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

1220150

13-AMRP-0149

APR 04 2013

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 NO. 2012-119 AND SUPPORTING DOCUMENTATION FOR THE 120-N-3, 163-N NEUTRALIZATION PIT AND FRENCH DRAIN, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2012-119 and supporting "Remaining Sites Verification Package for the 120-N-3, 163-N Neutralization Pit and French Drain," Rev. 0. If you have questions, please contact me or your staff may contact Joanne Chance, of my staff, on (509) 376-0811.

Sincerely,

Mark S. French, Federal Project Director
for the River Corridor Division

AMRP: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
T. Q. Howell, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC

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100-NR-1

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-119

Waste Site Code(s)/Subsite Code(s): 120-N-3

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 120-N-3, 163-N Neutralization Pit and French Drain waste site was identified as a 100-NR-1 Operable Unit waste site requiring remediation in 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). The 120-N-3 waste site received unknown amounts of corrosive liquids from December 1963 to March 1988. Intermittent, small releases of sulfuric acid and sodium hydroxide were discharged to the french drain from the 163-N Demineralized Water Treatment Plant day storage tanks.

Remedial action at the 120-N-3 waste site was performed between August 10, 2011, and January 31, 2012. The waste site was excavated to an approximate depth of 5 m (16.4 ft) resulting in approximately 3,917 bank cubic meters (5,123 bank cubic yards) of contaminated soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF).

Cleanup verification sampling was performed on August 6, 2012, to determine if the waste site met the remedial action objectives and remedial action goals (RAGs) established by 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 the ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Suspect oil staining unrelated to the 120-N-3 waste site was visible on the east sidewall of the excavation following the completion of the waste site remediation; therefore, informational in-process samples were collected within the stained area and analyzed for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs). Elevated concentrations of TPH and PAHs were present in the samples. This staining is considered part of the 100-N-106 waste site and no additional remediation was performed in this area.

Basis for reclassification:

Cleanup verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 120-N-3 waste site to Interim Closed Out. The current site conditions achieve the RAGs established by the 100-N Area ROD (EPA 1999). The evaluation (which includes consideration of fate-and-transport modeling and site-specific observations) of all data collected from the waste site resulted in a determination 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. Remediation did not extend significantly beyond 4.6 m (15 ft) deep and contamination is concluded to not exist further in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soils are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 120-N-3, 163-N Neutralization Pit and French Drain* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-119

Waste Site Code(s)/Subsite Code(s): 120-N-3

Regulator comments:

Approval of this Waste Site Reclassification Form documents the regulator's agreement that the 120-N-3 waste site qualifies for Interim Closed Out under this Interim Action ROD.

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	3/15/13
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	3/20/13
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 120-N-3, 163-N NEUTRALIZATION PIT AND FRENCH DRAIN

Attachment to Waste Site Reclassification Form 2012-119

April 2013

REMAINING SITES VERIFICATION PACKAGE FOR THE 120-N-3, 163-N NEUTRALIZATION PIT AND FRENCH DRAIN

EXECUTIVE SUMMARY

The 120-N-3, 163-N Neutralization Pit and French Drain waste site was identified as a 100-NR-1 Operable Unit waste site requiring remediation in 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-3, 163-N Neutralization Pit and French Drain waste site was a nonradioactive, hazardous liquid waste site that operated from December 1963 to March 1988 and received unknown amounts of corrosive liquids (WHC 1994). Intermittent, small releases of sulfuric acid and sodium hydroxide were discharged into the french drain from the 163-N Demineralized Water Treatment Plant day storage tanks (WHC 1994).

Remediation of the 120-N-3 waste site was performed between August 10, 2011, and January 31, 2012. The waste site was excavated to an approximate depth of 5.0 m (16.4 ft) resulting in approximately 3,917 bank cubic meters (5,123 bank cubic yards) of soil and debris being removed and disposed at the Environmental Restoration Disposal Facility.

Verification sampling was conducted on August 6, 2012. A summary of the cleanup evaluation for the soil sampling results against the applicable remedial action goals (RAGs) is presented in Table ES-1. The results of the verification sampling were used to make reclassification decisions for the 120-N-3 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-3 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 identified as COPCs for this site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	Concentrations of individual polycyclic aromatic hydrocarbons were above soil RAGs in several verification samples. However, these have been determined to be the result of cross-contamination from asphalt debris unrelated to the operation of the 120-N-3 waste site and are, therefore, not considered in attainment of direct exposure criteria. All other individual COPC concentrations are below the direct exposure RAGs.	Yes

Table ES-1. Summary of Remedial Action Goals for the 120-N-3 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
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 all sampling areas (8.6×10^{-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 total excess cancer risk (2.2×10^{-7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not identified as COPCs for this site.	NA
	Attain National Primary Drinking Water Regulations [a]: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	Residual concentrations of mercury, zinc, total PCBs (aroclor-1254 and aroclor-1260), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene 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 2006b), 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 the RESidual Radioactivity (RESRAD) modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006b) residual concentrations of mercury, zinc, total PCBs (aroclor-1254 and aroclor-1260), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are not predicted to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the lowest distribution coefficient of the contaminants [mercury and zinc] of 30 mL/g). The vadose zone underlying the excavation is approximately 15.5 m (50.9 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

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

Suspect oil staining unrelated to the 120-N-3 waste site was visible on the east sidewall of the excavation following the completion of the waste site remediation. Elevated concentrations of total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs) were present in informational in-process samples that were collected from three locations within the stained area. This staining is considered part of the 100-N-106 waste site (WCH 2012c) and no additional remediation was performed in this area. Elevated concentrations of PAHs were also observed in several verification samples outside of this area of staining, including exceedances of soil RAGs. These have been determined to be the result of cross-contamination with asphaltic debris and are not considered further in RAG attainment.

In accordance with this evaluation, the verification sampling results and modeling support a reclassification of the 120-N-3 waste site to Interim Closed Out. The current site conditions achieve the remedial action objectives (RAOs) and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (DOE-RL 2006b), 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 sample 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]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Remediation did not extend significantly into the deep zone and contamination is concluded to not exist further in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the 100-N Area ROD, a comparison against ecological risk screening levels has been made for the 120-N-3 waste site contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, mercury, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, manganese, vanadium, zinc, and high molecular weight PAH (benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and pyrene). Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below the Hanford Site or Washington State background values (note that background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 120-N-3, 163-N NEUTRALIZATION PIT AND FRENCH DRAIN

STATEMENT OF PROTECTIVENESS

The 120-N-3, 163-N Neutralization Pit and French Drain 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 2006b) 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. Remediation did not extend significantly into the deep zone and contamination is concluded to not exist further in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the 100-N Area ROD, a comparison against ecological risk screening levels has been made for the 120-N-3 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, mercury, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, manganese, vanadium, zinc, and high molecular weight polycyclic aromatic hydrocarbons (PAH) (benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and pyrene). Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below the Hanford Site or Washington State background values (note that background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 120-N-3, 163-N Neutralization Pit and French Drain waste site was a nonradioactive, hazardous liquid waste site that operated from December 1963 to March 1988 and received unknown amounts of corrosive liquids (WHC 1994). Intermittent, small releases of sulfuric acid and sodium hydroxide were discharged into the french drain from the 163-N Demineralized Water Treatment Plant day storage tanks (WHC 1994).

The 120-N-3, 163-N Neutralization Pit and French Drain was a concrete-walled pit that measured 10.2 m (33.3 ft) by 2.8 m (9 ft) and was 2.4 m (8 ft) deep. The bottom of the neutralization pit and french drain were open to the soil. The 120-N-3 waste site was located west of the 163-N Building (Figure 1). Figure 2 shows a photograph of the 120-N-3 concrete-walled pit, looking northwest. The photograph shows where the two pipelines from the 163-N facility day storage tanks entered the neutralization pit and french drain. The caustic material was released directly to the pit via the western-most pipe. The acid was released to the limestone filled french drain via the eastern most pipe. The french drain was located wholly within the concrete-walled pit.

REMEDIAL ACTION SUMMARY

Remedial action at the 120-N-3 waste site was performed August 10, 2011, through January 31, 2012, and continued to a depth of 5 m (16.4 ft) below ground surface resulting in approximately 3,917 bank cubic meters (5,123 bank cubic yards) of contaminated soil and debris removed for disposal at the Environmental Restoration Disposal Facility (ERDF). All material was direct-loaded from the excavation; therefore, no waste staging pile areas are associated with the site. Figure 3 is a post-remediation photograph of the site, looking towards the east slope. The final post-excavation civil survey is provided in Figure 4.

The waste material removed from the 120-N-3 waste site consisted of soil, concrete, and rebar. No anomalous materials were encountered during the excavation. There are no overburden piles or waste staging pile areas associated with the 120-N-3 waste site.

During remediation of the 120-N-3 waste site, suspect oil-stained soil was observed on the east sidewall of the excavation. This staining was not related to the 120-N-3 waste site, but informational in-process soil samples were collected from the stained area. Figure 5 shows the sample locations and the approximate observed area of the stain; sample results are presented in Appendix B. This staining will be addressed as part of the 100-N-106 waste site (WCH 2012c).

VERIFICATION SAMPLING ACTIVITIES

Verification sampling was conducted at the 120-N-3 waste site on August 6, 2012. Ion chromatography (IC) anions analysis was inadvertently removed from the chain of custody for sample J1PWD8 collected at sample location EXC-5; therefore, additional soil was collected from that location on October 22, 2012, and submitted to the laboratory for IC anions analysis as sample J1PWD8-A. 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 2006b) and 100-N Area ROD (EPA 1999).

Figure 1. The 120-N-3 Waste Site Location Map.

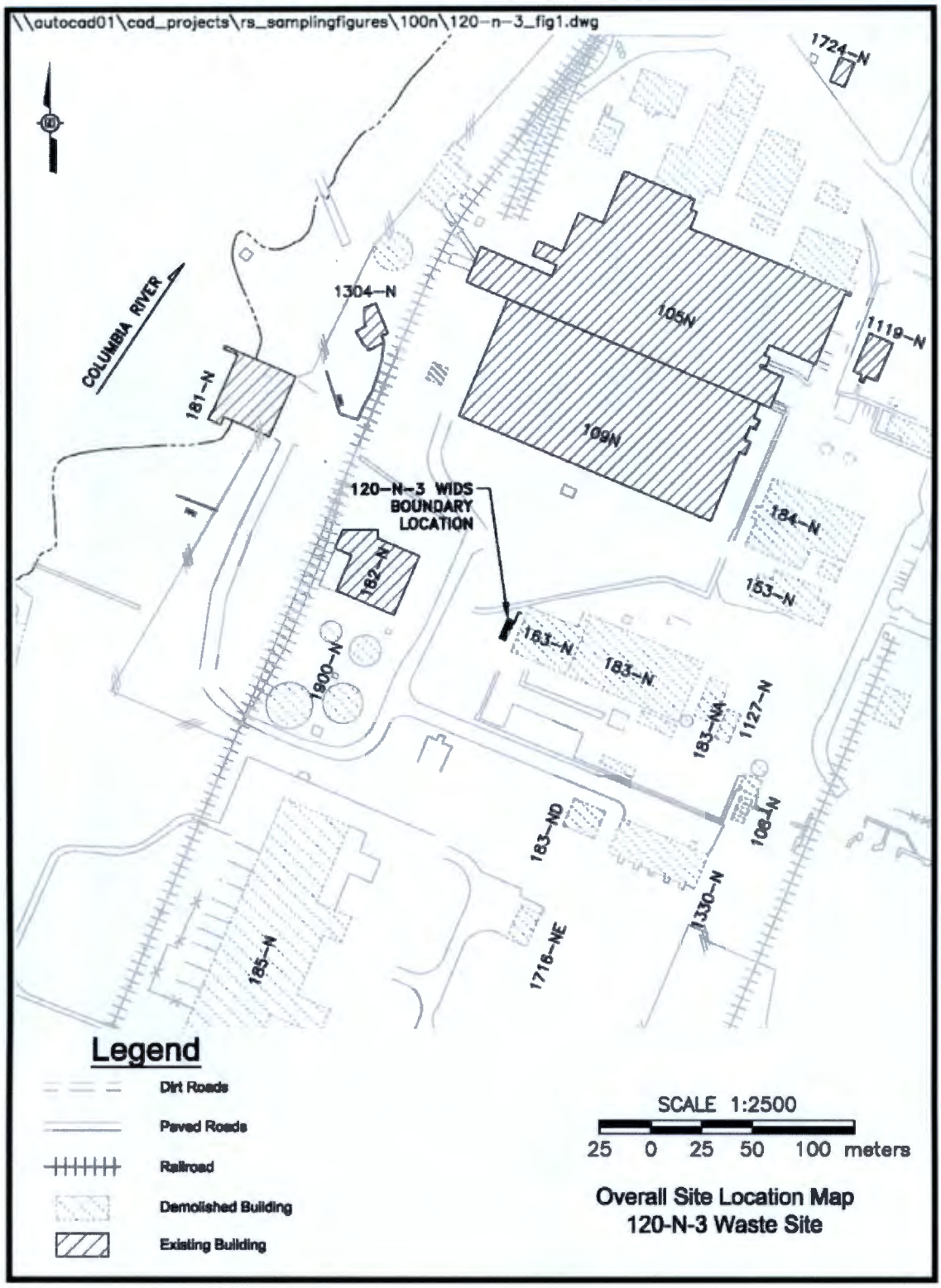


Figure 2. Photograph of the 120-N-3 Concrete-Walled Pit, Looking Northwest.

Figure 3. Post-Remediation Photograph of the 120-N-3 Waste Site (February 2, 2012).

Figure 4. The 120-N-3 Post-Excavation Civil Survey.

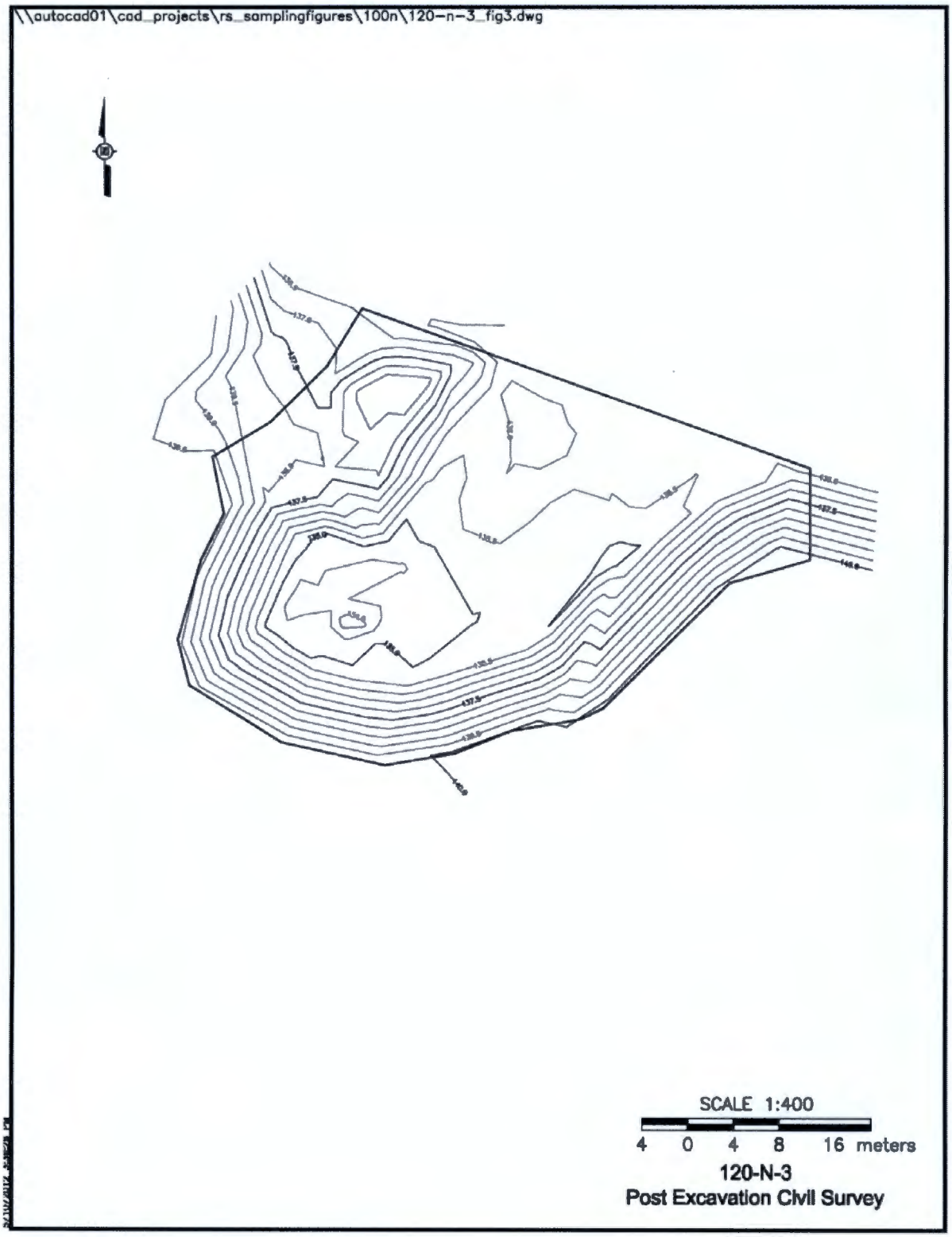
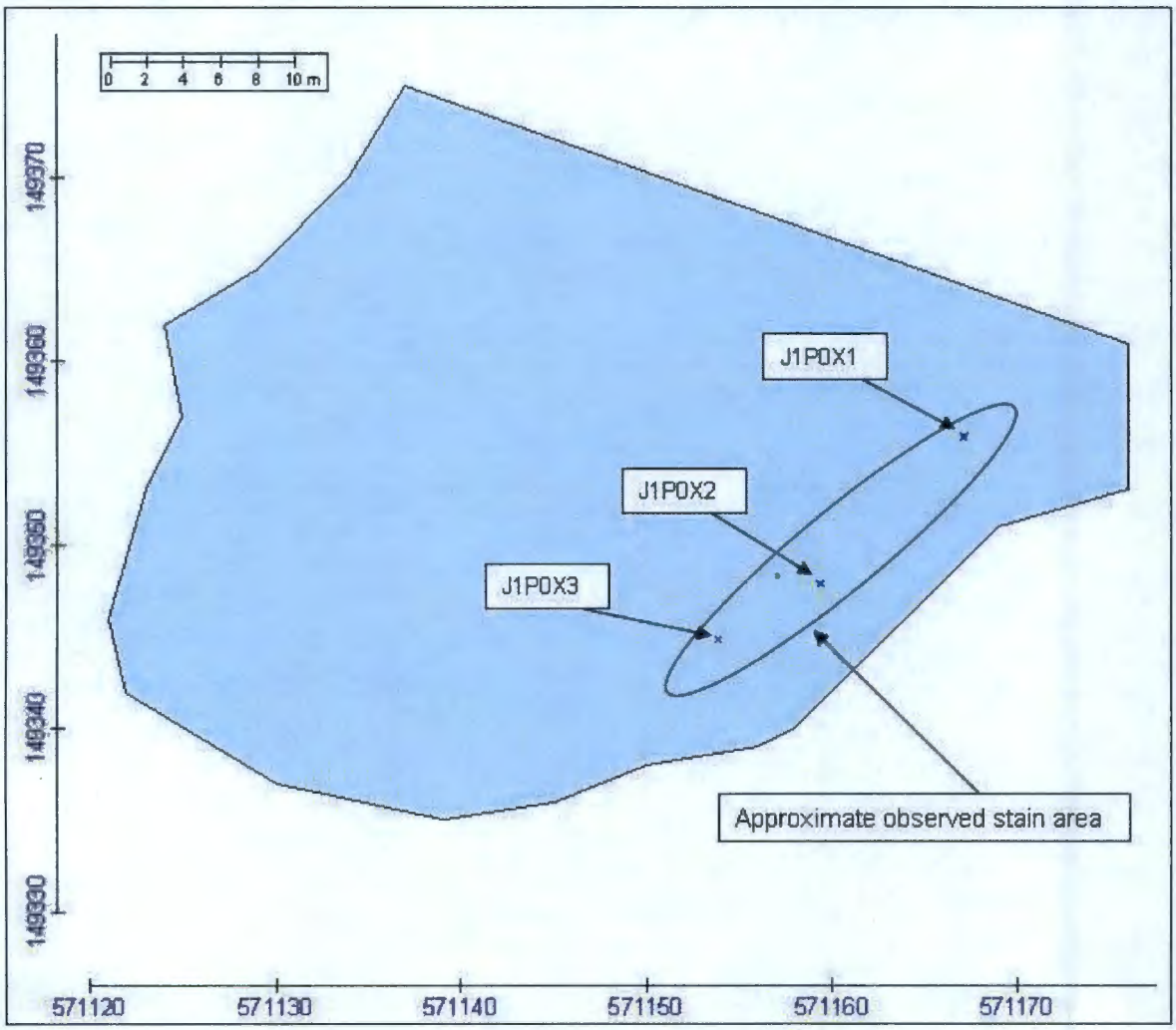


Figure 5. In-Process Sample Locations Within Petroleum Stained Soil Area (Circled).



The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and RAGs for the 120-N-3 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The statistical results of verification sampling are also summarized to support interim closure of the site. A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the 120-N-3, 163-N Neutralization Pit and French Drain* (WCH 2012d).

Contaminants of Potential Concern

The COPCs for the 120-N-3 waste site were determined based upon available historical information and the waste characterization sampling results obtained from the waste site prior to remediation. The Waste Information Data System and Stewardship Information System reports indicate that the site received intermittent small releases of corrosive liquids such as sodium

hydroxide and sulfuric acid; therefore, sulfate was included as a COPC. Although not a regulated quantity, pH was included to assist in the evaluation of the analytical data. Chromium (total), lead, mercury, PAHs, and polychlorinated biphenyls (PCBs) were detected in the waste characterization samples above remedial action goals; therefore, they were included as COPCs. Hexavalent chromium was included because of the use of water treatment chemicals. Although not considered as COPCs, antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc were included in the expanded list of inductively coupled plasma (ICP) metals. Total petroleum hydrocarbons (TPH) was added to the verification samples to support a greater effort to identify the extent of the TPH contamination in the 100-N Area. Total petroleum hydrocarbons is not considered a site COPC.

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

Table 1. Laboratory Analytical Methods.

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Chromium (total), lead
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
IC anions – EPA Method 300.0	Sulfate
PAH – EPA Method 8310	Polycyclic aromatic hydrocarbons
PCB – EPA Method 8082	Polychlorinated biphenyls
pH (soil) – EPA Method 9045	pH
TPH – EPA Method NWTPH-Dx	Total petroleum hydrocarbons [b]

[a] The expanded list of ICP metals will be requested to include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

[b] Analysis for TPH was performed for the 120-N-3 verification samples to support a greater effort to identify the extent of the TPH contamination in the 100-N Area. However, TPH is not considered a COPC for the 120-N-3 waste site.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
IC = ion chromatography
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

Verification Sample Design

The 120-N-3 waste site consisted of a single decision unit for verification sampling and includes the excavation footprint. Twelve statistical verification soil samples and a duplicate were collected from the excavation footprint. 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 2006a). 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 2012a, 2012b). The verification sample summary is provided in Table 2. Figure 6 shows the waste site footprint and the sampling locations.

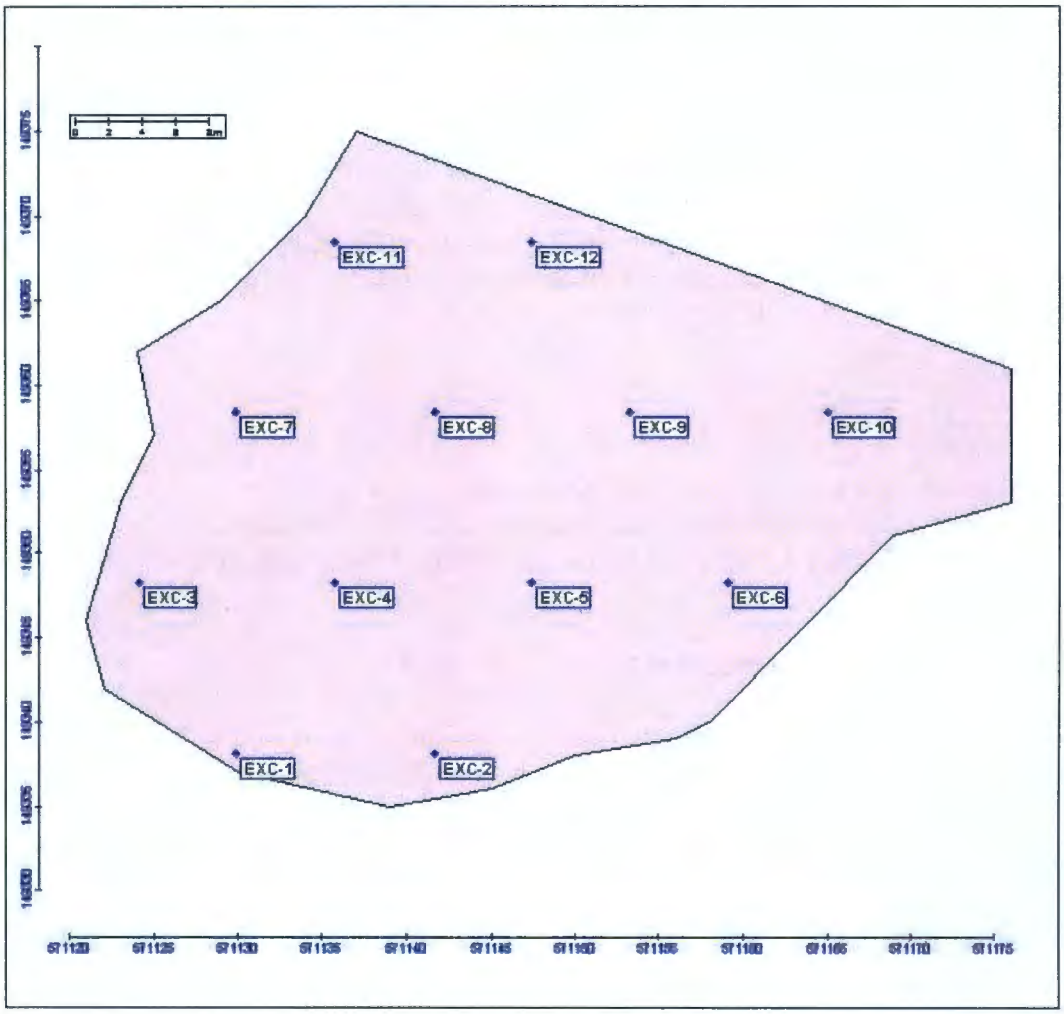
Table 2. 120-N-3 Waste Site Verification Sample Summary Table.

Sample Location	HEIS Sample Number	WSP Northing (m)	WSP Easting (m)	Sample Analysis [a]
EXC-1	J1PWD4	149338.2	571129.9	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-2	J1PWD5	149338.2	571141.6	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-3	J1PWD6	149348.3	571124.1	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-4	J1PWD7	149348.3	571135.8	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-5	J1PWD8	149348.3	571147.5	ICP metals [b], mercury, hexavalent chromium, PAH, PCB, TPH
	J1PWD8-A	149348.3	571147.5	IC anions
EXC-6	J1PWD9	149348.3	571159.1	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-7	J1PWF0	149358.4	571129.9	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-8	J1PWF1	149358.4	571141.6	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-9	J1PWF2	149358.4	571153.3	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-10	J1PWF3	149358.4	571165.0	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-11	J1PWF4	149368.5	571135.8	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
EXC-12	J1PWF5	149368.5	571147.5	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
Duplicate of EXC-10	J1PWF6	149358.4	571165.0	ICP metals [b], mercury, hexavalent chromium, IC anions, PAH, PCB, TPH
Equipment blank	J1PWF7	NA	NA	ICP metals [b], mercury

[a] Full protocol laboratory sample analysis was performed as defined in Table 1, Laboratory Analytical Methods.
[b] Analysis for the expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

HEIS = Hanford Environmental Information System
IC = ion chromatography
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons – diesel range organic
WSP = Washington State Plane

Figure 6. Verification Sample Locations for the 120-N-3 Waste Site Excavation.



Verification Sample Results

All verification samples were analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 120-N-3 excavation 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 were computed for the 120-N-3 excavation decision unit as specified by the 100-N Area RDR/RAWP (DOE-RL 2006b). 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 the 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-3 excavation against the RAGs are summarized in Table 3. Contaminants that were not detected by laboratory analysis are excluded from the table. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 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 COPCs and are also not included in the table. The complete laboratory results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to archival in 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-3 waste site achieve the applicable RAGs developed to support unrestricted land use at the 100-N Area as established in the 100-N Area ROD (EPA 1999) and documented in the 100-N Area RDR/RAWP (DOE-RL 2006b).

Attainment of Nonradionuclide RAGS

Table 3 compares the excavation cleanup verification sample values to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. Multiple PAHs were detected at concentrations above soil RAGs in verification samples. The presence of these PAHs is believed to be the result of cross-contamination from asphaltic debris material. Asphaltic materials associated with former facilities, utilities, and roadways remain throughout the 100-N Area, and solid debris was observed near the 120-N-3 verification sample location with the highest PAH results (Figure 7). These PAHs are nearly immobile in soil based on their high soil distribution coefficient values and do not pose a risk for migration to groundwater and the Columbia River. Because these PAHs are associated with asphaltic debris, they are not considered in evaluation of direct exposure soil RAGs. Washington State Department of Ecology considers additional excavation more hazardous to human health and the environment than leaving the asphalt in place. All other COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of mercury, zinc, and total PCBs (aroclor-1254 and aroclor-1260). However, given the lowest soil-partitioning coefficient of these contaminants (mercury and zinc) of 30 mL/g , none would be expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years based on RESidual Radioactivity (RESRAD) modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006b). The vadose zone beneath the 120-N-3 excavation is approximately 15.5 m (50.9 ft) thick. Based on RESRAD modeling, constituents with a soil-partitioning coefficient of 4.9 mL/g or greater are not predicted to migrate through a vadose zone of this thickness and reach groundwater in 1,000 years. Therefore, residual concentrations of mercury, zinc, and total PCBs (aroclor-1254 and aroclor-1260) are predicted to be protective of groundwater (and thus the Columbia River).

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 120-N-3 Excavation Statistical Verification 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		
Antimony [c]	0.62 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	2.4 (<BG)	20 [d]	20 [d]	20 [d]	No	--
Barium	64.7 (<BG)	16,000	200	400	No	--
Beryllium	0.17 (<BG)	10.4 [e]	1.51 [d]	1.51 [d]	No	--
Boron [f]	1.2	16,000	320	-- [g]	No	--
Cadmium [c]	0.17 (<BG)	13.9 [e]	0.81 [d]	0.81 [d]	No	--
Chromium	10.1 (<BG)	120,000	18.5 [d]	18.5 [d]	No	--
Cobalt	10.7 (<BG)	1,600	32	-- [g]	No	--
Copper	19.5 (<BG)	2,960	59.2	22.0 [d]	No	--
Hexavalent chromium [f]	0.250	2.1 [e]	4.8	2	No	--
Lead	9.6 (<BG)	353	10.2 [d]	10.2 [d]	No	--
Manganese	339 (<BG)	11,200	512 [d]	-- [g]	No	--
Mercury	1.5	24	0.33 [d]	0.33 [d]	Yes	Yes [h]
Molybdenum [f]	0.40	400	8	-- [g]	No	--
Nickel	15.1 (<BG)	1,600	19.1 [d]	27.4	No	--
Vanadium	73.5 (<BG)	560	85.1 [d]	-- [g]	No	--
Zinc	69.1	24,000	480	67.8 [d]	Yes	Yes [h]
Chloride	1193	--	25,000	-- [g]	No	--
Fluoride	5.7	4,800	96	400	No	--
Nitrogen in nitrate	2.8 (<BG)	128,000	1,000	2,000	No	--
Nitrogen in nitrite and nitrate	2.2 (<BG)	128,000	1,000	2,000	No	--
Sulfate	3,336	--	25,000	-- [g]	No	--
TPH – diesel range	47	NA	200	200	No	--
TPH – diesel range (extended)	72	NA	200	200	No	--
Aroclor-1254	0.028	0.5	0.017 [i]	0.017 [i]	Yes	Yes [h]
Aroclor-1260	0.020	0.5	0.017 [i]	0.017 [i]	Yes	Yes [h]
Total PCBs	0.048	0.5 [j]	0.017 [i]	0.017 [i]	Yes	Yes [h]
Acenaphthene	0.130	4,800	96	129	No	--
Anthracene	0.92	24,000	240	1,920	No	--
Benzo(a)anthracene	1.5	1.37	0.015 [i]	0.015 [i]	Yes [k]	Yes [h]
Benzo(a)pyrene	0.78	0.137	0.015 [i]	0.015 [i]	Yes [k]	Yes [h]
Benzo(b)fluoranthene	0.94	1.37	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(ghi)perylene [l]	0.38	2,400	48	192	No	--
Benzo(k)fluoranthene	0.45	13.7	0.12 [m]	0.1 [i]	Yes	Yes [h]
Chrysene	1.4	137	1.2	0.1 [i]	Yes	Yes [h]
Dibenz(a,h)anthracene	0.47	0.137	0.03 [i]	0.03 [i]	Yes [k]	Yes [h]
Fluoranthene	4.2	3,200	64	18.0	No	--
Fluorene	0.40	3,200	64	260	No	--

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 120-N-3 Excavation Statistical Verification 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		
Indeno(1,2,3-cd)pyrene	0.33	1.37	0.03 [i]	0.03 [i]	Yes	Yes [h]
Phenanthrene [l]	2.3	24,000	240	1,920	No	--
Pyrene	3.7	2,400	48	192	No	--

[a] RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2006b), unless otherwise noted.

[b] Maximum or 95% UCL, depending on data censorship, as described in the *120-N-3 Waste Site Cleanup Verification 95% UCL Calculation* (Appendix C).

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

[d] 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 2006b).

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

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

[g] 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]).

[h] Based on the RESRAD modeling discussed in the 100-N Area RDR/RAWP (DOE-RL 2006b), residual concentrations of mercury, zinc, total PCBs (aroclor-1254 and aroclor-1260), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the lowest distribution coefficient of the contaminants [mercury and zinc] of 30 mL/g). The vadose zone underlying the excavation is approximately 15.5 m (50.9 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

[i] Where cleanup levels are less than the RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). RDLs for PAHs are based on analysis by Method 8310.

[j] The soil cleanup value for PCBs is based on the formula presented in WAC 173-340-740(3)(a)(iii)(B), (Ecology 1996), and the cancer potency factor for ingestion of PCBs of 2.0 kg-day/mg (soils) from the EPA Integrated Risk Information System on the internet at http://www.epa.gov/iris.

[k] PAH results were determined to be the result of cross-contamination from asphaltic debris material and are not associated with wastes disposed to this site. Therefore, PAHs are not considered in attainment of direct exposure soil RAGs for the site.

[l] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals:
Contaminant: benzo(ghi)perylene; surrogate: pyrene
Contaminant: phenanthrene; surrogate: anthracene

[m] Cleanup level calculated per WAC 173-340-740, Method B, 1996.

-- = not applicable
AWQC = ambient water quality criteria
COPC = contaminant of potential concern
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
NA = not available
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Figure 7. Mastic Debris Observed Near Sample Location EX-12.

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-3 waste site excavation 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 lead, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene which fail 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 2006b), the residual concentrations of these constituents are predicted to migrate less than 1.8 m (5.9 ft) vertically within 1,000 years (based on the contaminant with the lowest soil-partitioning coefficient (K_d) [lead and zinc with a K_d of 30 mL/g]). The vadose zone beneath the 120-N-3 excavation is approximately 15.5 m (50.9 ft) thick. Based on RESRAD modeling, constituents with a K_d of 4.9 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 these contaminants 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 mercury, dibenz(a,h,)anthracene, aroclor-1254, and aroclor-1260 which fail one or more parts of the three-part test. However, based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006b), the residual concentration of these contaminants are predicted to migrate less than 1.8 m (5.9 ft) based on the contaminant with the lowest K_d [mercury with a K_d of 30 mL/g]. As stated above, the vadose zone beneath the 120-N-3 excavation is approximately 15.5 m (50.9 ft) thick. Based on RESRAD modeling, constituents with a soil-partitioning coefficient of 4.9 mL/g or greater are not predicted to migrate through a vadose zone of this thickness and reach groundwater in 1,000 years. Therefore, residual concentrations of mercury, dibenz(a,h,)anthracene, aroclor-1254, and aroclor-1260 are predicted to be protective of groundwater (and thus 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-3 waste site, these risk values were not calculated for constituents that were either not detected, were detected at concentrations below Hanford Site or Washington State background, or were determined to be the result of cross-contamination from asphalt debris. 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 8.6×10^{-2}. 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 2.2×10^{-7}, which is less than 1×10^{-5}. The 120-N-3 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 2006b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 120-N-3 waste site included 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 distribution 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 2006b). Based on this model and a vadose zone of approximately 15.5 m (50.9 ft) in thickness, a K_d of 4.9 or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 120-N-3 waste site is 5.6×10^{-2}, which is

less than 1.0. No carcinogenic constituents from groundwater met the criteria for evaluation at the 120-N-3 waste site: therefore, no calculations of excess carcinogenic risk were performed. 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 2012d), the field logbook (WCH 2012a, 2012b), 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-3 waste site established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the Environmental Restoration project-specific database for data evaluation prior to archival in the Hanford Environmental Information System and are summarized in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 120-N-3 waste site has been evaluated in accordance with 100-N Area ROD (EPA 1999) and the 100-N Area RDR/RAWP (DOE-RL 2006b). 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-3 waste site to interim closed out. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

REFERENCES

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 120-N-3 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)							
Antimony	5	5	NA	NA	NA	78	NA	0.27	0.62 (<BG)
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	1.2
Manganese	512	1,100[d]	NA	1,500	220	450	4,300	4,000	339 (<BG)
Mercury	0.33	0.3	0.1	5.5	NA	NA	NA	NA	1.5
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	73.5 (<BG)
Zinc	67.8	86[d]	200	360	160	120	46	79	69.1
High molecular weight PAH (total)	NA	NA	NA	NA	NA	18	NA	1.1	9.95

NOTE: Shaded cells indicate screening values that are exceeded.

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

[b] Available on the internet at (www.epa.gov/ecotox/ecossl).

[c] Wildlife.

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

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

APPENDIX B

IN-PROCESS SAMPLE DATA

TPH and PAH In-Process Samples from 120-N-3

HEIS Number	Location Identifier	Sample Date	Northing	Easting	TPH - Diesel			TPH Diesel EXT			Percent moisture (wet sample)		
					TPH			TPH			PHYSICAL		
					ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
J1P0X1	TPH-1	4/18/12 9:45	149355.9	571167.1	2700	JB	700	3600	JB	1000	5.5		0
J1P0X2	TPH-2	4/18/12 9:50	149347.9	571159.4	12000	B	700	15000	B	1000	6.1		0
J1P0X3	TPH-3	4/18/12 10:00	149344.9	571153.9	390000	B	670	460000	B	990	4.9		0

CONSTITUENT	J1P0X1			J1P0X2			J1P0X3		
	N149355.9			N149347.9 E571159.4			N149344.9		
	4/18/12 9:45			4/18/12 9:50			4/18/12 10:00		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	10	U	10	11	U	11	10	U	10
Acenaphthylene	9.2	U	9.2	9.6	U	9.6	9.3	U	9.3
Anthracene	13	J	3.1	110		3.2	87		3.2
Benzo(a)anthracene	19		3.3	190		3.4	210		3.3
Benzo(a)pyrene	14	J	6.5	120		6.8	120		6.7
Benzo(b)fluoranthene	16		4.3	130		4.5	170		4.4
Benzo(ghi)perylene	11	J	7.3	83		7.6	82		7.5
Benzo(k)fluoranthene	8.7	J	4	57		4.2	65		4.1
Chrysene	21	J	4.9	170	X	5.1	170		5
Dibenz[a,h]anthracene	11	U	11	26	JX	12	21	JX	11
Fluoranthene	45		13	430		14	370		13
Fluorene	5.4	U	5.4	52		5.6	43	X	5.5
Indeno(1,2,3-cd)pyrene	12	U	12	66		13	61		12
Naphthalene	12	U	12	13	U	13	12	U	12
Phenanthrene	30	J	12	260		13	170		12
Pyrene	43		12	440		13	370		12

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 has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The calculations provided in this appendix include:

120-N-3 Waste Site Cleanup Verification 95% UCL Calculations, 0100N-CA-V0171, Rev. 0, Washington Closure Hanford, Richland, Washington.

120-N-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100N-CA-V0172, Rev. 0, Washington Closure Hanford, Richland, Washington.

120-N-3 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100N-CA-V0175, 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-V0171

Subject: 120-N-3 Waste Site Cleanup Verification 95% UCL Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 16 Attm. 1 = 6 Total = 23	N. K. Schiffern N K Schiffern	C. H. Dobie C H Dobie	J. D. Skoglie	D. F. Obenauer D. F. Obenauer	3/25/13

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** 11/28/12	**Calc. No.** 0100N-CA-V0171	**Rev. No.** 0
Project 100-N Field Remediation	**Job No.** 14655	**Checked** C. H. Dobie	**Date** 11/28/12
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations			**Sheet No.** 1 of 16

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 concern (COC) and contaminant of potential concern (COPC), as necessary.

Table of Contents:
Sheets 1 to 5 - Calculation Sheet Summary
Sheet 6 to 11 - Calculation Sheet Verification Data - Excavation
Sheet 12 to 15 - Ecology Software (MTCAStat) Results
Sheet 16 - Calculation Sheet Duplicate Analysis
Attachment 1 - 120-N-3, Verification Sampling Results (6 sheets)

Given/References:
1) Sample Results (Attachment 1).
2) DOE-RL, 2006a, 100-N Area Sampling and Analysis Plan for CERCLA Waste Sites, DOE/RL-2005-92, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) DOE-RL, 2006b, Remedial Design Report/Remedial Action Work Plan for the 100-N Area, DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) Ecology, 1992, Statistical Guidance for Ecology Site Managers, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
5) 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.
6) Ecology, 2012, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
7) 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.
8) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," Washington Administrative Code.
9) EPA, 2011, ProUCL, Version 4.1.01, U.S. Environmental Protection Agency, Washington, D.C., <http://epa.gov/osp/hstl/tsc/software.htm>.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2006b). 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-3 waste site. The data were entered into an EXCEL 2003 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 2006b) 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-3 waste site underwent statistical sampling at one decision unit: excavation area.

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 NS	**Date**	11/28/12	**Calc. No.** 0100N-CA-V0171	**Rev. No.** 0
Project	100-N Field Remediation	**Job No.**	14655	**Checked** C. H. Dobie CD	**Date** 11/28/12
Subject	120-N-3 Waste Site Cleanup Verification 95% UCL Calculations				**Sheet No.** 2 of 16

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 2006b) 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 2006a). 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 NS	**Date**	11/28/12	**Calc. No.**	0100N-CA-V0171	**Rev. No.**	0
Project	100-N Field Remediation	**Job No.**	14655	**Checked**	C. H. Doble CD	**Date**	11/28/12
Subject	120-N-3 Waste Site Cleanup Verification 95% UCL Calculations					**Sheet No.**	3 of 16

Summary (continued)

QUALIFIER LIST

B = estimate
C = Sample was </= 5X the blank concentration
D = dilution
J = estimate
M = sample duplicate precision not met
N = recovery is outside control limits
P = aroclor flag, greater than 25% difference for detected concentrations between
R = rejected
U = undetected
X = Serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals).
X = More than 40% difference between columns, lower result reported (organics).

ACRONYM LIST

-- = not applicable
DE = direct exposure
EXC = excavation
GW = groundwater
MTCA = *Model Toxics Control Act*
NA = not applicable
PAH = polycyclic aromatic hudrocarbons
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
TPH = total petroleum hydrocarbons
UCL = upper confidence limit
WAC = Washington Administrative Code

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern NS **Date** 02/06/13 **Calc. No.** 0100N-CA-V0171 **Rev. No.** 0
Project 100-N Field Remediation **Job No.** 14655 **Checked** C. H. Dobie CD **Date** 02/06/13
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 16

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	EX		Units
	95% UCL Result	Maximum Result	
Antimony	0.62	--	mg/kg
Arsenic	2.4	--	mg/kg
Barium	64.7	--	mg/kg
Beryllium	0.17	--	mg/kg
Boron	--	1.2	mg/kg
Cadmium	0.17	--	mg/kg
Chromium	10.1	--	mg/kg
Cobalt	10.7	--	mg/kg
Copper	19.5	--	mg/kg
Hexavalent Chromium	0.250	--	mg/kg
Lead	9.6	--	mg/kg
Manganese	339	--	mg/kg
Mercury	--	1.5	mg/kg
Molybdenum	--	0.40	mg/kg
Nickel	15.1	--	mg/kg
Vanadium	73.5	--	mg/kg
Zinc	69.1	--	mg/kg
Chloride	1193	--	mg/kg
Fluoride	--	5.7	mg/kg
Nitrogen in Nitrate	2.8	--	mg/kg
Nitrogen in Nitrite and Nitrate	2.2	--	mg/kg
Sulfate [b]	3336	--	mg/kg
TPH- diesel range	47	--	mg/kg
TPH - diesel range EXT	72	--	mg/kg
Aroclor-1254	--	0.028	mg/kg
Aroclor-1260	--	0.020	mg/kg
Anthracene	0.92	--	mg/kg
Acenaphthene	--	1.0	mg/kg
Benzo(a)anthracene	1.5	--	mg/kg
Benzo(a)pyrene	0.78	--	mg/kg
Benzo(b)fluoranthene	0.94	--	mg/kg
Benzo(ghi)perylene	0.38	--	mg/kg
Benzo(k)fluoranthene	0.45	--	mg/kg
Chrysene	1.4	--	mg/kg
Dibenz(a,h)anthracene	--	0.47	mg/kg
Fluoranthene	4.2	--	mg/kg
Fluorene	0.40	--	mg/kg
Indeno(1,2,3-cd)pyrene	0.33	--	mg/kg
Phenanthrene	2.3	--	mg/kg
Pyrene	3.7	--	mg/kg
3-Part Test Evaluation:	**EX**		
95% UCL or maximum[c] > Cleanup	YES	YES	
> 10% above Cleanup Limit?	YES	YES	
Any sample > 2x Cleanup Limit?	YES	YES	

[a] The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.
[b] The 95% UCL result was determined using ProUCL 4.1 (EPA 2011) software instead of MTCA Stat software (WCH 2010).

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern NS	**Date** 11/27/12	**Calc. No.** 0100N-CA-V0171	**Rev. No.** 0
Project 100-N Field Remediation	**Job No.** 14655	**Checked** C. H. Dobie CD	**Date** 11/27/12
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations			**Sheet No.** 5 of 16

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.

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

Analyte	Duplicate Analysis
Aluminum	5.3%
Barium	19.4%
Calcium	1.4%
Cobalt	3.7%
Copper	0.5%
Iron	3.1%
Magnesium	2.1%
Manganese	1.2%
Silicon	10.2%
Sodium	3.8%
Vanadium	7.7%
Zinc	0.4%

[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%, is addressed in the data quality assessment section of the RSVP.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/28/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/28/12
Sheet No. 6 of 16

1 **120-N-3 Statistical Calculations**

2 **Verification Data -Excavation (EXC)**

3	Sample	Sample	Sample	Antimony			Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper		
4	Area	Number	Date	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
5	EXC-10	J1PWF3	8/6/2012	0.36	UJ	0.36	1.3		0.62	40.0	X	0.072	0.16	U	0.16	0.14	B	0.039	4.8	X	0.055	13.2	X	0.47	19.6		1.0
6	Duplicate of J1PWF3	J1PWF6	8/6/2012	0.37	UJ	0.37	1.0		0.65	48.6	X	0.075	0.16	U	0.16	0.14	B	0.040	5.2	X	0.057	13.7	X	0.49	19.5		1.1
7	EXC-1	J1PWD4	8/6/2012	1.1	MJ	0.37	2.2		0.65	64.5	X	0.074	0.18	B	0.032	0.21		0.040	10.3	X	0.057	9.3	X	0.098	23.0		0.21
8	EXC-2	J1PWD5	8/6/2012	0.38	UJ	0.38	2.1		0.66	47.1	X	0.076	0.13	B	0.033	0.12	B	0.041	6.7	X	0.058	8.8	X	0.099	16.7		0.22
9	EXC-3	J1PWD6	8/6/2012	0.55	BJ	0.38	3.1		0.67	75.9	X	0.077	0.22		0.033	0.18	B	0.041	13.6	X	0.059	9.1	X	0.10	17.7		0.22
10	EXC-4	J1PWD7	8/6/2012	0.77	J	0.36	1.8		0.62	71.5	X	0.071	0.031	U	0.031	0.12	B	0.039	5.8	X	0.055	9.1	X	0.094	14.7		0.20
11	EXC-5	J1PWD8	8/6/2012	0.48	BJ	0.36	1.1		0.62	42.6	X	0.072	0.058	B	0.031	0.084	B	0.039	5.7	X	0.055	8.1	X	0.094	17.4		0.20
12	EXC-6	J1PWD9	8/6/2012	0.55	BJ	0.37	1.4		0.65	53.9	X	0.075	0.16	B	0.033	0.13	B	0.040	6.4	X	0.057	9.5	X	0.099	17.9		0.21
13	EXC-7	J1PWF0	8/6/2012	0.38	UJ	0.38	1.9		0.66	47.8	X	0.076	0.20		0.033	0.12	B	0.041	11.7	X	0.058	8.3	X	0.10	16.1		0.22
14	EXC-8	J1PWF1	8/6/2012	0.57	J	0.36	1.7		0.63	62.5	X	0.072	0.16	U	0.16	0.13	B	0.039	5.5	X	0.055	12.0	X	0.48	17.2		1.0
15	EXC-9	J1PWF2	8/6/2012	0.77	J	0.35	1.8		0.61	63.6	X	0.070	0.15	U	0.15	0.22		0.038	7.3	X	0.054	11.9	X	0.46	21.4		1.0
16	EXC-11	J1PWF4	8/6/2012	0.38	UJ	0.38	3.3		0.65	68.5	X	0.075	0.22		0.033	0.16	B	0.041	12.1	X	0.057	9.2	X	0.099	19.5		0.21
17	EXC-12	J1PWF5	8/6/2012	0.35	UJ	0.35	2.2		0.61	52.7	X	0.070	0.15	B	0.031	0.12	B	0.038	8.4	X	0.054	10	X	0.093	18.1		0.20

18

19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22	EXC-10	J1PWF3/J1PWF6	8/6/2012	0.18	1.2	44.3	0.080	0.14	5.0	13.5	19.6
23	EXC-1	J1PWD4	8/6/2012	1.1	2.2	64.5	0.18	0.21	10.3	9.3	23.0
24	EXC-2	J1PWD5	8/6/2012	0.19	2.1	47.1	0.13	0.12	6.7	8.8	16.7
25	EXC-3	J1PWD6	8/6/2012	0.55	3.1	75.9	0.22	0.18	13.6	9.1	17.7
26	EXC-4	J1PWD7	8/6/2012	0.77	1.8	71.5	0.016	0.12	5.8	9.1	14.7
27	EXC-5	J1PWD8	8/6/2012	0.48	1.1	42.6	0.058	0.084	5.7	8.1	17.4
28	EXC-6	J1PWD9	8/6/2012	0.55	1.4	53.9	0.16	0.13	6.4	9.5	17.9
29	EXC-7	J1PWF0	8/6/2012	0.19	1.9	47.8	0.20	0.12	11.7	8.3	16.1
30	EXC-8	J1PWF1	8/6/2012	0.57	1.7	62.5	0.080	0.13	5.5	12.0	17.2
31	EXC-9	J1PWF2	8/6/2012	0.77	1.8	63.6	0.075	0.22	7.3	11.9	21.4
32	EXC-11	J1PWF4	8/6/2012	0.19	3.3	68.5	0.22	0.16	12.1	9.2	19.5
33	EXC-12	J1PWF5	8/6/2012	0.18	2.2	52.7	0.15	0.12	8.4	10	18.1

34 **Statistical Computations**

35		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
36	95% UCL based on	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), use MTCAStat lognormal distribution.	Large data set (n ≥10), use MTCAStat normal distribution.	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), use MTCAStat lognormal distribution.
37	N	12	12	12	12	12	12	12	12
38	% < Detection limit	42%	0%	0%	33%	0%	0%	0%	0%
39	Mean	0.48	2.0	57.9	0.13	0.14	8.2	9.9	18.3
40	Standard deviation	0.30	0.68	11.3	0.068	0.040	3.0	1.7	2.3
41	95% UCL on mean	0.62	2.4	64.7	0.17	0.17	10.1	10.7	19.5
42	Maximum value	1.1	3.3	75.9	0.22	0.22	13.6	13.7	23.0
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	5 GW & River Protection	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	0.81 GW & River Protection	18.5 GW & River Protection	32 GW Protection	22.0 River Protection
44	**WAC 173-340 3-PART TEST**								
45	95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NO
46	> 10% above Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NO
47	Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NO
48	**WAC 173-340 Compliance?**	Because all values are below background (5 mg/kg) the WAC 173-340 3-part test is not required.	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.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 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.

49 Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/28/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/28/12
Sheet No. 7 of 16

1 **120-N-3 Statistical Calculations**
2 **Verification Data -Excavation (EXC)**

3	Sample	Sample	Sample	Hexavalent Chromium			Lead			Manganese			Nickel			Vanadium			Zinc			TPH - diesel range			TPH - diesel range EXT		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-10	J1PWF3	8/6/2012	0.155	U	0.155	2.8		1.3	320	X	0.094	9.2	X	0.12	79.8	X	0.089	55.3	XJ	0.38	680	U	680	1000	U	1000
6	Duplicate of J1PWF3	J1PWF6	8/6/2012	0.155	U	0.155	2.8		1.3	324	X	0.098	8.8	X	0.12	73.9	X	0.092	55.1	XJ	0.39	1100	J	670	1300	J	980
7	EXC-1	J1PWD4	8/6/2012	0.528		0.155	11.2		0.26	355	X	0.098	12.3	X	0.12	55.1	X	0.092	138	NJM	0.39	26000		640	48000		940
8	EXC-2	J1PWD5	8/6/2012	0.155	U	0.155	3.1		0.27	298	X	0.099	9.1	X	0.12	70.4	X	0.093	44.0	XJ	0.40	2500	J	680	3500	J	1000
9	EXC-3	J1PWD6	8/6/2012	0.191		0.155	17.8		0.27	316	X	0.10	32.5	X	0.12	52.5	X	0.095	51.6	XJ	0.40	5700		680	9600		1000
10	EXC-4	J1PWD7	8/6/2012	0.170		0.155	10.3		0.25	288	X	0.094	7.1	X	0.12	98.2	X	0.088	54.4	XJ	0.37	680	U	680	1000	U	1000
11	EXC-5	J1PWD8	8/6/2012	0.211		0.155	2.2		0.25	236	X	0.094	7.1	X	0.12	60.4	X	0.089	40.9	XJ	0.38	670	U	670	990	U	990
12	EXC-6	J1PWD9	8/6/2012	0.247		0.155	5.5		0.27	297	X	0.099	9.8	X	0.12	54.4	X	0.093	50.9	XJ	0.39	12000		710	16000		1000
13	EXC-7	J1PWF0	8/6/2012	0.155	U	0.155	3.8		0.27	305	X	0.10	12.0	X	0.12	49.6	X	0.094	44.8	XJ	0.40	2900	J	660	3600	J	970
14	EXC-8	J1PWF1	8/6/2012	0.155	U	0.155	3.2		1.3	335	X	0.095	10.4	X	0.12	72.7	X	0.089	48.8	XJ	0.38	3300	J	630	4200		930
15	EXC-9	J1PWF2	8/6/2012	0.281		0.155	5.3		1.3	332	X	0.093	9.0	X	0.11	78.7	X	0.087	54.0	XJ	0.37	650	U	650	960	U	960
16	EXC-11	J1PWF4	8/6/2012	0.169		0.155	4.9		0.27	388	X	0.099	13.8	X	0.12	50.5	X	0.093	45.5	XJ	0.39	3600	J	670	4800		990
17	EXC-12	J1PWF5	8/6/2012	0.168		0.155	4.2		0.25	328	X	0.093	11.0	X	0.11	62.9	X	0.087	52.3	XJ	0.37	13000		680	16000		990

18
19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Hexavalent Chromium	Lead	Manganese	Nickel	Vanadium	Zinc	TPH - diesel range	TPH - diesel range EXT
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	ug/kg	ug/kg
22	EXC-10	J1PWF3/J1PWF6	8/6/2012	0.0775	2.8	322	9.0	76.9	55.2	720	900
23	EXC-1	J1PWD4	8/6/2012	0.528	11.2	355	12.3	55.1	138	26000	48000
24	EXC-2	J1PWD5	8/6/2012	0.0775	3.1	298	9.1	70.4	44.0	2500	3500
25	EXC-3	J1PWD6	8/6/2012	0.191	17.8	316	32.5	52.5	51.6	5700	9600
26	EXC-4	J1PWD7	8/6/2012	0.170	10.3	288	7.1	98.2	54.4	340	500
27	EXC-5	J1PWD8	8/6/2012	0.211	2.2	236	7.1	60.4	40.9	335	495
28	EXC-6	J1PWD9	8/6/2012	0.247	5.5	297	9.8	54.4	50.9	12000	16000
29	EXC-7	J1PWF0	8/6/2012	0.0775	3.8	305	12.0	49.6	44.8	2900	3600
30	EXC-8	J1PWF1	8/6/2012	0.0775	3.2	335	10.4	72.7	48.8	3300	4200
31	EXC-9	J1PWF2	8/6/2012	0.281	5.3	332	9.0	78.7	54.0	325	480
32	EXC-11	J1PWF4	8/6/2012	0.169	4.9	388	13.8	50.5	45.5	3600	4800
33	EXC-12	J1PWF5	8/6/2012	0.168	4.2	328	11.0	62.9	52.3	13000	16000

34 **Statistical Computations**

35		Hexavalent Chromium	Lead	Manganese	Nickel	Vanadium	Zinc	TPH - diesel range	TPH - diesel range EXT
36	95% UCL based on	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), use MTCAStat lognormal distribution.	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), use MTCAStat lognormal distribution.	Large data set (n ≥10), use MTCAStat lognormal distribution.
37	N	12	12	12	12	12	12	12	12
38	% < Detection limit	33%	0%	0%	0%	0%	0%	25%	25%
39	Mean	0.190	6.2	317	11.9	65.2	56.7	5893	9006
40	Standard deviation	0.127	4.6	37.5	6.8	14.6	26.0	7652	13492
41	95% UCL on mean	0.250	9.6	339	15.1	73.5	69.1	47211	71957
42	Maximum value	0.528	17.8	388	32.5	98.2	138	26000	48000
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless stated otherwise**	2 River Protection	10.2 GW & River Protection	512 GW Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection	200000 ug/kg DE, GW & River Protection	200000 ug/kg DE, GW & River Protection
44	**WAC 173-340 3-PART TEST**								
45	95% UCL > Cleanup Limit?	NO	NO	NA	NO	NO	YES	NO	NO
46	> 10% above Cleanup Limit?	NO	YES	NA	NO	NO	NO	NO	NO
47	Any sample > 2X Cleanup Limit?	NO	NO	NA	NO	NO	YES	NO	NO
48	**WAC 173-340 Compliance?**	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.	Because all values are below background (512 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.	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.	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.

49 Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/28/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/28/12
Sheet No. 8 of 16

1 **120-N-3 Statistical Calculations**
2 **Verification Data -Excavation (EXC)**

3	Sample	Sample	Sample	Chloride			Nitrogen in Nitrate			Nitrogen in Nitrite and Nitrate			Sulfate [a]		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	EXC-10	J1PWF3	8/6/2012	2.0	U	2.0	0.49	BJ	0.31	0.30	U	0.30	1.7	U	1.7
6	Duplicate of J1PWF3	J1PWF6	8/6/2012	2.9	B	1.9	0.50	BJ	0.31	0.30	U	0.30	2.1	B	1.7
7	EXC-1	J1PWD4	8/6/2012	2.5	B	2.0	0.75	BJ	0.31	0.30	U	0.30	7.5		1.7
8	EXC-2	J1PWD5	8/6/2012	1.9	U	1.9	0.57	BJ	0.31	0.30	U	0.30	1.7	U	1.7
9	EXC-3	J1PWD6	8/6/2012	2.0	U	2.0	0.75	BJ	0.31	0.35	B	0.30	8.4		1.7
10	EXC-4	J1PWD7	8/6/2012	2.0	U	2.0	0.66	BJ	0.32	0.30	U	0.30	119		1.7
11	EXC-5	J1PWD8-A	10/22/2012	8.8		1.9	0.65	B	0.31	0.55	BM	0.31	2350	DN	17
12	EXC-6	J1PWD9	8/6/2012	5360	D	40.8	4.5	J	0.32	3.4		0.32	73.1		1.8
13	EXC-7	J1PWF0	8/6/2012	4.6	B	1.9	0.95	BJ	0.31	0.61	B	0.30	11.6		1.7
14	EXC-8	J1PWF1	8/6/2012	85		2.0	0.66	BJ	0.32	0.30	U	0.30	10.0		1.7
15	EXC-9	J1PWF2	8/6/2012	2.3	B	2.0	0.68	BJ	0.31	0.30	U	0.30	4.3	B	1.7
16	EXC-11	J1PWF4	8/6/2012	26.6		1.9	8.2	J	0.30	7.2		0.30	2830	D	16.8
17	EXC-12	J1PWF5	8/6/2012	26.2		2.0	1.9	BJ	0.31	1.5		0.30	58.2		1.7

18
19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Chloride	Nitrogen in Nitrate	Nitrogen in Nitrite and Nitrate	Sulfate [a]
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg
22	EXC-10	J1PWF3/J1PWF6	8/6/2012	2.0	0.50	0.15	1.5
23	EXC-1	J1PWD4	8/6/2012	2.5	0.75	0.15	7.5
24	EXC-2	J1PWD5	8/6/2012	0.95	0.57	0.15	0.85
25	EXC-3	J1PWD6	8/6/2012	1.0	0.75	0.35	8.4
26	EXC-4	J1PWD7	8/6/2012	1.0	0.66	0.15	119
27	EXC-5	J1PWD8-A	10/22/2012	8.8	0.65	0.55	2350
28	EXC-6	J1PWD9	8/6/2012	5360	4.5	3.40	73.1
29	EXC-7	J1PWF0	8/6/2012	4.6	0.95	0.61	11.6
30	EXC-8	J1PWF1	8/6/2012	85.0	0.66	0.15	10.0
31	EXC-9	J1PWF2	8/6/2012	2.3	0.68	0.15	4.3
32	EXC-11	J1PWF4	8/6/2012	26.6	8.2	7.2	2830
33	EXC-12	J1PWF5	8/6/2012	26.2	1.9	1.5	58.2

34 **Statistical Computations**

35		Chloride	Nitrogen in Nitrate	Nitrogen in Nitrite and Nitrate	Sulfate [a]
36	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), use ProUCL gamma distribution.
37	N	12	12	12	12
38	% < Detection limit	25%	0%	50%	8%
39	Mean	460	1.7	1.2	456
40	Standard deviation	1543	2.3	2.1	1003
41	95% UCL on mean	1193	2.8	2.2	3336
42	Maximum value	5360	8.2	7.2	2830
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (ug/kg)**	25000 GW Protection	1000 GW Protection	1000 GW Protection	25000 GW Protection
44	**WAC 173-340 3-PART TEST**				
45	95% UCL > Cleanup Limit?	NO	NA	NA	NO
46	> 10% above Cleanup Limit?	NO	NA	NA	NO
47	Any sample > 2X Cleanup Limit?	NO	NA	NA	NO
48	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (11.8 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (11.8 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.

49 Qualifiers are defined on page 3.
50 [a] The 95% UCL result was determined using ProUCL 4.1 (EPA 2011) software instead of MTCA Stat software (WCH 2010).

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/28/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/28/12
Sheet No. 9 of 16

120-N-3 Statistical Calculations

Verification Data -Excavation (EXC)

Sample Area	Sample Number	Sample Date	Anthracene ug/kg	Q	PQL	Benzo(a)anthracene ug/kg	Q	PQL	Benzo(a)pyrene ug/kg	Q	PQL	Benzo(b)fluoranthene ug/kg	Q	PQL	Benzo(ghi)perylene ug/kg	Q	PQL	Benzo(k)fluoranthene ug/kg	Q	PQL	Chrysene ug/kg	Q	PQL	Fluoranthene ug/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	7.9	J	3.0	16		3.2	22		6.4	17		4.2	10	J	7.2	6.7	J	3.9	26	J	4.8	36	J	13
Duplicate of J1PWF3	J1PWF6	8/6/2012	20		3.0	20	X	3.1	33		6.3	31		4.1	22	JX	7.1	12	J	3.9	56		4.8	88		13
EXC-1	J1PWD4	8/6/2012	220		3.0	440		3.1	350		6.3	350		4.1	220		7.0	140		3.9	480		4.7	920	N	13
EXC-2	J1PWD5	8/6/2012	13	J	2.9	15	X	3.0	32		6.1	28		4.0	19	J	6.8	17		3.7	37	J	4.6	64		12
EXC-3	J1PWD6	8/6/2012	43		3.0	110		3.1	87		6.2	87		4.1	77		7.0	35		3.8	120		4.7	240		13
EXC-4	J1PWD7	8/6/2012	14	J	3.1	94		3.2	55		6.4	75		4.2	43		7.2	32		3.9	130		4.8	180		13
EXC-5	J1PWD8	8/6/2012	5.9	JX	3.0	13	JX	3.1	25		6.3	23		4.1	16	J	7.0	9.1	JX	3.8	36	J	4.7	48		13
EXC-6	J1PWD9	8/6/2012	110		3.1	360		3.2	250		6.5	280		4.3	140		7.3	140		4.0	360		4.9	650		13
EXC-7	J1PWF0	8/6/2012	18	J	3.0	22	X	3.1	39		6.2	42		4.1	22	J	7.0	15	X	3.8	50		4.7	96		13
EXC-8	J1PWF1	8/6/2012	19	J	3.0	26	X	3.1	45		6.3	44		4.1	27	J	7.0	16		3.9	57		4.7	110		13
EXC-9	J1PWF2	8/6/2012	26		3.1	53		3.2	44		6.5	44		4.2	16	JX	7.2	19		4.0	72		4.9	100		13
EXC-11	J1PWF4	8/6/2012	26	X	3.0	79		3.2	54		6.4	65		4.2	32		7.2	21	X	3.9	85		4.8	160		13
EXC-12	J1PWF5	8/6/2012	4000	DJ	15	6500	DJ	16	3200	DJ	32	3900	DXJ	21	1500	DJ	36	1900	DJ	20	6000	DJ	24	18000	DJ	65

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Anthracene ug/kg	Benzo(a)anthracene ug/kg	Benzo(a)pyrene ug/kg	Benzo(b)fluoranthene ug/kg	Benzo(ghi)perylene ug/kg	Benzo(k)fluoranthene ug/kg	Chrysene ug/kg	Fluoranthene ug/kg
EXC-10	J1PWF3/J1PWF6	8/6/2012	14	18	28	24	16	9.4	41	62
EXC-1	J1PWD4	8/6/2012	220	440	350	350	220	140	480	920
EXC-2	J1PWD5	8/6/2012	13	15	32	28	19	17	37	64
EXC-3	J1PWD6	8/6/2012	43	110	87	87	77	35	120	240
EXC-4	J1PWD7	8/6/2012	14	94	55	75	43	32	130	180
EXC-5	J1PWD8	8/6/2012	5.9	13	25	23	16	9.1	36	48
EXC-6	J1PWD9	8/6/2012	110	360	250	280	140	140	360	650
EXC-7	J1PWF0	8/6/2012	18	22	39	42	22	15	50	96
EXC-8	J1PWF1	8/6/2012	19	26	45	44	27	16	57	110
EXC-9	J1PWF2	8/6/2012	26	53	44	44	16	19	72	100
EXC-11	J1PWF4	8/6/2012	26	79	54	65	32	21	85	160
EXC-12	J1PWF5	8/6/2012	4000	6500	3200	3900	1500	1900	6000	18000

Statistical Computations

	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Chrysene	Fluoranthene
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.	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	12	12	12
% < Detection limit	0%	0%	0%	0%	0%	0%	0%	0%
Mean	376	644	351	414	177	196	622	1719
Standard deviation	1143	1849	903	1103	421	539	1699	5134
95% UCL on mean	919	1522	780	937	377	452	1429	4157
Maximum value	4000	6500	3200	3900	1500	1900	6000	18000
Most Stringent Cleanup Limit for nonradionuclide and RAG type (ug/kg)	240000 GW Protection	15 GW & River Protection	15 GW & River Protection	15 GW & River Protection	48000 GW Protection	15 River Protection	100 River Protection	18000 River Protection
WAC 173-340 3-PART TEST								
95% UCL > Cleanup Limit?	NO	YES	YES	YES	NO	YES	YES	NO
> 10% above Cleanup Limit?	NO	YES	YES	YES	NO	YES	YES	NO
Any sample > 2X Cleanup Limit?	NO	YES	YES	YES	NO	YES	YES	NO
WAC 173-340 Compliance?	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 does not meet the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set does not meet the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set does not meet 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.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	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 NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/28/12
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Calc. No. 0100N-CA-V0171
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Rev. No. 0
Date 11/28/12
Sheet No. 10 of 16

1 **120-N-3 Statistical Calculations**
2 **Verification Data -Excavation (EXC)**

3	Sample	Sample	Sample	Fluorene			Indeno(1,2,3-cd)pyrene			Phenanthrene			Pyrene		
4	Area	Number	Date	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-10	J1PWF3	8/6/2012	5.3	U	5.3	12	U	12	16	JX	12	38	J	12
6	Duplicate of J1PWF3	J1PWF6	8/6/2012	13	J	5.2	19	J	12	65		12	100		12
7	EXC-1	J1PWD4	8/6/2012	120		5.2	250		12	690	N	12	1100	N	12
8	EXC-2	J1PWD5	8/6/2012	6.9	J	5.0	19	J	11	31	J	11	83		11
9	EXC-3	J1PWD6	8/6/2012	19	JX	5.1	60		12	130		12	250		12
10	EXC-4	J1PWD7	8/6/2012	13	J	5.3	34		12	44		12	180		12
11	EXC-5	J1PWD8	8/6/2012	5.2	U	5.2	14	J	12	21	J	12	62		12
12	EXC-6	J1PWD9	8/6/2012	60		5.4	130		12	240		12	750		12
13	EXC-7	J1PWF0	8/6/2012	12	J	5.1	26	J	12	62		12	110		12
14	EXC-8	J1PWF1	8/6/2012	8.5	J	5.2	25	J	12	44		12	100		12
15	EXC-9	J1PWF2	8/6/2012	15	J	5.3	23	J	12	68	X	12	120		12
16	EXC-11	J1PWF4	8/6/2012	14	J	5.3	30		12	83	X	12	160		12
17	EXC-12	J1PWF5	8/6/2012	1700	DJ	26	1300	DJ	60	10000	DJ	60	16000	DJ	60

18
19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
21	Area	Number	Date	ug/kg	ug/kg	ug/kg	ug/kg
22	EXC-10	J1PWF3/J1PWF6	8/6/2012	7.8	13	41	69
23	EXC-1	J1PWD4	8/6/2012	120	250	690	1100
24	EXC-2	J1PWD5	8/6/2012	6.9	19	31	83
25	EXC-3	J1PWD6	8/6/2012	19	60	130	250
26	EXC-4	J1PWD7	8/6/2012	13	34	44	180
27	EXC-5	J1PWD8	8/6/2012	2.6	14	21	62
28	EXC-6	J1PWD9	8/6/2012	60	130	240	750
29	EXC-7	J1PWF0	8/6/2012	12	26	62	110
30	EXC-8	J1PWF1	8/6/2012	8.5	25	44	100
31	EXC-9	J1PWF2	8/6/2012	15	23	68	120
32	EXC-11	J1PWF4	8/6/2012	14	30	83	160
33	EXC-12	J1PWF5	8/6/2012	1700	1300	10000	16000

34 **Statistical Computations**

35		Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
36	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.
37	N	12	12	12	12
38	% < Detection limit	8%	0%	0%	0%
39	Mean	165	160	954	1582
40	Standard deviation	485	365	2855	4552
41	95% UCL on mean	395	334	2310	3744
42	Maximum value	1700	1300	10000	16000
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (ug/kg)**	64000 River Protection	15 GW & River Protection	240000 GW Protection	48000 GW Protection
44	**WAC 173-340 3-PART TEST**				
45	95% UCL > Cleanup Limit?	NO	YES	NO	NO
46	> 10% above Cleanup Limit?	NO	YES	NO	NO
47	Any sample > 2X Cleanup Limit?	NO	YES	NO	NO
48	**WAC 173-340 Compliance?**	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.	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.

49 Qualifiers are defined on page 3.
50

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 02/06/13
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CHD

Rev. No. 0
Date 02/06/13
Sheet No. 11 of 16

120-N-3 Maximum Calculations
Verification Data -Excavation (EXC)

Sample Area	Sample Number	Sample Date	Boron mg/kg	Boron Q	Boron PQL	Mercury mg/kg	Mercury Q	Mercury PQL	Molybdenum mg/kg	Molybdenum Q	Molybdenum PQL	Acenaphthene ug/kg	Acenaphthene Q	Acenaphthene PQL	Dibenz(a,h)anthracene ug/kg	Dibenz(a,h)anthracene Q	Dibenz(a,h)anthracene PQL	Aroclor-1254 ug/kg	Aroclor-1254 Q	Aroclor-1254 PQL	Aroclor-1260 ug/kg	Aroclor-1260 Q	Aroclor-1260 PQL
EXC-10	J1PWF3	8/6/2012	0.93	U	0.93	0.0066	B	0.0050	0.25	U	0.25	10	U	10	11	U	11	2.5	U	2.5	2.5	UJ	2.5
Duplicate of J1PWF3	J1PWF6	8/6/2012	0.96	U	0.96	0.012	B	0.0054	0.26	U	0.26	9.9	U	9.9	11	U	11	2.6	U	2.6	2.6	UJ	2.6
EXC-1	J1PWD4	8/6/2012	1.0	B	0.96	0.0057	U	0.0057	0.40	B	0.25	130	X	9.8	62	X	11	28	P	2.6	20	NJ	2.6
EXC-2	J1PWD5	8/6/2012	0.97	U	0.97	0.0048	U	0.0048	0.27	B	0.26	9.5	U	9.5	10	U	10	2.5	U	2.5	2.5	UJ	2.5
EXC-3	J1PWD6	8/6/2012	1.2	B	0.99	0.0068	U	0.0068	0.26	U	0.26	9.7	U	9.7	12	JX	11	9.1	JP	2.6	8.2	J	2.6
EXC-4	J1PWD7	8/6/2012	0.92	U	0.92	1.5		0.012	0.38	B	0.24	10	U	10	11	U	11	3.3	J	2.6	2.6	UJ	2.6
EXC-5	J1PWD8	8/6/2012	0.92	U	0.92	0.0055	U	0.0055	0.25	U	0.25	9.8	U	9.8	11	U	11	2.5	U	2.5	2.5	UJ	2.5
EXC-6	J1PWD9	8/6/2012	0.97	U	0.97	0.043		0.0058	0.26	U	0.26	10	U	10	42	X	11	2.6	U	2.6	2.6	UJ	2.6
EXC-7	J1PWF0	8/6/2012	0.98	U	0.98	0.0050	U	0.0050	0.26	U	0.26	9.7	U	9.7	11	U	11	2.4	U	2.4	2.4	UJ	2.4
EXC-8	J1PWF1	8/6/2012	0.93	U	0.93	0.0052	U	0.0052	0.25	U	0.25	9.8	U	9.8	11	U	11	2.4	U	2.4	2.4	UJ	2.4
EXC-9	J1PWF2	8/6/2012	0.91	U	0.91	0.28		0.0053	0.28	B	0.24	10	U	10	11	U	11	2.5	U	2.5	2.5	UJ	2.5
EXC-11	J1PWF4	8/6/2012	0.97	U	0.97	0.0056	U	0.0056	0.26	U	0.26	21	JX	9.9	11	U	11	2.5	U	2.5	2.5	UJ	2.5
EXC-12	J1PWF5	8/6/2012	0.91	U	0.91	0.0050	U	0.0050	0.24	U	0.24	1000	DX	50	470	DXJ	55	2.5	U	2.5	2.5	UJ	2.5

Statistical Computations

	Boron	Mercury	Molybdenum	Acenaphthene	Dibenz(a,h)anthracene	Aroclor-1254	Aroclor-1260
% < Detection limit	83%	67%	67%	75%	67%	75%	83%
Maximum value	1.2	1.5	0.40	1000	470	28	20
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless otherwise noted	320 GW Protection	0.33 GW & River Protection	8 GW Protection	96000 ug/kg GW Protection	30 ug/kg GW Protection	17 ug/kg GW & River Protection	17 ug/kg GW & River Protection
3-PART TEST							
Maximum > Cleanup Limit?	NO	YES	NO	NO	YES	YES	YES
> 10% above Cleanup Limit?	NO	NO	NO	NO	YES	NO	NO
Any sample > 2X Cleanup Limit?	NO	YES	NO	NO	YES	NO	NO
3-Part Test Compliance?	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.	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 does not meet the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.

120-N-3 Maximum Calculations
Verification Data -Excavation (EXC)

Sample Area	Sample Number	Sample Date	Fluoride mg/kg	Fluoride Q	Fluoride PQL
EXC-10	J1PWF3	8/6/2012	0.81	U	0.81
Duplicate of J1PWF3	J1PWF6	8/6/2012	0.81	U	0.81
EXC-1	J1PWD4	8/6/2012	0.82	U	0.82
EXC-2	J1PWD5	8/6/2012	0.81	U	0.81
EXC-3	J1PWD6	8/6/2012	1.2	BN	0.81
EXC-4	J1PWD7	8/6/2012	0.83	U	0.83
EXC-5	J1PWD8-A	10/22/2012	0.81	UN	0.81
EXC-6	J1PWD9	8/6/2012	0.85	U	0.85
EXC-7	J1PWF0	8/6/2012	0.81	U	0.81
EXC-8	J1PWF1	8/6/2012	0.83	U	0.83
EXC-9	J1PWF2	8/6/2012	0.81	U	0.81
EXC-11	J1PWF4	8/6/2012	5.7		0.80
EXC-12	J1PWF5	8/6/2012	0.82	U	0.82

Statistical Computations

	Fluoride
% < Detection limit	83%
Maximum value	5.7
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	96000 GW & River Protection
3-PART TEST	
Maximum > Cleanup Limit?	NO
> 10% above Cleanup Limit?	NO
Any sample > 2X Cleanup Limit?	NO
3-Part Test Compliance?	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-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/27/12
Job No. 14655

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Rev. No. 0
Date 11/27/12
Sheet No. 12 of 16

Ecology Software (MTCAStat) Results, 120-N-3 Excavation (EXC)

Antimony 95% UCL Calculation

DATA	ID
0.18	J1PWF3/J1PWF6
1.1	J1PWD4
0.19	J1PWD5
0.55	J1PWD6
0.77	J1PWD7
0.48	J1PWD8
0.55	J1PWD9
0.19	J1PWF0
0.57	J1PWF1
0.77	J1PWF2
0.19	J1PWF4
0.18	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.48
Censored		Lognormal mean	0.49
Detection limit or PQL		Std. devn.	0.30
Method detection limit		Median	0.52
TOTAL	12	Min.	0.18
		Max.	1.1

Lognormal distribution? r-squared is: 0.863
Normal distribution? r-squared is: 0.877
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.62

Arsenic 95% UCL Calculation

DATA	ID
1.2	J1PWF3/J1PWF6
2.2	J1PWD4
2.1	J1PWD5
3.1	J1PWD6
1.8	J1PWD7
1.1	J1PWD8
1.4	J1PWD9
1.9	J1PWF0
1.7	J1PWF1
1.8	J1PWF2
3.3	J1PWF4
2.2	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	2.0
Censored		Lognormal mean	2.0
Detection limit or PQL		Std. devn.	0.68
Method detection limit		Median	1.9
TOTAL	12	Min.	1.1
		Max.	3.3

Lognormal distribution? r-squared is: 0.959
Normal distribution? r-squared is: 0.919
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 2.4

Barium 95% UCL Calculation

DATA	ID
44.3	J1PWF3/J1PWF6
64.5	J1PWD4
47.1	J1PWD5
75.9	J1PWD6
71.5	J1PWD7
42.6	J1PWD8
53.9	J1PWD9
47.8	J1PWF0
62.5	J1PWF1
63.6	J1PWF2
68.5	J1PWF4
52.7	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	57.9
Censored		Lognormal mean	58.0
Detection limit or PQL		Std. devn.	11.3
Method detection limit		Median	58.2
TOTAL	12	Min.	42.6
		Max.	75.9

Lognormal distribution? r-squared is: 0.955
Normal distribution? r-squared is: 0.956
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 64.7

Beryllium 95% UCL Calculation

DATA	ID
0.080	J1PWF3/J1PWF6
0.18	J1PWD4
0.13	J1PWD5
0.22	J1PWD6
0.016	J1PWD7
0.058	J1PWD8
0.16	J1PWD9
0.20	J1PWF0
0.080	J1PWF1
0.075	J1PWF2
0.22	J1PWF4
0.15	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.13
Censored		Lognormal mean	0.14
Detection limit or PQL		Std. devn.	0.068
Method detection limit		Median	0.14
TOTAL	12	Min.	0.016
		Max.	0.22

Lognormal distribution? r-squared is: 0.833
Normal distribution? r-squared is: 0.954
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.17

Cadmium 95% UCL Calculation

DATA	ID
0.14	J1PWF3/J1PWF6
0.21	J1PWD4
0.12	J1PWD5
0.18	J1PWD6
0.12	J1PWD7
0.084	J1PWD8
0.13	J1PWD9
0.12	J1PWF0
0.13	J1PWF1
0.22	J1PWF2
0.16	J1PWF4
0.12	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.14
Censored		Lognormal mean	0.14
Detection limit or PQL		Std. devn.	0.040
Method detection limit		Median	0.13
TOTAL	12	Min.	0.084
		Max.	0.22

Lognormal distribution? r-squared is: 0.918
Normal distribution? r-squared is: 0.891
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.17

Chromium 95% UCL Calculation

DATA	ID
5.0	J1PWF3/J1PWF6
10.3	J1PWD4
6.7	J1PWD5
13.6	J1PWD6
5.8	J1PWD7
5.7	J1PWD8
6.4	J1PWD9
11.7	J1PWF0
5.5	J1PWF1
7.3	J1PWF2
12.1	J1PWF4
8.4	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	8.2
Censored		Lognormal mean	8.2
Detection limit or PQL		Std. devn.	3.0
Method detection limit		Median	7.0
TOTAL	12	Min.	5.0
		Max.	13.6

Lognormal distribution? r-squared is: 0.931
Normal distribution? r-squared is: 0.895
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 10.1

Cobalt 95% UCL Calculation

DATA	ID
13.5	J1PWF3/J1PWF6
9.3	J1PWD4
8.8	J1PWD5
9.1	J1PWD6
9.1	J1PWD7
8.1	J1PWD8
9.5	J1PWD9
8.3	J1PWF0
12.0	J1PWF1
11.9	J1PWF2
9.2	J1PWF4
10	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	9.9
Censored		Lognormal mean	9.9
Detection limit or PQL		Std. devn.	1.7
Method detection limit		Median	9.3
TOTAL	12	Min.	8.1
		Max.	13.5

Lognormal distribution? r-squared is: 0.883
Normal distribution? r-squared is: 0.849
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 10.7

Copper 95% UCL Calculation

DATA	ID
19.6	J1PWF3/J1PWF6
23.0	J1PWD4
16.7	J1PWD5
17.7	J1PWD6
14.7	J1PWD7
17.4	J1PWD8
17.9	J1PWD9
16.1	J1PWF0
17.2	J1PWF1
21.4	J1PWF2
19.5	J1PWF4
18.1	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	18.3
Censored		Lognormal mean	18.3
Detection limit or PQL		Std. devn.	2.3
Method detection limit		Median	17.8
TOTAL	12	Min.	14.7
		Max.	23.0

Lognormal distribution? r-squared is: 0.965
Normal distribution? r-squared is: 0.946
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 19.5

Hexavalent Chromium 95% UCL Calculation

DATA	ID
0.0775	J1PWF3/J1PWF6
0.528	J1PWD4
0.0775	J1PWD5
0.191	J1PWD6
0.170	J1PWD7
0.211	J1PWD8
0.247	J1PWD9
0.0775	J1PWF0
0.0775	J1PWF1
0.281	J1PWF2
0.169	J1PWF4
0.168	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.190
Censored		Lognormal mean	0.192
Detection limit or PQL		Std. devn.	0.127
Method detection limit		Median	0.170
TOTAL	12	Min.	0.0775
		Max.	0.528

Lognormal distribution? r-squared is: 0.899
Normal distribution? r-squared is: 0.787
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.250

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

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Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/27/12
Sheet No. 13 of 16

Ecology Software (MTCAStat) Results, 120-N-3 Excavation (EXC)

Lead 95% UCL Calculation

DATA	ID
2.8	J1PWF3/J1PWF6
11.2	J1PWD4
3.1	J1PWD5
17.8	J1PWD6
10.3	J1PWD7
2.2	J1PWD8
5.5	J1PWD9
3.8	J1PWF0
3.2	J1PWF1
5.3	J1PWF2
4.9	J1PWF4
4.2	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	6.2
Censored		Lognormal mean	6.2
Detection limit or PQL		Std. devn.	4.6
Method detection limit		Median	4.6
TOTAL	12	Min.	2.2
		Max.	17.8

Lognormal distribution? r-squared is: 0.933
Normal distribution? r-squared is: 0.772
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.6

Manganese 95% UCL Calculation

DATA	ID
322	J1PWF3/J1PWF6
355	J1PWD4
298	J1PWD5
316	J1PWD6
288	J1PWD7
236	J1PWD8
297	J1PWD9
305	J1PWF0
335	J1PWF1
332	J1PWF2
388	J1PWF4
328	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	317
Censored		Lognormal mean	317
Detection limit or PQL		Std. devn.	37.5
Method detection limit		Median	319
TOTAL	12	Min.	236
		Max.	388

Lognormal distribution? r-squared is: 0.917
Normal distribution? r-squared is: 0.941
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 339

Nickel 95% UCL Calculation

DATA	ID
9.0	J1PWF3/J1PWF6
12.3	J1PWD4
9.1	J1PWD5
32.5	J1PWD6
7.1	J1PWD7
7.1	J1PWD8
9.8	J1PWD9
12.0	J1PWF0
10.4	J1PWF1
9.0	J1PWF2
13.8	J1PWF4
11.0	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	11.9
Censored		Lognormal mean	11.8
Detection limit or PQL		Std. devn.	6.8
Method detection limit		Median	10.1
TOTAL	12	Min.	7.1
		Max.	32.5

Lognormal distribution? r-squared is: 0.785
Normal distribution? r-squared is: 0.581
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 15.1

Vanadium 95% UCL Calculation

DATA	ID
76.9	J1PWF3/J1PWF6
55.1	J1PWD4
70.4	J1PWD5
52.5	J1PWD6
98.2	J1PWD7
60.4	J1PWD8
54.4	J1PWD9
49.6	J1PWF0
72.7	J1PWF1
78.7	J1PWF2
50.5	J1PWF4
62.9	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	65.2
Censored		Lognormal mean	65.3
Detection limit or PQL		Std. devn.	14.6
Method detection limit		Median	61.7
TOTAL	12	Min.	49.6
		Max.	98.2

Lognormal distribution? r-squared is: 0.940
Normal distribution? r-squared is: 0.903
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 73.5

Zinc 95% UCL Calculation

DATA	ID
55.2	J1PWF3/J1PWF6
138	J1PWD4
44.0	J1PWD5
51.6	J1PWD6
54.4	J1PWD7
40.9	J1PWD8
50.9	J1PWD9
44.8	J1PWF0
48.8	J1PWF1
54.0	J1PWF2
45.5	J1PWF4
52.3	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	56.7
Censored		Lognormal mean	56.2
Detection limit or PQL		Std. devn.	26.0
Method detection limit		Median	51.3
TOTAL	12	Min.	40.9
		Max.	138

Lognormal distribution? r-squared is: 0.591
Normal distribution? r-squared is: 0.463
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 69.1

Chloride 95% UCL Calculation

DATA	ID
2.0	J1PWF3/J1PWF6
2.5	J1PWD4
0.95	J1PWD5
1.0	J1PWD6
1.0	J1PWD7
8.8	J1PWD8-A
5360	J1PWD9
4.6	J1PWF0
85	J1PWF1
2.3	J1PWF2
26.6	J1PWF4
26.2	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	460
Censored		Lognormal mean	196
Detection limit or PQL		Std. devn.	1543
Method detection limit		Median	3.6
TOTAL	12	Min.	0.95
		Max.	5360

Lognormal distribution? r-squared is: 0.812
Normal distribution? r-squared is: NA
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1193

Nitrogen in Nitrate 95% UCL Calculation

DATA	ID
0.50	J1PWF3/J1PWF6
0.75	J1PWD4
0.57	J1PWD5
0.75	J1PWD6
0.66	J1PWD7
0.65	J1PWD8-A
4.5	J1PWD9
0.95	J1PWF0
0.66	J1PWF1
0.68	J1PWF2
8.2	J1PWF4
1.9	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	1.7
Censored		Lognormal mean	1.6
Detection limit or PQL		Std. devn.	2.3
Method detection limit		Median	0.72
TOTAL	12	Min.	0.50
		Max.	8.2

Lognormal distribution? r-squared is: 0.741
Normal distribution? r-squared is: 0.561
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 2.8

Nitrogen in Nitrite and Nitrate 95% UCL Calculation

DATA	ID
0.15	J1PWF3/J1PWF6
0.15	J1PWD4
0.15	J1PWD5
0.35	J1PWD6
0.15	J1PWD7
0.55	J1PWD8-A
3.4	J1PWD9
0.61	J1PWF0
0.15	J1PWF1
0.15	J1PWF2
7.2	J1PWF4
1.5	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	1.2
Censored		Lognormal mean	1.1
Detection limit or PQL		Std. devn.	2.1
Method detection limit		Median	0.25
TOTAL	12	Min.	0.15
		Max.	7.2

Lognormal distribution? r-squared is: 0.813
Normal distribution? r-squared is: 0.570
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 2.2

Sulfate 95% UCL Calculation

DATA	ID
1.5	J1PWF3/J1PWF6
7.5	J1PWD4
0.85	J1PWD5
8.4	J1PWD6
119	J1PWD7
2350	J1PWD8-A
73.1	J1PWD9
11.6	J1PWF0
10.0	J1PWF1
4.3	J1PWF2
2830	J1PWF4
58.2	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	456
Censored		Lognormal mean	767
Detection limit or PQL		Std. devn.	1003
Method detection limit		Median	10.8
TOTAL	12	Min.	0.85
		Max.	2830

Lognormal distribution? r-squared is: 0.923
Normal distribution? r-squared is: 0.499
Recommendations:
Use gamma distribution.

UCL (Approximate gamma) is 3336

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-N Field Remediation
Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/27/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/27/12
Sheet No. 14 of 16

Ecology Software (MTCAStat) Results, 120-N-3 Excavation (EXC)

TPH- diesel range 95% UCL Calculation

DATA	ID
720	J1PWF3/J1PWF6
26000	J1PWD4
2500	J1PWD5
5700	J1PWD6
340	J1PWD7
335	J1PWD8
12000	J1PWD9
2900	J1PWF0
3300	J1PWF1
325	J1PWF2
3600	J1PWF4
13000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	5893
Censored		Lognormal mean	7821
Detection limit or PQL		Std. devn.	7652
Method detection limit		Median	3100
TOTAL	12	Min.	325
		Max.	26000

Lognormal distribution? r-squared is: 0.937
Normal distribution? r-squared is: 0.735
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 47211

TPH- diesel range EXT 95% UCL Calculation

DATA	ID
900	J1PWF3/J1PWF6
48000	J1PWD4
3500	J1PWD5
9600	J1PWD6
500	J1PWD7
495	J1PWD8
16000	J1PWD9
3600	J1PWF0
4200	J1PWF1
480	J1PWF2
4800	J1PWF4
16000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	9006
Censored		Lognormal mean	11377
Detection limit or PQL		Std. devn.	13492
Method detection limit		Median	3900
TOTAL	12	Min.	480
		Max.	48000

Lognormal distribution? r-squared is: 0.938
Normal distribution? r-squared is: 0.639
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 71957

Anthracene 95% UCL Calculation

DATA	ID
14	J1PWF3/J1PWF6
220	J1PWD4
13	J1PWD5
43	J1PWD6
14	J1PWD7
5.9	J1PWD8
110	J1PWD9
18	J1PWF0
19	J1PWF1
26	J1PWF2
26	J1PWF4
4000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	376
Censored		Lognormal mean	184
Detection limit or PQL		Std. devn.	1143
Method detection limit		Median	23
TOTAL	12	Min.	5.9
		Max.	4000

Lognormal distribution? r-squared is: 0.785
Normal distribution? r-squared is: NA
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 919

Benzo(a)anthracene 95% UCL Calculation

DATA	ID
18	J1PWF3/J1PWF6
440	J1PWD4
15	J1PWD5
110	J1PWD6
94	J1PWD7
13	J1PWD8
360	J1PWD9
22	J1PWF0
26	J1PWF1
53	J1PWF2
79	J1PWF4
6500	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	644
Censored		Lognormal mean	421
Detection limit or PQL		Std. devn.	1849
Method detection limit		Median	66
TOTAL	12	Min.	13
		Max.	6500

Lognormal distribution? r-squared is: 0.870
Normal distribution? r-squared is: 0.351
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1522

Benzo(a)pyrene 95% UCL Calculation

DATA	ID
28	J1PWF3/J1PWF6
350	J1PWD4
32	J1PWD5
87	J1PWD6
55	J1PWD7
25	J1PWD8
250	J1PWD9
39	J1PWF0
45	J1PWF1
44	J1PWF2
54	J1PWF4
3200	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	351
Censored		Lognormal mean	227
Detection limit or PQL		Std. devn.	903
Method detection limit		Median	50
TOTAL	12	Min.	25
		Max.	3200

Lognormal distribution? r-squared is: 0.771
Normal distribution? r-squared is: 0.374
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 780

Benzo(b)fluoranthene 95% UCL Calculation

DATA	ID
24	J1PWF3/J1PWF6
350	J1PWD4
28	J1PWD5
87	J1PWD6
75	J1PWD7
23	J1PWD8
280	J1PWD9
42	J1PWF0
44	J1PWF1
44	J1PWF2
65	J1PWF4
3900	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	414
Censored		Lognormal mean	261
Detection limit or PQL		Std. devn.	1103
Method detection limit		Median	55
TOTAL	12	Min.	23
		Max.	3900

Lognormal distribution? r-squared is: 0.802
Normal distribution? r-squared is: 0.364
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 937

Benzo(ghi)perylene 95% UCL Calculation

DATA	ID
16	J1PWF3/J1PWF6
220	J1PWD4
19	J1PWD5
77	J1PWD6
43	J1PWD7
16	J1PWD8
140	J1PWD9
22	J1PWF0
27	J1PWF1
16	J1PWF2
32	J1PWF4
1500	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	177
Censored		Lognormal mean	130
Detection limit or PQL		Std. devn.	421
Method detection limit		Median	30
TOTAL	12	Min.	16
		Max.	1500

Lognormal distribution? r-squared is: 0.815
Normal distribution? r-squared is: 0.404
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 377

Benzo(k)fluoranthene 95% UCL Calculation

DATA	ID
9.4	J1PWF3/J1PWF6
140	J1PWD4
17	J1PWD5
35	J1PWD6
32	J1PWD7
9.1	J1PWD8
140	J1PWD9
15	J1PWF0
16	J1PWF1
19	J1PWF2
21	J1PWF4
1900	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	196
Censored		Lognormal mean	118
Detection limit or PQL		Std. devn.	539
Method detection limit		Median	20
TOTAL	12	Min.	9.1
		Max.	1900

Lognormal distribution? r-squared is: 0.785
Normal distribution? r-squared is: 0.356
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 452

Chrysene 95% UCL Calculation

DATA	ID
41	J1PWF3/J1PWF6
480	J1PWD4
37	J1PWD5
120	J1PWD6
130	J1PWD7
36	J1PWD8
360	J1PWD9
50	J1PWF0
57	J1PWF1
72	J1PWF2
85	J1PWF4
6000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	622
Censored		Lognormal mean	376
Detection limit or PQL		Std. devn.	1699
Method detection limit		Median	79
TOTAL	12	Min.	36
		Max.	6000

Lognormal distribution? r-squared is: 0.789
Normal distribution? r-squared is: 0.356
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1429

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
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Date 11/27/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/27/12
Sheet No. 15 of 16

Ecology Software (MTCAStat) Results, 120-N-3 Excavation (EXC)

Fluoranthene 95% UCL Calculation

DATA	ID
62	J1PWF3/J1PWF6
920	J1PWD4
64	J1PWD5
240	J1PWD6
180	J1PWD7
48	J1PWD8
650	J1PWD9
96	J1PWF0
110	J1PWF1
100	J1PWF2
160	J1PWF4
18000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	1719
Censored		Lognormal mean	871
Detection limit or PQL		Std. devn.	5134
Method detection limit		Median	135
TOTAL	12	Min.	48
		Max.	18000

Lognormal distribution? r-squared is: 0.784
Normal distribution? r-squared is: 0.333
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 4157

Fluorene 95% UCL Calculation

DATA	ID
7.8	J1PWF3/J1PWF6
120	J1PWD4
6.9	J1PWD5
19	J1PWD6
13	J1PWD7
2.6	J1PWD8
60	J1PWD9
12	J1PWF0
8.5	J1PWF1
15	J1PWF2
14	J1PWF4
1700	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	165
Censored		Lognormal mean	90
Detection limit or PQL		Std. devn.	485
Method detection limit		Median	14
TOTAL	12	Min.	2.6
		Max.	1700

Lognormal distribution? r-squared is: 0.809
Normal distribution? r-squared is: 0.341
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 395

Indeno(1,2,3-cd)pyrene 95% UCL Calculation

DATA	ID
13	J1PWF3/J1PWF6
250	J1PWD4
19	J1PWD5
60	J1PWD6
34	J1PWD7
14	J1PWD8
130	J1PWD9
26	J1PWF0
25	J1PWF1
23	J1PWF2
30	J1PWF4
1300	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	160
Censored		Lognormal mean	120
Detection limit or PQL		Std. devn.	365
Method detection limit		Median	28
TOTAL	12	Min.	13
		Max.	1300

Lognormal distribution? r-squared is: 0.828
Normal distribution? r-squared is: 0.424
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 334

Phenanthrene 95% UCL Calculation

DATA	ID
41	J1PWF3/J1PWF6
690	J1PWD4
31	J1PWD5
130	J1PWD6
44	J1PWD7
21	J1PWD8
240	J1PWD9
62	J1PWF0
44	J1PWF1
68	J1PWF2
83	J1PWF4
10000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	954
Censored		Lognormal mean	479
Detection limit or PQL		Std. devn.	2855
Method detection limit		Median	65
TOTAL	12	Min.	21
		Max.	10000

Lognormal distribution? r-squared is: 0.784
Normal distribution? r-squared is: 0.337
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 2310

Pyrene 95% UCL Calculation

DATA	ID
69	J1PWF3/J1PWF6
1100	J1PWD4
83	J1PWD5
250	J1PWD6
180	J1PWD7
62	J1PWD8
750	J1PWD9
110	J1PWF0
100	J1PWF1
120	J1PWF2
160	J1PWF4
16000	J1PWF5

Number of samples		Uncensored values	
Uncensored	12	Mean	1582
Censored		Lognormal mean	866
Detection limit or PQL		Std. devn.	4552
Method detection limit		Median	140
TOTAL	12	Min.	62
		Max.	16000

Lognormal distribution? r-squared is: 0.773
Normal distribution? r-squared is: 0.345
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 3744

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
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Subject 120-N-3 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/28/12
Job No. 14655

Calc. No. 0100N-CA-V0171
Checked C. H. Dobie CD

Rev. No. 0
Date 11/28/12
Sheet No. 16 of 16

Duplicate Analysis - 120-N-3 Excavation (EXC)

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			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	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	5480	X	1.5	1.3		0.62	40.0	X	0.072	0.14	B	0.039	4970	X	13.3	4.8	X	0.055	13.2	X	0.47	19.6		1.0	26400	X	3.6
Duplicate of EXC-10	J1PWF6	8/6/2012	5780	X	1.5	1.0		0.65	48.6	X	0.075	0.14	B	0.040	4900	X	13.9	5.2	X	0.057	13.7	X	0.49	19.5		1.1	25600	X	3.7

Analysis:

TDL		5	10	2	0.2	100	1	2	1	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)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	5.3%		19.4%		1.4%		3.7%	0.5%	3.1%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	Not applicable

Duplicate Analysis - 120-N-3 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury			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-10	J1PWF3	8/6/2012	2.8		1.3	4430	X	3.5	320	X	0.094	0.0066	B	0.0050	9.2	X	0.12	513		38.7	186	XJ	5.3	483		55.7	79.8	X	0.089
Duplicate of EXC-10	J1PWF6	8/6/2012	2.8		1.3	4340	X	3.6	324	X	0.098	0.012	B	0.0054	8.8	X	0.12	632		40.3	206	XJ	5.6	465		58.0	73.9	X	0.092

Analysis:

TDL		5	75	5	0.2	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?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD		2.1%	1.2%				10.2%	3.8%	7.7%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable

Duplicate Analysis - 120-N-3 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Zinc			Nitrogen in Nitrate			Anthracene			Benzo(a)anthracene			Benzo(a)pyrene			Benzo(b)fluoranthene			Benzo(ghi)perylene			Benzo(k)fluoranthene			Chrysene		
			mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	55.3	XJ	0.38	0.49	BJ	0.31	7.9	J	3.0	16		3.2	22		6.4	17		4.2	10	J	7.2	6.7	J	3.9	26	J	4.8
Duplicate of EXC-10	J1PWF6	8/6/2012	55.1	XJ	0.39	0.50	BJ	0.31	20		3.0	20	X	3.1	33		6.3	31		4.1	22	JX	7.1	12	J	3.9	56		4.8

Analysis:

TDL		1	0.75	15	15	15	15	15	15	15
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)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	0.4%								
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 120-N-3 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Fluoranthene			Phenanthrene			Pyrene		
			ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	36	J	13	16	JX	12	38	J	12
Duplicate of EXC-10	J1PWF6	8/6/2012	88		13	65		12	100		12

Analysis:

TDL		15	15	15
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD			
	Difference > 2 TDL?	Yes - assess further	Yes - assess further	Yes - assess further

Qualifiers are defined on page 3.

Attachment 1. 120-N-3 Waste Site Verification Sample Results (Metals).

Sample Area	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	5480	X	1.5	0.36	UJ	0.36	1.3		0.62	40.0	X	0.072	0.16	U	0.16	0.93	U	0.93	0.14	B	0.039
Duplicate of EXC-10	J1PWF6	8/6/2012	5780	X	1.5	0.37	UJ	0.37	1.0		0.65	48.6	X	0.075	0.16	U	0.16	0.96	U	0.96	0.14	B	0.040
EXC-1	J1PWD4	8/6/2012	7870	X	1.5	1.1	MJ	0.37	2.2		0.65	64.5	X	0.074	0.18	B	0.032	1.0	B	0.96	0.21		0.040
EXC-2	J1PWD5	8/6/2012	5940	X	1.5	0.38	UJ	0.38	2.1		0.66	47.1	X	0.076	0.13	B	0.033	0.97	U	0.97	0.12	B	0.041
EXC-3	J1PWD6	8/6/2012	7980	X	1.6	0.55	BJ	0.38	3.1		0.67	75.9	X	0.077	0.22		0.033	1.2	B	0.99	0.18	B	0.041
EXC-4	J1PWD7	8/6/2012	5560	X	1.5	0.77	J	0.36	1.8		0.62	71.5	X	0.071	0.031	U	0.031	0.92	U	0.92	0.12	B	0.039
EXC-5	J1PWD8	8/6/2012	4500	X	1.5	0.48	BJ	0.36	1.1		0.62	42.6	X	0.072	0.058	B	0.031	0.92	U	0.92	0.084	B	0.039
EXC-6	J1PWD9	8/6/2012	7170	X	1.5	0.55	BJ	0.37	1.4		0.65	53.9	X	0.075	0.16	B	0.033	0.97	U	0.97	0.13	B	0.040
EXC-7	J1PWF0	8/6/2012	7530	X	1.5	0.38	UJ	0.38	1.9		0.66	47.8	X	0.076	0.20		0.033	0.98	U	0.98	0.12	B	0.041
EXC-8	J1PWF1	8/6/2012	5140	X	1.5	0.57	J	0.36	1.7		0.63	62.5	X	0.072	0.16	U	0.16	0.93	U	0.93	0.13	B	0.039
EXC-9	J1PWF2	8/6/2012	7050	X	1.4	0.77	J	0.35	1.8		0.61	63.6	X	0.070	0.15	U	0.15	0.91	U	0.91	0.22		0.038
EXC-11	J1PWF4	8/6/2012	8130	X	1.5	0.38	UJ	0.38	3.3		0.65	68.5	X	0.075	0.22		0.033	0.97	U	0.97	0.16	B	0.041
EXC-12	J1PWF5	8/6/2012	7760	X	1.4	0.35	UJ	0.35	2.2		0.61	52.7	X	0.070	0.15	B	0.031	0.91	U	0.91	0.12	B	0.038
Equipment Blank	J1PWF7	8/6/2012	294	X	1.6	0.38	UJ	0.38	0.69	B	0.66	2.5	X	0.076	0.11	B	0.033	0.98	U	0.98	0.041	U	0.041

Sample Area	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	4970	X	13.3	4.8	X	0.055	13.2	X	0.47	19.6		1.0	0.155	U	0.155	26400	X	3.6	2.8		1.3
Duplicate of EXC-10	J1PWF6	8/6/2012	4900	X	13.9	5.2	X	0.057	13.7	X	0.49	19.5		1.1	0.155	U	0.155	25600	X	3.7	2.8		1.3
EXC-1	J1PWD4	8/6/2012	6340	X	13.8	10.3	X	0.057	9.3	X	0.098	23.0		0.21	0.528		0.155	23300	X	3.7	11.2		0.26
EXC-2	J1PWD5	8/6/2012	7460	X	14.0	6.7	X	0.058	8.8	X	0.099	16.7		0.22	0.155	U	0.155	23900	X	3.8	3.1		0.27
EXC-3	J1PWD6	8/6/2012	7430	X	14.2	13.6	X	0.059	9.1	X	0.10	17.7		0.22	0.191		0.155	21600	X	3.8	17.8		0.27
EXC-4	J1PWD7	8/6/2012	3460	X	13.3	5.8	X	0.055	9.1	X	0.094	14.7		0.20	0.170		0.155	32000	X	3.6	10.3		0.25
EXC-5	J1PWD8	8/6/2012	5340	X	13.3	5.7	X	0.055	8.1	X	0.094	17.4		0.20	0.211		0.155	28400	X	3.6	2.2		0.25
EXC-6	J1PWD9	8/6/2012	10800	X	13.9	6.4	X	0.057	9.5	X	0.099	17.9		0.21	0.247		0.155	23400	X	3.7	5.5		0.27
EXC-7	J1PWF0	8/6/2012	8220	X	14.1	11.7	X	0.058	8.3	X	0.10	16.1		0.22	0.155	U	0.155	20300	X	3.8	3.8		0.27
EXC-8	J1PWF1	8/6/2012	5440	X	13.4	5.5	X	0.055	12.0	X	0.48	17.2		1.0	0.155	U	0.155	25700	X	3.6	3.2		1.3
EXC-9	J1PWF2	8/6/2012	5210	X	13.1	7.3	X	0.054	11.9	X	0.46	21.4		1.0	0.281		0.155	30300	X	3.5	5.3		1.3
EXC-11	J1PWF4	8/6/2012	15100	X	13.9	12.1	X	0.057	9.2	X	0.099	19.5		0.21	0.169		0.155	19900	X	3.8	4.9		0.27
EXC-12	J1PWF5	8/6/2012	4300	X	13.1	8.4	X	0.054	10	X	0.093	18.1		0.20	0.168		0.155	23900	X	3.5	4.2		0.25
Equipment Blank	J1PWF7	8/6/2012	51.2	X	14.1	0.20	XCUJ	0.058	0.10	UX	0.10	0.39	B	0.22				1440	X	3.8	0.63		0.27

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

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

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

B = Estimated result. Result is less than the RL, but greater than the MDL.

HEIS = Hanford Environmental Information System

C = deteced in both sample and the QC blank, and the sample concentration <= 5X the blank concentration.

D = obtained from dilution.

EXC = excavation

J = estimate

M = sample duplicate precision not met.

N= recovery exceeds upper or lower control limits

P = aroclor flag, greater than 25% difference for detected concentrations between the two GC columns.

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyls

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

R = rejected

TPH = total petroleum hydrocarbons

U = undetected

X = Serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals).

X = More than 40% difference between columns, lower result reported (organics).

Attachment	1	Sheet No.	1 of 6
Originator	N. K. Schiffern NS	Date	11/28/12
Checked	C. H. Dobie CD	Date	11/28/12
Calc. No.	0100N-CA-V0171	Rev. No.	0

Attachment 1. 120-N-3 Waste Site Verification Sample Results (Metals).

Sample Area	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	4430	X	3.5	320	X	0.094	0.0066	B	0.0050	0.25	U	0.25	9.2	X	0.12	513		38.7	0.81	U	0.81
Duplicate of EXC-10	J1PWF6	8/6/2012	4340	X	3.6	324	X	0.098	0.012	B	0.0054	0.26	U	0.26	8.8	X	0.12	632		40.3	0.85	U	0.85
EXC-1	J1PWD4	8/6/2012	4860	X	3.6	355	X	0.098	0.0057	U	0.0057	0.40	B	0.25	12.3	X	0.12	1260		40.1	0.84	U	0.84
EXC-2	J1PWD5	8/6/2012	4290	X	3.7	298	X	0.099	0.0048	U	0.0048	0.27	B	0.26	9.1	X	0.12	781		40.8	0.86	U	0.86
EXC-3	J1PWD6	8/6/2012	6630	X	3.7	316	X	0.10	0.0068	U	0.0068	0.26	U	0.26	32.5	X	0.12	1360		41.4	0.87	U	0.87
EXC-4	J1PWD7	8/6/2012	2590	X	3.5	288	X	0.094	1.5		0.012	0.38	B	0.24	7.1	X	0.12	970		38.5	0.81	U	0.81
EXC-5	J1PWD8	8/6/2012	3630	X	3.5	236	X	0.094	0.0055	U	0.0055	0.25	U	0.25	7.1	X	0.12	509		38.7	0.81	U	0.81
EXC-6	J1PWD9	8/6/2012	5190	X	3.7	297	X	0.099	0.043		0.0058	0.26	U	0.26	9.8	X	0.12	1010		40.4	0.85	U	0.85
EXC-7	J1PWF0	8/6/2012	4820	X	3.7	305	X	0.10	0.0050	U	0.0050	0.26	U	0.26	12.0	X	0.12	1160		41.0	0.86	U	0.86
EXC-8	J1PWF1	8/6/2012	4670	X	3.5	335	X	0.095	0.0052	U	0.0052	0.25	U	0.25	10.4	X	0.12	655		39.0	0.82	U	0.82
EXC-9	J1PWF2	8/6/2012	4840	X	3.4	332	X	0.093	0.28		0.0053	0.28	B	0.24	9.0	X	0.11	859		38.0	0.80	U	0.80
EXC-11	J1PWF4	8/6/2012	4670	X	3.7	388	X	0.099	0.0056	U	0.0056	0.26	U	0.26	13.8	X	0.12	1190		40.5	0.85	U	0.85
EXC-12	J1PWF5	8/6/2012	5080	X	3.4	328	X	0.093	0.0050	U	0.0050	0.24	U	0.24	11.0	X	0.11	1010		38.0	0.80	U	0.80
Equipment Blank	J1PWF7	8/6/2012	26.8	X	3.7	9.5	X	0.10	0.0054	U	0.0054	0.26	U	0.26	0.30	BX	0.12	41.0	U	41.0	0.86	U	0.86

Sample Area	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-10	J1PWF3	8/6/2012	186	XJ	5.3	0.15	U	0.15	483		55.7	79.8	X	0.089	55.3	XJ	0.38
Duplicate of EXC-10	J1PWF6	8/6/2012	206	XJ	5.6	0.16	U	0.16	465		58.0	73.9	X	0.092	55.1	XJ	0.39
EXC-1	J1PWD4	8/6/2012	342	NXJ	5.5	0.16	U	0.16	399		57.7	55.1	X	0.092	138	NJMX	0.39
EXC-2	J1PWD5	8/6/2012	238	XJ	5.6	0.16	U	0.16	412		58.7	70.4	X	0.093	44.0	XJ	0.40
EXC-3	J1PWD6	8/6/2012	374	XJ	5.7	0.16	U	0.16	375		59.6	52.5	X	0.095	51.6	XJ	0.40
EXC-4	J1PWD7	8/6/2012	202	XJ	5.3	0.15	U	0.15	995		55.5	98.2	X	0.088	54.4	XJ	0.37
EXC-5	J1PWD8	8/6/2012	158	XJ	5.3	0.15	U	0.15	421		55.7	60.4	X	0.089	40.9	XJ	0.38
EXC-6	J1PWD9	8/6/2012	225	XJ	5.6	0.16	U	0.16	1100		58.2	54.4	X	0.093	50.9	XJ	0.39
EXC-7	J1PWF0	8/6/2012	325	XJ	5.7	0.16	U	0.16	298		59.0	49.6	X	0.094	44.8	XJ	0.40
EXC-8	J1PWF1	8/6/2012	218	XJ	5.4	0.15	U	0.15	319		56.1	72.7	X	0.089	48.8	XJ	0.38
EXC-9	J1PWF2	8/6/2012	282	XJ	5.2	0.15	U	0.15	1390		54.7	78.7	X	0.087	54.0	XJ	0.37
EXC-11	J1PWF4	8/6/2012	332	XJ	5.6	0.16	U	0.16	416		58.3	50.5	X	0.093	45.5	XJ	0.39
EXC-12	J1PWF5	8/6/2012	290	XJ	5.2	0.15	U	0.15	319		54.7	62.9	X	0.087	52.3	XJ	0.37
Equipment Blank	J1PWF7	8/6/2012	149	XJ	5.7	0.16	U	0.16	59.0	U	59.0	0.56	BX	0.094	4.1	XJ	0.40

Attachment	1	Sheet No.	2 of 6
Originator	N. K. Schiffern	Date	11/28/12
Checked	C. H. Dobie	Date	11/28/12
Calc. No.	0100N-CA-V0171	Rev. No.	0

Attachment 1. 120-N-3 Waste Site Verification Sample Results (Anions, Physical, and TPH).

Sample Area	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrite			Nitrogen in Nitrite and Nitrate			Phosphorous in phosphate			Sulfate		
			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-10	J1PWF3	8/6/2012	0.38	U	0.38	2.0	U	2.0	0.81	U	0.81	0.49	BJ	0.31	0.33	UR	0.33	0.30	U	0.30	1.2	UR	1.2	1.7	U	1.7
Duplicate of EXC-10	J1PWF6	8/6/2012	0.38	U	0.38	2.9	B	1.9	0.81	U	0.81	0.50	BJ	0.31	0.33	UR	0.33	0.30	U	0.30	1.2	UR	1.2	2.1	B	1.7
EXC-1	J1PWD4	8/6/2012	0.39	U	0.39	2.5	B	2.0	0.82	U	0.82	0.75	BJ	0.31	0.33	UR	0.33	0.30	U	0.30	1.2	UR	1.2	7.5		1.7
EXC-2	J1PWD5	8/6/2012	0.38	U	0.38	1.9	U	1.9	0.81	U	0.81	0.57	BJ	0.31	0.33	UR	0.33	0.30	U	0.30	1.2	UR	1.2	1.7	U	1.7
EXC-3	J1PWD6	8/6/2012	0.38	U	0.38	2.0	U	2.0	1.2	BN	0.81	0.75	BJ	0.31	0.33	UR	0.33	0.35	B	0.30	1.2	UNR	1.2	8.4		1.7
EXC-4	J1PWD7	8/6/2012	0.39	U	0.39	2.0	U	2.0	0.83	U	0.83	0.66	BJ	0.32	0.34	UR	0.34	0.30	U	0.30	1.2	UR	1.2	119		1.7
EXC-5	J1PWD8-A	10/22/2012	0.38	U	0.38	8.8		1.9	0.81	UN	0.81	0.65	B	0.31	0.33	U	0.33	0.55	BM	0.31	1.2	UN	1.2	2350	DN	17
EXC-6	J1PWD9	8/6/2012	4.1		0.40	5360	D	40.8	0.85	U	0.85	4.5	J	0.32	0.35	UR	0.35	3.4		0.32	1.3	UR	1.3	73.1		1.8
EXC-7	J1PWF0	8/6/2012	0.38	U	0.38	4.6	B	1.9	0.81	U	0.81	0.95	BJ	0.31	0.33	UR	0.33	0.61	B	0.30	1.2	UR	1.2	11.6		1.7
EXC-8	J1PWF1	8/6/2012	0.39	U	0.39	85		2.0	0.83	U	0.83	0.66	BJ	0.32	0.34	UR	0.34	0.30	U	0.30	1.3	UR	1.3	10.0		1.7
EXC-9	J1PWF2	8/6/2012	0.38	U	0.38	2.3	B	2.0	0.81	U	0.81	0.68	BJ	0.31	0.33	UR	0.33	0.30	U	0.30	2.8	BJ	1.2	4.3	B	1.7
EXC-11	J1PWF4	8/6/2012	0.92	B	0.38	26.6		1.9	5.7		0.80	8.2	J	0.30	0.33	UR	0.33	7.2		0.30	1.2	UR	1.2	2830	D	16.8
EXC-12	J1PWF5	8/6/2012	0.39	U	0.39	26.2		2.0	0.82	U	0.82	1.9	BJ	0.31	0.34	UR	0.34	1.5		0.30	1.2	UR	1.2	58.2		1.7

Sample Area	HEIS Number	Sample Date	TPH - Diesel			TPH - Diesel EXT			Percent moisture (wet sample)			pH Measurement		
			ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL	pH	Q	PQL
EXC-10	J1PWF3	8/6/2012	680	U	680	1000	U	1000	1.0		0.10	9.31	J	0.100
Duplicate of EXC-10	J1PWF6	8/6/2012	1100	J	670	1300	J	980	1.2		0.10	8.93	J	0.100
EXC-1	J1PWD4	8/6/2012	26000		640	48000		940	1.6		0.10	8.71	J	0.100
EXC-2	J1PWD5	8/6/2012	2500	J	680	3500	J	1000	1.4		0.10	9.33	J	0.100
EXC-3	J1PWD6	8/6/2012	5700		680	9600		1000	1.0		0.10	8.97	J	0.100
EXC-4	J1PWD7	8/6/2012	680	U	680	1000	U	1000	1.5		0.10	7.78	J	0.100
EXC-5	J1PWD8	8/6/2012	670	U	670	990	U	990	0.94		0.10			
EXC-5	J1PWD8-A	10/22/2012							3.9		0.10	6.92		0.100
EXC-6	J1PWD9	8/6/2012	12000		710	16000		1000	5.3		0.10	7.02	J	0.100
EXC-7	J1PWF0	8/6/2012	2900	J	660	3600	J	970	0.95		0.10	8.36	J	0.100
EXC-8	J1PWF1	8/6/2012	3300	J	630	4200		930	0.82		0.10	8.79	J	0.100
EXC-9	J1PWF2	8/6/2012	650	U	650	960	U	960	1.0		0.10	9.75	J	0.100
EXC-11	J1PWF4	8/6/2012	3600	J	670	4800		990	1.7		0.10	8.28	J	0.100
EXC-12	J1PWF5	8/6/2012	13000		680	16000		990	1.1		0.10	7.78	J	0.100
Equipment Blank	J1PWF7	8/6/2012							0.1	U	0.10			

Attachment	1	Sheet No.	3 of 6
Originator	N. K. Schiffern	Date	11/28/12.
Checked	C. H. Dobie	Date	11/28/12
Calc. No.	0100N-CA-V0171	Rev. No.	0

Attachment 1. 120-N-3 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1PWF3, EXC-10			J1PWF6, Duplicate of J1PWF3			J1PWD4, EXC-1			J1PWD5, EXC-2			J1PWD6, EXC-3		
		8/6/2012			8/6/2012			8/6/2012			8/6/2012			8/6/2012		
		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	9.9	U	9.9	130	X	9.8	9.5	U	9.5	9.7	U	9.7
Acenaphthylene	PAH	9.0	U	9.0	8.9	U	8.9	8.8	U	8.8	8.5	U	8.5	8.7	U	8.7
Anthracene	PAH	7.9	J	3.0	20		3.0	220		3.0	13	J	2.9	43		3.0
Benzo(a)anthracene	PAH	16		3.2	20	X	3.1	440		3.1	15	X	3.0	110		3.1
Benzo(a)pyrene	PAH	22		6.4	33		6.3	350		6.3	32		6.1	87		6.2
Benzo(b)fluoranthene	PAH	17		4.2	31		4.1	350		4.1	28		4.0	87		4.1
Benzo(ghi)perylene	PAH	10	J	7.2	22	JX	7.1	220		7.0	19	J	6.8	77		7.0
Benzo(k)fluoranthene	PAH	6.7	J	3.9	12	J	3.9	140		3.9	17		3.7	35		3.8
Chrysene	PAH	26	J	4.8	56		4.8	480		4.7	37	J	4.6	120		4.7
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	62	X	11	10	U	10	12	JX	11
Fluoranthene	PAH	36	J	13	88		13	920	N	13	64		12	240		13
Fluorene	PAH	5.3	U	5.3	13	J	5.2	120		5.2	6.9	J	5.0	19	JX	5.1
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	19	J	12	250		12	19	J	11	60		12
Naphthalene	PAH	12	U	12	12	U	12	12	U	12	11	U	11	12	U	12
Phenanthrene	PAH	16	JX	12	65		12	690	N	12	31	J	11	130		12
Pyrene	PAH	38	J	12	100		12	1100	N	12	83		11	250		12
Aroclor-1016	PCB	2.6	U	2.6	2.8	U	2.8	2.8	U	2.8	2.7	U	2.7	2.8	U	2.8
Aroclor-1221	PCB	7.6	U	7.6	8.1	U	8.1	8.1	U	8.1	7.8	U	7.8	8.0	U	8.0
Aroclor-1232	PCB	1.9	U	1.9	2.0	U	2.0	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0
Aroclor-1242	PCB	4.4	U	4.4	4.7	U	4.7	4.7	U	4.7	4.5	U	4.5	4.7	U	4.7
Aroclor-1248	PCB	4.4	U	4.4	4.7	U	4.7	4.7	U	4.7	4.5	U	4.5	4.7	U	4.7
Aroclor-1254	PCB	2.5	U	2.5	2.6	U	2.6	28	P	2.6	2.5	U	2.5	9.1	JP	2.6
Aroclor-1260	PCB	2.5	UJ	2.5	2.6	U	2.6	20	NJ	2.6	2.5	UJ	2.5	8.2	J	2.6

Attachment	1	Sheet No.	4 of 6
Originator	N. K. Schiffern	Date	11/28/12
Checked	C. H. Dobie	Date	11/28/12
Calc. No.	0100N-CA-V0171	Rev. No.	0

Attachment 1. 120-N-3 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1PWD7, EXC-4			J1PWD8, EXC-5			J1PWD9, EXC-6			J1PWF0, EXC-7			J1PWF1, EXC-8		
		8/6/2012			8/6/2012			8/6/2012			8/6/2012			8/6/2012		
		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	9.8	U	9.8	10	U	10	9.7	U	9.7	9.8	U	9.8
Acenaphthylene	PAH	9.0	U	9.0	8.8	U	8.8	9.2	U	9.2	8.8	U	8.8	8.8	U	8.8
Anthracene	PAH	14	J	3.1	5.9	JX	3.0	110		3.1	18	J	3.0	19	J	3.0
Benzo(a)anthracene	PAH	94		3.2	13	JX	3.1	360		3.2	22	X	3.1	26	X	3.1
Benzo(a)pyrene	PAH	55		6.4	25		6.3	250		6.5	39		6.2	45		6.3
Benzo(b)fluoranthene	PAH	75		4.2	23		4.1	280		4.3	42		4.1	44		4.1
Benzo(ghi)perylene	PAH	43		7.2	16	J	7.0	140		7.3	22	J	7.0	27	J	7.0
Benzo(k)fluoranthene	PAH	32		3.9	9.1	JX	3.8	140		4.0	15	X	3.8	16		3.9
Chrysene	PAH	130		4.8	36	J	4.7	360		4.9	50		4.7	57		4.7
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	42	X	11	11	U	11	11	U	11
Fluoranthene	PAH	180		13	48		13	650		13	96		13	110		13
Fluorene	PAH	13	J	5.3	5.2	U	5.2	60		5.4	12	J	5.1	8.5	J	5.2
Indeno(1,2,3-cd)pyrene	PAH	34		12	14	J	12	130		12	26	J	12	25	J	12
Naphthalene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12
Phenanthrene	PAH	44		12	21	J	12	240		12	62		12	44		12
Pyrene	PAH	180		12	62		12	750		12	110		12	100		12
Aroclor-1016	PCB	2.8	U	2.8	2.7	U	2.7	2.7	U	2.7	2.6	U	2.6	2.6	U	2.6
Aroclor-1221	PCB	8.0	U	8.0	7.7	U	7.7	7.9	U	7.9	7.5	U	7.5	7.5	U	7.5
Aroclor-1232	PCB	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0	1.9	U	1.9	1.9	U	1.9
Aroclor-1242	PCB	4.7	U	4.7	4.5	U	4.5	4.6	U	4.6	4.3	U	4.3	4.4	U	4.4
Aroclor-1248	PCB	4.7	U	4.7	4.5	U	4.5	4.6	U	4.6	4.3	U	4.3	4.4	U	4.4
Aroclor-1254	PCB	3.3	J	2.6	2.5	U	2.5	2.6	U	2.6	2.4	U	2.4	2.4	U	2.4
Aroclor-1260	PCB	2.6	UJ	2.6	2.5	UJ	2.5	2.6	UJ	2.6	2.4	UJ	2.4	2.4	UJ	2.4

Attachment	1	Sheet No.	5 of 6
Originator	N. K. Schiffern	Date	11/28/12
Checked	C. H. Dobie	Date	11/28/12
Calc. No.	0100N-CA-V0171	Rev. No.	0

Attachment 1. 120-N-3 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1PWF2, EXC-9			J1PWF4, EXC-11			J1PWF5, EXC-12		
		8/6/2012			8/6/2012			8/6/2012		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	10	U	10	21	JX	9.9	1000	DX	50
Acenaphthylene	PAH	9.1	U	9.1	8.9	U	8.9	45	UD	45
Anthracene	PAH	26		3.1	26	X	3.0	4000	DJ	15
Benzo(a)anthracene	PAH	53		3.2	79		3.2	6500	DJ	16
Benzo(a)pyrene	PAH	44		6.5	54		6.4	3200	DJ	32
Benzo(b)fluoranthene	PAH	44		4.2	65		4.2	3900	DXJ	21
Benzo(ghi)perylene	PAH	16	JX	7.2	32		7.2	1500	DJ	36
Benzo(k)fluoranthene	PAH	19		4.0	21	X	3.9	1900	DJ	20
Chrysene	PAH	72		4.9	85		4.8	6000	DJ	24
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	470	DXJ	55
Fluoranthene	PAH	100		13	160		13	18000	DJ	65
Fluorene	PAH	15	J	5.3	14	J	5.3	1700	DJ	26
Indeno(1,2,3-cd)pyrene	PAH	23	J	12	30		12	1300	DJ	60
Naphthalene	PAH	12	U	12	12	U	12	60	UD	60
Phenanthrene	PAH	68	X	12	83	X	12	10000	DJ	60
Pyrene	PAH	120		12	160		12	16000	DJ	60
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7	2.6	U	2.6
Aroclor-1221	PCB	7.8	U	7.8	7.8	U	7.8	7.6	U	7.6
Aroclor-1232	PCB	1.9	U	1.9	2.0	U	2.0	1.9	U	1.9
Aroclor-1242	PCB	4.5	U	4.5	4.5	U	4.5	4.4	U	4.4
Aroclor-1248	PCB	4.5	U	4.5	4.5	U	4.5	4.4	U	4.4
Aroclor-1254	PCB	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5
Aroclor-1260	PCB	2.5	UJ	2.5	2.5	UJ	2.5	2.5	UJ	2.5

Attachment	1	Sheet No.	6 of 6
Originator	N. K. Schiffern	Date	02/06/13
Checked	C. H. Dobie	Date	02/06/13
Calc. No.	0100N-CA-V0171	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-V0172

Subject: 120-N-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 3 Total = 4	N. K. Schiffern N.K. Schiffern	J. D. Skoglie	C. H. Dobie	D. F. Obenauer D.F. Obenauer	3/25/13

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern NS	Date:	3/11/2013	Calc. No.:	0100N-CA-V0172	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie JD	Date:	3/11/2013
Subject:	120-N-3 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-3 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2006b), 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, 2006a, *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites*, DOE/RL-2005-92, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2006b, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, DOE/RL-2005-93, Rev. 0, 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, 2012, *120-N-3 Waste Site Cleanup Verification 95% UCL Calculations, Calculation Number 0100N-CA-V0171*, 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 2006b).

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 2006b).

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:	N. K. Schiffern	Date:	12/3/2012	Calc. No.:	0100N-CA-V0172	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	12/3/2012
Subject:	120-N-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 3	

METHODOLOGY:

The 120-N-3 waste site is comprised of one decision unit for verification sampling consisting of the excavation area. The direct contact hazard quotient and carcinogenic risk calculations for the 120-N-3 waste site were conservatively calculated for the entire waste site using the greater of the maximum or statistical verification soil sample results (WCH 2012). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, molybdenum, and the detected polychlorinated biphenyls (PCBs) require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Of the contaminants of potential concern (COPCs) for this site mercury, zinc, and fluoride require HQ and risk calculations because these analytes were detected above a Washington State or Hanford Site background value. Although total petroleum hydrocarbons (diesel range extended) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. Polycyclic aromatic hydrocarbons (PAHs) were excluded from the HQ and carcinogenic risk calculations as discussed in RSVP (WCH 2012). All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.2 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), produces an HQ value of 7.5×10^{-5}. 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 8.6×10^{-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 0.028 mg/kg, divided by 0.5 mg/kg, and multiplied as indicated, is 5.6×10^{-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 2.2×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern NS	Date:	12/3/2012	Calc. No.:	0100N-CA-V0172	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie JD	Date:	12/3/2012
Subject:	120-N-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 3	

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

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 120-N-3 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	1.2	16,000	7.5E-05	--	--
Chromium, hexavalent[c]	0.250	240	1.0E-03	2.1	1.2E-07
Mercury	1.5	24	6.3E-02	--	--
Molybdenum	0.40	400	1.0E-03	--	--
Zinc	69.1	24,000	2.9E-03	--	--
Anions					
Fluoride	5.7	4800	1.2E-03	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.028	1.6	1.8E-02	0.5	5.6E-08
Aroclor-1260	0.020	--	--	0.5	4.0E-08
Total Petroleum Hydrocarbons					
Diesel Range EXT [d]	72	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**8.6E-02**		
Cumulative Excess Cancer Risk:					**2.2E-07**

Notes:

[a] = From WCH (2012a).

[b] = Value obtained from the RDR/RAWP (DOE-RL 2006b) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

[c] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway (WAC) 173-340-750(3), 1996.

[d] = The risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation.

-- = not applicable

RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 120-N-3 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 2006b) and SAP (DOE-RL 2006a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0175

Subject: 120-N-3 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	N. K. Schiffern N K Schiffern	J. D. Stoglie	C. H. Dobie C H Dobie	D. F. Obenauer D. F. Obenauer	3/25/13

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern NS	Date:	12/03/12	Calc. No.:	0100N-CA-V0175	Rev.:	0
Project:	100-N Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie JS	Date:	12/03/12
Subject:	120-N-3 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-3 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 2006), 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, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area,* DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) WAC 173-340-740 (3)(a)(ii)(A), "Groundwater Protection".

4) WCH, 2012, *120-N-3 Waste Site Cleanup Verification 95% UCL Calculations*, 0100N-CA-V0171, 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 2006).

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 2006).

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:	N. K. Schiffern NS	Date:	12/03/12	Calc. No.:	0100N-CA-V0175	Rev.:	0
Project:	100-N Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie JS	Date:	12/03/12
Subject:	120-N-3 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 120-N-3 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-3 waste site were conservatively calculated for the entire waste site using the statistical or maximum value for each analyte (WCH 2012). Based on the generic site RESRAD model (DOE-RL 2006) and a vadose zone of approximately 15.5 m (50.9 ft) thickness, a K_d of 4.9 or greater is required to show no predicted migration to groundwater in 1,000 years. Boron and hexavalent chromium are included because they have a K_d of less than 4.9, and no Hanford background value has been established. All other site nonradionuclide COPCs were undetected, quantified below background levels, or have a K_d greater than or equal to 4.9. 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 1.2 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg, produces an HQ value of 3.8×10^{-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-3 waste site is 5.6×10^{-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, and then multiplied by 1×10^{-6}. There were not any detected constituents with a carcinogenic RAG associated with it. Therefore, the requirement of $<1 \times 10^{-6}$ is met. The criterion for cumulative excess cancer risk for carcinogens is also met.

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	12/03/12	Calc. No.:	0100N-CA-V0175	Rev.:	0
Project:	100-N Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	12/03/12
Subject:	120-N-3 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-3 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	1.2	320	3.8E-03	--	--
Chromium, hexavalent	0.250	4.8	5.2E-02	--	--
Totals					
Cumulative Hazard Quotient:			**5.6E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2012).
[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-3 waste site meets the requirements for the hazard quotients and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2006).

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2012a). 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 2012a), the field logbooks (WCH 2012b, WCH 2012c), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. In addition to the analyses indicated in the sample design (WCH 2012a), acidity (pH) by method 9045 and nitrite/nitrate analysis by method 353.2, were also requested. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis and radiochemical 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 sample data collected at the 120-N-3 waste site were provided by the laboratories in sample delivery groups (SDGs) J01577 and JP0418. SDG J01577 was submitted for third-party validation. Both major and minor deficiencies were identified in the 120-N-3 analytical data set and are discussed 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.

MAJOR DEFICIENCIES

Samples were collected on August 6, 2012, and analyzed for IC anions on August 13, 2012. Due to holding time exceedances in the method 9056M anion analysis of greater than twice the established limit, third-party validation qualified the associated undetected nitrite and orthophosphate results in SDG J01577 as rejected, with "R" flags. Additionally all of the detected method 9056M detected nitrate and orthophosphate results are qualified as estimated, with "J" flags. This result was anticipated, and EPA analytical method 353.2 was also requested to provide acceptable nitrate/nitrite data for decision making purposes. Therefore, the estimated and rejected data for nitrate and nitrite and do not hinder the evaluation of the 120-N-3 waste site. Phosphate is not a regulated chemical under *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act-Cleanup."

Minor Deficiencies

SDG J01577

This SDG comprises of 13 statistical verification soil samples (J1PWD4 through J1PWD9 and J1PWF0 through J1PWF6) from the 120-N-3 excavation. This SDG includes a field duplicate pair (J1PWF3/J1PWF9). All samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, ion chromatography (IC) anions, nitrate/nitrite, pH, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH), with the exception of J1PWD8. Analyses for IC anions and nitrate/nitrite were mistakenly not requested for sample J1PWD8. SDG J01577 was submitted for third-party validation. In addition, one equipment blank (J1PWF7) was analyzed for ICP metals and mercury.

In the ICP metals analysis, the matrix spike (MS) recoveries were out of project acceptance criteria for aluminum, antimony, iron, manganese, silicon, and zinc. For aluminum, iron, and manganese, 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 analytical variability of the native concentration rather than a measure of the recovery from the sample and these data may be considered estimated. Antimony and silicon did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony, silicon, and zinc were 47%, 17%, and -48%. All antimony, silicon, and zinc data for SDG J01577 were considered estimates and flagged "J" by third-party validation due to the MS recoveries outside the limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, all silicon results were considered estimates and flagged "J" by third-party validation due to a laboratory control sample (LCS) below quality control (QC) limits at 11%. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the chromium was detected above the reporting limit in the method blank (MB) for sample J1PWF7. This chromium result was flagged "UJ" by third-party validation. Method blank contamination of this magnitude will have no significant impact on the field sample results. The data may be considered estimated. Estimated data are usable for decision-making purposes.

In the zinc analysis, the relative percent difference (RPD) calculated for the laboratory duplicate is 82%, which is above the project QC limit of 30%. All zinc data for SDG J01577 were considered estimates and flagged "J" by third-party validation due to the laboratory RPD outside of the QC limits. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. Estimated data are usable for decision-making purposes.

In the hexavalent chromium analysis, the RPD calculated for the laboratory duplicate is 102.6%, which is above the project QC limit of 30%. The MS and LSC recoveries were both acceptable. All hexavalent chromium data for SDG J01577 may be considered estimated. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. Estimated data are usable for decision-making purposes.

In the methods 9045 pH and 9056M IC anions, the holding times for pH, nitrate, nitrite, and orthophosphate are exceeded by more than twice the acceptable range on all samples. The nondetected nitrate and orthophosphate results are discussed in the "Major Deficiencies" section above. All detected pH, nitrate, nitrite, and orthophosphate results in SDG J01567 were qualified as estimated, with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In method 9056M IC anions analysis, the MS recovery for orthophosphate was outside of QC limits at 69%. The associated orthophosphate results were qualified as estimates and were qualified with a "J" flag by third-party validation. This application affects only J1PFW2 as all other orthophosphate data were rejected due to hold time exceedance. Estimated data are usable for decision-making purposes.

In the PAH analysis, the surrogate recovery in J1PWF5 was outside of project QC limits at 254%. All PAH analytes in J1PWF5, except acenaphthene, acenaphthylene, and naphthalene, were flagged with a "J" by third-party validation. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the PCB analysis, the MS/MSD recovery for aroclor-1260 was outside of project QC criteria at 49% and 44%, respectively. The laboratory surrogate MS/MSD recoveries were acceptable. The LCS had an acceptable recovery at 86% and all of the samples met the RDL. All aroclor-1260 results in SDG J01577 were qualified with a "J" flag by third party validation. Analytical results for this analyte may be considered estimated. Estimated data are usable for decision making purposes.

SDG JP0418

This SDG is comprised of one statistical verification soil sample (J1PWD8-A) from the 120-N-3 excavation, collected on October 22, 2012. The analysis for IC anions and nitrate/nitrite had inadvertently not been requested for sample J1PWD8, collected August 6, 2012. The project collected sample J1PWD8-A on October 22, 2012, to complete the analyses required by the sampling instruction (WCH 2012a). This sample was analyzed for IC anions, nitrate/nitrite, and pH.

Minor Deficiencies

In the methods 9045 pH and 9056M IC anions, the holding times for pH, nitrate, nitrite, and orthophosphate were exceeded on all samples. However, the exceedance was less than twice the acceptable range. Therefore, all results from these analyses may be considered estimated. Estimated data are usable for decision-making purposes. Analysis of nitrate/nitrite is also provided by EPA analytical method 353.2 for this sample.

In method 9056M IC anions analysis, the MS recovery for orthophosphate was outside of QC limits at 17%. The associated orthophosphate result can be considered an estimate. Estimated data are usable for decision-making purposes.

The MS recovery for sulfate, orthophosphate, and fluoride were out of project acceptance criteria at 10%, 17%, and 55%, respectively. For sulfate, 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 analytical variability of the native concentration rather than a measure of the recovery from the sample and the data may be considered estimated. Orthophosphate and fluoride did not have mismatched spike and native concentrations in the original MS. The LCS analysis results are acceptable for all three analytes and, therefore, there is no indication that the analytical system was operating out of control. These data may be considered estimated due to the MS recoveries outside the limits. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2012b), 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
Excavation	J1PWF3	J1PWF6

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern (COPC). Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit. 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.

None of the RPD calculated for the field duplicate sample are above the acceptance criteria (30%). A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit (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. No sample results 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-3 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-3 waste site 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 Environmental Restoration (ENRE) project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System (HEIS) database. The verification sample analytical data are also summarized in Appendix C.

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