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

JUL 23 2013

13-AMRP-0264

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 FORMS AND SUPPORTING DOCUMENTATION FOR THE 100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 WASTE SITES, REVISION 0

Attached for your use are the approved Waste Site Reclassification Form Nos. 2012-095, 2012-096, 2012-097, and 2012-098 and supporting "Remaining Sites Verification Package for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites," 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

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WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-095

Waste Site Code(s)/Subsite Code(s): 100-N-87

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-N-87, 116-N Ventilation Stack Piping and French Drain waste site located north of the 105-N Reactor Building is associated with the 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites. The stack foundation contained a floor drain that discharged the condensate that collected inside the stack to the 100-N-87 french drain through a 2-in.-diameter galvanized iron pipe. The 100-N-87 waste site is included in the *Explanation of Significant Differences for the Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2011), as a candidate site for confirmatory sampling. However, it was subsequently remediated with the stack foundation.

The 116-N ventilation stack was a tall cylindrical concrete structure, and was demolished in 2008. Remedial action to remove the below-grade stack foundation, including all the components of 100-N-87 waste site, was performed in January and February 2011. Excavation continued until the french drain, associated piping, and contaminated soil and debris were removed. Because the excavation and removal of the 116-N stack foundation was performed by the Deactivation, Decontamination, Decommissioning, and Demolition (D4) Project, which does not routinely track excavation volume, the exact volume of material removed is unknown. Verification sampling was performed on October 23, 2012 and March 4, 2013 to determine if the waste site meets the remedial action objectives and remedial action goals (RAGs) established by 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), and the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (RDR/RAWP), DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2006b). 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 Environmental Restoration Disposal Facility, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

The verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-N-87 waste site to Interim Closed Out. The current site conditions achieve the RAGs established by the 100-N Area ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2006b). The evaluation (which may include fate-and-transport modeling) 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. Because shallow zone and deep zone components were considered as one decision unit and interim closed using the more restrictive of the shallow zone/deep zone protection criteria, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-095

Waste Site Code(s)/Subsite Code(s): 100-N-87

Regulator comments:

Waste Site Controls:

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

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

J. P. Neath	J P Neath	6/21/13
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	7/2/13
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-096

Waste Site Code(s)/Subsite Code(s): 100-N-102:1

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-N-102:1,100-N Potentially Contaminated French Drains waste site consists of potentially contaminated pipelines associated with the french drains in the 100-N-87 and UPR-100-N-14 waste site excavation. The 100-N-102 waste site is included in the *Explanation of Significant Differences for the Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2011), as a candidate site for confirmatory sampling. The 100-N-102 waste site was subdivided into the 100-N-102:1 and 100-N-102:2 subsites. The 100-N-102:1 subsite was remediated with the 100-N-87, UPR-100-N-9, and UPR-100-N-14 waste sites in January and February 2011. Because the excavation and removal of the 116-N stack foundation was performed by the Deactivation, Decontamination, Decommissioning, and Demolition (D4) Project, which does not routinely track excavation volume, the exact volume of material removed is unknown. The 100-N-102:2 subsite was reclassified as Interim No Action in June 2012.

Verification sampling was performed on October 23, 2012 and March 4, 2013 to determine if the subsite meets the remedial action objectives and remedial action goals (RAGs) established by 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), and the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (RDR/RAWP) DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2006b). The selected remedy for the 100-N-102:1 subsite involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the subsite for reclassification as Interim Closed Out.

Basis for reclassification:

The verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-N-102:1 subsite to Interim Closed Out. The current site conditions achieve the RAGs established by the 100-N Area ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2006b). The evaluation (which may include fate-and-transport modeling) 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. Because shallow zone and deep zone components were considered as one decision unit and interim closed using the more restrictive of the shallow zone/deep zone protection criteria, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-096

Waste Site Code(s)/Subsite Code(s): 100-N-102:1

Regulator comments:

Waste Site Controls:

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

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

J. P. Neath	J P Neath	6/21/13
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	7/2/13
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-097

Waste Site Code(s)/Subsite Code(s): UPR-100-N-14

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 UPR-100-N-14, 119-N Drain System Leak waste site consisted of contaminated soil near the 119-N Sample Building. An unplanned release of radioactively contaminated effluent water occurred at this site on August 5, 1974. Contaminated soil with readings greater than 1,000 counts per minute was removed from the site and shipped to the 200 Area for disposal. The remaining contaminated soil was covered with clean fill material. The UPR-100-N-14 waste site is identified for 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 UPR-100-N-14 waste site was remediated along with the 100-N-102:1, 100-N-87, and UPR-100-N-9 waste sites in January and February 2011. Because the excavation and removal of the 116-N stack foundation was performed by the Deactivation, Decontamination, Decommissioning, and Demolition (D4) Project, which does not routinely track excavation volume, the exact volume of material removed is unknown.

Verification sampling was performed on October 23, 2012 and March 4, 2013 to determine if the waste site meets 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 Environmental Restoration Disposal Facility, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

The verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the UPR-100-N-14 waste site to Interim Closed Out. The current site conditions achieve the RAGs established by the 100-N Area ROD (EPA 1999) and the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (RDR/RAWP), DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2006b). The evaluation (which may include fate-and-transport modeling) 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. Because shallow zone and deep zone components were considered as one decision unit and interim closed using the more restrictive of the shallow zone/deep zone protection criteria, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-097

Waste Site Code(s)/Subsite Code(s): UPR-100-N-14

Regulator comments:

Waste Site Controls:

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

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

J. P. Neath	J P Neath	6/21/13
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	7/2/13
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-098

Waste Site Code(s)/Subsite Code(s): UPR-100-N-9

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 UPR-100-N-9, 119-N Cooling Water Drain Leak waste site was an unplanned release that occurred on October 14, 1974, during exploratory excavation near the 119-N Air Sample Monitoring Stack. The UPR-100-N-9 waste site is identified for 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 UPR-100-N-9 waste site was remediated along with the 100-N-102:1, 100-N-87, and UPR-100-N-14 waste sites in January and February 2011. Because the excavation and removal of the 116-N stack foundation was performed by the Deactivation, Decontamination, Decommissioning, and Demolition (D4) Project, which does not routinely track excavation volume, the exact volume of material removed is unknown.

Verification sampling was performed on October 23, 2012 and March 4, 2013 to determine if the waste site meets the remedial action objectives and remedial action goals (RAGs) established by 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 Environmental Restoration Disposal Facility, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

The verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the UPR-100-N-9 waste site to Interim Closed Out. The current site conditions achieve the RAGs established by the 100-N Area ROD (EPA 1999) and the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (RDR/RAWP), DOE/RL-2005-93, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2006b). The evaluation (which may include fate-and-transport modeling) 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. Because shallow zone and deep zone components were considered as one decision unit and interim closed using the more restrictive of the shallow zone/deep zone protection criteria, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2012-098

Waste Site Code(s)/Subsite Code(s): UPR-100-N-9

Regulator comments:

Waste Site Controls:

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

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

J. P. Neath	J P Neath	6/21/13
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	7/2/13
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 WASTE SITES

Attachment to Waste Site Reclassification Forms 2012-095, 2012-096, 2012-097, and 2012-098

July 2013

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REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 WASTE SITES

EXECUTIVE SUMMARY

The 100-N-87, 116-N Ventilation Stack Piping and French Drain; 100-N-102:1, 100-N Potentially Contaminated French Drains; UPR-100-N-14, 119-N Drain System Leak; and UPR-100-N-9, 119-N Cooling Water Drain Line Leak waste sites were all located north of the 105-N Reactor within the former location of the 116-N Reactor Ventilation Stack and were removed when the below-grade stack foundation was remediated. The 100-N-87 waste site consisted of the 116-N ventilation stack drain line and a french drain. The 100-N-102:1 subsite consisted of the drain lines that received waste from the 119-N Exhaust Air Monitoring Building. The UPR-100-N-14 waste site consisted of soil that was contaminated by backflow of radioactively contaminated effluent water when maintenance personnel were working to correct loss of coolant flow in the 119-N Building drain system. The UPR-100-N-9 waste site was an unplanned release that occurred on October 14, 1974, when an excavator accidentally ruptured a buried 2-in.-diameter cooling water pipeline during exploratory digging.

Remedial action at the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites was accomplished in January and February 2011. Excavation continued to a depth of approximately 8.5 m (28 ft) below ground surface until the french drain, associated piping, and contaminated soil and debris were removed. This excavation exceeded the depth that would be required to remove the UPR-100-N-9 and UPR-100-N-14 waste sites and the 100-N-102:1 subsite. Because the excavation and removal of the 116-N stack foundation was performed by the Deactivation, Decontamination, Decommissioning, and Demolition (D4) Project, which does not routinely track excavation volume, the exact volume of material removed is unknown.

Verification sampling was performed on October 23, 2012. One sample location (EXC-2) exceeded direct exposure remedial action goals (RAGs) for carbon-14. Additional remediation was performed on March 4, 2013, and location EXC-2 was resampled. A reclassification of Interim Closed Out for the 100-N-102:1, 100-N-87, UPR-100-N-9, and UPR-100-N-14 waste sites is supported based on the final verification sampling results. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (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). A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1.

Table ES-1. Summary of Remedial Action Goals for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites. (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.	Maximum dose rate for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites estimated using sum-of-fractions evaluations with generic dose equivalence lookup values is 4.44 mrem/yr above background for statistical samples and 8.13 mrem/yr for focused samples.	Yes
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All hazard quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The direct exposure cumulative hazard quotient (7.7×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	All 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 direct exposure total excess cancer risk (1.1×10^{-6}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	No radionuclide COPCs were quantified above groundwater/river protection lookup values.	Yes
	Attain National Primary Drinking Water Standards [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	No radionuclide COPCs were quantified above groundwater/river protection lookup values.	
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5 [b].	No alpha-emitting radionuclide COPCs were quantified above groundwater/river protection lookup values.	
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].	Uranium was quantified below levels that are protective of 100 Area groundwater.	

Table ES-1. Summary of Remedial Action Goals for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and total PCBs (aroclor-1254, aroclor-1260) exceeded the soil RAGs for the protection of groundwater and/or the Columbia River. However, it is predicted that these constituents will not migrate to groundwater (and thus the Columbia River) at concentrations exceeding groundwater or river criteria within 1,000 years. Therefore, residual concentrations achieve the remedial action objectives for groundwater and river protection [d].	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the 100 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).

[d] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006b), the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, aroclor-1254, aroclor-1260, and total PCBs are not expected to migrate vertically more than 1 m (3.3 ft) in 1,000 years (based on the aroclor-1254 distribution coefficient [K_d] value of 75.6 mL/g). When contaminant K_d values are greater than 40 mL/g, RESRAD modeling predicts that the contaminants will not migrate more than 1 m within the 100 Area vadose zone and will have no impact on groundwater or the Columbia River. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

COPC = contaminant of potential concern
MCL = maximum contaminant level
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*
RESRAD = RESidual RADioactivity (dose model)

The results of the verification sampling are used to make reclassification decisions for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011). Excavation depths include both shallow zone and deep zone components. However, the excavation shallow zone and deep zone components are considered as one decision unit and are interim closed out using the more restrictive of the direct exposure and groundwater/river protection criteria. Direct exposure criteria were not exceeded; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the 100-N Area ROD (EPA 1999), comparisons against ecological risk screening have been made for the waste sites contaminants of potential concern and other constituents. Vanadium was the only constituent exceeding the ecological screening level in the *Washington Administrative Code* 173-340, Table 749-3. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for manganese, vanadium, and zinc. Exceeding screening values does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of manganese, vanadium, and zinc are below Hanford Site background levels (DOE-RL 2006b), 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 ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site. A table showing contaminant concentrations from the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites that exceed ecological screening levels is provided in Appendix A.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 WASTE SITES

STATEMENT OF PROTECTIVENESS

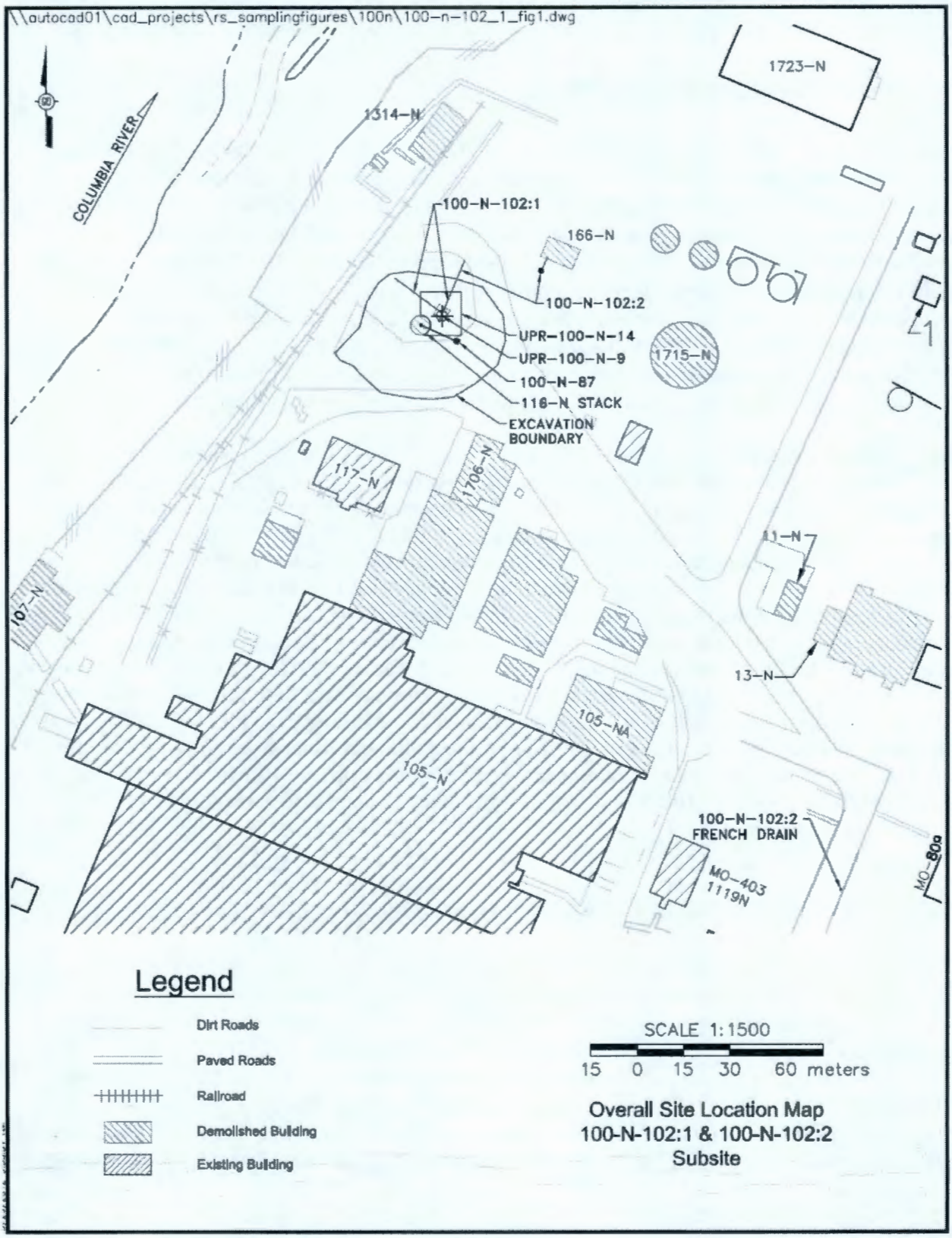
The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste site verification sampling data demonstrate that these sites meet the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (RDR/RAWP) (DOE-RL 2006b) and the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-N Area ROD) (EPA 1999). Excavation depths include both shallow zone and deep zone (greater than 4.6 m [15 ft] below ground surface [bgs]) components. However, the excavation shallow zone and deep zone components are considered as one decision unit and are reclassified to Interim Closed Out using the more restrictive of the direct exposure and groundwater/river protection criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the 100-N Area ROD (EPA 1999), comparisons against ecological risk screening have been made for the waste site contaminants of potential concern (COPCs) and other constituents. Vanadium was the only constituent exceeding the ecological screening level in *Washington Administrative Code* (WAC) 173-340, Table 749-3. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for manganese, vanadium, and zinc. Exceeding screening values does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of manganese, vanadium, and zinc are below Hanford Site background levels (DOE-RL 2006b), 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 ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site. A table showing contaminant concentrations from the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites that exceed ecological screening levels is provided in Appendix A.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites, part of the 100-NR-1 Operable Unit, were all located below grade around the northeast section of the 116-N Reactor Ventilation Stack location (Figure 1). The 116-N exhaust stack was located approximately 95 m (312 ft) north of the 105-N Reactor Building. The UPR-100-N-14 and UPR-100-N-9 waste sites are identified for remediation in the 100-N Area ROD (EPA 1999). The 100-N-87 and 100-N-102 waste sites are included in the *Explanation of Significant Differences for the Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (EPA 2011) as candidate sites for confirmatory sampling.

Figure 1. The 100-N-102:1, 100-N-87, UPR-100-N-9, and UPR-100-N-14 Waste Site Location Map.



Due to the collocation of the waste sites at the 116-N ventilation stack, the verification sample analytical results are also used to support the closure of the 116-N ventilation stack in accordance with the *Removal Action Work Plan for 100-N Area Ancillary Facilities* (DOE-RL 2006c).

100-N-87, 116-N Ventilation Stack Piping and French Drain

The 100-N-87 waste site consisted of the 116-N ventilation stack drain line and a french drain. The 100-N-87 waste site was identified during the orphan sites evaluation historical review as documented in the *100-N Area Orphan Sites Evaluation Report* (WCH 2009). The 116-N ventilation stack appeared as a tall cylindrical concrete structure near the reactor. The above-grade portion of the stack was demolished in 2008. The below-grade stack foundation was removed by the Deactivation, Decontamination, Decommissioning, and Demolition (D4) Project. All of the components of this waste site were below grade. The stack drain was located in the center of the stack foundation and connected to the 2-in.-diameter Schedule 40 galvanized steel stack drain pipeline that discharged to a french drain filled with gravel.

The 116-N exhaust stack was constructed in 1961 and was in use until the 105-N Reactor was ordered permanently shut down in 1991. The stack was designed to control worker exposure to airborne radioactive contaminants from the reactor by discharging any residual contamination remaining after passing through the 117-N Filter Building high into the atmosphere. Air from the ventilation confinement zones in the 105-N Reactor Building was routed through moisture separators, high-efficiency particulate filters, and charcoal absorbers in the 117-N Filter Building to remove airborne contamination. The filtered air was discharged to the stack. Moisture and other condensates in the filtered air steam would collect on the inside of the stack and be discharged through the stack drain and stack drain pipeline to the french drain.

100-N-102:1 Pipeline and UPR-100-N-14, 119-N Drain System Leak

The 100-N-102 waste site consists of potentially contaminated french drains at three separate locations and includes any known associated piping and surrounding soil. The 100-N-102 waste site was subdivided into 100-N-102:1 and 100-N-102:2 subsites. The 100-N-102 pipelines that are within the 100-N-87, UPR-100-N-14, UPR-100-N-9 waste site excavation are included in the 100-N-102:1 subsite. All remaining 100-N-102 pipelines and french drains, outside the 100-N-87, UPR-100-N-14, UPR-100-N-9 waste site excavation, are included in the 100-N-102:2 subsite. The 100-N-102:2 subsite is addressed in the *Waste Site Reclassification Form No. 2012-001 and Supporting Information for Reclassification of the 100-N-102:2* (WCH 2012b).

The UPR-100-N-14 waste site consisted of soil near the 119-N Sample Building that was contaminated by an unplanned release of radioactively contaminated effluent water on August 5, 1974. The contaminated soil was covered with plastic sheeting and the area was barricaded. Contaminated soil with readings greater than 1,000 cpm was removed from the site and shipped to the 200 Area for disposal. The remaining contaminated soil was covered with clean fill material.

UPR-100-N-9, 119-N Cooling Water Drain Line Leak

The UPR-100-N-9 waste site was an unplanned release that occurred on October 14, 1974, when an excavator accidentally ruptured a buried 2-in.-diameter cooling water pipeline during exploratory digging. This resulted in an immediate flow of radioactive water into the excavation hole with the water level remaining 1.2 m (4 ft) below grade. An unknown amount of contaminated excavation spoils were removed to a 200 Area burial ground, and the area was filled with clean soil. This unplanned release was documented in Unusual Occurrence Report #74-29 (WHC 1991).

REMEDIAL ACTION SUMMARY

Remedial action at the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites was performed during January and February 2011. Remediation involved removal of the foundations of the 116-N stack, the 119-N and 119-NA structures, and the underlying soil (WCH 2012d). Excavation continued until the french drain, associated piping, and contaminated soil and debris were removed. This excavation exceeded the depth that would be required to remove the 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites. According to drawing H-1-46389 (WHC 1988), the depth of the 100-N-102:1 subsite, and therefore the unplanned release waste sites UPR-100-N-9 and UPR-100-N-14, was at 0.76 m (2.5 ft) bgs. The final excavation depth was approximately 8.5 m (28 ft) bgs. The post-excavation boundary is shown in Figure 2. Because the excavation and removal of the 116-N stack foundation was performed by the D4 Project, the volume of material removed is unknown. An aerial photograph of the excavation after remedial action was completed is included in Appendix B, Figure B-1.

The debris removed from the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites consisted of soil, concrete, piping, and other debris associated with the 116-N, 119-N, and 119-NA structures and french drain. All material from these waste sites was disposed at the Environmental Restoration Disposal Facility (ERDF). No anomalous material was encountered during the excavation.

On March 19 and 20, 2012, the D4 Project constructed a ramp across the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation to provide access and to support remediation activities at 1303-N (118-N-1 waste site). An aerial photograph showing the location on the ramp within the excavation is included in Appendix B, Figure B-2. The ramp material was excavated on September 28, 2012, and disposed of at ERDF.

In order to determine if the ramp fill material was completely removed from the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation, a follow-up walkaround boundary determination was performed on October 4, 2012. The contours of the walkaround boundary were compared to the original post-excavation survey showing that the contours after the ramp was removed were essentially the same as the contours of the original excavation (Figure 3). The walkaround boundary confirmed that all fill material used for the ramp had been removed. An aerial photograph of the excavation after the ramp was removed is included in Appendix B, Figure B-3.

Figure 2. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Post-Excavation Contour Map (July 2011).

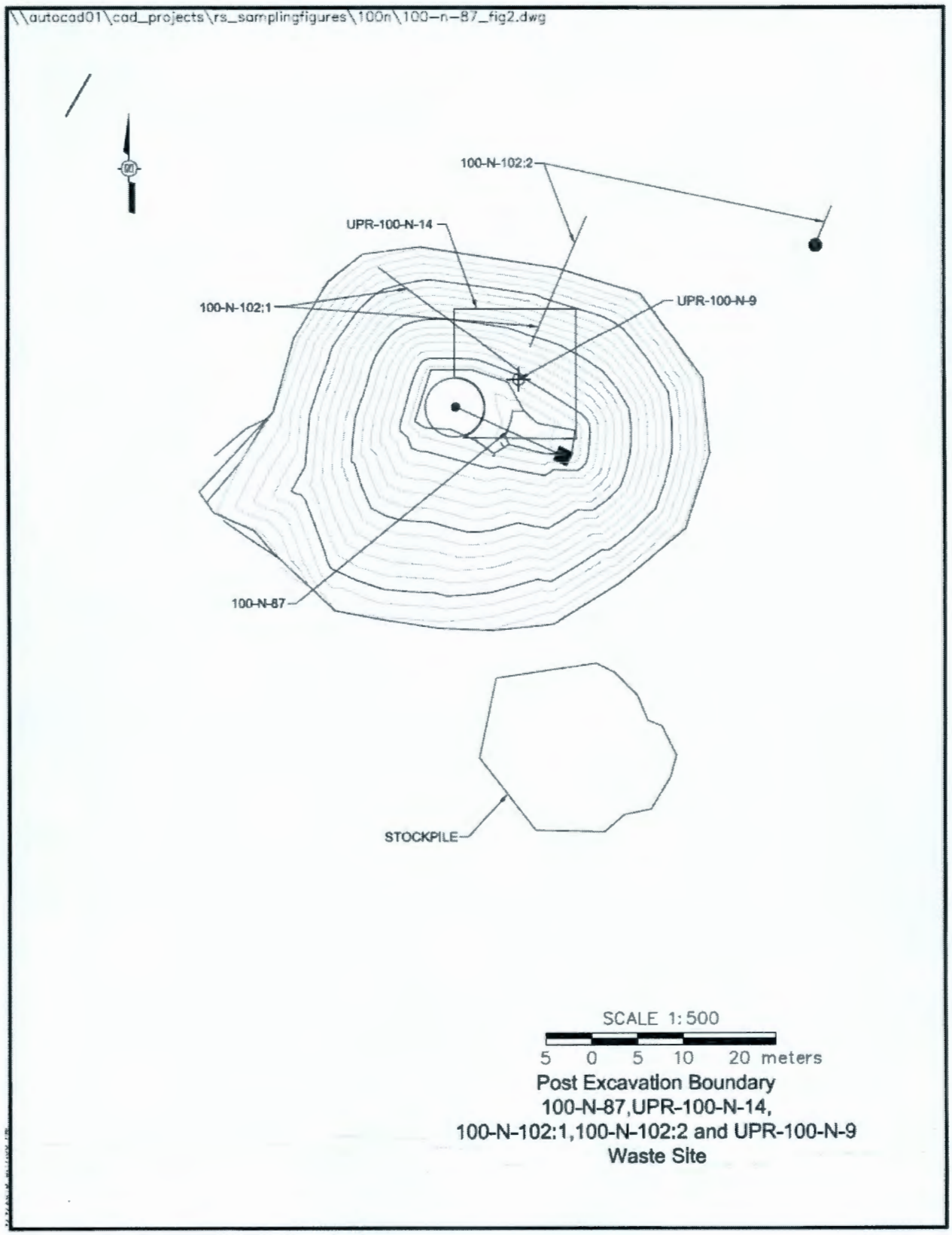
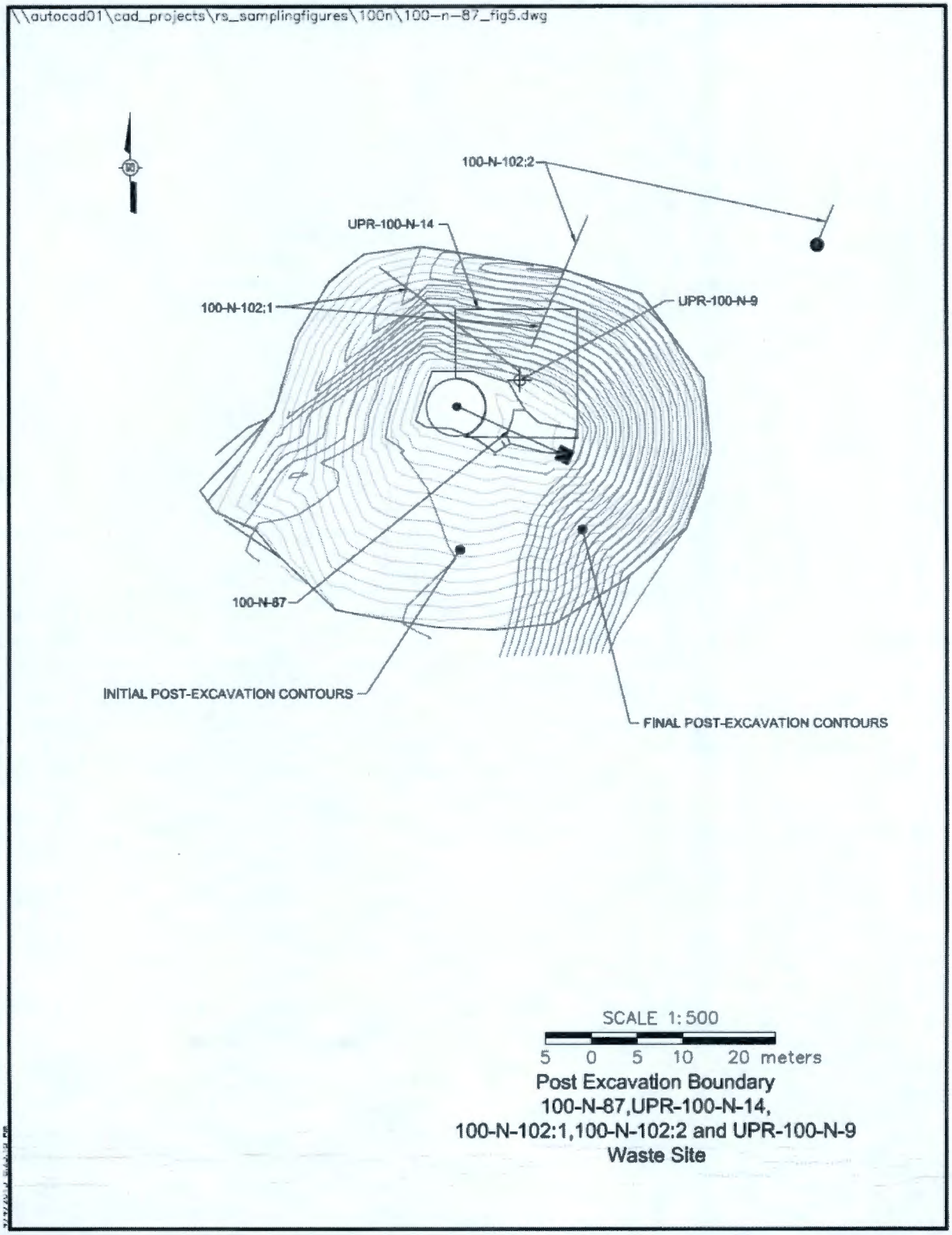


Figure 3. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Post-Excavation Original Contour Map (July 2011), Overlain by the Final Contour Map (October 2012).



Verification sampling results indicated that one sample location, EXC-2 exceeded direct exposure RAG for carbon-14. Per the agreement "100-N-87 Group Plume Chase Request", additional remediation of the excavation was performed on March 1, 2013, to remove additional contaminated soil at sample location EXC-2 (DOE-RL 2012). The additional remediation of the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation generated an approximate volume of 120 BCM (157 BCY) of material for direct load out to ERDF. Verification resampling at this location followed on March 4, 2013.

Following waste site remediation, a Global Positioning Environmental Radiological Surveyor (GPERS) survey was performed on May 20, 2011, within the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation. The GPERS survey results indicated no beta or gamma readings above background (Appendix C, Figures C-1 and C-2). Following the excavation of the ramp material, a follow-up gamma survey was performed on October 3, 2012, within the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation. Gamma survey results indicated gamma readings above background at two locations (Appendix C, Figure C-3). Additional remediation was performed to address areas where the GPERS survey results indicated elevated radiological results. The location showing elevated gamma readings above 5,000 cpm was resurveyed on October 17, 2012, and showed no elevated readings above background (Appendix C, Figure C-4). The beta GPERS survey, performed on October 19, 2012, indicated no elevated readings above background (Appendix C, Figure C-5).

Staging Pile Area

The *Work Instruction for Verification Sampling of the 100-N-87, 116-N Ventilation Stack Piping and French Drain; UPR-100-N-9, 119-N Cooling Water Drain Line Leak; UN-100-N-9; UPR-100-N-14, 119-N Drain System Leak, UN-100-N-14; and 100-N-102:1, 100-N Potentially Contaminated French Drains* (WCH 2012c) erroneously identified a staging pile area on the southeast side of the excavation and suggested it would be closed out with another applicable waste site. However, this staging pile area was used only for D4 purposes, for temporary staging of demolition debris. Some staged materials in this staging pile area may have been associated with the 116-N exhaust stack demolition; however, it was determined that the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste site excavation is not associated with this staging pile area. This staging pile area will be addressed within the greater D4 area of contamination (AOC) boundary.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites was performed on October 23, 2012. These samples were collected to support a determination that residual contaminant concentrations at this site meet the cleanup criteria specified in the RDR/RAWP (DOE-RL 2006b) and the 100-N Area ROD (EPA 1999). The verification sample results are provided in Appendix D. The following subsections provide additional discussion of the information used to develop the verification sampling design. A more detailed discussion of the verification sample design can be found in the *Work Instruction for Verification Sampling of the 100-N-87, 116-N Ventilation Stack Piping and French Drain;*

UPR-100-N-9, 119-N Cooling Water Drain Line Leak; UN-100-N-9; UPR-100-N-14, 119-N Drain System Leak, UN-100-N-14; and 100-N-102:1, 100-N Potentially Contaminated French Drains (WCH 2012c).

Contaminants of Potential Concern

The contaminants of potential concern (COPCs) for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites were determined based upon process knowledge, available historical information, and the sampling results obtained from the 116-N stack prior to demolition. The waste sites are adjacent to each other and the excavation is a continuous area; therefore, the cumulative COPCs were used for verification sampling. The primary COPCs included the expanded list of inductively coupled plasma (ICP) metals (antimony, arsenic, barium, boron, cadmium, chromium [total], cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc), mercury, hexavalent chromium, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH).

Additional COPCs were added based on the available 116-N stack sampling results and included cobalt-60, cesium-137, europium-152, europium-154, and europium-155. Sampling results for the 116-N stack indicated gross beta activity above 23 pCi/g; therefore, strontium-90 was added to the list of COPCs. Sample results collected from the 116-N stack floor drain also detected uranium-233, uranium-234, and uranium-238; therefore, isotopic uranium was added to the list of COPCs. Carbon-14 was detected at concentrations exceeding remedial action goals (RAGs) and was also included in the list of COPCs. Thorium-228, thorium-230, and thorium-232 were detected at very low concentrations and are not included as COPCs because they are not related to the operational history of the site and were all detected at levels below statistical background activities. The analytical methods that were performed for each verification soil sample are provided in Table 1.

Table 1. Laboratory Analytical Methods. (2 Pages)

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Metals
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
PAH – EPA Method 8310	PAH
PCB – EPA Method 8082	PCBs
TPH – EPA Method NWTPH-Dx	TPH
GEA – gamma spectroscopy	Cesium-137, cobalt-60, europium-152, europium-154, europium-155
Carbon-14 – liquid scintillation	Carbon-14

Table 1. Laboratory Analytical Methods. (2 Pages)

Analytical Method	Contaminants of Potential Concern
Strontium-90 – liquid scintillation	Strontium-90
Isotopic uranium	Uranium-233/234, uranium-238

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, magnesium, manganese, molybdenum, nickel, selenium, silver, vanadium, zinc.

EPA = U.S. Environmental Protection Agency
GEA = gamma energy analysis
ICP = inductively coupled plasma
NWTPH-Dx = Northwest total petroleum hydrocarbon-diesel range organics
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

Verification Sample Design

One decision unit was identified for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 combined waste sites and consists of the excavation area. A total of 12 statistical verification soil samples and 1 duplicate were collected from this decision unit. In addition, two focused samples were collected: one from the center of the UPR-100-N-14 waste site, and one from the center of the 100-N-87 french drain location.

The verification samples are listed in Table 2, and sample locations are shown in Figures 4 and 5.

Table 2. 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
EXC-1	J1R483	149646.6	571248.5	ICP metals [a], mercury, hexavalent chromium, PAH, PCBs, TPH, GEA, carbon-14, strontium-90, isotopic uranium, isotopic thorium
EXC-2	J1R484	149659.0	571251.4	
Resample of EXC-2 (C-14 only)	J1RH76	149659.0	571251.4	
EXC-3	J1R485	149642.9	571236.3	
EXC-4	J1R486	149655.3	571239.2	
EXC-5	J1R487	149667.7	571242.1	
EXC-6	J1R488	149651.6	571227.0	
EXC-7	J1R489	149664.0	571229.9	
EXC-8	J1R490	149676.4	571232.8	
EXC-9	J1R491	149647.9	571214.9	
EXC-10	J1R492	149660.3	571217.7	
EXC-11	J1R493	149672.7	571220.6	
EXC-12	J1R494	149656.6	571205.6	
Duplicate of J1R484	J1R495	149659.0	571251.4	
Duplicate of J1RH76 (C-14 only)	J1RH77	149659.0	571251.4	
FS-1	J1R4F5	149667.3	571236.5	
FS-2	J1R4F6	149658.1	571241.2	

Table 2. 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
Equipment blank	J1R496	NA	NA	ICP metals [a], mercury, PAH

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium(total), cobalt, copper, lead, magnesium, manganese, molybdenum, nickel, selenium, silver, vanadium, zinc.

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

Figure 4. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Verification Sample Locations.

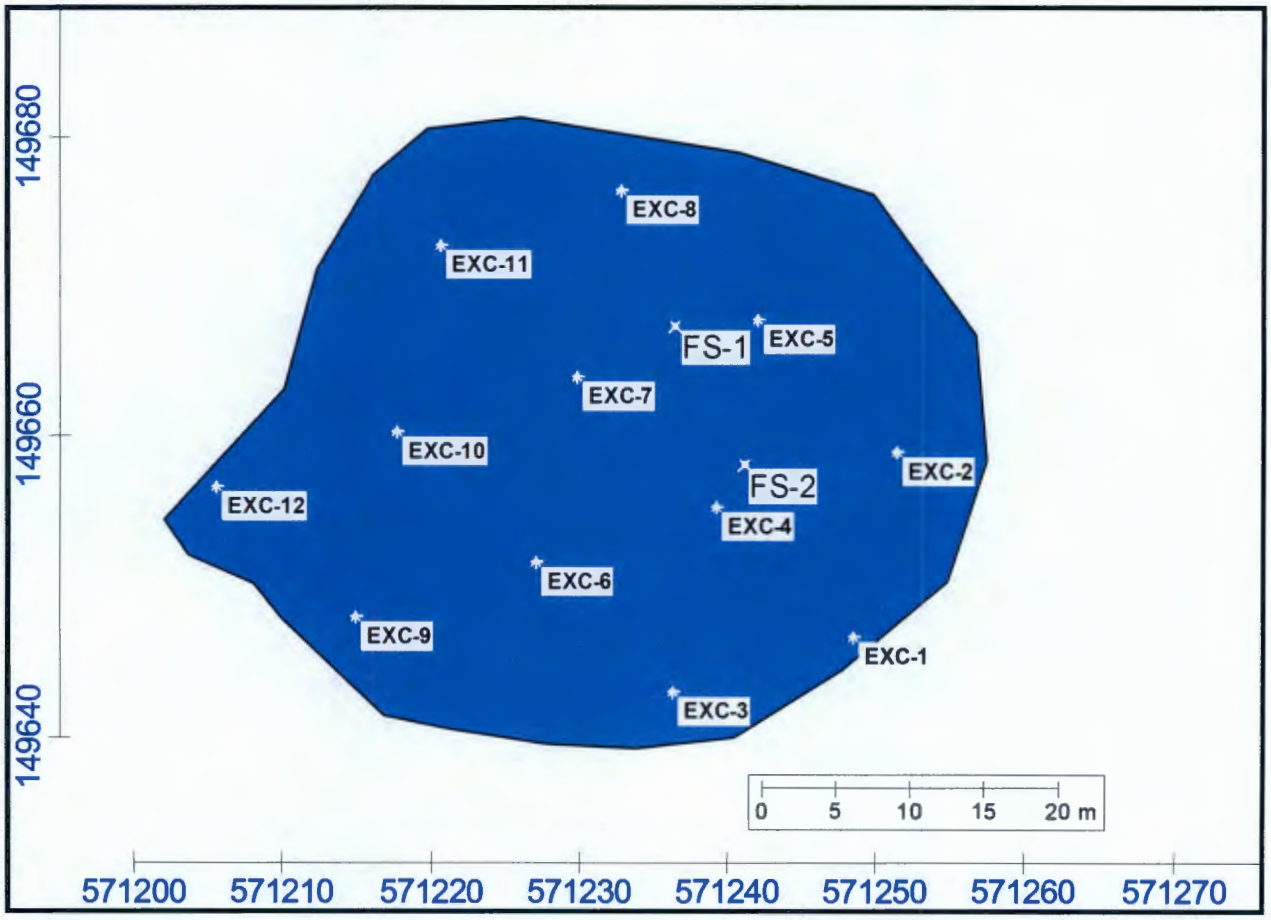
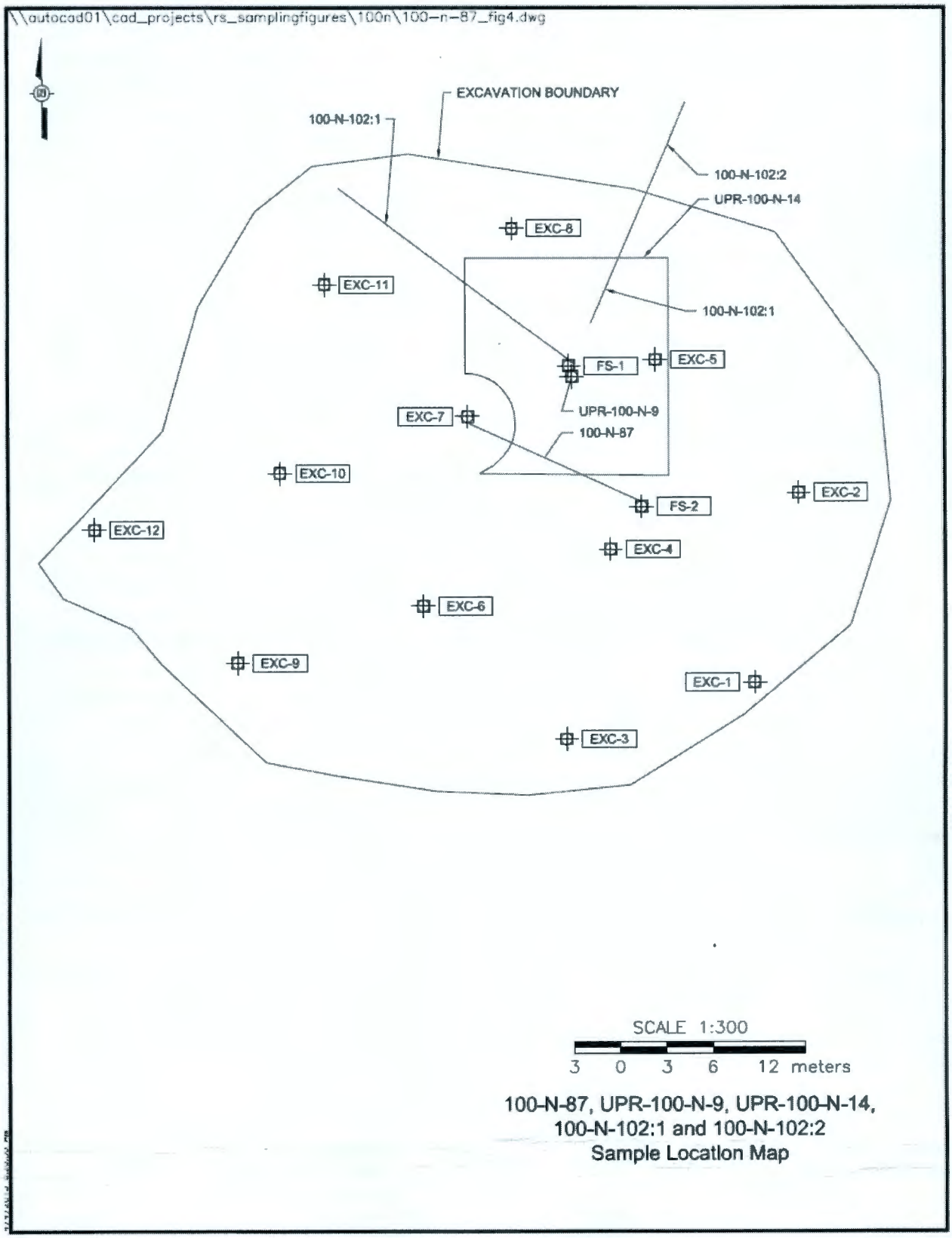


Figure 5. Verification Sample Locations Overlay with 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Site WIDS Boundaries.



Sampling Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2006a). One decision unit was identified for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites and includes the excavation only. Evaluation of the verification data from the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites was performed by direct comparison of the statistical or maximum sample results for each COPC against cleanup criteria. One sample location (EXC-2) failed direct exposure RAGs for carbon-14. Following additional soil removal, a replacement sample (J1RH76) was collected. Since the failed sample location (J1RH77) included a duplicate sample, a replacement duplicate sample was also collected. The replacement sample and a duplicate were analyzed for the carbon-14 only.

The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COPC are computed for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation as specified by the RDR/RAWP (DOE-RL 2006b). The calculations are provided in Appendix D. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for a decision unit, the maximum detected value was used for comparison to RAGs. If no detections for a given COPC were reported in the data set, then no statistical calculation or evaluation was performed for that COPC.

Comparisons of the statistical results for COPCs against the site RAGs are summarized in Tables 3 and 4. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2011) 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 these tables. The laboratory-reported data results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to inclusion into the Hanford Environmental Information System (HEIS) and are presented as part of the 95% UCL calculation in Appendix D.

CLEANUP VERIFICATION DATA EVALUATION

This section demonstrates that remedial action at the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste site has achieved the applicable RAGs developed to support unrestricted land use at the 100 Area as documented in the RDR/RAWP (DOE-RL 2006b).

Table 3. Comparison of Statistical Samples Contaminant Concentrations to Remedial Action Goals for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Site Excavation Sampling Data. (2 Pages)

COPCs and Other Analytes	Statistical or Maximum Result [b] (pCi/g)	Soil Lookup Values (pCi/g) [a]			Does the Result Exceed Lookup Values?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Soil Lookup Value for Groundwater Protection	Soil Lookup Value for River Protection		
Carbon-14	1.29	8.69	NA	NA	No	--
Cesium-137	0.286 (<BG)	6.2	1,465	2,930	No	--
Cobalt-60	0.043	1.4	13,900	27,800	No	--
Strontium-90	0.320	4.5	27.6	55.2	No	--
Uranium-233/234	0.574 (<BG)	1.1 [c]	1.1 [c]	1.1 [c]	No	--
Uranium-238	0.546 (<BG)	1.1 [c]	1.1 [c]	1.1 [c]	No	--
COPCs and Other Analytes	**Statistical Result or Maximum Result [b] (mg/kg)**	**Remedial Action Goals (mg/kg) [a]**			**Does the Result Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	**Soil Cleanup Level for Groundwater Protection**	**Soil Cleanup Level for River Protection**		
Arsenic	2.10 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	55.3 (<BG)	16,000 [d]	200	400	No	--
Beryllium	0.269 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Chromium (total)	8.88 (<BG)	120,000 [d]	18.5 [c]	18.5 [c]	No	--
Cobalt	9.10 (<BG)	1,600 [d]	32	NA	No	--
Copper	16.7 (<BG)	2,960 [d]	59.2	22.0 [c]	No	--
Lead	3.79 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	313 (<BG)	11,200 [d]	512 [c]	512 [c]	No	--
Molybdenum [f]	0.536	400 [d]	8	NA	No	--
Nickel	10.5 (<BG)	1,600 [d]	19.1 [c]	27.4	No	--
Vanadium	65.8 (<BG)	560 [d]	85.1 [c]	NA	No	--
Zinc	53.3 (<BG)	24,000 [d]	480	67.8 [c]	No	--
Acenapthene	0.006	4,800 [d]	96	129	No	--
Acenapthylene [g]	0.022	4,800 [d]	96	129	No	--
Anthracene	0.072	24,000 [d]	240	1,920	No	--
Benzo(a)anthracene	0.134	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(a)pyrene	0.072	0.137	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(b)fluoranthene	0.041	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(ghi)perylene [g]	0.016	2,400 [d]	48	192	No	--
Benzo(k)fluoranthene	0.012	13.7	0.12	0.015 [h]	No	--
Chrysene	0.052	137	1.2	0.10 [h]	No	--
Dibenz(a,h)anthracene	0.005	0.137	0.03 [h]	0.03 [h]	No	--
Fluoranthene	0.484	3,200 [d]	64	18.0	No	--
Fluorene	0.026	3,200 [d]	64	260	No	--
Indeno(1,2,3-cd)pyrene	0.020	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Naphthalene	0.118	1,600 [d]	16.0	988	No	--
Phenanthrene [g]	0.067	24,000 [d]	240	1,920	No	--
Pyrene	0.293	2,400 [d]	48	192	No	--
Aroclor-1254	0.121	0.5	0.017 [h]	0.017 [h]	Yes	Yes [i]
Aroclor-1260	0.075	0.5	0.017 [h]	0.017 [h]	Yes	Yes [i]
PCB total	0.196	0.5	0.017 [h]	0.017 [h]	Yes	Yes [i]

Table 3. Comparison of Statistical Samples Contaminant Concentrations to Remedial Action Goals for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Site Excavation Sampling Data. (2 Pages)

COPCs and Other Analytes	Statistical Result 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		
TPH – diesel range	8	200	200	200	No	--
TPH – motor oil	45	200	200	200	No	--

[a] Lookup values and RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2006b) or the 100 Area RDR/RAWP (DOE-RL 2009).
[b] Maximum or 95% UCL, depending on data censorship, as described in Appendix D.
[c] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100-N Area RDR/RAWP (DOE-RL 2006b).
[d] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B (Ecology 1996).
[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (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] Toxicity data for this chemical are not available. Cleanup levels are based on the following surrogate chemicals:
Contaminant: acenapthylene, surrogate: acenapthene.
Contaminant: benzo(g,h,i)perylene; surrogate: pyrene
Contaminant: phenanthrene; surrogate: anthracene
[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). RDL-based RAGs for polycyclic aromatic hydrocarbon constituents from the 100 Area RDR/RAWP (DOE-RL 2009).
[i] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006b), the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, aroclor-1254, aroclor-1260, and total PCBs are not expected to migrate vertically more than 1 m (3.3 ft) in 1,000 years (based on the aroclor-1254 distribution coefficient [K_d] value of 75.6 mL/g). When contaminant K_d values are greater than 40 mL/g, RESRAD modeling predicts that the contaminants will not migrate more than 1 m within the 100 Area vadose zone and will have no impact on groundwater or the Columbia River. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Acton Work Plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Table 4. Comparison of Focused Samples Contaminant Concentrations to Remedial Action Goals for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Site Excavation Sampling Data. (2 Pages)

COPCs and Other Analytes	Maximum Result (pCi/g)	Soil Lookup Values (pCi/g) [a]			Does the Result Exceed Lookup Values?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Soil Lookup Value for Groundwater Protection	Soil Lookup Value for River Protection		
Carbon-14	1.60	8.69	NA	NA	No	--
Strontium-90	1.61	4.5	27.6	55.2	No	--
Uranium-233/234	0.700 (<BG)	1.1 [b]	1.1 [b]	1.1 [b]	No	--
Uranium-238	0.626 (<BG)	1.1 [b]	1.1 [b]	1.1 [b]	No	--
COPCs and Other Analytes	**Maximum Result (mg/kg)**	**Remedial Action Goals (mg/kg) [a]**			**Does the Result Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	**Soil Cleanup Level for Groundwater Protection**	**Soil Cleanup Level for River Protection**		
Arsenic	1.94 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	61.1 (<BG)	16,000 [c]	200	400	No	--
Beryllium	0.273 (<BG)	10.4 [d]	1.51 [b]	1.51 [b]	No	--
Chromium (total)	7.45 (<BG)	120,000 [c]	18.5 [b]	18.5 [b]	No	--
Cobalt	9.92 (<BG)	1,600 [c]	32	NA	No	--
Copper	18.7 (<BG)	2,960 [c]	59.2	22.0 [b]	No	--
Lead	3.11 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	409 (<BG)	11,200 [c]	512 [b]	512 [b]	No	--
Nickel	9.93 (<BG)	1,600 [c]	19.1 [b]	27.4	No	--
Vanadium	69.6 (<BG)	560 [c]	85.1 [b]	NA	No	--
Zinc	51.9 (<BG)	24,000 [c]	480	67.8 [b]	No	--
Benzo(a)anthracene	0.010	1.37	0.015 [f]	0.015 [f]	No	--
Benzo(a)pyrene	0.006	0.137	0.015 [f]	0.015 [f]	No	--
Benzo(b)fluoranthene	0.005	1.37	0.015 [f]	0.015 [f]	No	--
Benzo(ghi)perylene [e]	0.006	2,400 [c]	48	192	No	--
Benzo(k)fluoranthene	0.003	13.7	0.12	0.015 [f]	No	--
Chrysene	0.005	137	1.2	0.10 [f]	No	--
Fluoranthene	0.010	3,200 [c]	64	18.0	No	--
Indeno(1,2,3-cd)pyrene	0.006	1.37	0.015 [f]	0.015 [f]	No	--
Naphthalene	0.006	1,600 [c]	16.0	988	No	--
Phenanthrene [e]	0.002	24,000 [c]	240	1,920	No	--
Pyrene	0.010	2,400 [c]	48	192	No	--
Aroclor-1254	0.105	0.5	0.017 [f]	0.017 [f]	Yes	Yes [g]
Aroclor-1260	0.100	0.5	0.017 [f]	0.017 [f]	Yes	Yes [g]
PCB total	0.205	0.5	0.017 [f]	0.017 [f]	Yes	Yes [g]

Table 4. Comparison of Focused Samples Contaminant Concentrations to Remedial Action Goals for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Site Excavation Sampling Data. (2 Pages)

COPCs and Other Analytes	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
TPH – diesel range	2	200	200	200	No	--
TPH – motor oil	4	200	200	200	No	--

[a] Lookup values and RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2006b) or the 100 Area RDR/RAWP (DOE-RL 2009).
[b] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2006b).
[c] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B (Ecology 1996).
[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[e] Toxicity data for this chemical are not available. Cleanup levels are based on the following surrogate chemicals:
Contaminant: benzo(g,h,i)perylene; surrogate: pyrene
Contaminant: phenanthrene; surrogate: anthracene
[f] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). RDL-based RAGs for polycyclic aromatic hydrocarbon constituents from the 100 Area RDR/RAWP (DOE-RL 2009).
[g] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006c), the residual concentrations of aroclor-1254, aroclor-1260 and total PCBs are not expected to migrate vertically more than 1 m (3.3 ft) in 1,000 years (based on the aroclor-1254 K_d value of 75.6 mL/g). When contaminant K_d values are greater than 40 mL/g, RESRAD modeling predicts that the contaminants will not migrate more than 1 m (3.3 ft) within the 100 Area vadose zone and will have no impact on groundwater or the Columbia River. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Acton Work Plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Attainment of Radionuclide RAGs

Because the analytical results for the verification samples were below lookup values, a site-specific cleanup verification model was not developed. Evaluation of direct exposure RAG attainment for radionuclides was performed using the single-radionuclide dose-equivalence lookup values to do sum-of-fractions evaluations. The model used to develop these dose-equivalence lookup values is presented in the RDR/RAWP (DOE-RL 2006b).

Tables 5 and 6 compare the radionuclide cleanup verification results for the statistical and focused data set to direct exposure singe radionuclide 15 mrem/yr dose-equivalence values and shows the sum-of-fractions evaluation for comparison of the total radionuclide dose to the RAG of 15 mrem/yr. The columns on the left side of the tables are the COPCs and the radionuclide activities corrected for background, as appropriate. The third column presents the single radionuclide 15 mrem/yr dose-equivalence activities, and the last column presents the radionuclide activities divided by the dose-equivalence activities. As demonstrated by the summation of these fractions, the cumulative dose contributed by residual radionuclide populations will be less than the 15 mrem/yr RAG at 4.44 mrem/yr and 8.13 mrem/yr, respectively.

Table 5. Attainment of Radionuclide Direct Exposure Remedial Action Goals (Statistical Samples).

COPCs	95% UCL Statistical Values [a] (pCi/g)	Activity Equivalent to 15 mrem/yr Dose [b] (pCi/g)	Fraction
Carbon-14	1.29	8.69	0.148
Cesium-137	0.286 (<BG)	6.2	0.0461
Cobalt-60	0.043	1.4	0.0307
Strontium-90	0.320	4.5	0.0711
Uranium-233/234	0 (<BG)	0.58	0
Uranium-238	0 (<BG)	0.61	0
		Total	0.296
		Equivalent Dose (mrem/yr)	4.44

[a] Hanford Site background values for uranium-233/234 (1.1 pCi/g), and uranium-238 (1.1 pCi/g) (*Hanford Site Background: Part 2, Soil Background for Radionuclides* [DOE-RL 1996]) have been subtracted from 95% UCL values for the shallow zone excavation.

[b] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (DOE-RL 2006b).

BG = background
COPC= contaminant of potential concern
UCL = upper confidence limit

Table 6. Attainment of Radionuclide Direct Exposure Remedial Action Goals (Focused Samples).

COPCs	95% UCL Statistical Values [a] (pCi/g)	Activity Equivalent to 15 mrem/yr Dose [b] (pCi/g)	Fraction
Carbon-14	1.60	8.69	0.184
Strontium-90	1.61	4.5	0.358
Uranium-233/234	0 (<BG)	0.58	0
Uranium-238	0 (<BG)	0.61	0
		Total	0.542
		Equivalent Dose (mrem/yr)	8.13

[a] Hanford Site background values for uranium-233/234 (1.1 pCi/g), and uranium-238 (1.1 pCi/g) (*Hanford Site Background: Part 2, Soil Background for Radionuclides* [DOE-RL 1996]) have been subtracted from 95% UCL values for the shallow-zone excavation.

[b] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (DOE-RL 2006b).

BCG = background
COPC= contaminant of potential concern
UCL = upper confidence limit

Direct Comparison to RAGs

Evaluation of the verification sampling results in Tables 3 and 4 shows that all direct exposure RAGs are met for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites. Groundwater protection and Columbia River protection cleanup levels were exceeded for total PCBs (aroclor-1254 and aroclor-1260) and four PAH constituents (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene). However, RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2006b) indicates that residual concentrations of contaminants are not predicted to migrate more than 1 m (3.3 ft) vertically within 1,000 years based on the contaminant with the lowest distribution coefficient (K_d value) of the contaminants that exceeded the RAGs: aroclor-1254 with a K_d value of 75.6 mL/g. The vadose zone underlying the excavation is approximately 12.5 m (41 ft) thick. Therefore, residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, aroclor-1254, aroclor-1260, and total PCBs are not predicted to migrate through the soil column to groundwater (and thus the Columbia River) within 1,000 years.

Three-Part Test for Nonradionuclides

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The WAC 173-340 three-part test consists of the following criteria: (1) the cleanup verification 95% UCL value must be less than the cleanup level, (2) no single detection can 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 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 remediation footprint is included in the statistical calculations (Appendix D).

The results of this evaluation indicate that benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, aroclor-1254, and aroclor-1260 data sets have sample results that exceeded the cleanup limit by greater than two times in comparison against the soil RAGs for groundwater and river protection in the excavation decision unit. Greater than 10% of the sample results for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, aroclor-1254, and aroclor-1260 in the excavation decision unit exceed the cleanup levels. However, based on the RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2006b), the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, aroclor-1254, and aroclor-1260 are not expected to migrate more than 1 m (3.3 ft) vertically in 1,000 years (based on the lowest K_d of the contaminants exceeding RAGs, aroclor-1254, with K_d of 75.6 mL/g). Therefore, the residual concentrations of these constituents 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, which default to the maximum because less than half of the data set was detected. The results of this evaluation indicate that all residual COPC concentrations pass the three-part test in comparison against applicable RAGs.

Direct Contact Noncarcinogenic Hazard Quotient Remedial Action Goal

Assessment of the risk requirements for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites was determined by calculation of the hazard quotient and excess carcinogenic risk. The 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 excess carcinogenic risk of less than 1×10^{-5}. Hazard quotient and excess carcinogenic risk calculations for direct contact were conservatively performed for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites using the highest of the focused and statistical values from the excavation area. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. All individual hazard quotients are below 1.0, and all individual excess carcinogenic risk values are below 1×10^{-6}. The direct contact cumulative hazard quotient for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites is 7.7×10^{-2}, and the cumulative excess carcinogenic risk value is 1.1×10^{-6}, satisfying the criteria of less than 1.0 and less than 1×10^{-5}, respectively. Therefore, the nonradionuclide risk requirements are met.

Hazard Quotient and Carcinogenic Risk Calculation for Groundwater

Assessment of the risk requirements for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites 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}. These risk values were conservatively calculated for the entire waste site using the highest value for each COPC from the excavation area. 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 K_ds for these contaminants are less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2006b). The cumulative hazard quotient is 7.4×10^{-3}, which is less than 1.0. No carcinogenic constituents were subject to the groundwater cancer risk calculations. Nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach, the field logbooks, and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The cleanup verification sample analytical data are stored in the ENRE project-specific database for

data evaluation prior to its archival in HEIS and are summarized in Appendix D. The detailed DQA is presented in Appendix E.

SUMMARY FOR INTERIM CLOSURE

The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites have been evaluated in accordance with the 100-N Area ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2006b). Verification sampling results indicate that the residual concentrations of COPCs at this site meet the RAGs and corresponding remedial action objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites to Interim Closed Out. Excavation depths include both shallow zone and deep zone (greater than 4.6 m [15ft] bgs) components. However, the excavation shallow zone and deep zone components are considered as one decision unit and are interim closed out using the more restrictive of the direct exposure and groundwater/river protection criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

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APPENDIX A

EXCEEDANCES OF ECOLOGICAL SCREENING LEVELS FOR THE 100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 WASTE SITES

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Waste Sites [a].

Hazardous Substance		2007 WAC 173-340, Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum of Focused or Statistical Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg):							
Manganese	512	1,100	--	1,500	220	450	4,300	4,000	409 (<BG)
Vanadium	85.1	2	--	--	--	--	7.8	280	69.6 (<BG)
Zinc	67.8	86	200	360	160	120	46	79	53.3 (<BG)

NOTE: Shaded cells are exceeded by the maximum of the focused or statistical result.

[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.

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

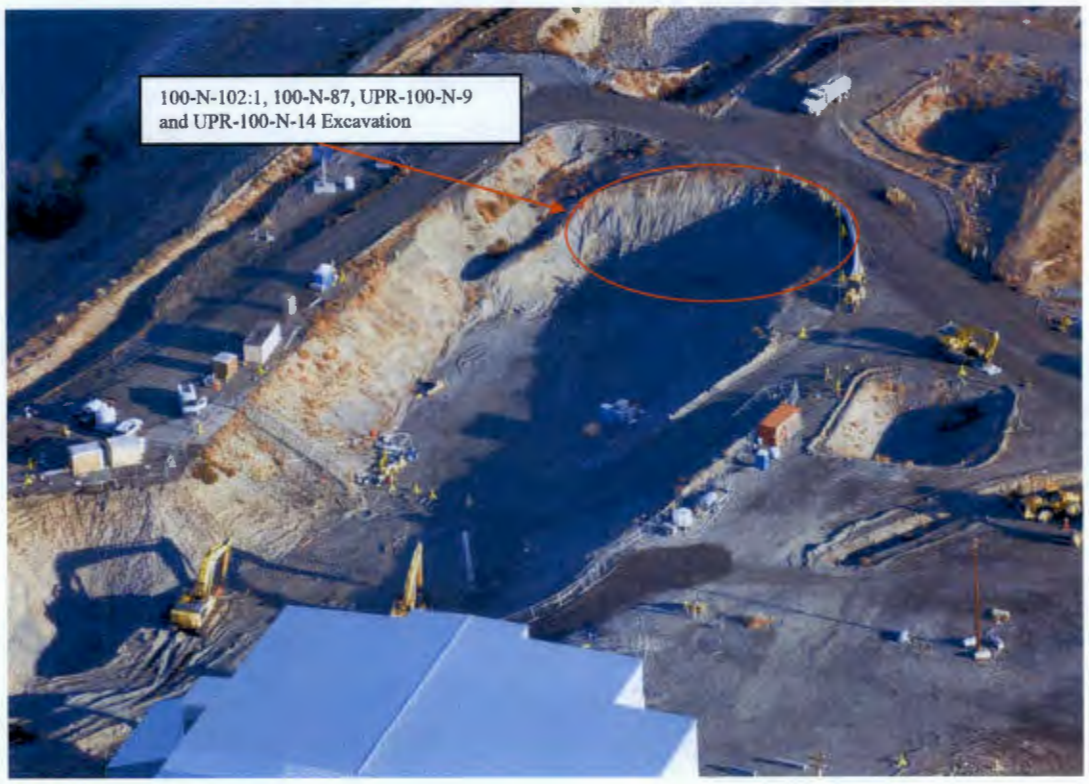
APPENDIX B

100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 PHOTOGRAPHS

Figure B-1. Photograph of the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation (May 20, 2011).

Figure B-2. Photograph of the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation After Ramp Installation (September 11, 2012).

Figure B-3. Photographs of the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation After Ramp Removal (October 18, 2012).



APPENDIX C

GLOBAL POSITIONING ENVIRONMENTAL RADIOLOGICAL SURVEYOR (GPERS) SURVEY

Figure C-1. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation Beta Track Survey Map (May 20, 2011).

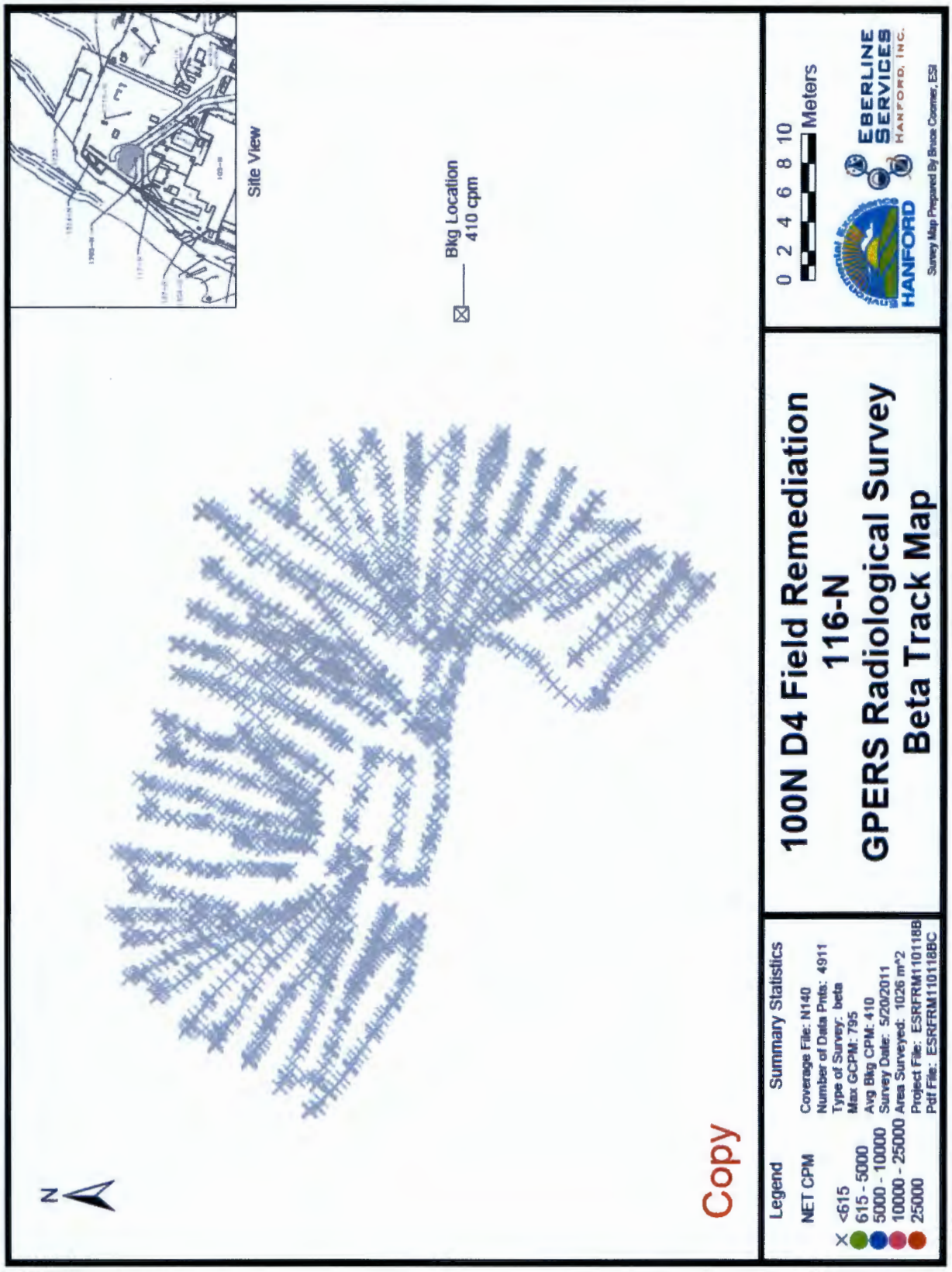


Figure C-2. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation Gamma Track Survey Map (May 20, 2011).

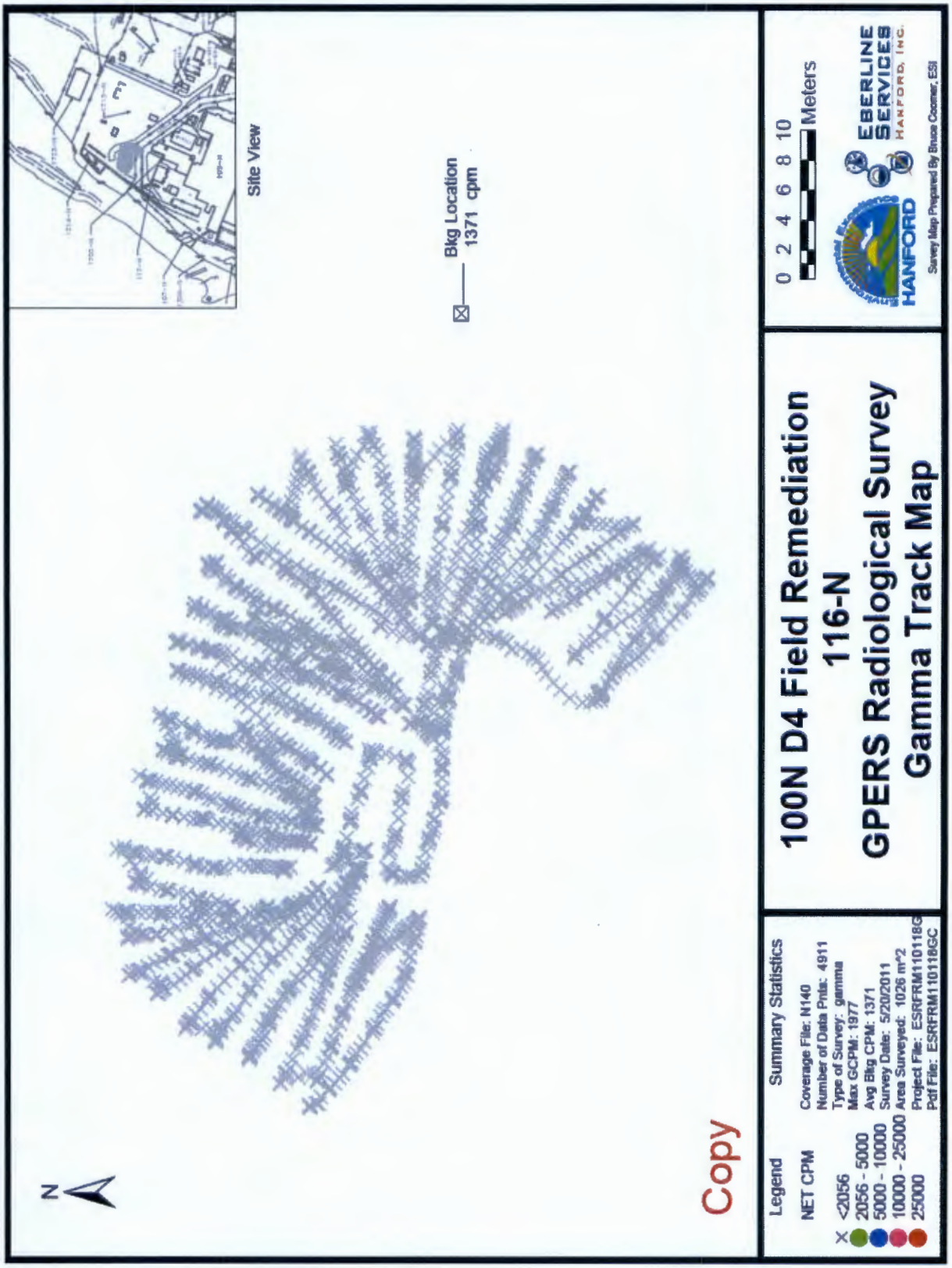


Figure C-3. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation Gamma Track Survey Map (October 3, 2012).

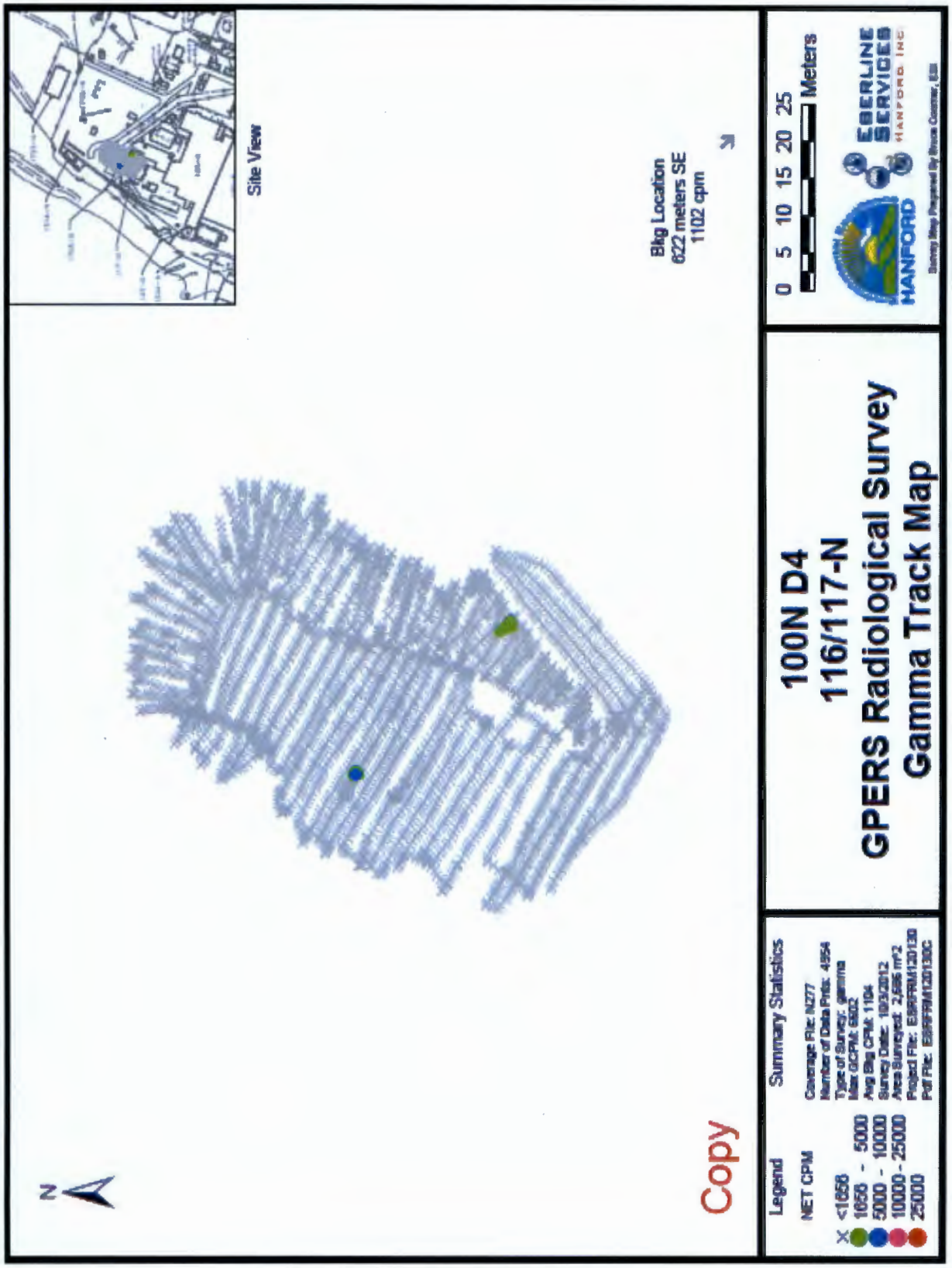


Figure C-4. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation Gamma Track Survey Map (October 17, 2012).

Figure C-5. The 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation Beta Track Survey Map (October 19, 2012).

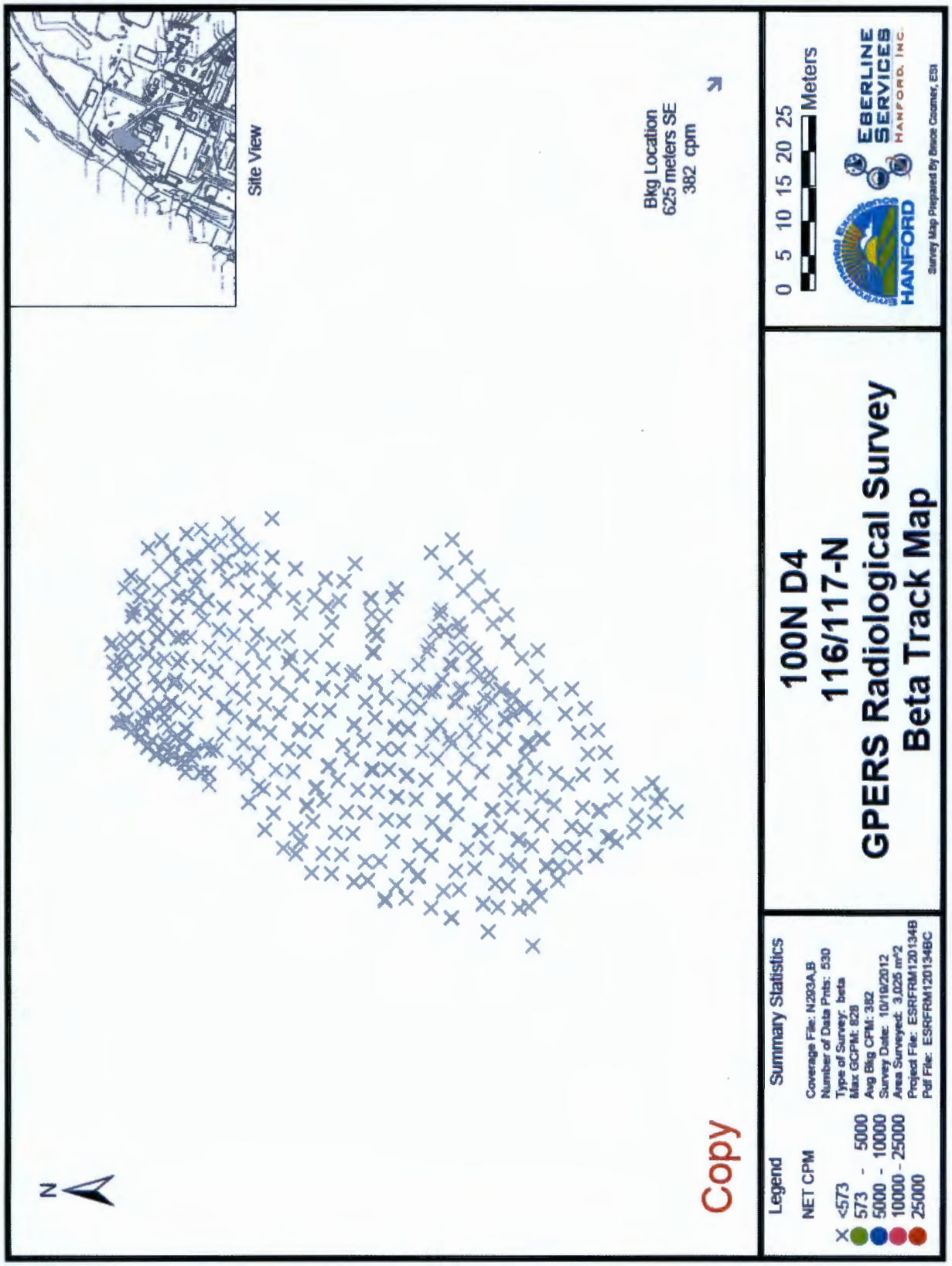
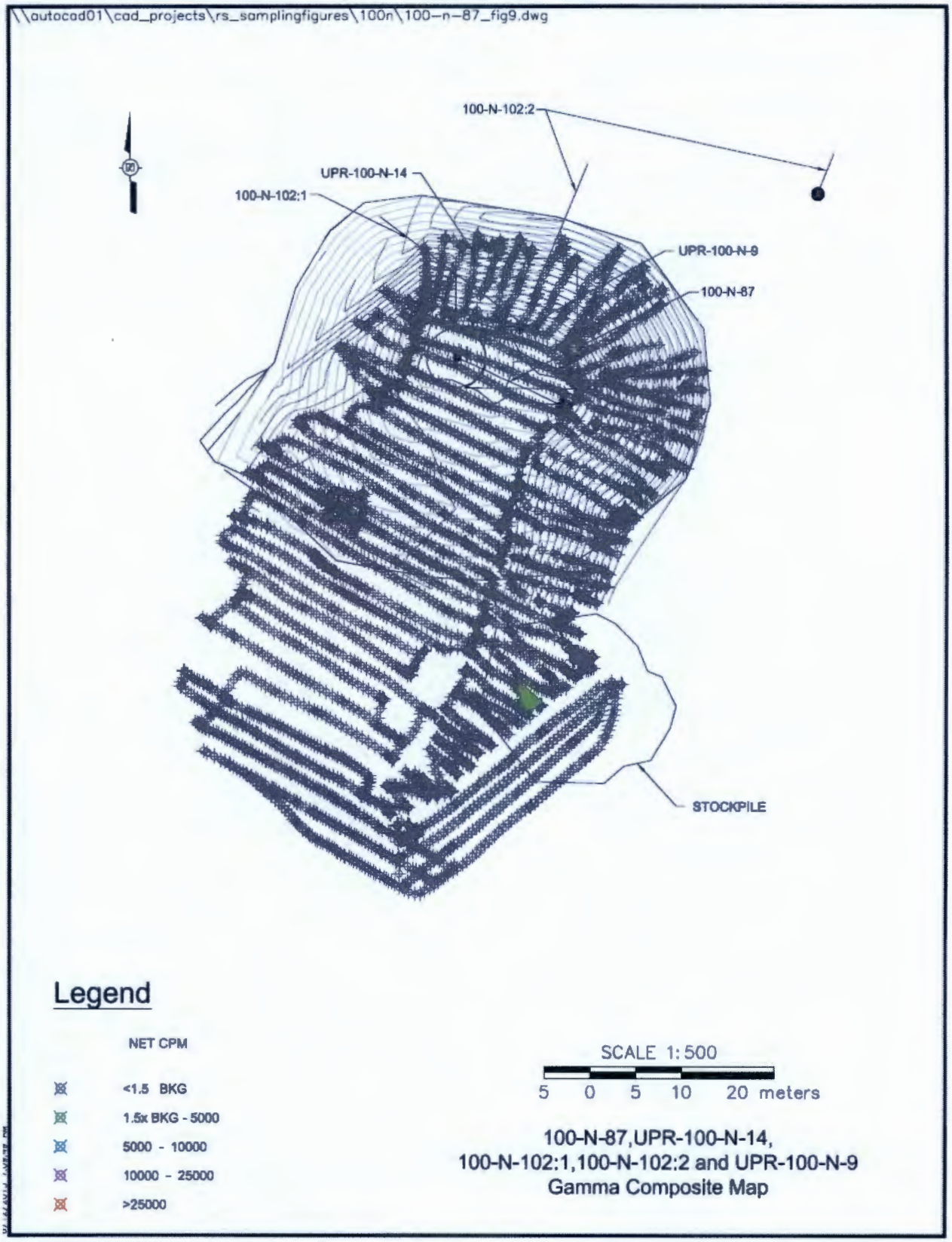


Figure C-6. Gamma Surveys from Figures C-3 and C-4 Overlain on 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 Excavation Contour Map.



APPENDIX D

CALCULATIONS

APPENDIX D

CALCULATION BRIEF

The calculations in this appendix 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. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix.

100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification, 95% UCL Calculation, 0100N-CA-V0197, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0100N-CA-V0198, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100N-CA-V0199, 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-V0197

Subject: 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites 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 = 13 Attm. 1 = 7 Total = 21	J. D. Skoglie	N. K. Schiffern	I. B. Berezovskiy	S.G. Wilkinson ~~D. F. Obenauer~~	7/9/13

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	J. D. Skoglie	**Date**	03/26/13	**Calc. No.** 0100N-CA-V0197	**Rev. No.** 0
Project	100-N Field Remediation	**Job No.**	14655	**Checked** N. K. Schiffern	**Date** 03/26/13
Subject	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations				**Sheet No.** 1 of 13

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 4 - Calculation Sheet Summary
Sheets 5 to 9 - Calculation Sheet Verification Data - Excavation Area
Sheets 10 to 12 - Ecology Software (MTCAStat) Results
Sheet 13 - Calculation Sheet Duplicate Analysis
Attachment 1 - 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14, Verification Sampling Results (7 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, 2011, 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.

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 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 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 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste site underwent statistical sampling at one decision unit; excavation area. Two focused samples were also taken. Sample location EXC-2 failed direct exposure remedial action goals (RAGs) for carbon-14. Since the failed sample location included a duplicate sample, a replacement duplicate sample was also collected. The replacement sample and the duplicate sample was analyzed for the failing analyte only.

Analytical results for all sampling locations are summarized in the tables provided on sheets 3 and 4. 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 J. D. Skoglie **Date** 03/26/13 **Calc. No.** 0100N-CA-V0197 **Rev. No.** 0
Project 100-N Field Remediation **Job No.** 14655 **Checked** N. K. Schiffern **Date** 03/26/13
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 2 of 13

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 2011) 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. The 95% UCL values were not calculated for potassium-40, radium-226, radium-228, thorium-228, and thorium-232 based on natural occurence at the Hanford Site.

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 either the duplicate or split value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed in Table 2-1 of the SAP (DOE-RL 2006a) for certain constituents. All other constituents will have their own pre-determined TDL's based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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 J. D. Skoglie **Date** 03/26/13 **Calc. No.** 0100N-CA-V0197 **Rev. No.** 0
Project 100-N Field Remediation **Job No.** 14655 **Checked** N. K. Schiffern **Date** 03/26/13
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 3 of 13

Summary (continued)

QUALIFIER LIST

B = estimated result. Result is less than the RL, but greater than MDL.
D = reported from a dilution
J = estimate
U = undetected

ACRONYM LIST

– = not applicable
DE = direct exposure
EXC = excavation
FS = focused sample
GW = groundwater
HEIS = Hanford Environmental Information System
MDA = minimal detectable activity
MTCA = *Model Toxics Control Act*
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyls
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 J. D. Skoglie	**Date** 03/26/13	**Calc. No.** 0100N-CA-V0197	**Rev. No.** 0
Project 100-N Field Remediation	**Job No.** 14655	**Checked** N. K. Schiffern	**Date** 03/26/13
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations			**Sheet No.** 4 of 13

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 area, focused samples, 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 these sites.

Results Summary -Excavation Area and Focused Samples

Analyte	EXC		Focused samples	Units
	95% UCL Result	Maximum Result	Maximum Result	
Carbon-14	1.29	--	1.60	pCi/g
Cesium-137	0.286	--	--	pCi/g
Cobalt-60	0.043	--	--	pCi/g
Total beta radiostrontium	0.320	--	1.61	pCi/g
Uranium-233/234 AEA	0.574	--	0.700	pCi/g
Uranium-238 AEA	0.546	--	0.626	pCi/g
Arsenic	2.10	--	1.94	mg/kg
Barium	55.3	--	61.1	mg/kg
Beryllium	0.269	--	0.273	mg/kg
Chromium	8.88	--	7.45	mg/kg
Cobalt	9.10	--	9.92	mg/kg
Copper	16.7	--	18.7	mg/kg
Lead	3.79	--	3.11	mg/kg
Manganese	313	--	409	mg/kg
Molybdenum	--	0.536	--	mg/kg
Nickel	10.5	--	9.93	mg/kg
Vanadium	65.8	--	69.6	mg/kg
Zinc	53.3	--	51.9	mg/kg
TPH - Diesel Range	8	--	2	mg/kg
TPH - Motor Oil	--	45	4	mg/kg
Acenapthene	--	0.006	--	mg/kg
Acenapthylene	--	0.022	--	mg/kg
Anthracene	--	0.072	--	mg/kg
Benzo(a)anthracene	0.134	--	0.010	mg/kg
Benzo(a)pyrene	0.072	--	0.006	mg/kg
Benzo(b)fluoranthene	0.041	--	0.005	mg/kg
Benzo(ghi)perylene	0.016	--	0.006	mg/kg
Benzo(k)fluoranthene	0.012	--	0.003	mg/kg
Chrysene	0.052	--	0.005	mg/kg
Dibenz(a,h)anthracene	--	0.005	--	mg/kg
Fluoranthene	0.484	--	0.010	mg/kg
Fluorene	--	0.026	--	mg/kg
Indeno(1,2,3-cd)pyrene	0.020	--	0.006	mg/kg
Naphthalene	0.118	--	0.006	mg/kg
Phenanthrene	0.067	--	0.002	mg/kg
Pyrene	0.293	--	0.010	mg/kg
Aroclor-1254	0.121	--	0.105	mg/kg
Aroclor-1260	0.075	--	0.100	mg/kg
Total PCBs	0.196	--	0.205	mg/kg

3-Part Test Evaluation:

	EXC	
95% UCL or maximum[a] > Cleanup Limit?	YES	NO
> 10% above Cleanup Limit?	YES	NO
Any sample > 2x Cleanup Limit?	YES	NO

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

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

Analyte	Duplicate Analysis EXC
Potassium-40	0.0%
Aluminum	7.9%
Barium	15.0%
Calcium	14.3%
Chromium	16.9%
Copper	5.7%
Iron	0.5%
Magnesium	22.9%
Manganese	2.7%
Silicon	8.3%
Sodium	9.7%
Vanadium	3.8%
Zinc	2.7%

[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 J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/26/13
Job No. 14655

Calc. No. 0100N-CA-V0197
Checked N. K. Schiffern

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Date 03/26/13
Sheet No. 5 of 13

100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Statistical Calculations

Verification Data - Excavation (EXC)

Sample Area	Sample Number	Sample Date	Carbon-14 [a]			Cesium-137			Cobalt-60			Total beta radiostrontium			Uranium-233/234 AEA			Uranium-238 AEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Re-sample of EXC-2	J1RH76	3/4/13	0.121	U	0.935															
Duplicate of J1RH76	J1RH77	3/4/13	0.982		0.934															
EXC-2	J1R484	10/23/12				0.126	U	0.126	0.063	U	0.063	0.062	U	0.282	0.712		0.218	0.370		0.218
Duplicate of J1R484	J1R495	10/23/12				0.077		0.054	0.069	U	0.069	0.469		0.242	0.588		0.188	0.564		0.188
EXC-1	J1R483	10/23/12	0.477	UJ	0.848	0.056	U	0.057	0.061	U	0.061	0.023	U	0.300	0.428		0.156	0.489		0.156
EXC-3	J1R485	10/23/12	1.11	J	0.905	0.907		0.064	0.076		0.059	1.03		0.257	0.466		0.178	0.420		0.178
EXC-4	J1R486	10/23/12	0.807	UJ	0.905	0.071		0.058	0.049	U	0.049	0.149	U	0.292	0.553		0.223	0.524		0.223
EXC-5	J1R487	10/23/12	0.809	UJ	0.935	0.087	U	0.087	0.102	U	0.102	-0.100	U	0.275	0.290		0.201	0.421		0.201
EXC-6	J1R488	10/23/12	1.23	J	0.913	0.120	U	0.120	0.073	U	0.073	0.018	U	0.292	0.333		0.142	0.463		0.142
EXC-7	J1R489	10/23/12	1.60	J	0.852	0.063		0.051	0.051	U	0.051	0.056	U	0.329	0.375		0.179	0.656		0.179
EXC-8	J1R490	10/23/12	1.09	J	0.835	0.053	U	0.053	0.036	U	0.036	0.061	U	0.297	0.425		0.148	0.444		0.148
EXC-9	J1R491	10/23/12	1.37	J	0.828	0.097		0.073	0.058	U	0.058	0.169	U	0.309	0.535		0.176	0.553		0.141
EXC-10	J1R492	10/23/12	1.65	J	0.822	0.047	U	0.047	0.046	U	0.046	-0.009	U	0.294	0.601		0.192	0.551		0.192
EXC-11	J1R493	10/23/12	0.872	J	0.784	0.171		0.068	0.084	U	0.084	0.097	U	0.335	0.807		0.220	0.663		0.220
EXC-12	J1R494	10/23/12	1.21	J	0.810	0.396		0.085	0.071	U	0.071	0.383		0.256	0.590		0.167	0.393		0.167

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Carbon-14 [a] pCi/g	Cesium-137 pCi/g	Cobalt-60 pCi/g	Total beta radiostrontium pCi/g	Uranium-233/234 AEA pCi/g	Uranium-238 AEA pCi/g
Re-sample of EXC-2	J1RH76/ J1RH77	3/4/13	0.552					
EXC-2	J1R484/ J1R495	10/23/12		0.0700	0.033	0.266	0.650	0.467
EXC-1	J1R483	10/23/12	0.477	0.056	0.031	0.023	0.428	0.489
EXC-3	J1R485	10/23/12	1.11	0.907	0.076	1.03	0.466	0.420
EXC-4	J1R486	10/23/12	0.807	0.071	0.025	0.149	0.553	0.524
EXC-5	J1R487	10/23/12	0.809	0.044	0.051	-0.100	0.290	0.421
EXC-6	J1R488	10/23/12	1.23	0.060	0.037	0.018	0.333	0.463
EXC-7	J1R489	10/23/12	1.60	0.063	0.026	0.056	0.375	0.656
EXC-8	J1R490	10/23/12	1.09	0.027	0.018	0.061	0.425	0.444
EXC-9	J1R491	10/23/12	1.37	0.097	0.029	0.169	0.535	0.553
EXC-10	J1R492	10/23/12	1.65	0.024	0.023	-0.009	0.601	0.551
EXC-11	J1R493	10/23/12	0.872	0.171	0.042	0.097	0.807	0.663
EXC-12	J1R494	10/23/12	1.21	0.396	0.036	0.383	0.590	0.393

Statistical Computations

	Carbon-14 [a]	Cesium-137	Cobalt-60	Total beta radiostrontium	Uranium-233/234 AEA	Uranium-238 AEA
95% UCL based on	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.
N	11	12	12	12	12	12
% < Detection limit	27%	42%	92%	75%	0%	0%
Mean	1.11	0.165	0.035	0.179	0.504	0.504
Standard deviation	0.356	0.255	0.016	0.297	0.147	0.089
Z-statistic	1.64	1.64	1.64	1.64	1.64	1.64
95% UCL on mean	1.29	0.286	0.043	0.320	0.574	0.546
Maximum value	1.65	0.907	0.076	1.03	0.807	0.663

Qualifiers are defined on page 3.

[a] Sample location EXC-2 failed direct exposure remedial action goals (RAGs) for carbon-14. Since the failed sample location included a duplicate sample, a replacement duplicate sample was also collected. The replacement sample and the duplicate sample was analyzed for the failing analyte only.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/26/13
Job No. 14655

Calc. No. 0100N-CA-V0197
Checked N. K. Schiffern

Rev. No. 0
Date 03/26/13
Sheet No. 6 of 13

1 **100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Statistical Calculations**

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

3	Sample	Sample	Sample	Arsenic			Barium			Beryllium			Chromium			Cobalt			Copper			Lead			Manganese			Nickel			Vanadium		
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	mg/kg	Q	PQL	mg/kg	Q	PQL
5	EXC-2	J1R484	10/23/12	1.97	B	2.57	39.5	J	1.28	0.224	B	0.513	8.33		0.513	6.62		5.13	14.5		2.57	2.77		1.28	266		12.8	12.7		10.3	54.8		6.42
6	Duplicate of J1R484	J1R495	10/23/12	1.90	B	2.40	45.9	J	1.20	0.219	B	0.480	7.03		0.480	7.92		4.80	13.7		2.40	2.36		1.20	259		12.0	8.30	B	9.60	56.9		6.00
7	EXC-1	J1R483	10/23/12	2.38		2.38	48.6	J	1.19	0.291	B	0.477	10.2		0.477	7.32		4.77	15.1		2.38	4.20		1.19	302		11.9	10.2		9.53	59.8		5.96
8	EXC-3	J1R485	10/23/12	1.76	B	2.40	56.0	J	1.20	0.267	B	0.481	6.96		0.481	9.03		4.81	16.4		2.40	5.96		1.20	312		12.0	8.69	B	9.61	62.4		6.01
9	EXC-4	J1R486	10/23/12	1.55	B	2.88	60.0	J	1.44	0.248	B	0.575	4.64		0.575	9.98		5.75	15.9		2.88	2.53		1.44	343		14.4	9.27	B	11.5	76.7		7.19
10	EXC-5	J1R487	10/23/12	2.02	B	2.76	48.0	J	1.38	0.281	B	0.552	6.85		0.552	8.74		5.52	18.6		2.76	2.97		1.38	310		13.8	11.2		11.0	61.2		6.90
11	EXC-6	J1R488	10/23/12	1.37	B	2.61	54.7	J	1.31	0.237	B	0.522	3.27		0.522	9.57		5.22	15.9		2.61	2.13		1.31	298		13.1	6.83	B	10.4	65.3		6.53
12	EXC-7	J1R489	10/23/12	1.72	B	2.67	55.9	J	1.34	0.256	B	0.535	7.60		0.535	8.30		5.35	17.5		2.67	3.85		1.34	315		13.4	12.0		10.7	63.6		6.69
13	EXC-8	J1R490	10/23/12	2.37	B	3.01	52.2	J	1.50	0.275	B	0.601	7.93		0.601	8.42		6.01	15.9		3.01	3.33		1.50	315		15.0	9.55	B	12.0	62.9		7.51
14	EXC-9	J1R491	10/23/12	1.22	B	2.65	56.6	J	1.32	0.239	B	0.529	4.49		0.529	9.85		5.29	16.8		2.65	2.34		1.32	317		13.2	9.76	B	10.6	69.6		6.62
15	EXC-10	J1R492	10/23/12	1.42	B	2.45	50.7	J	1.22	0.257	B	0.490	4.97		0.490	8.48		4.90	16.4		2.45	2.35		1.22	285		12.2	8.19	B	9.80	63.7		6.12
16	EXC-11	J1R493	10/23/12	1.89	B	2.50	53.1	J	1.25	0.251	B	0.501	7.19		0.501	6.93		5.01	14.6		2.50	2.88		1.25	269		12.5	8.95	B	10.0	54.1		6.26
17	EXC-12	J1R494	10/23/12	2.38	B	2.67	52.9	J	1.33	0.271	B	0.533	12.6		0.533	5.67		5.33	11.2		2.67	3.27		1.33	255		13.3	10.3	B	10.7	42.5		6.66

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19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Vanadium
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22	EXC-2	J1R484/ J1R495	10/23/12	1.94	42.7	0.222	7.68	7.27	14.1	2.57	263	10.5	55.9
23	EXC-1	J1R483	10/23/12	2.38	48.6	0.291	10.2	7.32	15.1	4.20	302	10.2	59.8
24	EXC-3	J1R485	10/23/12	1.76	56.0	0.267	6.96	9.03	16.4	5.96	312	8.69	62.4
25	EXC-4	J1R486	10/23/12	1.55	60.0	0.248	4.64	9.98	15.9	2.53	343	9.27	76.7
26	EXC-5	J1R487	10/23/12	2.02	48.0	0.281	6.85	8.74	18.6	2.97	310	11.2	61.2
27	EXC-6	J1R488	10/23/12	1.37	54.7	0.237	3.27	9.57	15.9	2.13	298	6.83	65.3
28	EXC-7	J1R489	10/23/12	1.72	55.9	0.256	7.60	8.30	17.5	3.85	315	12.0	63.6
29	EXC-8	J1R490	10/23/12	2.37	52.2	0.275	7.93	8.42	15.9	3.33	315	9.55	62.9
30	EXC-9	J1R491	10/23/12	1.22	56.6	0.239	4.49	9.85	16.8	2.34	317	9.76	69.6
31	EXC-10	J1R492	10/23/12	1.42	50.7	0.257	4.97	8.48	16.4	2.35	285	8.19	63.7
32	EXC-11	J1R493	10/23/12	1.89	53.1	0.251	7.19	6.93	14.6	2.88	269	8.95	54.1
33	EXC-12	J1R494	10/23/12	2.38	52.9	0.271	12.6	5.67	11.2	3.27	255	10.3	42.5

34 **Statistical Computations**

35		Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Vanadium
36	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	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), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat normal distribution.
37	N	12	12	12	12	12	12	12	12	12	12
38	% < Detection limit	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
39	Mean	1.83	52.6	0.258	7.03	8.30	15.7	3.20	299	9.6	61.5
40	Standard deviation	0.404	4.64	0.020	2.58	1.29	1.87	1.07	26.0	1.38	8.39
41	95% UCL on mean	2.10	55.3	0.269	8.88	9.10	16.7	3.79	313	10.5	65.8
42	Maximum value	2.38	60.0	0.291	12.6	10.0	18.6	5.96	343	12.7	76.7
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	18.5 GW & River Protection	32 GW Protection	22.0 River Protection	10.2 GW & River Protection	512 GW Protection	19.1 GW Protection	85.1 GW Protection
44	**WAC 173-340 3-PART TEST**										
45	95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
46	> 10% above Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
47	Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
48	**WAC 173-340 Compliance?**	Because all values are below background (6.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (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.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/26/13
Job No. 14655

Calc. No. 0100N-CA-V0197
Checked N. K. Schiffern

Rev. No. 0
Date 03/26/13
Sheet No. 7 of 13

1 **100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Statistical Calculations**

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

3	Sample	Sample	Sample	Zinc			TPH - Diesel Range			Benzo(a)anthracene			Benzo(a)pyrene			Benzo(b)fluoranthene			Benzo(ghi)perylene			Benzo(k)fluoranthene			Chrysene			Fluoranthene			Indeno(1,2,3-cd)pyrene		
4	Area	Number	Date	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	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-2	J1R484	10/23/12	36.8		25.7	3730	U	3730	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	0.994	J	3.82	3.82	U	3.82
6	Duplicate of J1R484	J1R495	10/23/12	37.8		24.0	1100	J	3410	1.90	J	3.42	1.46	J	3.42	3.42	U	3.42	3.42	U	3.42	3.42	U	3.42	1.87	J	3.42	3.77		3.42	3.42	U	3.42
7	EXC-1	J1R483	10/23/12	44.0		23.8	7020		3470	11.1		3.45	8.12		3.45	5.57		3.45	4.89		3.45	2.63	J	3.45	8.37		3.45	17.2		3.45	3.45	U	3.45
8	EXC-3	J1R485	10/23/12	56.3		24.0	27600	J	3490	77.0		3.42	51.7		3.42	36.8		3.42	55.3		3.42	25.0		3.42	48.0		3.42	130		3.42	28.7		3.42
9	EXC-4	J1R486	10/23/12	51.4		28.8	3410	U	3410	1.47	J	3.50	1.40	J	3.50	3.50	U	3.50	3.50	U	3.50	3.5	U	3.50	2.67	J	3.50	2.54	J	3.50	1.47	J	3.50
10	EXC-5	J1R487	10/23/12	45.6		27.6	3460	U	3460	1.87	J	3.46	1.94	J	3.46	3.46	U	3.46	1.73	J	3.46	3.46	U	3.46	2.41	J	3.46	3.68		3.46	2.27	J	3.46
11	EXC-6	J1R488	10/23/12	50.3		26.1	1020	J	3450	26.2		3.52	15.1		3.52	14.4		3.52	13.7		3.52	7.78		3.52	12.1		3.52	50.5		3.52	6.59		3.52
12	EXC-7	J1R489	10/23/12	73.2		26.7	6810		3530	15.5		3.44	10.7		3.44	10.4		3.44	3.44	U	3.44	5.34		3.44	11.7		3.44	27.9		3.44	6.58		3.44
13	EXC-8	J1R490	10/23/12	47.3		30.1	1660	J	3470	2.43	J	3.37	1.42	J	3.37	0.928	J	3.37	1.92	J	3.37	3.37	U	3.37	1.62	J	3.37	1.84	J	3.37	2.95	J	3.37
14	EXC-9	J1R491	10/23/12	49.2		26.5	3480	U	3480	87.3		3.37	60.1		3.37	38.4		3.37	3.37	U	3.37	30.6		3.37	61.2		3.37	313		3.37	25.6		3.37
15	EXC-10	J1R492	10/23/12	43.6		24.5	2820	J	3530	19.8		3.48	14.8		3.48	7.17		3.48	7.98		3.48	6.94		3.48	15.3		3.48	32.5		3.48	10.1		3.48
16	EXC-11	J1R493	10/23/12	41.0		25.0	1730	J	3500	14.8		3.50	10.4		3.50	8.94		3.50	8.48		3.50	5.68		3.50	9.53		3.50	20.7		3.50	6.11		3.50
17	EXC-12	J1R494	10/23/12	36.2		26.7	1440	J	3470	3.79		3.47	2.66	J	3.47	2.71	J	3.47	4.85		3.47	1.41	J	3.47	4.08		3.47	8.67		3.47	3.79		3.47

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19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Zinc	TPH - Diesel Range	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Chrysene	Fluoranthene	Indeno(1,2,3-cd)pyrene
21	Area	Number	Date	mg/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
22	EXC-2	J1R484/ J1R495	10/23/12	37.3	1483	1.91	1.69	1.81	1.81	1.81	1.89	2.38	1.81
23	EXC-1	J1R483	10/23/12	44.0	7020	11.1	8.12	5.57	4.89	2.63	8.37	17.2	1.73
24	EXC-3	J1R485	10/23/12	56.3	27600	77.0	51.7	36.8	55.3	25.0	48.0	130	28.7
25	EXC-4	J1R486	10/23/12	51.4	1705	1.47	1.40	1.75	1.75	1.75	2.67	2.54	1.47
26	EXC-5	J1R487	10/23/12	45.6	1730	1.87	1.94	1.73	1.73	1.73	2.41	3.68	2.27
27	EXC-6	J1R488	10/23/12	50.3	1020	26.2	15.1	14.4	13.7	7.78	12.1	50.5	6.59
28	EXC-7	J1R489	10/23/12	73.2	6810	15.5	10.7	10.4	1.72	5.34	11.7	27.9	6.58
29	EXC-8	J1R490	10/23/12	47.3	1660	2.43	1.42	0.928	1.92	1.69	1.62	1.84	2.95
30	EXC-9	J1R491	10/23/12	49.2	1740	87.3	60.1	38.4	1.69	30.6	61.2	313	25.6
31	EXC-10	J1R492	10/23/12	43.6	2820	19.8	14.8	7.17	7.98	6.94	15.3	32.5	10.1
32	EXC-11	J1R493	10/23/12	41.0	1730	14.8	10.4	8.94	8.48	5.68	9.53	20.7	6.11
33	EXC-12	J1R494	10/23/12	36.2	1440	3.79	2.66	2.71	4.85	1.41	4.08	8.67	3.79

34 **Statistical Computations**

35		Zinc	TPH - Diesel Range	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Chrysene	Fluoranthene	Indeno(1,2,3-cd)pyrene
36	95% UCL based on	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.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	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	12	12
38	% < Detection limit	0%	25%	0%	0%	25%	33%	33%	0%	0%	17%
39	Mean	48.0	4730	21.9	15.0	10.9	8.82	7.70	14.9	50.9	8.14
40	Standard deviation	9.85	7489	29.3	19.9	13.2	15.1	9.73	19.3	89.9	9.28
41	95% UCL on mean	53.3	8286	134	72.2	41.3	16.0	12.3	51.7	484	19.9
42	Maximum value	73.2	27600	87.3	60.1	38.4	55.3	30.6	61.2	313	28.7
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless stated otherwise noted**	67.8 River Protection	200000 ug/kg GW and River Protection	15 ug/kg GW and River Protection	15 ug/kg GW and River Protection	15 ug/kg GW and River Protection	48,000 ug/kg GW Protection	15 ug/kg River Protection	100 ug/kg River Protection	18,000 ug/kg River Protection	15 ug/kg GW and River Protection
44	**WAC 173-340 3-PART TEST**										
45	95% UCL > Cleanup Limit?	NO	NO	YES	YES	YES	NO	NO	NO	NO	YES
46	> 10% above Cleanup Limit?	NO	NO	YES	YES	YES	NO	YES	NO	NO	YES
47	Any sample > 2X Cleanup Limit?	NO	NO	YES	YES	YES	NO	YES	NO	NO	NO
48	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	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.	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.	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 meets the 3-part test criteria when compared to the direct exposure RAG.

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie — Date 03/26/13 — Calc. No. 0100N-CA-V0197 — Rev. No. 0

Project 100-N Field Remediation — Job No. 14655 — Checked N. K. Schiffern — Date 03/26/13

Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations — Sheet No. 8 of 13

1 **100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Statistical Calculations**

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

3	Sample	Sample	Sample	Naphthalene			Phenanthrene			Pyrene			Aroclor-1254			Aroclor-1260		
4	Area	Number	Date	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-2	J1R484	10/23/12	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	14.9	U	14.9	14.9	U	14.9
6	Duplicate of J1R484	J1R495	10/23/12	4.62		3.42	1.66	J	3.42	3.12	J	3.42	13.8	U	13.8	4.00	J	13.8
7	EXC-1	J1R483	10/23/12	12.1		3.45	9.25		3.45	14.7		3.45	130	D	27.1	128	D	27.1
8	EXC-3	J1R485	10/23/12	73.2		3.42	43.8		3.42	102		3.42	440	D	55.1	193	D	55.1
9	EXC-4	J1R486	10/23/12	1.44	J	3.50	3.50	U	3.50	2.95	J	3.50	80.0		13.6	105		13.6
10	EXC-5	J1R487	10/23/12	4.49		3.46	1.47	J	3.46	3.42	J	3.46	27.6		13.8	29.4		13.8
11	EXC-6	J1R488	10/23/12	23.9		3.52	20.2		3.52	41.2		3.52	13.9	U	13.9	6.80	J	13.9
12	EXC-7	J1R489	10/23/12	16.3		3.44	13.7		3.44	22.8		3.44	14.8		14.1	41.3		14.1
13	EXC-8	J1R490	10/23/12	2.36	J	3.37	3.37	U	3.37	1.47	J	3.37	13.8	U	13.8	13.8	U	13.8
14	EXC-9	J1R491	10/23/12	145		3.37	267		3.37	210		3.37	3.65	J	13.9	5.81	J	13.9
15	EXC-10	J1R492	10/23/12	8.70		3.48	9.22		3.48	30.5		3.48	14.1	U	14.1	14.1	U	14.1
16	EXC-11	J1R493	10/23/12	14.0		3.50	6.31		3.50	18.1		3.50	7.09	J	14.0	5.13	J	14.0
17	EXC-12	J1R494	10/23/12	4.34		3.47	1.91	J	3.47	6.05		3.47	13.4	U	13.4	13.4	U	13.4

18

19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Naphthalene	Phenanthrene	Pyrene	Aroclor-1254	Aroclor-1260
21	Area	Number	Date	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
22	EXC-2	J1R484/ J1R495	10/23/12	3.27	1.79	2.52	7.18	5.73
23	EXC-1	J1R483	10/23/12	12.1	9.25	14.7	130	128
24	EXC-3	J1R485	10/23/12	73.2	43.8	102	440	193
25	EXC-4	J1R486	10/23/12	1.44	1.75	2.95	80.0	105
26	EXC-5	J1R487	10/23/12	4.49	1.47	3.42	27.6	29.4
27	EXC-6	J1R488	10/23/12	23.9	20.2	41.2	6.95	6.80
28	EXC-7	J1R489	10/23/12	16.3	13.7	22.8	14.8	41.3
29	EXC-8	J1R490	10/23/12	2.36	1.69	1.47	6.90	6.90
30	EXC-9	J1R491	10/23/12	145	267	210	3.65	5.81
31	EXC-10	J1R492	10/23/12	8.70	9.22	30.5	7.05	7.05
32	EXC-11	J1R493	10/23/12	14.0	6.31	18.1	7.09	5.13
33	EXC-12	J1R494	10/23/12	4.34	1.91	6.05	6.70	6.70

34 **Statistical Computations**

35		Naphthalene	Phenanthrene	Pyrene	Aroclor-1254	Aroclor-1260
36	95% UCL based on	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), lognormal and normal distribution rejected, use z-statistic.
37	N	12	12	12	12	12
38	% < Detection limit	0%	17%	0%	42%	25%
39	Mean	25.8	31.5	38.0	61.5	45.1
40	Standard deviation	42.4	75.1	61.0	125	62.6
41	95% UCL on mean	118	67.2	293	121	74.8
42	Maximum value	145	267	210	440	193
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (ug/kg)**	16,000 GW Protection	240,000 GW Protection	48,000 GW Protection	17 GW and River Protection	17 GW and River Protection
44	**WAC 173-340 3-PART TEST**					
45	95% UCL > Cleanup Limit?	NO	NO	NO	YES	YES
46	> 10% above Cleanup Limit?	NO	NO	NO	YES	YES
47	Any sample > 2X Cleanup Limit?	NO	NO	NO	YES	YES
48	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	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.

Qualifiers are defined on page 3.

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations

Date 04/15/13
Job No. 14655

Calc. No. 0100N-CA-V0197
Checked N. K. Schiffern

Rev. No. 0
Date 04/15/13
Sheet No. 9 of 13

100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste SIte Maximum Calculations

Verification Data - Excavation (EXC)

Sample Area	Sample Number	Sample Date	Molybdenum			TPH - Motor Oil			Acenaphthene			Acenaphthylene			Anthracene			Dibenz(a,h)anthracene			Fluorene		
			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
EXC-2	J1R484	10/23/12	0.536	B	5.13	11200	UJ	11200	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82	3.82	U	3.82
Duplicate of J1R484	J1R495	10/23/12	4.80	U	4.80	4230	J	10200	3.42	U	3.42	3.42	U	3.42	3.42	U	3.42	3.42	U	3.42	4.45		3.42
EXC-1	J1R483	10/23/12	4.77	U	4.77	12700	J	10400	3.45	U	3.45	3.45	U	3.45	3.45	U	3.45	3.45	U	3.45	3.45	U	3.45
EXC-3	J1R485	10/23/12	4.81	U	4.81	44600	J	10500	3.42	U	3.42	3.42	U	3.42	7.71		3.42	5.28		3.42	1.20	J	3.42
EXC-4	J1R486	10/23/12	5.75	U	5.75	10200	UJ	10200	6.17		3.50	3.50	U	3.50	3.50	U	3.50	3.50	U	3.50	3.50	U	3.50
EXC-5	J1R487	10/23/12	5.52	U	5.52	10400	UJ	10400	2.69	J	3.46	3.46	U	3.46	3.46	U	3.46	3.46	U	3.46	3.46	U	3.46
EXC-6	J1R488	10/23/12	5.22	U	5.22	10400	UJ	10400	3.52	U	3.52	19.2		3.52	4.05		3.52	1.43	J	3.52	3.52	U	3.52
EXC-7	J1R489	10/23/12	5.35	U	5.35	10900	J	10600	3.44	U	3.44	3.44	U	3.44	3.44	U	3.44	0.913	J	3.44	3.44	U	3.44
EXC-8	J1R490	10/23/12	6.01	U	6.01	3650	J	10400	3.37	U	3.37	3.37	U	3.37	3.37	U	3.37	3.37	U	3.37	3.37	U	3.37
EXC-9	J1R491	10/23/12	5.29	U	5.29	10400	UJ	10400	3.37	U	3.37	21.9		3.37	71.7		3.37	4.51		3.37	25.8		3.37
EXC-10	J1R492	10/23/12	4.90	U	4.90	10600	UJ	10600	3.48	U	3.48	3.48	U	3.48	3.48	U	3.48	1.29	J	3.48	3.48	U	3.48
EXC-11	J1R493	10/23/12	5.01	U	5.01	10500	UJ	10500	3.50	U	3.50	3.50	U	3.50	3.50	U	3.50	3.50	U	3.50	3.50	U	3.50
EXC-12	J1R494	10/23/12	5.33	U	5.33	10400	UJ	10400	3.47	U	3.47	3.47	U	3.47	3.47	U	3.47	3.47	U	3.47	3.47	U	3.47

Statistical Computations

	Molybdenum	TPH - Motor Oil	Acenaphthene	Acenaphthylene	Anthracene	Dibenz(a,h)anthracene	Fluorene
% < Detection limit	92%	58%	83%	83%	75%	58%	75%
Maximum value	0.536	44600	6.17	21.9	71.7	5.28	25.8
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless otherwise noted	8 GW Protection	200,000 ug/kg GW and River Protection	96,000 ug/kg GW Protection	96,000 ug/kg GW Protection	240,000 ug/kg GW Protection	30 ug/kg GW and River Protection	64,000 ug/kg GW Protection
3-PART TEST							
Maximum > Cleanup Limit?	NO	NO	NO	NO	NO	NO	NO
> 10% above Cleanup Limit?	NO	NO	NO	NO	NO	NO	NO
Any sample > 2X Cleanup Limit?	NO	NO	NO	NO	NO	NO	NO
3-Part Test Compliance?	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	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.

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator	J. D. Skoglie	Date 03/26/13	Calc. No. 0100N-CA-V0197	Rev. No. 0
Project	100-N Field Remediation	Job No. 14655	Checked N. K. Schiffern	Date 03/26/13
Subject	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations			Sheet No. 10 of 13

Ecology Software (MTCAStat) Results, 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Excavation (EXC)

DATA	ID	Arsenic 95% UCL Calculation			
1.94	J1R484/ J1R495				
2.38	J1R483				
1.76	J1R485	Number of samples		Uncensored values	
1.55	J1R486	Uncensored	12	Mean	1.83
2.02	J1R487	Censored		Lognormal mean	1.84
1.37	J1R488	Detection limit or PQL		Std. devn.	0.404
1.72	J1R489	Method detection limit		Median	1.83
2.37	J1R490	TOTAL	12	Min.	1.22
1.22	J1R491			Max.	2.38
1.42	J1R492				
1.89	J1R493				
2.38	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.957		r-squared is: 0.952	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		2.10	

DATA	ID	Barium 95% UCL Calculation			
42.7	J1R484/ J1R495				
48.6	J1R483				
56.0	J1R485	Number of samples		Uncensored values	
60.0	J1R486	Uncensored	12	Mean	52.6
48.0	J1R487	Censored		Lognormal mean	52.6
54.7	J1R488	Detection limit or PQL		Std. devn.	4.64
55.9	J1R489	Method detection limit		Median	53.0
52.2	J1R490	TOTAL	12	Min.	42.7
56.6	J1R491			Max.	60.0
50.7	J1R492				
53.1	J1R493				
52.9	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.937		r-squared is: 0.957	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		55.3	

DATA	ID	Beryllium 95% UCL Calculation			
0.222	J1R484/ J1R495				
0.291	J1R483				
0.267	J1R485	Number of samples		Uncensored values	
0.248	J1R486	Uncensored	12	Mean	0.258
0.281	J1R487	Censored		Lognormal mean	0.258
0.237	J1R488	Detection limit or PQL		Std. devn.	0.0201
0.256	J1R489	Method detection limit		Median	0.257
0.275	J1R490	TOTAL	12	Min.	0.222
0.239	J1R491			Max.	0.291
0.257	J1R492				
0.251	J1R493				
0.271	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.987		r-squared is: 0.991	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		0.269	

DATA	ID	Chromium 95% UCL Calculation			
7.68	J1R484/ J1R495				
10.2	J1R483				
6.96	J1R485	Number of samples		Uncensored values	
4.64	J1R486	Uncensored	12	Mean	7.03
6.85	J1R487	Censored		Lognormal mean	7.09
3.27	J1R488	Detection limit or PQL		Std. devn.	2.58
7.60	J1R489	Method detection limit		Median	7.08
7.93	J1R490	TOTAL	12	Min.	3.27
4.49	J1R491			Max.	12.6
4.97	J1R492				
7.19	J1R493				
12.6	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.955		r-squared is: 0.930	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		8.88	

DATA	ID	Cobalt 95% UCL Calculation			
7.27	J1R484/ J1R495				
7.32	J1R483				
9.03	J1R485	Number of samples		Uncensored values	
9.98	J1R486	Uncensored	12	Mean	8.30
8.74	J1R487	Censored		Lognormal mean	8.31
9.57	J1R488	Detection limit or PQL		Std. devn.	1.29
8.30	J1R489	Method detection limit		Median	8.45
8.42	J1R490	TOTAL	12	Min.	5.67
9.85	J1R491			Max.	9.98
8.48	J1R492				
6.93	J1R493				
5.67	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.924		r-squared is: 0.955	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		9.10	

DATA	ID	Copper 95% UCL Calculation			
14.1	J1R484/ J1R495				
15.1	J1R483				
16.4	J1R485	Number of samples		Uncensored values	
15.9	J1R486	Uncensored	12	Mean	15.7
18.6	J1R487	Censored		Lognormal mean	15.7
15.9	J1R488	Detection limit or PQL		Std. devn.	1.87
17.5	J1R489	Method detection limit		Median	15.9
15.9	J1R490	TOTAL	12	Min.	11.2
16.8	J1R491			Max.	18.6
16.4	J1R492				
14.6	J1R493				
11.2	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.853		r-squared is: 0.902	
		Recommendations:			
		Use normal distribution.			
		UCL (based on t-statistic) is		16.7	

DATA	ID	Lead 95% UCL Calculation			
2.57	J1R484/ J1R495				
4.20	J1R483				
5.96	J1R485	Number of samples		Uncensored values	
2.53	J1R486	Uncensored	12	Mean	3.20
2.97	J1R487	Censored		Lognormal mean	3.20
2.13	J1R488	Detection limit or PQL		Std. devn.	1.07
3.85	J1R489	Method detection limit		Median	2.93
3.33	J1R490	TOTAL	12	Min.	2.13
2.34	J1R491			Max.	5.96
2.35	J1R492				
2.88	J1R493				
3.27	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.925		r-squared is: 0.828	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		3.79	

DATA	ID	Manganese 95% UCL Calculation			
263	J1R484/ J1R495				
302	J1R483				
312	J1R485	Number of samples		Uncensored values	
343	J1R486	Uncensored	12	Mean	299
310	J1R487	Censored		Lognormal mean	299
298	J1R488	Detection limit or PQL		Std. devn.	26.0
315	J1R489	Method detection limit		Median	306
315	J1R490	TOTAL	12	Min.	255
317	J1R491			Max.	343
285	J1R492				
269	J1R493				
255	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.930		r-squared is: 0.937	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		313	

DATA	ID	Nickel 95% UCL Calculation			
10.5	J1R484/ J1R495				
10.2	J1R483				
8.69	J1R485	Number of samples		Uncensored values	
9.27	J1R486	Uncensored	12	Mean	9.62
11.2	J1R487	Censored		Lognormal mean	9.63
6.83	J1R488	Detection limit or PQL		Std. devn.	1.38
12.0	J1R489	Method detection limit		Median	9.66
9.55	J1R490	TOTAL	12	Min.	6.83
9.76	J1R491			Max.	12.0
8.19	J1R492				
8.95	J1R493				
10.3	J1R494				
		Lognormal distribution?		Normal distribution?	
		r-squared is: 0.957		r-squared is: 0.982	
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is		10.5	

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie — Date 03/26/13 — Calc. No. 0100N-CA-V0197 — Rev. No. 0

Project 100-N Field Remediation — Job No. 14655 — Checked N. K. Schiffern — Date 03/26/13

Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations — Sheet No. 11 of 13

Ecology Software (MTCAStat) Results, 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Excavation (EXC)

Vanadium 95% UCL Calculation

DATA	ID
55.9	J1R484/ J1R495
59.8	J1R483
62.4	J1R485
76.7	J1R486
61.2	J1R487
65.3	J1R488
63.6	J1R489
62.9	J1R490
69.6	J1R491
63.7	J1R492
54.1	J1R493
42.5	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	61.5
Censored		Lognormal mean	61.6
Detection limit or PQL		Std. devn.	8.39
Method detection limit		Median	62.7
TOTAL	12	Min.	42.5
		Max.	76.7

Lognormal distribution? r-squared is: 0.873

Normal distribution? r-squared is: 0.914

Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 65.8

Zinc 95% UCL Calculation

DATA	ID
37.3	J1R484/ J1R495
44.0	J1R483
56.3	J1R485
51.4	J1R486
45.6	J1R487
50.3	J1R488
73.2	J1R489
47.3	J1R490
49.2	J1R491
43.6	J1R492
41.0	J1R493
36.2	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	48.0
Censored		Lognormal mean	48.0
Detection limit or PQL		Std. devn.	9.85
Method detection limit		Median	46.5
TOTAL	12	Min.	36.2
		Max.	73.2

Lognormal distribution? r-squared is: 0.930

Normal distribution? r-squared is: 0.862

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 53.3

TPH - Diesel Range 95% UCL Calculation

DATA	ID
1483	J1R484/ J1R495
7020	J1R483
27600	J1R485
1705	J1R486
1730	J1R487
1020	J1R488
6810	J1R489
1660	J1R490
1740	J1R491
2820	J1R492
1730	J1R493
1440	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	4730
Censored		Lognormal mean	4156
Detection limit or PQL		Std. devn.	7489
Method detection limit		Median	1730
TOTAL	12	Min.	1020
		Max.	27600

Lognormal distribution? r-squared is: 0.766

Normal distribution? r-squared is: 0.488

Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 8286

Benzo(a)anthracene 95% UCL Calculation

DATA	ID
1.91	J1R484/ J1R495
11.1	J1R483
77.0	J1R485
1.47	J1R486
1.87	J1R487
26.2	J1R488
15.5	J1R489
2.43	J1R490
87.3	J1R491
19.8	J1R492
14.8	J1R493
3.79	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	21.9
Censored		Lognormal mean	26.2
Detection limit or PQL		Std. devn.	29.3
Method detection limit		Median	13.0
TOTAL	12	Min.	1.47
		Max.	87.3

Lognormal distribution? r-squared is: 0.935

Normal distribution? r-squared is: 0.704

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 134

Benzo(a)pyrene 95% UCL Calculation

DATA	ID
1.69	J1R484/ J1R495
8.12	J1R483
51.7	J1R485
1.40	J1R486
1.94	J1R487
15.1	J1R488
10.7	J1R489
1.42	J1R490
60.1	J1R491
14.8	J1R492
10.4	J1R493
2.66	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	15.0
Censored		Lognormal mean	16.9
Detection limit or PQL		Std. devn.	19.9
Method detection limit		Median	9.26
TOTAL	12	Min.	1.40
		Max.	60.1

Lognormal distribution? r-squared is: 0.920

Normal distribution? r-squared is: 0.693

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 72.2

Benzo(b)fluoranthene 95% UCL Calculation

DATA	ID
1.81	J1R484/ J1R495
5.57	J1R483
36.8	J1R485
1.75	J1R486
1.73	J1R487
14.4	J1R488
10.4	J1R489
0.928	J1R490
38.4	J1R491
7.17	J1R492
8.94	J1R493
2.71	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	10.9
Censored		Lognormal mean	12.0
Detection limit or PQL		Std. devn.	13.2
Method detection limit		Median	6.37
TOTAL	12	Min.	0.928
		Max.	38.4

Lognormal distribution? r-squared is: 0.955

Normal distribution? r-squared is: 0.730

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 41.3

Benzo(ghi)perylene 95% UCL Calculation

DATA	ID
1.81	J1R484/ J1R495
4.89	J1R483
55.3	J1R485
1.75	J1R486
1.73	J1R487
13.7	J1R488
1.72	J1R489
1.92	J1R490
1.69	J1R491
7.98	J1R492
8.48	J1R493
4.85	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	8.82
Censored		Lognormal mean	7.89
Detection limit or PQL		Std. devn.	15.1
Method detection limit		Median	3.39
TOTAL	12	Min.	1.69
		Max.	55.3

Lognormal distribution? r-squared is: 0.827

Normal distribution? r-squared is: 0.496

Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 16.0

Benzo(k)fluoranthene 95% UCL Calculation

DATA	ID
1.81	J1R484/ J1R495
2.63	J1R483
25.0	J1R485
1.75	J1R486
1.73	J1R487
7.78	J1R488
5.34	J1R489
1.69	J1R490
30.6	J1R491
6.94	J1R492
5.68	J1R493
1.41	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	7.70
Censored		Lognormal mean	7.60
Detection limit or PQL		Std. devn.	9.73
Method detection limit		Median	3.99
TOTAL	12	Min.	1.41
		Max.	30.6

Lognormal distribution? r-squared is: 0.882

Normal distribution? r-squared is: 0.666

Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 12.3

Chrysene 95% UCL Calculation

DATA	ID
1.89	J1R484/ J1R495
8.37	J1R483
48.0	J1R485
2.67	J1R486
2.41	J1R487
12.1	J1R488
11.7	J1R489
1.62	J1R490
61.2	J1R491
15.3	J1R492
9.53	J1R493
4.08	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	14.9
Censored		Lognormal mean	15.7
Detection limit or PQL		Std. devn.	19.3
Method detection limit		Median	8.95
TOTAL	12	Min.	1.62
		Max.	61.2

Lognormal distribution? r-squared is: 0.946

Normal distribution? r-squared is: 0.686

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 51.7

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations

Date 03/26/13
Job No. 14655

Calc. No. 0100N-CA-V0197
Checked N. K. Schiffern

Rev. No. 0
Date 03/26/13
Sheet No. 12 of 13

Ecology Software (MTCAStat) Results, 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Excavation (EXC)

Fluoranthene 95% UCL Calculation

DATA	ID
2.38	J1R484/ J1R495
17.2	J1R483
130	J1R485
2.54	J1R486
3.68	J1R487
50.5	J1R488
27.9	J1R489
1.84	J1R490
313	J1R491
32.5	J1R492
20.7	J1R493
8.67	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	50.9
Censored		Lognormal mean	60.7
Detection limit or PQL		Std. devn.	89.9
Method detection limit		Median	19.0
TOTAL	12	Min.	1.84
		Max.	313

Lognormal distribution? r-squared is: 0.961
Normal distribution? r-squared is: 0.575
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 484

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

DATA	ID
1.81	J1R484/ J1R495
1.73	J1R483
28.7	J1R485
1.47	J1R486
2.27	J1R487
6.59	J1R488
6.58	J1R489
2.95	J1R490
25.6	J1R491
10.10	J1R492
6.11	J1R493
3.79	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	8.14
Censored		Lognormal mean	8.22
Detection limit or PQL		Std. devn.	9.28
Method detection limit		Median	4.95
TOTAL	12	Min.	1.47
		Max.	28.7

Lognormal distribution? r-squared is: 0.934
Normal distribution? r-squared is: 0.709
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 19.9

Naphthalene 95% UCL Calculation

DATA	ID
3.27	J1R484/ J1R495
12.1	J1R483
73.2	J1R485
1.44	J1R486
4.49	J1R487
23.9	J1R488
16.3	J1R489
2.36	J1R490
145	J1R491
8.70	J1R492
14.0	J1R493
4.34	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	25.8
Censored		Lognormal mean	26.2
Detection limit or PQL		Std. devn.	42.4
Method detection limit		Median	10.4
TOTAL	12	Min.	1.44
		Max.	145

Lognormal distribution? r-squared is: 0.964
Normal distribution? r-squared is: 0.592
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 118

Phenanthrene 95% UCL Calculation

DATA	ID
1.79	J1R484/ J1R495
9.25	J1R483
43.8	J1R485
1.75	J1R486
1.47	J1R487
20.2	J1R488
13.7	J1R489
1.69	J1R490
267	J1R491
9.22	J1R492
6.31	J1R493
1.91	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	31.5
Censored		Lognormal mean	26.6
Detection limit or PQL		Std. devn.	75.1
Method detection limit		Median	7.77
TOTAL	12	Min.	1.47
		Max.	267

Lognormal distribution? r-squared is: 0.883
Normal distribution? r-squared is: 0.415
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 67.2

Pyrene 95% UCL Calculation

DATA	ID
2.52	J1R484/ J1R495
14.7	J1R483
102	J1R485
2.95	J1R486
3.42	J1R487
41.2	J1R488
22.8	J1R489
1.47	J1R490
210	J1R491
30.5	J1R492
18.1	J1R493
6.05	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	38.0
Censored		Lognormal mean	45.0
Detection limit or PQL		Std. devn.	61.0
Method detection limit		Median	16.4
TOTAL	12	Min.	1.47
		Max.	210

Lognormal distribution? r-squared is: 0.971
Normal distribution? r-squared is: 0.624
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 293

Aroclor-1254 95% UCL Calculation

DATA	ID
7.18	J1R484/ J1R495
130	J1R483
440	J1R485
80.0	J1R486
27.6	J1R487
6.95	J1R488
14.8	J1R489
6.90	J1R490
3.65	J1R491
7.05	J1R492
7.09	J1R493
6.70	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	61.5
Censored		Lognormal mean	53.1
Detection limit or PQL		Std. devn.	125
Method detection limit		Median	7.13
TOTAL	12	Min.	3.65
		Max.	440

Lognormal distribution? r-squared is: 0.816
Normal distribution? r-squared is: 0.498
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 121

Aroclor-1260 95% UCL Calculation

DATA	ID
5.73	J1R484/ J1R495
128	J1R483
193	J1R485
105	J1R486
29.4	J1R487
6.80	J1R488
41.3	J1R489
6.90	J1R490
5.81	J1R491
7.05	J1R492
5.13	J1R493
6.70	J1R494

Number of samples		Uncensored values	
Uncensored	12	Mean	45.1
Censored		Lognormal mean	47.7
Detection limit or PQL		Std. devn.	62.6
Method detection limit		Median	6.98
TOTAL	12	Min.	5.13
		Max.	193

Lognormal distribution? r-squared is: 0.814
Normal distribution? r-squared is: 0.704
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 74.8

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie — Date 03/26/13 — Calc. No. 0100N-CA-V0197 — Rev. No. 0

Project 100-N Field Remediation — Job No. 14655 — Checked N. K. Schiffern — Date 03/26/13

Subject 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Cleanup Verification 95% UCL Calculations — Sheet No. 13 of 13

Duplicate Analysis - 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Excavation (EXC)

Sampling Area	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-232			Uranium-233/234 AEA			Uranium-238 AEA			Aluminum			Arsenic		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1R484	10/23/12	10.0		0.570	0.268		0.111	0.488		0.176	0.572		0.127	0.488		0.176	0.712		0.218	0.370		0.218	5520	J	12.8	1.97	B	2.57
Duplicate of J1R484	J1R495	10/23/12	10.0		0.585	0.331		0.105	0.473		0.197	0.481		0.066	0.473		0.197	0.588		0.188	0.564		0.188	5100	J	12.0	1.90	B	2.40

Analysis:

	TDL	0.5	0.1	0.2	1	1	1	1	5	10
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	
	RPD	0.0%							7.9%	
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable

Duplicate Analysis - 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Barium			Beryllium			Calcium			Chromium			Cobalt			Copper			Iron			Lead			Magnesium		
			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-2	J1R484	10/23/12	39.5	J	1.28	0.224	B	0.513	6900	J	257	8.33		0.513	6.62		5.13	14.5		2.57	19700		51.3	2.77		1.28	4670		192
Duplicate of J1R484	J1R495	10/23/12	45.9	J	1.20	0.219	B	0.480	5980	J	240	7.03		0.480	7.92		4.80	13.7		2.40	19800		48.0	2.36		1.20	3710		180

Analysis:

	TDL	2	0.2	100	1	2	1	5	5	75
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	15.0%		14.3%	16.9%		5.7%	0.5%		22.9%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

Duplicate Analysis - 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Excavation (EXC)

Sampling Area	HEIS Number	Sample Date	Manganese			Nickel			Potassium			Silicon			Sodium			Vanadium			Zinc			Fluoranthene		
			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	ug/kg	Q	PQL
EXC-2	J1R484	10/23/12	266		12.8	12.7		10.3	707	B	1030	103	J	5.13	264		128	54.8		6.42	36.8		25.7	0.994	J	3.82
Duplicate of J1R484	J1R495	10/23/12	259		12.0	8.30	B	9.60	691	B	960	94.8	J	4.80	291		120	56.9		6.00	37.8		24.0	3.77		3.42

Analysis:

	TDL	5	4	400	2	50	2.5	1	15
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	Yes (calc RPD)			Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	
	RPD	2.7%			8.3%	9.7%	3.8%	2.7%	
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable

Qualifiers are defined on page 3.

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Radionuclides).

Location	HEIS Number	Sample Date	Americium-241			Carbon-14 [a]			Cesium-137			Cobalt-60			Europium-152		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
EXC-2	J1R484	10/23/12	0.070	U	0.070	14.5	J	0.911	0.126	U	0.126	0.063	U	0.063	0.165	U	0.165
Duplicate of J1R484	J1R495	10/23/12	0.128	U	0.128	1.08	J	0.804	0.077		0.054	0.069	U	0.069	0.156	U	0.156
Re-sample of EXC-2	J1RH76	3/4/13				0.121	U	0.935									
Duplicate of J1RH76	J1RH77	3/4/13				0.982		0.934									
EXC-1	J1R483	10/23/12	0.132	U	0.132	0.477	UJ	0.848	0.056	U	0.057	0.061	U	0.061	0.140	U	0.140
EXC-3	J1R485	10/23/12	0.069	U	0.069	1.11	J	0.905	0.907		0.064	0.076		0.059	0.146	U	0.146
EXC-4	J1R486	10/23/12	0.102	U	0.102	0.807	UJ	0.905	0.071		0.058	0.049	U	0.049	0.133	U	0.133
EXC-5	J1R487	10/23/12	0.414	U	0.414	0.809	UJ	0.935	0.087	U	0.087	0.102	U	0.102	0.236	U	0.236
EXC-6	J1R488	10/23/12	0.078	U	0.078	1.23	J	0.913	0.120	U	0.120	0.073	U	0.073	0.176	U	0.176
EXC-7	J1R489	10/23/12	0.065	U	0.065	1.60	J	0.852	0.063		0.051	0.051	U	0.051	0.136	U	0.136
EXC-8	J1R490	10/23/12	0.209	U	0.209	1.09	J	0.835	0.053	U	0.053	0.036	U	0.036	0.123	U	0.123
EXC-9	J1R491	10/23/12	0.064	U	0.064	1.37	J	0.828	0.097		0.073	0.058	U	0.058	0.147	U	0.147
EXC-10	J1R492	10/23/12	0.100	U	0.100	1.65	J	0.822	0.047	U	0.047	0.046	U	0.046	0.118	U	0.118
EXC-11	J1R493	10/23/12	0.332	U	0.332	0.872	J	0.784	0.171		0.068	0.084	U	0.084	0.193	U	0.193
EXC-12	J1R494	10/23/12	0.097	U	0.097	1.21	J	0.810	0.396		0.085	0.071	U	0.071	0.200	U	0.200
FS-1	J1R4F5	10/23/12				1.01	J	0.866	0.099	U	0.099	0.109	U	0.109	0.252	U	0.252
FS-2	J1R4F6	10/23/12				1.60	J	0.874	0.060	U	0.060	0.067	U	0.067	0.159	U	0.159

Location	HEIS Number	Sample Date	Europium-154			Europium-155			Potassium-40			Radium-226			Radium-228		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
EXC-2	J1R484	10/23/12	0.187	U	0.187	0.125	U	0.125	10.0		0.570	0.268		0.111	0.488		0.176
Duplicate of J1R484	J1R495	10/23/12	0.231	U	0.231	0.136	U	0.136	10.0		0.585	0.331		0.105	0.473		0.197
EXC-1	J1R483	10/23/12	0.140	U	0.140	0.136	U	0.136	9.90		0.518	0.350		0.096	0.626		0.174
EXC-3	J1R485	10/23/12	0.152	U	0.152	0.113	U	0.113	7.94		0.626	0.327		0.090	0.487		0.143
EXC-4	J1R486	10/23/12	0.160	U	0.160	0.107	U	0.107	8.00		0.467	0.366		0.089	0.488		0.194
EXC-5	J1R487	10/23/12	0.308	U	0.308	0.234	U	0.234	8.30		0.680	0.476		0.151	0.449		0.265
EXC-6	J1R488	10/23/12	0.233	U	0.233	0.146	U	0.146	7.09		0.911	0.308		0.140	0.534		0.250
EXC-7	J1R489	10/23/12	0.172	U	0.172	0.116	U	0.116	8.36		0.432	0.348		0.109	0.503		0.214
EXC-8	J1R490	10/23/12	0.171	U	0.171	0.150	U	0.150	11.1		0.543	0.429		0.103	0.695		0.178
EXC-9	J1R491	10/23/12	0.172	U	0.172	0.118	U	0.118	7.22		0.686	0.283		0.109	0.373		0.233
EXC-10	J1R492	10/23/12	0.136	U	0.136	0.102	U	0.102	8.40		0.368	0.313		0.101	0.468		0.207
EXC-11	J1R493	10/23/12	0.238	U	0.238	0.186	U	0.186	9.62		0.716	0.368		0.106	0.563		0.313
EXC-12	J1R494	10/23/12	0.212	U	0.212	0.168	U	0.168	13.7		0.891	0.415		0.154	0.721		0.407
FS-1	J1R4F5	10/23/12	0.301	U	0.301	0.219	U	0.219	8.84		0.850				0.468		0.339
FS-2	J1R4F6	10/23/12	0.206	U	0.206	0.125	U	0.125	9.14		0.543				0.439		0.254

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

[a] Sample location EXC-2 failed direct exposure remedial action goals (RAGs) for carbon-14. Since the failed sample location included a duplicate sample, a replacement duplicate sample was also collected. The replacement sample and the duplicate sample was analyzed for the failing analyte only.

Attachment	1	Sheet No.	1 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	Rev. No.	0

AEA = alpha energy analysis
B = blank contamination (inorganic constituents)
D = reported from a dilution
EXC = excavation
FS = focused sample
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
J = estimate
MDA = minimal detectable activity
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyls
PQL = practical quantitation limit
Q = qualifier
TPH = total petroleum hydrocarbons
U = undetected

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Radionuclides).

Location	HEIS Number	Sample Date	Thorium-228			Thorium-232			Total beta radiostrontium			Uranium-233/234 AEA			Uranium-235 AEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
EXC-2	J1R484	10/23/12	0.572		0.127	0.488		0.176	0.062	U	0.282	0.712		0.218	0.104	UJ	0.264
Duplicate of J1R484	J1R495	10/23/12	0.481		0.066	0.473		0.197	0.469		0.242	0.588		0.188	0.030	UJ	0.227
EXC-1	J1R483	10/23/12	0.492		0.069	0.626		0.174	0.023	U	0.300	0.428		0.156	0.025	UJ	0.189
EXC-3	J1R485	10/23/12	0.415		0.070	0.487		0.143	1.03		0.257	0.466		0.178	0.085	UJ	0.216
EXC-4	J1R486	10/23/12	0.446		0.056	0.488		0.194	0.149	U	0.292	0.553		0.223	0.035	UJ	0.269
EXC-5	J1R487	10/23/12	0.458		0.166	0.449		0.265	-0.100	U	0.275	0.290		0.201	0.064	UJ	0.244
EXC-6	J1R488	10/23/12	0.612		0.110	0.534		0.250	0.018	U	0.292	0.333		0.142	0.045	UJ	0.172
EXC-7	J1R489	10/23/12	0.464		0.100	0.503		0.214	0.056	U	0.329	0.375		0.179	0.085	UJ	0.217
EXC-8	J1R490	10/23/12	0.538		0.067	0.695		0.178	0.061	U	0.297	0.425		0.148	0	UJ	0.179
EXC-9	J1R491	10/23/12	0.563		0.116	0.373		0.233	0.169	U	0.309	0.535		0.176	0.022	UJ	0.171
EXC-10	J1R492	10/23/12	0.466		0.057	0.468		0.207	-0.009	U	0.294	0.601		0.192	0.061	UJ	0.232
EXC-11	J1R493	10/23/12	0.612		0.136	0.563		0.313	0.097	U	0.335	0.807		0.220	0	UJ	0.267
EXC-12	J1R494	10/23/12	0.696		0.108	0.721		0.407	0.383		0.256	0.590		0.167	0.053	UJ	0.202
FS-1	J1R4F5	10/23/12	0.551		0.139	0.468		0.339	1.61		0.260	0.700		0.282	0.045	UJ	0.341
FS-2	J1R4F6	10/23/12	0.471		0.083	0.439		0.254	-0.016	U	0.261	0.671		0.233	0	UJ	0.282

Location	HEIS Number	Sample Date	Uranium-238 AEA			Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q		pCi/g	Q	MDA	pCi/g	Q	MDA
EXC-2	J1R484	10/23/12	0.370		0.218	0.303	U	0.303	7.07	U	7.07
Duplicate of J1R484	J1R495	10/23/12	0.564		0.188	0.354	U	0.354	8.05	U	8.05
EXC-1	J1R483	10/23/12	0.489		0.156	0.304	U	0.304	5.77	U	5.77
EXC-3	J1R485	10/23/12	0.420		0.178	0.257	U	0.257	5.99	U	5.99
EXC-4	J1R486	10/23/12	0.524		0.223	0.235	U	0.235	5.82	U	5.82
EXC-5	J1R487	10/23/12	0.421		0.201	0.456	U	0.456	10.2	U	10.2
EXC-6	J1R488	10/23/12	0.463		0.142	0.357	U	0.357	7.75	U	7.75
EXC-7	J1R489	10/23/12	0.656		0.179	0.276	U	0.276	6.14	U	6.14
EXC-8	J1R490	10/23/12	0.444		0.148	0.292	U	0.292	6.24	U	6.24
EXC-9	J1R491	10/23/12	0.553		0.141	0.282	U	0.282	6.13	U	6.13
EXC-10	J1R492	10/23/12	0.551		0.192	0.247	U	0.247	5.85	U	5.85
EXC-11	J1R493	10/23/12	0.663		0.220	0.381	U	0.381	7.84	U	7.84
EXC-12	J1R494	10/23/12	0.393		0.167	0.393	U	0.393	7.64	U	7.64
FS-1	J1R4F5	10/23/12	0.626		0.282	0.458	U	0.458	10.3	U	10.3
FS-2	J1R4F6	10/23/12	0.396		0.233	0.310	U	0.310	7.04	U	7.04

Attachment	1	Sheet No.	2 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	Rev. No.	0

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Metals).

Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1R484	10/23/12	5520	J	12.8	1.54	UJ	1.54	1.97	B	2.57	39.5	J	1.28	0.224	B	0.513
Duplicate of J1R484	J1R495	10/23/12	5100	J	12.0	1.44	UJ	1.44	1.90	B	2.40	45.9	J	1.20	0.219	B	0.480
EXC-1	J1R483	10/23/12	6670	J	11.9	1.43	UJ	1.43	2.38		2.38	48.6	J	1.19	0.291	B	0.477
EXC-3	J1R485	10/23/12	5970	J	12.0	1.44	UJ	1.44	1.76	B	2.40	56.0	J	1.20	0.267	B	0.481
EXC-4	J1R486	10/23/12	5420	J	14.4	1.73	UJ	1.73	1.55	B	2.88	60.0	J	1.44	0.248	B	0.575
EXC-5	J1R487	10/23/12	7730	J	13.8	1.66	UJ	1.66	2.02	B	2.76	48.0	J	1.38	0.281	B	0.552
EXC-6	J1R488	10/23/12	4720	J	13.1	1.57	UJ	1.57	1.37	B	2.61	54.7	J	1.31	0.237	B	0.522
EXC-7	J1R489	10/23/12	6460	J	13.4	1.60	UJ	1.60	1.72	B	2.67	55.9	J	1.34	0.256	B	0.535
EXC-8	J1R490	10/23/12	6190	J	15.0	1.80	UJ	1.80	2.37	B	3.01	52.2	J	1.50	0.275	B	0.601
EXC-9	J1R491	10/23/12	4980	J	13.2	1.59	UJ	1.59	1.22	B	2.65	56.6	J	1.32	0.239	B	0.529
EXC-10	J1R492	10/23/12	5410	J	12.2	1.47	UJ	1.47	1.42	B	2.45	50.7	J	1.22	0.257	B	0.490
EXC-11	J1R493	10/23/12	6110	J	12.5	1.50	UJ	1.50	1.89	B	2.50	53.1	J	1.25	0.251	B	0.501
EXC-12	J1R494	10/23/12	6600	J	13.3	1.60	UJ	1.60	2.38	B	2.67	52.9	J	1.33	0.271	B	0.533
FS-1	J1R4F5	10/23/12	5980	J	14.3	1.71	UJ	1.71	1.72	B	2.85	61.1	J	1.43	0.273	B	0.570
FS-2	J1R4F6	10/23/12	6030	J	14.4	1.72	UJ	1.72	1.94	B	2.87	50.8	J	1.44	0.267	B	0.574
Equipment Blank	J1R496	10/23/12	160	J	4.55	0.545	UJ	0.545	0.909	U	0.909	1.30	J	0.455	0.182	U	0.182

Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1R484	10/23/12	5.13	U	5.13	0.513	U	0.513	6900	J	257	8.33		0.513	6.62		5.13
Duplicate of J1R484	J1R495	10/23/12	4.80	U	4.80	0.480	U	0.480	5980	J	240	7.03		0.480	7.92		4.80
EXC-1	J1R483	10/23/12	4.77	U	4.77	0.477	U	0.477	7530	J	238	10.2		0.477	7.32		4.77
EXC-3	J1R485	10/23/12	4.81	U	4.81	0.481	U	0.481	7390	J	240	6.96		0.481	9.03		4.81
EXC-4	J1R486	10/23/12	5.75	U	5.75	0.575	U	0.575	7320	J	288	4.64		0.575	9.98		5.75
EXC-5	J1R487	10/23/12	5.52	U	5.52	0.552	U	0.552	8070	J	276	6.85		0.552	8.74		5.52
EXC-6	J1R488	10/23/12	5.22	U	5.22	0.522	U	0.522	6680	J	261	3.27		0.522	9.57		5.22
EXC-7	J1R489	10/23/12	5.35	U	5.35	0.535	U	0.535	11300	J	267	7.60		0.535	8.30		5.35
EXC-8	J1R490	10/23/12	6.01	U	6.01	0.601	U	0.601	7320	J	301	7.93		0.601	8.42		6.01
EXC-9	J1R491	10/23/12	5.29	U	5.29	0.529	U	0.529	5850	J	265	4.49		0.529	9.85		5.29
EXC-10	J1R492	10/23/12	4.90	U	4.90	0.490	U	0.490	5590	J	245	4.97		0.490	8.48		4.90
EXC-11	J1R493	10/23/12	5.01	U	5.01	0.501	U	0.501	5820	J	250	7.19		0.501	6.93		5.01
EXC-12	J1R494	10/23/12	5.33	U	5.33	0.533	U	0.533	3910	J	267	12.6		0.533	5.67		5.33
FS-1	J1R4F5	10/23/12	5.70	U	5.70	0.570	U	0.570	8180	J	285	5.25		0.570	9.92		5.70
FS-2	J1R4F6	10/23/12	5.74	U	5.74	0.574	U	0.574	7550	J	287	7.45		0.574	8.78		5.74
Equipment Blank	J1R496	10/23/12	1.82	U	1.82	0.182	U	0.182	28.9	UJB	90.9	0.182	U	0.182	1.82	U	1.82

Attachment	1	Sheet No.	3 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	Rev. No.	0

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Metals).

Location	HEIS Number	Sample Date	Copper			Hexavalent Chromium			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1R484	10/23/12	14.5		2.57	0.23	U	0.23	19700		51.3	2.77		1.28	4670		192
Duplicate of J1R484	J1R495	10/23/12	13.7		2.40	0.21	U	0.21	19800		48.0	2.36		1.20	3710		180
EXC-1	J1R483	10/23/12	15.1		2.38	0.21	U	0.21	22200		47.7	4.20		1.19	4690		179
EXC-3	J1R485	10/23/12	16.4		2.40	0.21	U	0.21	25600		48.1	5.96		1.20	4700		180
EXC-4	J1R486	10/23/12	15.9		2.88	0.21	U	0.21	29300		57.5	2.53		1.44	4900		216
EXC-5	J1R487	10/23/12	18.6		2.76	0.21	U	0.21	24800		55.2	2.97		1.38	5330		207
EXC-6	J1R488	10/23/12	15.9		2.61	0.21	U	0.21	26200		52.2	2.13		1.31	4190		196
EXC-7	J1R489	10/23/12	17.5		2.67	0.21	U	0.21	24000		53.5	3.85		1.34	4880		201
EXC-8	J1R490	10/23/12	15.9		3.01	0.21	U	0.21	23800		60.1	3.33		1.50	4530		225
EXC-9	J1R491	10/23/12	16.8		2.65	0.21	U	0.21	27100		52.9	2.34		1.32	4640		199
EXC-10	J1R492	10/23/12	16.4		2.45	0.21	U	0.21	24600		49.0	2.35		1.22	4220		184
EXC-11	J1R493	10/23/12	14.6		2.50	0.21	U	0.21	20800		50.1	2.88		1.25	4000		188
EXC-12	J1R494	10/23/12	11.2		2.67	0.21	U	0.21	17700		53.3	3.27		1.33	3520		200
FS-1	J1R4F5	10/23/12	18.7		2.85	0.21	U	0.21	26200		57.0	2.60		1.43	4800		214
FS-2	J1R4F6	10/23/12	16.4		2.87	0.21	U	0.21	25000		57.4	3.11		1.44	4500		215
Equipment Blank	J1R496	10/23/12	0.909	U	0.909				185		18.2	0.295	B	0.455	16.7	B	68.2

Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1R484	10/23/12	266		12.8	0.0287	U	0.0287	0.536	B	5.13	12.7		10.3	707	B	1030
Duplicate of J1R484	J1R495	10/23/12	259		12.0	0.0260	U	0.0260	4.80	U	4.80	8.30	B	9.60	691	B	960
EXC-1	J1R483	10/23/12	302		11.9	0.0262	U	0.0262	4.77	U	4.77	10.2		9.53	1020		953
EXC-3	J1R485	10/23/12	312		12.0	0.0272	U	0.0272	4.81	U	4.81	8.69	B	9.61	746	B	961
EXC-4	J1R486	10/23/12	343		14.4	0.0297	U	0.0297	5.75	U	5.75	9.27	B	11.5	667	B	1150
EXC-5	J1R487	10/23/12	310		13.8	0.0253	U	0.0253	5.52	U	5.52	11.2		11.0	914	B	1100
EXC-6	J1R488	10/23/12	298		13.1	0.0273	U	0.0273	5.22	U	5.22	6.83	B	10.4	565	B	1040
EXC-7	J1R489	10/23/12	315		13.4	0.0292	U	0.0292	5.35	U	5.35	12.0		10.7	871	B	1070
EXC-8	J1R490	10/23/12	315		15.0	0.0276	U	0.0276	6.01	U	6.01	9.55	B	12.0	912	B	1200
EXC-9	J1R491	10/23/12	317		13.2	0.0251	U	0.0251	5.29	U	5.29	9.76	B	10.6	612	B	1060
EXC-10	J1R492	10/23/12	285		12.2	0.0265	U	0.0265	4.90	U	4.90	8.19	B	9.80	709	B	980
EXC-11	J1R493	10/23/12	269		12.5	0.0291	U	0.0291	5.01	U	5.01	8.95	B	10.0	873	B	1000
EXC-12	J1R494	10/23/12	255		13.3	0.0262	U	0.0262	5.33	U	5.33	10.3	B	10.7	1100		1070
FS-1	J1R4F5	10/23/12	409		14.3	0.0246	U	0.0246	5.70	U	5.70	9.93	B	11.4	778	B	1140
FS-2	J1R4F6	10/23/12	313		14.4	0.0271	U	0.0271	5.74	U	5.74	8.97	B	11.5	708	B	1150
Equipment Blank	J1R496	10/23/12	3.32	B	4.55	0.0237	U	0.0237	1.82	U	1.82	3.64	U	3.64	29	B	364

Attachment	1	Sheet No.	4 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	Rev. No.	0

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Metals, Physical, and TPH).

Location	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1R484	10/23/12	0.770	U	0.770	103	J	5.13	0.513	U	0.513	264		128	54.8		6.42
Duplicate of J1R484	J1R495	10/23/12	0.720	U	0.720	94.8	J	4.80	0.480	U	0.480	291		120	56.9		6.00
EXC-1	J1R483	10/23/12	0.715	U	0.715	183	J	4.77	0.477	U	0.477	318		119	59.8		5.96
EXC-3	J1R485	10/23/12	0.721	U	0.721	91.0	J	4.81	0.481	U	0.481	477		120	62.4		6.01
EXC-4	J1R486	10/23/12	0.863	U	0.863	108	J	5.75	0.575	U	0.575	539		144	76.7		7.19
EXC-5	J1R487	10/23/12	0.828	U	0.828	111	J	5.52	0.552	U	0.552	678		138	61.2		6.90
EXC-6	J1R488	10/23/12	0.783	U	0.783	86.1	J	5.22	0.522	U	0.522	510		131	65.3		6.53
EXC-7	J1R489	10/23/12	0.802	U	0.802	110	J	5.35	0.535	U	0.535	568		134	63.6		6.69
EXC-8	J1R490	10/23/12	0.902	U	0.902	129	J	6.01	0.601	U	0.601	334		150	62.9		7.51
EXC-9	J1R491	10/23/12	0.794	U	0.794	87.8	J	5.29	0.529	U	0.529	505		132	69.6		6.62
EXC-10	J1R492	10/23/12	0.735	U	0.735	92.1	J	4.90	0.490	U	0.490	414		122	63.7		6.12
EXC-11	J1R493	10/23/12	0.751	U	0.751	108	J	5.01	0.501	U	0.501	359		125	54.1		6.26
EXC-12	J1R494	10/23/12	0.800	U	0.800	130	J	5.33	0.533	U	0.533	192		133	42.5		6.66
FS-1	J1R4F5	10/23/12	0.855	U	0.855	103	J	5.70	0.570	U	0.570	547		143	59.1		7.13
FS-2	J1R4F6	10/23/12	0.861	U	0.861	100	J	5.74	0.574	U	0.574	443		144	69.6		7.18
Equipment Blank	J1R496	10/23/12	0.273	U	0.273	54.9	J	1.82	0.182	U	0.182	45.5	U	45.5	0.249	B	2.27

Location	HEIS Number	Sample Date	Zinc			TPH - Diesel Range			TPH - Motor Oil			Percent Solids		
			mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
EXC-2	J1R484	10/23/12	36.8		25.7	3730	U	3730	11200	UJ	11200	87.2		0.1
Duplicate of J1R484	J1R495	10/23/12	37.8		24.0	1100	J	3410	4230	J	10200	96.2		0.1
EXC-1	J1R483	10/23/12	44.0		23.8	7020		3470	12700	J	10400	95.4		0.1
EXC-3	J1R485	10/23/12	56.3		24.0	27600	J	3490	44600	J	10500	94.6		0.1
EXC-4	J1R486	10/23/12	51.4		28.8	3410	U	3410	10200	UJ	10200	94.8		0.1
EXC-5	J1R487	10/23/12	45.6		27.6	3460	U	3460	10400	UJ	10400	93.7		0.1
EXC-6	J1R488	10/23/12	50.3		26.1	1020	J	3450	10400	UJ	10400	94.2		0.1
EXC-7	J1R489	10/23/12	73.2		26.7	6810		3530	10900	J	10600	93.5		0.1
EXC-8	J1R490	10/23/12	47.3		30.1	1660	J	3470	3650	J	10400	96.0		0.1
EXC-9	J1R491	10/23/12	49.2		26.5	3480	U	3480	10400	UJ	10400	94.5		0.1
EXC-10	J1R492	10/23/12	43.6		24.5	2820	J	3530	10600	UJ	10600	94.2		0.1
EXC-11	J1R493	10/23/12	41.0		25.0	1730	J	3500	10500	UJ	10500	93.6		0.1
EXC-12	J1R494	10/23/12	36.2		26.7	1440	J	3470	10400	UJ	10400	95.4		0.1
FS-1	J1R4F5	10/23/12	51.9		28.5	1700	J	3510	3590	J	10500	94.0		0.1
FS-2	J1R4F6	10/23/12	49.0		28.7	1630	J	3490	10500	UJ	10500	95.0		0.1
Equipment Blank	J1R496	10/23/12	9.09	U	9.09							100		0.1

Attachment	1	Sheet No.	5 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	Rev. No.	0

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	EXC-2 - J1R484			Duplicate of J1R484 - J1R495			EXC-1 - J1R483			EXC-3 - J1R485			EXC-4 - J1R486		
		10/23/12			10/23/12			10/23/12			10/23/12			10/23/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	3.82	U	3.82	3.42	U	3.42	3.45	U	3.45	3.42	U	3.42	6.17		3.50
Acenaphthylene	PAH	3.82	U	3.82	3.42	U	3.42	3.45	U	3.45	3.42	U	3.42	3.50	U	3.50
Anthracene	PAH	3.82	U	3.82	3.42	U	3.42	3.45	U	3.45	7.71		3.42	3.50	U	3.50
Benzo(a)anthracene	PAH	3.82	U	3.82	1.90	J	3.42	11.1		3.45	77.0		3.42	1.47	J	3.50
Benzo(a)pyrene	PAH	3.82	U	3.82	1.46	J	3.42	8.12		3.45	51.7		3.42	1.40	J	3.50
Benzo(b)fluoranthene	PAH	3.82	U	3.82	3.42	U	3.42	5.57		3.45	36.8		3.42	3.50	U	3.50
Benzo(ghi)perylene	PAH	3.82	U	3.82	3.42	U	3.42	4.89		3.45	55.3		3.42	3.50	U	3.50
Benzo(k)fluoranthene	PAH	3.82	U	3.82	3.42	U	3.42	2.63	J	3.45	25.0		3.42	3.50	U	3.50
Chrysene	PAH	3.82	U	3.82	1.87	J	3.42	8.37		3.45	48.0		3.42	2.67	J	3.50
Dibenz[a,h]anthracene	PAH	3.82	U	3.82	3.42	U	3.42	3.45	U	3.45	5.28		3.42	3.50	U	3.50
Fluoranthene	PAH	0.994	J	3.82	3.77		3.42	17.2		3.45	130		3.42	2.54	J	3.50
Fluorene	PAH	3.82	U	3.82	4.45		3.42	3.45	U	3.45	1.20	J	3.42	3.50	U	3.50
Indeno(1,2,3-cd)pyrene	PAH	3.82	U	3.82	3.42	U	3.42	3.45	U	3.45	28.7		3.42	1.47	J	3.50
Naphthalene	PAH	3.82	U	3.82	4.62		3.42	12.1		3.45	73.2		3.42	1.44	J	3.50
Phenanthrene	PAH	3.82	U	3.82	1.66	J	3.42	9.25		3.45	43.8		3.42	3.50	U	3.50
Pyrene	PAH	3.82	U	3.82	3.12	J	3.42	14.7		3.45	102		3.42	2.95	J	3.50
Aroclor-1016	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6
Aroclor-1221	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6
Aroclor-1232	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6
Aroclor-1242	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6
Aroclor-1248	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6
Aroclor-1254	PCB	14.9	U	14.9	13.8	U	13.8	130	D	27.1	440	D	55.1	80.0		13.6
Aroclor-1260	PCB	14.9	U	14.9	4.00	J	13.8	128	D	27.1	193	D	55.1	105		13.6
Aroclor-1262	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6
Aroclor-1268	PCB	14.9	U	14.9	13.8	U	13.8	27.1	UD	27.1	55.1	UD	55.1	13.6	U	13.6

CONSTITUENT	CLASS	EXC-5 - J1R487			EXC-6 - J1R488			EXC-7 - J1R489			EXC-8 - J1R490			EXC-9 - J1R491		
		10/23/12			10/23/12			10/23/12			10/23/12			10/23/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	2.69	J	3.46	3.52	U	3.52	3.44	U	3.44	3.37	U	3.37	3.37	U	3.37
Acenaphthylene	PAH	3.46	U	3.46	19.2		3.52	3.44	U	3.44	3.37	U	3.37	21.9		3.37
Anthracene	PAH	3.46	U	3.46	4.05		3.52	3.44	U	3.44	3.37	U	3.37	71.7		3.37
Benzo(a)anthracene	PAH	1.87	J	3.46	26.2		3.52	15.5		3.44	2.43	J	3.37	87.3		3.37
Benzo(a)pyrene	PAH	1.94	J	3.46	15.1		3.52	10.7		3.44	1.42	J	3.37	60.1		3.37
Benzo(b)fluoranthene	PAH	3.46	U	3.46	14.4		3.52	10.4		3.44	0.928	J	3.37	38.4		3.37
Benzo(ghi)perylene	PAH	1.73	J	3.46	13.7		3.52	3.44	U	3.44	1.92	J	3.37	3.37	U	3.37
Benzo(k)fluoranthene	PAH	3.46	U	3.46	7.78		3.52	5.34		3.44	3.37	U	3.37	30.6		3.37
Chrysene	PAH	2.41	J	3.46	12.1		3.52	11.7		3.44	1.62	J	3.37	61.2		3.37
Dibenz[a,h]anthracene	PAH	3.46	U	3.46	1.43	J	3.52	0.913	J	3.44	3.37	U	3.37	4.51		3.37
Fluoranthene	PAH	3.68		3.46	50.5		3.52	27.9		3.44	1.84	J	3.37	313		3.37
Fluorene	PAH	3.46	U	3.46	3.52	U	3.52	3.44	U	3.44	3.37	U	3.37	25.8		3.37
Indeno(1,2,3-cd)pyrene	PAH	2.27	J	3.46	6.59		3.52	6.58		3.44	2.95	J	3.37	25.6		3.37
Naphthalene	PAH	4.49		3.46	23.9		3.52	16.3		3.44	2.36	J	3.37	145		3.37
Phenanthrene	PAH	1.47	J	3.46	20.2		3.52	13.7		3.44	3.37	U	3.37	267		3.37
Pyrene	PAH	3.42	J	3.46	41.2		3.52	22.8		3.44	1.47	J	3.37	210		3.37
Aroclor-1016	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9
Aroclor-1221	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9
Aroclor-1232	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9
Aroclor-1242	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9
Aroclor-1248	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9
Aroclor-1254	PCB	27.6		13.8	13.9	U	13.9	14.8		14.1	13.8	U	13.8	3.65	J	13.9
Aroclor-1260	PCB	29.4		13.8	6.80	J	13.9	41.3		14.1	13.8	U	13.8	5.81	J	13.9
Aroclor-1262	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9
Aroclor-1268	PCB	13.8	U	13.8	13.9	U	13.9	14.1	U	14.1	13.8	U	13.8	13.9	U	13.9

Attachment	1	Sheet No.	6 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	Rev. No.	0

Attachment 1. 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	EXC-10 - J1R492			EXC-11 - J1R493			EXC-12 - J1R494			FS-1 - J1R4F5			FS-2 - J1R4F6		
		10/23/12			10/23/12			10/23/12			10/23/12			10/23/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	3.48	U	3.48	3.50	U	3.50	3.47	U	3.47	3.49	U	3.49	34.7	UD	34.7
Acenaphthylene	PAH	3.48	U	3.48	3.50	U	3.50	3.47	U	3.47	3.49	U	3.49	34.7	UD	34.7
Anthracene	PAH	3.48	U	3.48	3.50	U	3.50	3.47	U	3.47	3.49	U	3.49	34.7	UD	34.7
Benzo(a)anthracene	PAH	19.8		3.48	14.8		3.50	3.79		3.47	8.16		3.49	9.83	J D	34.7
Benzo(a)pyrene	PAH	14.8		3.48	10.4		3.50	2.66	J	3.47	5.79		3.49	34.7	UD	34.7
Benzo(b)fluoranthene	PAH	7.17		3.48	8.94		3.50	2.71	J	3.47	4.60		3.49	34.7	UD	34.7
Benzo(ghi)perylene	PAH	7.98		3.48	8.48		3.50	4.85		3.47	6.31		3.49	34.7	UD	34.7
Benzo(k)fluoranthene	PAH	6.94		3.48	5.68		3.50	1.41	J	3.47	2.95	J	3.49	34.7	UD	34.7
Chrysene	PAH	15.3		3.48	9.53		3.50	4.08		3.47	5.44		3.49	34.7	UD	34.7
Dibenz[a,h]anthracene	PAH	1.29	J	3.48	3.50	U	3.50	3.47	U	3.47	3.49	U	3.49	34.7	UD	34.7
Fluoranthene	PAH	32.5		3.48	20.7		3.50	8.67		3.47	9.97		3.49	34.7	UD	34.7
Fluorene	PAH	3.48	U	3.48	3.50	U	3.50	3.47	U	3.47	3.49	U	3.49	34.7	UD	34.7
Indeno(1,2,3-cd)pyrene	PAH	10.1		3.48	6.11		3.50	3.79		3.47	5.98		3.49	34.7	UD	34.7
Naphthalene	PAH	8.70		3.48	14.0		3.50	4.34		3.47	5.68		3.49	34.7	UD	34.7
Phenanthrene	PAH	9.22		3.48	6.31		3.50	1.91	J	3.47	1.92	J	3.49	34.7	UD	34.7
Pyrene	PAH	30.5		3.48	18.1		3.50	6.05		3.47	9.74		3.49	34.7	UD	34.7
Aroclor-1016	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8
Aroclor-1221	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8
Aroclor-1232	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8
Aroclor-1242	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8
Aroclor-1248	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8
Aroclor-1254	PCB	14.1	U	14.1	7.09	J	14.0	13.4	U	13.4	6.70	J	13.9	105		13.8
Aroclor-1260	PCB	14.1	U	14.1	5.13	J	14.0	13.4	U	13.4	14.5		13.9	99.9		13.8
Aroclor-1262	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8
Aroclor-1268	PCB	14.1	U	14.1	14.0	U	14.0	13.4	U	13.4	13.9	U	13.9	13.8	U	13.8

CONSTITUENT	CLASS	Equipment Blank - J1R496		
		10/23/12		
		ug/kg	Q	PQL
Acenaphthene	PAH	3.28	U	3.28
Acenaphthylene	PAH	3.28	U	3.28
Anthracene	PAH	3.28	U	3.28
Benzo(a)anthracene	PAH	3.28	U	3.28
Benzo(a)pyrene	PAH	3.28	U	3.28
Benzo(b)fluoranthene	PAH	3.28	U	3.28
Benzo(ghi)perylene	PAH	3.28	U	3.28
Benzo(k)fluoranthene	PAH	3.28	U	3.28
Chrysene	PAH	3.28	U	3.28
Dibenz[a,h]anthracene	PAH	3.28	U	3.28
Fluoranthene	PAH	3.28	U	3.28
Fluorene	PAH	3.28	U	3.28
Indeno(1,2,3-cd)pyrene	PAH	3.28	U	3.28
Naphthalene	PAH	3.28	U	3.28
Phenanthrene	PAH	3.28	U	3.28
Pyrene	PAH	3.28	U	3.28
Aroclor-1016	PCB			
Aroclor-1221	PCB			
Aroclor-1232	PCB			
Aroclor-1242	PCB			
Aroclor-1248	PCB			
Aroclor-1254	PCB			
Aroclor-1260	PCB			
Aroclor-1262	PCB			
Aroclor-1268	PCB			

Attachment	1	Sheet No.	7 of 7
Originator	J. D. Skoglie	Date	3/26/13
Checked	N. K. Schiffern	Date	3/26/13
Calc. No.	0100N-CA-V0197	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-V0198

Subject: 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites 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 = 4 Total = 5	J. D. Skoglie	N. K. Schiffern NKSchiffern	I. B. Berezovskiy IB Berezovskiy	S.G. Wilkinson for D. F. Obenauer	7/9/13

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	3/26/2013	Calc. No.:	0100N-CA-V0198	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	3/26/2013
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 4	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2006a), 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, *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) DOE-RL, 2006b, *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) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.

4) WCH, 2013, *Remaining Sites Verification Package for the 100-N-87, 116-N Ventilation Stack Piping and French Drain; UPR-100-N-14, 119-N Drain System Leak, UN-100-N-14; UPR-100-N-9, 119-N Cooling Water Drain Line Leak, UN-100-N-9; and 100-N-102:1, 100-N Potentially Contaminated French Drains Waste Site*, Attachment to Waste Site Reclassification Forms 2012-095, 2012-096, 2012-097, and 2012-098, 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 2006a).

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 2006a).

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:	J. D. Skoglie	Date:	3/26/2013	Calc. No.:	0100N-CA-V0198	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	3/26/2013
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 4	

METHODOLOGY:

The 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites are comprised of one decision unit for verification sampling consisting of an excavation area. Also included are two focused samples. The direct contact hazard quotient and carcinogenic risk calculations for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites were conservatively calculated for the entire waste sites using the greater of the maximum or statistical verification soil sample results (WCH 2013). Of the contaminants of potential concern (COPCs) for these sites, molybdenum, the detected polycyclic aromatic hydrocarbons (PAHs), and the detected polychlorinated biphenyls require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Although total petroleum hydrocarbons (diesel range + motor oil) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for molybdenum is 0.536 mg/kg, divided by the noncarcinogenic RAG value of 400 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 1.3×10^{-3}. 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 7.7×10^{-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 statistical value for benzo(b)flouranthene is 0.041 mg/kg, divided by 1.37 mg/kg, and multiplied as indicated, is 3.0×10^{-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 1.1×10^{-6}. 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:	J. D. Skoglie	Date:	3/26/2013	Calc. No.:	0100N-CA-V0198	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	3/26/2013
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 4	

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 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites

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					
Molybdenum	0.536	400	1.3E-03	--	--
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.006	4,800	1.3E-06	--	--
Acenaphthylene[c]	0.022	4,800	4.6E-06	--	--
Anthracene	0.072	24,000	3.0E-06	--	--
Benzo(a)anthracene	0.134	--	--	1.37	9.8E-08
Benzo(a)pyrene	0.072	--	--	0.137	5.3E-07
Benzo(b)fluoranthene	0.041	--	--	1.37	3.0E-08
Benzo(k)fluoranthene	0.012	--	--	13.7	8.8E-10
Benzo(ghi)perylene[c]	0.016	2,400	6.7E-06	--	--
Chrysene	0.052	--	--	137	3.8E-10
Dibenz(a,h)anthracene	0.005	--	--	0.137	3.6E-08
Fluoranthene	0.484	3,200	1.5E-04	--	--
Fluorene	0.026	3,200	8.1E-06	--	--
Indeno(1,2,3-cd)pyrene	0.020	--	--	1.37	1.5E-08
Naphthalene	0.118	1,600	7.4E-05	--	--
Phenanthrene[c]	0.067	24,000	2.8E-06	--	--
Pyrene	0.293	2,400	1.2E-04	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.121	1.6	7.6E-02	0.5	2.4E-07
Aroclor-1260	0.100	--	--	0.5	2.0E-07
Total Petroleum Hydrocarbons					
TPH - (Diesel Range + Motor Oil)[d]	53	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**7.7E-02**		
Cumulative Excess Cancer Risk:					**1.1E-06**

Notes:

[a] = From WCH (2013).

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

[c] = Toxicity data for these chemicals are not available. The cleanup levels are based on use of surrogate chemicals.

acenaphthylene surrogate: acenaphthene

benzo(g,h,i)perylene surrogate: pyrene

phenanthrene surrogate: anthracene

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

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	3/26/2013	Calc. No.:	0100N-CA-V0198	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	3/26/2013
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 4	

CONCLUSION:

The calculations in Table 1 demonstrates that the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites meet the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2006a) and SAP (DOE-RL 2006b). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for these sites.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0199

Subject: 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 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	J. D. Skoglie	N. K. Schiffern	I. B. Berezovskiy	S.G. Wilkinson D. F. Obenauer	7/9/13

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:	J. D. Skoglie	Date:	03/27/13	Calc. No.:	0100N-CA-V0199	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	03/27/13
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites. 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) WCH, 2013, *Remaining Sites Verification Package for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites,* Attachment to Waste Site Reclassification Forms 2012-095, 2012-096, 2012-097, and 2012-098, 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:	J. D. Skoglie	Date:	03/27/13	Calc. No.:	0100N-CA-V0199	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	03/27/13
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites underwent statistical sampling at one decision unit; excavation area. In addition, two focused samples were collected. The protection of groundwater hazard quotient and carcinogenic risk calculations for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites were conservatively calculated for the entire waste sites using the statistical or maximum value for each analyte (WCH 2013). Based on the generic site RESRAD model (DOE-RL 2006) and a vadose zone of approximately 12.5 m (41 ft) thickness, a K_d of 6.1 or greater is required to show no predicted migration to groundwater in 1,000 years. Acenaphthene and naphthalene are included because they have a K_d of less than 6.1, 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 6.1. 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 acenaphthene is 0.006 mg/kg, divided by the noncarcinogenic RAG value of 96 mg/kg is 6.3×10^{-5}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites is 7.4×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

3) No carcinogenic constituents met the criteria for evaluation in groundwater at the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites; therefore, no calculations of excess carcinogenic risk were performed.

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:	J. D. Skoglie	Date:	03/27/13	Calc. No.:	0100N-CA-V0199	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	03/27/13
Subject:	100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 Waste Sites Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater					Sheet No. 3 of 3	

RESULTS:

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

Table 1 shows the results of the calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites.

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
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.006	96	6.3E-05	--	--
Naphthalene	0.118	16	7.4E-03	--	--
Totals					
Cumulative Hazard Quotient:			**7.4E-03**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2013).
[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-N-87, 100-N-102:1, UPR-100-N-9, and UPR-100-N-14 waste sites meet the requirements for the hazard quotients and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2006).

APPENDIX E

100-N-87, 100-N-102:1, UPR-100-N-14, AND UPR-100-N-9 DATA QUALITY ASSESSMENT

APPENDIX E

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 2012c). 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 2012c), the field logbooks (WCH 2012a, 2013), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the SAP data assurance requirements and the data validation 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 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites were provided by the laboratories in sample delivery groups (SDGs) K4012 and JP0494. SDG K4012 was submitted for third-party validation. No major deficiencies were identified. Minor deficiencies are discussed for the data sets, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MINOR DEFICIENCIES

SDG K4012

This SDG comprises 13 statistical (J1R483 through J1R495) and two focused (J1R4F5 through J1R4F6) verification soil samples from the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 excavation area, collected on October 23, 2012. This SDG includes a field duplicate pair (J1R484/J1R495). All samples were analyzed for gamma energy analysis (GEA), carbon-14, isotopic thorium, isotopic uranium, strontium-90, inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH). In addition, one equipment blank (J1R496) was analyzed for ICP metals, mercury, and PAH. SDG K4012 was submitted for third-party validation.

In the ICP metals analysis, the matrix spike (MS) recoveries were outside of project acceptance criteria for aluminum (891%), antimony (31%), calcium (137%), iron (1,460%), and silicon (173%). For aluminum, calcium, and iron, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the 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. To confirm quantitation, a post-digestion spike (PDS) and serial dilution was prepared for all subject analytes. Recovery was acceptable for all analytes. All antimony, calcium, and silicon data were considered estimated and flagged "J" by third-party validation due to the MS recoveries outside the limits. All aluminum and iron results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, all aluminum (171%), antimony (65%), and silicon (24%) results were considered estimates and flagged "J" by third-party validation due to laboratory control sample (LCS) recovery outside of quality control (QC) limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the relative percent difference (RPD) calculations for barium (35%) and silicon (35%) from the laboratory duplicate analysis were above QC limits. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All barium and silicon were considered estimates and flagged "J" by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium was detected in the method blank (MB) at less than 1/2 of the reporting limit (RL). The calcium result in the equipment blank (J1R496) was considered estimated and flagged "J" by third-party validation. Estimated data are usable for decision-making purposes. Detections in the MB were also measured for aluminum (less than 5% of the concentration in the associated sample), boron (less than the RL), and magnesium (less than 1/20 of the RL). Method blank contamination at these concentrations does not significantly impact the sample data and the data are usable for decision-making purposes

In the mercury analysis, the MS recovery was above QC criteria at 139%. To confirm quantitation, a PDS and serial dilution was prepared for mercury. As described in the case narrative, the mercury recovery in the PDS (110%) was acceptable. All associated mercury results may be considered estimated. Estimated data are usable for decision-making purposes.

In the TPH analysis, there was no MS, MSD, or LCS for the motor oil range organics. All motor oil range TPH results in SDG K4012 were considered estimates and flagged "J" by third-party validation. Estimated data are usable for decision-making purposes.

In the TPH analysis, the surrogate recovery in sample J1R485 was outside of laboratory QC limits. Both diesel range and motor oil range organic results in sample J1R485 were qualified as estimated and flagged "J" by third-party validation. Estimated data are usable for decision-making purposes.

In the carbon-14 analysis, no MS was performed. In the isotopic uranium analyses, no LCS analysis was performed for uranium-235. Third-party validation qualified all carbon-14 and uranium-235 results in SDG K4012 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the isotopic uranium analysis for uranium-238 associated with samples J1R4F5 and J1R4F6, the RPD associated with the laboratory duplicate was above QC criteria at 58%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. The uranium-238 data for J1R4F5 and J1R4F6 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG JP0494

This SDG comprises two verification soil samples (J1RH76 and J1RH77). Both samples were collected from sample location EXC-2 on March 4, 2013. Sample J1RH77 is a duplicate sample associated with J1RH76. The samples were analyzed for carbon-14 only.

In the carbon-14 analysis, no MS was performed. The carbon-14 results associated with these samples may be considered estimated. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

The RPD 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 2012a), are shown in Table E-1. The main and QA/QC sample results are presented in Appendix D.

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

Sample Area	Main Sample	Duplicate Sample
EXC-2	J1R484/J1RH76	J1R495/J1RH77

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 difference values 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 D provides details on duplicate pair evaluation and RPD calculation.

None of the RPDs calculated for the field duplicate samples 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 D) to indicate that a visual check of the data is required by the reviewer. None of the data required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for the 100-N-87, 100-N-102:1, UPR-100-N-14, and UPR-100-N-9 waste sites 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 project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix D.

REFERENCES

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

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

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

WCH, 2012a, *100-N Field Remediation Sampling*, Logbook EL-1652-07, pp. 57-59, Washington Closure Hanford, Richland, Washington.

WCH, 2012b, *Work Instruction for Verification Sampling of the 100-N-87, 116-N Ventilation Stack Piping and French Drain; UPR-100-N-9, 119-N Cooling Water Drain Line Leak, UN-100-N-9;UPR-100-N-14, 119-N Drain System Leak, UN-100-N-14; and 100-N-102:1, Potentially Contaminated French Drains,* 0100N-WI-G0028, Rev. 1, Washington Closure Hanford, Richland, Washington.

WCH, 2013, *100-N Field Remediation Sampling*, Logbook EL-1652-08, pp. 65-67, Washington Closure Hanford, Richland, Washington.