST	0.24	U	0.24	0.25	U	0.25	0.23	U	0.23	0.23	U	0.23
Dichlorodiphenyltrichloroethane	PEST	0.59	U	0.59	0.61	U	0.61	0.57	U	0.57	0.58	U	0.58
Dieldrin	PEST	0.21	U	0.21	0.22	U	0.22	0.20	U	0.20	0.21	U	0.21
Endosulfan I	PEST	0.17	U	0.17	0.18	U	0.18	0.17	U	0.17	0.17	U	0.17
Endosulfan II	PEST	0.29	U	0.29	0.30	U	0.30	0.28	U	0.28	0.28	U	0.28
Endosulfan sulfate	PEST	0.27	U	0.27	0.29	U	0.29	0.26	U	0.26	0.27	U	0.27
Endrin	PEST	0.30	U	0.30	0.32	U	0.32	0.29	U	0.29	0.30	U	0.30
Endrin aldehyde	PEST	0.17	U	0.17	0.18	U	0.18	0.16	U	0.16	0.17	U	0.17
Endrin ketone	PEST	0.49	U	0.49	0.51	U	0.51	0.47	U	0.47	0.48	U	0.48
Gamma-BHC (Lindane)	PEST	0.46	U	0.46	0.48	U	0.48	0.44	U	0.44	0.46	U	0.46
gamma-Chlordane	PEST	0.26	U	0.26	0.28	U	0.28	0.25	U	0.25	0.26	U	0.26
Heptachlor	PEST	0.21	U	0.21	0.22	U	0.22	0.21	U	0.21	0.21	U	0.21
Heptachlor epoxide	PEST	0.42	U	0.42	0.44	U	0.44	0.41	U	0.41	0.42	U	0.42
Methoxychlor	PEST	0.45	U	0.45	0.47	U	0.47	0.43	U	0.43	0.44	U	0.44
Toxaphene	PEST	16	UJ	16	16	UJ	16	15	UJ	15	16	UJ	16

Attachment	1	Sheet No.	7 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	Rev. No.	0

Attachment 1. 120-N-4 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1T827			J1T830, Split of J1T819		
		1/23/2014			1/23/2014		
		ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.7	U	9.7	5.09	U	5.09
Acenaphthylene	PAH	8.7	U	8.7	5.09	U	5.09
Anthracene	PAH	3.0	U	3.0	1.70	U	1.70
Benzo(a)anthracene	PAH	3.1	U	3.1	0.543	U	0.543
Benzo(a)pyrene	PAH	6.2	U	6.2	0.543	U	0.543
Benzo(b)fluoranthene	PAH	4.1	U	4.1	0.543	U	0.543
Benzo(ghi)perylene	PAH	7.0	U	7.0	0.543	U	0.543
Benzo(k)fluoranthene	PAH	3.8	U	3.8	0.271	U	0.271
Chrysene	PAH	4.7	U	4.7	0.543	U	0.543
Dibenz[a,h]anthracene	PAH	11	U	11	0.543	U	0.543
Fluoranthene	PAH	13	U	13	0.543	U	0.543
Fluorene	PAH	5.1	U	5.1	5.09	U	5.09
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	0.543	U	0.543
Naphthalene	PAH	12	U	12	5.09	U	5.09
Phenanthrene	PAH	12	U	12	5.09	U	5.09
Pyrene	PAH	12	U	12	0.543	U	0.543
Aroclor-1016	PCB	2.8	U	2.8	1.13	U	1.13
Aroclor-1221	PCB	8.2	U	8.2	1.13	U	1.13
Aroclor-1232	PCB	2.1	U	2.1	1.13	U	1.13
Aroclor-1242	PCB	4.8	U	4.8	1.13	U	1.13
Aroclor-1248	PCB	4.8	U	4.8	1.13	U	1.13
Aroclor-1254	PCB	2.7	U	2.7	1.13	U	1.13
Aroclor-1260	PCB	2.7	U	2.7	1.13	U	1.13
Aldrin	PEST	0.24	U	0.24	0.170	U	0.170
Alpha-BHC	PEST	0.21	U	0.21	0.170	U	0.170
alpha-Chlordane	PEST	0.31	U	0.31	0.170	U	0.170
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.64	U	0.64	0.170	U	0.170
Delta-BHC	PEST	0.39	U	0.39	0.170	U	0.170
Dichlorodiphenyldichloroethane	PEST	0.53	U	0.53	0.340	U	0.340
Dichlorodiphenyldichloroethylene	PEST	0.23	U	0.23	0.340	U	0.340
Dichlorodiphenyltrichloroethane	PEST	0.57	U	0.57	0.340	U	0.340
Dieldrin	PEST	0.20	U	0.20	0.340	U	0.340
Endosulfan I	PEST	0.17	U	0.17	0.170	U	0.170
Endosulfan II	PEST	0.28	U	0.28	0.340	U	0.340
Endosulfan sulfate	PEST	0.27	U	0.27	0.340	U	0.340
Endrin	PEST	0.30	U	0.30	0.340	U	0.340
Endrin aldehyde	PEST	0.17	U	0.17	0.340	U	0.340
Endrin ketone	PEST	0.47	U	0.47	0.340	U	0.340
Gamma-BHC (Lindane)	PEST	0.45	U	0.45	0.170	U	0.170
gamma-Chlordane	PEST	0.26	U	0.26	0.170	U	0.170
Heptachlor	PEST	0.21	U	0.21	0.170	U	0.170
Heptachlor epoxide	PEST	0.41	U	0.41	0.170	U	0.170
Methoxychlor	PEST	0.43	U	0.43	1.70	U	1.70
Toxaphene	PEST	15	UJ	15	5.67	U	5.67

Attachment	1	Sheet No.	8 of 8
Originator	N. K. Schiffern	Date	03/04/14
Checked	I. B. Berezovskiy	Date	03/04/14
Calc. No.	0100N-CA-V0252	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-V0254

Subject: 120-N-4 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	I. B. Berezovskiy	J. D. Skoglie	N. K. Schiffern	D. F. Obenauer	4/30/14

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:	I.B. Berezovskiy	Date:	03/18/14	Calc. No.:	0100N-CA-V0254	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	03/18/14
Subject:	120-N-4 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 120-N-4 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, *120-N-4 Waste Site Cleanup Verification 95% UCL Calculation,* 0100N-CA-V0252, Rev. 0, 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 $<1 \times 10^{-5}$.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I.B. Berezovskiy	Date:	03/18/14	Calc. No.:	0100N-CA-V0254	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	03/18/14
Subject:	120-N-4 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 120-N-4 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 120-N-4 waste site were conservatively calculated for the entire waste site using the statistical or maximum value for each analyte (WCH 2014). Based on the generic site RESRAD model (DOE-RL 2013) and a vadose zone of approximately 19.5 m (64 ft) thickness, a K_d of 3.8 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 3.8, 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 3.8. 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 or statistical 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 3.0 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 9.4×10^{-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 120-N-4 waste site is 9.4×10^{-3}. 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, 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:	I.B. Berezovskiy	Date:	03/18/14	Calc. No.:	0100N-CA-V0254	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	03/18/14
Subject:	120-N-4 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 120-N-4 Waste Site.

Contaminants of Potential Concern[a]	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	3.0	320	9.4E-03	--	--
Totals					
Cumulative Hazard Quotient:			**9.4E-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 120-N-4 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).

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental Calculation No: 0100N-CA-V0255

Subject: 120-N-4 Waste Site 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 = 3 Total = 4	I. B. Berezovskiy	J. D. Skoglie	N. K. Schiffern	D. F. Obenauer	4/30/14

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	3/18/2014	Calc. No.:	0100N-CA-V0255	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	3/18/2014
Subject:	120-N-4 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 120-N-4 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.

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

4) WCH, 2014, *120-N-4 Waste Site Cleanup Verification 95% UCL Calculation*, 0100N-CA-V0252, Rev. 0, 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).

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	3/18/2014	Calc. No.:	0100N-CA-V0255	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	3/18/2014
Subject:	120-N-4 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 3	

METHODOLOGY:

The 120-N-4 waste site is comprised of one decision unit for verification sampling consisting of an excavation area. The direct contact hazard quotient and carcinogenic risk calculations for the 120-N-4 waste site were conservatively calculated for the entire waste site using the greater of the maximum or statistical verification soil sample results (WCH 2014). Of the contaminants of potential concern (COPCs) for this site, boron, molybdenum, aroclor-1254 and the detected polycyclic aromatic hydrocarbons require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Copper requires HQ and risk calculations because it 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 3.0 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]), is 1.9×10^{-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 2.8×10^{-2}. 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}. For example, the maximum value for aroclor-1254 is 0.019 mg/kg, divided by 0.5 mg/kg, and multiplied as indicated, is 3.8×10^{-8}. Comparing this value, and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

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. The sum of the excess cancer risk values is 4.1×10^{-8}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Table 1 shows the results of the hazard quotient and excess cancer risk calculations.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	3/18/2014	Calc. No.:	0100N-CA-V0255	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	3/18/2014
Subject:	120-N-4 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 3

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for 120-N-4 Waste Site

Contaminants of Potential Concern	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	3.0	16,000	1.9E-04	--	--
Copper	29.1	2,960	9.8E-03	--	--
Molybdenum	2.50	400	6.3E-03	--	--
Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene	0.0046	--	--	1.37	3.4E-09
Chrysene	0.0065	--	--	137	4.7E-11
Pyrene	0.014	2,400	5.8E-06	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.019	1.6	1.2E-02	0.5	3.8E-08
Totals					
Cumulative Hazard Quotient:			**2.8E-02**		
Cumulative Excess Cancer Risk:					**4.1E-08**

Notes:

[a] = From WCH (2014).

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

RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 120-N-4 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2013) and SAP (DOE-RL 2006). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

APPENDIX D

DATA QUALITY ASSESSMENT

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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 SAP data assurance requirements and the data validation procedure for chemical analysis (BHI 2000) are 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 120-N-4 waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG JP0711 and SDG XP0040. SDG JP0711 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 120-N-4 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 JP0711

This SDG comprises 12 statistical soil samples (J1T816 through J1T827) collected from the 120-N-4 excavation area. This SDG includes one field duplicate pair (J1T819/J1T828). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, pesticides, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAH). In addition, one equipment blank (J1T829) was collected and analyzed for ICP metals and mercury. SDG JP0711 was submitted for third-party validation. Minor deficiencies are as follows:

In the TPH analysis, due to method blank (MB) contamination, all diesel range extended results (except J1T826) were raised to the required quantitation level (RQL), qualified as undetected, and flagged “U” by third-party validation. Also, third-party validation qualified diesel range

extended results in sample J1T826 as undetected, with "U" flags. The data are usable for decision-making purposes.

In the TPH analysis, due to MB contamination, all diesel range data in SDG JP0711, were raised to the RQL, and qualified as undetected, with "U" flags, by third-party validation. The data are usable for decision-making purposes.

In the ICP metals analysis, zinc was detected in the MB. Zinc results in sample J1T829 were qualified as undetected, with "U" flags, by third-party validation. The data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are outside the project acceptance criteria for four analytes (aluminum [1,241%], antimony [52%], iron [1,391%], and silicon [26%]). For aluminum and iron the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. All antimony and silicon data were qualified by third-party validation as estimated, with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery is outside the quality control (QC) limit for silicon (9%). Third-party validation qualified all silicon data in SDG JP0711 as estimated, with "J" flags. Estimated data are usable for decision-making purposes.

In the pesticide analysis, due to the lack of MS, matrix spike duplicate (MSD), and LCS analysis for toxaphene, third-party validation qualified all toxaphene data as estimated, with "J" flags. Estimated data are usable for decision-making purposes.

SDG XP0040

This SDG comprises one statistical soil sample (J1T830) collected from the 120-N-4 excavation area. Field sample J1T830 is a split sample associated with sample J1T819. This sample was analyzed for ICP metals, mercury, pesticides, TPH, PCBs, and PAH. Minor deficiencies are as follows:

In the pesticide analysis, the MS, MSD, and LCS analyses were not performed for toxaphene. Although not qualified for the lack of the MS, MSD, and LCS analysis, toxaphene data in SDG XP0040 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, manganese, potassium, and zinc were detected at less than twice the method detection limit in the MB. Method blank contamination of this magnitude has no significant impact on the field sample results. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are outside the project acceptance criteria for silicon (48.9%). The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS deficiency, all silicon data in SDG XP0040 may be considered estimated. Estimated data are usable for decision-making purposes.

In the TPH analysis, although the method was the same as the TPH analysis method performed by the laboratory for SDG JP0711, the laboratory techniques differed for the quantified hydrocarbon range. Due to these differences, the TPH data from SDG JP0711 and SDG XP0040 cannot be directly compared. The 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
120-N-4 Excavation	J1T819	J1T828	J1T830

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 relative percent difference (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. The calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation.

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. Minor deficiencies for the field duplicates and split samples are as follows:

None of the RPDs calculated for the field duplicate sample are above the acceptance criteria (30%). In the split evaluation, the RPD calculated for silicon (96.9%) was above the field split acceptance criteria (less than 35%). 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 split) 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. Split 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 120-N-4 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 120-N-4 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.

REFERENCES

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

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.

EPA, 2006, *Guidance on Systematic Planning using the Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

WCH, 2014a, *100-N Field Remediation and Sampling*, Logbook EL-1652-11, pp. 40-43, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *Work Instruction for Verification Sampling of the 120-N-4; 1310-N Hazardous Waste Storage Area; 1310-N Non-Hazardous Waste Pad; 1310-N Waste Oil Storage Pad*, 0100N-WI-G0081, Rev. 0, Washington Closure Hanford, Richland, Washington.