WASTE SITE RECLASSIFICATION FORM		
Date Submitted: <u>4/14/08</u> Originator: <u>J. M. Capron</u> Phone: <u>372-9227</u>	Operable Unit(s): <u>300-FF-2</u> Waste Site Code: <u>600-243</u> Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: <u>2007-033</u>
<p>This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.</p>		
<p><u>Description of current waste site condition:</u></p> <p>The 600-243 waste site consisted of a bioremediation pad for petroleum-contaminated soils resulting from the 1100 Area Underground Storage Tank (UST) upgrades in 1994. Remediation and verification sampling of this site have been performed in accordance with remedial action objectives and goals established by the <i>Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington</i> (300-FF-2 Operable Unit ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved (1) evaluating the site using available process information, (2) remediating the site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to Interim Closed Out.</p> <p><u>Basis for reclassification:</u></p> <p>In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the 300-FF-2 Operable Unit ROD. The results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the <i>Remaining Sites Verification Package for the 600-243 Petroleum Contaminated Soil Bioremediation Pad</i> (attached).</p> <p><u>Waste Site Controls:</u> Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M requirements: Yes ☐ No ☒ If any of the Waste Site Controls are checked Yes specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.</p>		
M. S. French DOE Federal Project Director (printed)	Signature	<u>11-7-08</u> Date
N/A Ecology Project Manager (printed)	Signature	Date
A. L. Boyd EPA Project Manager (printed)	Signature	<u>10-29-08</u> Date

**REMAINING SITES VERIFICATION PACKAGE FOR THE 600-243
PETROLEUM-CONTAMINATED SOIL BIOREMEDIATION PAD**

Attachment to Waste Site Reclassification Form 2007-033

October 2008

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-243 PETROLEUM-CONTAMINATED SOIL BIOREMEDIATION PAD

EXECUTIVE SUMMARY

The 600-243 waste site is located within the 300-FF-2 Operable Unit on the Hanford Site in southeastern Washington State. The site was used as a bioremediation pad for petroleum-contaminated soils resulting from the 1100 Area underground storage tank (UST) upgrades in 1994. The petroleum-contaminated soil that made up this waste site was placed on a plastic liner. Soil surrounding and underneath this plastic liner contains significant amounts of coal ash. Additionally, there is evidence that oils had been applied in the general area of the 600-243 waste site, most likely for dust suppression.

Site excavation and waste disposal are complete, and the exposed surfaces have been sampled and analyzed to verify attainment of the remedial action goals. Results of the sampling, laboratory analyses, and data evaluations for the 600-243 site indicate that all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met for unrestricted land use (Table ES-1). Results of this evaluation demonstrate that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). This site does not have a deep zone; therefore, no deep zone institutional controls are required.

The site meets cleanup standards and has been reclassified as Interim Closed Out in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline *Tri-Party Agreement Handbook Management Procedures*, TPA-MP-14 procedure (DOE-RL 2007).

Remedial action at the waste site was performed in August 2007. The contaminated soil and liner were removed during excavation, resulting in disposal of approximately 2,134 bank cubic meters (BCM) (2,791 bank cubic yards [BCY]) of contaminated materials to the Environmental Restoration Disposal Facility.

Verification sampling for the 600-243 waste site was performed in October 2007 to collect data to determine if the remedial action goals had been met. The contaminants of potential concern (COPCs) for verification sampling included petroleum hydrocarbons in the diesel and motor oil ranges, benzo(k)fluoranthene, chrysene, fluoranthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, polychlorinated biphenyls, and lead (WCH 2007b). The coal ash that had originally been underneath the waste site was exposed after remediation. This material affected the verification sampling results for the waste site as the ash contains multiple metals. While a limited sampling of surrounding coal ash was undertaken, a full evaluation of the coal ash underlying and surrounding the waste is outside the scope of this remaining sites verification package. Radiological field surveys were performed to ensure that radiological contamination was not present at the waste site.

A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the 600-243 waste site in accordance with the TPA-MP-14 procedure (DOE-RL 2007).

**Table ES-1. Summary of Remedial Action Goals for the 600-243
Waste Site – Unrestricted Land Use. (2 Pages).**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15-mrem/yr dose rate above background over 1,000 years.	There are no radionuclide COPCs.	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 less than 1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (3.1×10^{-1}) is less than 1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for carcinogens is less than 1×10^{-6} .	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk (9.1×10^{-7}) is less than 1×10^{-5} .	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	There are no radionuclide COPCs.	NA
	Attain national primary drinking water standards: ^a 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	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		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L).		

**Table ES-1. Summary of Remedial Action Goals for the 600-243
Waste Site – Unrestricted Land Use. (2 Pages).**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of selenium, diesel range TPH, and motor oil range TPH are above the groundwater and river protection soil RAGs. However, RESRAD modeling predicts these constituents will not reach groundwater (and, therefore, 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 *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2004a).

^d RESRAD modeling predicts that compounds having a K_d greater than 7 mL/g will not migrate through the 12 m (39-ft) thick vadose zone between the shallow zone and groundwater at this site (BHI 2005a). The COPCs that failed groundwater and river protection RAGs at the 600-243 waste site have K_d values of greater than 22 mL/g and are not predicted to reach groundwater or the Columbia River within 1,000 years.

COPC = contaminant of potential concern

MCL = maximum contaminant level (drinking water standard)

NA = not applicable

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

TPH = total petroleum hydrocarbons

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2004a) and the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (ROD) (EPA 2001). 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 contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

Soil cleanup levels were established in the interim action ROD 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 waste site contaminants of concern and other constituents. Screening levels were exceeded for antimony, barium, boron, cadmium, copper, lead, manganese, selenium, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below Hanford Site background levels, it is believed that the presence of these constituents does not pose a risk to ecological receptors. The remaining metals that exceed ecological risk screening levels are due to coal ash, which is ubiquitous in the general area of the 600-243 waste site. A more complete quantitative ecological risk assessment

will be presented in the baseline risk assessment for the river corridor portion of the Hanford Site and will be used to support the final closeout decision for this waste site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-243 PETROLEUM-CONTAMINATED SOIL BIOREMEDIATION PAD

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 600-243 petroleum-contaminated soil bioremediation pad meets the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2004b) and the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (ROD) (EPA 2001). 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 contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

A comparison against ecological risk screening levels has been made for the site contaminants of concern and other constituents. Screening levels were exceeded for antimony, barium, boron, cadmium, copper, lead, manganese, selenium, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below Hanford Site background levels, it is believed that the presence of these constituents does not pose a risk to ecological receptors. The remaining metals that exceed ecological risk screening levels are due to coal ash, which is ubiquitous in the general area of the 600-243 waste site. The bioremediation pad had been placed directly on coal ash, and the verification sample results reflect the composition of the coal ash. A more complete quantitative ecological risk assessment will be presented in the baseline risk assessment for the river corridor portion of the Hanford Site and will be used to support the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 600-243 petroleum-contaminated soil bioremediation pad, part of the 300-FF-2 Operable Unit, is located approximately 300 m (328 yd) west of the 300 Area and south of a dead-end dirt road that heads west from Route 4 South (see Figure 1). The waste site was a treatment facility for petroleum-contaminated soil that was removed during excavation of the 1100 Area underground storage tanks (USTs) in 1994 as part of Project LO-44, UST Removals. Nutrients and moisture were periodically added to the soil to facilitate bioremediation of petroleum hydrocarbons.

The soil was staged on a heavy, black plastic liner and surrounded with a 0.9 m (3-ft) soil berm as seen in Figure 2. The site, including the berm, was 48.5 m (159 ft) long and 38.7 m (127 ft) wide. The average depth of the staged soil was 0.6 m (2 ft) for an approximate volume of 991 m³ (1,296 yd³).

Figure 1. 600-243 Waste Site Location Map.

Figure 2. Photograph of the 600-243 Waste Site Including Plastic-Covered Soil Berm (June 2007).

In 1995, eight samples from the bioremediation pile were collected and analyzed for gasoline, diesel, and heavy oils. The original data for the 1995 samples could not be located; however, a presentation on the bioremediation pad status using these data was prepared by Fluor Hanford in 2003 (Appendix A). The presentation reported that all samples for gasoline range total petroleum hydrocarbons (TPH) were below the method detection limit (MDL) of 20 mg/kg.

A second sampling for diesel and heavy oils performed in 2001 showed the presence of heavy oils (motor oils) exceeding the Model Toxics Control Act (MTCA) 1996 Method A cleanup levels for soil of 200 mg/kg TPH based on protection of groundwater (Appendix B). Total petroleum hydrocarbons in the diesel range were not detected above the MDL of 25 mg/kg.

Sampling to support waste characterization was conducted in July 2007 at the 600-243 waste site prior to remediation. These results are provided in Appendix C and confirmed the 2001 findings that petroleum hydrocarbons were present in the motor oil range, and diesel range organics were not detected. Results from metal analyses indicated levels at or below Hanford Site background for all metals except lead (DOE-RL 2001).

PRE-REMEDATION ACTIVITIES

Nonintrusive Investigation Results

A site walkdown of the 600-243 waste site was conducted in June 2007. Reconnaissance surveys for ecological and cultural resources were performed in March 2006 and updated in May 2007 (Teel 2007). No species of concern were identified during the survey, and no impacts to ecological resources were anticipated from the remediation of the 600-243 waste site.

A geophysical survey was performed in July 2007 to support planned soil removal activities. The geophysical interpretation showed an electrical conductivity anomaly beneath the plastic liner of the bioremediation pad. The anomaly appeared inside and outside of the site boundary (Figure 3) and was believed to be caused by the coal ash that was placed at this location prior to its use as a soil bioremediation pad. The soil in areas surrounding the waste site also visually appeared to contain significant quantities of coal ash.

Confirmatory Sample Design

Based on process knowledge and historical information, the 600-243 waste site was determined to require remediation and no confirmatory sampling was performed.

Waste Characterization Sampling

Samples of the bioremediated soil pile located at the 600-243 waste site were collected on July 24, 2007, and analyzed for metals by inductively coupled plasma (ICP), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), northwest total petroleum hydrocarbons (diesel and motor oil range) (NWTPH-Dx+), and volatile organic compounds (VOCs) (WCH 2007a) to support waste characterization and disposal. Results of these samples contain only a single result of a metal above Hanford Site background (lead) and no results above remedial action goals (RAGS) for petroleum hydrocarbons. The results of these samples are provided in Appendix C.

Figure 3. Outline of Geophysical Anomaly at the 600-243 Waste Site.

REMEDIAL ACTION SUMMARY

The 600-243 waste site was remediated in August 2007. Approximately 2,134 BCM (2,791 BCY) of soil and plastic was removed via direct loadout and disposed to the Environmental Restoration Disposal Facility (ERDF).

Visual observation of the area surrounding the 600-243 waste site established that this area was used for placement of coal ash. As expected based on the geophysical investigation and observations of the soil surrounding the waste site, a significant amount of coal ash was found below the plastic liner of the waste site during remediation (Figures 4 and 5).

A Global Positioning Environmental Radiological Surveyor (GPERS) with instrumentation specific to the detection of radiation associated with beta- and gamma-emitting radionuclides was used to perform final radiological surveys of the site after remediation (Figures 6 and 7).

Figure 4. View of Coal Ash in the 600-243 Waste Site During Remediation.

Figure 5. View of Coal Ash in the 600-243 Waste Site During Remediation.

Figure 6. Beta Track Survey of the 600-243 Waste Site.

Figure 7. Gamma Track Survey of the 600-243 Waste Site.

VERIFICATION SAMPLING ACTIVITIES

Remedial action goals are the specific numeric goals against which the cleanup verification data are evaluated to demonstrate attainment of the remedial action objectives for the site.

Verification sampling for the 600-243 waste site was performed on October 1, 2007 (WCH 2007a) to collect data to determine if the RAGs had been met. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern

The waste site contaminants of potential concern (COPCs) for the 600-243 waste site are described in the verification work instruction (WCH 2007b). COPCs for verification sampling included petroleum hydrocarbons in the diesel and motor oil ranges, benzo(k)fluoranthene, chrysene, fluoranthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, PCBs, and lead. Radionuclides were not COPCs for this site; however, the presence of radiological contaminants was evaluated using field radiological survey instrumentation during field activities. All analyses are discussed in the Data Evaluation portion of this remaining sites verification package.

Verification Sample Design

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples that were collected. The 600-243 waste site excavation footprint was a single decision unit for the purpose of verification sampling.

Verification Sampling – Excavation Footprint

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% upper confidence limit (UCL) on the sample mean, with the cleanup level. Therefore, a statistical sampling design is the preferred verification sampling approach for this site because the distribution of potential residual soil contamination over the site is uncertain. The Washington State Department of Ecology publication *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used. This sampling approach is referred to by the Washington State Department of Ecology as “area-wide sampling.”

Statistical parameters (i.e., standard deviation within the populations) for residual contaminant levels following remediation at the 600-243 waste site were estimated based on assumptions of residual contamination after remediation. These assumptions were verified using the resulting verification sampling data and considered in the data quality assessment (DQA) for the data set.

The footprint of the 600-243 waste site was delineated in Visual Sample Plan¹ and used as the basis for location of a random-start systematic grid for verification soil sample collection locations. A total of 11 soil samples were collected on a random-start, triangular grid for this sampling area. A triangular grid was selected for this investigation based on studies that indicate triangular grids are superior to square grids (Gilbert 1987).

A map of the sample locations is provided in Figure 8, and a summary of the sampling coordinates for the 600-243 waste site is provided in Table 1. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *300 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2004a) and subsequent agreement for sampling and analysis of newly discovered waste sites within the 300-FF-2 Operable Unit, as documented in the *300 Area Unit Manager Meeting Minutes, December 7, 2004* (BHI 2005b).

¹ Visual Sample Plan is a site map-based user-interface program that may be downloaded at <http://dgo.pnl.gov>.

Figure 8. 600-243 Waste Site Verification Sample Locations.

Table 1. Verification Sample Summary for the 600-243 Waste Site.^a

Sample Location	Sample Media	Sample Coordinates ^b	HEIS Number	Sample Analysis
		Northing Easting		
1	Soil	N 116122.4 E 593173.9	J15HN1	ICP metals, NWTPH-Dx+ ^c , PCB, SVOA
2	Soil	N 116114.0 E 593134.2	J15HN2	ICP metals, NWTPH-Dx+, PCB, SVOA
3	Soil	N 116121.9 E 593147.3	J15HN3	ICP metals, NWTPH-Dx+, PCB, SVOA
4	Soil	N 116129.9 E 593160.5	J15HN4	ICP metals, NWTPH-Dx+, PCB, SVOA
5	Soil	N 116137.8 E 593173.7	J15HN5	ICP metals, NWTPH-Dx+, PCB, SVOA
6	Soil	N 116129.4 E 593133.9	J15HN6	ICP metals, NWTPH-Dx+, PCB, SVOA
7	Soil	N 116137.3 E 593147.1	J15HN7	ICP metals, NWTPH-Dx+, PCB, SVOA
8	Soil	N 116145.2 E 593160.3	J15HN8	ICP metals, NWTPH-Dx+, PCB, SVOA
9	Soil	N 116153.1 E 593173.4	J15HN9	ICP metals, NWTPH-Dx+, PCB, SVOA
10	Soil	N 116144.8 E 593133.6	J15HP0	ICP metals, NWTPH-Dx+, PCB, SVOA
11	Soil	N 116152.7 E 593146.8	J15HP1	ICP metals, NWTPH-Dx+, PCB, SVOA
Duplicate of J15HP1	Soil	N 116152.7 E 593146.8	J15HP2	ICP metals, NWTPH-Dx+, PCB, SVOA
Equipment blank	Silica sand	NA	J15HN0	ICP metals, NWTPH-Dx+, PCB, SVOA

^a Source: Field logbook EFL-1395-12 (WCH 2007a).^b Washington State Plane (meters).^c NWTPH-Dx+ analysis measures diesel and motor oil range hydrocarbons.

ICP = inductively coupled plasma

NA = not available

NWTPH = northwest total petroleum hydrocarbons

PCB = polychlorinated biphenyl

SVOA = semivolatile organic analysis

Verification Sampling Results

Verification samples were analyzed using U.S. Environmental Protection Agency-approved analytical methods. The laboratory-reported data results for all constituents are stored in the Environmental Restoration project-specific database prior to archival in the Hanford Environmental Information System and are presented as Attachment 1 of the 95% UCL calculation (Appendix D).

The 600-243 waste site was a single decision unit for verification sampling. Evaluation of the verification data from the excavation footprint was calculated using the 95% UCL on the true population mean for residual concentrations of COPCs as specified by the RDR/RAWP (DOE-RL 2004b). These calculations are provided in Appendix D. When a COPC was detected in fewer than 50% of the verification samples collected, the maximum detected value was used for comparison against the RAGs. If no detections for a given COPC were reported in the data set, then no statistical evaluation or calculations were performed for that COPC.

Comparisons of the statistical and maximum results for COPCs with the shallow zone RAGs for the excavation footprint are summarized in Table 2. The site was evaluated using the unrestricted use cleanup criteria (DOE-RL 2004b). Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the *Cleanup Levels and Risk Calculations Database* (Ecology 2005) under *Washington Administrative Code* (WAC) 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs.

Table 2. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the 600-243 Waste Site Excavation Verification Sampling Event. (2 Pages)

COPC	Maximum or Statistical Result (mg/kg)	Remedial Action Goals ^a (mg/kg)			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Antimony	1.3 (<BG)	32	5 ^b	5 ^b	No	--
Arsenic	4.9 (<BG)	20	20	20	No	--
Barium	318	1,600 ^c	132 ^b	224	Yes	Yes ^d
Beryllium	2.9	10.4 ^c	1.51 ^b	1.51 ^b	Yes	Yes ^d
Boron	267	16,000	320	-- ^e	No	--
Cadmium	1.0	13.9 ^c	0.81 ^b	0.81 ^b	Yes	Yes ^d
Chromium (total)	17.0 (<BG)	120,000	18.5 ^b	18.5 ^b	No	--
Cobalt	6.0 (<BG)	1,600	32	-- ^e	No	--
Copper	65.2	2,960	59.2	22.0 ^b	Yes	Yes ^d
Lead	33.6	353	10.2 ^b	10.2 ^b	Yes	Yes ^d
Manganese	254 (<BG)	11,200	512 ^b	512 ^b	No	--
Molybdenum	2.0	400	8	-- ^e	No	--
Nickel	20.0	1,600	18.1 ^b	27.4	Yes	Yes ^d
Selenium	6.9	400	5	1	Yes	Yes ^d
Silver	0.67 (<BG)	400	8	0.73 ^b	No	--
Vanadium	46.8 (<BG)	560	85.1 ^b	-- ^e	No	--
Zinc	75.1	24,000	480	67.8 ^c	Yes	Yes ^d
Total petroleum hydrocarbons - diesel range	220	-- ^f	200	400	Yes	Yes ^d
Total petroleum hydrocarbons - motor oil (high boiling)	520	-- ^f	200	400	Yes	Yes ^d
Aroclor-1254	0.067	0.5	0.017 ^b	0.017 ^b	Yes	Yes ^d
Aroclor-1260	0.021	0.5	0.017 ^b	0.017 ^b	Yes	Yes ^d
Anthracene	0.035	24,000	240	1,920	No	--
Benzo(a)anthracene	0.14	1.37	0.33 ^b	0.33 ^b	No	--
Benzo(a)pyrene	0.046	0.33 ^b	0.33 ^b	0.33 ^b	No	--
Benzo(b)fluoranthene	0.15	1.37	0.33 ^b	0.33 ^b	No	--
Benzo(g,h,i)perylene	0.044	2,400	48	192	No	--
Benzo(k)fluoranthene	0.16	13.7	0.33 ^b	0.33 ^b	No	--
Chrysene	0.10	137	0.33 ^b	0.33 ^b	No	--
Dibenzofuran	0.14	160	3.2	-- ^e	No	--
Di-n-butylphthalate	0.11	8,000	160	540	No	--
Fluoranthene	0.091	3,200	64	18.0	No	--
Indeno(1,2,3-cd)pyrene	0.028	1.37	0.33 ^b	0.33 ^b	No	--
2-Methylnaphthalene	0.34	320	3.2	-- ^e	No	--
Naphthalene	0.23	1600	16.0	988	No	--
Phenanthrene ^g	0.12	24,000	240	1,920	No	--

Table 2. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the 600-243 Waste Site Excavation Verification Sampling Event. (2 Pages)

COPC	Maximum or Statistical Result (mg/kg)	Remedial Action Goals ^a (mg/kg)			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Pyrene	0.11	2,400	48	192	No	--

^a Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2004b) or (where unavailable from the 300 Area RDR/RAWP) were calculated per the 1996 version of WAC 173-340 per the 300 Area ROD, unless otherwise noted.

^b Where cleanup levels are less than background or RDLs, cleanup levels default to background or RDLs per WAC 173-340-700(4)(d) (1996) and WAC 173-340-707(2) (1996), respectively.

^c Cleanup limit based on the inhalation exposure pathway per WAC 173-340-750(4)(b)(ii)(a) or (b).

^d RESRAD modeling predicts that compounds having a K_d greater than 7 mL/g will not migrate through the 12 m (39-ft-) thick vadose zone between the shallow zone and groundwater at this site (BHI 2005). The COPCs that failed groundwater and river protection RAGs at the 600-243 waste site have K_d values of greater than 22 mL/g and are not predicted to reach groundwater or the Columbia River within 1,000 years.

^e No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

^f No published cleanup standard identified for constituent and pathway.

^g Toxicity data for phenanthrene are not available. The cleanup level is based on the surrogate chemical anthracene.

BG = background

COPC = contaminant of potential concern

RAG = remedial action goal

RDL = required detection limit

RESRAD = RESidual RADioactivity (dose assessment model)

TPH = total petroleum hydrocarbons

WAC = *Washington Administrative Code*

Coal Ash

Given that the entire bioremediation pad including the liner was completely removed and the site was remediated to a point below the plastic liner, concentrations of the COPCs in the verification samples were expected to be low. However, the presence of coal ash below the waste site complicates the results as this material is known to contain many metal and organic constituents. The components of the coal ash are believed to contribute to the metals concentrations reported in the verification data results.

To better understand the chemical makeup of the general site area, four discrete samples of surrounding soil/coal ash were collected and analyzed for the waste site COPCs (WCH 2007a). The samples were collected from outside the boundary of the waste site. These 600-243 waste site-specific soil surrounding sample results as well as results from previous analyses of Hanford Site coal ash are discussed below.

In a study of alternative uses of Hanford Site coal ash for environmental restoration (WHC 1994), an assessment of chemical analysis data of ash originating from 284 East Building boilers was examined. The authors note that the highest concentrations of metals in the samples (barium and boron) were greater than 1,000 parts per million (1,000 mg/kg). The samples were analyzed by

Hazen Research (WHC 1992). The original results from chemical analysis of the ash samples are included in the results reported in Table 3.

Table 3. Analyses of Two Coal Ash Samples from the 284 East Building.^a

Constituent	284 E. Coal Ash (ppm)	
	J69-5	J69-7
Antimony	<20	<20
Arsenic	2.0	31.3
Barium	1,370	2,230
Beryllium	<5	6
Boron	690	1,060
Cadmium	<5	<5
Chlorine	<100	200
Chromium	94	140
Cobalt	30	28
Copper	52	74
Fluorine	<100	300
Germanium	<10	<10
Lead	48	60
Lithium	40	40
Mercury	0.3	0.2
Molybdenum	<3	<3
Nickel	34	32
Selenium	0.6	2.4
Silver	<5	<5
Thallium	<50	<50
Tungsten	<30	<50
Uranium	6	<30
Vanadium	<50	<50
Zinc	76	87

^a Original data reproduced from WHC (1992).

In another study, Hanford Site coal ash associated with the 188-D ash disposal basin (126-D-1) was analyzed to support the closeout of the 100-D Ponds (DOE-RL 1998). The coal ash originated from the 184-D powerhouse and was sluiced to the 188-D ash disposal basin in a water sluice via pipeline. Two samples and one duplicate of coal ash were collected from the ash disposal basin and analyzed. While the results for most metals were low, barium, selenium, and silver levels exceed Hanford Site background levels (Table 4). Of note, the barium levels measured in the 284 East powerhouse ash (1,370 and 2,230 mg/kg) are at least 10 times greater than Hanford Site background (132 mg/kg) (DOE-RL 2001), while the levels at the 188-D ash disposal pit (629, 687, and 633 mg/kg) are nearly 5 times the Hanford Site background level (DOE-RL 2001). Unfortunately, boron was not analyzed in the ash from the 188-D disposal basin so a comparison cannot be made.

Table 4. Analyses of Two Coal Ash Samples and One Duplicate from the 184-D Powerhouse.^a

Constituent	Coal Ash from 188-D Ash Disposal Basin (mg/kg)		
	B07259	B07260	B07261 (Duplicate of B07260)
Aluminum	13,600	14,900	13,900
Antimony	<13	<13.3	<12.8
Arsenic	<2.0	2.2	<1.8
Barium	629	687	633
Cadmium	<1.52	<1.55	<1.50
Calcium	19,400	19,300	17,100
Chromium	6.9	7.3	6.7
Cobalt	<4.4	<5.9	<5.2
Copper	9.1	11	9.4
Iron	3,970	4,110	4,270
Lead	1.9	2.5	2.1
Magnesium	3,880	4,320	3,850
Manganese	269	217	214
Mercury	<0.08	<0.06	<0.06
Nickel	<5.2	<8.5	<6.2
Potassium	<290	<297	<287
Selenium	<0.46	1.2	<0.51
Silver	7.7	<2.22	<2.14
Sodium	<226	<254	<229
Thallium	<0.44	<0.44	<0.45
Vanadium	17.3	18.6	17.4
Zinc	15.1	28.7	25.7

^a Original table data reproduced from DOE-RL (1998).

At the 600-243 waste site, samples from soil/coal ash from outside of the waste site boundary were taken on January 7, 2008, in order to quantify the constituents of the coal ash in soil not associated with the waste site. The locations of the samples are shown in Figure 9. The samples were analyzed for the same COPCs as the verification samples (Table 1), and the results are summarized in Table 5 and reported in Appendix E. The results show concentrations of barium, beryllium, cadmium, copper, lead, mercury, nickel, selenium, and zinc greater than Hanford Site background levels (DOE-RL 2001) exist in surrounding soils. Barium levels in the soils inside and outside of the 600-243 waste site have similar concentrations as those seen in the 284 East Building and 188-D ash samples.

Figure 9. Locations of the 600-243 Waste Site Surrounding Soil Sample Sites Containing Coal Ash.

Table 5. ICP Metals and TPH Analyses of Four Coal Ash Samples from Area Surrounding the 600-243 Waste Site.

Constituent	600-243 Surrounding Coal Ash Analyses (mg/kg)			
	J16438	J16439	J16440	J16441
Antimony	U	U	2.1	1.4
Arsenic	5.2	8.3	22.0	12.3
Barium	373	459	936	715
Beryllium	2.0	3.1	2.3	1.8
Boron	496	262	279	230
Cadmium	0.71	1.3	0.96	0.91
Chromium	15.5	23.7	10	8.9
Cobalt	4.5	6.2	3.9	4.3
Copper	34.6	56	51.3	35.4
Lead	25.9	51.1	78.7	47.9
Manganese	110	120	29.1	46.5
Mercury	0.17	0.36	0.24	0.16
Molybdenum	U	U	5.7	2.5
Nickel	16.9	26.1	12.3	14
Selenium	4.7	10.8	8.1	4.1
Silver	U	U	U	U
Vanadium	42.2	55.5	40.8	32.2
Zinc	54.9	102	81.6	96.1
TPH – Diesel Range	120	110	59	78
TPH- Motor Oil	270	300	120	160

ICP = inductively coupled plasma

TPH = total petroleum hydrocarbons

U = undetected

In comparison with the 600-243 waste site verification samples, the surrounding soil/coal ash samples show metals in the same range of values. Levels of boron and motor oil range hydrocarbons that exceed current groundwater and/or river protections RAGs are also seen in the soil/coal ash samples. It is hypothesized that oils were applied to the soils in this general area as a dust suppressant prior to the placement of the bioremediation pad. This hypothesis also explains the inconsistency seen in the TPH results between the waste characterization sample results (Appendix C) relative to the verification sample results (Appendix D). Waste characterization sample results showed motor oil levels less than 71 mg/kg, but the verification samples contained concentrations up to 620 mg/kg. A similar trend is seen for diesel range organics that were undetected in the waste characterization samples but measured up to 170 mg/kg in the verification samples. If the source of the TPH is within the soil/coal ash that was beneath the UST petroleum-contaminated soil, this would explain the lower levels of TPH seen in the waste characterization samples from within the site relative to the verification samples taken of material originally below the waste site.

Table 6 lists the sites or sources of coal ash and which constituents were measured at levels exceeding Hanford Site background levels (DOE-RL 2001). In comparison to the previous coal ash data, the prior sample results for barium (range from 629 to 2,230 mg/kg) are higher than the greatest concentration measured in the 600-243 waste site verification samples (426 mg/kg). Boron sample results from the 284 East coal ash samples (690 and 1,060 mg/kg) are also greater than the highest 600-243 waste site result (497 mg/kg). Arsenic, beryllium, copper, lead, nickel,

selenium, silver, and zinc were also measured in at least one of the previous studies in an amount that exceeds Hanford Site soil background (DOE-RL 2001).

Table 6. Sites/Waste Sites with Coal Ash Samples that Exceed Hanford Site Background Levels of Selected Constituents.

Constituent	284 East	188-D	600-243, Verification Samples	600-243, Surrounding Soil Samples
Arsenic	X			X
Barium	X	X	X	X
Beryllium	X	NA	X	X
Boron	X ^a	NA	X ^a	X ^a
Cadmium	DL	DL	X	X
Chromium	X		X	X
Cobalt	X			
Copper	X		X	X
Lead	X		X	X
Nickel	X		X	X
Selenium	X	X	X	X
Silver	DL	X		
Zinc	X		X	X

^a Hanford Site background for boron is not available (DOE-RL 2001); results exceed the groundwater protection RAG.

DL = sample results indicate detection levels are greater than Hanford Site background.

ICP = inductively coupled plasma

NA = not applicable, analyte not reported or not analyzed

DATA EVALUATION

Groundwater and/or Columbia River protection RAGs were exceeded by cleanup verification sample analyses for selenium, diesel range TPH, and motor oil range TPH. Each of these constituents has a distribution coefficient (K_d) of 50 ml/g or greater. The vadose zone at this site is approximately 12 m (39 ft) and contaminants with a K_d of 7 ml/g or greater are not predicted to reach groundwater within 1,000 years based on RESidual RADioactivity (RESRAD) modeling (BHI 2005a). Therefore, these results are predicted to be protective of groundwater and the Columbia River. All remaining verification sample COPCs achieved compliance with direct exposure, groundwater, and river protection RAGs.

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The application of the three-part test for the 600-243 waste site is included in the statistical calculations (Appendix D). Residual COPC concentrations for the 600-243 waste site that fail the three-part test are barium, beryllium, boron, cadmium, chromium, copper, lead, nickel, selenium, zinc, diesel range TPH, motor oil range TPH, Aroclor-1260, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene. The vadose zone at the 600-243 waste site is approximately 12 m (39 ft). Given this depth, contaminants with a K_d of 7 ml/g or greater are not predicted to reach groundwater within 1,000 years based on RESRAD modeling (BHI 2005a). Of the COPCs that fail the three-part test, all have a K_d greater than 22 ml/g, with the exception of boron. Therefore, with the

exception of boron, RESRAD modeling predicts that none of these COPCs will reach groundwater or the Columbia River within 1,000 years (BHI 2005a).

The failure of the boron results in the three-part test is due to a failure of the 10% criterion only. The boron value passes the other parts of the test. In fact, the presence of boron in the 600-243 waste site verification samples is not due to the soil associated with the soil from the UST removals, but instead originates from the large volume of coal ash that was deposited at the site prior to the placement of the bioremediation pad. Boron concentrations in the four waste characterization soil samples that were collected prior to site remediation are all less than 10 mg/kg (Appendix C). These values provide a more realistic representation of the boron concentration in the waste site soil rather than the boron concentration of the coal ash underlying the waste site.

Additionally, the boron concentrations in the coal ash/soil samples taken in the immediate vicinity of the 600-243 waste site (Table 5) compare well with those from the verification samples (Appendix D). These four soil surrounding soil samples, which contained a comparable amount of coal ash as the verification samples, have boron concentrations ranging from 230 to 496 mg/kg. The boron concentrations in the verification samples range from 11.9 to 497 mg/kg with a 95% UCL value of 267 mg/kg. Boron concentrations of 690 and 1,060 mg/kg in previous coal ash samples from the 284 East Building further support the validity of the boron concentrations seen in this coal ash (Table 3).

Verification sample J15HP1 and duplicate sample J15HP2 have the highest concentrations of boron (497 and 443 mg/kg, respectively) of the sample set. This sample and duplicate also have the highest concentrations of antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, lead, selenium, vanadium, and zinc from within the sample set. Given the knowledge that (1) coal ash contains multiple metals, (2) the verification samples with highest values for boron also have the highest concentrations of other metals, (3) coal ash is ubiquitous at the waste site and surrounding area, and (4) waste characterization samples of the site contained minimal boron, it is reasonable to assume that the boron levels measured in the verification samples are not related to the petroleum-contaminated soil from 1100 Area that is the 600-243 waste site. Therefore, the failure of boron in the MTCA three-part test is not considered in the remediation results for interim closure of the 600-243 waste site. Further evaluation of the coal ash present at and surrounding the waste site may be warranted but is outside the scope of this remediation.

Assessment of the risk requirements for the 600-243 petroleum-contaminated soil bioremediation pad is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix F. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6} , and a cumulative excess carcinogenic risk of less than 1×10^{-5} . These risk values were conservatively calculated for the entire waste site, including the coal ash components, using the highest values from each of the decision units. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicated that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 600-243 waste site is 3.1×10^{-1} . All

individual cumulative carcinogenic risk values are less than 1×10^{-6} . The cumulative carcinogenic risk value is 9.1×10^{-7} . Therefore, nonradionuclide risk requirements are met.

VERIFICATION SAMPLING DATA QUALITY ASSESSMENT

A DQA was performed to compare on verification sampling approach and resulting analytical data. Results of the DQA are reported in Appendix G.

SUMMARY FOR INTERIM CLOSURE

The 600-243 waste site petroleum-contaminated soil bioremediation pad has been remediated in accordance with the ROD (EPA 2001) and the RDR/RAWP (DOE-RL 2004b). The site was remediated by removing approximately 2,134 BCM (2791 BCY) of material for disposal at the ERDF. Statistical sampling to verify the completeness of remediation was performed and analytical results for the decision unit were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. Accordingly, an interim closure reclassification is supported for the 600-243 waste site. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

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APPENDIX A

**2003 PRESENTATION ON STATUS OF FLUOR
BIOREMEDIATION PADS**

Closure of Bioremediation Cells for PCS

Briefing and Discussion
November 5, 2003

Meeting Objective

- Provide information about the treatment of petroleum contaminated soil generated during corrective actions for leaking USTs at Hanford
- Obtain consensus about the process and requirements for closure of bioremediation cells

Current Management

- Bioremediation cells were created to manage soils contaminated as a result of leaks or spills associated with underground storage tank systems for petroleum products.
- UST corrective actions performed under WAC 173-360 (UST rules)
- Bioremediation cells are 'problem wastes' under WAC 173-304 (solid waste rules)
 - Problem waste section reserved.

Impact of New Solid Waste Handling Rule (WAC 173-350)

- WAC 173-350-030(2)(e)
 - “An existing facility completing closure within twelve months of the effective date of this chapter may close in compliance with...chapter 173-304 WAC”
- Went into effect February 10, 2003
- If not closed by 2/10/04, comply with
 - Operating, monitoring, closure plan (2/10/05)
 - Performance and design (2/10/06)

Clean Soil Defined

- No contamination at concentrations which could negatively impact existing quality of air, waters of the state, soils, or sediments; or pose a threat to health of humans or other living organisms
- Key factors are the nature of the contaminant, its concentration, and circumstances such as location

Numeric Standards

- WAC 173-340 provides clean-up standards that are intended to be protective of human health and the environment while considering location-specific factors
- Cleanup standards for PCS were amended in February 2001, subsequent to the creation of the soil cells

Pit 6 (West of 300 Area)

- Lined and bermed area 108' by 162' with an average depth of 24 inches (1296 cubic yards)
- PCS from 1100 Area UST upgrades in 1994
- Potential contaminant sources include gasoline, diesel and used oil
- Nutrients and moisture have been added periodically
- 8 samples analyzed in 1995 for gasoline, diesel and heavy oils
- 11 samples analyzed in 2001 for diesel and heavy oils

607 (Between 2E and 2W)

- Lined and bermed area about 112' by 178' with an average depth of 12 inches (738 cubic yards)
- PCS from 200 Area UST upgrades in 1994
- Potential contaminant sources are gasoline, diesel, and oils
- 9 samples and 4 check samples in 1995 & 1996 screened for petroleum and if positive tested for gasoline, diesel and heavy oil
- Site Assessment report transmitted to Ecology in March 1996 to request closure.

400 Area

- Lined and bermed area about 78' by 74' with average depth of 15 inches (267 cubic yards)
- PCS from 400 area fire station UST upgrade
- Diesel fuel was the source of contamination
- 8 samples screened for petroleum in 1995 with any positive results tested for gasoline, diesel, and heavy oil
- Site assessment report prepared in 1996 with recommendation to spread soil and add nutrients
- 11 samples analyzed in 2001 for diesel
- Performance Monitoring Report for closure prepared

heavy
diesel

Pit 9 (North of 300 Area)

- Lined area approximately 85' by 162' with an average depth of 28 inches (1173 cubic yards)
- PCS from 384 Powerhouse Day tank
- Passively bioremediated and aerated
- Soil at Day Tank site sampled in conjunction with site assessment
- 11 samples analyzed for BTEX, PAH, TPH in September 2003
- All results were below current MTCA Method A cleanup levels

Process for Closure

- Cleanup Level
- If the soil is deemed to meet the standard what is expectation for the treated soil?
- How should "closure" be documented?
 - Performance Monitoring Report
 - Independent Cleanup Report for USTs
 - WIDS Site Reclassification Form
 - Other mechanism

Status of Bunker Tank Corrective Action

- Clean soil staged at the site
- Preparing to collect samples to test for petroleum fractions in bottom of excavation
- Fractions necessary to determine if the site meets Method B cleanup levels
- If Method B is not feasible, proceed with actions discussed at May 15th meeting (request interim closure, suggest compliance monitoring to be performed and propose institutional controls to be implemented)

Summary of Analytical Results for PCS Bioremediation Areas

Site	Date Sampled	Samples Analyzed for	Results		
			Mean* (mg/kg)	Range	UCL (mg/kg)
400 Area (Associated with WIDS Site 400-15)	2001	TPH-Diesel	< 25	All < 25	< 25
400 Area (Associated with WIDS Site 400-15)	1995	TPH-Gasoline	<20	All <20	<20
400 Area (Associated with WIDS Site 400-15)	1995	TPH-Heavy Oil	135	<100 - 380	380
Batch Plant (WIDS Site 600-236)	1996 & 1996	TPH-Diesel	<50	All <50	<50
Batch Plant (WIDS Site 600-236)	1995 & 1996	TPH-Gasoline	<20	All <20	<20
Batch Plant (WIDS Site 600-236)	1997 & 1996	TPH-Heavy Oil	<100	All <100	<100
Pit 6 (WIDS Site 600-243)	2001	TPH-Diesel	<25	All <25	<25
Pit 6 (WIDS Site 600-243)	1995	TPH-Gasoline	<20	All <20	<20
Pit 6 (WIDS Site 600-243)	2001	TPH-Motor Oil	434.5	<100 - 3700	3700?
Pit 9 (WIDS Site 600-278)	2003	BTEX	<0.002	All <0.002	<0.002
Pit 9 (WIDS Site 600-278)	2003	PAH	1.4	0.48 - 1.9	1.6 (based on t-statistic)
Pit 9 (WIDS Site 600-278)	2003	TPH-Diesel	<5.5	<3.80 - <7.60	<7.60
Pit 9 (WIDS Site 600-278)	2003	TPH-Motor Oil	126.4	100 - 160	135.2 (Land's Method)

* Less than values were used in some of the calculations.

APPENDIX B

DATA FROM 2001 SAMPLING OF THE 600-243 WASTE SITE

WSCF ANALYTICAL RESULTS REPORT

for

DYNACORP TRI-CITIES SERVICES, INC.
P.O. BOX 1400
G3-26
RICHLAND, WA 99354

Attention: Ron Del Mar G3-26 FX 2-1694

Analytical: Markus Stauffer Markus Stauffer 5/22/07

Client Services: John Trechter John Trechter 5/22/07

All results are reported on an "as received" basis unless otherwise noted in the comment section.

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Report#: 20010870
Report Date: 22-may-2007
Report W004/ver. 5.3
DYNACORP TRI-CITIES SERVICES, INC.

Page 1

WSCF ANALYTICAL RESULTS REPORT

Attention:
Project:

Ron Del Mar G3-26 FX 2-1694
DYNCORP WSTE: DYNCORP WASTE PROJECTS

Group #: 20010870

WSCF												
Sample #	Client ID		CAS #	Test Performed	Matrix	Method	RQ	Result	Unit	DF	MDL	Analyze Sample Receive
W01DC00076	PIT6SOIL-01	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/10/01 06/26/01 06/26/01
W01DC00076	PIT6SOIL-01	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		2.70e+03	mg/kg	1.00	1.0e+02	07/10/01 06/26/01 06/26/01
W01DC00077	PIT6SOIL-02	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00077	PIT6SOIL-02	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		<100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00078	PIT6SOIL-03	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00078	PIT6SOIL-03	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		52 J	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00079	PIT6SOIL-04	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00079	PIT6SOIL-04	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		<100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00080	PIT6SOIL-05	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00080	PIT6SOIL-05	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		<100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00081	PIT6SOIL-06	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00081	PIT6SOIL-06	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		<100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00082	PIT6SOIL-07	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00082	PIT6SOIL-07	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		<100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00083	PIT6SOIL-08	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	ug/g	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00083	PIT6SOIL-08	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		75 J	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00084	PIT6SOIL-09	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00084	PIT6SOIL-09	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		56 J	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00085	PIT6SOIL-10	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00085	PIT6SOIL-10	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00086	PIT6SOIL-11	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00086	PIT6SOIL-11	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		180	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00087	PIT6SOIL-12	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/10/01 06/26/01 06/26/01
W01DC00087	PIT6SOIL-12	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		3.70e+03	mg/kg	1.00	1.0e+02	07/10/01 06/26/01 06/26/01
W01DC00088	PIT6SOIL-13	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	SOLID	LA-523-493		<25	mg/kg	1.00	25	07/09/01 06/26/01 06/26/01
W01DC00088	PIT6SOIL-13	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	SOLID	NWTPH		<100	mg/kg	1.00	1.0e+02	07/09/01 06/26/01 06/26/01
W01DC00089	PIT6SOIL-14	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	WATER	LA-523-493		<0.25	mg/L	1.00	0.25	07/05/01 06/26/01 06/26/01

MDL=Minimum Detection Limit
RQ=Result Qualifier

DF=Dilution Factor

* - Indicates results that have NOT been validated; + - Indicates more than six qualifier symbols

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DYNCORP TRI-CITIES SERVICES, INC.

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WSCF ANALYTICAL RESULTS REPORT

Attention: Ron Del Mar G3-26 FX 2-1694
Project: DYNCORP WSTE: DYNCORP WASTE PROJECTS

Group #: 20010870

Sample #	Client ID	CAS #	Test Performed	Matrix	WSCF Method	RQ	Result	Unit	DF	MDL	Analyze	Sample	Receive
W01DC00089	PIT6SOIL-14	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	WATER	NWTPH	<1.0	mg/L	1.00	1.0	07/05/01	06/26/01	06/26/01
W01DC00090	PIT6SOIL-15	DEL MAR	TPHDIESEL	Total Pet. Hydrocarbons Diesel	WATER	LA-523-493	<0.25	mg/L	1.00	0.25	07/05/01	06/26/01	06/26/01
W01DC00090	PIT6SOIL-15	DEL MAR	GCN016	Tot Pet H-Carbons Motor Oil	WATER	NWTPH	<1.0	mg/L	1.00	1.0	07/05/01	06/26/01	06/26/01

MDL=Minimum Detection Limit

RQ=Result Qualifier

DF=Dilution Factor

* - Indicates results that have NOT been validated; + - Indicates more than six qualifier symbols

Report W004/ver. 5.3

DYNCORP TRI-CITIES SERVICES, INC.

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WSCF ANALYTICAL COMMENT REPORT

Attention: Ron Del Mar G3-26 FX 2-1694
Project Number DYNCORP WSTE

Group #: 20010870

Sample #	Client ID	Lab Area	Test	Comment
		VALGROUP		TPHD-WA: Interim advisory limits of 80-120% are too narrow. Limits should be 70-130% for LCS. The water LCS of 77% Rec is normal. cgc
W01DC00078	PIT6SOIL-03	DEL MAR	VALTEST	TPH-Extended Oil Motor Oil
				Sample contains motor oil less than the quantitation limit. Results are J flagged to indicate analyte is detectable but the results are only estimates and may be inaccurate. cgc
W01DC00083	PIT6SOIL-08	DEL MAR	VALTEST	TPH-Extended Oil Motor Oil
				Results are J flagged indicating that the results are less than the quantitation limit. The analyte is detectable but the results are estimates and may be inaccurate. cgc
W01DC00084	PIT6SOIL-09	DEL MAR	VALTEST	TPH-Extended Oil Motor Oil
				Results are J flagged because the analyte is less than the quantitation limit. The analyte is detectable and the reported results are estimates and may be inaccurate. cgc

Lab Areas: VALGROUP - Group Validation
LOGSAMP - Login for Sample

VALTEST - Test Validation
LOGTEST - Login for Tests

TESTDATA - Test Data Entry

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w04c/3 Report#: 20010870

Report Date: 22-may-2007

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WSCF
TENTATIVELY IDENTIFIED PEAK REPORT

Attention: Project Number		:	Group #: 20010870					
Sample #	Client ID	Test Name	Peak Name	CAS#	RT	RQ	Result	Units

RQ=Result Qualifier

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Report Date: 22-may-2007

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WSCF METHOD REFERENCES REPORT

The results provided in this report were generated using the following WSCF Laboratory procedures. For your convenience, this table provides a listing of the regulatory or industry methods that are referenced by each of these WSCF procedures. Please note that the most recent version of the regulatory or industry method is listed here even though the WSCF procedure may reference an older version of the method. Also, a reference to a regulatory or industry method here does not necessarily indicate a verbatim implementation of that method.

LA-523-493	NWTPH-Diesel and/or Gasoline	
	HEIS WTPH DIESEL (HEIS)	Total Petroleum Hydrocarbons in Diesel
	WDOE TPHD	Total Petroleum Hydrocarbons in Diesel
NWTPH	NWTPH-Diesel and/or Gasoline	
	WDOE NWTPH-Dx/Gx	Total Petroleum Hydrocarbons - Diesel/Gasoline

Note: A complete list of WSCF analytical procedures and referenced regulatory or industry methods is available online at <http://apweb02/asponlinedocs/wscf/sample%20mgmt/ProcedureMethodCrossReference.pdf>. This document includes on-line links to full-text versions of the procedures and methods, where available.

Report Date: 22-may-2007
Report#: 20010870
Report W04M/2

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WSCF ANALYTICAL LABORATORY QC REPORT

SDG Number: 20010870

SAF Number:

Matrix:
Test:Sample Date:
Receive Date:

QC Type	Analyte	CAS #	Results	Units	Analysis Date	Lower Limit	Upper Limit
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Lab ID:
BATCH QC ASSOCIATED WITH SAMPLE

w13qlog v4.2 22-may-2007 07:27:02

Department: Miscellaneous

W13q Worklist/Batch/QC Report for Group# WSCF0

WL#	S#	Batch	QC#	Tray Type	Sample#	Test
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w13qlog v4.2 22-may-2007 07:27:02

Department: Radiochemistry

W13q Worklist/Batch/QC Report for Group# WSCF0

WL#	S#	Batch	QC#	Tray Type	Sample#	Test
31891	1	32273		SAMPLE	W07GR01012	A/B by Liquid Scintillation
31891	2	32273		SAMPLE	W07GR01013	A/B by Liquid Scintillation
31891	3	32273		SAMPLE	W07GR01014	A/B by Liquid Scintillation

APPENDIX C

**600-243 WASTE SITE CHARACTERIZATION
SAMPLING DATA**

600-243 Waste Characterization Sampling Results.

Sample Location	Sample Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15708	7/24/2007	0.73	C	0.66	1.9		1.2	47.8	C	0.06	0.1		0.03	1.1	U	1.1	0.15	U	0.15
2	J15709	7/24/2007	0.69	U	0.69	2.2		1.3	73.3	C	0.06	0.1		0.03	3.5		1.1	0.21		0.16
3	J15710	7/24/2007	0.71	U	0.71	3.5		1.3	59.3	C	0.06	0.04		0.03	1.2	U	1.2	0.16	U	0.16
4	J15711	7/24/2007	0.69	U	0.69	3.1		1.3	81.1	C	0.06	0.14		0.03	8.2		1.1	0.16		0.16
Duplicate of J15711	J15712	7/24/2007	0.67	U	0.67	3.1		1.2	74.3	C	0.06	0.13		0.03	9.2		1.1	0.15	U	0.15

Sample Location	Sample Number	Sample Date	Chromium			Cobalt			Copper			Lead			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15708	7/24/2007	6.2	C	0.3	4.3		0.24	7.7	C	0.27	3.2		0.98	217		0.21	0.02	U	0.02
2	J15709	7/24/2007	7.9	C	0.31	6.6		0.25	20.3	C	0.28	8.1		1	277		0.22	0.01	U	0.01
3	J15710	7/24/2007	5.7	C	0.32	7.9		0.26	10.3	C	0.29	5.9		1.1	360		0.23	0.02	U	0.02
4	J15711	7/24/2007	8.6	C	0.31	6.2		0.25	13.1	C	0.28	29.3		1	270		0.22	0.02	U	0.02
Duplicate of J15711	J15712	7/24/2007	6.6	C	0.3	6		0.24	14	C	0.27	7.7		1	246		0.21	0.02		0.02

Sample Location	Sample Number	Sample Date	Molybdenum			Nickel			Selenium			Silver			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15708	7/24/2007	0.48	U	0.48	6.7		0.8	1.3	U	1.3	0.27	U	0.27	23.7		0.24	24.7	C	0.12
2	J15709	7/24/2007	0.5	U	0.5	9		0.84	1.3	U	1.3	0.28	U	0.28	43.2		0.25	42.2	C	0.12
3	J15710	7/24/2007	0.52	U	0.52	7.2		0.88	1.4	U	1.4	0.29	U	0.29	44		0.26	52.9	C	0.13
4	J15711	7/24/2007	0.5	U	0.5	9.9		0.85	1.3	U	1.3	0.28	U	0.28	46.3		0.25	41.5	C	0.13
Duplicate of J15711	J15712	7/24/2007	0.49	U	0.49	8.6		0.82	1.3	U	1.3	0.27	U	0.27	40.9		0.24	36.5	C	0.12

Sample Location	Sample Number	Sample Date	Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)		
			mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15708	7/24/2007	3.44	U	3.44	10.3	U	10.3
2	J15709	7/24/2007	3.57	U	3.57	45		10.4
3	J15710	7/24/2007	3.78	U	3.78	29		10.5
4	J15711	7/24/2007	3.63	U	3.63	66		10.4
Duplicate of J15711	J15712	7/24/2007	3.48	U	3.48	71		10.3

C = blank contamination (inorganic constituents)
D = diluted
I = interference
J = estimate
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier

600-243 Waste Characterization Sampling Results.												
Constituent	J15708 Sample Location 1 Sample Date 7/24/07			J15709 Sample Location 2 Sample Date 7/24/07			J15710 Sample Location 3 Sample Date 7/24/07			J15711 Sample Location 4 Sample Date 7/24/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	14	U	14	14	U	14	15	U	15	15	U	15
Aroclor-1221	14	U	14	14	U	14	15	U	15	15	U	15
Aroclor-1232	14	U	14	14	U	14	15	U	15	15	U	15
Aroclor-1242	14	U	14	14	U	14	15	U	15	15	U	15
Aroclor-1248	14	U	14	14	U	14	15	U	15	15	U	15
Aroclor-1254	14	U	14	14	U	14	15	U	15	15	U	15
Aroclor-1260	20		14	110		14	36		15	59		15
Pesticides												
Aldrin	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Alpha-BHC	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
alpha-Chlordane	1.4	UD	1.4	1.5	JD	1.5	1.5	UD	1.5	1.5	UD	1.5
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	4.1	JXD	1.5
Delta-BHC	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Dichlorodiphenyldichloroethane	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Dichlorodiphenyldichloroethylene	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Dichlorodiphenyltrichloroethane	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	15	D	1.5
Dieldrin	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Endosulfan I	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Endosulfan II	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Endosulfan sulfate	1.4	UD	1.4	8.1	DX	1.4	1.9	JDX	1.5	4.1	JXD	1.5
Endrin	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Endrin aldehyde	1.4	UD	1.4	8.2	DX	1.4	1.5	UD	1.5	4.3	JD	1.5
Endrin ketone	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Gamma-BHC (Lindane)	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
gamma-Chlordane	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Heptachlor	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Heptachlor epoxide	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Methoxychlor	1.4	UD	1.4	1.4	UD	1.4	1.5	UD	1.5	1.5	UD	1.5
Toxaphene	14	UD	14	14	UD	14	15	UD	15	15	UD	15
Semivolatile Organic Analytes												
1,2,4-Trichlorobenzene	340	U	340	360	U	360	380	U	380	360	U	360
1,2-Dichlorobenzene	340	U	340	360	U	360	380	U	380	360	U	360
1,3-Dichlorobenzene	340	U	340	360	U	360	380	U	380	360	U	360
1,4-Dichlorobenzene	340	U	340	360	U	360	380	U	380	360	U	360
2,4,5-Trichlorophenol	860	U	860	890	U	890	950	U	950	910	U	910
2,4,6-Trichlorophenol	340	U	340	360	U	360	380	U	380	360	U	360
2,4-Dichlorophenol	340	U	340	360	U	360	380	U	380	360	U	360
2,4-Dimethylphenol	340	U	340	360	U	360	380	U	380	360	U	360
2,4-Dinitrophenol	860	U	860	890	U	890	950	U	950	910	U	910
2,4-Dinitrotoluene	340	U	340	360	U	360	380	U	380	360	U	360
2,6-Dinitrotoluene	340	U	340	360	U	360	380	U	380	360	U	360
2-Chloronaphthalene	340	U	340	360	U	360	380	U	380	360	U	360
2-Chlorophenol	340	U	340	360	U	360	380	U	380	360	U	360
2-Methylnaphthalene	340	U	340	360	U	360	380	U	380	38	J	360
2-Methylphenol (cresol, o-)	340	U	340	360	U	360	380	U	380	360	U	360
2-Nitroaniline	860	U	860	890	U	890	950	U	950	910	U	910
2-Nitrophenol	340	U	340	360	U	360	380	U	380	360	U	360
3,3'-Dichlorobenzidine	340	U	340	360	U	360	380	U	380	360	U	360
4-Methylphenol (p-cresol)	340	U	340	360	U	360	380	U	380	360	U	360
3-Nitroaniline	860	U	860	890	U	890	950	U	950	910	U	910
4,6-Dinitro-2-methylphenol	860	U	860	890	U	890	950	U	950	910	U	910
4-Bromophenyl-phenylether	340	U	340	360	U	360	380	U	380	360	U	360
4-Chloro-3-methylphenol	340	U	340	360	U	360	380	U	380	360	U	360
4-Chloroaniline	340	U	340	360	U	360	380	U	380	360	U	360
4-Chlorophenyl-phenylether	340	U	340	360	U	360	380	U	380	360	U	360
4-Nitroaniline	860	U	860	890	U	890	950	U	950	910	U	910
4-Nitrophenol	860	U	860	890	U	890	950	U	950	910	U	910
Acenaphthene	340	U	340	360	U	360	380	U	380	360	U	360
Acenaphthylene	340	U	340	360	U	360	380	U	380	360	U	360

600-243 Waste Characterization Sampling Results.												
Constituent	J15708 Sample Location 1 Sample Date 7/24/07			J15709 Sample Location 2 Sample Date 7/24/07			J15710 Sample Location 3 Sample Date 7/24/07			J15711 Sample Location 4 Sample Date 7/24/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)												
Anthracene	340	U	340	360	U	360	380	U	380	360	U	360
Benzo(a)anthracene	340	U	340	28	J	360	380	U	380	360	U	360
Benzo(a)pyrene	340	U	340	26	J	360	380	U	380	360	U	360
Benzo(b)fluoranthene	340	U	340	24	J	360	380	U	380	360	U	360
Benzo(g,h,i)perylene	25	J	340	21	J	360	380	U	380	360	U	360
Benzo(k)fluoranthene	340	U	340	23	J	360	380	U	380	360	U	360
Bis(2-chloro-1-methylethyl)ether	340	U	340	360	U	360	380	U	380	360	U	360
Bis(2-chloroethoxy)methane	340	U	340	360	U	360	380	U	380	360	U	360
Bis(2-chloroethyl) ether	340	U	340	360	U	360	380	U	380	360	U	360
Bis(2-ethylhexyl) phthalate	150	JB	340	110	JB	360	110	JB	380	150	JB	360
Butylbenzylphthalate	33	J	340	22	J	360	380	U	380	360	U	360
Carbazole	340	U	340	360	U	360	380	U	380	360	U	360
Chrysene	340	U	340	41	J	360	380	U	380	25	J	360
Di-n-butylphthalate	81	JB	340	360	U	360	83	JB	380	74	JB	360
Di-n-octylphthalate	340	U	340	360	U	360	380	U	380	360	U	360
Dibenz[a,h]anthracene	340	U	340	360	U	360	380	U	380	360	U	360
Dibenzofuran	340	U	340	360	U	360	380	U	380	360	U	360
Diethylphthalate	32	J	340	360	U	360	37	J	380	31	J	360
Dimethyl phthalate	340	U	340	360	U	360	380	U	380	360	U	360
Fluoranthene	18	J	340	53	J	360	380	U	380	42	J	360
Fluorene	340	U	340	360	U	360	380	U	380	360	U	360
Hexachlorobenzene	340	U	340	360	U	360	380	U	380	360	U	360
Hexachlorobutadiene	340	U	340	360	U	360	380	U	380	360	U	360
Hexachlorocyclopentadiene	340	U	340	360	U	360	380	U	380	360	U	360
Hexachloroethane	340	U	340	360	U	360	380	U	380	360	U	360
Indeno(1,2,3-cd)pyrene	20	J	340	360	U	360	380	U	380	360	U	360
Isophorone	340	U	340	360	U	360	380	U	380	360	U	360
N-Nitroso-di-n-dipropylamine	340	U	340	220	U	220	380	U	380	360	U	360
N-Nitrosodiphenylamine	340	U	340	360	U	360	380	U	380	360	U	360
Naphthalene	340	U	340	360	U	360	380	U	380	22	J	360
Nitrobenzene	340	U	340	360	U	360	380	U	380	360	U	360
Pentachlorophenol	860	U	860	890	U	890	950	U	950	910	U	910
Phenanthrene	340	U	340	24	J	360	380	U	380	37	J	360
Phenol	57	JB	340	360	U	360	54	JB	380	52	JB	360
Pyrene	18	J	340	59	J	360	380	U	380	26	J	360
Volatile Organic Analytes (continued)												
1,1,1-Trichloroethane	5	U	5	5	U	5	5	U	5	5	U	5
1,1,2,2-Tetrachloroethane	5	U	5	5	U	5	5	U	5	5	U	5
1,1,2-Trichloroethane	5	U	5	5	U	5	5	U	5	5	U	5
1,1-Dichloroethane	5	U	5	5	U	5	5	U	5	5	U	5
1,1-Dichloroethene	5	U	5	5	U	5	5	U	5	5	U	5
1,2-Dichloroethane	5	U	5	5	U	5	5	U	5	5	U	5
1,2-Dichloroethene(Total)	5	U	5	5	U	5	5	U	5	5	U	5
1,2-Dichloropropane	5	U	5	5	U	5	5	U	5	5	U	5
2-Butanone	10	U	10	10	U	10	10	U	10	10	U	10
2-Hexanone	10	U	10	10	U	10	10	U	10	10	U	10
4-Methyl-2-Pentanone	10	U	10	10	U	10	10	U	10	10	U	10
Acetone	10	U	10	10	U	10	10	U	10	9	J	10
Benzene	5	U	5	5	U	5	5	U	5	5	U	5
Bromodichloromethane	5	U	5	5	U	5	5	U	5	5	U	5
Bromoform	5	U	5	5	U	5	5	U	5	5	U	5
Bromomethane	10	U	10	10	U	10	10	U	10	10	U	10
Carbon disulfide	5	U	5	5	U	5	5	U	5	5	U	5
Carbon tetrachloride	5	U	5	5	U	5	5	U	5	5	U	5
Chlorobenzene	5	U	5	5	U	5	5	U	5	5	U	5
Chloroethane	10	U	10	10	U	10	10	U	10	10	U	10
Chloroform	5	U	5	5	U	5	5	U	5	5	U	5
Chloromethane	10	U	10	10	U	10	10	U	10	10	U	10
cis-1,2-Dichloroethylene	5	U	5	5	U	5	5	U	5	5	U	5
cis-1,3-Dichloropropene	5	U	5	5	U	5	5	U	5	5	U	5

600-243 Waste Characterization Sampling Results.												
Constituent	J15708			J15709			J15710			J15711		
	Sample Location 1			Sample Location 2			Sample Location 3			Sample Location 4		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)												
Dibromochloromethane	5	U	5	5	U	5	5	U	5	5	U	5
Ethylbenzene	5	U	5	5	U	5	5	U	5	5	U	5
Methylenechloride	1	JB	5	2	JB	5	2	JB	5	3	JB	5
Styrene	5	U	5	5	U	5	5	U	5	5	U	5
Tetrachloroethene	5	U	5	5	U	5	5	U	5	5	U	5
Toluene	1	J	5	6		5	5	U	5	5	U	5
trans-1,2-Dichloroethylene	5	U	5	5	U	5	5	U	5	5	U	5
trans-1,3-Dichloropropene	5	U	5	5	U	5	5	U	5	5	U	5
Trichloroethene	5	U	5	5	U	5	5	U	5	5	U	5
Vinyl chloride	10	U	10	10	U	10	10	U	10	10	U	10
Xylenes (total)	5	U	5	5	U	5	5	U	5	5	U	5

600-243 Waste Characterization Sampling Results.			
Constituent	J15712 Duplicate of J15711 Sample Date 7/24/07		
	µg/kg	Q	PQL
Polychlorinated Biphenyls			
Aroclor-1016	14	U	14
Aroclor-1221	14	U	14
Aroclor-1232	14	U	14
Aroclor-1242	14	U	14
Aroclor-1248	14	U	14
Aroclor-1254	14	U	14
Aroclor-1260	36		14
Pesticides			
Aldrin	1.4	UD	1.4
Alpha-BHC	1.4	UD	1.4
alpha-Chlordane	1.4	UD	1.4
beta-1,2,3,4,5,6-Hexachlorocyclohexane	2.7	JXD	1.4
Delta-BHC	1.4	UD	1.4
Dichlorodiphenyldichloroethane	1.4	UD	1.4
Dichlorodiphenyldichloroethylene	1.4	UD	1.4
Dichlorodiphenyltrichloroethane	1.4	UD	1.4
Dieldrin	1.4	UD	1.4
Endosulfan I	1.4	UD	1.4
Endosulfan II	1.4	UD	1.4
Endosulfan sulfate	2.3	JXD	1.4
Endrin	1.4	UD	1.4
Endrin aldehyde	2.7	JXD	1.4
Endrin ketone	1.4	UD	1.4
Gamma-BHC (Lindane)	1.4	UD	1.4
gamma-Chlordane	1.4	UD	1.4
Heptachlor	1.4	UD	1.4
Heptachlor epoxide	1.4	UD	1.4
Methoxychlor	1.4	UD	1.4
Toxaphene	14	UD	14
Semivolatile Organic Analytes			
1,2,4-Trichlorobenzene	350	U	350
1,2-Dichlorobenzene	350	U	350
1,3-Dichlorobenzene	350	U	350
1,4-Dichlorobenzene	350	U	350
2,4,5-Trichlorophenol	870	U	870
2,4,6-Trichlorophenol	350	U	350
2,4-Dichlorophenol	350	U	350
2,4-Dimethylphenol	350	U	350
2,4-Dinitrophenol	870	U	870
2,4-Dinitrotoluene	350	U	350
2,6-Dinitrotoluene	350	U	350
2-Chloronaphthalene	350	U	350
2-Chlorophenol	350	U	350
2-Methylnaphthalene	44	J	350
2-Methylphenol (cresol, o-)	350	U	350
2-Nitroaniline	870	U	870
2-Nitrophenol	350	U	350
3,3'-Dichlorobenzidine	350	U	350
4-Methylphenol (p-cresol)	350	U	350
3-Nitroaniline	870	U	870
4,6-Dinitro-2-methylphenol	870	U	870
4-Bromophenyl-phenylether	350	U	350
4-Chloro-3-methylphenol	350	U	350
4-Chloroaniline	350	U	350
4-Chlorophenyl-phenylether	350	U	350
4-Nitroaniline	870	U	870
4-Nitrophenol	870	U	870
Acenaphthene	350	U	350
Acenaphthylene	350	U	350

600-243 Waste Characterization Sampling Results.			
Constituent	J15712 Duplicate of J15711 Sample Date 7/24/07		
	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)			
Anthracene	350	U	350
Benzo(a)anthracene	350	U	350
Benzo(a)pyrene	350	U	350
Benzo(b)fluoranthene	350	U	350
Benzo(g,h,i)perylene	350	U	350
Benzo(k)fluoranthene	350	U	350
Bis(2-chloro-1-methylethyl)ether	350	U	350
Bis(2-chloroethoxy)methane	350	U	350
Bis(2-chloroethyl) ether	350	U	350
Bis(2-ethylhexyl) phthalate	110	JB	350
Butylbenzylphthalate	20	J	350
Carbazole	350	U	350
Chrysene	28	J	350
Di-n-butylphthalate	47	JB	350
Di-n-octylphthalate	350	U	350
Dibenz[a,h]anthracene	350	U	350
Dibenzofuran	25	J	350
Diethylphthalate	18	J	350
Dimethyl phthalate	350	U	350
Fluoranthene	42	J	350
Fluorene	350	U	350
Hexachlorobenzene	350	U	350
Hexachlorobutadiene	350	U	350
Hexachlorocyclopentadiene	350	U	350
Hexachloroethane	350	U	350
Indeno(1,2,3-cd)pyrene	350	U	350
Isophorone	350	U	350
N-Nitroso-di-n-dipropylamine	350	U	350
N-Nitrosodiphenylamine	350	U	350
Naphthalene	28	J	350
Nitrobenzene	350	U	350
Pentachlorophenol	870	U	870
Phenanthrene	46	J	350
Phenol	21	JB	350
Pyrene	23	J	350
Volatile Organic Analytes (continued)			
1,1,1-Trichloroethane	5	U	5
1,1,2,2-Tetrachloroethane	5	U	5
1,1,2-Trichloroethane	5	U	5
1,1-Dichloroethane	5	U	5
1,1-Dichloroethene	5	U	5
1,2-Dichloroethane	5	U	5
1,2-Dichloroethene(Total)	5	U	5
1,2-Dichloropropane	5	U	5
2-Butanone	10	U	10
2-Hexanone	10	U	10
4-Methyl-2-Pentanone	10	U	10
Acetone	10	U	10
Benzene	5	U	5
Bromodichloromethane	5	U	5
Bromoform	5	U	5
Bromomethane	10	U	10
Carbon disulfide	5	U	5
Carbon tetrachloride	5	U	5
Chlorobenzene	5	U	5
Chloroethane	10	U	10
Chloroform	5	U	5
Chloromethane	10	U	10
cis-1,2-Dichloroethylene	5	U	5
cis-1,3-Dichloropropene	5	U	5

600-243 Waste Characterization Sampling Results.			
Constituent	J15712 Duplicate of J15711		
	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)			
Dibromochloromethane	5	U	5
Ethylbenzene	5	U	5
Methylenechloride	3	JB	5
Styrene	5	U	5
Tetrachloroethene	5	U	5
Toluene	5	U	5
trans-1,2-Dichloroethylene	5	U	5
trans-1,3-Dichloropropene	5	U	5
Trichloroethene	5	U	5
Vinyl chloride	10	U	10
Xylenes (total)	5	U	5

APPENDIX D

**95 % UCL CALCULATIONS AND VERIFICATION
SAMPLING RESULTS**

APPENDIX D

CALCULATION BRIEF

The calculation in this appendix is kept in the active Washington Closure Hanford project files and is available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculation is provided in this appendix:

600-243 Cleanup Verification 95% UCL Calculations, 0300X-CA-V0088, Rev. 1, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculation that is provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

Acrobat 8.0

CALCULATION COVER SHEETProject Title: 300 Area Field RemediationJob No. 14655Area: 300 AreaDiscipline: Environmental*Calculation No: 0300X-CA-V0088Subject: 600-243 Cleanup Verification 95% UCL CalculationsComputer Program: ExcelProgram 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 = 14 Attns 1 = 10 Total = 25	H. M. Sulloway	L. D. Habel	NA	J. D. Ludowise	
1	Cover = 1 Sheets = 14 Attns 1 = 10 Total = 25	H. M. Sulloway	L. D. Habel	NA	J. D. Ludowise	3-18-08

SUMMARY OF REVISION

1	Cover page replaced in entirety for convenience. Sheet 3 revised to correct significant figure errors for organics. Also changed maximum value of silver from 0.52 (J15HP1) to 0.67 (duplicate of J15HP1).
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WCH-DE-018 (05/08/2007)

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford

CALCULATION SHEET

Originator HM Sulloway

Date 01/10/08

Calc. No. 0300X-CA-V0088

Rev. No. 0

Project 300 Area Field Remediation

Job No. 14655

Checked L. D. Habel

Date 1/10/08

Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Sheet No. 1 of 14

1 **Summary**2 **Purpose:**

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

8 **Table of Contents:**

9
 10 Sheets 1 to 3 - Calculation Sheet Summary
 11 Sheet 4 to 7 - Calculation Sheet Shallow Zone Verification Data
 12 Sheet 8 to 9 - Calculation Sheet Duplicate Analyses
 13 Sheet 8 to 12 - Ecology Software (MTCASat) Results
 14 Attachment 1 - 600-243 Verification Sampling Results (11 sheets)
 15

16 **Given/References:**

- 17 1) Sample Results (Attachment 1).
- 18 2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2004b), DOE-RL (2001), and Ecology (1996).
- 19 3) DOE-RL, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 4,
 20 U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 21 4) DOE-RL, 2004a, *300 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-2001-48, Rev. 1,
 22 U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 23 5) DOE-RL, 2004b, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP),
 24 DOE/RL-2001-47, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 25 6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology,
 26 Olympia, Washington.
- 27 7) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with*
 28 *Below-detection Limit or Below-PQL Values (Censored Data Sets)*, Publication #92-54, Washington Department of Ecology,
 29 Olympia, Washington.
- 30 8) Ecology, 1996, *Model Toxic Control Act Cleanup Levels and Risk Calculations (CLARC II)*, Publication #94-145,
 31 Washington State Department of Ecology, Olympia, Washington.
- 32 9) Ecology, 2005, *Cleanup Levels and Risk Calculations (CLARC) Database*, Washington State Department of Ecology,
 33 Olympia, Washington, <<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>>.
- 34 10) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code*.
 35
 36

37 **Solution:**

38 Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2004b).
 39 Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for
 40 nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in
 41 a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).
 42
 43

44 **Calculation Description:**

45 The subject calculations were performed on data from soil verification samples (Attachment 1) from the 600-243 waste site. The data
 46 were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating
 47 formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2004b) is documented
 48 by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.
 49
 50
 51
 52

Washington Closure Hanford

CALCULATION SHEET

Originator HM Sulloway *HS*
 Project 300 Area Field Remediation
 Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 01/10/08
 Job No. 14655

Calc. No. 0300X-CA-V0088
 Checked L. D. Habel *LH*

Rev. No. 0
 Date 1/10/08
 Sheet No. 2 of 14

1 Summary (continued)

2 Methodology:

3 For nonradioactive analytes with ≤50% of the data below detection limits the statistical value calculated to evaluate the effectiveness of
 4 cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection
 5 of the sample results (Attachment 1), the maximum detected value for the data set is used instead of the 95% UCL, and no further
 6 calculations are performed for those data sets. For convenience, these maximum detected values are included in the summary tables
 7 that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in
 8 Ecology (2005) under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these
 9 constituents are not considered site COCs/COPCs and are also not included in these calculations.

11 All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology
 12 1993). For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after
 13 adjustments for censored data as described above.

15 For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and
 16 the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n < 10) the
 17 calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data
 18 sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCASat software (Ecology 1993). Due to
 19 differences in addressing censored data between the RDR/RAWP (DOE-RL 2004b) and MTCASat coding and due to a limitation in the
 20 MTCASat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are
 21 performed before software input and the resulting data set treated as uncensored.

23 The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:

- 24 1) the 95% UCL exceeds the most stringent cleanup limit for each COPC/COC,
- 25 2) greater than 10% of the raw data exceed the most stringent cleanup limit for each COPC/COC,
- 26 3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each COPC/COC.

28 The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are
 29 greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method
 30 and is listed in Table II-1 of the SAP (DOE-RL 2004a). Where direct evaluation of the attached sample data showed that a given
 31 analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD
 32 calculations use the following formula:

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

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

38 For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably.
 39 If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed.
 40 Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP. No split samples were
 41 collected for cleanup verification of the subject site.

Washington Closure Hanford

CALCULATION SHEET

Originator HM Sulloway

Date 03/18/08

Calc. No. 0300X-CA-V0088

Rev. No. 1

Project 300 Area Field Remediation

Job No. 14655

Checked L. D. Habel

Date 3/18/08

Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Sheet No. 13 of 14

1 Summary (continued)

2 Results:

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

Results Summary - Shallow Zone Excavation			
Analyte	95% UCL Result ^a	Maximum Value ^a	Units
Arsenic	4.9		mg/kg
Barium	318		mg/kg
Beryllium	2.9		mg/kg
Boron	267		mg/kg
Cadmium	1.0		mg/kg
Chromium	17.0		mg/kg
Cobalt	6.0		mg/kg
Copper	65.2		mg/kg
Lead	33.6		mg/kg
Manganese	254		mg/kg
Molybdenum	2.0		mg/kg
Nickel	20.0		mg/kg
Selenium	6.9		mg/kg
Vanadium	46.8		mg/kg
Zinc	75.1		mg/kg
TPH- Diesel Range	220		mg/kg
TPH - Motor Oil Range	520		mg/kg
Aroclor-1260	0.021		mg/kg
2-Methylnaphthalene	0.34		mg/kg
Benzo(a)anthracene	0.14		mg/kg
Benzo(b)fluoranthene	0.15		mg/kg
Benzo(k)fluoranthene	0.16		mg/kg
Chrysene	0.10		mg/kg
Di-n-butylphthalate	0.11		mg/kg
Dibenzofuran	0.14		mg/kg
Fluoranthene	0.091		mg/kg
Naphthalene	0.23		mg/kg
Phenanthrene	0.12		mg/kg
Pyrene	0.11		mg/kg
Antimony		1.3	mg/kg
Silver		0.67	mg/kg
Aroclor-1254		0.067	mg/kg
Anthracene		0.035	mg/kg
Benzo(a)pyrene		0.046	mg/kg
Benzo(g,h,i)perylene		0.044	mg/kg
Indeno(1,2,3-cd)pyrene		0.028	mg/kg

45 ^aThe 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.

46

47 Abbreviations/Acronyms: The following abbreviations and/or acronyms are used in this calculation:

48 B = blank contamination (organics)
49 BG = background
50 C = blank contamination (inorganics)
51 COC = contaminant of concern
52 COPC = contaminant of potential concern
53 D = diluted
54 DE = direct exposure
55 GW = groundwater
56 J = estimate
57 MDA = minimal detectable activity
58 MTCA = Model Toxics Control Act
59 PQL = practical quantitation limit
60 Q = qualifier
61 QA/QC = quality assurance/quality control

RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial
action work plan
RESRAD = RESidual RADioactivity (dose model)
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
TDL = target detection limit
TPH = total petroleum hydrocarbons
U = undetected
UCL = upper confidence limit
WAC = Washington Administrative Code

WAC 173-340-740(7)(e) Evaluation:

WAC 173-340 3-Part Test for most stringent RAG:

95% UCL > Cleanup Limit? YES
> 10% above Cleanup Limit? YES
Any sample > 2x Cleanup Limit? YES

Relative Percent Difference Results, J15HP1
and J15PH2 - QA/QC Analysis^b

Analyte	Duplicate Analysis
Barium	6.8%
Beryllium	11.1%
Boron	11.5%
Chromium	1.2%
Copper	4.5%
Lead	13.8%
Manganese	37.9%
Nickel	25.2%
Vanadium	4.2%
Zinc	2.4%
TPH - Diesel Range	1.7%
TPH - Motor Oil Range	21.1%

^bRelative percent difference evaluation was not
required for analytes not included in this table.

Washington Closure Hanford

Originator HM Sulloway
Project 300 Area Field Remediation
Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 01/10/08
Job No. 14855

Calc. No. 0300X-CA-V0088
Checked L. D. Habel

Rev. No. 0
Date 1/10/08
Sheet No. 4 of 14

1 Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt			Copper		
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA
11	J15HP1	10/1/2007	4.2		1.3	426	C	0.09	3.4		0.04	497		1.6	1.4		0.22	24.3		0.43	7.4		0.35	53.7		0.39
Duplicate of J15HP1	J15HP2	10/1/2007	3.6		1.2	398	C	0.09	3.6		0.04	443		1.6	1.4		0.22	24.0		0.43	7.0		0.35	56.2		0.39
1	J15HN1	10/1/2007	4.2		1.3	130	C	0.06	0.48		0.03	56.8		1.1	0.22		0.15	12.3	C	0.31	5.9	C	0.25	26	C	0.28
2	J15HN2	10/1/2007	3.6		1.2	114	C	0.06	0.46		0.03	54.7		1.1	0.29		0.15	12.7	C	0.30	6.4	C	0.24	19.1	C	0.27
3	J15HN3	10/1/2007	3.6		1.2	79.4	C	0.06	0.21		0.03	11.9		1.1	0.15	U	0.15	12.0	C	0.30	6.4	C	0.24	14.3	C	0.27
4	J15HN4	10/1/2007	4.8		1.4	278	C	0.07	1.4		0.03	267		1.2	0.62		0.17	15.6	C	0.33	4.0	C	0.27	61.2	C	0.30
5	J15HN5	10/1/2007	5.0		1.5	229	C	0.08	1.6		0.04	232		1.4	0.64		0.19	14.8	C	0.38	3.7	C	0.30	55.9	C	0.34
6	J15HN6	10/1/2007	4.5		1.2	196	C	0.06	1.2		0.03	139		1.1	0.52		0.15	14.9	C	0.30	6.0	C	0.24	27.4	C	0.27
7	J15HN7	10/1/2007	2.8		1.2	112	C	0.06	0.38		0.03	49.9		1.0	0.22		0.15	9.50	C	0.29	6.3	C	0.23	22.2	C	0.26
8	J15HN8	10/1/2007	4.9		1.4	241	C	0.07	1.1		0.03	195		1.3	0.39		0.17	11.9	C	0.35	3.3	C	0.28	71.5	C	0.31
9	J15HN9	10/1/2007	4.4		1.4	266	C	0.07	1.3		0.03	261		1.2	0.41		0.17	13.0	C	0.33	2.8	C	0.27	71.4	C	0.30
10	J15HP0	10/1/2007	5.8		1.4	330	C	0.07	2.2		0.03	338		1.3	0.72		0.17	19.1		0.85	5.7		0.28	39.2		0.31

2 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt			Copper		
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA
11	J15HP1/J15HP2	10/1/2007	3.9			412			3.6			470			1.4			24.2			7.2			55.0		
1	J15HN1	10/1/2007	4.2			130			0.48			56.8			0.22			12.3			5.9			26.0		
2	J15HN2	10/1/2007	3.6			114			0.46			54.7			0.29			12.7			6.4			19.1		
3	J15HN3	10/1/2007	3.6			79.4			0.21			11.9			0.08			12.0			6.4			14.3		
4	J15HN4	10/1/2007	4.8			278			1.4			267			0.62			15.6			4.0			61.2		
5	J15HN5	10/1/2007	5.0			229			1.6			232			0.64			14.8			3.7			55.9		
6	J15HN6	10/1/2007	4.5			196			1.2			139			0.52			14.9			6.0			27.4		
7	J15HN7	10/1/2007	2.8			112			0.38			49.9			0.22			9.50			6.3			22.2		
8	J15HN8	10/1/2007	4.9			241			1.1			195			0.39			11.9			3.3			71.5		
9	J15HN9	10/1/2007	4.4			266			1.3			261			0.41			13.0			2.8			71.4		
10	J15HP0	10/1/2007	5.8			330			2.2			338			0.72			19.1			5.7			39.2		

30 Statistical Computations

Sampling Area	HEIS Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt			Copper		
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA
11	J15HP1	10/1/2007	4.2		1.3	426	C	0.09	3.4		0.04	497		1.6	1.4		0.22	24.3		0.43	7.4		0.35	53.7		0.39
1	J15HN1	10/1/2007	4.2		1.3	130	C	0.06	0.48		0.03	56.8		1.1	0.22		0.15	12.3	C	0.31	5.9	C	0.25	26	C	0.28
2	J15HN2	10/1/2007	3.6		1.2	114	C	0.06	0.46		0.03	54.7		1.1	0.29		0.15	12.7	C	0.30	6.4	C	0.24	19.1	C	0.27
3	J15HN3	10/1/2007	3.6		1.2	79.4	C	0.06	0.21		0.03	11.9		1.1	0.15	U	0.15	12.0	C	0.30	6.4	C	0.24	14.3	C	0.27
4	J15HN4	10/1/2007	4.8		1.4	278	C	0.07	1.4		0.03	267		1.2	0.62		0.17	15.6	C	0.33	4.0	C	0.27	61.2	C	0.30
5	J15HN5	10/1/2007	5.0		1.5	229	C	0.08	1.6		0.04	232		1.4	0.64		0.19	14.8	C	0.38	3.7	C	0.30	55.9	C	0.34
6	J15HN6	10/1/2007	4.5		1.2	196	C	0.06	1.2		0.03	139		1.1	0.52		0.15	14.9	C	0.30	6.0	C	0.24	27.4	C	0.27
7	J15HN7	10/1/2007	2.8		1.2	112	C	0.06	0.38		0.03	49.9		1.0	0.22		0.15	9.50	C	0.29	6.3	C	0.23	22.2	C	0.26
8	J15HN8	10/1/2007	4.9		1.4	241	C	0.07	1.1		0.03	195		1.3	0.39		0.17	11.9	C	0.35	3.3	C	0.28	71.5	C	0.31
9	J15HN9	10/1/2007	4.4		1.4	266	C	0.07	1.3		0.03	261		1.2	0.41		0.17	13.0	C	0.33	2.8	C	0.27	71.4	C	0.30
10	J15HP0	10/1/2007	5.8		1.4	330	C	0.07	2.2		0.03	338		1.3	0.72		0.17	19.1		0.85	5.7		0.28	39.2		0.31

46 C = blank contamination

GW = groundwater

MDA = minimum detectable activity

PQL = practical quantitation limit

UCL = upper confidence limit

47 DE = direct exposure

HEIS = Hanford Environmental Information System

MTCAL = Model Toxic Control Act

U = undetected

WAC = Washington Administrative Code

Washington Closure Hanford

Originator: HM Sulway
Project: 300 Area Plots Remediation
Subject: 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date: 01/10/09
Job No.: 14855

Calc. No.: 0300X CA-V0088
Checked: L. D. Habel

Rev. No.: 0
Date: 4/15/06
Sheet No.: 5 of 14

1 Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Lead			Manganese			Molybdenum			Nickel			Selenium			Vanadium			Zinc			Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)			
			pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	
11	J15HP1	10/1/2007	50.9		1.4	127		0.20	2.6	C	0.69	26.0		1.5	11		1.9	55.8		0.35	126		C	0.17	60	J	10	210	J	10
Duplicate of J15HP1	J15HP2	10/1/2007	69.9		1.4	86.5		0.20	2.3	C	0.69	33.5		1.2	6.8		1.9	53.6		0.35	123		C	0.17	59	J	10	170	J	10
7	J15HN1	10/1/2007	27.3		1.0	267		0.22	1.1		0.49	12.3		0.83	1.8		1.3	46.2		0.25	50.0		C	0.12	42	JD	100	160	JD	100
6	J15HN2	10/1/2007	14.7		0.99	248		0.21	1.1		0.48	24.5		0.81	2.6		1.3	39.8		0.24	46.5		C	0.12	5.3	JD	20	71	JD	20
3	J15HN3	10/1/2007	21.0		1.0	298		0.21	0.98		0.49	10.3		0.82	1.3		1.3	46.8		0.24	58.8		C	0.12	7.5	JD	20	41	JD	20
9	J15HN4	10/1/2007	27.7		1.1	117		0.23	2.0		0.54	15.4		0.90	4.4		1.4	35.1		0.27	68.9		C	0.13	64	JD	100	240	JD	100
5	J15HN5	10/1/2007	20.7		1.2	67.8		0.28	1.5		0.60	14.6		1.0	5.3		1.5	33.9		0.30	54.0		C	0.15	67	JD	100	230	JD	100
10	J15HN6	10/1/2007	31.7		0.98	202		0.21	0.75		0.47	14.8		0.80	3.3		1.3	45.9		0.24	58.8		C	0.12	38	JD	100	160	JD	100
12	J15HN7	10/1/2007	15.2		0.96	247		0.20	0.62		0.47	11.1		0.73	2.3		1.3	44.1		0.23	55.6		C	0.12	33	JD	100	170	JD	100
8	J15HN8	10/1/2007	15.9		1.1	112		0.24	1.2		0.56	12.4		0.94	2.2		1.5	31.0		0.28	56.4		C	0.14	170	JD	200	620	JD	200
14	J15HN9	10/1/2007	15.9		1.1	71.4		0.23	2.3		0.54	11.9		0.90	3.0		1.4	28.6		0.27	45.0		C	0.13	120	JD	200	490	JD	200
15	J15HP0	10/1/2007	34.2		1.1	144		0.24	1.6	C	0.56	20.1		0.94	6.7		1.5	48.4		0.28	76.2		C	0.14	150	J	10	390	J	10

2 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Lead			Manganese			Molybdenum			Nickel			Selenium			Vanadium			Zinc			Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)		
			pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15HP2	10/1/2007	27.6			267			1.1			2.3			1.6			54.6			124.5			60			190		
2	J15HN2	10/1/2007	14.7			248			1.1			24.5			2.6			39.8			46.5			42			160		
3	J15HN3	10/1/2007	21.0			298			0.9			10.3			0.7			46.8			58.8			5.3			71		
4	J15HN4	10/1/2007	27.7			117			2.0			15.4			4.4			35.1			68.9			64			240		
5	J15HN5	10/1/2007	20.7			67.8			1.8			14.8			5.3			33.9			54.0			67			230		
6	J15HN6	10/1/2007	31.7			202			0.8			14.8			3.3			45.9			58.8			38			160		
7	J15HN7	10/1/2007	15.2			247			0.6			11.1			2.3			44.1			55.6			33			170		
8	J15HN8	10/1/2007	15.9			112			1.2			12.4			2.2			31.0			56.4			170			620		
9	J15HN9	10/1/2007	15.9			71			2.3			11.9			3.0			28.6			45.0			120			490		
10	J15HP0	10/1/2007	34.2			144			1.6			20.1			6.7			48.4			76.2			150			390		

3 Statistical Computations

Sampling Area	HEIS Number	Sample Date	Lead			Manganese			Molybdenum			Nickel			Selenium			Vanadium			Zinc			Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)		
			pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15HP2	10/1/2007	27.6			267			1.1			2.3			1.6			54.6			124.5			60			190		
2	J15HN2	10/1/2007	14.7			248			1.1			24.5			2.6			39.8			46.5			42			160		
3	J15HN3	10/1/2007	21.0			298			0.9			10.3			0.7			46.8			58.8			5.3			71		
4	J15HN4	10/1/2007	27.7			117			2.0			15.4			4.4			35.1			68.9			64			240		
5	J15HN5	10/1/2007	20.7			67.8			1.8			14.8			5.3			33.9			54.0			67			230		
6	J15HN6	10/1/2007	31.7			202			0.8			14.8			3.3			45.9			58.8			38			160		
7	J15HN7	10/1/2007	15.2			247			0.6			11.1			2.3			44.1			55.6			33			170		
8	J15HN8	10/1/2007	15.9			112			1.2			12.4			2.2			31.0			56.4			170			620		
9	J15HN9	10/1/2007	15.9			71			2.3			11.9			3.0			28.6			45.0			120			490		
10	J15HP0	10/1/2007	34.2			144			1.6			20.1			6.7			48.4			76.2			150			390		

4 Most Stringent Cleanup Limit for nonradioactive and RAG type

Sampling Area	HEIS Number	Sample Date	Lead	Manganese	Molybdenum	Nickel	Selenium	Vanadium	Zinc	Total petroleum hydrocarbons - diesel range	Total petroleum hydrocarbons - motor oil (high boiling)
1	J15HP2	10/1/2007	10.2	512	8.0	19.1	1	85.1	67.8	200	200

5 WAC 173-340 3-PART TEST

Sampling Area	HEIS Number	Sample Date	Lead	Manganese	Molybdenum	Nickel	Selenium	Vanadium	Zinc	Total petroleum hydrocarbons - diesel range	Total petroleum hydrocarbons - motor oil (high boiling)
1	J15HP2	10/1/2007	YES	NO	NO	YES	YES	NO	YES	YES	YES
2	J15HN2	10/1/2007	YES	NO	NO	YES	YES	NO	YES	YES	YES
3	J15HN3	10/1/2007	YES	NO	NO	NO	YES	NO	NO	NO	YES

6 WAC 173-340 Compliance?

Sampling Area	HEIS Number	Sample Date	Lead	Manganese	Molybdenum	Nickel	Selenium	Vanadium	Zinc	Total petroleum hydrocarbons - diesel range	Total petroleum hydrocarbons - motor oil (high boiling)
1	J15HP2	10/1/2007	Because of the "yes" answers to the 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to the direct exposure cleanup level.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because of the "yes" answers to the 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to the direct exposure cleanup level.	Because of the "yes" answers to the 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to the direct exposure cleanup level.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	Because of the "yes" answers to the 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to the direct exposure cleanup level.	Because of the "yes" answers to the 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to the direct exposure cleanup level.	Because of the "yes" answers to the 3-part test, a detailed assessment using RESRAD will be performed. The data set meets the 3-part test criteria when compared to the direct exposure cleanup level.

7 Legend

45 C = blank contamination
46 D = diluted
47 HE = Hanford Environmental Information System
48 J = estimate
49 MDA = minimum detectable activity
50 MTC = Metals Toxicity Control Act
51 PQL = practical quantitation limit
52 U = undetected
53 UCL = upper confidence limit
54 WAC = Washington Administrative Code

Washington Closure Hanford

Originator: HM Sulloway
Project: 300 Area Field Remediation
Subject: 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date: 01/10/08
Job No.: 14655

Calc. No.: 0300X-CA-V0088
Checked: L. D. Habel

Rev. No.: 0
Date: 1/10/08
Sheet No.: 6 of 14

1 Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Aroclor-1260			2-Methylnaphthalene			Benzo(a)anthracene			Benzo(b)fluoranthene			Benzo(k)fluoranthene			Chrysene			Di-n-butylphthalate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1	10/1/2007	0.010	J	0.020	0.081	J	0.50	0.50	U	0.50	0.032	J	0.50	0.50	UJ	0.50	0.033	J	0.50	0.029	J	0.50
Duplicate of J15HP1	J15HP2	10/1/2007	0.0087	J	0.019	0.66	J	0.49	0.034	J	0.49	0.030	J	0.49	0.033	J	0.49	0.060	J	0.49	0.49	UJ	0.49
1	J15HN1	10/1/2007	0.026		0.015	0.094	J	0.37	0.024	J	0.37	0.37	U	0.37	0.37	U	0.37	0.041	J	0.37	0.035	JB	0.37
2	J15HN2	10/1/2007	0.015	U	0.015	0.027	J	0.37	0.37	U	0.37	0.37	U	0.37	0.37	U	0.37	0.37	U	0.37	0.37	U	0.37
3	J15HN3	10/1/2007	0.014	U	0.014	0.033	J	0.36	0.36	U	0.36	0.36	U	0.36	0.36	U	0.36	0.020	J	0.020	0.027	JB	0.03
4	J15HN4	10/1/2007	0.012	J	0.017	0.15	J	0.42	0.039	J	0.42	0.063	J	0.42	0.033	J	0.42	0.071	J	0.42	0.042	JB	0.42
5	J15HN5	10/1/2007	0.014	J	0.018	0.19	J	0.45	0.035	J	0.45	0.45	U	0.45	0.45	U	0.45	0.068	J	0.45	0.45	U	0.45
6	J15HN6	10/1/2007	0.005	J	0.016	0.051	J	0.39	0.39	U	0.39	0.39	U	0.39	0.39	U	0.39	0.025	J	0.39	0.026	JB	0.39
7	J15HN7	10/1/2007	0.036		0.014	0.049	J	0.36	0.36	U	0.36	0.033	J	0.36	0.020	J	0.36	0.039	J	0.36	0.023	JB	0.36
8	J15HN8	10/1/2007	0.012	J	0.016	0.26	J	0.40	0.043	J	0.40	0.039	J	0.40	0.028	J	0.40	0.081	J	0.40	0.047	JB	0.40
9	J15HN9	10/1/2007	0.016	U	0.016	0.25	J	0.41	0.044	J	0.41	0.021	J	0.41	0.030	J	0.41	0.061	J	0.41	0.036	JB	0.41
10	J15HP0	10/1/2007	0.013	J	0.017	0.12	J	0.41	0.047	J	0.41	0.043	J	0.41	0.023	J	0.41	0.067	J	0.41	0.026	J	0.41

16 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Aroclor-1260			2-Methylnaphthalene			Benzo(a)anthracene			Benzo(b)fluoranthene			Benzo(k)fluoranthene			Chrysene			Di-n-butylphthalate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1/J15HP2	10/1/2007	0.0094			0.37			0.142			0.031			0.142			0.047			0.137		
1	J15HN1	10/1/2007	0.026			0.094			0.024			0.185			0.185			0.041			0.035		
2	J15HN2	10/1/2007	0.0075			0.027			0.185			0.185			0.185			0.185			0.185		
3	J15HN3	10/1/2007	0.007			0.033			0.180			0.180			0.180			0.020			0.027		
4	J15HN4	10/1/2007	0.012			0.15			0.039			0.063			0.033			0.071			0.042		
5	J15HN5	10/1/2007	0.014			0.19			0.035			0.225			0.225			0.068			0.225		
6	J15HN6	10/1/2007	0.005			0.051			0.195			0.195			0.195			0.025			0.026		
7	J15HN7	10/1/2007	0.036			0.049			0.180			0.033			0.020			0.039			0.023		
8	J15HN8	10/1/2007	0.012			0.26			0.043			0.039			0.028			0.081			0.047		
9	J15HN9	10/1/2007	0.008			0.25			0.044			0.021			0.030			0.061			0.036		
10	J15HP0	10/1/2007	0.013			0.12			0.047			0.043			0.023			0.067			0.026		

30 Statistical Computations

Sampling Area	HEIS Number	Sample Date	Aroclor-1260			2-Methylnaphthalene			Benzo(a)anthracene			Benzo(b)fluoranthene			Benzo(k)fluoranthene			Chrysene			Di-n-butylphthalate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1/J15HP2	10/1/2007	0.0094			0.37			0.142			0.031			0.142			0.047			0.137		
1	J15HN1	10/1/2007	0.026			0.094			0.024			0.185			0.185			0.041			0.035		
2	J15HN2	10/1/2007	0.0075			0.027			0.185			0.185			0.185			0.185			0.185		
3	J15HN3	10/1/2007	0.007			0.033			0.180			0.180			0.180			0.020			0.027		
4	J15HN4	10/1/2007	0.012			0.15			0.039			0.063			0.033			0.071			0.042		
5	J15HN5	10/1/2007	0.014			0.19			0.035			0.225			0.225			0.068			0.225		
6	J15HN6	10/1/2007	0.005			0.051			0.195			0.195			0.195			0.025			0.026		
7	J15HN7	10/1/2007	0.036			0.049			0.180			0.033			0.020			0.039			0.023		
8	J15HN8	10/1/2007	0.012			0.26			0.043			0.039			0.028			0.081			0.047		
9	J15HN9	10/1/2007	0.008			0.25			0.044			0.021			0.030			0.061			0.036		
10	J15HP0	10/1/2007	0.013			0.12			0.047			0.043			0.023			0.067			0.026		

43 B = blank contamination (organics) GW = groundwater J = estimate MTCA = Model Toxic Control Act U = undetected WAC = Washington Administrative Code
44 DE = direct exposure HEIS = Hanford Environmental Information System MDA = minimum detectable activity PQL = practical quantitation limit UCL = upper confidence limit

Washington Closure Hanford

Originator HM Sulloway
Project 300 Area Field Remediation
Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 01/10/08
Job No. 14655

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1 Shallow Zone Verification Data

Sampling Area	HEIS Number	Sample Date	Dibenzofuran			Fluoranthene			Naphthalene			Phenanthrene			Pyrene		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1	10/1/2007	0.060	J	0.50	0.056	J	0.50	0.11	J	0.50	0.091	J	0.50	0.047	J	0.50
Duplicate of J15HP1	J15HP2	10/1/2007	0.13	J	0.49	0.096	J	0.49	0.52	J	0.49	0.15	J	0.49	0.066	J	0.49
1	J15HN1	10/1/2007	0.035	J	0.37	0.063	J	0.37	0.054	J	0.37	0.078	J	0.37	0.059	J	0.37
2	J15HN2	10/1/2007	0.37	U	0.37	0.027	J	0.37	0.022	J	0.37	0.030	J	0.37	0.37	U	0.37
3	J15HN3	10/1/2007	0.36	U	0.36	0.027	J	0.03	0.020	J	0.36	0.034	J	0.36	0.02	J	0.36
4	J15HN4	10/1/2007	0.066	J	0.42	0.10	J	0.42	0.087	J	0.42	0.13	J	0.42	0.08	J	0.42
5	J15HN5	10/1/2007	0.063	J	0.45	0.066	J	0.45	0.13	J	0.45	0.14	J	0.45	0.06	J	0.45
6	J15HN6	10/1/2007	0.030	J	0.39	0.041	J	0.39	0.062	J	0.39	0.060	J	0.39	0.03	J	0.39
7	J15HN7	10/1/2007	0.020	J	0.36	0.035	J	0.36	0.035	J	0.36	0.044	J	0.36	0.04	J	0.36
8	J15HN8	10/1/2007	0.074	J	0.40	0.080	J	0.40	0.14	J	0.40	0.14	J	0.40	0.08	J	0.4
9	J15HN9	10/1/2007	0.068	J	0.41	0.071	J	0.41	0.15	J	0.41	0.14	J	0.41	0.08	J	0.41
10	J15HP0	10/1/2007	0.066	J	0.41	0.11	J	0.41	0.12	J	0.41	0.15	J	0.41	0.09	J	0.41

16 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Dibenzofuran			Fluoranthene			Naphthalene			Phenanthrene			Pyrene		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1/J15HP2	10/1/2007	0.095			0.078			0.32			0.12			0.057		
1	J15HN1	10/1/2007	0.035			0.063			0.054			0.078			0.059		
2	J15HN2	10/1/2007	0.19			0.027			0.022			0.030			0.19		
3	J15HN3	10/1/2007	0.18			0.027			0.020			0.034			0.023		
4	J15HN4	10/1/2007	0.066			0.10			0.087			0.13			0.078		
5	J15HN5	10/1/2007	0.063			0.066			0.13			0.14			0.062		
6	J15HN6	10/1/2007	0.030			0.041			0.062			0.060			0.028		
7	J15HN7	10/1/2007	0.020			0.035			0.035			0.044			0.035		
8	J15HN8	10/1/2007	0.074			0.080			0.14			0.14			0.075		
9	J15HN9	10/1/2007	0.068			0.071			0.15			0.14			0.080		
10	J15HP0	10/1/2007	0.066			0.11			0.12			0.15			0.086		

30 Statistical Computations

	Dibenzofuran			Fluoranthene			Naphthalene			Phenanthrene			Pyrene		
	Large data set (n > 10), use MTCASat lognormal distribution.			Large data set (n > 10), use MTCASat lognormal distribution.			Large data set (n > 10), use MTCASat lognormal distribution.			Large data set (n > 10), lognormal and normal distribution rejected, use z-statistic.			Large data set (n > 10), use MTCASat lognormal distribution.		
95% UCL value based on	11			11			11			11			11		
% < Detection limit	18%			0%			0%			0%			9%		
Mean	0.080			0.063			0.10			0.097			0.070		
Standard deviation	0.055			0.028			0.085			0.048			0.044		
95% UCL on mean	0.14			0.091			0.23			0.12			0.11		
Maximum detected value	0.13			0.11			0.52			0.15			0.086		
Statistical value	0.14			0.091			0.23			0.12			0.11		
Most Stringent Cleanup Limit for nonradionuclide and RAG type	3.20	GW Protection		18.0	River Protection		16.0	GW Protection		240	GW Protection		48	GW Protection	
WAC 173-340 3-PART TEST															
95% UCL > Cleanup Limit?	NO			NO			NO			NO			NO		
> 10% above Cleanup Limit?	NO			NO			NO			NO			NO		
Any sample > 2X Cleanup Limit?	NO			NO			NO			NO			NO		
WAC 173-340 Compliance?	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.			The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.			The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.			The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.			The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.		

46 GW = groundwater

47 HEIS = Hanford Environmental Information System

MDA = minimum detectable activity

MTCASat = Model Toxic Control Act

PQL = practical quantitation limit

U = undetected

UCL = upper confidence limit

WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator HM Sulloway

Project 300 Area Field Remediation

Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 01/10/08
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Duplicate Analysis																										
Sampling Area	Sample Number	Sample Date	Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1	10/1/2007	10.2		1.8	426	C	0.09	3.4		0.04	497		1.6	1.4		0.22	24.3		0.43	7.4		0.35	53.7		0.39
Duplicate of J15HP1	J15HP2	10/1/2007	7.2		1.8	398	C	0.09	3.8		0.04	443		1.6	1.4		0.22	24		0.43	7		0.35	56.2		0.39
Analysis:																										
Duplicate Analysis	TDL		10			2			0.5			2			0.5			1			2			1		
	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
	Both >5xTDL?		No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)			Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)		
	RPD					6.8%			11.1%			11.5%						1.2%						4.5%		
	Difference > 2 TDL?		No - acceptable			Not applicable			Not applicable			Not applicable			No - acceptable			Not applicable			No - acceptable			Not applicable		
Sampling Area	HEIS Number	Sample Date	Lead			Manganese			Molybdenum			Nickel			Selenium			Silver			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
11	J15HP1	10/1/2007	60.9		1.4	127		0.3	2.6	C	0.69	26		1.2	11		1.9	0.52		0.39	55.9		0.35	126	C	0.17
Duplicate of J15HP1	J15HP2	10/1/2007	69.9		1.4	86.5		0.3	2.3	C	0.69	33.5		1.2	6.8		1.9	0.67		0.39	53.6		0.35	123	C	0.17
Analysis:																										
Duplicate Analysis	TDL		5			5			2			4			10			2			2.5			1		
	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
	Both >5xTDL?		Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)		
	RPD		13.8%			37.9%						25.2%						4.2%						2.4%		
	Difference > 2 TDL?		Not applicable			Not applicable			No - acceptable			Not applicable			No - acceptable			No - acceptable			Not applicable			Not applicable		
Sampling Area	HEIS Number	Sample Date	Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)			Aroclor-1260			2-Methylnaphthalene			Benzo(a)pyrene			Benzo(b)fluoranthene			Chrysene			Dibenzofuran		
			mg/kg	Q	PQL	mg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
11	J15HP1	10/1/2007	60	J	10	210	J	10	10	J	20	81	J	500	25	J	500	32	J	500	33	J	500	60	J	500
Duplicate of J15HP1	J15HP2	10/1/2007	59	J	10	170	J	10	8.7	J	19	660	J	490	35	J	490	30	J	490	60	J	490	13	J	490
Analysis:																										
Duplicate Analysis	TDL		5			5			16.5			330			330			330			330			330		
	Both > PQL?		Yes (continue)			Yes (continue)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)		
	Both >5xTDL?		Yes (calc RPD)			Yes (calc RPD)																				
	RPD		1.7%			21.1%																				
	Difference > 2 TDL?		Not applicable			Not applicable			No - acceptable			No - acceptable			No - acceptable			No - acceptable			No - acceptable			No - acceptable		

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Originator HM Sulloway

Project 300 Area Field Remediation

Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 01/10/08

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Calc. No. 0300X-CA-V0088

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Date 1/12/08

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1 Duplicate Analysis

Duplicate Analysis											
Sampling Area	Sample Number	Sample Date	Naphthalene			Phenanthrene			Pyrene		
			µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
1	J15HP1	10/1/2007	110	J	500	91	J	500	47	J	500
Duplicate of J15HP1	J15HP2	10/1/2007	524		490	150	J	490	66	J	490

6 Analysis:

7 Duplicate Analysis	TDL		330		330		330	
	Both > PQL?		No-Stop (acceptable)		No-Stop (acceptable)		No-Stop (acceptable)	
	Both >5xTDL?							
	RPD							
11	Difference > 2 TDL?		No - acceptable		No - acceptable		No - acceptable	

Washington Closure Hanford

CALCULATION SHEET

Originator HM Sulloway
Project 300 Area Field Remediation
Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

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Ecology Software (MTCStat) Results

DATA	ID	Arsenic 95% UCL Calculation				DATA	ID	Barium 95% UCL Calculation				DATA	ID	Beryllium 95% UCL Calculation			
3.9	J15HP1/J15HP2					412	J15HP1/J15HP2					3.6	J15HP1/J15HP2				
4.2	J15HN1					130	J15HN1					0.48	J15HN1				
3.6	J15HN2	Number of samples	Uncensored values			114	J15HN2	Number of samples	Uncensored values			0.46	J15HN2	Number of samples	Uncensored values		
3.6	J15HN3	Uncensored	11	Mean	4.3	79.4	J15HN3	Uncensored	11	Mean	217	0.21	J15HN3	Uncensored	11	Mean	1.3
4.8	J15HN4	Censored		Lognormal mean	4.3	278	J15HN4	Censored		Lognormal mean	222	1.4	J15HN4	Censored		Lognormal mean	1.4
5.0	J15HN5	Detection limit or PQL		Std. devn.	0.82	229	J15HN5	Detection limit or PQL		Std. devn.	103	1.6	J15HN5	Detection limit or PQL		Std. devn.	1.0
4.5	J15HN6	Method detection limit		Median	4.4	195	J15HN6	Method detection limit		Median	229	1.2	J15HN6	Method detection limit		Median	1.2
2.8	J15HN7	TOTAL	11	Min.	2.8	112	J15HN7	TOTAL	11	Min.	79.4	0.98	J15HN7	TOTAL	11	Min.	0.21
4.9	J15HN8			Max.	5.8	241	J15HN8			Max.	412	1.1	J15HN8			Max.	3.6
4.4	J15HN9					266	J15HN9					1.5	J15HN9				
5.8	J15HP0					330	J15HP0					2.2	J15HP0				
		Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?	
		r-squared is:	0.96	r-squared is:	0.98			r-squared is:	0.957	r-squared is:	0.960			r-squared is:	0.96	r-squared is:	0.88
		Recommendations:						Recommendations:						Recommendations:			
		Use lognormal distribution.						Use lognormal distribution.						Use lognormal distribution.			
		UCL (Land's method) is	4.9					UCL (Land's method) is	318					UCL (Land's method) is	2.9		
DATA	ID	Boron 95% UCL Calculation				DATA	ID	Cadmium 95% UCL Calculation				DATA	ID	Chromium 95% UCL Calculation			
470	J15HP1/J15HP2					1.4	J15HP1/J15HP2					24.2	J15HP1/J15HP2				
55.8	J15HN1					0.22	J15HN1					12.3	J15HN1				
54.7	J15HN2	Number of samples	Uncensored values			0.29	J15HN2	Number of samples	Uncensored values			12.7	J15HN2	Number of samples	Uncensored values		
11.9	J15HN3	Uncensored	11	Mean	189	0.08	J15HN3	Uncensored	11	Mean	0.50	12.0	J15HN3	Uncensored	11	Mean	14.5
267	J15HN4	Censored		Lognormal mean	231	0.62	J15HN4	Censored		Lognormal mean	0.53	15.5	J15HN4	Censored		Lognormal mean	14.6
232	J15HN5	Detection limit or PQL		Std. devn.	142	0.64	J15HN5	Detection limit or PQL		Std. devn.	0.36	14.8	J15HN5	Detection limit or PQL		Std. devn.	4.05
139	J15HN6	Method detection limit		Median	196	0.52	J15HN6	Method detection limit		Median	0.41	14.9	J15HN6	Method detection limit		Median	13.0
49.9	J15HN7	TOTAL	11	Min.	11.9	0.22	J15HN7	TOTAL	11	Min.	0.075	9.5	J15HN7	TOTAL	11	Min.	9.50
196	J15HN8			Max.	470	0.39	J15HN8			Max.	1.4	11.9	J15HN8			Max.	24.2
201	J15HN9					0.41	J15HN9					13.0	J15HN9				
338	J15HP0					0.72	J15HP0					19.1	J15HP0				
		Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?	
		r-squared is:	0.899	r-squared is:	0.941			r-squared is:	0.94	r-squared is:	0.85			r-squared is:	0.923	r-squared is:	0.851
		Recommendations:						Recommendations:						Recommendations:			
		Use normal distribution.						Use lognormal distribution.						Use lognormal distribution.			
		UCL (based on t-statistic) is	267					UCL (Land's method) is	1.0					UCL (Land's method) is	17.0		

Washington Closure Hanford

CALCULATION SHEET

Originator HM Sillway *HS*
 Project 300 Area Field Remediation
 Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date 01/10/08
 Job No. 14655

Calc. No. 0300X-CA-V0088
 Checked L. D. Habel *LKH*

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Ecology Software (MTCStat) Results

<p>DATA ID Cobalt 95% UCL Calculation</p> <p>7.2 J15HP1/J15HP2</p> <p>5.9 J15HN1</p> <p>6.4 J15HN2</p> <p>6.4 J15HN3</p> <p>4.0 J15HN4</p> <p>3.7 J15HN5</p> <p>6.0 J15HN6</p> <p>6.3 J15HN7</p> <p>3.3 J15HN8</p> <p>2.8 J15HN9</p> <p>5.7 J15HP0</p> <p>Lognormal distribution? Normal distribution?</p> <p>r-squared is: 0.87 r-squared is: 0.89</p> <p>Recommendations:</p> <p>Reject BOTH lognormal and normal distributions.</p> <p>UCL (based on Z-statistic) is 6.0</p>	<p>DATA ID Copper 95% UCL Calculation</p> <p>55.0 J15HP1/J15HP2</p> <p>26.0 J15HN1</p> <p>19.1 J15HN2</p> <p>14.3 J15HN3</p> <p>61.2 J15HN4</p> <p>55.9 J15HN5</p> <p>27.4 J15HN6</p> <p>22.2 J15HN7</p> <p>71.5 J15HN8</p> <p>71.4 J15HN9</p> <p>39.2 J15HP0</p> <p>Lognormal distribution? Normal distribution?</p> <p>r-squared is: 0.933 r-squared is: 0.92</p> <p>Recommendations:</p> <p>Use lognormal distribution.</p> <p>UCL (Land's method) is 65.2</p>	<p>DATA ID Lead 95% UCL Calculation</p> <p>65.4 J15HP1/J15HP2</p> <p>27.6 J15HN1</p> <p>14.7 J15HN2</p> <p>21.0 J15HN3</p> <p>27.7 J15HN4</p> <p>20.7 J15HN5</p> <p>31.7 J15HN6</p> <p>15.2 J15HN7</p> <p>15.9 J15HN8</p> <p>15.9 J15HN9</p> <p>34.2 J15HP0</p> <p>Lognormal distribution? Normal distribution?</p> <p>r-squared is: 0.892 r-squared is: 0.742</p> <p>Recommendations:</p> <p>Reject BOTH lognormal and normal distributions.</p> <p>UCL (based on Z-statistic) is 33.6</p>
<p>DATA ID Manganese 95% UCL Calculation</p> <p>107 J15HP1/J15HP2</p> <p>267 J15HN1</p> <p>248 J15HN2</p> <p>296 J15HN3</p> <p>117 J15HN4</p> <p>67.8 J15HN5</p> <p>202 J15HN6</p> <p>247 J15HN7</p> <p>112 J15HN8</p> <p>71.4 J15HN9</p> <p>144 J15HP0</p> <p>Lognormal distribution? Normal distribution?</p> <p>r-squared is: 0.933 r-squared is: 0.924</p> <p>Recommendations:</p> <p>Use lognormal distribution.</p> <p>UCL (Land's method) is 254</p>	<p>DATA ID Molybdenum 95% UCL Calculation</p> <p>2.5 J15HP1/J15HP2</p> <p>1.1 J15HN1</p> <p>1.1 J15HN2</p> <p>0.88 J15HN3</p> <p>2.0 J15HN4</p> <p>1.8 J15HN5</p> <p>0.75 J15HN6</p> <p>0.62 J15HN7</p> <p>1.2 J15HN8</p> <p>2.3 J15HN9</p> <p>1.6 J15HP0</p> <p>Lognormal distribution? Normal distribution?</p> <p>r-squared is: 0.97 r-squared is: 0.95</p> <p>Recommendations:</p> <p>Use lognormal distribution.</p> <p>UCL (Land's method) is 2.0</p>	<p>DATA ID Nickel 95% UCL Calculation</p> <p>29.8 J15HP1/J15HP2</p> <p>12.3 J15HN1</p> <p>24.5 J15HN2</p> <p>10.3 J15HN3</p> <p>15.4 J15HN4</p> <p>14.8 J15HN5</p> <p>14.8 J15HN6</p> <p>11.1 J15HN7</p> <p>12.4 J15HN8</p> <p>11.9 J15HN9</p> <p>20.1 J15HP0</p> <p>Lognormal distribution? Normal distribution?</p> <p>r-squared is: 0.906 r-squared is: 0.831</p> <p>Recommendations:</p> <p>Use lognormal distribution.</p> <p>UCL (Land's method) is 20.0</p>

Washington Closure Hanford

CALCULATION SHEET

Originator: HM Sulloway
Project: 300 Area Field Remediation
Subject: 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

Date: 01/10/08
Job No.: 14855

Calc. No.: 0300X-CA-V0088
Checked: L. D. Habel

Rev. No.: 0
Date: 1/16/09
Sheet No.: 12 of 14

Ecology Software (MTCStat) Results

DATA	ID	Selenium 95% UCL Calculation			
8.9	J15HP1/J15HP2				
1.8	J15HN1				
2.6	J15HN2	Number of samples	Uncensored values		
0.55	J15HN3	Uncensored	11	Mean	3.7
4.4	J15HN4	Censored		Lognormal mean	3.9
5.3	J15HN5	Detection limit or PQL		Std. devn.	2.4
3.3	J15HN6	Method detection limit		Median	3.0
2.3	J15HN7	TOTAL	11	Min.	0.7
2.2	J15HN8			Max.	8.9
3.0	J15HN9				
6.7	J15HP0				
		Lognormal distribution?	Normal distribution?		
		r-squared is: 0.95	r-squared is: 0.91		
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is	6.9		

DATA	ID	Vanadium 95% UCL Calculation			
54.8	J15HP1/J15HP2				
46.2	J15HN1				
30.8	J15HN2	Number of samples	Uncensored values		
46.8	J15HN3	Uncensored	11	Mean	41.3
35.1	J15HN4	Censored		Lognormal mean	41.4
33.9	J15HN5	Detection limit or PQL		Std. devn.	6.23
45.9	J15HN6	Method detection limit		Median	44.1
44.1	J15HN7	TOTAL	11	Min.	28.6
31.0	J15HN8			Max.	54.8
28.6	J15HN9				
48.4	J15HP0				
		Lognormal distribution?	Normal distribution?		
		r-squared is: 0.945	r-squared is: 0.957		
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is	46.8		

DATA	ID	Zinc 95% UCL Calculation			
125	J15HP1/J15HP2				
50.0	J15HN1				
46.5	J15HN2	Number of samples	Uncensored values		
68.8	J15HN3	Uncensored	11	Mean	64.1
68.9	J15HN4	Censored		Lognormal mean	64.0
54.0	J15HN5	Detection limit or PQL		Std. devn.	22.3
58.8	J15HN6	Method detection limit		Median	56.4
55.6	J15HN7	TOTAL	11	Min.	45.0
56.4	J15HN8			Max.	125
45.0	J15HN9				
76.2	J15HP0				
		Lognormal distribution?	Normal distribution?		
		r-squared is: 0.853	r-squared is: 0.726		
		Recommendations:			
		Reject BOTH lognormal and normal distributions.			
		UCL (based on Z-statistic) is	75.1		

DATA	ID	TPH Diesel Range 95% UCL Calculation			
60	J15HP1/J15HP2				
42	J15HN1				
2.3	J15HN2	Number of samples	Uncensored values		
7.6	J15HN3	Uncensored	11	Mean	69
64	J15HN4	Censored		Lognormal mean	80
67	J15HN5	Detection limit or PQL		Std. devn.	55
38	J15HN6	Method detection limit		Median	60
33	J15HN7	TOTAL	11	Min.	7.6
170	J15HN8			Max.	170
120	J15HN9				
150	J15HP0				
		Lognormal distribution?	Normal distribution?		
		r-squared is: 0.91	r-squared is: 0.90		
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is	220		

DATA	ID	TPH Motor Oil 95% UCL Calculation			
190	J15HP1/J15HP2				
160	J15HN1				
71	J15HN2	Number of samples	Uncensored values		
41	J15HN3	Uncensored	11	Mean	251
240	J15HN4	Censored		Lognormal mean	267
230	J15HN5	Detection limit or PQL		Std. devn.	178
160	J15HN6	Method detection limit		Median	190
170	J15HN7	TOTAL	11	Min.	41.0
620	J15HN8			Max.	620
490	J15HN9				
390	J15HP0				
		Lognormal distribution?	Normal distribution?		
		r-squared is: 0.95	r-squared is: 0.89		
		Recommendations:			
		Use lognormal distribution.			
		UCL (Land's method) is	520		

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CALCULATION SHEET

Originator HM Salloway
Project 300 Area Field Remediation
Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

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Ecology Software (MTCStat) Results

DATA	ID	Aroclor-1260 95% UCL Calculation				DATA	ID	2-Methylnaphthalene 95% UCL Calculation				DATA	ID	Benzo(a)anthracene 95% UCL Calculation			
0.0094	J15HP1/J15HP2					0.37	J15HP1/J15HP2					0.14	J15HP1/J15HP2				
0.026	J15HN1					0.094	J15HN1					0.024	J15HN1				
0.0075	J15HN2	Number of samples	Uncensored values			0.027	J15HN2	Number of samples	Uncensored values			0.19	J15HN2	Number of samples	Uncensored values		
0.0070	J15HN3	Uncensored	11	Mean	0.014	0.033	J15HN3	Uncensored	11	Mean	0.14	0.18	J15HN3	Uncensored	11	Mean	0.10
0.014	J15HN4	Censored		Lognormal mean	0.014	0.15	J15HN4	Censored		Lognormal mean	0.16	0.039	J15HN4	Censored		Lognormal mean	0.11
0.014	J15HN5	Detection limit or PQL		Std. devn.	0.009	0.19	J15HN5	Detection limit or PQL		Std. devn.	0.11	0.035	J15HN5	Detection limit or PQL		Std. devn.	0.073
0.0052	J15HN6	Method detection limit		Median	0.012	0.051	J15HN6	Method detection limit		Median	0.12	0.20	J15HN6	Method detection limit		Median	0.047
0.036	J15HN7	TOTAL	11	Min.	0.0052	0.049	J15HN7	TOTAL	11	Min.	0.027	0.18	J15HN7	TOTAL	11	Min.	0.024
0.012	J15HN8			Max.	0.036	0.26	J15HN8			Max.	0.37	0.043	J15HN8			Max.	0.20
0.0080	J15HN9					0.25	J15HN9					0.044	J15HN9				
0.013	J15HP0					0.12	J15HP0					0.047	J15HP0				
		Lognormal distribution?	Normal distribution?					Lognormal distribution?	Normal distribution?					Lognormal distribution?	Normal distribution?		
		r-squared is:	0.934	r-squared is:	0.769			r-squared is:	0.962	r-squared is:	0.92			r-squared is:	0.84	r-squared is:	0.80
		Recommendations:						Recommendations:						Recommendations:			
		Use lognormal distribution.						Use lognormal distribution.						Reject BOTH lognormal and normal distributions			
		UCL (Land's method) is	0.021					UCL (Land's method) is	0.34					UCL (based on Z-statistic) is	0.14		
DATA	ID	Benzo(b)fluoranthene 95% UCL Calculation				DATA	ID	Benzo(k)fluoranthene 95% UCL Calculation				DATA	ID	Chrysene 95% UCL Calculation			
0.031	J15HP1/J15HP2					0.14	J15HP1/J15HP2					0.047	J15HP1/J15HP2				
0.19	J15HN1					0.19	J15HN1					0.041	J15HN1				
0.19	J15HN2	Number of samples	Uncensored values			0.19	J15HN2	Number of samples	Uncensored values			0.19	J15HN2	Number of samples	Uncensored values		
0.18	J15HN3	Uncensored	11	Mean	0.11	0.18	J15HN3	Uncensored	11	Mean	0.11	0.020	J15HN3	Uncensored	11	Mean	0.064
0.063	J15HN4	Censored		Lognormal mean	0.12	0.033	J15HN4	Censored		Lognormal mean	0.13	0.071	J15HN4	Censored		Lognormal mean	0.065
0.23	J15HN5	Detection limit or PQL		Std. devn.	0.083	0.23	J15HN5	Detection limit or PQL		Std. devn.	0.085	0.068	J15HN5	Detection limit or PQL		Std. devn.	0.045
0.20	J15HN6	Method detection limit		Median	0.063	0.20	J15HN6	Method detection limit		Median	0.14	0.025	J15HN6	Method detection limit		Median	0.061
0.033	J15HN7	TOTAL	11	Min.	0.021	0.020	J15HN7	TOTAL	11	Min.	0.020	0.039	J15HN7	TOTAL	11	Min.	0.020
0.039	J15HN8			Max.	0.23	0.026	J15HN8			Max.	0.23	0.081	J15HN8			Max.	0.19
0.021	J15HN9					0.030	J15HN9					0.061	J15HN9				
0.043	J15HP0					0.023	J15HP0					0.067	J15HP0				
		Lognormal distribution?	Normal distribution?					Lognormal distribution?	Normal distribution?					Lognormal distribution?	Normal distribution?		
		r-squared is:	0.87	r-squared is:	0.82			r-squared is:	0.81	r-squared is:	0.82			r-squared is:	0.94	r-squared is:	0.74
		Recommendations:						Recommendations:						Recommendations:			
		Reject BOTH lognormal and normal distributions						Reject BOTH lognormal and normal distributions						Use lognormal distribution.			
		UCL (based on Z-statistic) is	0.15					UCL (based on Z-statistic) is	0.16					UCL (Land's method) is	0.10		

Washington Closure Hanford

CALCULATION SHEET

Originator HM Sulloway
Project 300 Area Field Remediation
Subject 600-243 CLEANUP VERIFICATION 95% UCL CALCULATIONS

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Ecology Software (MTCStat) Results

DATA	ID	Di-n-butylphthalate 95% UCL Calculation				DATA	ID	Dibenzofuran 95% UCL Calculation				DATA	ID	Fluoranthene 95% UCL Calculation			
0.14	J15HP1/J15HP2					0.095	J15HP1/J15HP2					0.076	J15HP1/J15HP2				
0.035	J15HN1					0.035	J15HN1					0.063	J15HN1				
0.19	J15HN2	Number of samples	Uncensored values			0.19	J15HN2	Number of samples	Uncensored values			0.027	J15HN2	Number of samples	Uncensored values		
0.027	J15HN3	Uncensored	11	Mean	0.074	0.18	J15HN3	Uncensored	11	Mean	0.080	0.027	J15HN3	Uncensored	11	Mean	0.063
0.042	J15HN4	Censored		Lognormal mean	0.073	0.095	J15HN4	Censored		Lognormal mean	0.082	0.10	J15HN4	Censored		Lognormal mean	0.065
0.23	J15HN5	Detection limit or POL		Std. devn.	0.073	0.053	J15HN5	Detection limit or POL		Std. devn.	0.055	0.066	J15HN5	Detection limit or POL		Std. devn.	0.028
0.026	J15HN6	Method detection limit		Median	0.036	0.030	J15HN6	Method detection limit		Median	0.066	0.041	J15HN6	Method detection limit		Median	0.066
0.023	J15HN7	TOTAL	11	Min.	0.023	0.020	J15HN7	TOTAL	11	Min.	0.020	0.035	J15HN7	TOTAL	11	Min.	0.027
0.047	J15HN8			Max.	0.23	0.074	J15HN8			Max.	0.19	0.080	J15HN8			Max.	0.1
0.036	J15HN9					0.068	J15HN9					0.071	J15HN9				
0.026	J15HP0					0.095	J15HP0					0.11	J15HP0				
		Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?	
		r-squared is:	0.83	r-squared is:	0.71			r-squared is:	0.94	r-squared is:	0.82			r-squared is:	0.93	r-squared is:	0.95
		Recommendations:						Recommendations:						Recommendations:			
		Reject BOTH lognormal and normal distributions						Use lognormal distribution.						Use lognormal distribution.			
		UCL (based on Z-statistic) is	0.11					UCL (Land's method) is	0.14					UCL (Land's method) is	0.091		
DATA	ID	Naphthalene 95% UCL Calculation				DATA	ID	Phenanthrene 95% UCL Calculation				DATA	ID	Pyrene 95% UCL Calculation			
0.32	J15HP1/J15HP2					0.12	J15HP1/J15HP2					0.057	J15HP1/J15HP2				
0.054	J15HN1					0.078	J15HN1					0.059	J15HN1				
0.022	J15HN2	Number of samples	Uncensored values			0.030	J15HN2	Number of samples	Uncensored values			0.19	J15HN2	Number of samples	Uncensored values		
0.020	J15HN3	Uncensored	11	Mean	0.10	0.034	J15HN3	Uncensored	11	Mean	0.097	0.023	J15HN3	Uncensored	11	Mean	0.070
0.037	J15HN4	Censored		Lognormal mean	0.11	0.13	J15HN4	Censored		Lognormal mean	0.10	0.078	J15HN4	Censored		Lognormal mean	0.071
0.13	J15HN5	Detection limit or POL		Std. devn.	0.085	0.14	J15HN5	Detection limit or POL		Std. devn.	0.048	0.062	J15HN5	Detection limit or POL		Std. devn.	0.044
0.082	J15HN6	Method detection limit		Median	0.087	0.060	J15HN6	Method detection limit		Median	0.12	0.028	J15HN6	Method detection limit		Median	0.062
0.035	J15HN7	TOTAL	11	Min.	0.020	0.044	J15HN7	TOTAL	11	Min.	0.030	0.035	J15HN7	TOTAL	11	Min.	0.023
0.14	J15HN8			Max.	0.32	0.14	J15HN8			Max.	0.15	0.075	J15HN8			Max.	0.19
0.15	J15HN9					0.14	J15HN9					0.080	J15HN9				
0.12	J15HP0					0.15	J15HP0					0.086	J15HP0				
		Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?				Lognormal distribution?		Normal distribution?	
		r-squared is:	0.96	r-squared is:	0.83			r-squared is:	0.85	r-squared is:	0.87			r-squared is:	0.93	r-squared is:	0.78
		Recommendations:						Recommendations:						Recommendations:			
		Use lognormal distribution.						Reject BOTH lognormal and normal distributions						Use lognormal distribution.			
		UCL (Land's method) is	0.23					UCL (based on Z-statistic) is	0.12					UCL (Land's method) is	0.11		

Attachment 1. 600-243 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15HN1	10/1/2007	0.68	UJ	0.68	4.2		1.3	130	C	0.06	0.48		0.03	56.8		1.1	0.22		0.15
2	J15HN2	10/1/2007	0.66	UJ	0.66	3.6		1.2	114	C	0.06	0.46		0.03	54.7		1.1	0.29		0.15
3	J15HN3	10/1/2007	0.67	UJ	0.67	3.6		1.2	79.4	C	0.06	0.21		0.03	11.9		1.1	0.15	U	0.2
4	J15HN4	10/1/2007	0.74	UJ	0.74	4.8		1.4	278	C	0.07	1.4		0.03	267		1.2	0.62		0.2
5	J15HN5	10/1/2007	0.83	UJ	0.83	5.0		1.5	229	C	0.08	1.8		0.04	232		1.4	0.64		0.2
6	J15HN6	10/1/2007	0.65	UJ	0.65	4.5		1.2	196	C	0.06	1.2		0.03	139		1.1	0.52		0.2
7	J15HN7	10/1/2007	0.64	UJ	0.64	2.8		1.2	112	C	0.06	0.4		0.03	49.9		1	0.22		0.2
8	J15HN8	10/1/2007	0.77	UJ	0.77	4.9		1.4	241	C	0.07	1.1		0.03	196		1.3	0.39		0.2
9	J15HN9	10/1/2007	0.74	UJ	0.74	4.4		1.4	266	C	0.07	1.3		0.03	261		1.2	0.41		0.2
10	J15HP0	10/1/2007	0.76	UJ	0.76	5.8		1.4	330	C	0.07	2.2		0.03	338		1.3	0.72		0.2
11	J15HP1	10/1/2007	1.3	J	0.95	10.2		1.8	426	C	0.09	3.4		0.04	497		1.6	1.4		0.2
Duplicate of J15HP1	J15HP2	10/1/2007	0.95	U	0.95	7.2		1.8	398	C	0.09	3.8		0.04	443		1.6	1.4		0.2
equip blank	J15HN0	10/1/2007	0.63	UJ	0.63	1.2	U	1.2	3.6	C	0.06	0.12		0.03	2.1		1	0.14	U	0.14

Sample Location	Sample Number	Sample Date	Chromium			Cobalt			Copper			Lead			Manganese			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15HN1	10/1/2007	12.3	C	0.31	5.9	C	0.25	26	C	0.28	27.6		1	267	C	0.22	1.1		0.5
2	J15HN2	10/1/2007	12.7	C	0.3	6.4	C	0.24	19.1	C	0.27	14.7		0.99	248	C	0.21	1.1		0.5
3	J15HN3	10/1/2007	12.0	C	0.3	6.4	C	0.24	14.3	C	0.27	21		1	298	C	0.21	0.88		0.5
4	J15HN4	10/1/2007	15.6	C	0.33	4	C	0.27	61.2	C	0.3	27.7		1.1	117	C	0.23	2.0		0.5
5	J15HN5	10/1/2007	14.8	C	0.38	3.7	C	0.3	55.9	C	0.34	20.7		1.2	67.8	C	0.26	1.8		0.6
6	J15HN6	10/1/2007	14.9	C	0.3	6	C	0.24	27.4	C	0.27	31.7		0.98	202	C	0.21	0.8		0.5
7	J15HN7	10/1/2007	9.5	C	0.29	6.3	C	0.23	22.2	C	0.26	15.2		0.96	247	C	0.2	0.6		0.5
8	J15HN8	10/1/2007	11.9	C	0.35	3.3	C	0.28	71.5	C	0.31	15.9		1.1	112	C	0.24	1.2		0.6
9	J15HN9	10/1/2007	13.0	C	0.33	2.8	C	0.27	71.4	C	0.3	15.9		1.1	71.4	C	0.23	2.3		0.5
10	J15HP0	10/1/2007	19.1		0.35	5.7		0.28	39.2		0.31	34.2		1.1	144		0.24	1.6	C	0.6
11	J15HP1	10/1/2007	24.3		0.43	7.4		0.35	53.7		0.39	60.9		1.4	127		0.3	2.6	C	0.7
Duplicate of J15HP1	J15HP2	10/1/2007	24.0		0.4	7		0.35	56.2		0.39	69.9		1.40	86.5		0.30	2.3	C	0.69
equip blank	J15HN0	10/1/2007	0.45	C	0.29	0.28	C	0.23	0.39	C	0.26	2.7		0.95	95.7	C	0.2	0.86		0.5

Attachment 1
 Originator HM Sulloway
 Checked L. D. Habel
 Calc. No. 0300X-CA-V0088

Sheet No. 1 of 10
 Date 01/10/08
 Date 1/10/08
 Rev. No. 0

Attachment 1. 600-243 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Nickel			Selenium			Silver			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15HN1	10/1/2007	12.3		0.83	1.8		1.3	0.28	U	0.28	46.2		0.25	50.0	C	0.12
2	J15HN2	10/1/2007	24.5		0.81	2.6		1.3	0.27	U	0.27	39.8		0.24	46.5	C	0.12
3	J15HN3	10/1/2007	10.3		0.82	1.3	U	1.3	0.27	U	0.27	46.8		0.24	68.8	C	0.12
4	J15HN4	10/1/2007	15.4		0.90	4.4		1.4	0.30	U	0.30	35.1		0.27	68.9	C	0.13
5	J15HN5	10/1/2007	14.8		1.00	5.3		1.6	0.46		0.34	33.9		0.3	54.0	C	0.15
6	J15HN6	10/1/2007	14.8		0.80	3.3		1.3	0.27	U	0.27	45.9		0.24	58.8	C	0.12
7	J15HN7	10/1/2007	11.1		0.78	2.3		1.3	0.26	U	0.26	44.1		0.23	55.6	C	0.12
8	J15HN8	10/1/2007	12.4		0.94	2.2		1.5	0.31	U	0.31	31.0		0.28	56.4	C	0.14
9	J15HN9	10/1/2007	11.9		0.90	3.0		1.4	0.32		0.30	28.6		0.27	45.0	C	0.13
10	J15HP0	10/1/2007	20.1		0.94	6.7		1.5	0.31	U	0.31	48.4		0.28	76.2	C	0.14
11	J15HP1	10/1/2007	26.0		1.2	11		1.9	0.52		0.39	55.9		0.35	126	C	0.17
Duplicate of J15HP1	J15HP2	10/1/2007	33.5		1.2	6.8		1.9	0.67		0.39	53.6		0.35	123	C	0.17
equip blank	J15HN0	10/1/2007	0.78	U	0.78	1.2	U	1.2	0.26	U	0.26	0.6		0.23	5	J	0.12

Sample Location	Sample Number	Sample Date	Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)		
			mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15HN1	10/1/2007	42	JD	100	160	JD	100
2	J15HN2	10/1/2007	8.3	JD	20	71	JD	20
3	J15HN3	10/1/2007	7.6	JD	20	41	JD	20
4	J15HN4	10/1/2007	64	JD	100	240	JD	100
5	J15HN5	10/1/2007	67	JD	100	230	JD	100
6	J15HN6	10/1/2007	38	JD	100	160	JD	100
7	J15HN7	10/1/2007	33.0	JD	100	170	JD	100
8	J15HN8	10/1/2007	170.0	JD	200	620	JD	200
9	J15HN9	10/1/2007	120.0	JD	200	490	JD	200
10	J15HP0	10/1/2007	150	J	10	390	J	10
11	J15HP1	10/1/2007	60	J	10	210	J	10
Duplicate of J15HP1	J15HP2	10/1/2007	59	J	10	170	J	10
equip blank	J15HN0	10/1/2007	0.95	JD	10	10	JD	10

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

Note: Data qualified with C, D, I, and/or J are considered acceptable values for decision-making purposes.

C = blank contamination (inorganic constituents)

D = diluted

I = interference

J = estimate

MDA = minimum detectable activity

PQL = practical quantitation limit

Q = qualifier

U = undetected

Attachment	1	Sheet No.	2 of 10
Originator	HM Sulloway	Date	01/10/08
Checked	L. D. Habel	Date	4/0/08
Calc. No.	0300X-CA-V0088	Rev. No.	0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN1 Sample Location 1 Sample Date 10/1/07			J15HN2 Sample Location 2 Sample Date 10/1/07			J15HN3 Sample Location 3 Sample Date 10/1/07			J15HN4 Sample Location 4 Sample Date 10/1/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	15	U	15	15	U	15	14	U	14	17	U	17
Aroclor-1221	15	U	15	15	U	15	14	U	14	17	U	17
Aroclor-1232	15	U	15	15	U	15	14	U	14	17	U	17
Aroclor-1242	15	U	15	15	U	15	14	U	14	17	U	17
Aroclor-1248	15	U	15	15	U	15	14	U	14	17	U	17
Aroclor-1254	18	J	15	12	J	12	14	J	14	17	U	17
Aroclor-1260	26		15	15	U	15	14	U	14	12	J	17
Semivolatile Organic Analytes												
1,2,4-Trichlorobenzene	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
1,2-Dichlorobenzene	370	U	370	370	U	370	360	U	360	420	U	420
1,3-Dichlorobenzene	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
1,4-Dichlorobenzene	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
2,4,5-Trichlorophenol	930	U	930	940	U	940	890	U	890	1100	U	1100
2,4,6-Trichlorophenol	370	U	370	370	U	370	360	U	360	420	U	420
2,4-Dichlorophenol	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
2,4-Dimethylphenol	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
2,4-Dinitrophenol	930	U	930	940	U	940	890	U	890	1100	U	1100
2,4-Dinitrotoluene	370	U	370	370	U	370	360	U	360	420	U	420
2,6-Dinitrotoluene	370	U	370	370	U	370	360	U	360	420	U	420
2-Chloronaphthalene	370	U	370	370	U	370	360	U	360	420	U	420
2-Chlorophenol	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
2-Methylnaphthalene	94	J	370	27	J	370	33	J	360	150	J	420
2-Methylphenol (cresol, o-)	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
2-Nitroaniline	930	U	930	940	U	940	890	U	890	1100	U	1100
2-Nitrophenol	370	U	370	370	U	370	360	U	360	420	U	420
3,3'-Dichlorobenzidine	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
4-Methylphenol (p-cresol)	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
3-Nitroaniline	930	UJ	930	940	UJ	940	890	UJ	890	1100	UJ	1100
4,6-Dinitro-2-methylphenol	930	U	930	940	U	940	890	U	890	1100	U	1100
4-Bromophenyl-phenylether	370	U	370	370	U	370	360	U	360	420	U	420
4-Chloro-3-methylphenol	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
4-Chloroaniline	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
4-Chlorophenyl-phenylether	370	U	370	370	U	370	360	U	360	420	U	420
4-Nitroaniline	930	UJ	930	940	UJ	940	890	UJ	890	1100	UJ	1100
4-Nitrophenol	930	U	930	940	U	940	890	U	890	1100	U	1100
Acenaphthene	370	U	370	370	U	370	360	U	360	420	U	420
Acenaphthylene	370	U	370	370	U	370	360	U	360	420	U	420
Anthracene	370	U	370	370	U	370	360	U	360	420	U	420
Benzo(a)anthracene	24	J	370	370	U	370	360	U	360	39	J	420
Benzo(a)pyrene	370	U	370	370	U	370	360	U	360	420	U	420
Benzo(b)fluoranthene	370	U	370	370	U	370	360	U	360	63	J	420
Benzo(g,h,i)perylene	370	U	370	370	U	370	360	U	360	420	U	420
Benzo(k)fluoranthene	370	U	370	370	U	370	360	U	360	33	J	420
Bis(2-chloro-1-methylethyl)ether	370	U	370	370	U	370	360	U	360	420	U	420
Bis(2-chloroethoxy)methane	370	U	370	370	U	370	360	U	360	420	U	420
Bis(2-chloroethyl) ether	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
Bis(2-ethylhexyl) phthalate	63	B	370	98	B	370	50	B	360	68	B	420
Butylbenzylphthalate	370	U	370	370	U	370	360	U	360	420	U	420

Attachment	1	Sheet No.	3 of 10
Originator	HM Sulloway	Date	01/10/08
Checked	L. D. Habel	Date	1/10/08
Calc. No.	0300X-CA-V0088	Rev. No.	

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN1 Sample Location 1 Sample Date 10/1/07			J15HN2 Sample Location 2 Sample Date 10/1/07			J15HN3 Sample Location 3 Sample Date 10/1/07			J15HN4 Sample Location 4 Sample Date 10/1/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)												
Carbazole	370	U	370	370	U	370	360	U	360	420	U	420
Chrysene	41	J	370	370	U	370	20	J	20	71	J	420
Di-n-butylphthalate	35	JB	370	370	U	370	27	JB	27	42	JB	420
Di-n-octylphthalate	370	U	370	370	U	370	360	U	360	420	U	420
Dibenz[a,h]anthracene	370	U	370	370	U	370	360	U	360	420	U	420
Dibenzofuran	35	J	370	370	U	370	360	U	360	66	J	420
Diethylphthalate	370	U	370	370	U	370	360	U	360	420	U	420
Dimethyl phthalate	370	U	370	370	U	370	360	U	360	420	U	420
Fluoranthene	63	J	370	27	J	370	27	J	27	100	J	420
Fluorene	370	U	370	370	U	370	360	U	360	420	U	420
Hexachlorobenzene	370	U	370	370	U	370	360	U	360	420	U	420
Hexachlorobutadiene	370	U	370	370	U	370	360	U	360	420	U	420
Hexachlorocyclopentadiene	370	U	370	370	U	370	360	U	360	420	U	420
Hexachloroethane	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
Indeno(1,2,3-cd)pyrene	370	U	370	370	U	370	360	U	360	420	U	420
Isophorone	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
N-Nitroso-di-n-dipropylamine	370	U	370	370	U	370	360	U	360	420	U	420
N-Nitrosodiphenylamine	370	U	370	370	U	370	360	U	360	420	U	420
Naphthalene	54	J	370	22	J	370	20	J	360	87	J	420
Nitrobenzene	370	UJ	370	370	UJ	370	360	UJ	360	420	UJ	420
Pentachlorophenol	930	UJ	930	940	UJ	940	890	UJ	890	1100	UJ	1100
Phenanthrene	78	J	370	30	J	370	34	J	360	130	J	420
Phenol	370	U	370	370	U	370	360	U	360	420	U	420
Pyrene	59	J	370	370	U	370	23	J	360	78	J	420

Attachment
Originator
Checked
Calc. No.

1
HM Sulloway
L. D. Habel *LH*
0300X-CA-V0088

Sheet No.
Date
Date
Rev. No.

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01/10/08
1/10/08
0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN5 Sample Location 5 Sample Date 10/1/07			J15HN6 Sample Location 6 Sample Date 10/1/07			J15HN7 Sample Location 7 Sample Date 10/1/07			J15HN8 Sample Location 8 Sample Date 10/1/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	18	U	18	16	U	16	14	U	14	16	U	16
Aroclor-1221	18	U	18	16	U	16	14	U	14	16	U	16
Aroclor-1232	18	U	18	16	U	16	14	U	14	16	U	16
Aroclor-1242	18	U	18	16	U	16	14	U	14	16	U	16
Aroclor-1248	18	U	18	16	U	16	14	U	14	16	U	16
Aroclor-1254	18	U	18	16	U	16	67		14	16	U	16
Aroclor-1260	14	J	18	5.2	J	16	36		14	12	J	16
Semivolatile Organic Analytes												
1,2,4-Trichlorobenzene	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
1,2-Dichlorobenzene	450	U	450	390	U	390	360	U	360	400	U	400
1,3-Dichlorobenzene	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
1,4-Dichlorobenzene	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
2,4,5-Trichlorophenol	1100	U	1100	970	U	970	900	U	900	1000	U	1000
2,4,6-Trichlorophenol	450	U	450	390	U	390	360	U	360	400	U	400
2,4-Dichlorophenol	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
2,4-Dimethylphenol	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
2,4-Dinitrophenol	1100	U	1100	970	U	970	900	U	900	1000	U	1000
2,4-Dinitrotoluene	450	U	450	390	U	390	360	U	360	400	U	400
2,6-Dinitrotoluene	450	U	450	390	U	390	360	U	360	400	U	400
2-Chloronaphthalene	450	U	450	390	U	390	360	U	360	400	U	400
2-Chlorophenol	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
2-Methylnaphthalene	190	J	450	51	J	390	49	J	360	260	J	400
2-Methylphenol (cresol, o-)	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
2-Nitroaniline	1100	U	1100	970	U	970	900	U	900	1000	U	1000
2-Nitrophenol	450	U	450	390	U	390	360	U	360	400	U	400
3,3'-Dichlorobenzidine	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
4-Methylphenol (p-cresol)	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
3-Nitroaniline	1100	UJ	1100	970	UJ	970	900	UJ	900	1000	UJ	1000
4,6-Dinitro-2-methylphenol	1100	U	1100	970	U	970	900	U	50	1000	U	1000
4-Bromophenyl-phenylether	450	U	450	390	U	390	360	U	360	400	U	400
4-Chloro-3-methylphenol	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
4-Chloroaniline	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
4-Chlorophenyl-phenylether	450	U	450	390	U	390	360	U	360	400	U	400
4-Nitroaniline	1100	UJ	1100	970	UJ	970	900	UJ	900	1000	UJ	1000
4-Nitrophenol	1100	U	1100	970	U	970	900	U	900	1000	U	1000
Acenaphthene	450	U	450	390	U	390	360	U	360	400	U	400
Acenaphthylene	450	U	450	390	U	390	360	U	360	400	U	400
Anthracene	29	J	450	390	U	390	360	U	360	25	J	400
Benzo(a)anthracene	35	J	450	390	U	390	360	U	360	43	J	400
Benzo(a)pyrene	450	U	450	390	U	390	23	J	360	46	J	400
Benzo(b)fluoranthene	450	U	450	390	U	390	33	J	360	39	J	400
Benzo(g,h,i)perylene	450	U	450	390	U	390	44	J	360	400	U	400
Benzo(k)fluoranthene	450	U	450	390	U	390	20	J	360	28	J	400
Bis(2-chloro-1-methylethyl)ether	450	U	450	390	U	390	360	U	360	400	U	400
Bis(2-chloroethoxy)methane	450	U	450	390	U	390	360	U	360	400	U	400
Bis(2-chloroethyl) ether	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
Bis(2-ethylhexyl) phthalate	110	B	450	88	UJB	390	110	B	360	78	B	400
Butylbenzylphthalate	450	U	450	390	U	390	360	U	360	400	U	400

Attachment	I	Sheet No.	5 of 10
Originator	HM Sulloway	Date	01/10/08
Checked	L. D. Habel <i>LH</i>	Date	4/10/08
Calc. No.	0300X-CA-V0088	Rev. No.	0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN5 Sample Location 5 Sample Date 10/1/07			J15HN6 Sample Location 6 Sample Date 10/1/07			J15HN7 Sample Location 7 Sample Date 10/1/07			J15HN8 Sample Location 8 Sample Date 10/1/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)												
Carbazole	450	U	450	390	U	390	360	U	360	400	U	400
Chrysene	68	J	450	25	J	390	39	J	360	81	J	400
Di-n-butylphthalate	450	U	450	26	JB	390	23	JB	360	47	JB	400
Di-n-octylphthalate	450	U	450	390	U	390	360	U	360	400	U	400
Dibenz[a,h]anthracene	450	U	450	390	U	390	360	U	360	400	U	400
Dibenzofuran	63	J	450	30	J	390	20	J	360	74	J	400
Diethylphthalate	450	U	450	390	U	390	360	U	360	400	U	400
Dimethyl phthalate	450	U	450	390	U	390	360	U	360	400	U	400
Fluoranthene	66	J	450	41	J	390	35	J	360	80	J	400
Fluorene	450	U	450	390	U	390	360	U	360	400	U	400
Hexachlorobenzene	450	U	450	390	U	390	360	U	360	400	U	400
Hexachlorobutadiene	450	U	450	390	U	390	360	U	360	400	U	400
Hexachlorocyclopentadiene	450	U	450	390	U	390	360	U	360	400	U	400
Hexachloroethane	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
Indeno(1,2,3-cd)pyrene	450	U	450	390	U	390	360	U	360	400	U	400
Isophorone	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
N-Nitroso-di-n-dipropylamine	450	U	450	390	U	390	360	U	360	400	U	400
N-Nitrosodiphenylamine	450	U	450	390	U	390	360	U	360	400	U	400
Naphthalene	130	J	450	62	J	390	35	J	360	140	J	400
Nitrobenzene	450	UJ	450	390	UJ	390	360	UJ	360	400	UJ	400
Pentachlorophenol	1100	UJ	1100	970	UJ	970	900	UJ	900	1000	UJ	1000
Phenanthrene	140	J	450	60	J	390	44	J	360	140	J	400
Phenol	450	U	450	390	U	390	360	U	360	400	U	400
Pyrene	62	J	450	28	J	390	35	J	360	75	J	400

Attachment

1

Sheet No.

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Originator

HM Sulloway

Date

01/10/08

Checked

L. D. Habel

Date

1/10/08

Calc. No.

0300X-CA-V0088

Rev. No.

0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN9 Sample Location 9 Sample Date 10/1/07			J15HP0 Sample Location 10 Sample Date 10/1/07			J15HP1 Sample Location 11 Sample Date 10/1/07			J15HP2 Dup of J15HP1 Sample Date 10/1/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	16	U	16	17	U	17	20	U	20	19	U	19
Aroclor-1221	16	U	16	17	U	17	20	U	20	19	U	19
Aroclor-1232	16	U	16	17	U	17	20	U	20	19	U	19
Aroclor-1242	16	U	16	17	U	17	20	U	20	19	U	19
Aroclor-1248	16	U	16	17	U	17	20	U	20	19	U	19
Aroclor-1254	16	U	16	17	U	17	20	U	20	19	U	19
Aroclor-1260	16	U	16	13	J	17	10	J	20	8.7	J	19
Semivolatile Organic Analytes												
1,2,4-Trichlorobenzene	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
1,2-Dichlorobenzene	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
1,3-Dichlorobenzene	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
1,4-Dichlorobenzene	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
2,4,5-Trichlorophenol	1000	U	1000	1000	U	1000	1300	U	1300	1200	UJ	1200
2,4,6-Trichlorophenol	410	U	410	410	U	410	500	U	500	490	UJ	490
2,4-Dichlorophenol	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
2,4-Dimethylphenol	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
2,4-Dinitrophenol	1000	U	1000	1000	U	1000	1300	U	1300	1200	UJ	1200
2,4-Dinitrotoluene	410	U	410	410	U	410	500	U	500	490	U	490
2,6-Dinitrotoluene	410	U	410	410	U	410	500	U	500	490	U	490
2-Chloronaphthalene	410	U	410	410	U	410	500	U	500	490	U	490
2-Chlorophenol	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
2-Methylnaphthalene	250	J	410	120	J	410	81	J	500	660	J	490
2-Methylphenol (cresol, o-)	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
2-Nitroaniline	1000	U	1000	1000	UJ	1000	1300	UJ	1300	1200	UJ	1200
2-Nitrophenol	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
3,3'-Dichlorobenzidine	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
4-Methylphenol (p-cresol)	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
3-Nitroaniline	1000	UJ	1000	1000	UJ	1000	1300	UJ	1300	1200	UJ	1200
4,6-Dinitro-2-methylphenol	1000	U	1000	1000	U	1000	1300	U	1300	1200	U	1200
4-Bromophenyl-phenylether	410	U	410	410	U	410	500	U	500	490	UJ	490
4-Chloro-3-methylphenol	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
4-Chloroaniline	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
4-Chlorophenyl-phenylether	410	U	410	410	U	410	500	U	500	490	UJ	490
4-Nitroaniline	1000	UJ	1000	1000	UJ	1000	1300	UJ	1300	1200	UJ	1200
4-Nitrophenol	1000	U	1000	1000	UJ	1000	1300	UJ	1300	1200	UJ	1200
Acenaphthene	410	U	410	410	U	410	500	U	500	490	U	490
Acenaphthylene	410	U	410	410	U	410	500	U	500	490	U	490
Anthracene	24	J	410	25	J	410	500	UJ	500	35	J	490
Benzo(a)anthracene	44	J	410	47	J	410	500	U	500	34	J	490
Benzo(a)pyrene	410	U	410	43	J	410	25	J	500	35	J	490
Benzo(b)fluoranthene	21	J	410	43	J	410	32	J	500	30	J	490
Benzo(g,h,i)perylene	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
Benzo(k)fluoranthene	30	J	410	23	J	410	500	UJ	500	33	J	490
Bis(2-chloro-1-methylethyl)ether	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
Bis(2-chloroethoxy)methane	410	U	410	410	U	410	500	U	500	490	UJ	490
Bis(2-chloroethyl) ether	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
Bis(2-ethylhexyl) phthalate	59	B	410	660	U	660	660	UB	660	660	UJB	660
Butylbenzylphthalate	410	U	410	410	U	410	500	U	500	490	UJ	490

Attachment

1

Sheet No.

7 of 10

Originator

HM Sulloway

Date

01/10/08

Checked

L. D. Habel

Date

1/15/08

Calc. No.

0300X-CA-V0088

Rev. No.

0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN9 Sample Location 9 Sample Date 10/1/07			J15HP0 Sample Location 10 Sample Date 10/1/07			J15HP1 Sample Location 11 Sample Date 10/1/07			J15HP2 Dup of J15HP1 Sample Date 10/1/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)												
Carbazole	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
Chrysene	61	J	410	67	J	410	33	J	500	60	J	490
Di-n-butylphthalate	36	JB	410	26	J	410	29	J	500	490	UJ	490
Di-n-octylphthalate	410	U	410	410	U	410	500	U	500	490	UJ	490
Dibenz[a,h]anthracene	410	U	410	410	U	410	500	U	500	490	U	490
Dibenzofuran	68	J	410	66	J	410	60	J	500	13	J	490
Diethylphthalate	410	U	410	410	U	410	500	U	500	490	UJ	490
Dimethyl phthalate	410	U	410	410	U	410	500	U	500	490	UJ	490
Fluoranthene	71	J	410	110	J	410	56	J	500	96	J	490
Fluorene	410	U	410	410	U	410	500	U	500	490	U	490
Hexachlorobenzene	410	U	410	410	U	410	500	U	500	490	U	490
Hexachlorobutadiene	410	U	410	410	U	410	500	U	500	490	U	490
Hexachlorocyclopentadiene	410	U	410	410	U	410	500	U	500	490	U	490
Hexachloroethane	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
Indeno(1,2,3-cd)pyrene	410	U	410	28	J	410	500	UJ	500	490	UJ	490
Isophorone	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
N-Nitroso-di-n-dipropylamine	410	U	410	410	U	410	500	U	500	490	U	490
N-Nitrosodiphenylamine	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
Naphthalene	150	J	410	120	J	410	110	J	500	524		490
Nitrobenzene	410	UJ	410	410	UJ	410	500	UJ	500	490	UJ	490
Pentachlorophenol	1000	UJ	1000	1000	UJ	1000	1300	UJ	1300	1200	UJ	1200
Phenanthrene	140	J	410	150	J	410	91	J	500	150	J	490
Phenol	410	U	410	410	UJ	410	500	UJ	500	490	UJ	490
Pyrene	80	J	410	86	J	410	47	J	500	66	J	490

Attachment

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Sheet No.

8 of 10

Originator

HM Sulloway

Date

01/10/08

Checked

L. D. Habel

Date

7/10/08

Calc. No.

0300X-CA-V0088

Rev. No.

0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN0 Equip blank Sample Date 10/1/07		
	µg/kg	Q	PQL
Polychlorinated Biphenyls			
Aroclor-1016	13	U	13
Aroclor-1221	13	U	13
Aroclor-1232	13	U	13
Aroclor-1242	13	U	13
Aroclor-1248	13	U	13
Aroclor-1254	13	U	13
Aroclor-1260	13	U	13
Semivolatile Organic Analytes			
1,2,4-Trichlorobenzene	330	UJ	330
1,2-Dichlorobenzene	330	U	330
1,3-Dichlorobenzene	330	UJ	330
1,4-Dichlorobenzene	330	UJ	330
2,4,5-Trichlorophenol	830	U	830
2,4,6-Trichlorophenol	330	U	330
2,4-Dichlorophenol	330	UJ	330
2,4-Dimethylphenol	330	UJ	330
2,4-Dinitrophenol	830	U	830
2,4-Dinitrotoluene	330	U	330
2,6-Dinitrotoluene	330	U	330
2-Chloronaphthalene	330	U	330
2-Chlorophenol	330	UJ	330
2-Methylnaphthalene	330	UJ	330
2-Methylphenol (cresol, o-)	330	UJ	330
2-Nitroaniline	830	U	830
2-Nitrophenol	330	U	330
3,3'-Dichlorobenzidine	330	UJ	330
4-Methylphenol (p-cresol)	330	UJ	330
3-Nitroaniline	830	UJ	830
4,6-Dinitro-2-methylphenol	830	U	830
4-Bromophenyl-phenylether	330	U	330
4-Chloro-3-methylphenol	330	UJ	330
4-Chloroaniline	330	UJ	330
4-Chlorophenyl-phenylether	330	U	330
4-Nitroaniline	830	UJ	830
4-Nitrophenol	830	U	830
Acenaphthene	330	U	330
Acenaphthylene	330	U	330
Anthracene	330	U	330
Benzo(a)anthracene	330	U	330
Benzo(a)pyrene	330	U	330
Benzo(b)fluoranthene	330	U	330
Benzo(g,h,i)perylene	330	U	330
Benzo(k)fluoranthene	330	U	330
Bis(2-chloro-1-methylethyl)ether	330	U	330
Bis(2-chloroethoxy)methane	330	U	330
Bis(2-chloroethyl) ether	330	UJ	330
Bis(2-ethylhexyl) phthalate	41	B	330
Butylbenzylphthalate	330	U	330

Attachment	1	Sheet No.	9 of 10
Originator	HM Sulloway	Date	01/10/08
Checked	L. D. Habel <i>L.H.</i>	Date	4/10/08
Calc. No.	0300X-CA-V0088	Rev. No.	0

Attachment 1. 600-243 Verification Sampling Results.

Constituent	J15HN0 Equip blank Sample Date 10/1/07		
	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)			
Carbazole	330	U	330
Chrysene	330	U	330
Di-n-butylphthalate	23	JB	330
Di-n-octylphthalate	330	U	330
Dibenz[a,h]anthracene	330	U	330
Dibenzofuran	330	U	330
Diethylphthalate	330	U	330
Dimethyl phthalate	330	U	330
Fluoranthene	330	U	330
Fluorene	330	U	330
Hexachlorobenzene	330	U	330
Hexachlorobutadiene	330	U	330
Hexachlorocyclopentadiene	330	U	330
Hexachloroethane	330	UJ	330
Indeno(1,2,3-cd)pyrene	330	U	330
Isophorone	330	UJ	330
N-Nitroso-di-n-dipropylamine	330	U	330
N-Nitrosodiphenylamine	330	U	330
Naphthalene	330	U	330
Nitrobenzene	330	UJ	330
Pentachlorophenol	830	UJ	830
Phenanthrene	330	U	330
Phenol	330	U	330
Pyrene	330	U	330

Attachment	1	Sheet No.	10 of 10
Originator	HM Sulloway	Date	01/10/08
Checked	L. D. Habel <i>LH</i>	Date	1/10/08
Calc. No.	0300X-CA-V0088	Rev. No.	0

APPENDIX E

DATA FROM SAMPLING OF COAL ASH/SOIL SURROUNDING THE 600-243 WASTE SITE

600-243 Coal Ash Characterization Sampling Results.

Sample Location	Sample Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J16438	1/7/2008	1.1	U	1.1	5.2		1.9	373		0.37	2.0		0.19	496		1.9	0.71		0.19
2	J16439	1/7/2008	1.3	U	1.3	8.3		2.2	459		0.45	3.1		0.22	262		2.2	1.3		0.22
3	J16440	1/7/2008	2.1		1	22.0		1.7	936		0.35	2.3		0.17	279		1.7	0.96		0.17
4	J16441	1/7/2008	1.4		1.1	12.3		1.8	715		0.35	1.8		0.18	230		1.8	0.91		0.18

Sample Location	Sample Number	Sample Date	Chromium			Cobalt			Copper			Lead			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J16438	1/7/2008	15.5		0.74	4.5		0.74	34.6		0.76	25.9		1.1	110		0.15	0.17		0.01
2	J16439	1/7/2008	23.7		0.90	6.2		0.9	56		0.9	51.1		1.3	120		0.18	0.36		0.02
3	J16440	1/7/2008	10		0.7	3.9		0.7	51.3		0.7	78.7		1	29.1		0.14	0.24		0.01
4	J16441	1/7/2008	8.9		0.71	4.3		0.71	35.4		0.71	47.9		1.1	46.5		0.14	0.16		0.01

Sample Location	Sample Number	Sample Date	Molybdenum			Nickel			Selenium			Silver			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J16438	1/7/2008	1.1	U	1.1	16.9		0.74	4.7		2.2	0.37	U	0.37	42.2		0.52	54.9		2.2
2	J16439	1/7/2008	1.3	U	1.3	26.1		0.9	10.8		2.7	0.45	U	0.45	55.5		0.63	102		2.7
3	J16440	1/7/2008	5.7		1	12.3		0.7	8.1		2.1	0.35	U	0.35	40.8		0.49	81.6		2.1
4	J16441	1/7/2008	2.5		1.1	14		0.71	4.1		2.1	0.35	U	0.35	32.2		0.5	96.1		2.1

Sample Location	Sample Number	Sample Date	Total petroleum hydrocarbons - diesel range			Total petroleum hydrocarbons - motor oil (high boiling)		
			mg/kg	Q	PQL	mg/kg	Q	PQL
1	J16438	1/7/2008	120			270		
2	J16439	1/7/2008	110			300		
3	J16440	1/7/2008	59			120		
4	J16441	1/7/2008	78			160		

C = blank contamination (inorganic constituents)

D = diluted

I = interference

J = estimate

MDA = minimum detectable activity

PQL = practical quantitation limit

Q = qualifier

U = undetected

600-243 Coal Ash Characterization Sampling Results.												
Constituent	J16438 Sample Location 1 Sample Date 1/7/08			J16439 Sample Location 2 Sample Date 1/7/08			J16440 Sample Location 3 Sample Date 1/7/08			J16441 Sample Location 4 Sample Date 1/7/08		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls												
Aroclor-1016	17	U	17	22	U	22	17	U	17	17	U	17
Aroclor-1221	17	U	17	22	U	22	17	U	17	17	U	17
Aroclor-1232	17	U	17	22	U	22	17	U	17	17	U	17
Aroclor-1242	17	U	17	22	U	22	17	U	17	17	U	17
Aroclor-1248	17	U	17	22	U	22	17	U	17	17	U	17
Aroclor-1254	17	U	17	22	U	22	17	U	17	17	U	17
Aroclor-1260	17	U	17	22	U	22	17	U	17	17	U	17
Pesticides												
Aldrin	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
Alpha-BHC	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
alpha-Chlordane	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
beta-1,2,3,4,5,6-Hexachlorocyclohexane	10		1.7	9	JI	2.2	30		1.7	37	I	1.7
Delta-BHC	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	4.2	JI	1.7
Dichlorodiphenyldichloroethane	4	J	1.7	2.2	U	2.2	3.3	JI	1.7	2.7	I	1.7
Dichlorodiphenyldichloroethylene	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	28		1.7
Dichlorodiphenyltrichloroethane	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	18	I	1.7
Dieldrin	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
Endosulfan I	1.7	U	1.7	2.2	U	2.2	6.9	J	1.7	14		1.7
Endosulfan II	1.7	U	1.7	2.6	JI	2.2	4.8	JI	1.7	1.7	U	1.7
Endosulfan sulfate	2.3	JI	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
Endrin	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
Endrin aldehyde	1.7	JI	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
Endrin ketone	2.3	JI	1.7	2.9	JI	2.2	2.9	JI	1.7	1.7	U	1.7
Gamma-BHC (Lindane)	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	3.6	JI	1.7
gamma-Chlordane	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.9	JI	1.7
Heptachlor	1.7	U	1.7	2.2	U	2.2	1.8	J	1.7	3.1	JI	1.7
Heptachlor epoxide	1.7	U	1.7	2.2	U	2.2	3.4	JI	1.7	3.5	JI	1.7
Methoxychlor	1.7	U	1.7	2.2	U	2.2	1.7	U	1.7	1.7	U	1.7
Toxaphene	17	U	17	22	U	22	17	U	17	17	U	17
Semivolatile Organic Analytes												
1,2,4-Trichlorobenzene	430	U	430	540	U	540	420	U	420	440	U	440
1,2-Dichlorobenzene	430	U	430	540	U	540	420	U	420	440	U	440
1,3-Dichlorobenzene	430	U	430	540	U	540	420	U	420	440	U	440
1,4-Dichlorobenzene	430	U	430	540	U	540	420	U	420	440	U	440
2,4,5-Trichlorophenol	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
2,4,6-Trichlorophenol	430	U	430	540	U	540	420	U	420	440	U	440
2,4-Dichlorophenol	430	U	430	540	U	540	420	U	420	440	U	440
2,4-Dimethylphenol	430	U	430	540	U	540	420	U	420	440	U	440
2,4-Dinitrophenol	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
2,4-Dinitrotoluene	430	U	430	540	U	540	420	U	420	440	U	440
2,6-Dinitrotoluene	430	U	430	540	U	540	420	U	420	440	U	440
2-Chloronaphthalene	430	U	430	540	U	540	420	U	420	440	U	440
2-Chlorophenol	430	U	430	540	U	540	420	U	420	440	U	440
2-Methylnaphthalene	240	J	430	180	J	540	160	J	420	380	J	440
2-Methylphenol (cresol, o-)	430	U	430	540	U	540	420	U	420	440	U	440
2-Nitroaniline	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
2-Nitrophenol	430	U	430	540	U	540	420	U	420	440	U	440
3,3'-Dichlorobenzidine	430	U	430	540	U	540	420	U	420	440	U	440
4-Methylphenol (p-cresol)	430	U	430	540	U	540	420	U	420	440	U	440
3-Nitroaniline	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
4,6-Dinitro-2-methylphenol	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
4-Bromophenyl-phenylether	430	U	430	540	U	540	420	U	420	440	U	440
4-Chloro-3-methylphenol	430	U	430	540	U	540	420	U	420	440	U	440
4-Chloroaniline	430	U	430	540	U	540	420	U	420	440	U	440
4-Chlorophenyl-phenylether	430	U	430	540	U	540	420	U	420	440	U	440
4-Nitroaniline	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
4-Nitrophenol	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
Acenaphthene	430	U	430	540	U	540	420	U	420	440	U	440
Acenaphthylene	430	U	430	540	U	540	420	U	420	440	U	440

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600-243 Coal Ash Characterization Sampling Results.												
Constituent	J16438 Sample Location 1 Sample Date 1/7/08			J16439 Sample Location 2 Sample Date 1/7/08			J16440 Sample Location 3 Sample Date 1/7/08			J16441 Sample Location 4 Sample Date 1/7/08		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analytes (continued)												
Anthracene	40	J	430	36	J	540	420	U	420	440	U	440
Benzo(a)anthracene	42	J	430	54	J	540	420	U	420	440	U	440
Benzo(a)pyrene	430	U	430	540	U	540	430	U	420	440	U	440
Benzo(b)fluoranthene	430	U	430	42	J	540	420	U	420	440	U	440
Benzo(g,h,i)perylene	430	U	430	540	U	540	420	U	420	440	U	440
Benzo(k)fluoranthene	430	U	430	540	U	540	420	U	420	440	U	440
Bis(2-chloro-1-methylethyl)ether	430	U	430	540	U	540	420	U	420	440	U	440
Bis(2-chloroethoxy)methane	430	U	430	540	U	540	420	U	420	440	U	440
Bis(2-chloroethyl) ether	430	U	430	540	U	540	420	U	420	440	U	440
Bis(2-ethylhexyl) phthalate	100	JB	430	130	JB	540	140	JB	420	98	JB	440
Butylbenzylphthalate	430	U	430	540	U	540	420	U	420	440	U	440
Carbazole	430	U	430	540	U	540	420	U	420	440	U	440
Chrysene	80	J	430	89	J	540	32	U	420	58	J	440
Di-n-butylphthalate	27	JB	430	32	JB	540	72	JB	420	42	JB	440
Di-n-octylphthalate	430	U	430	540	U	540	420	U	420	440	U	440
Dibenz[a,h]anthracene	430	U	430	540	U	540	420	U	420	440	U	440
Dibenzofuran	50	J	430	85	J	540	66	J	420	110	J	440
Diethylphthalate	430	U	430	540	U	540	420	U	420	440	U	440
Dimethyl phthalate	430	U	430	540	U	540	420	U	420	440	U	440
Fluoranthene	90	J	430	130	J	540	41	U	420	63	J	440
Fluorene	430	U	430	540	U	540	420	U	420	440	U	440
Hexachlorobenzene	430	U	430	540	U	540	420	U	420	440	U	440
Hexachlorobutadiene	430	U	430	540	U	540	420	U	420	440	U	440
Hexachlorocyclopentadiene	430	U	430	540	U	540	420	U	420	440	U	440
Hexachloroethane	430	U	430	540	U	540	420	U	420	440	U	440
Indeno(1,2,3-cd)pyrene	430	U	430	540	U	540	420	U	420	440	U	440
Isophorone	430	U	430	540	U	540	420	U	420	440	U	440
N-Nitroso-di-n-dipropylamine	430	U	430	540	U	540	420	U	420	440	U	440
N-Nitrosodiphenylamine	430	U	430	540	U	540	420	U	420	440	U	440
Naphthalene	120	J	430	120	J	540	130	J	420	200	J	440
Nitrobenzene	430	U	430	540	U	540	420	U	420	440	U	440
Pentachlorophenol	1100	U	1100	1400	U	1400	1000	U	1000	1100	U	1100
Phenanthrene	170	J	430	160	J	540	87	J	420	140	J	440
Phenol	430	U	430	540	U	540	420	U	420	440	U	440
Pyrene	79	J	430	140	J	540	27	U	420	47	J	440

APPENDIX F

**HAZARD QUOTIENT AND CARCINOGENIC
RISK CALCULATIONS**

APPENDIX F HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS

The calculation in this appendix is kept in the active Washington Closure Hanford project files and is available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculation is provided in this appendix:

600-243 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation, 0600X-CA-V0065, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculation provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

Acrobat 8.0

CALCULATION COVER SHEETProject Title: 300 Area Field Remediation Job No. 14655Area: 300 AreaDiscipline: Environmental *Calculation No: 0600X-CA-V0065Subject: 600-243 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk CalculationComputer 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 = 4 Total = 5	H. M. Stulloway <i>H. M. Stulloway</i>	L. D. Habel <i>L. D. Habel</i>	NA	J. D. Ludowise <i>J. D. Ludowise</i>	1-15-08

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:	H. M. Sulloway <i>HMS</i>	Date:	01/10/08	Calc. No.:	0600X-CA-V0065	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	L. D. Habel <i>LH</i>	Date:	1/14/08
Subject:	600-243 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 4

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk for the 600-243 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2004), 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 x 10⁻⁶ for individual carcinogens
- 4) A cumulative excess cancer risk of <1 x 10⁻⁵ for carcinogens.

GIVEN/REFERENCES:

- 1) DOE-RL, 2004, *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, DOE/RL-2001-47, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 2) EPA, 1994, *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.
- 3) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.
- 4) WCH, 2007, *Remaining Sites Verification Package for the 600-243 Petroleum Contaminated Soil Bioremediation Pad*, Attachment to Waste Site Reclassification Form 2007-033, 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 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 or required detection limit/practical quantitation limit and compare it to the excess cancer risk of <1 x 10⁻⁶ (DOE-RL 2005).
- 4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of <1 x 10⁻⁵.

Washington Closure Hanford, Inc.

CALCULATION SHEET

Originator:	H. M. Sulloway <i>HMS</i>	Date:	01/10/08	Calc. No.:	0600X-CA-V0065	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	L. D. Habel <i>LX</i>	Date:	1/14/08
Subject:	600-243 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 4

METHODOLOGY:

The 600-243 waste site was a single area for the purpose of verification sampling and consisted of the excavation footprint of the 600-243 waste site.

Hazard quotient and carcinogenic risk calculations for the 600-243 waste site were conservatively calculated for the entire waste site using the highest of the statistically calculated results for each analyte from WCH (2007). Of the contaminants of potential concern (COPCs) for this site, barium, beryllium, cadmium, copper, nickel, selenium, and zinc are included because they were detected at a concentration above their Washington State background value. Boron and molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Several polychlorinated biphenyls and semivolatile analytes (as shown in Table 1 below) are included because they were detected in verification samples and cannot be attributed to natural occurrence. Lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. As a result, the statistical value for lead is reported but not included in the hazard quotient calculation. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

- 1) For example, the statistical value for boron is 267 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (boron is identified as a noncarcinogen in WAC 173-340-740[3]), is 1.7×10^{-2} . Comparing this value, and all other individual values, to the requirement of <1.0 , this criteria is met.
- 2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. The sum of the HQ values is 3.1×10^{-1} . Comparing this value to the requirement of <1.0 , this criteria is met.
- 3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6} . For example, the statistical value for beryllium is 2.9 mg/kg, divided by 10.4 mg/kg, and multiplied as indicated, is 2.8×10^{-7} . Comparing this value and all other individual values to the requirement of $<1 \times 10^{-6}$, this criteria 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. The sum of the excess cancer risk values is 9.1×10^{-7} . Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Table 1 shows the results of the calculations.

Washington Closure Hanford, Inc.

CALCULATION SHEET

Originator:	H. M. Sulloway <i>HMS</i>	Date:	01/10/08	Calc. No.:	0600X-CA-V0065	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	L. D. Habel <i>LH</i>	Date:	1/14/08
Subject:	600-243 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 4

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 600-243 Waste Site.

Contaminants of Concern ^a	Maximum Value ^a (mg/kg)	Noncarcinogen RAG ^b (mg/kg)	Hazard Quotient	Carcinogen RAG ^b (mg/kg)	Carcinogen Risk
Metals					
Barium ^c	318	1,600	2.0E-01	--	--
Beryllium ^c	2.9	160	1.8E-02	10.4	2.8E-07
Boron	267	16,000	1.7E-02	--	--
Cadmium ^c	1.00	80	1.3E-02	13.9	7.2E-08
Copper	65.2	2,960	2.2E-02	--	--
Lead ^d	33.6	353	9.5E-02	--	--
Molybdenum	2.0	400	5.0E-03	--	--
Nickel	20.0	1,600	1.3E-02	--	--
Selenium	6.9	400	1.7E-02	--	--
Zinc	75.1	24,000	3.1E-03	--	--
Semivolatiles					
Anthracene	0.035	24,000	1.5E-06	--	--
Benzo(a)anthracene	0.138	--	--	1.37	1.0E-07
Benzo(a)pyrene	0.046	--	--	0.137	1.4E-07
Benzo(b)fluoranthene	0.150	--	--	1.37	1.1E-07
Benzo(k)fluoranthene	0.155	--	--	13.7	1.1E-08
Benzo(ghi)perylene	0.044	2,400	1.8E-05	--	--
Chrysene	0.101	--	--	137	7.4E-10
Dibenzofuran	0.140	160	8.8E-04	--	--
Di-n-butylphthalate	0.110	8,000	1.4E-05	--	--
Fluoranthene	0.091	3,200	2.8E-05	--	--
Indeno(1,2,3-cd) pyrene	0.028	--	--	1.37	2.0E-08
Methylnaphthalene; 2-	0.344	320	1.1E-03	--	--
Naphthalene	0.233	1,600	1.5E-04	--	--
Phenanthrene	0.121	24,000	5.0E-06	--	--
Pyrene	0.108	2,400	4.5E-05	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.067	--	--	0.5	1.3E-07
Aroclor-1260	0.021	--	--	0.5	4.2E-08
Totals					
Cumulative Hazard Quotient:			3.1E-01		
Cumulative Excess Cancer Risk:					9.1E-07

Notes:

^a = From WCH (2007).^b = Value obtained from the RDR/RAWP (DOE-RL 2004) 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 noncarcinogen RAG obtained from EPA (1994).

Method B, 1996.

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford, Inc.		CALCULATION SHEET					
Originator:	H. M. Sulloway <i>HMS</i>	Date:	01/10/08	Calc. No.:	0600X-CA-V0065	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	L. D. Habel <i>L.D.H.</i>	Date:	1/14/08
Subject:	600-243 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation						Sheet No. 4 of 4

1 **CONCLUSION:**

2

3 This calculation demonstrates that the 600-243 waste site meets the requirements for the hazard
4 quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2004).

APPENDIX G

**DATA QUALITY ASSESSMENT OF THE 600-243 WASTE SITE
VERIFICATION SAMPLES**

VERIFICATION SAMPLING DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (WCH 2007a). This DQA was performed in accordance with site-specific data quality objectives found in the *300 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2004).

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., evaluate against cleanup criteria to indicate if remedial action goals [RAGS] have been met). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

A review of the sample design (WCH 2007b), the field logbook (WCH 2007a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. The samples collected are sufficient to indicate if all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met. The verification sample data collected at the 600-243 waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG K0988 and SDG K0989. SDG K0988 was submitted for third-party validation. No major deficiencies were identified in the analytical data. Minor deficiencies are discussed below.

SDG K0988

This SDG comprises three field samples from the 600-243 excavation area (J15HP0, J15HP1, and J15HP2). Sample J15HP2 is the field duplicate of sample J15HP1.

The field samples were analyzed for inductively coupled plasma (ICP) metals, mercury, polychlorinated biphenyls (PCBs), diesel range organics (DRO), motor oil range organics, and semivolatile organic compounds (SVOCs). SDG K0988 was submitted for third-party validation. No major deficiencies were found in SDG K0988. Minor deficiencies are as follows:

The matrix spike (MS) recovery for antimony was outside the acceptance criteria at 60.4%. Third-party validation qualified all of the antimony data in SDG K0988 as estimated with “J” flags. Estimated data are useable for decision-making purposes.

The relative percent difference (RPD) calculated for manganese in the field duplicate pair (J15HP1, J15HP2) is above the acceptance criteria at 37.9%. This elevated RPD result indicates natural heterogeneity in the sample matrix. Third-party validation did not qualify any data based on this result, nor is any qualification required. The data are useable for decision-making purposes.

The laboratory duplicate associated with SDG K0988 indicated elevated RPDs for the analytes molybdenum and arsenic were above the acceptance criteria at 46.2% and 33.1%, respectively. Third-party validation did not qualify any data based on this result, nor is any qualification required. The data are useable for decision-making purposes.

In the PCB analysis of SDG K0988, 4 of 14 surrogates were outside the acceptance criteria. The elevated surrogates were in the method blank (MB) and the laboratory control sample (LCS). All four results were high (123%-151%), indicating a possible high bias in the data. The MS, matrix spike duplicate (MSD), and other samples surrogates were all within criteria. The sample recoveries were below the required quantitation limit (RQL). The possible high bias in the data has had no affect on the field sample data. The data are useable for decision-making purposes.

In the SVOC analysis the common analytical contaminant bis(2-ethylhexyl)phthalate was detected in the (MB). Third-party validation raised all sample results for bis(2-ethylhexyl)phthalate in SDG K0988 to the RQL and qualified all of those results as undetected with "U" flags. The data are useable for decision-making purposes.

The motor oil range organic analysis did not include an MS, MSD, or LCS. Furthermore, in the DRO analysis the MS and MSD recoveries were interfered with and not evaluated. Third-party validation qualified all of the motor oil range organic data and all of the DRO data in SDG K0988 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

Due to the nature of the sample matrix (carbon) many of the quality control/quality assurance (QA/QC) measurements in the SVOC analysis were compromised. A carbon substrate is commonly used to adsorb organic molecules in a variety of applications. Therefore, the SVOC analytes and surrogates are expected to adsorb onto the sample matrix. This is seen in the following paragraphs concerning the QA/QC of the SVOC analysis. It should be noted that the performance of the analysis is demonstrated by LCS where these QA/QC deficiencies are not seen.

All of the MS and MSD recoveries were lowered due to the nature of the sample matrix (carbon). Third-party validation qualified all results for 29 SVOC analytes in SDG K0988 as estimated with "J" flags (phenol, bis[2-chloroethyl]ether, 2-chlorophenol, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 2-methylphenol, 3/4-methylphenol, hexachloroethane, nitrobenzene, isophorone, 2-nitrophenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 1,2,4-trichlorobenzene, 4-chloroaniline, 4-chloro-3-methylphenol, 2-methylnaphthalene, 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, n-nitrosodiphenylamine, phenanthrene, carbazole, 3,3'-dichlorobenzidine, benzo[b]fluoranthene, benzo[a]pyrene, ideno[1,2,3-cd]pyrene, and benzo[g,h,i]perylene). The recoveries of these analytes were below the lower acceptance criteria in both the MS and MSD. Estimated data are useable for decision-making purposes.

Third-party validation also qualified all results for an additional four analytes (2,2'-oxybis[1-chloropropane], 4-nitrophenol, anthracene, and benzo[k]fluoranthene) as estimated with "J" flags due to recoveries that are below the lower acceptance criteria in either the MS or the MSD. Estimated data are useable for decision-making purposes.

Recoveries of the surrogate 2-fluorophenol in the MS and MSD are below the lower acceptance criteria. Third-party validation qualified all the data for the associated analytes (2-chlorophenol, 2,4-dichlorophenol, and 4-chloro-3-methylphenol) in SDG K0988 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

Recoveries for three surrogates (phenol-d5, 2-fluorophenol, and 2,4,6-tribromophenol) in sample J15HP2 are also low. Third-party validation qualified data for the associated analytes (phenol, 2-methylphenol, 3/4-methylphenol, 2,4-dimethylphenol, 2-nitrophenol, 2,4-dinitrophenol, dimethyl phthalate, diethylphthalate, di-n-butyl phthalate, butylbenzylphthalate, bis[2-ethylhexyl] phthalate, di-n-octylphthalate, isophorone, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, pentachlorophenol, bis[2-chloroethyl]ether, bis[2-chloroethoxy]methane, 4-chlorophenyl phenyl ether, and 4-bromophenyl phenyl ether) in sample J15HP2 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

An evaluation of the SVOC MS and MSD recoveries using an RPD calculation identified five analytes (2-methylphenol, 2,4-dimethylphenol, 4-chloroaniline, 4-nitrophenol, and 4-nitroaniline) in the SVOC analysis with RPDs greater than the acceptance criteria. Third-party validation qualified all data in SDG K0988 from these five analytes as estimated with "J" flags. Estimated data are useable for decision-making purposes.

SDG K0989

This SDG comprises 10 field samples from the 600-243 excavation area: J15HN0, J15HN1, J15HN2, J15HN3, J15HN4, J15HN5, J15HN6, J15HN7, J15HN8, and J15HN9.

The field samples were analyzed for ICP metals, mercury, PCBs, DRO, motor oil range organics, and SVOCs. No major deficiencies were found in SDG K0989. Minor deficiencies are as follows:

The MS recovery for antimony was outside the acceptance criteria at 59.3%. The project has qualified all of the antimony data in SDG K0989 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

MS recoveries for three other analytes (barium, copper, and manganese) were also outside the acceptance criteria. In these three cases the spiked amount was not significantly greater than the native amount identified in the sample. Quantitation of these analytes was confirmed using post-digestion spikes (PDSs). The results of the PDSs were in the range of 74.4% to 103.9%. No qualification is needed for these results. The data are useable for decision-making purposes.

The result for zinc in the equipment blank (EB) sample (J15HN0) was not more than 20 times the zinc result in the method blank sample. The project has qualified the zinc result in sample J15HN0 as estimated with a "J" flag. Both results are well below the applicable remediation action goals (RAGs) for zinc. The data are useable for decision-making purposes.

In the PCB analysis of SDG K0989, 4 of 28 surrogates were outside the acceptance criteria. The elevated surrogates were in samples J15HN5 and J15HN8. All four results were high (129%-137%), indicating a possible high bias in the data. Surrogates in the MS, MSD, LCS, MB, and other samples were within the acceptance criteria. A high bias in the data is acceptable for decision-making purposes.

In the SVOC analysis, the common analytical contaminant bis(2-ethylhexyl)phthalate was detected in the MB. The project has raised all sample results for bis(2-ethylhexyl)phthalate in SDG K0989 to the RQL and qualified all of those results as undetected with "U" flags. The data are useable for decision-making purposes.

The motor oil range organic analysis did not include an MS, MSD, or LCS. Furthermore, in the DRO analysis the MS and MSD recoveries were interfered with and not evaluated. The project has qualified all of the motor oil range organic data and all of the DRO data in SDG K0989 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

As was seen in SDG K0988, the nature of the sample matrix (carbon) has affected many of the QA/QC measurements in the SVOC analysis. A carbon substrate is commonly used to adsorb organic molecules in a variety of applications. Therefore, the SVOC analytes and surrogates are expected to adsorb onto the sample matrix. This is seen in the following paragraphs concerning the QA/QC of the SVOC analysis. It should be noted that the performance of the analysis is demonstrated by LCS where these QA/QC deficiencies are not seen.

Most of the MS and MSD recoveries were low due to the nature of the sample matrix (carbon). The project has qualified all results for 15 SVOC analytes in SDG K0989 as estimated with "J" flags (1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-methylphenol, 3/4-methylphenol, hexachloroethane, nitrobenzene, isophorone, 2,4-dimethylphenol, 1,2,4-trichlorobenzene, 4-chloroaniline, 2-methylnaphthalene, 3-nitroaniline, 4-nitroaniline, 3,3'-dichlorobenzidine, and pentachlorophenol). The recoveries of these analytes were outside the acceptance criteria in both the MS and MSD. Estimated data are useable for decision-making purposes.

The project qualified all results for the analyte bis(2-chloroethyl)ether in SDG K0989 as estimated with "J" flags due to a MSD recovery (47%) that is below the lower acceptance criteria. Estimated data are useable for decision-making purposes.

Recoveries of the surrogates 2-fluorophenol and 2,4,6-tribromophenol in sample J15HN5 are below the lower acceptance criteria at 17% and 14%, respectively. The project has qualified all the data for the associated analytes (2-chlorophenol, 2,4-dichlorophenol, and 4-chloro-3-methylphenol) in SDG K0989 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

RPD evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies shown 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. The field QA/QC samples for the 600-243 waste site, listed in the field logbook (WCH 2007a), are primary and duplicate field samples from the excavation (J15HP1/J15HP2). 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 duplicate samples for each COC. Only analytes with values above five times the detection limits for both the main and duplicate samples are compared. The 95% UCL calculation brief in Appendix D provides details on duplicate pair evaluation and RPD calculation. The RPD calculated for manganese in the field sample duplicate pair J15HP1/J15HP2 is above the acceptance criteria (30%) at 37.7%. Variability in environmental soil samples such as is noted here is attributed to natural heterogeneity in the soil matrix. The data are useable 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 target detection limit (TDL), including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix D) to indicate that a visual check of the data is required by the reviewer. None of the 600-243 waste site results required this check.

An overall visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are suitable for the intended purpose of cleanup verification.

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 600-243 verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for the 600-243 waste site concludes that the data are of the right type, quality, and quantity to support the intended use. The verification sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix D.

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