1220923

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

13-AMRP-0244

JUN 27 2013

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

Dear Ms. Hedges:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 100-D-101, 108-D ACID PIT AND SUMP, 108-D CAR SPOT, 108-D SODIUM SILICATE SUMP, 108-D STORAGE TANKS, MISCELLANEOUS STRUCTURES WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2012-062 and supporting documentation for the "Remaining Sites Verification Package for the 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures Waste Site," Rev. 0. If you have questions, please contact me or your staff may contact Tom Post, of my staff, at (509) 376-3232.

Sincerely,

for

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

AMRP:TCP

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-DR-1

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WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2012-062

Waste Site Code(s)/Subsite Code(s): 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures Waste Site

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-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures waste site consists of four chemical storage tanks, an acid neutralization pit and sump, a sodium silicate sump, two sets of pumps, and a railroad car spot.

Confirmatory sampling at this waste site consisted of excavating three test pits and two test trenches and collecting soil samples at each. In addition, stained soil at the site was sampled. Samples were analyzed for chemical contamination as required by the *100 Area Remedial Action Sampling and Analysis Plan* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009a). Laboratory analytical results were compared to cleanup levels in accordance with remedial action objectives and goals established in the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999). The 100-D-101 waste site was included as a candidate site in the Tri-Party Agreement Administrative Record *Fact Sheet: Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 1999 Interim Action Record of Decision for the 100 Area,* U.S. Department of Energy, Richland, Washington (DOE-RL 2011a). The selected remedy involved (1) evaluating the waste site using available process information, (2) demonstrating through confirmatory sampling and field screening that cleanup goals have been achieved, and (3) proposing the waste site for reclassification to Interim No Action.

Basis for reclassification:

Confirmatory sampling results were evaluated in comparison to cleanup levels. In accordance with this evaluation, the confirmatory sampling results support a reclassification of the 100-D-101 waste site to Interim No Action. The current site conditions achieve the remedial action goals established by the Remaining Sites ROD (EPA 1999). The results of confirmatory sampling demonstrate that residual contaminant concentrations do not preclude any future land uses (as bounded by a rural-residential scenario) and allow for unrestricted future use of shallow zone soils (i.e., surface to 4.6 m [15 ft]). The results also show that residual contaminant concentrations are protective of groundwater and the Columbia River. The 100-D-101 waste site contamination does not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures* (attached).

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WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2012-062

Waste Site Code(s)/Subsite Code(s): 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures Waste Site

Regulator Comments:

Waste Site Controls:

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

J. P. Neath		5/29/13
DOE Federal Project Director (printed)	Signature	Date
N. Menard		6/11/13
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

A-6006-136 (REV 0)

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-101, 108-D ACID PIT AND SUMP, 108-D CAR SPOT, 108-D SODIUM SILICATE SUMP, 108-D STORAGE TANKS, MISCELLANEOUS STRUCTURES WASTE SITE

Attachment to Waste Site Reclassification Form 2012-062

June 2013

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-101, 108-D ACID PIT AND SUMP, 108-D CAR SPOT, 108-D SODIUM SILICATE SUMP, 108-D STORAGE TANKS, MISCELLANEOUS STRUCTURES WASTE SITE

EXECUTIVE SUMMARY

The 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures waste site was the location of a water treatment chemical delivery, storage, and handling facility. The 100-D-101 waste site is included as a "candidate" site in the Tri-Party Agreement Administrative Record *Fact Sheet: 100 Area "Plug-In" and Candidate Sites for Fiscal Year 2010* (DOE-RL 2011a) in accordance with the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999) and the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009).

The 100-D-101 waste site includes several features associated with a railroad car chemical unloading facility and storage tanks adjacent to the 108-D Building. Confirmatory sampling was performed per the *Work Instruction for Confirmatory Sampling of the 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures Waste Site* (WCH 2011) as required by *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). The results indicate that the 100-D-101 waste site achieves compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) of the Remaining Sites ROD (EPA 1999); therefore, remediation is not necessary. A summary of the cleanup evaluation for the soil analyses against the applicable RAGs is presented in Table ES-1. The results of the confirmatory sampling are used to make reclassification decisions for the 100-D-101 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011b).

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario.

Table ES-1. Summary of Remedial Action Goals for the 100-D-101 Waste Site.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15 mrem/yr above background for 1,000 years.	Radionuclides are not COPCs for this site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All hazard quotients are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (1.5×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	All individual carcinogens have an excess risk below 1×10^{-6}.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk is 3.5×10^{-7}.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Radionuclides are not COPCs for this site.	NA
	Attain national primary drinking water standards [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	Radionuclides are not COPCs for this site.	
	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].	Radionuclides are not COPCs for this site.	
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].	Uranium was not a COPC at this site.	
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Lead, zinc and chrysene are present at concentrations above soil RAGs for groundwater and/or Columbia River protection. However, based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), it is predicted that these constituents will not reach groundwater (and thus the Columbia River) within 1,000 years [d].	Yes

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

[b] *Radiation Protection of the Public and the 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 RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, zinc, and chrysene are not expected to migrate to groundwater within 1,000 years. The vadose zone underlying the soil below the waste site is approximately 26 m (85 ft) thick. RESRAD modeling indicates a constituent with a distribution coefficient (K_d) value of greater than 3 mL/g will not migrate more than 25 m in 1,000 years. The K_d values for lead, zinc, and chrysene are 30, 30, and 200 mL/g, respectively. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)

The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 100-D-101 waste site contamination did not extend into the deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. Those constituents exceeding an ecological screening level in the 2007 *Washington Administrative Code* (WAC) Chapter 173-340, Table 749-3 are boron, lead, vanadium, and zinc. U.S. Environmental Protection Agency ecological soil screening levels are exceeded by lead, manganese, vanadium, zinc, and high molecular weight polycyclic aromatic hydrocarbons. Exceeding screening values does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of manganese and vanadium are below background levels, 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-D-101 waste site in comparison to ecological screening levels is provided in Appendix A.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-101, 108-D ACID PIT AND SUMP, 108-D CAR SPOT, 108-D SODIUM SILICATE SUMP, 108-D STORAGE TANKS, MISCELLANEOUS STRUCTURES WASTE SITE

STATEMENT OF PROTECTIVENESS

The 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures waste site confirmatory data and supporting documentation demonstrate that this site meets the remedial action objectives (RAOs) and corresponding remedial action goals (RAGs) established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 100-D-101 waste site contamination does not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern (COPCs) and other constituents. Those constituents exceeding an ecological screening level in the 2007 *Washington Administrative Code* (WAC) Chapter 173-340, Table 749-3 are boron, lead, vanadium, and zinc. U.S. Environmental Protection Agency (EPA) ecological soil screening levels are exceeded by lead, manganese, vanadium, zinc, and high molecular weight polycyclic aromatic hydrocarbons. Exceeding screening values does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of manganese and vanadium are below background levels, it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for 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-D-101 waste site in comparison to ecological screening levels is provided in Appendix A.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-D-101 waste site is located in the 100-DR-2 Operable Unit, north of the 105-D Reactor Building (Figure 1). According to the Waste Information Data System and the Stewardship Information System general summary reports (WCH 2011), the original site facilities consisted of two sulfuric acid storage tanks, two sodium silicate storage tanks, an acid neutralization pit and sump, a sodium silicate sump, two sets of pumps, and a railroad tank car spot. All of the components were located west of the 108-D Building. The 100-D-101 waste site is centered at Washington State Plane coordinates N 151779, E 573743. A detailed layout of the 100-D-101 waste site is presented in Figure 2. A discussion of the process knowledge of each component follows.

Sulfuric Acid Tanks and Pumps

The sulfuric acid storage tanks were filled with 68% to 70% sulfuric acid that was delivered to the Hanford Site in railroad tank cars. From the storage tanks, a gravity flow line supplied the 108-D Building with acid for controlling the pH of process water. In addition, equipment was set up in the 108-D Building for diluting the sulfuric acid to make weaker solutions. Pumps with suction piping were used to transport acid from the tanks into the 108-D Building. Historic photographs indicate that the sulfuric acid tanks were removed before 1952.

Acid Neutralization Pit

The acid neutralization pit was used to safely neutralize acidic solutions. In particular, piping was in place to transfer acid that overflowed or leaked out of the tanks and pumps during the unloading process. Also, by using valves located both near the pumps and near the acid neutralization pit, acid could be released directly into the acid neutralization pit. According to drawing HW-74807, only sulfuric acid was supposed to be used in the acid neutralization pit (HW 1944).

Sodium Silicate Tanks and Pumps

Sodium silicate was received in railroad tank cars and moved to the two storage tanks by using the nearby pumps. Those same pumps were then used to transfer the silicate into the 108-D Building, where it was diluted with process water. This weaker solution was later transported to the 185-D Building for process water treatment.

Sodium Silicate Sump

The 108-D Sodium Silicate Sump was built as part of the Alum-Activated Silica Water Treatment Facilities project in 1954. The purpose of the sump was to address the issue of potential spills during the unloading and transfer of sodium silicate solution. However, there is no indication of any drains extending to the sump from the sodium silicate tanks or pumps, so it is not clear how the sump addressed the issue. The sump was located just north of the sodium silicate pumps and drained to the 100-D-31:3 process sewer via a 15-cm (6-in.) vitrified clay pipe. The sump was covered by a steel grating.

Figure 1. 100-D-101 Waste Site Location.

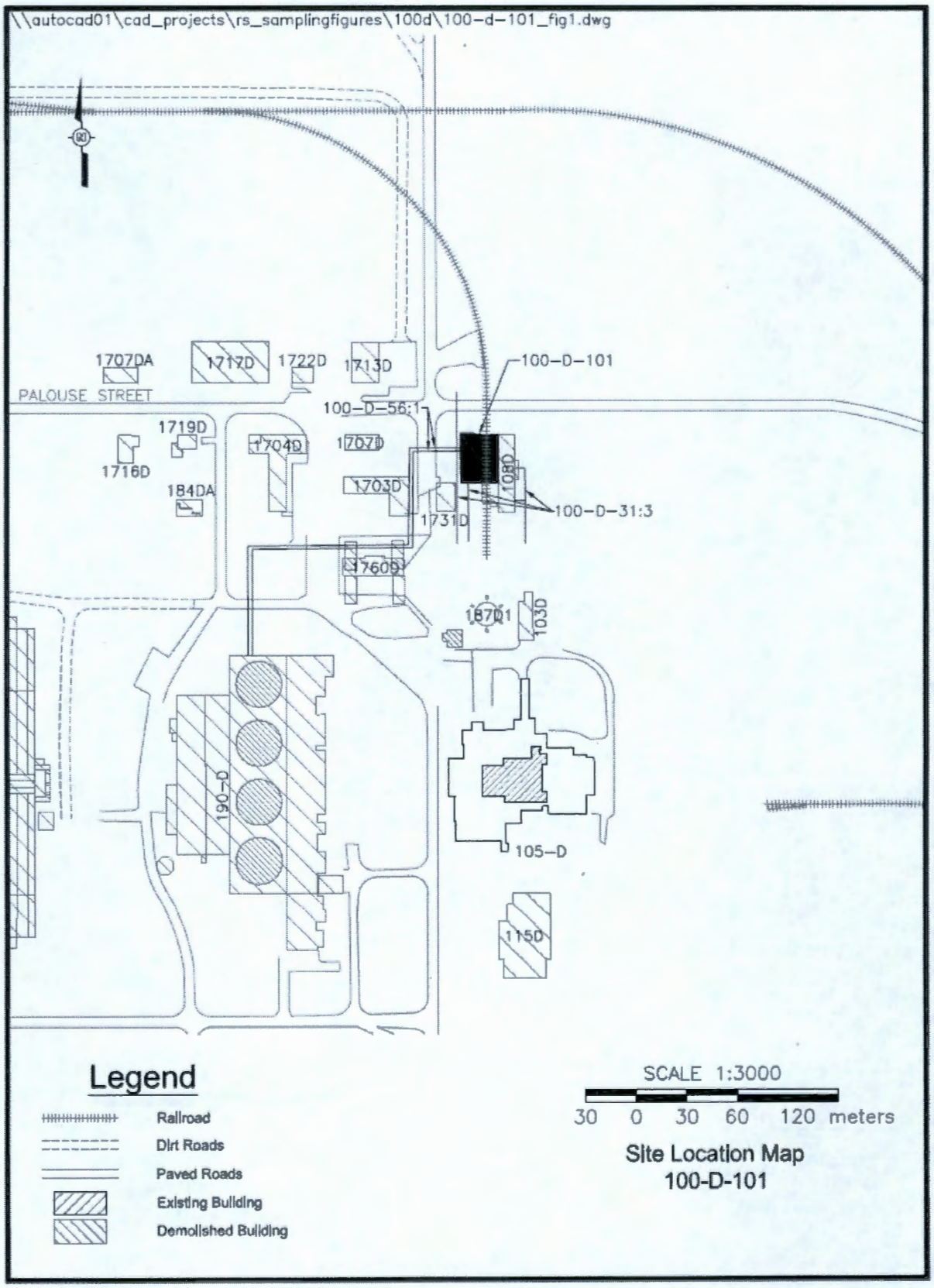
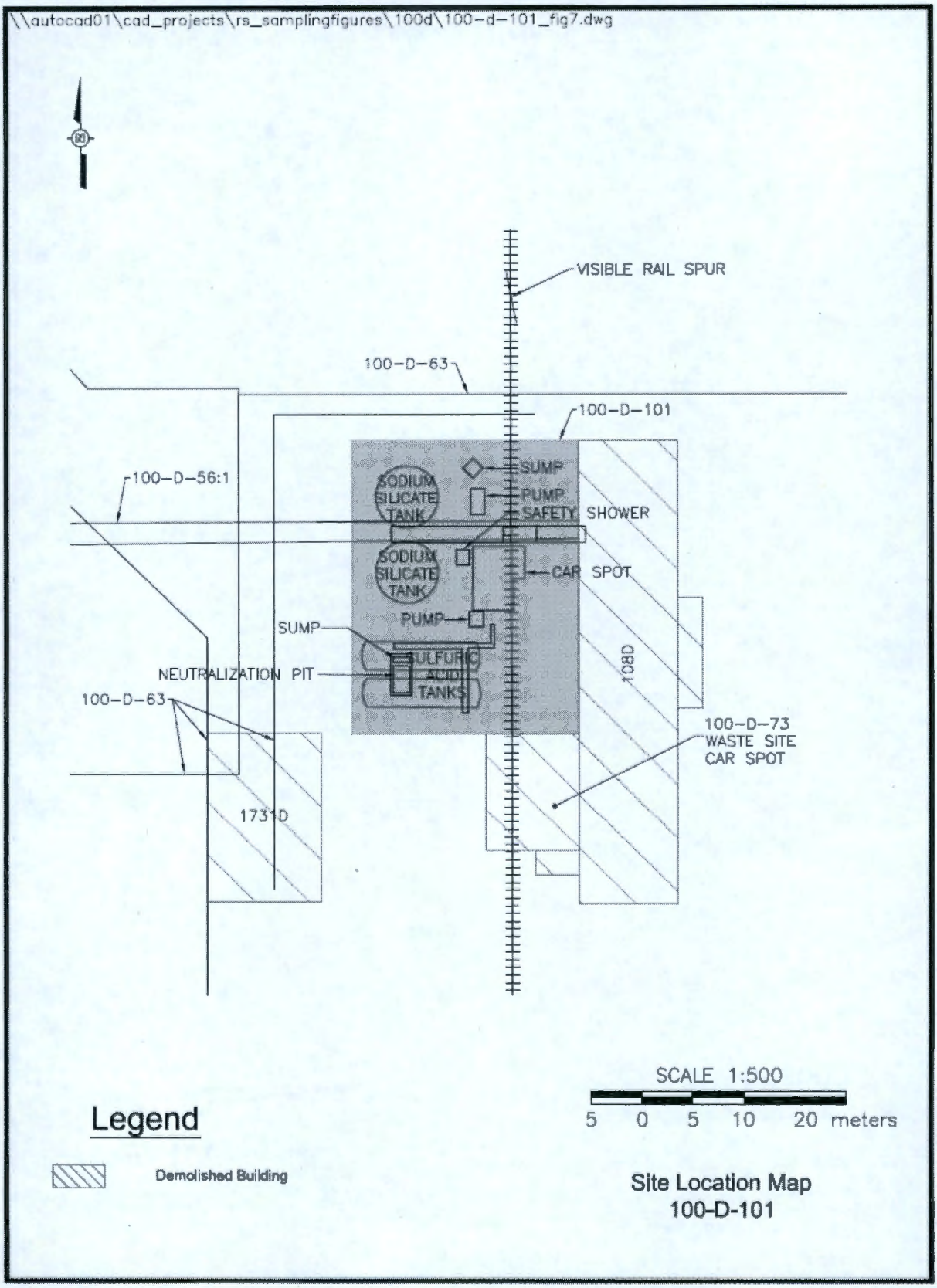


Figure 2. Layout of 100-D-101 Waste Site Components.



Car Spot

The 108-D Car Spot was used to unload liquid chemicals for the 108-D Building and the nearby storage tanks. Using flexible connecting hoses, sodium silicate solution and sulfuric acid were pumped out of railcars and into the storage tanks. A second car spot, included in the 100-D-73, 108-D chemical pumphouse sodium dichromate system waste site, was used to unload solids and move them into the 108-D Building. Among the chemicals transported this way was sodium dichromate.

Process Description

The two chemicals stored near 108-D were sulfuric acid and sodium silicate. Each chemical had its own set of two large storage tanks. Additionally, each chemical had a set of two pumps for unloading solution out of railroad tank cars at the car spot. An acid neutralization pit/sump was located underneath the acid storage tanks, while another sump was located near the sodium silicate tanks. A car spot and railroad line passed through the site for delivering the solutions.

The two elevated sulfuric acid storage tanks measured 2.7 by 11 m (9 by 36 ft) and were oriented horizontally, at a height of approximately 5 m (16.4 ft) off the ground. A set of wooden stairs allowed workers to reach the top of the tanks. To fill the tanks, two self-priming unloading pumps were situated nearby in a protective shed. The capacity of each pump was 189 L/min (50 gpm), and they were run by 440 -V electric motors. These storage tanks were removed sometime prior to 1952.

Two elevated sodium silicate tanks were located just north of the sulfuric acid tanks. Each of these measured 6.1 m (20 ft) in diameter and 4.6 m (15 ft) in height, and had an internal steam heating coil system. The tanks were removed prior to 1970, and most of the soil underneath them falls within the cleanup footprint for 100-D-56:1 and 100-D-31:3. According to History of the Project Volume III (Du Pont 1945), the pumps used for unloading sodium silicate from the car spot were identical to those used for the sulfuric acid. These pumps were also used to transfer sodium silicate into the 108-D Building and were housed in a wooden shed with a radiator.

A 108-D Acid Neutralization Pit and Sump was located underground beneath the sulfuric acid storage tanks on the west side of the 108-D Building. The pit was covered with a removable 1.4-m (4.6-ft) wooden plank. A 10.1-cm (4-in.) overflow pipe was attached to the south end of the pit, which connected to the water treatment process sewer (100-D-31:3). The northern portion of the pit was separated from the rest by a brick barrier and was used as a sump. Two 5.1-cm (2-in.) inlet pipes inside an underground wooden box structure brought acidic solution into the sump. In addition, there were two 10.1-cm (4-in.) drain pipes extending from the west ends of the acid tanks, with another 10.1 cm (4 in.) drain line originating from the pump shed. Another overflow drain line connected from the center of the tanks. All of these overflow lines connected to the sump portion of the pit. With the exception of the 5.1-cm (2-in.) inlet lines in the wooden box and the sewer drain line, the rest of this piping was above ground. The acid pit consisted of two layers of acid-proof brick. The bottom layer was laid in asphalt, while the top

layer was laid in Tegal Vitrabond. Joints were sealed with Vitrabond. The acid pit (excluding the sump portion) had an additional third layer, which was coated with 10.1 cm (4 in.) of asphalt.

Nearby Waste Sites

Waste sites in proximity to the 100-D-101 waste site include the 100-D-73, 100-D-76, 100-D-31:3, and 100-D-56:1 waste sites. The 100-D-73 waste site is the 108-D Building which housed the Sodium Dichromate System. The 100-D-76, former 116-D-3 waste site is a crib associated with the 108-D Building. The remedial excavation for these two waste sites is on the south and east sides of the 100-D-101 site. The 100-D-31:3, 105-D sewer pipelines subsite is a sewer pipeline that serviced the 105-D Building. The 100-D-56:1, north portion of 100-D-56 subsite consists of pipelines that conveyed water treatment chemical solutions from the 108-D Building to the 185-D Building. The 100-D-31:3 and 100-D-56:1 remedial excavations border the 100-D-101 waste site on the west. Adjacent waste sites are shown in Figures 1 and 2.

Ecological and Cultural

Ecological and culture reviews of the waste site and proposed sampling plan were performed (WCH 2012a). Results of these reviews indicate the waste site is located within the highly industrialized 100-D Area that has received extensive previous disturbance. The scope of confirmatory sampling activities was not expected to impact important vegetative habitat and would have no adverse effect on cultural resources.

CONFIRMATORY SAMPLING SUMMARY

Confirmatory Sample Design

Historical information, process knowledge, and associated waste sites were used to develop a site-specific sample design. The confirmatory sampling was performed to collect information to support evaluation of the site against the RAGs identified in the Remaining Sites ROD (EPA 1999). Analytical sample results were evaluated against the cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b) to support a No Action reclassification or a remedial action decision.

Contaminants of Potential Concern

The COPCs for the 100-D-101 waste site were identified based on process knowledge and available analytical data associated with the 100-D-73 and 100-D-76 waste sites.

The COPC list for the 100-D-101 waste site includes total chromium, lead, mercury, hexavalent chromium, and semivolatile organic compounds. Anions and pH analyses were added as COPCs because sulfuric acid storage tanks were previously present at the waste site. Nitrate/nitrite analysis was added based on detections at the 100-D-73 and 100-D-76 waste sites. Although not considered COPCs, analysis for the expanded list of inductively coupled plasma (ICP) metals

(antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc) was performed.

Asbestos may have been used in piping systems for outer insulation and gasket materials (BHI 1996). If suspected asbestos-containing material had been identified during field activities, a note was to have been made in the field logbook and a sample collected if necessary to confirm the presence or absence of asbestos. No suspected asbestos material was observed during confirmatory sampling activities.

Field screening for volatile organic compounds (VOCs) was performed during sampling using an organic vapor monitor (OVM). Volatile organic analysis was to have been included in the sample evaluations if elevated VOC readings were detected. No elevated VOC readings were observed during confirmatory sampling activities.

Although the field instruments did not detect radiological activity or VOCs during confirmatory sampling activities, gamma energy analysis and volatile organic compounds analysis were erroneously requested for the two samples (J1RFV0 and J1RFV1).

Confirmatory Sampling Activities

Confirmatory sampling was performed on May 31, June 4 and 5, 2012, and February 27, 2013, per the *Work Instruction for Confirmatory Sampling of the 100-D-101, 108-D Acid Pit and Sump, 108-D Car Spot, 108-D Sodium Silicate Sump, 108-D Storage Tanks, Miscellaneous Structures Waste Site* (WCH 2011). All sampling was performed in accordance with ENV-1, *Environmental Monitoring and Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). Field observations during sampling are provided in the field logbook (WCH 2012b). Discrete samples were collected as available at each sample location. Table 1 presents a summary of the samples collected at the site and the analyses performed for each.

Test pit 1 (TP1) was excavated at the location of the neutralization pit. The pit structure had been removed during remediation of the adjacent 100-D-31:3 waste site, leaving the TP1 sample location on the side slope of the open excavation. In order to reach the target sample depth of 3 m (10 ft) below the original grade, the side slope was excavated an additional 0.6 to 0.9 m (2 to 3 ft) below the existing grade. Wood, brick, and concrete debris were present in the side slope. All of the piping connecting to the neutralization pit and sump, including the acid neutralization pit was removed with the 100-D-31:3 excavation.

Table 1. Sample Summary Table.

Test Pit/ Trench	Sample Location	Sample Media	Sample Number	WSP Coordinate Locations	Sample Depth	Sample Analysis
Test pit 1 (TP1)	Acid neutralization pit/sump	Anomalous material other solid/soil	J1PPP6, J1PPR6	N 151771 E 573737	10 ft (3 m)	ICP metals [a], mercury, hexavalent chromium, SVOA, IC anions, nitrate/nitrite, pH
		Underlying soil	J1PPM6			
Test pit 2 (TP2)	Sodium silicate sump	Sump contents (if present)	Not found	N 151791 E 573744	10 ft (3 m)	
		Underlying soil	J1PPM8			
Test pit 3 (TP3)	Sulfuric acid pumps	Underlying soil	J1PPM7	N 151776 E 573744	3 ft (0.9 m)	
Test trench 1 (TT1)	Concrete trench between sodium silicate tanks	Contents (soil) inside trench, sample - 1 (west)	J1PPN6	N 151785 E 573742	3-4 ft (0.9 m)	
		Contents (soil) inside trench, sample - 2 (center)	J1PPR1, J1PPT1	N 151785 E 573737		
		Contents (soil) inside trench, sample - 3 (east)	J1PPN7	N 151785 E 573747		
		Underlying soil 1 (west)	J1RFV0	N 151784 E 573731	9 ft (2.7 m)	ICP metals [a], mercury, hexavalent chromium, SVOA, IC anions, nitrate/nitrite, pH, VOA, GEA
		Underlying soil 2 (center)	J1PPN8	N 151786 E 573742	7 ft (2.1m)	ICP metals [a], mercury, hexavalent chromium, SVOA, IC anions, nitrate/nitrite, pH
		Underlying soil 3 (east)	J1RFV1	N 151784 E 573753	9 ft (2.7 m)	ICP metals [a], mercury, hexavalent chromium, SVOA, IC anions, nitrate/nitrite, pH, VOA, GEA
Test trench 2 (TT2)	Railroad bed	Underlying soil 1 (south)	J1PPP1	N 151806 E 573748	1 ft (0.3 m)	ICP metals [a], mercury, hexavalent chromium, SVOA, IC anions, nitrate/nitrite, pH
		Underlying soil 2 (north)	J1PPP2	N 151809 E 573747		
Duplicate of J1PPP2	TT2	Underlying soil 2 (north)	J1PPP3	N 151809 E 573747	1 ft (0.3 m)	
Equipment blank	NA	Silica sand	J1PPM9	NA	NA	ICP metals [a], mercury

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

GEA = gamma energy analysis
IC = ion chromatography
ICP = inductively coupled plasma
NA = not applicable
SVOA = semivolatile organic analysis
VOA = volatile organic analysis
WSP = Washington State Plane

Heavily stained soil and rocks were also present. Although no sulfur smell was noted, the yellow-brown stains were characteristic of stains seen at sulfuric acid unloading and processing facilities elsewhere at the Hanford Site. The amount of staining suggested significant anomalous material was intermixed with the soil. Representative samples (J1PPP6 and J1PPR6) were collected of the anomalous material/soil. A sample (J1PPM6) was also collected of soil from the bottom of the excavation. The excavation was backfilled carefully to minimize the material that might roll down the side hill into the adjacent waste site excavation.

Test pit 2 (TP2) was excavated at the suspected location of a silica pump. No structure was found. The excavation proceeded through clean fill material to an approximate depth of 2.4 m (8 ft), where a few rotten boards were discovered. Below this level was black, gravely sand that was considered to be undisturbed native soil. A sample (J1PPM8) was collected of this soil. The excavation was backfilled.

Test pit 3 (TP3) was excavated to a depth of 0.9 (3 ft) below ground surface (bgs). No debris was found. A small amount of stained soil was observed. Since the staining was minimal and consistent with that sampled at TP1, no additional samples of the anomalous material were collected. A sample (J1PPM7) was collected of the soil from the bottom of the excavation and the hole was backfilled.

Test trench 1 (TT1) was excavated in a former concrete pipe trench. The bottom and side walls of the trench were found largely intact. There was no piping or other debris in the soil material that filled the trench. A sample (J1PPN6) was collected of the trench contents (fill material) near the west end. The excavation proceeded to the east inside the trench. Towards the center of the trench, the bottom was up to 1.2 m (4 ft) bgs. The lower approximately 0.3 m (1 ft) of material in the trench was discolored from the fill material above it (Figure 3). The deeper soil appeared darker, possibly due to a higher organic content. White crystalline material was also mixed with this anomalously colored soil. Samples (J1PPR1 and J1PPT1) were collected of this anomalously colored soil (Figure 4). The excavation proceeded to the eastern end of the trench. A sample (J1PPN7) was collected of the soil fill near the bottom of the trench at the east end. The trench was then backfilled.

The confirmatory work instruction called for excavating under the concrete trench and collecting three discrete samples from that location (WCH 2011). However, the backhoe was unable to break through the bottom of the concrete trench. Also, physical constraints of the site, namely the adjacent waste site excavations, did not allow for use of larger equipment. Therefore, a single pothole was excavated outside the trench to access the underlying soil. The pothole was excavated near the center of the north side of the trench to a depth of 2.1 m (7 ft) bgs. The material appeared to be fill with a small amount of concrete debris and short conduit sections. A sample (J1PPN8) was collected of the soil from the bottom of the pothole. The pothole was backfilled.

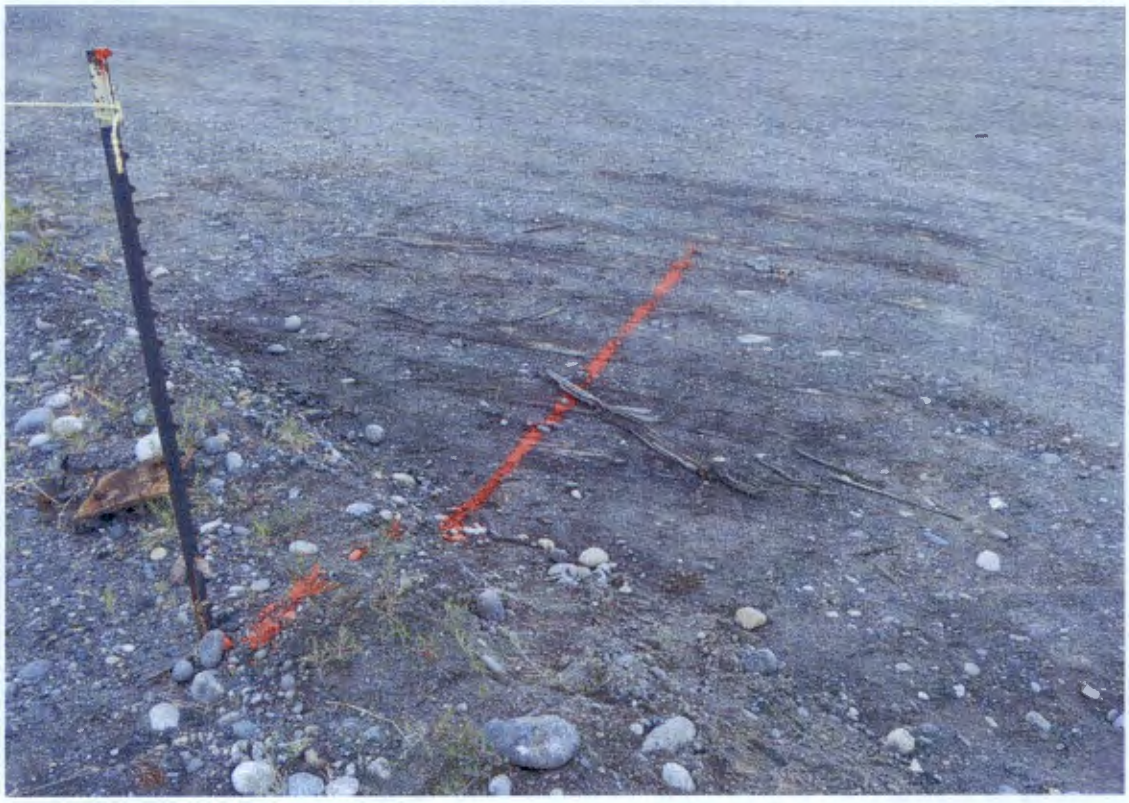
Figure 3. Discolored Soil Near the Bottom Center of 100-D-101 Test Trench 1.

Figure 4. Sampling Discolored Soil from the Bottom Center of 100-D-101 Test Trench 1.

Following a review of 100-D-101 waste site physical and procedural constraints and in consultation with Washington State Department of Ecology, it was determined that the two soil samples beneath the concrete trench could be obtained via access through adjacent excavations (100-D-31:3 to the west and 100-D-73/100-D-76 to the east). The samples could be collected by hand means, with shovel excavations from the east and west ends of the trench. Sampling of the 100-D-101 waste site was resumed on February 27, 2013, when shovel excavations were made to access soil underlying the concrete trench that is located between the former sodium silicate tanks. Two soil samples were collected from the west (J1RFV0) and east (J1RFV1) end of the concrete trench, approximately 9 ft (2.7 m) bgs, and 1.5-2 ft below the concrete trench.

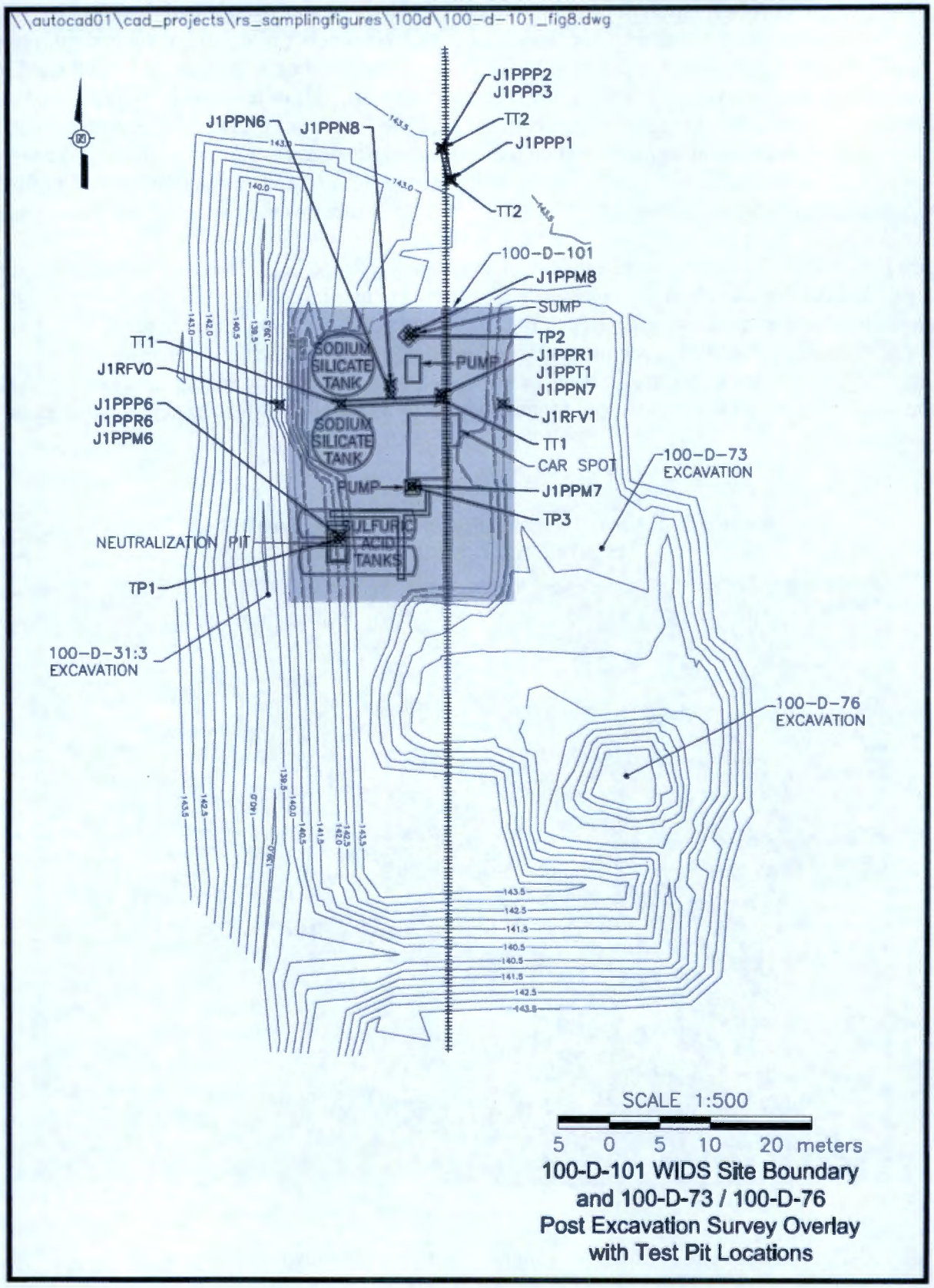
Test trench 2 (TT2) was excavated inside an abandoned railroad bed. The railroad ties were still in place at the surface when the excavation was started (Figure 5). These ties were removed and stacked near the excavation. The excavation then proceeded to an approximate depth of 0.3 m (1 ft). A sample (J1PPP1) was collected from the bottom of the trench at the south end. A sample (J1PPP2) and duplicate (J1PPP3) were collected from the bottom near the north end. The site was left as a shallow excavation, roped, and posted as an exclusion zone pending analytical results.

Figure 5. Railroad Ties Visible on the Surface at 100-D-101 Test Trench 2 Prior to Excavation.



The 100-D-101 waste site confirmatory sample locations are shown in Figure 6.

Figure 6. 100-D-101 Waste Site Confirmatory Sample Locations.



Analytical Results and Data Evaluation

Confirmatory samples were analyzed using EPA-approved analytical methods. Evaluation of the soil sample data was performed by direct comparison of the maximum detected value for each COPC against the RAGs. If no detections for a given COPC were reported in the data set, then no comparisons were performed for that COPC.

Comparisons of the maximum results for COPCs and the site RAGs for the 100-D-101 waste site are presented in Table 2. Contaminants that were not detected by laboratory analysis are excluded from this table. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2012) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (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 not included in Table 2. The laboratory-reported data results for all constituents are stored in the Environmental Restoration project-specific database prior to submission to the Hanford Environmental Information System and are presented as an attachment to the direct contact hazard quotient and relative percent difference calculation in Appendix B.

Table 2. Comparison of Contaminant Concentrations to Action Levels for the 100-D-101 Waste Site. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Statistical Result Exceed RAGs?	Does the Statistical Result Pass RESRAD Modeling?
		Direct Exposure Soil Cleanup Level	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Inorganic						
Arsenic	3.2 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	101 (<BG)	5,600	200	400	No	--
Beryllium	0.52 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	5.37	7,200	320	-- [e]	No	--
Cadmium	0.237 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	10.8 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Chromium (hexavalent)	0.358	2.1 [c]	4.8	2	No	--
Cobalt	7.4 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	17.6 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	71.4	353	10.2 [b]	10.2 [b]	Yes	Yes [f]
Manganese	301 (<BG)	3,760	512 [b]	512 [b]	No	--
Mercury	0.215 (<BG)	24	0.33 [b]	0.33 [b]	No	
Molybdenum [d]	0.441	400	8	-- [e]	No	--
Nickel	11.1 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	52.9 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	192	24,000	480	67.8 [b]	Yes	Yes [f]

Table 2. Comparison of Contaminant Concentrations to Action Levels for the 100-D-101 Waste Site. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Statistical Result Exceed RAGs?	Does the Statistical Result Pass RESRAD Modeling?
		Direct Exposure Soil Cleanup Level	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Chloride	21.9 (<BG)	-- [e]	25,000	-- [e]	No	--
Nitrogen in nitrate	0.72 (<BG)	128,000	1,000	2,000	No	--
Nitrogen in nitrite and nitrate	5.45 (<BG)	128,000	1,000	2,000	No	--
Sulfate	2,100	-- [e]	25,000	-- [e]	No	--
Semivolatile Organic Analysis						
Bis(2-ethylhexyl)phthalate	0.201	71.4	0.6	0.6	No	--
Chrysene	2.47	13.7	0.12	0.1 [g]	Yes	Yes [f]
Fluoranthene	3.55	3,200	64	18	No	--
Pyrene	5.08	2,400	48	192	No	--
Volatile Organic Analysis						
Acetone	0.0075	6,400	64	1,360	No	--
Toluene	0.00065	72,000	720	-- [e]	No	--

[a] RAGs obtained from the RDR/RAWP (DOE-RL 2009b).

[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level 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 2009b).

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

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

[e] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database (Ecology 2012) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], Ecology 1996 [Method B for surface waters]).

[f] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, zinc, and chrysene are not expected to migrate to groundwater within 1,000 years. The vadose zone under the 100-D-101 waste site is 26 m (85 ft) thick. RESRAD modeling indicates a constituent with a distribution coefficient (K_d) value of greater than 3 mL/g will not migrate more than 25 m in 1,000 years. The K_d values for lead, zinc, and chrysene are 30, 30, and 200 mL/g, respectively. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

[g] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). The cited RDLs are based on EPA-approved analytical methods that may not be available for rapid turnaround analyses. Prior notification and concurrence with the laboratory may be necessary to meet this RDL. Actual detection limits may differ from any RDL.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Inspection of Table 2 shows that all COPCs were detected below their respective direct exposure RAG at the 100-D-101 waste site. Three COPCs (lead, zinc, and chrysene) were detected above the applicable groundwater and river protection RAGs. However, RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b) shows that these constituents are not expected to migrate to the water table within 1,000 years. The vadose

zone under the 100-D-101 waste site is 26 m (85 ft) thick. The RESRAD model indicates a constituent with a distribution coefficient (K_d) value of greater than 3 mL/g will not migrate more than 25 m in 1,000 years. The K_d values for lead, zinc, and chrysene are 30, 30, and 200 mL/g, respectively. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

DATA EVALUATION

This section demonstrates that the 100-D-101 waste site meets applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the RDR/RAWP (DOE-RL 2009b).

Attainment of Radionuclide RAGS

Radionuclides are not a COPC at this site and therefore were not analyzed for in the samples.

Attainment of Nonradionuclide RAGS

All COPCs for all sampling areas were quantified below their respective direct exposure soil RAGs or lookup values. Three constituents (lead, zinc, and chrysene; which are compared to cleanup levels in Table 2) were quantified above their groundwater and river protection lookup value. However, RESRAD modeling demonstrates these constituents will not migrate to groundwater within 1,000 years. Therefore, residual concentrations of all constituents are protective of groundwater and thus the Columbia River.

Three-Part Test for Nonradionuclides

The WAC 173-340-740(7)(e) three-part test is a statistical evaluation of the data that does not apply to results of focused samples such as those taken at the 100-D-101 waste site.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. For the 100-D-101 waste site, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents detected above background, or for which there are no background values, is 1.5×10^{-2}. All calculated individual carcinogenic risk values are less than 1×10^{-6}, and the cumulative carcinogenic risk value is 3.5×10^{-7}, which is less than 1×10^{-5}. The 100-D-101 waste site meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-D-101 waste site included calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. These risk values were conservatively calculated for the entire waste site using the highest value for each COPC. 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. Based on RESRAD modeling, constituents are eliminated from a groundwater calculation if their K_d value is sufficiently high that the constituent will not migrate to groundwater in less than 1,000 years. As discussed above, the surface and groundwater elevations at the 100-D-101 waste site are such that any constituent with a K_d of 3 mL/g or greater is protective of groundwater. Of the constituents detected at this site, only hexavalent chromium, with a K_d of zero, is subject to the groundwater hazard quotient calculation. The groundwater noncarcinogen RAG for hexavalent chromium is 4.8 mg/kg and the detected concentration is 0.358 mg/kg. This results in a groundwater hazard quotient of 0.0746, which is less than 1. There are no established hexavalent chromium toxicity data for calculating the cancer risk associated with ingestion of groundwater. This analysis shows that all individual groundwater hazard quotients for noncarcinogenic constituents are less than 1.0, as is the cumulative hazard quotient. The 100-D-101 waste site does not have carcinogenic constituents subject to groundwater cancer risk calculation; therefore, the criterion for excess cancer risk is met. Nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2011). This DQA was performed in accordance with site specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). A review of the sample design (WCH 2011), the field logbook (WCH 2012b), and applicable analytical data packages has been performed as part of this DQA. This review determined the data are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The detailed DQA is presented in Appendix C.

SUMMARY FOR NO ACTION

The 100-D-101 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Confirmatory sampling results indicate that the residual concentrations of COPCs at this site meet the RAGs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory investigation results support a reclassification of the 100-D-101 waste site to Interim No Action. The 100-D-101 waste site contamination did not extend into the

deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

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APPENDIX A

ECOLOGICAL SCREENING EVALUATION

Table A-1. Ecological Screening Levels [a].

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Waste Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
Metals (mg/kg)									
	Background								
Arsenic III	6.5*	--	--	7	18	--	43	46	3.2 (<BG)
Barium	132	500	--	102	--	330	--	2,000	101 (<BG)
Beryllium	1.51	10	--	--	--	40	--	21	0.52 (<BG)
Boron	--	0.5	--	--	--	--	--	--	5.37
Cadmium	0.81	4	20	14	32	140	0.77	0.36	0.237 (<BG)
Chromium (total)	18.5	42 [d]	42 [d]	67	--	--	26	34	10.8 (<BG)
Chromium VI	--	--	--	--	--	--	--	130	0.358
Cobalt	15.7	20	--	--	13	--	120	230	7.4 (<BG)
Copper	22	100	50	217	70	80	28	49	17.6 (<BG)
Lead	10.2	50	500	118	120	1,700	11	56	71.4
Manganese	512	1,100 [d]	--	1,500	220	450	4,300	4,000	301 (<BG)
Molybdenum	--	2	--	7	--	--	--	--	0.441
Nickel	19.1	30	200	980	38	280	210	130	11.1 (<BG)
Vanadium	85.1	2	--	--	--	--	7.8	280	52.9 (<BG)
Zinc	67.8	86 [d]	200	360	160	120	46	79	192
Nonchlorinated Organics (mg/kg)									
Low molecular weight PAHs [e]	--	--	--	--	29	--	100		3.55
High molecular weight PAHs [f]		--	--	--	18	--	1.1		7.55

Highlighted values indicate exceedances of ecological screening levels for individual hazardous substances.

* The Hanford Site background for arsenic is 6.5 mg/kg. An 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 Area RDR/RAWP, DOE/RL-96-17, Rev. 6.

[a] Per WAC 173-340-7490(4)(b) (Ecology 2007), soil concentrations deeper than the standard point of compliance of 4.6 m (15 ft) are not considered in evaluation of risk to ecological receptors because this represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities, resulting in exposure by ecological receptors. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site, which will include a more complete quantitative ecological risk assessment.

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

[c] Wildlife.

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

[e] Low molecular weight polynuclear aromatic hydrocarbons (LMW-PAHs), e.g., acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene

[f] High molecular weight polynuclear aromatic hydrocarbons (HMW-PAHs), e.g., benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, perylene, pyrene.

-- = no value exists
BG = background
EPA = U.S. Environmental Protection Agency
PAH = polynuclear aromatic hydrocarbons
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
WAC = *Washington Administrative Code*

APPENDIX B

CALCULATIONS

APPENDIX B

CALCULATION BRIEFS

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

100-D-101 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0100D-CA-V0462, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-D-101 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100D-CA-V0489, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-D Area

Discipline: Environmental Calculation No: 0100D-CA-V0462

Subject: 100-D-101 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk 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 Summary = 6 Attachment = 8 Total = 15	C.H. Dobie C H Dobie	N. K. Schiffern N K Schiffern	J. D. Skoglie J D Skoglie	D. F. Obenauer D F Obenauer	6/12/13

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	C. H. Dobie CD	Date:	3/21/2013	Calc. No.:	0100D-CA-V0462	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	N. K. Schiffern NS	Date:	3/21/2013
Subject:	100-D-101 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-D-101 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

Also, calculate the relative percent difference (RPD) for the primary-duplicate sample pairs from the 100-D-101 waste site confirmatory sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.

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

5) WCH, 2013, *Remaining Sites Verification Package for the 100-D-101, 108-D Acid Pit and Sump; 108-D Car Spot; 108-D Sodium Silicate Sump; 108-D Storage Tanks; Miscellaneous Structures Waste Site,* Attachment to Waste Site Reclassification Form 2012-062, 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 2009b).

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 2009b).

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

5) Use data from WCH (2013) to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 100-D-101 waste site underwent discrete focused sampling at seven locations for the purpose of confirmatory sampling. One duplicate sample was collected. The direct contact hazard quotient and carcinogenic risk calculations for the 100-D-101 waste site were conservatively calculated for the entire waste site using the greatest of the maximum soil sample results (WCH 2013). Of the contaminants of potential concern (COPCs) for this site, zinc requires HQ and risk calculations because this analyte was detected above background value. Boron, hexavalent chromium, molybdenum, the detected semivolatiles, and the detected volatiles require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Lead was quantitated at a concentration above Hanford Site background; however, lead is not included in the calculation based on modeling of child blood levels, which is fundamentally different from the oral reference dose and cancer slope factors used to calculate typical cleanup levels and associated HQs and cancer risks. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 5.37 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), produces a HQ value of 7.5×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values is 1.5×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. For example, the maximum value for hexavalent chromium is 0.358 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 1.7×10^{-7}. 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 3.5×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDLs are

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pre-determined values for analytical methods and constituents with cleanup levels as listed in Table 2-1 of the SAP (DOE-RL 2009a). Table 2-1 includes nominal TDLs for identified methods based organic analyses. The nominal TDLs are also used in support of the RPD calculation for the methods based analytes. TDLs not included in Table 2-1 are based on the laboratory and/or methods used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

When an analyte is detected in the primary or duplicate 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 results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for the confirmatory sampling of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2013), as necessary.

RESULTS:

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

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

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

Table 2 shows the results of the RPD calculations for the 100-D-101 waste site.

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Table 1. Direct Contact HQ and Excess Cancer Risk Results for the 100-D-101 waste site.

Contaminants of Potential Concern	Maximum Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	5.37	7,200	7.5E-04	--	--
Chromium, hexavalent[c]	0.358	240	1.5E-03	2.1	1.7E-07
Lead[d]	71.4	353	--	--	--
Molybdenum	0.441	400	1.1E-03	--	--
Zinc	192	24,000	8.0E-03	--	--
Semivolatiles					
Bis(2-ethylhexyl) phthalate	0.201	1,600	1.3E-04	71.4	2.8E-09
Chrysene	2.47	--	--	13.7	1.8E-07
Fluoranthene	3.55	3,200	1.1E-03	--	--
Pyrene	5.08	2,400	2.1E-03	--	--
Volatiles					
Acetone	0.0075	72,000	1.0E-07	--	--
Toluene	0.00065	6,400	1.0E-07	--	--
Totals					
Cumulative Hazard Quotient:			**1.5E-02**		
Cumulative Excess Cancer Risk:					**3.5E-07**

Notes:

[a] = From WCH (2013).

[b] = Value obtained from the RDR/RAWP (DOE-RL 2009b) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

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

[d] = Value for the noncarcinogenic RAG calculated using Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children, EPA/540/R 93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

-- = not applicable

RAG = remedial action goal

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Table 2. Relative Percent Difference Calculations for the 100-D-101 waste site.

100-D-101 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 2 (North)	J1PPP2	6/5/12	4220		5.18	2.53		1.04	52.7		0.518	0.211		0.207
Duplicate of J1PPP2	J1PPP3	6/5/12	5020		4.51	2.64		0.902	56.8		0.451	0.214		0.180

Analysis:

TDL		5	10	2	0.2
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)
	RPD	17.3%		7.5%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

100-D-101 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 2 (North)	J1PPP2	6/5/12	1.36	B	2.07	0.0900	B	0.207	4210		104	7.04		0.207
Duplicate of J1PPP2	J1PPP3	6/5/12	1.35	B	1.80	0.0812	B	0.180	5810		90.2	7.50		0.180

Analysis:

TDL		2	0.2	100	1
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?			**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD			*31.9%*	6.3%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable

100-D-101 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 2 (North)	J1PPP2	6/5/12	5.11		2.07	13.5		1.04	18000		20.7	9.79		0.518
Duplicate of J1PPP2	J1PPP3	6/5/12	5.20		1.80	11.8		0.902	16700		18.0	8.02		0.451

Analysis:

TDL		2	1	5	5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)
	RPD		13.4%	7.5%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

100-D-101 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Magnesium			Manganese			Molybdenum			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 2 (North)	J1PPP2	6/5/12	3090		77.7	230		5.18	0.383	B	2.07	6.57		4.14
Duplicate of J1PPP2	J1PPP3	6/5/12	3630		67.7	258		4.51	0.441	B	1.80	7.28		3.61

Analysis:

TDL		75	5	2	4
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)
	RPD	16.1%	11.5%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

100-D-101 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 2 (North)	J1PPP2	6/5/12	759		414	298		2.07	179		51.8	46.3		2.59
Duplicate of J1PPP2	J1PPP3	6/5/12	821		361	256		1.80	200		45.1	44.4		2.26

Analysis:

TDL		400	2	50	2.5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD		15.2%		4.2%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable

100-D-101 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc			Sulfate			Fluoranthene			Pyrene		
			mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
TT2 - Underlying Soil 2 (North)	J1PPP2	6/5/12	40.7		10.4	5.8		1.1	3550	JD	14300	5080	JD	14300
Duplicate of J1PPP2	J1PPP3	6/5/12	39.3		9.02	6.3		1.0	2680	JD	14500	3920	JD	14500

Analysis:

TDL		1	5	660	660
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	No-Stop (acceptable)
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)		**Yes (calc RPD)**
	RPD	3.5%			
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

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CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-D-101 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009b). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Radionuclides).

LOCATION	HEIS Number	Sample Date	Americium-241			Cesium-137			Cobalt-60			Europium-152			Europium-154		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
West	J1RFV0	2/27/13	0.00128	U	0.0413	-0.0109	U	0.0244	-0.00200	U	0.0274	0.0256	U	0.0600	0.0221	U	0.0807
East	J1RFV1	2/27/13	0.0244	U	0.156	0.00554	U	0.0235	0.00569	U	0.0260	-0.0146	U	0.0571	-0.0436	U	0.0790

LOCATION	HEIS Number	Sample Date	Europium-155			Gross alpha			Gross beta			Potassium-40		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
West	J1RFV0	2/27/13	0.0199	U	0.0626	-1.36	U	7.51	21.4		2.35	12.6		0.230
East	J1RFV1	2/27/13	0.0241	U	0.0666	3.16	U	6.72	19.4		2.35	12.0		0.187

Acronyms and notes apply to all of the tables in this attachment.
Gray cells indicate not applicable.
Note: Data qualified with B, D, and J are considered acceptable values.
B = estimated
D = identifies all compounds identified in an analysis at a secondary dilution factor
HEIS = Hanford Environmental Information system
J = estimate
MDA = minimal detectable limit
N = recovery is outside control limits
PQL = practical quantitation limit
Q = qualifier
R = rejected
SVOA = semivolatile organic analysis
TP = test pit
TT = test trench
U = undetected
VOA = volatile organic analysis
X = serial dilution in analytical batch indicates physical and chemcial interferences (metals)
X = more than 40% difference between columns, lower result reported (organics)

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Attachment 1. 100-D-101 Waste Site Confirmatory 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
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	4220		5.18	0.621	U	0.621	2.53		1.04	52.7		0.518	0.211		0.207
Duplicate of J1PPP2	J1PPP3	6/5/12	5020		4.51	0.541	U	0.541	2.64		0.902	56.8		0.451	0.214		0.180
TP1 - Underlying Soil	J1PPM6	5/31/12	3240		4.67	0.560	U	0.560	0.983		0.933	36.3		0.467	0.160	B	0.187
TP1 - Anomalous Material	J1PPP6	5/31/12	4210		4.10	0.492	U	0.492	2.03		0.820	46.1		0.410	0.162	B	0.164
TP2 - Underlying Soil	J1PPM8	6/4/12	3550		3.46	0.416	U	0.416	1.78		0.693	43.4		0.346	0.161		0.139
TP3 - Underlying Soil	J1PPM7	6/4/12	4530		4.38	0.526	U	0.526	1.88		0.877	41.2		0.438	0.200		0.175
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	6620	J	4.58	0.550	UJ	0.550	2.68		0.917	72.6		0.458	0.249		0.183
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	4880		4.10	0.492	U	0.492	2.70		0.820	101		0.410	0.231		0.164
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	5350	J	3.82	0.459	UJ	0.459	2.35		0.764	60.9		0.382	0.216		0.153
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	5900	J	5.54	0.664	UJ	0.664	2.21		1.11	59.5		0.554	0.237		0.221
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	4130		3.60	0.431	U	0.431	2.13		0.719	53.5		0.360	0.186		0.144
West	J1RFV0	2/27/13	6250		1.5	0.37	U	0.37	3.1		0.64	67.7		0.073	0.51		0.032
East	J1RFV1	2/27/13	5840		1.4	0.34	U	0.34	3.2		0.59	64.0		0.068	0.52		0.029
Equipment Blank	J1PPM9	6/4/12	203		3.68	0.441	U	0.441	0.735	U	0.735	1.87		0.368	0.147	U	0.147

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
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	1.36	B	2.07	0.0900	B	0.207	4210		104	7.04		0.207	5.11		2.07
Duplicate of J1PPP2	J1PPP3	6/5/12	1.35	B	1.80	0.0812	B	0.180	5810		90.2	7.50		0.180	5.20		1.80
TP1 - Underlying Soil	J1PPM6	5/31/12	0.520	B	1.87	0.0687	B	0.187	4680		93.3	3.55		0.187	5.20		1.87
TP1 - Anomalous Material	J1PPP6	5/31/12	1.21	B	1.64	0.0764	B	0.164	6730		82.0	5.50		0.164	5.00		1.64
TP2 - Underlying Soil	J1PPM8	6/4/12	1.58		1.39	0.0612	B	0.139	4470		69.3	4.55		0.139	5.60		1.39
TP3 - Underlying Soil	J1PPM7	6/4/12	0.924	B	1.75	0.0705	B	0.175	6600		87.7	5.95		0.175	5.21		1.75
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	2.16		1.83	0.124	B	0.183	7230	J	91.7	10.2		0.183	5.84		1.83
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	5.37		1.64	0.206		0.164	5940		82.0	10.8		0.164	4.63		1.64
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	3.16		1.53	0.237		0.153	7520	J	76.4	7.47		0.153	6.06		1.53
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	2.97		2.21	0.103	B	0.221	5580	J	111	8.13		0.221	6.18		2.21
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	1.28	B	1.44	0.0843	B	0.144	4520		71.9	6.06		0.144	4.72		1.44
West	J1RFV0	2/27/13	1.4	B	0.94	0.066	B	0.039	8910		13.6	7.7	X	0.056	7.4	X	0.096
East	J1RFV1	2/27/13	0.87	U	0.87	0.071	B	0.036	8000		12.5	9.7	X	0.052	7.3	X	0.089
Equipment Blank	J1PPM9	6/4/12	1.47	U	1.47	0.147	U	0.147	34.1	B	73.5	0.147	U	0.147	1.47	U	1.47

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
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	13.5		1.04	0.22	U	0.22	18000		20.7	9.79		0.518	3090		77.7
Duplicate of J1PPP2	J1PPP3	6/5/12	11.8		0.902	0.22	U	0.22	16700		18.0	8.02		0.451	3630		67.7
TP1 - Underlying Soil	J1PPM6	5/31/12	9.8		0.933	0.21	U	0.21	17100		18.7	1.51		0.467	2840		70.0
TP1 - Anomalous Material	J1PPR6	5/31/12				0.358		0.155									
TP1 - Anomalous Material	J1PPP6	5/31/12	11.8		0.820				16600		16.4	5.78		0.410	2950		61.5
TP2 - Underlying Soil	J1PPM8	6/4/12	11.3		0.693	0.21	U	0.21	16400		13.9	5.39		0.346	3580		52.0
TP3 - Underlying Soil	J1PPM7	6/4/12	11.6		0.877	0.21	U	0.21	17700		17.5	2.53		0.438	3380		65.8
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	14.5		0.917	0.29	B	0.21	19800		18.3	10.7	J	0.458	4190		68.7
TT1 - Contents Inside Trench 2 (Center)	J1PPT1	6/4/12				0.155	U	0.155									
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	17.6		0.820				15300		16.4	71.4		0.410	3360		61.5
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	12.6		0.764	0.26	B	0.22	18100		15.3	8.44	J	0.382	4100		57.3
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	12.8		1.11	0.31	B	0.22	18800		22.1	4.69	J	0.554	4180		83.0
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	10.5		0.719	0.22	U	0.22	15500		14.4	10.7		0.360	2980		53.9
West	J1RFV0	2/27/13	15.6		0.21	0.155	U	0.155	20500	X	3.7	3.6		0.26	4630		3.6
East	J1RFV1	2/27/13	16.4		0.19	0.226		0.155	20800	X	3.4	4.1		0.24	4170		3.3
Equipment Blank	J1PPM9	6/4/12	0.735	U	0.735				470		14.7	0.484		0.368	18.9	B	55.2

Attachment	1	Sheet No.	2 of 8
Originator	C. H. Dobie	Date	3/20/2013
Checked	N. K. Schiffern	Date	3/20/2013
Calc. No.	0100D-CA-V0462	Rev. No.	0

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Metals).

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
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	230		5.18	0.0291	U	0.0291	0.383	B	2.07	6.57		4.14	759		414
Duplicate of J1PPP2	J1PPP3	6/5/12	258		4.51	0.0254	U	0.0254	0.441	B	1.80	7.28		3.61	821		361
TP1 - Underlying Soil	J1PPM6	5/31/12	205		4.67	0.0280	U	0.0280	0.332	B	1.87	5.94		3.73	428		373
TP1 - Anomalous	J1PPP6	5/31/12	220		4.10	0.215		0.0265	0.285	B	1.64	9.43		3.28	634		328
TP2 - Underlying Soil	J1PPM8	6/4/12	229		3.46	0.0240	U	0.0240	0.195	B	1.39	6.56		2.77	526		277
TP3 - Underlying Soil	J1PPM7	6/4/12	227		4.38	0.0256	U	0.0256	0.283	B	1.75	6.74		3.51	613		351
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	301		4.58	0.0269	U	0.0269	0.294	B	1.83	9.20		3.67	1070		367
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	231		4.10	0.141		0.0243	0.405	B	1.64	8.94		3.28	843		328
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	262		3.82	0.116		0.0264	0.257	B	1.53	7.53		3.06	1130		306
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	286		5.54	0.0176	B	0.0285	0.393	B	2.21	7.82		4.43	1090		443
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	229		3.60	0.0172	B	0.0289	0.420	B	1.44	5.56		2.88	694		288
West	J1RFV0	2/27/13	279	X	0.096	0.0052	U	0.0052	0.25	U	0.25	11.1	X	0.12	1040		39.5
East	J1RFV1	2/27/13	282	X	0.089	0.048		0.0062	0.23	B	0.23	9.1	X	0.11	1070		36.5
Equipment Blank	J1PPM9	6/4/12	10.8		3.68	0.0243	U	0.0243	1.47	U	1.47	2.94	U	2.94	42.7	B	294

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
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	0.311	U	0.311	298		2.07	0.207	U	0.207	179		51.8	46.3		2.59
Duplicate of J1PPP2	J1PPP3	6/5/12	0.271	U	0.271	256		1.80	0.180	U	0.180	200		45.1	44.4		2.26
TP1 - Underlying Soil	J1PPM6	5/31/12	0.280	U	0.280	178		1.87	0.187	U	0.187	231		46.7	48.7		2.33
TP1 - Anomalous	J1PPP6	5/31/12	0.246	U	0.246	218		1.64	0.164	U	0.164	328		41.0	47.6		2.05
TP2 - Underlying Soil	J1PPM8	6/4/12	0.208	U	0.208	262		1.39	0.139	U	0.139	797		34.6	45.8		1.73
TP3 - Underlying Soil	J1PPM7	6/4/12	0.263	U	0.263	490		1.75	0.175	U	0.175	296		43.8	48.8		2.19
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	0.275	U	0.275	521	J	1.83	0.183	U	0.183	420		45.8	52.9	J	2.29
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	0.246	U	0.246	328		1.64	0.164	U	0.164	480		41.0	36.7		2.05
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	0.229	U	0.229	433	J	1.53	0.153	U	0.153	860		38.2	43.5	J	1.91
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	0.332	U	0.332	654	J	2.21	0.221	U	0.221	1010		55.4	48.9	J	2.77
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	0.216	U	0.216	251		1.44	0.144	U	0.144	183		36.0	39.1		1.80
West	J1RFV0	2/27/13	0.83	U	0.83	448	N	5.4	0.15	U	0.15	1330		56.8	47.0		0.090
East	J1RFV1	2/27/13	0.77	U	0.77	513		5.0	0.14	U	0.14	314		52.5	47.1		0.084
Equipment Blank	J1PPM9	6/4/12	0.221	U	0.221	154		1.47	0.147	U	0.147	36.8	U	36.8	0.326	B	1.84

LOCATION	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	40.7		10.4
Duplicate of J1PPP2	J1PPP3	6/5/12	39.3		9.02
TP1 - Underlying Soil	J1PPM6	5/31/12	34.7		9.33
TP1 - Anomalous Material	J1PPP6	5/31/12	36.9		8.20
TP2 - Underlying Soil	J1PPM8	6/4/12	31.8		6.93
TP3 - Underlying Soil	J1PPM7	6/4/12	34.0		8.77
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	41.9		9.17
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	67.1		8.20
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	192		7.64
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	55.9		11.1
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	41.8		7.19
West	J1RFV0	2/27/13	38.4	X	0.38
East	J1RFV1	2/27/13	43.8	X	0.35
Equipment Blank	J1PPM9	6/4/12	1.14	B	7.35

Attachment	1	Sheet No.	3 of 8
Originator	C. H. Dobie	Date	3/21/2013
Checked	N. K. Schiffern	Date	3/21/2013
Calc. No.	0100D-CA-V0462	Rev. No.	0

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Anions).

Sample Area	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrate			Nitrite		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	1.1	U	1.1	1.1	U	1.1	1.1	U	1.1	1.1	U	1.1	1.1	U	1.1
Duplicate of J1PPP2	J1PPP3	6/5/12	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0
TP1 - Underlying Soil	J1PPM6	5/31/12	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0
TP1 - Anomalous Material	J1PPP6	5/31/12	1.0	U	1.0	1.0	U	1.0	1.2	B	1.0	2.7	B	1.0	1.0	U	1.0
TP2 - Underlying Soil	J1PPM8	6/4/12	1.0	U	1.0	3.2	B	1.0	1.0	U	1.0	3.9	B	1.0	1.0	U	1.0
TP3 - Underlying Soil	J1PPM7	6/4/12	1.0	U	1.0	2.4	B	1.0	1.0	B	1.0	2.4	B	1.0	1.0	U	1.0
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	1.0	U	1.0	1.0	U	1.0	1.0	U	1.0	5.0	JB	1.0	1.0	UR	1.0
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	1.0	U	1.0	2.8	B	1.0	1.0	B	1.0	10.1		1.0	1.0	U	1.0
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	1.0	U	1.0	21.9		1.0	1.0	U	1.0	22.5	J	1.0	1.0	UR	1.0
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	1.1	U	1.1	18.0		1.1	1.1	U	1.1	15.4	J	1.1	1.1	UR	1.1
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	1.1	U	1.1	1.4	B	1.1	1.1	U	1.1	1.8	B	1.1	1.1	U	1.1
West	J1RFV0	2/27/13	0.41	U	0.41	4.2	B	2.1	1.3	B	0.86						
East	J1RFV1	2/27/13	0.40	U	0.40	10.4		2.0	0.85	UN	0.85						

Sample Area	HEIS Number	Sample Date	Nitrogen in Nitrate			Nitrogen in Nitrite			Nitrogen in Nitrite and Nitrate			Phosphate			Phosphorous in Phosphate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12							0.10	U	0.10	2.2	U	2.2			
Duplicate of J1PPP2	J1PPP3	6/5/12							0.10	U	0.10	2.0	U	2.0			
TP1 - Underlying Soil	J1PPM6	5/31/12							0.13	B	0.10	2.0	U	2.0			
TP1 - Anomalous Material	J1PPP6	5/31/12							0.65		0.09	1.9	U	1.9			
TP2 - Underlying Soil	J1PPM8	6/4/12							0.89		0.10	3.8	B	2.0			
TP3 - Underlying Soil	J1PPM7	6/4/12							0.39	B	0.10	2.7	B	2.0			
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12							1.24		0.10	3.7	JB	2.0			
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12							2.25		0.10	3.3	B	2.0			
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12							5.45		0.11	2.6	JB	2.1			
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12							3.44		0.11	4.4	JB	2.2			
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12							0.47	B	0.10	2.2	U	2.2			
West	J1RFV0	2/27/13	0.33	U	0.33	0.35	U	0.35	0.33	U	0.33				1.3	U	1.3
East	J1RFV1	2/27/13	0.72	B	0.32	0.35	U	0.35	0.33	B	0.32				1.3	UN	1.3
Equipment Blank	J1PPM9	6/4/12															

Sample Area	HEIS Number	Sample Date	Sulfate			Percent Solids			pH Measurement		
			mg/kg	Q	PQL	%	Q	PQL	pH	Q	PQL
TT2 - Underlying Soil 1 (North)	J1PPP2	6/5/12	5.8		1.1	91.1		0.1	8.88		0.10
Duplicate of J1PPP2	J1PPP3	6/5/12	6.3		1.0	90.9		0.1	8.84		0.10
TP1 - Underlying Soil	J1PPM6	5/31/12	144	D	2.0	97.4		0.1	8.96		0.10
TP1 - Anomalous Material	J1PPP6	5/31/12	2100	D	48.3				7.43		0.10
TP2 - Underlying Soil	J1PPM8	6/4/12	19.4		1.0	96.2		0.1	9.74		0.10
TP3 - Underlying Soil	J1PPM7	6/4/12	16.1		1.0	95.0		0.1	9.37		0.10
TT1 - Contents Inside Trench 1 (West)	J1PPN6	6/4/12	10.9		1.0	95.7		0.1	9.39	J	0.10
TT1 - Contents Inside Trench 2 (Center)	J1PPR1	6/4/12	32.5		1.0				9.03		0.10
TT1 - Underlying Soil 2 (Center)	J1PPN8	6/4/12	112	D	2.1	89.6		0.1	9.53	J	0.10
TT1 - Contents Inside Trench 3 (East)	J1PPN7	6/4/12	97.3		1.1	90.3		0.1	9.59	J	0.10
TT2 - Underlying Soil 1 (South)	J1PPP1	6/5/12	10.4		1.1	91.5		0.1	9.21		0.10
West	J1RFV0	2/27/13	3.3	B	1.8	5.6		0.10	9.27		0.100
East	J1RFV1	2/27/13	7.1		1.8	4.7		0.10	9.15		0.100
Equipment Blank	J1PPM9	6/4/12				100		0.1			

Attachment	1	Sheet No.	4 of 8
Originator	C. H. Dobie	Date	03/21/13
Checked	N. K. Schiffern	Date	03/21/13
Calc. No.	0100D-CA-V0462	Rev. No.	0

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Organics).

Constituents	Class	TT2 - Underlying Soil 1 (North) - J1PPP2			Duplicate of J1PPP2 - J1PPP3			TP1 - Underlying Soil - J1PPM6			TP1 - Anomalous Material - J1PPP6			TP2 - Underlying Soil - J1PPM8		
		6/5/12			6/5/12			5/31/12			5/31/12			6/4/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
1,2-Dichlorobenzene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
1,3-Dichlorobenzene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
1,4-Dichlorobenzene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2,4,5-Trichlorophenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2,4,6-Trichlorophenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2,4-Dichlorophenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2,4-Dimethylphenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2,4-Dinitrophenol	SVOA	71600	UDR	71600	72500	UDR	72500	1690	U	1690	49100	UDR	49100	1660	U	1660
2,4-Dinitrotoluene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2,6-Dinitrotoluene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2-Chloronaphthalene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2-Chlorophenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2-Methylnaphthalene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2-Methylphenol (cresol, o-)	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
2-Nitroaniline	SVOA	71600	UD	71600	72500	UD	72500	1690	U	1690	49100	UD	49100	1660	U	1660
2-Nitrophenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
3+4 Methylphenol (cresol, m+p)	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
3,3'-Dichlorobenzidine	SVOA	28600	UD	28600	29000	UD	29000	675	U	675	19600	UD	19600	664	U	664
3-Nitroaniline	SVOA	71600	UD	71600	72500	UD	72500	1690	U	1690	49100	UD	49100	1660	U	1660
4,6-Dinitro-2-methylphenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UDR	9810	332	U	332
4-Bromophenylphenyl ether	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
4-Chloro-3-methylphenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
4-Chloroaniline	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
4-Chlorophenylphenyl ether	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
4-Nitroaniline	SVOA	71600	UD	71600	72500	UD	72500	1690	U	1690	49100	UD	49100	1660	U	1660
4-Nitrophenol	SVOA	71600	UD	71600	72500	UD	72500	1690	U	1690	49100	UD	49100	1660	U	1660
Acenaphthene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Acenaphthylene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Anthracene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Benzo(a)anthracene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Benzo(a)pyrene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Benzo(b)fluoranthene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Benzo(ghi)perylene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Benzo(k)fluoranthene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Bis(2-chloro-1-methylethyl)ether	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Bis(2-Chloroethoxy)methane	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Bis(2-chloroethyl) ether	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Bis(2-ethylhexyl) phthalate	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Butylbenzylphthalate	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Carbazole	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Chrysene	SVOA	2470	JD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Di-n-butylphthalate	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Di-n-octylphthalate	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Dibenz[a,h]anthracene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Dibenzofuran	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Diethyl phthalate	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Dimethyl phthalate	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Fluoranthene	SVOA	3550	JD	14300	2680	JD	14500	337	U	337	9810	UD	9810	332	U	332
Fluorene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Hexachlorobenzene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Hexachlorobutadiene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Hexachlorocyclopentadiene	SVOA	14300	UDR	14300	14500	UDR	14500	337	U	337	9810	UDR	9810	332	U	332
Hexachloroethane	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Indeno(1,2,3-cd)pyrene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Isophorone	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
N-Nitroso-di-n-dipropylamine	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
N-Nitrosodiphenylamine	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Naphthalene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Nitrobenzene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Pentachlorophenol	SVOA	71600	UD	71600	72500	UD	72500	1690	U	1690	49100	UD	49100	1660	U	1660
Phenanthrene	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Phenol	SVOA	14300	UD	14300	14500	UD	14500	337	U	337	9810	UD	9810	332	U	332
Pyrene	SVOA	5080	JD	14300	3920	JD	14500	337	U	337	9810	UD	9810	332	U	332

Attachment	1	Sheet No.	5 of 8
Originator	C. H. Dobie	Date	03/20/13
Checked	N. K. Schiffern	Date	03/20/13
Calc. No.	0100D-CA-V0462	Rev. No.	0

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Organics).

Constituents	Class	TP3 - Underlying Soil - J1PPM7			TT1 - Contents Inside Trench 1 (West) - J1PPN6			TT1 - Contents Inside Trench 2 (Center) - J1PPR1			TT1 - Underlying Soil 2 (Center) - J1PPN8			TT1 - Contents Inside Trench 3 (East) - J1PPN7			TT2 - Underlying Soil 1 (South) - J1PPP1		
		6/4/12			6/4/12			6/4/12			6/4/12			6/4/12			6/5/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
1,2-Dichlorobenzene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
1,3-Dichlorobenzene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
1,4-Dichlorobenzene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2,4,5-Trichlorophenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2,4,6-Trichlorophenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2,4-Dichlorophenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2,4-Dimethylphenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2,4-Dinitrophenol	SVOA	1720	U	1720	3250	UJD	3250	19500	UDR	19500	3660	UJD	3660	36200	UJD	36200	36100	UDR	36100
2,4-Dinitrotoluene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2,6-Dinitrotoluene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
2-Chloronaphthalene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2-Chlorophenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2-Methylnaphthalene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2-Methylphenol (cresol, o-)	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
2-Nitroaniline	SVOA	1720	U	1720	3250	UD	3250	19500	UD	19500	3660	UD	3660	36200	UD	36200	36100	UD	36100
2-Nitrophenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
3+4 Methylphenol (cresol, m+p)	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
3,3'-Dichlorobenzidine	SVOA	689	U	689	1300	UJD	1300	7800	UD	7800	1470	UJD	1470	14500	UJD	14500	14400	UD	14400
3-Nitroaniline	SVOA	1720	U	1720	3250	UJD	3250	19500	UD	19500	3660	UJD	3660	36200	UJD	36200	36100	UD	36100
4,6-Dinitro-2-methylphenol	SVOA	344	U	344	651	UJD	651	3900	UDR	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
4-Bromophenylphenyl ether	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
4-Chloro-3-methylphenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
4-Chloroaniline	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
4-Chlorophenylphenyl ether	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
4-Nitroaniline	SVOA	1720	U	1720	3250	UJD	3250	19500	UD	19500	3660	UJD	3660	36200	UJD	36200	36100	UD	36100
4-Nitrophenol	SVOA	1720	U	1720	3250	UJD	3250	19500	UDR	19500	3660	UJD	3660	36200	UJD	36200	36100	UD	36100
Acenaphthene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Acenaphthylene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Anthracene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Benzo(a)anthracene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Benzo(a)pyrene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Benzo(b)fluoranthene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Benzo(ghi)perylene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Benzo(k)fluoranthene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Bis(2-chloro-1-methylethyl)ether	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Bis(2-Chloroethoxy)methane	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Bis(2-chloroethyl) ether	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Bis(2-ethylhexyl) phthalate	SVOA	201	J	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Butylbenzylphthalate	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Carbazole	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Chrysene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	1380	DJ	7210
Di-n-butylphthalate	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Di-n-octylphthalate	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Dibenz[a,h]anthracene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Dibenzofuran	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Diethyl phthalate	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Dimethyl phthalate	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Fluoranthene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	1880	DJ	7210
Fluorene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Hexachlorobenzene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Hexachlorobutadiene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Hexachlorocyclopentadiene	SVOA	344	U	344	651	UJD	651	3900	UDR	3900	733	UJD	733	7230	UJD	7230	7210	UDR	7210
Hexachloroethane	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Indeno(1,2,3-cd)pyrene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Isophorone	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
N-Nitroso-di-n-dipropylamine	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
N-Nitrosodiphenylamine	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Naphthalene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Nitrobenzene	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Pentachlorophenol	SVOA	1720	U	1720	3250	UJD	3250	19500	UDR	19500	3660	UJD	3660	36200	UJD	36200	36100	UD	36100
Phenanthrene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	7210	UD	7210
Phenol	SVOA	344	U	344	651	UJD	651	3900	UD	3900	733	UJD	733	7230	UJD	7230	7210	UD	7210
Pyrene	SVOA	344	U	344	651	UD	651	3900	UD	3900	733	UD	733	7230	UD	7230	3380	JD	7210

Attachment	1	Sheet No.	6 of 8
Originator	C. H. Dobie	Date	03/21/13
Checked	N. K. Schiffern	Date	03/21/13
Calc. No.	0100D-CA-V0462	Rev. No.	0

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Organics).

Constituents	Class	West - J1RFV0			East - J1RFV1		
		2/27/13			2/27/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	29	U	29	29	U	29
1,2-Dichlorobenzene	SVOA	23	U	23	23	U	23
1,3-Dichlorobenzene	SVOA	13	U	13	12	U	12
1,4-Dichlorobenzene	SVOA	14	U	14	14	U	14
2,4,5-Trichlorophenol	SVOA	10	U	10	10	U	10
2,4,6-Trichlorophenol	SVOA	10	U	10	10	U	10
2,4-Dichlorophenol	SVOA	10	U	10	10	U	10
2,4-Dimethylphenol	SVOA	69	U	69	68	U	68
2,4-Dinitrophenol	SVOA	350	U	350	340	U	340
2,4-Dinitrotoluene	SVOA	69	U	69	68	U	68
2,6-Dinitrotoluene	SVOA	29	U	29	29	U	29
2-Chloronaphthalene	SVOA	10	U	10	10	U	10
2-Chlorophenol	SVOA	22	U	22	22	U	22
2-Methylnaphthalene	SVOA	20	U	20	20	U	20
2-Methylphenol (cresol, o-)	SVOA	14	U	14	13	U	13
2-Nitroaniline	SVOA	52	U	52	52	U	52
2-Nitrophenol	SVOA	10	U	10	10	U	10
3+4 Methylphenol (cresol, m+p)	SVOA	35	U	35	34	U	34
3,3'-Dichlorobenzidine	SVOA	94	U	94	93	U	93
3-Nitroaniline	SVOA	77	U	77	76	U	76
4,6-Dinitro-2-methylphenol	SVOA	350	U	350	340	U	340
4-Bromophenylphenyl ether	SVOA	20	U	20	20	U	20
4-Chloro-3-methylphenol	SVOA	69	U	69	68	U	68
4-Chloroaniline	SVOA	86	U	86	85	U	85
4-Chlorophenylphenyl ether	SVOA	22	U	22	22	U	22
4-Nitroaniline	SVOA	76	U	76	75	U	75
4-Nitrophenol	SVOA	100	U	100	100	U	100
Acenaphthene	SVOA	11	U	11	11	U	11
Acenaphthylene	SVOA	18	U	18	18	U	18
Anthracene	SVOA	18	U	18	18	U	18
Benzo(a)anthracene	SVOA	21	U	21	21	U	21
Benzo(a)pyrene	SVOA	21	U	21	21	U	21
Benzo(b)fluoranthene	SVOA	27	U	27	27	U	27
Benzo(ghi)perylene	SVOA	17	U	17	17	U	17
Benzo(k)fluoranthene	SVOA	42	U	42	41	U	41
Bis(2-chloro-1-methylethyl)ether	SVOA	24	U	24	24	U	24
Bis(2-Chloroethoxy)methane	SVOA	24	U	24	24	U	24
Bis(2-chloroethyl) ether	SVOA	17	U	17	17	U	17
Bis(2-ethylhexyl) phthalate	SVOA	48	U	48	48	U	48
Butylbenzylphthalate	SVOA	45	U	45	45	U	45
Carbazole	SVOA	38	U	38	37	U	37
Chrysene	SVOA	28	U	28	28	U	28
Di-n-butylphthalate	SVOA	30	U	30	30	U	30
Di-n-octylphthalate	SVOA	15	U	15	15	U	15
Dibenz[a,h]anthracene	SVOA	20	U	20	20	U	20
Dibenzofuran	SVOA	21	U	21	21	U	21
Diethyl phthalate	SVOA	27	U	27	27	U	27
Dimethyl phthalate	SVOA	24	U	24	24	U	24
Fluoranthene	SVOA	38	U	38	37	U	37
Fluorene	SVOA	19	U	19	19	U	19
Hexachlorobenzene	SVOA	30	U	30	30	U	30
Hexachlorobutadiene	SVOA	10	U	10	10	U	10
Hexachlorocyclopentadiene	SVOA	52	U	52	52	U	52
Hexachloroethane	SVOA	22	U	22	22	U	22
Indeno(1,2,3-cd)pyrene	SVOA	23	U	23	23	U	23
Isophorone	SVOA	18	U	18	18	U	18
N-Nitroso-di-n-dipropylamine	SVOA	33	U	33	32	U	32
N-Nitrosodiphenylamine	SVOA	22	U	22	22	U	22
Naphthalene	SVOA	33	U	33	32	U	32
Nitrobenzene	SVOA	23	U	23	23	U	23
Pentachlorophenol	SVOA	350	U	350	340	U	340
Phenanthrene	SVOA	18	U	18	18	U	18
Phenol	SVOA	19	U	19	19	U	19
Pyrene	SVOA	13	U	13	13	U	13

Attachment	1	Sheet No.	7 of 8
Originator	C. H. Dobie	Date	03/20/13
Checked	N. K. Schiffern	Date	03/20/13
Calc. No.	0100D-CA-V0462	Rev. No.	0

Attachment 1. 100-D-101 Waste Site Confirmatory Sample Results (Organics).

Constituents	Class	West - J1RFV0			East - J1RFV1		
		2/27/13			2/27/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL
1,1,1-Trichloroethane	VOA	0.26	U	0.26	0.37	U	0.37
1,1,2,2-Tetrachloroethane	VOA	0.30	UX	0.30	0.44	U	0.44
1,1,2-Trichloroethane	VOA	0.44	U	0.44	0.63	U	0.63
1,1-Dichloroethane	VOA	0.10	U	0.10	0.15	U	0.15
1,1-Dichloroethene	VOA	0.29	U	0.29	0.42	U	0.42
1,2-Dichloroethane	VOA	0.35	U	0.35	0.50	U	0.50
1,2-Dichloroethene(Total)	VOA	0.19	U	0.19	0.28	U	0.28
1,2-Dichloropropane	VOA	0.27	U	0.27	0.39	U	0.39
2-Butanone	VOA	0.91	U	0.91	1.3	U	1.3
2-Hexanone	VOA	2.4	U	2.4	3.5	U	3.5
4-Methyl-2-Pentanone	VOA	2.2	U	2.2	3.1	U	3.1
Acetone	VOA	4.4	JB	2.7	7.5	JB	3.8
Benzene	VOA	0.23	U	0.23	0.34	U	0.34
Bromodichloromethane	VOA	0.11	U	0.11	0.16	U	0.16
Bromoform	VOA	0.11	U	0.11	0.16	U	0.16
Bromomethane	VOA	0.25	U	0.25	0.36	U	0.36
Carbon disulfide	VOA	0.21	U	0.21	0.30	U	0.30
Carbon tetrachloride	VOA	0.31	U	0.31	0.45	U	0.45
Chlorobenzene	VOA	0.27	U	0.27	0.39	U	0.39
Chloroethane	VOA	0.44	U	0.44	0.64	U	0.64
Chloroform	VOA	0.14	U	0.14	0.21	U	0.21
Chloromethane	VOA	0.38	U	0.38	0.55	U	0.55
cis-1,3-Dichloropropene	VOA	0.64	U	0.64	0.92	U	0.92
Dibromochloromethane	VOA	0.28	U	0.28	0.41	U	0.41
Ethylbenzene	VOA	0.33	U	0.33	0.48	U	0.48
Methylenechloride	VOA	0.79	U	0.79	1.1	U	1.1
Styrene	VOA	0.31	U	0.31	0.45	U	0.45
Tetrachloroethene	VOA	0.29	U	0.29	0.42	U	0.42
Toluene	VOA	0.58	J	0.34	0.65	J	0.49
trans-1,3-Dichloropropene	VOA	0.33	U	0.33	0.48	U	0.48
Trichloroethene	VOA	0.11	U	0.11	0.16	U	0.16
Vinyl chloride	VOA	0.66	U	0.66	0.96	U	0.96
Xylenes (total)	VOA	0.30	U	0.30	0.44	U	0.44

Attachment	1	Sheet No.	8 of 8
Originator	C. H. Dobie	Date	03/21/13
Checked	N. K. Schiffern	Date	03/21/13
Calc. No.	0100D-CA-V0462	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0489

Subject: 100-D-101 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	C. H. Dobie	N. K. Schiffern	J. D. Skoglie	D. F. Obenauer	6/12/13

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:	C. H. Dobie CD	Date:	3/21/2013	Calc. No.:	0100D-CA-V0489	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	N. K. Schiffern NS	Date:	3/21/2013
Subject:	100-D-101 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-D-101 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), 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) BHI, 2005, *100 Area Analogous Sites RESRAD Evaluation*, Calculation No. 0100X-CA-V0050 Rev 0, Bechtel Hanford, Inc., Richland, Washington.

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

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

4) WCH, 2013, *100-D-101 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation*, 0100D-CA-V0462, 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 (BHI 2005).

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 (BHI 2005).

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:	C. H. Dobie CD	Date:	3/21/2013	Calc. No.:	0100D-CA-V0489	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	N. K. Schiffern NS	Date:	3/21/2013
Subject:	100-D-101 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-D-101 waste site were conservatively calculated for the entire waste site using the maximum value for each analyte in the entire decision unit from the RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation (WCH 2013). Contaminants of potential concern (COPCs) are included in this calculation if they were detected above established Hanford Site background concentrations and have small enough distribution coefficients (K_d) to migrate to groundwater within 1,000 years, as predicted by the generic site model RESRAD model (BHI 2005). Based on this model and a vadose zone thickness of approximately 22 m (72 ft), a K_d value of 3.4 mL/g, or higher, predicts no breakthrough to groundwater within 1,000 years. Based on these criteria, boron hexavalent chromium, acetone, toluene, and nitrogen in nitrate are included in this calculation. All other site nonradionuclide COPCs were either not detected, quantified below background levels, or have a K_d greater than 3.4 mL/g. 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 (mg/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 mg (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 hexavalent chromium 0.358 mg/kg, divided by the noncarcinogenic RAG value of 4.8 mg/kg is 7.5×10^{-2}. 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-D-101 waste site is 9.1×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by 1×10^{-6}. The 100-D-101 waste site does not have any constituents with carcinogen RAGs, the criterion for excess cancer risk is met. Consequently, the criterion for cumulative excess cancer risk for carcinogens is also met.

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

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	C. H. Dobie CD	Date:	3/21/2013	Calc. No.:	0100D-CA-V0489	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	N. K. Schiffern NS	Date:	3/21/2013
Subject:	100-D-101 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 3 of 3	

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-D-101 Waste Site.

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	5.37	320	1.7E-02	--	--
Chromium, hexavalent[c]	0.358	4.8	7.5E-02	--	--
Volatiles					
Acetone	0.0075	720	1.0E-05	--	--
Toluene	0.00065	64	1.0E-05	--	--
Totals					
Cumulative Hazard Quotient:			**9.1E-02**		
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.
[c] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway (WAC) 173-340-750(3), 1996.

CONCLUSION:

The calculation in Table 1 demonstrates that the 100-D-101 waste site meets the requirements for the hazard quotients and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C

DATA QUALITY ASSESSMENT

CONFIRMATORY SAMPLING

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2012b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2012b), the field logbooks (WCH 2012a, WCH 2013), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design, with minimal alterations, as warranted by field conditions.

To ensure quality data, the SAP data assurance requirements and the data validation procedure for chemical analysis (BHI 2000) is used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Confirmatory sample data collected at the 100-D-101 waste site were provided by the laboratories in nine sample delivery groups (SDGs): SDG J01546, SDG J01548, SDG K3912, SDG K3913, SDG K3916, SDG K3917, SDG K3918, SDG K3919 and J01729. SDG K3916 was submitted for third-party validation. Major and minor deficiencies are discussed for the 100-D-101 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MAJOR DEFICIENCIES

Samples were collected between May 31 and June 5, 2012, and were analyzed between June 13 and June 19, 2012. Due to the holding time exceedances of greater than twice the limit (48 hours) in the method 300.0 anion analysis, third-party validation qualified the undetected nitrite results in SDG K3916 as rejected, with "R" flags. Additionally all of the method 300.0 detected nitrate, nitrite, and orthophosphate results are qualified as estimated, with "J" flags. This result was anticipated, and EPA analytical method 353.2 was also requested to provide acceptable nitrate/nitrite data for decision-making purposes. Therefore, the estimated and rejected data for nitrate and nitrite and do not hinder the evaluation of the 100-D-101 waste site. Phosphate is not a regulated chemical under *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act-Cleanup."

In SDGs K3913, K3918, and K3919, samples J1PPP6, J1PPR1, and J1PPP1 through J1PPP3 were collected from test pit 1, test trench 1, and test pit 2, respectively. Due to the nature of the semivolatile organic compound (SVOC) extracts produced from these samples, the laboratory diluted the extracts prior to analysis. Subsequently, the matrix spikes (MSs) prepared from these samples were similarly diluted.

As a result of these dilutions, in SDG K3913 three analytes (2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, and hexachlorocyclopentadiene), which were all undetected in the field samples, were also undetected or had unacceptably low recoveries in the MS results. These data have been rejected by the project.

Similarly, dilutions in SDG K3918 resulted in five analytes (2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, 4-nitrophenol, and pentachlorophenol), all undetected in the field samples, undetected or had unacceptably low recoveries in the MS results. These data have been rejected by the project.

Also similarly, dilutions in SDG K3919 resulted in two analytes (2,4-dinitrophenol and hexachlorocyclopentadiene), all undetected in the field samples, undetected or had unacceptably low recoveries in the MS results. These data have been rejected by the project.

These data rejections do not suggest that these analytes were present in the field samples. The SVOC analysis was added to the analytical list for the 100-D-101 waste site as a conservative approach due to low concentrations of bis(2-ethylhexyl)phalate and di-n-butyl phthalate detected in the associated confirmatory data for the 100-D-73 and 100-D-76 waste sites.

None of the rejected compounds (2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, 4-nitrophenol, and pentachlorophenol) were detected in the 100-D-73 and 100-D-76 waste site confirmatory data, nor were they detected in the remainder of the 100-D-101 SDGs where acceptable MS recoveries were achieved. The history of the 100-D-101 waste site, process knowledge, and professional judgment also do not suggest that 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, 4-nitrophenol, and pentachlorophenol contamination is present at the 100-D-101 waste site. Therefore, it is concluded the resulting data set is sufficient for the intended purpose of waste site closure.

MINOR DEFICIENCIES

SDG J01546

This SDG comprises soil sample J1PPR6 collected from test pit 1 and analyzed for hexavalent chromium.

No minor deficiencies were found in SDG J01546.

SDG J01548

This SDG comprises soil sample J1PPT1, collected from the contents in the center of test trench 1. The sample was analyzed for hexavalent chromium.

No minor deficiencies were found in SDG J01546.

SDG K3912

This SDG comprises soil sample J1PPM6, collected from test pit 1, the former location of the acid neutralization pit. The sample was analyzed for inductively coupled plasma (ICP) metals, mercury, nitrate/nitrite, hydrogen ion concentration (pH), SVOCs, and ion chromatography (IC) anions.

In the SVOC analysis, the laboratory control sample (LCS) recovery for 2,4-dinitrophenol is below the laboratory and project recovery acceptance criteria. The LCS recoveries for 4,6-dinitro-2-methylphenol, 4-chloroaniline, hexachlorocyclopentadiene, and pentachlorophenol are within the laboratory recovery acceptance criteria, but below the project recovery limits at 24%, 42%, 27%, and 41%, respectively. Results for these analytes may be considered estimated. The data are usable for decision-making purposes.

In the SVOC analysis, the MS and the matrix spike duplicate (MSD) recoveries for 2,4,6-trichlorophenol (28%, 25%), 4-chloroaniline (39%, 42%), 4-nirophenol (47%, 30%), and hexachlorocyclopentadiene (24%, 38%) are all below quality assurance (QA) limits. All results for these analytes in SDG K3912 may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, relative percent differences (RPDs) in the MS/MSD pair for 4-nitrophenol and hexachlorocyclopentadiene are above the acceptance criteria (30%) at 44%. All 4-nitrophenol and hexachlorocyclopentadiene results in SDG K3912 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium was detected in the method blank (MB) at very low levels. Calcium is not a regulated compound or a contaminant of potential concern (COPC) for the 100-D-101 waste site. All calcium results in SDG K3912 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPDs for boron, chromium, and silicon are above the acceptance criteria (30%) at 34.1%, 41.7%, and 46.4, respectively. All boron, chromium, and silicon results in SDG K3912 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for 10 analytes (aluminum [-39.6%], antimony [49.3%], beryllium [69.1%], boron [68.1%], cadmium [67.3%], calcium [68.0%], chromium [64.0%], iron, lead [64.6%], and silver [67.7%]). 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 variability of the native concentration rather than a measure of the recovery from the sample. All other analytes do not have mismatched spike and native concentrations in the MS. The method quantitation is confirmed by acceptable LCS results. All antimony, beryllium, boron, cadmium, chromium, lead, and silver results for SDG K3912 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate are exceeded by more than twice the acceptable range for all samples. The nondetected nitrate, nitrite, and orthophosphate results are discussed in the "Major Deficiencies" section above. All detected nitrate, nitrite, and orthophosphate results in SDG 3912 may be considered estimated. Estimated data are usable for decision-making purposes.

In the IC anions analysis, the laboratory duplicate RPD for nitrate and nitrite as nitrogen are above the acceptance criteria (30%) at 37.9%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All nitrate and nitrite as nitrogen results in SDG K3912 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K3913

This SDG comprises stained soil sample J1PPP6, collected from test pit 1 at stained soil within the former location of the acid neutralization pit. The sample was analyzed for ICP metals, mercury, nitrate/nitrite, pH, SVOCs, and IC anions.

In the SVOC analysis, the LCS recovery for 2,4-dinitrophenol is below the laboratory and project recovery limits at 13%. The LCS recoveries for 2,4,6-trichlorophenol, 4,6-dinitro-2-methylphenol, 4-chloroaniline, hexachlorocyclopentadiene, and pentachlorophenol are within the laboratory recovery acceptance criteria, but below the project recovery limits at 49%, 24%, 42%, 27%, and 41%, respectively. All results in SDG K3913 for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, data for three analytes (2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, and hexachlorocyclopentadiene) were rejected; please refer to the "Major Deficiency" section above.

In the SVOC analysis, 20 of the 128 MS and MSD recoveries are outside the acceptance criteria. The MS and MSD recoveries for 3,3-dichlorobenzidine (30%, 36%) are below QA limits. The 4-chloro-3-methylphenol MS recovery is 46%. The 4-nitroaniline MS recovery is 40%. The MS and MSD recoveries for 4-nitrophenol are (28%, 39%) and bis(2-ethylhexyl)phthalate (35%, 49%) are all below the QA limits. The carbazole MS and MSD recoveries are above the quality control (QC) limits, at 156% and 176%, respectively. The di-n-octyl phthalate MS and MSD recoveries are 45% and 29%, respectively. The pentachlorophenol MS and MSD recoveries are 25% and 14%, respectively. Analytical results for all of these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, 13 of the laboratories' MS/MSD RPDs are above the acceptance criteria of 30%. The RPDs for these analytes are as follows: 2,4,6-trichlorophenol (41%), 2,4-dinitrophenol (86%), 2,6-dinitrotoluene (38%), 2-methylnaphthalene (32%), 4,6-dinitro-2-methylphenol (124%), 4-nitroaniline (31%), 4-nitrophenol (33%), acenaphthylene (34%), bis(2-ethylhexyl)phthalate (33%), di-n-octyl phthalate (42%), indeno(1,2,3-cd)pyrene (37%), nitrobenzene (35%), and pentachlorophenol (57%). Results for these analytes in SDG K3913 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium was detected in the MB at very low levels. Calcium is not a regulated compound or a COPC for the 100-D-101 waste site. All calcium results in SDG K3913 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPD for nickel is above the acceptance criteria of 30%, at 50.9%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All nickel results in SDG K3913 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for 13 analytes (aluminum, antimony, beryllium, boron, cadmium, cobalt, iron, lead, magnesium, manganese, nickel, selenium, and silver). For aluminum, iron, magnesium, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Most of the analytes did not have mismatched spike and native concentrations in the MS. The MS recoveries are as follows: antimony (37.8%), beryllium (68.3%), boron (66.0%), cadmium (66.4%), cobalt (60.9%), lead (64.7%), nickel (60.0%), selenium (69.3%), and silver (69.7%). All antimony, beryllium, boron, cadmium, cobalt, lead, nickel, selenium, and silver results for SDG K3913 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anion analysis, the holding times for nitrate, nitrite, and orthophosphate are exceeded by more than twice the acceptable limit for all samples. The nondetected nitrate, nitrite, and orthophosphate results are discussed in the "Major Deficiencies" section above. All detected nitrate, nitrite, and orthophosphate results in SDG 3913 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K3916

This SDG comprises three soil samples (J1PPN6 through J1PPN8) collected from three focused sampling locations within the 100-D-101 test pit 3 and test trench 1. Samples were analyzed for ICP metals, mercury, nitrate/nitrite, pH, SVOCs, and IC anions. SDG K3916 was submitted for third-party validation. Minor deficiencies are as follows:

In the SVOC analysis, the LCS recoveries are outside the QC limits for 2,4,6-trichlorophenol (40%), 4-chloroanaline (42%), and hexachlorocyclopentadiene (16%). All of the data for these

analytes in SDG K3916 were qualified by third-party validation as estimated with "J" flags. Estimated data are acceptable for decision-making purposes.

In the SVOC analysis, the MS recoveries are out of the laboratory and project acceptance criteria for 1,2,4-trichlorobenzene (39%), 1,2-dichlorobenzene (43%), 1,3-dichlorobenzene (40%), 1,4-dichlororbenzene (41%), 2,4,5-trichlorophenol (45%), 2,4,6-trichlorophenol (41%), 2,4-dichlorophenol (45%), 2,4-dimethylphenol (42%), 2,4-dinitrophenol (27%), 2,4-diinitrotoluene (47%), 2-chloronaphthalene (46%), 2-chlorophenol (44%), 2-methylnaphthalene (44%), 2-methylphenol (45%), 2-nitrophenol (42%), 3,3-dichlorobenzicine (31%), 4,6-dinitro-2-methylphenol (46%), 4-chloro-3-methylphenol (46%), 4-chloroanaline (36%), 4-chlorophenyl phenyl ether (48%), 3-and/or 4-methylpehnol (44%), 4-nitroanaline (49%), 4-nitrophenol (23%), acenaphthene (47%), acenaphthylene (42%), benzo(a)pyrene (46%), benzo(g,h,i)perylene (48%), bis(2-chloroethoxy)methane (44%), bis(2-chloroethyl)ether (43%), bis(2-chloroisopropyl)ether (43%), bis(2-ethylhexyl)phthalate (49%), dibenz(a,h)anthracene (27%), dimethyl phthalate (48%), di-n-octyl phthalate (48%), hexachlorobutadiene (44%), hexachlorocyclopentadiene (22%), hexachloroethane (40%), indeno(1,2,3-cd)pyrene (40%), isophorone (44%), naphthalene (49%), nitrobenzene (42%), n-nitrosodi-n-propylamine (47%), pentachlorophenol (25%), and phenol (46%). All of these analytes for SDG K3916 were considered estimated and flagged "J" by third-party validation due to the MS recoveries below the QC limits. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MSD recoveries are out of laboratory and project acceptance criteria for 2,4,6-trichlorophenol (43%), 2,4-dinitrophenol (30%), 4,6-dinitro-2-methylphenol (49%), 4-nitrophenol (37%), dibenz(a,h)anthacene (41%), hexachlorocyclopentadiene (26%), and pentachlorophenol (28%). All of these analytes for SDG K3916 were qualified as estimated, with "J" flags, by third-party validation. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the RPDs are outside the project QC limit (<30%) for 1,2,4-trichlorobenzene (36%), 1,2-dichlorobenzene (32%), 1,3-dichlorobenzene (32%), 1,4-dichloeobenzene (35%), 2,4-dinitrotoluene (31%), 2-chlorophenol (33%), 2-methylphenol (38%), 3,3-dichlorobenzicine (47%), 3-nitroanaline (43%), 4-chloro-3-methylphenol (32%), 4-chloroanaline (46%), 3-and/or 4-methylphenol (36%), 4-nitroanaline (44%), 4-nitrophenol (48%), benzo(a)pyrene (33%), benzo(g,h,i)perylene (33%), bis(2-chloroethozy)methane (32%), bis(2-chloroethyl)ether (36%), bis(2-chloroisopropyl)ether (41%), bis(2-ethylhexyl)phthalate (34%), carbazole (33%), dibenz(a,h)anthracene (41%), di-n-octyl phthalate (38%), hexachloroethane (33%), indeno(1,2,3-cd)pyrene (42%), nitrobenzene (35%), n-nitrosodi-n-propylamine (35%), and phenol (32%). Data for all of these analytes for SDG K3916 were qualified estimated, with "J" flags, by third-party validation due to RPDs outside the QC limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium and magnesium were detected at low levels, less than 1/25th of the most stringent cleanup limit in the MB. Due to MB contamination all detected calcium and molybdenum results in SDG K3916 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for eight analytes (aluminum, antimony, calcium, iron, lead, manganese, silicon, and vanadium). For aluminum, iron, manganese, and silicon, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony, calcium, lead, and vanadium did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony, calcium, lead, and vanadium are 33.6%, 56.4%, 68.8%, and 65.7%, respectively. All antimony, calcium, lead, and vanadium results for SDG K3916 are considered estimated and flagged "J" by third-party validation due to the MS recoveries below the QC limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recoveries are outside the QC limits for aluminum (152%) and silicon (151%). This may suggest a high bias in the field sample data for aluminum and silicon. All antimony and silicon data in SDG K3916 were qualified by third-party validation as estimated with "J" flags. High biased and estimated data are acceptable for decision-making purposes.

SDG K3917

This SDG comprises two soil samples (J1PPM7 and J1PPM8), collected from two focused sampling locations within test pits 1 and 2. Samples were analyzed for ICP metals, mercury, nitrate/nitrite, pH, SVOCs, and IC anions. In addition, one equipment blank (J1PPM9) was collected and analyzed for ICP metals and mercury.

In the SVOC analysis, the LCS recoveries for 2,4,6-trichlorophenol, 2,4-dinitrophenol, 4-chloroaniline, and hexachlorocyclopentadiene are outside the project acceptance criteria at 40%, 37%, 42% and 16%, respectively. All results for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, 17 of 128 MS and MSD recoveries are outside the acceptance criteria. The analytes with low MS recoveries are as follows: 1,2,4-tirchlorobenzene (47%), 1,3-dichlorobenzene (48%), 1,4-dichlorobenzene (49%), 2,4,6-trichlorophenol (48%), 2,4-dichlorophenol (49%), 2,4-dimethylphenol (45%), 2-methylnaphthalene (48%), 2-nitrophenol (49%), 4-chloroaniline (45%), acenaphthylene (49%), bis(2-chloroethoxy)methane (48%), dibenz(a,h)anthracene (42%), hexachlorocyclopentadiene (17%), hexachloroethane (49%), isophorone (46%), and nitrobenzene (47%). The MSD recovery for hexachlorocyclopentadiene is 38%. All results for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, most of the laboratory MSD RPDs are above the acceptance criteria of 30%. The RPDs for most analytes range between 30% and 58%, with the exception of hexachlorocyclopentadiene with an RPD of 75%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All of these results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium and magnesium are detected in the MB, at very low levels. Calcium and magnesium are not regulated compounds or COPCs for the 100-D-101 waste site. Field sample results are significantly higher than concentrations detected in the MB; therefore, there is no significant impact to these analytes. Data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for 16 analytes (aluminum, antimony, beryllium, boron, cadmium, calcium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, silicon, silver, and vanadium). For aluminum, calcium, copper, iron, silicon, and vanadium, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Most of the analytes did not have mismatched spike and native concentrations in the MS. The MS recoveries for these analytes are as follows: antimony (454%), beryllium (69.0%), boron (64.8%), cadmium (69.9%), cobalt (66.0%), lead (60.9%), molybdenum (69.3%), nickel (64.7%), selenium (67.4%), and silver (65.0%). All antimony, beryllium, boron, cadmium, cobalt, lead, molybdenum, nickel, selenium, and silver results for SDG K3917 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range. The nondetected nitrate, nitrite, and orthophosphate results are discussed in the "Major Deficiencies" section above. All detected nitrate, nitrite, and orthophosphate results in SDG 3917 may be considered estimated. Estimated data are usable for decision-making purposes.

In the IC anions analysis, the laboratory duplicate RPD for orthophosphate is above the acceptance criteria (30%) at 31.5%. Orthophosphate is not a regulated chemical and is not a COPC for the 100-D-101 waste site. All orthophosphate results in SDG K3917 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K3918

This SDG comprises soil sample J1PPR1, collected from the center of test trench 1. The sample was analyzed for ICP metals, mercury, nitrate/nitrite, pH, SVOCs, and IC anions.

In the SVOC analysis, the LCS recoveries for 2,4,6-trichlorophenol, 2,4-dinitrophenol, 4-chloroaniline, and hexachlorocyclopentadiene are outside the project acceptance criteria at 40%, 37%, 42%, and 16%, respectively. All results for analytes with low LCS recoveries may be considered estimated. The data are usable for decision-making purposes.

In the SVOC analysis, data for five analytes (2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, 4-nitrophenol, and pentachlorophenol) were rejected; please refer to the "Major Deficiency" section above.

In the SVOC analysis, 17 of the 128 MS and MSD recoveries are outside the acceptance criteria. The dibenz(a,h)anthracene MS and MSD recoveries are 43% and 34%, respectively. The following are analytes with low MSD recoveries: 1,3-dichlorobenzene (48%),

1,4-dichlorobenzene (49%), 2,4,5-trichlorophenol (38%), 2,3,6-trichlorophenol (33%), 2,4-dichlorophenol (22%), 2,4-dimethylphenol (13%), 2-methylphenol (33%), 3,3'-dichlorobenzidiene (8%), 4-chloroaniline (48%), 3-and/or-methylphenol (14%), 4-nitroaniline (39%), bis(2-ethylhexyl)phthalate (42%), di-n-octyl phthalate (30%), and hexachloroethane (46%). The 4-chloro-3-methylphenol MSD recovery was not reported because the result was undetected. Analytical results for all of these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, 18 of the laboratory MSD RPDs are above the acceptance criteria of 30%. The RPDs for these analytes are as follows: 1,3-dichlorobenzene (37%), 1,4-dichlorobenzene (37%), 2,4,5-trichlorophenol (53%), 2,4,5-trichlorophenol (44%), 2,4-dichlorophenol (99%), 2,4-dimethylphenol (121%), 2-methylphenol (63%), 3,3-dichlorobenzidiene (157%), 4,6-dinitro-2-methylphenol (170%), 4-chloroaniline (35%), 3-and/or 4-methylphenol (131%), 4-nitroaniline (57%), bis(2-ethylhexyl)phthalate (87%), butyl benzyl phthalate (49%), carbazole (33%), di-n-octyl phthalate (109%), hexachlorocyclopentadiene (119%), and n-nitrosodi-n-propylamine (38%). All of the data associated with these results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium and magnesium were detected in the MB at very low levels. Calcium and magnesium are not regulated compounds or COPCs for the 100-D-101 waste site. All calcium and magnesium results in SDG K3917 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPDs for arsenic, boron, chromium, copper, iron, molybdenum, and nickel are above the acceptance criteria of 30%, at 55.1%, 31.5%, 55.4%, 78.0%, 58.0%, 98.2%, and 57.7% respectively. All analytes with RPD results above the acceptance criteria in SDG K3918 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for six analytes (aluminum, antimony, iron, lead, nickel, and silicon). For aluminum, iron, lead, and silicon, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. The rest of the analytes did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and nickel are 36.9% and 69.4%, respectively. All antimony and nickel data in SDG K3918 may be considered estimated due to the MS recoveries outside of the QC limits. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range. The nondetected nitrate, nitrite, and orthophosphate results are discussed in the "Major Deficiencies" section above. All detected nitrate, nitrite, and orthophosphate results in SDG 3918 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K3919

This SDG comprises three soil samples (J1PPP1 through J1PPP3) collected from two focused sampling locations within the 100-D-101 test pit 2. Samples were analyzed for ICP metals, mercury, nitrate/nitrite, pH, SVOCs, and IC anions. This SDG includes one field duplicate pair (J1PPP2/J1PPP3). Minor deficiencies are as follows:

In the SVOC analysis, the LCS recoveries for 2,4,6-trichlorophenol, 2,4-dinitrophenol, 4-chloroaniline, and hexachlorocyclopentadiene are outside the project acceptance criteria at 40%, 37%, 42%, and 16%, respectively. All results for these analytes may be considered estimated. The data are usable for decision-making purposes.

In the SVOC analysis, data for two analytes (2,4-dinitrophenol and hexachlorocyclopentadiene) were rejected; please refer to the "Major Deficiency" section above.

In the SVOC analysis, the MS and MSD recoveries for 4,6-dinitro-2-methylphenol (27%, 26%), 4-nitrophenol (21%, 35%), and pentachlorophenol (26%, 36%) are all below the laboratory QA limits. The MS recoveries for fluoranthene and pyrene are 45% and 19%, respectively. Analytical results for all of these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MS/MSD RPDs for 4-nitrophenol, chrysene, and pentachlorophenol are above the acceptance criteria (30%) at 50%, 33%, and 34%, respectively. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All 4-nitrophenol, chrysene, and pentachlorophenol results in SDG K3919 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium, magnesium, and molybdenum were detected in the MB at very low levels. Calcium and magnesium are not regulated compounds or COPCs for the 100-D-101 waste site. Molybdenum was also detected in the field samples at very low concentrations, significantly below the most stringent cleanup limits. All calcium, magnesium, and molybdenum results in SDG K3919 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPDs for arsenic, boron, and calcium are above the acceptance criteria of 30%, at 35.6%, 39.4%, and 89.5% respectively. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All analytes with RPD results above the acceptance criteria in SDG K3919 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for 16 analytes (aluminum, antimony, arsenic, boron, cadmium, calcium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, potassium, selenium, and silicon). For aluminum, calcium, copper, iron, manganese, and silicon, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery

from the sample. The rest of the analytes did not have mismatched spike and native concentrations in the MS. The MS recoveries for these analytes are as follows: antimony (36.0%), arsenic (69.6%), boron (65.2%), cadmium (69.9%), cobalt (66.4%), lead (63.7%), molybdenum (68.8%), nickel (65.4%), potassium (68.0%), and selenium (65.4%). All antimony, arsenic, boron, cadmium, cobalt, lead, molybdenum, nickel, potassium, and selenium results for SDG K3919 may be considered estimated. Estimated data are usable for decision-making purposes.

In the mercury analysis, the laboratory duplicate RPD for mercury is above the acceptance criteria of 30%, at 39.4%. All mercury results in SDG K3919 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All method 300.0 detected nitrate, nitrite, and orthophosphate results in SDG 3919 may be considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrate, nitrite, and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG J01729

This SDG comprises two soil samples (J1RFV0 and J1RFV1) collected from two focused sampling locations within the 100-D-101 waste site test trench 1. Samples were analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, pH, SVOCs, volatile organic compounds (VOCs) and gamma energy analysis (GEA). VOCs and radionuclides are not 100-D-101 waste site COPCs. The VOC and GEA analysis were erroneously requested for these two samples during confirmatory sampling. Minor deficiencies are as follows:

In the VOC analysis, acetone was detected in the MB. Similar results are detected in the field samples. All acetone results in SDG J01729 may be considered estimated. Estimated data are useable for decision-making purposes.

In the VOC analysis, the MS recoveries for 27 of the 33 analytes were below the QC limits. The MSD recoveries were outside of the QC limits for 28 out of 33 analytes. The results for these analytes may be considered estimated. The VOCs were undetected with field instruments during confirmatory sampling. The VOCs were erroneously requested for analysis, and are not site COPCs. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the LCS recovery for 3,3'-dichlorobenzidine (42%) is below the QC limits. All 3.3'dechlorobenzidine data for SDG J01729 may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, chromium was detected in the MB, at very low levels. Field sample results for chromium are significantly higher than concentrations detected in MB; therefore there is no significant impact to the field sample data. These data are useable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project QC limit, at 10%. All silicon results in SDG J01729 may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries were outside the project acceptance criteria for five analytes [(aluminum (972%), antimony (52%), iron (1249%), manganese (143%), silicon (19%)]. For aluminum, iron and manganese the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. All antimony and silicon results for SDG J01729 may be considered estimated. Estimated data are useable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent differences 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 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 C-1. The main and QA/QC sample results are presented in Appendix B.

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

Sample Area	Main Sample	Duplicate Sample
Test trench 2, underlying soil – north end	J1PPP2	J1PPP3

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 COPC. Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit (TDL). Relative percent differences of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The calculation brief in Appendix B provides details on duplicate pair evaluation and RPD calculation.

The calculated calcium (31.9%) RPD for the duplicate analysis is above the acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. There is no indication that the analytical system was operating out of control. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. No sample results required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-D-101 waste site confirmatory 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 100-D-101 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

The confirmatory 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 confirmatory sample analytical data are also summarized in Appendix B.

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