0068097

WCH-28
Rev. 0

River Corridor
Closure Contract

Results of Remediation and Verification Sampling for the 600-270 Horseshoe Landfill

RECEIVED
JAN 17 2006
EDMC

December 2005

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy. Available in paper copy and microfiche.

Available for a processing fee to U.S. Department of Energy and its contractors from:
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
(865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov
online ordering: http://www.doe.gov/bridge

Available for sale to the public, in paper, from:
U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(800) 553-6847
fax: (703) 605.6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

Printed in the United States of America

DISCLM-5.CHP (11/99)

WCH-28
Rev. 0
OU: 1100-IU-1
TSD: N/A
ERA: N/A

CONCURRENCE PAGE

Title: Results of Remediation and Verification Sampling for the 600-270 Horseshoe Landfill

Concurrences:

J. Zeisloft, Project Manager
U.S. Department of Energy, Richland Operations Office

Signature _____ Date 12/8/05

D. R. Einan, Project Manager
U.S. Environmental Protection Agency

Signature _____ for Date 12-8-05

WCH-28
Rev. 0

River Corridor
Closure Contract

Results of Remediation and Verification Sampling for the 600-270 Horseshoe Landfill

December 2005

Author:
W. S. Thompson

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 BACKGROUND 1

1.2 LOCATION 1

1.3 PREVIOUS INVESTIGATIONS 3

2.0 FIELD REMEDIAL ACTION ACTIVITIES 4

2.1 PHASE I REMEDIATION AND SAMPLING 5

2.2 PHASE II REMEDIATION AND SAMPLING 6

2.3 PHASE III REMEDIATION AND SAMPLING 8

3.0 SUMMARY OF VERIFICATION SAMPLING 10

3.1 BACKFILL MATERIAL SAMPLE RESULTS 10

3.2 VERIFICATION SAMPLE RESULTS 10

3.2.1 Phase I Verification Sampling Results 10
3.2.2 Phase II Verification Sampling Results 12
3.2.3 Phase III Verification Sampling Results 13
3.2.4 Data Quality Assessment 13

4.0 SUMMARY OF PROTECTIVENESS 14

5.0 REFERENCES 15

APPENDIX

A LABORATORY ANALYTICAL RESULTS ..... A-i

FIGURES

1. Location of the Horseshoe Landfill. 2
2. Horseshoe Landfill Surface Soil Sampling Results (DDT/DDE/DDD). 5
3. Phase I Verification Sample Locations. 6
4. Phase II Sample Locations. 7
5. Phase III Verification Soil Sample Areas. 8
6. Post-Excavation Civil Survey of the Remediated Portion of the 600-270 Horseshoe Landfill. 9
7. Verification Sample Locations with Total Concentration DDT/DDE/DDD (mg/kg). 16

TABLES

1. Phase I Verification Soil Sample Results for DDT/DDE/DDD. 11
2. Phase II Verification Soil Sample Results for DDT/DDE/DDD. 12

ACRONYMS

BCM	bank cubic meters
CRQL	contract-required quantitation limit
DDD	dichlorodiphenyl dichloroethane
DDE	dichlorodiphenyl dichloroethylene
DDT	dichlorodiphenyl trichloroethane
DOE	U.S. Department of Energy
DQA	data quality assessment
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ICP	inductively coupled plasma
ROD	Record of Decision
SDG	sample delivery group
SVOC	semivolatile organic compound
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VSP	Visual Sample Plan
WAC	*Washington Administrative Code*

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

This report presents the results of the 2005 remedial action and verification soil sampling conducted at the 600-270 waste site (also known as the Horseshoe Landfill) after removal of soil containing residual concentrations of dichlorodiphenyl trichloroethane (DDT) and its breakdown products dichlorodiphenyl dichloroethylene (DDE) and dichlorodiphenyl dichloroethane (DDD). The remediation was performed in response to post-closure surface soil sampling performed between 1998 and 2003 that indicated the presence of residual DDT contamination exceeding the Record of Decision (ROD) for the 1100 Area National Priorities List site (EPA 1993) cleanup criteria of 1 mg/kg that was established for the original 1994 cleanup activities.

A memo-to-file (EPA 2005) provides documentation for nonsignificant/minor changes to the 1100 Area ROD to support additional remediation of soil contaminated with DDT. The cleanup level for DDT during the original cleanup in 1994 was 1 mg/kg based on *Washington Administrative Code* [WAC] 173-340-740, Method A. However, for this additional remediation, the parties have agreed to remove DDT to meet the more stringent ecological indicator soil concentration for protection of terrestrial plants and animals for total DDT/DDE/DDD of 0.75 mg/kg (WAC 173-340, Table 749-3). The verification soil sampling was conducted as identified in the *Work Instruction for Verification Sampling of the 600-270 Horseshoe Landfill* (BHI 2005).

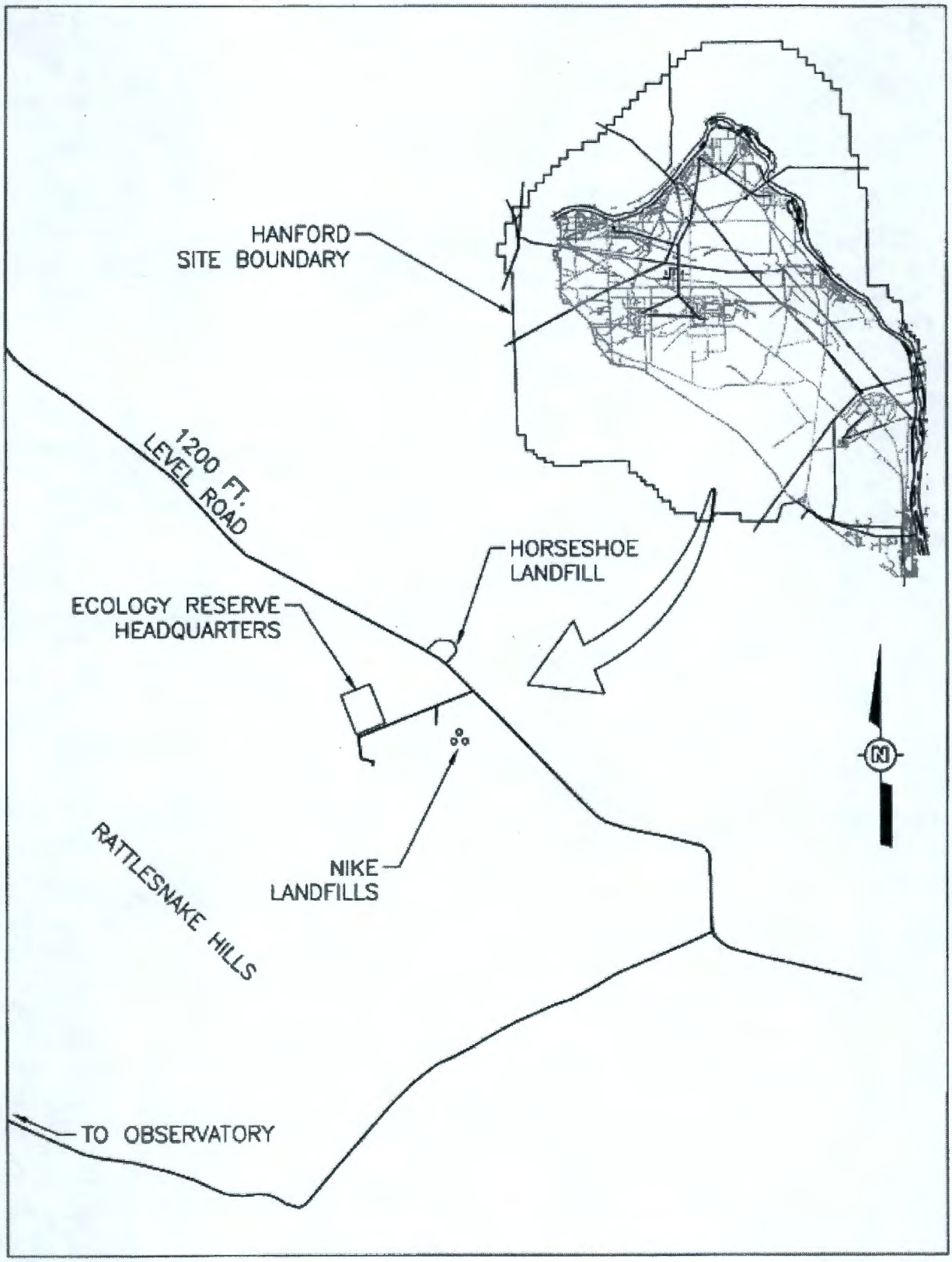
1.1 BACKGROUND

The Horseshoe Landfill is a former *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* waste site that was part of the 1100-IU-1 Operable Unit. It was remediated as part of the activities outlined in the ROD for the 1100 Area National Priorities List site (EPA 1993) and was removed from the National Priorities List in 1996 (61 *Federal Register* 51019). The primary contaminant of concern at this site was DDT. Post-closure biota sampling and soil sampling performed between 1998 and 2003 at the site indicated that concentrations of DDT and its breakdown products DDE and DDD were present in low concentrations within the landfill surface soils exceeding the 1994 cleanup criteria of 1 mg/kg (DOE-RL 2002).

1.2 LOCATION

The Horseshoe Landfill is located on the Fitzner-Eberhardt Arid Lands Ecology Reserve and served as a military landfill for the nearby Nike missile base. Figure 1 provides a map of the Horseshoe Landfill location. In 1996, approximately 1,911 m^3 (2,500 yd^3) of soil contaminated with DDT and other hazardous material and debris were excavated from the landfill (DOE-RL 1996). The remediated area was revegetated with native grasses and sagebrush. The wildfire of 2000 burned the vegetation at the site; however, the perennial grasses and forbs remain and are beginning to recover.

Figure 1. Location of the Horseshoe Landfill.



1.3 PREVIOUS INVESTIGATIONS

In 1994, electromagnetic profiling, magnetics, and ground-penetrating radar surveys were performed at the Horseshoe Landfill to identify areas of buried waste. These areas were then excavated in longitudinal trenches, 1.5 to 3 m (5 to 10 ft) wide, to evaluate the presence or absence of hazardous material. Contaminated materials encountered during excavation were segregated, inventoried, and stockpiled near the excavation site on plastic sheeting. Soil contaminated with DDT was discovered in one of the excavations. Field screening (using the EnviroGard™ field test kits) was used to evaluate the soil for DDT contamination and guide the extent of remediation. Soil samples were also submitted to an offsite laboratory for organochlorine pesticides analysis. Offsite laboratory analysis indicated that DDT and associated breakdown byproducts of DDD and DDE were present at concentrations of up to 945 mg/kg, 360 mg/kg, and 27.2 mg/kg, respectively (DOE-RL 1994, CDM 1995). The total volume of excavated soil was approximately 1,911 m^3 (2,500 yd^3) (DOE-RL 1996). After all of the debris and contaminated soil were removed, composite and grab samples were collected and submitted for offsite analysis to verify that cleanup goals were met. The cleanup level for DDT was 1 mg/kg based on the *Model Toxics Control Act Cleanup Regulation* Method A soil cleanup level (WAC 173-340-740). The site was then backfilled with clean material, returned to original grade, and revegetated.

In 1998, the U.S. Fish and Wildlife Service (USFWS) conducted a Level III preacquisition environmental contaminant survey for the Hanford North Slope (Wahluke Slope) and the Fitzner-Eberhardt Arid Lands Ecology Reserve (Roy 1998). The survey detected DDE in darkling beetles and other biota at several of the sites, including the Horseshoe Landfill. Three darkling beetle samples were collected at the landfill and exhibited DDT (0.02 mg/kg, 0.02 mg/kg, and 0.06 mg/kg) and DDE (0.89 mg/kg, 0.75 mg/kg, and 2.01 mg/kg). Three samples of deer mice were collected and exhibited 0.12 mg/kg, 2.26 mg/kg, and 0.45 mg/kg DDE; DDT was not detected above the laboratory method detection limit in the deer mice samples. One horned lark egg was sampled and had DDT present at 0.91 mg/kg and DDE present at 45.5 mg/kg. The study recommended additional organochlorine pesticide (primarily DDT and breakdown products) exposure monitoring in biota and in surface soil (0 to 5 cm [0 to 2 in.]) on or near the sites where elevated risk to migratory birds was predicted.

As a follow-up assessment in 1999, the U.S. Department of Energy, Richland Operations Office, examined the extent and distribution of residual DDT/DDE at four sites with the highest concentrations in beetle tissues (BHI 1999). The Horseshoe Landfill was included in this investigation. The study included the sampling of ground-dwelling insects and bird eggs to determine the extent and distribution of residual organochlorine contamination across the remediation portion of the site and to evaluate the use of insects in monitoring contamination pathways. The contaminants of concern were DDT and its breakdown products DDD and DDE. The contaminant detected most frequently was DDE. DDT was the only other contaminant found, occurring in one insect sample (0.65 mg/kg). The average concentration of DDE in insects at the Horseshoe Landfill was 0.68 mg/kg. An egg collected at the site contained 1.8 mg/kg DDE. The DDE concentrations in insect tissue found during the study were fairly consistent with the levels observed in the 1998 USFWS study. One discrepancy was noted, however, in that DDE concentrations in meadowlark eggs sampled in 1999 at the Horseshoe Landfill were significantly lower than the 0.045 mg/kg observed in a horned lark egg sampled by the USFWS in 1998. The study concluded that although residual concentrations of DDE are

™ EnviroGard is a registered trademark of Millipore Corporation, Bedford, Massachusetts.

present, it is not likely that the levels are high enough to cause lethal or sublethal effects to individuals, and it is impossible to have population-level impacts.

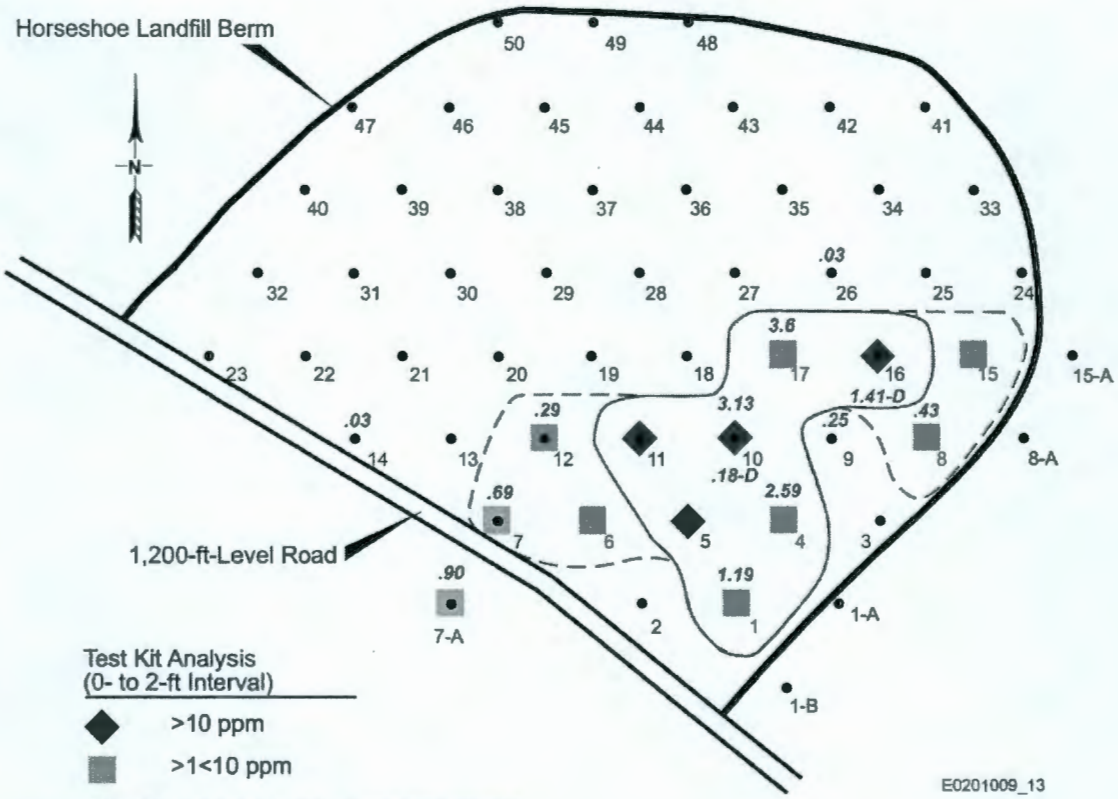
On October 28, 1999, Ecology collected three soil samples from the landfill for analysis of DDT, DDE, and DDD. A duplicate sample of each soil sample was also analyzed. The results for DDT were 0.014 mg/kg, 1.1 mg/kg, and 1.6 mg/kg. The results for DDE were 0.12 mg/kg, 1.5 mg/kg, and 0.92 mg/kg. The results for DDD were 0.0035 mg/kg, 0.035 mg/kg, and 0.073 mg/kg. During October 2001 through May 2002, sampling and analysis of soil and biota (mice, plants) was performed to collect data to address Tribal concerns related to potential residual DDT and its breakdown products DDD and DDE (Thompson 2001). The results of this investigation are provided in *Evaluation of Risk to Ecological Receptors from DDT at the Horseshoe Landfill* (DOE-RL 2002). The only contaminant found in mouse tissue collected from five samples was DDE, with concentrations ranging from 0.15 mg/kg to 0.38 mg/kg. The results of laboratory analysis of plant samples detected DDE ranging from 0.005 mg/kg to 1 mg/kg and concentrations of DDT ranging from 0.01 mg/kg to 0.33 mg/kg. Soil samples were collected using a systematic sampling design to evaluate the 0- to 0.6-m (0- to 2-ft) interval with additional soil samples collected from the 0.6- to 1.2-m (2- to 4-ft) depth based on the results of the upper 0.6-m (2-ft) sample interval. Field immunoassay analysis using the EnviroGard DDT soil test kit was used as a semi-quantitative field test for the detection of DDT and its breakdown products DDD and DDE in soil in accordance with U.S. Environmental Protection Agency (EPA) Method 4042 (EPA 1986). The results of the field immunoassay analysis were then used to select split soil samples for laboratory analysis using EPA Method 8081 (EPA 1986). Evaluation of the field and laboratory analytical results indicated that concentrations of residual DDT, DDE, and DDD greater than 1 mg/kg total were clustered toward the south end of the landfill (Figure 2). The maximum concentration of summed DDT, DDE, and DDD at a single sample location was 3.6 mg/kg.

In 2003, soil and biota samples were collected and analyzed to reconfirm concentrations of residual DDT, DDE, and DDD at the Horseshoe Landfill (Poston et al. 2004). Four soil samples from the southern portion of the landfill contained concentrations of DDT/DDE/DDD of 6.3, 7.3, 9.2, and 19.1 mg/kg. Three soil samples collected from the northern region of the landfill contained low levels that ranged between 0.01 and 0.09 mg/kg. Four vegetation samples taken on the landfill ranged between 1.0 and 9.0 mg/kg. Three mouse samples collected at the landfill contained detectable concentrations of DDT/DDE/DDD ranging from 0.01 to 0.95 mg/kg. Concentrations in soil samples obtained in 2003 were consistent with concentrations measured in previous assessments, with samples collected from the southern region of the Horseshoe Landfill having the highest concentrations of DDT/DDE/DDD.

2.0 FIELD REMEDIAL ACTION ACTIVITIES

Based on the results of the post-closure soil sampling that indicated residual DDT/DDE/DDD contamination exceeding the ecological indicator soil concentration, a decision was made to perform additional remediation of the southern portion of the Horseshoe Landfill. Three phases of remediation and verification sampling were performed based on the results of the verification soil sampling. Additionally, one verification sample of the soil delivered to the site for use as clean backfill of the excavation was collected. The results of the backfill and the excavation verification sample analysis are provided in Appendix A.

Figure 2. Horseshoe Landfill Surface Soil Sampling Results (DDT/DDE/DDD).



Test Kit Analysis
(0- to 2-ft Interval)

◆ >10 ppm

■ >1<10 ppm

NOTE: At sites 10 and 16, concentrations at 2- to 4-ft interval were >1<10 ppm.

Laboratory Analysis

0.00 0- to 2-ft Interval

0.00-D 2- to 4-ft Interval

— — — Outer Contour Line Based on Test Kit Analysis >1 ppm (4,300 sq. m, 1.06 ac.)

——— Inner Contour Line Based on Laboratory Analysis ³1 ppm (2,555 sq. m, 0.63 ac.)

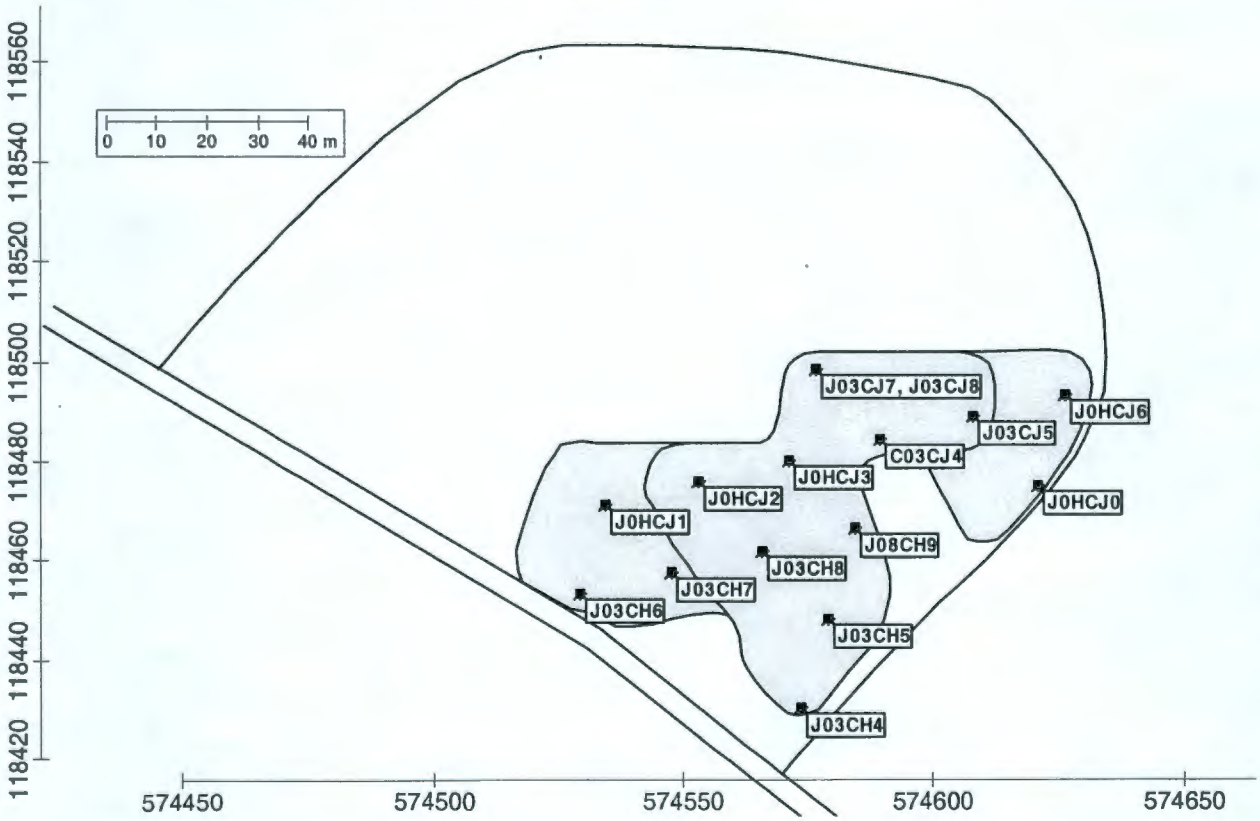
Remediation of the Horseshoe Landfill was initiated on May 17, 2005, and completed on August 24, 2005. The cost for remediation, waste transportation, waste disposal, sampling and laboratory analysis associated with the soil removal action was $640,000.

2.1 PHASE I REMEDIATION AND SAMPLING

Remediation of contaminated soil to a depth of 1.2 m (4 ft) in the southern portion of the Horseshoe Landfill was initiated on May 17, 2005, and completed on June 3, 2005, with removal of approximately 4,800 bank cubic meters (BCM) for disposal to the Environmental Restoration Disposal Facility. Statistical sampling of the excavation was performed to support site closeout as specified in the *Work Instruction for Verification Sampling of the 600-270 Horseshoe Landfill*

(BHI 2005). Visual Sample Plan (VSP)[1] was used to locate 14 statistical samples using a random start systematic grid. The samples were analyzed for organochlorine pesticides analysis in accordance with EPA Method 8081 (EPA 1986). Figure 3 provides the locations of the Phase I verification soil samples. The results of the laboratory analysis indicated two areas within the newly excavated area having residual concentrations of DDT/DDE/DDD exceeding the ecological cleanup criteria of 0.75 mg/kg total DDD/DDE/DDD. Field observations of these areas indicated the contamination was associated with localized presence of debris consisting of nonhazardous solid debris (e.g., spoons, bottles) and cattle bones and hide. The results of the Phase I sample analysis are provided in Appendix A, Table A-2.

Figure 3. Phase I Verification Sample Locations.



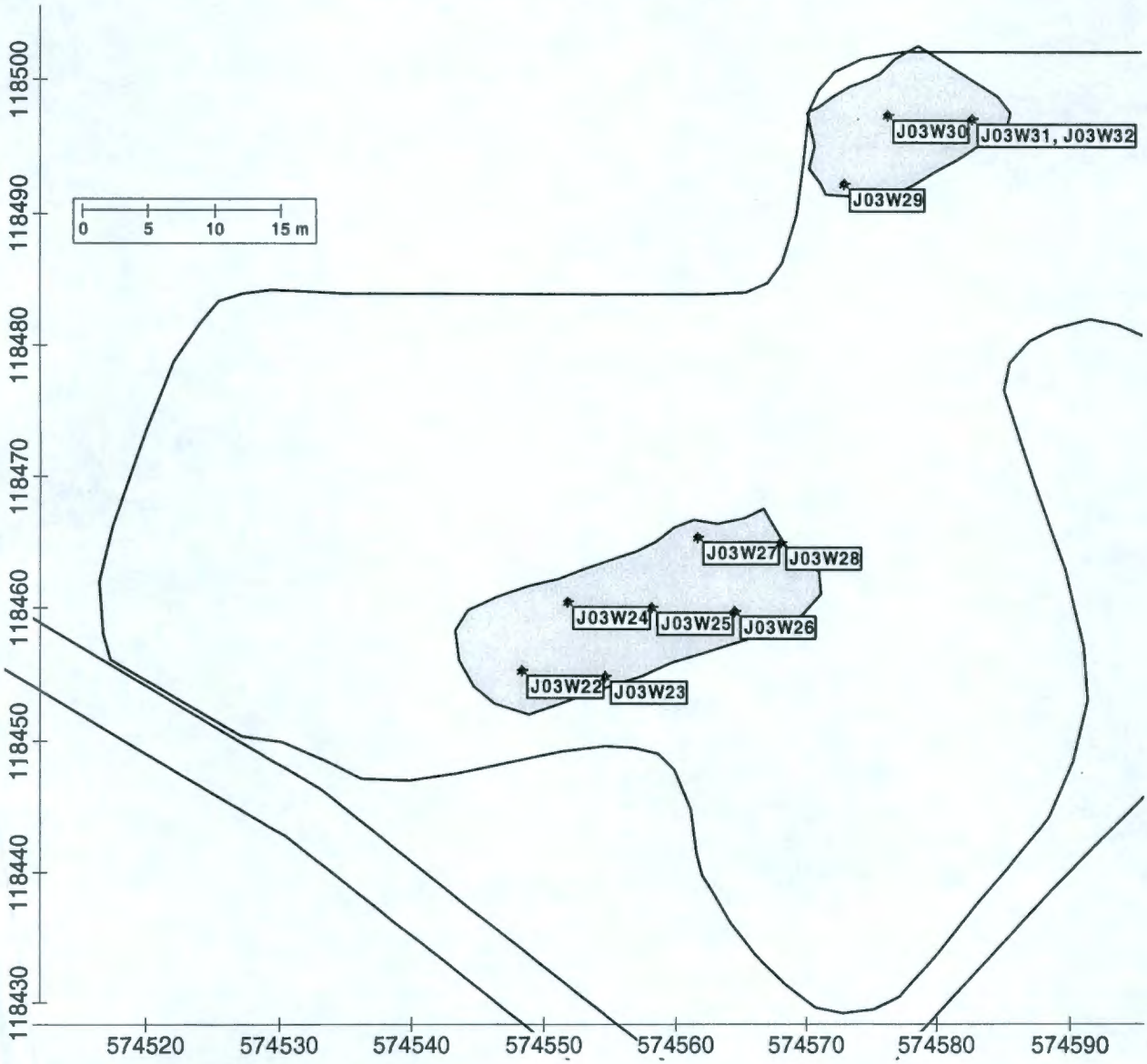
2.2 PHASE II REMEDIATION AND SAMPLING

Based on discussions of the Phase I sample results with the U.S. Environmental Protection Agency (EPA), it was decided to remove an additional 0.6 m (2 ft) of soil from the two areas exhibiting contamination above the cleanup criteria, treating this contamination as a separate population for additional verification sampling. On July 26, 2005, through July 27, 2005, another 100 BCM of DDT/DDE/DDD-contaminated soil was excavated. Visual Sample Plan was used to locate 10 statistical verification soil samples within the area that was excavated to a depth of 1.8 m (6 ft) below ground surface. Figure 4 shows the location of the Phase II verification soil

[1] Visual Sampling Plan is a site map-based user-interface program that may be downloaded at http://dqo.pnl.gov.

samples. The sample results indicated that one of the two areas still had residual concentrations of DDT/DDE/DDD that exceeded the ecological cleanup criteria. The results of the Phase II sample analysis are provided in Appendix A, Table A-3.

Figure 4. Phase II Sample Locations.



2.3 PHASE III REMEDIATION AND SAMPLING

The Phase II sample results were used to delineate an area for further soil removal. It was agreed with the EPA to excavate to a depth of 4.6 m (15 ft) in the area where Phase II sample results indicated residual soil contamination remaining at a depth of 1.8 m (6 ft). On August 24, 2005, soil removal continued until basalt was encountered at a depth of 2.7 m (9 ft). An additional 35 BCM of DDT/DDE/DDD-contaminated soil was removed. The 2.7-m (9-ft)-deep excavation was divided into two approximately equal portions, and one soil sample was collected from each. Each soil sample consisted of aliquots of soil collected from the excavator bucket representative of the residual soil at the base of the excavation. Figure 5 shows the extent of the three phases of excavation and the location of the Phase III verification samples. The sample results were both well below the ecological cleanup criteria. The results of the Phase III sample analysis are provided in Appendix A, Table A-4. Figure 6 provides the post-excavation civil survey of the remediated portion of the site.

Figure 5. Phase III Verification Soil Sample Areas.

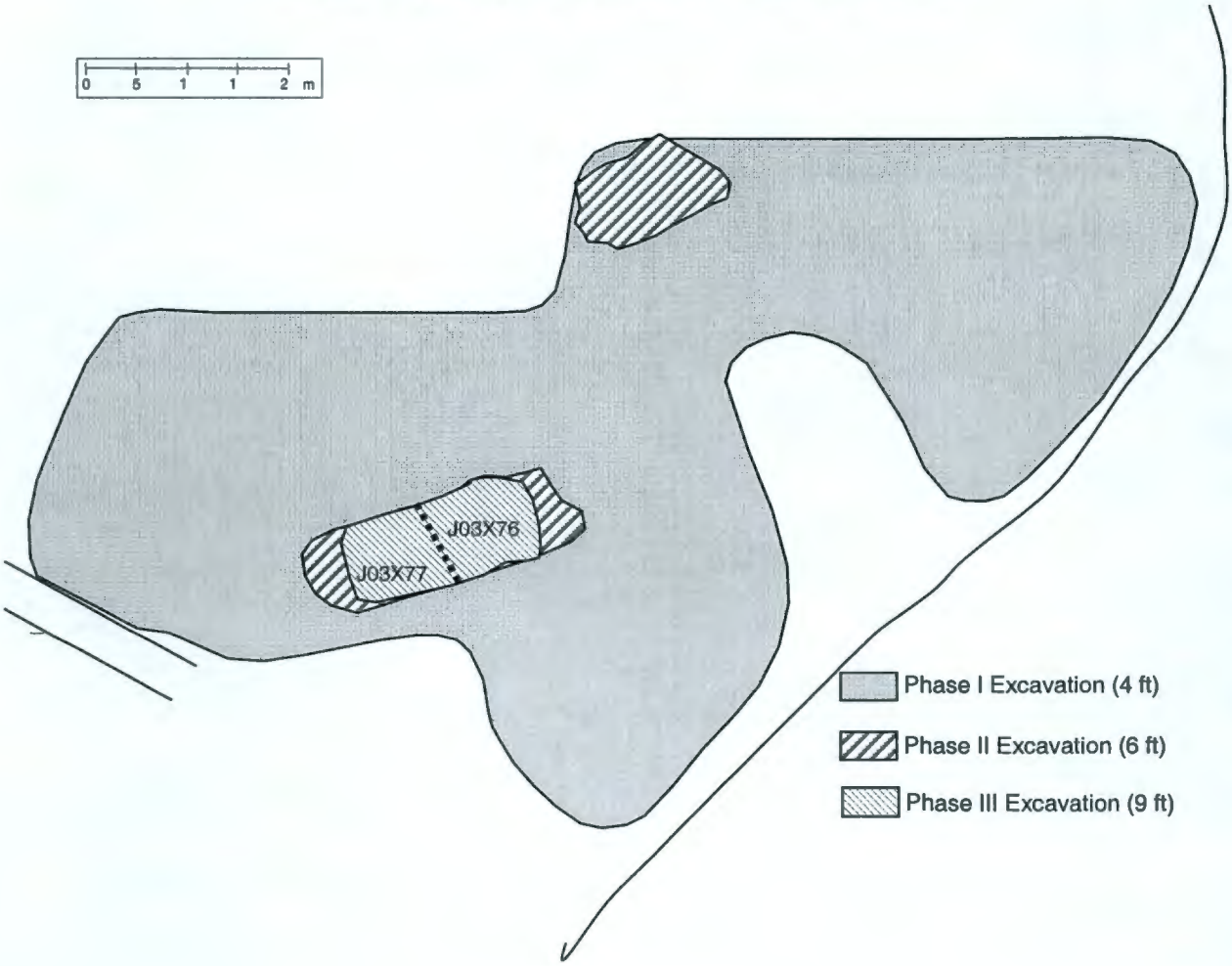
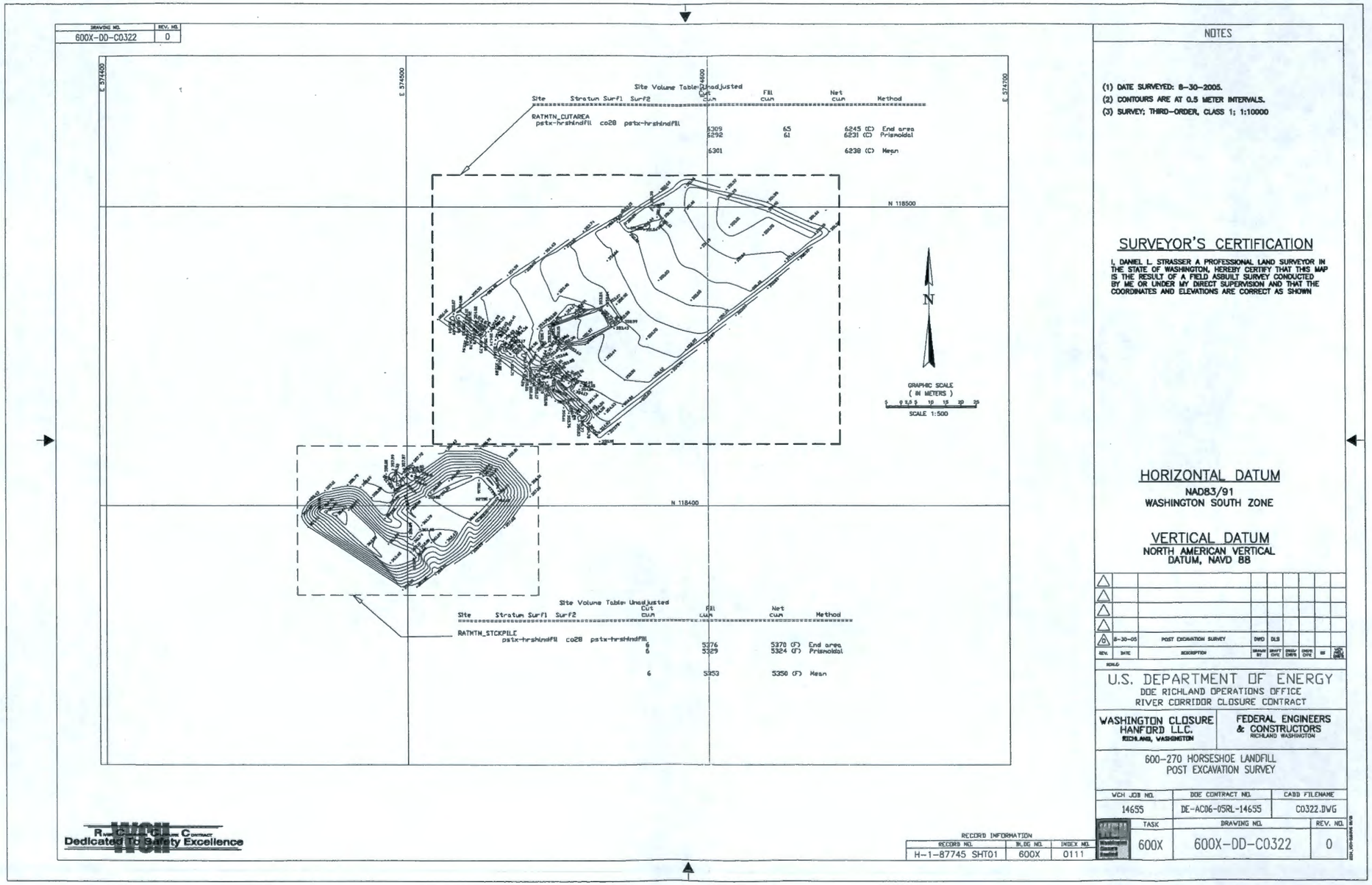


Figure 6. Post-Excavation Civil Survey of the Remediated Portion of the 600-270 Horseshoe Landfill.



3.0 SUMMARY OF VERIFICATION SAMPLING

This section discusses the results of the verification soil sampling that was performed after remediation of the southern portion of the Horseshoe Landfill where residual DDT/DDE/DDD contamination exceeded the ecological soil cleanup criteria for protection of terrestrial plants and animals. Additionally, sampling was performed to evaluate the suitability of the soil that will be used for backfill material. This backfill soil consists of clean soil that was removed during the construction of the new Environmental Restoration Disposal Facility cells.

3.1 BACKFILL MATERIAL SAMPLE RESULTS

Fifty aliquots of soil were collected over the surface of the backfill stockpile and combined into one sample for laboratory analysis. The sample was analyzed for inductively coupled plasma (ICP) metals, mercury, herbicides, pesticides, polychlorinated biphenyls, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) to verify the suitability of the soil for use as clean backfill for the excavation. The results of the laboratory analysis are provided in Appendix A, Table A-1 and support acceptance of the soil for use as clean backfill for the excavation.

3.2 VERIFICATION SAMPLE RESULTS

As previously discussed, three phases of excavation with three phases of verification soil sampling were performed. All sampling was performed in accordance with BHI-EE-01, *Environmental Investigations Procedures.* For Phases I and II, VSP was used to locate the soil samples using a statistical sampling design on a random start systematic grid. The soil sample locations were global positional surveyed and staked prior to sample collection. Professional judgment was used to locate Phase III soil samples within two localized areas where residual contamination was removed.

Each soil sample was analyzed for pesticides using EPA Method 8081. Only the results for total DDT/DDE/DDD are discussed further in this report to evaluate compliance after remediation with the project objective of evaluating the residual DDT/DDE/DDD with the ecological soil indicator concentration for protection of terrestrial plants and animals of 0.75 mg/kg (WAC 173-340-900, Table 749-3).

3.2.1 Phase I Verification Sampling Results

Figure 3 provides a map of the 14 soil sample locations that were collected for verification sampling after the site had been excavated to a depth of 1.2 m (4 ft). One soil sample was collected at each location and consisted of approximately 25 aliquots collected to a depth of approximately 5 cm (2 in.) and distributed in an estimated 1-m square grid surrounding the surveyed sample location. The 25 aliquots were combined into 1 sample for laboratory analysis for a total of 14 soil samples. In addition, one field duplicate sample (J03CJ8) was collected. The sample results are provided in Appendix A, Table A-2.

The results of the laboratory analysis indicated two areas within the newly excavated area having residual concentrations of DDT/DDE/DDD exceeding the ecological cleanup criteria of 0.75 mg/kg total DDT/DDE/DDD. These two areas were identified using the sample results for

J03CH7, J03CH8, J03CJ7, and J03CJ8 as summarized in Table 1. Field observations of these areas indicated the contamination was associated with localized presence of debris consisting of nonhazardous solid debris (e.g., spoons, bottles) and cattle bones and hide. Based on discussions of the Phase I sample results with the EPA, it was decided to remove an additional 0.6 m (2 ft) of soil from the two areas exhibiting contamination above the cleanup criteria, treating the contamination as a separate population for additional verification sampling. The two areas requiring additional soil removal are shown in Figure 5 and are indicated as Phase II excavation.

Table 1. Phase I Verification Soil Sample Results for DDT/DDE/DDD.

HEIS Sample Number	**J03CH4 (mg/kg)**	**J03CH5 (mg/kg)**	**J03CH6 (mg/kg)**	**J03CH7 (mg/kg)**	**J03CH8 (mg/kg)**
Dichlorodiphenyl dichloroethane (DDD)	0.0074	0.0027	0.0095	0.150	0.069
Dichlorodiphenyl dichloroethylene (DDE)	0.150	0.078	0.190	1.30	0.460
Dichlorodiphenyl trichloroethane (DDT)	0.082	0.027	0.140	1.700	0.420
Total DDT/DDE/DDD	0.2394	0.1077	0.3395	3.150 [a,b]	0.949 [a,b]
HEIS Sample Number	**J03CH9 (mg/kg)**	**J03CJ0 (mg/kg)**	**J03CJ1 (mg/kg)**	**J03CJ2 (mg/kg)**	**J03CJ3 (mg/kg)**
Dichlorodiphenyl dichloroethane (DDD)	0.0078	0.0033	0.0081	0.0019	0.0026
Dichlorodiphenyl dichloroethylene (DDE)	0.150	0.026	0.310	0.051	0.064
Dichlorodiphenyl trichloroethane (DDT)	0.092	0.0091	0.110	0.024	0.025
Total DDT/DDE/DDD	0.2498	0.0384	0.4281	0.0769	0.0916
HEIS Sample Number	**J03CJ4 (mg/kg)**	**J03CJ5 (mg/kg)**	**J03CJ6 (mg/kg)**	**J03CJ7 (mg/kg)**	**J03CJ8[c] (mg/kg)**
Dichlorodiphenyl dichloroethane (DDD)	0.0059	0.0019	0.0063	0.012	0.013
Dichlorodiphenyl dichloroethylene (DDE)	0.150	0.140	0.220	0.540	0.640
Dichlorodiphenyl trichloroethane (DDT)	0.070	0.023	0.110	0.170	0.210
Total DDT/DDE/DDD	0.2259	0.1649	0.3363	0.722[b]	0.863[a,b]

[a] Sample result exceeds ecological cleanup criteria for total DDT/DDE/DDD of 0.75 mg/kg.
[b] This sample result is in the area where additional excavation (Phase II) occurred and was not used in calculation of the Phase I 95% upper confidence limit.
[c] Duplicate sample of J03CJ7.
HEIS = Hanford Environmental Information System

For the purpose of evaluation of the remaining Phase I area not requiring remediation, the other 11 soil sample results were used to evaluate compliance with the ecological soil cleanup criteria as a separate population. When using a statistical sampling approach, a requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The total DDT/DDE/DDD concentration in the remaining Phase I area passes the three-part test in comparison against the ecological soil criteria. The 95% upper confidence limit for Phase I soil is 0.407 mg/kg (407 μg/kg) and demonstrates that this area meets the ecological cleanup criteria of 0.75 mg/kg total DDT/DDE/DDD.

3.2.2 Phase II Verification Sampling Results

Phase II verification soil sampling was performed after an additional 0.6 m (2 ft) of soil removal was performed in two areas as shown in Figure 5. Figure 4 provides a map of the 10 soil sample locations that were collected for verification sampling after the additional excavation. One soil sample was collected at each location and consisted of approximately 25 aliquots collected to a depth of approximately 5 cm (2 in.) and distributed in an estimated 1-m square grid surrounding the surveyed sample location. The 25 aliquots were combined into 1 sample for laboratory analysis for a total of 10 soil samples. In addition, one field duplicate sample (J03W32) was collected. The sample results are provided in Appendix A, Table A-3.

The Phase II verification sample results are summarized in Table 2 and were used to evaluate the two areas that required additional soil removal. Soil samples in the northern area indicated the additional remediation adequately removed residual contamination. However, soil samples in the southern area indicated residual DDT/DDE/DDD contamination exceeding the ecological cleanup criteria and were used to delineate an area requiring additional soil removal. It was agreed with the EPA to excavate to a depth of 4.6 m (15 ft) in this area as shown in Figure 5 and indicated as Phase III excavation.

Table 2. Phase II Verification Soil Sample Results for DDT/DDE/DDD.

HEIS Sample Number	**J03W22 (mg/kg)**	**J03W23 (mg/kg)**	**J03W24 (mg/kg)**	**J03W25 (mg/kg)**	**J03W26 (mg/kg)**
Dichlorodiphenyl dichloroethane (DDD)	0.016	0.150	0.400	0.420	0.160
Dichlorodiphenyl dichloroethylene (DDE)	0.100	.0034	0.890	0.930	0.590
Dichlorodiphenyl trichloroethane (DDT)	0.160	0.780	0.780	0.780	0.100
Total DDT/DDE/DDD	0.276	0.9334 [a]	2.070 [a]	2.130 [a]	0.850 [a]
HEIS Sample Number	**J03W27 (mg/kg)**	**J03W28 (mg/kg)**	**J03W29 (mg/kg)**	**J03W30 (mg/kg)**	**J03W31 (mg/kg)**
Dichlorodiphenyl dichloroethane (DDD)	0.960	.048	ND	ND	.0048
Dichlorodiphenyl dichloroethylene (DDE)	ND	0.130	0.013	0.062	0.250
Dichlorodiphenyl trichloroethane (DDT)	ND	0.160	0.0082	0.029	0.120
Total DDT/DDE/DDD	0.960 [a]	0.338	0.0212	0.091	0.3748
HEIS Sample Number	**J03W32 [b] (mg/kg)**				
Dichlorodiphenyl dichloroethane (DDD)	0.0032				
Dichlorodiphenyl dichloroethylene (DDE)	0.170				
Dichlorodiphenyl trichloroethane (DDT)	0.093				
Total DDT/DDE/DDD	0.2662				

[a] Sample result exceeds ecological cleanup criteria for total DDT/DDE/DDD of 0.75 mg/kg. Located in area identified for additional remediation (Phase III).
[b] Duplicate sample of J03W31.
<D = less than detectable
HEIS = Hanford Environmental Information System

3.2.3 Phase III Verification Sampling Results

On August 24, 2005, soil removal continued until basalt was encountered at a depth of 2.7 m (9 ft). An additional 35 BCM of DDT/DDE/DDD contaminated soil was removed. The 2.7-m (9-ft)-deep excavation was divided into two approximately equal portions, and one soil sample was collected from each. Each soil sample consisted of aliquots of soil collected from the excavator bucket representative of the residual soil at the base of the excavation. Figure 5 shows the extent of the three phases of excavation and the location of the Phase III verification samples. The sample results were both well below the ecological soil cleanup criteria. The results of the Phase III sample analysis are provided in Appendix A, Table A-4. Figure 6 provides the post-excavation civil survey of the remediated portion of the site.

3.2.4 Data Quality Assessment

A data quality assessment (DQA) review was performed to compare the verification sampling approach and analytical data with the sampling and data requirements specified by the project objectives. This review involves evaluation of the data to determine if it is of the right type, quality, and quantity to support the intended use. The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

This DQA review was performed in accordance with BHI-EE-01, *Environmental Investigations Procedures*. Specific data quality objectives for the site are found in the *Work Instruction for Verification Sampling of the 600-270 Horseshoe Landfill* (BHI 2005) and are consistent with those specified in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2005). All samples were collected per agreements with the lead regulatory agency. To ensure quality data sets, the *100 Area Remedial Action Sampling and Analysis Plan* data assurance requirements as well as the validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) are followed where appropriate. Three sample delivery groups (SDGs) were generated during verification sampling at the Horseshoe Landfill. The relevant SDGs are H3206, H3305, and H3349.

SDG H3206 consists of two samples (J03CJ9, J03CH3) that were analyzed for SVOCs, VOCs, herbicides, chlorinated pesticides, and ICP metals. Seventeen samples were analyzed for chlorinated pesticides (J03CJ0, J03CJ1, J03CJ2, J03CJ3, J03CJ4, J03CJ5, J03CJ6, J03CJ7, J03CJ8, J03CJ9, J03CH3, J03CH4, J03CH5, J03CH6, J03CH7, J03CH8, and J03CH9). This SDG was submitted for third-party validation. No major deficiencies were found. All of the data were found to be useable for decision-making purposes. Minor deficiencies were found in the analyses of SVOCs, VOCs, ICP metals, and chlorinated pesticides.

In the SVOC analysis for SDG H3206, diethylphthalate, bis(2ethylhexyl)phthalate, and di-n-phthalate were found in the method blank below the contract-required quantitation limit (CRQL). Third-party validation altered all of the samples to the CRQL values with nondetected "U" flags. The sample data are useable for decision-making purposes.

Also in the SVOC analysis for SDG H3206, 2,4-dinitrophenol had low recoveries in the matrix spike duplicate and the blank spike at 13% and 18%, respectively. The analyte 2,4-dinitrophenol also had a relative percent difference of 104% in the duplicate results. Third-party validation qualified all of the 2,4-dinitrophenol results as estimates by assigning "J" flags to the data. The data remain useable for decision-making purposes.

In the VOC analysis for SDG H3206, methylene chloride was found in the method blank below the CRQL. The methylene chloride found in the method blank is not significant relevant to the project objectives. The field sample data are unaffected and remain useable for decision-making purposes.

The ICP metals analysis for SDG H3206 had two analytes with matrix spike recoveries that were out of acceptance criteria. In the metals analysis, it is standard procedure to run serial dilutions and post-digestion spikes to bring the analytes back into criteria. These procedures were run for manganese and antimony with good result. The data are useable for decision-making purposes.

The chlorinated pesticide analysis for SDG H3206 had a high response in the matrix spike for 4-4'-DDD at 122%. Third-party validation qualified all of the data as estimated, with "J" flags, for the analyte 4-4"-DDD. The data remain useable for decision-making purposes.

SDG H3305 consists of 11 samples (J03W22, J03W23, J03W24, J03W25, J03W26, J03W27, J03W28, J03W29, J03W30, J03W31, and J03W32) that were analyzed for chlorinated pesticides. The surrogates for sample J03W29 were slightly high at 123%, implying a slight high bias in the data. Examination of the data shows that none of the analytes for sample J03W29 have exceeded remedial action goal values based on this high bias. The data are useable for decision-making purposes.

SDG H3349 consists of two samples (J03X76, J03X77) that were analyzed for chlorinated pesticides. No deficiencies were noted in SDG H3349.

Limited, random, or sample matrix-specific influenced batch quality control issues such as those noted above are a potential for any analysis. The number and types seen in these data sets were within expectations for the matrix types and analyses performed.

The DQA review for the Horseshoe Landfill found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling. The DQA review concludes that the data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of quality assurance and quality control deficiencies. All analytical data were found to be acceptable for decision-making purposes. The verification sample analytical data are stored in the Environmental Restoration Project-Specific Database prior to archiving in the Hanford Environmental Information System and are summarized in Appendix A.

4.0 SUMMARY OF PROTECTIVENESS

The residual DDT-contaminated soil in the southern portion of the 600-270 waste site (known as the Horseshoe Landfill) that exceeded the ecological cleanup criteria of 0.75 mg/kg total DDT/DDE/DDD and the ROD cleanup criteria of 1 mg/kg was remediated in accordance with the nonsignificant changes specified by the EPA in *Memo-to-File Documenting Non-Significant Changes to the 1100 Area Record of Decision, Hanford Site, Benton County, Washington* (EPA 2005). Approximately 4,935 BCM of soil was removed for disposal at the Environmental Restoration Disposal Facility. A combination of statistical sampling and judgmental sampling to

verify the completeness of remediation was performed, and analytical results were shown to meet the cleanup objectives for direct exposure (1 mg/kg DDT) and ecological protection (0.75 mg/kg total DDT/DDE/DDD). Figure 7 provides a map showing the final verification sample locations and the associated concentration of total DDT/DDE/DDD. In accordance with this evaluation, the verification sampling results support that the remediation of the DDT-contaminated soil has been acceptably performed as provided in EPA (2005).

5.0 REFERENCES

61 FR 51019, "Notice of Deletion of the Hanford 1100 – Area (USDOE) from National Priorities List," *Federal Register*, Vol. 61, No. 190, p. 51019, September 30, 1996.

BHI-EE-01, *Environmental Investigations Procedures*, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1999, *Assessment of Residual DDE at Four Remediated Hanford Waste Sites, Richland, Washington*, BHI-01331, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000a, *Data Validation Procedure for Chemical Analysis*, BHI-10435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

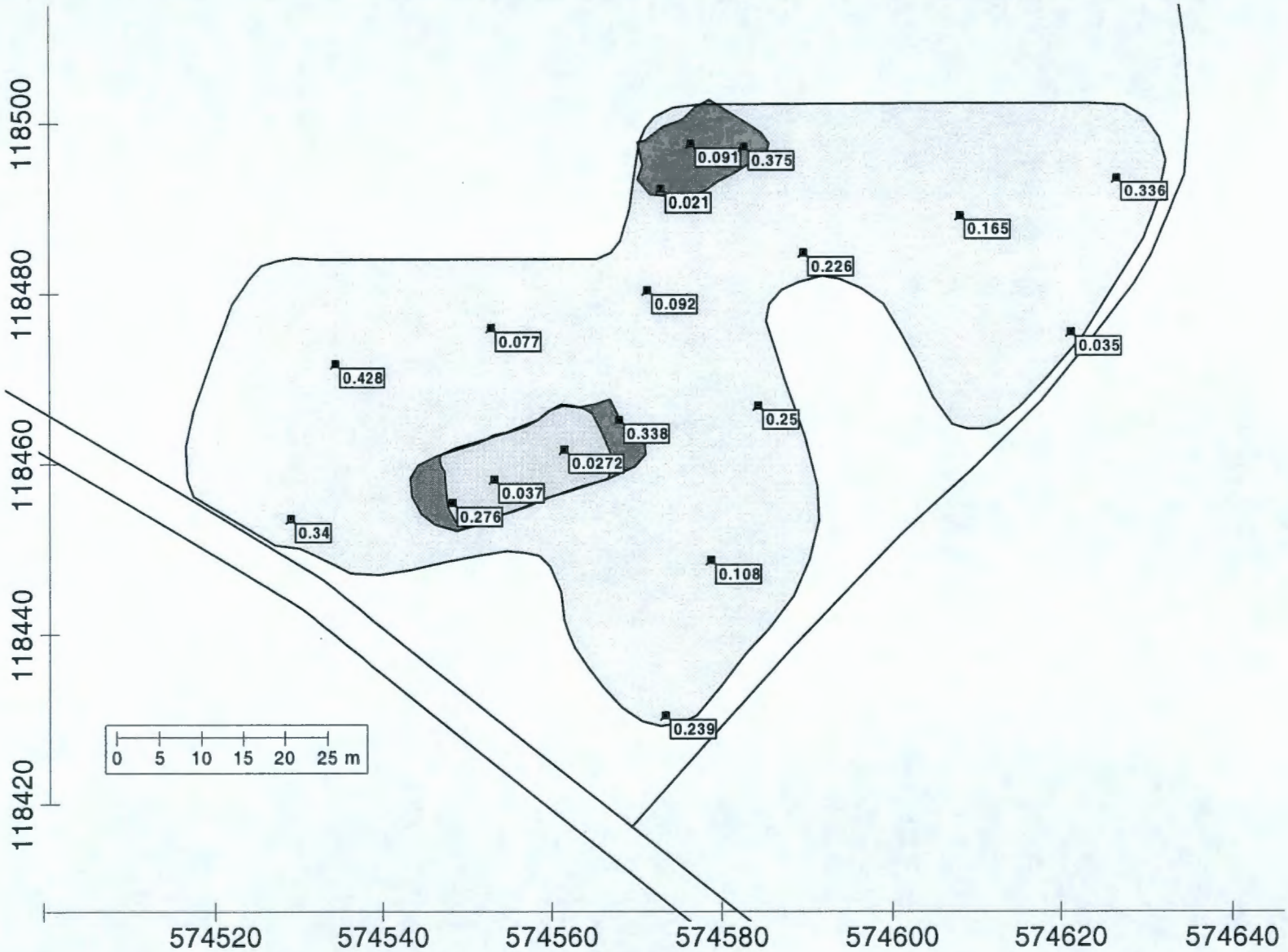
BHI, 2005, *Work Instruction for Verification Sampling of the 600-270 Horseshoe Landfill*, 0600X-WI-G0011, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CDM, 1995, *Miscellaneous Architect Engineer Services for Hazardous, Toxic, and Radiological Waste (HTRW) Projects for U.S. Army Corps of Engineers Walla Walla District: Draft Final Report Landfill Characterization and Remediation Horseshoe and Nike Base Landfills, Hanford Arid Lands Ecology Reserve, Washington*, Contract No. DACW68-94-D-0001, CDM Federal Programs, Inc., Richland, Washington.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 601, et seq.

DOE-RL, 1994, *A Compendium of Field Reports for the Fitzner-Eberhardt Arid Lands Ecology Reserve Remedial Action, Hanford, Washington*, DOE/RL-94-141, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Figure 7. Verification Sample Locations with Total Concentration DDT/DDE/DDD (mg/kg).



DOE-RL, 1996, *Superfund Site Final Closeout Report*, Administrative Record Number 0044910, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2002, *Evaluation of Risk to Ecological Receptors from DDT at the Horseshoe Landfill*, DOE/RL-2002-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1986, *Test Methods for Evaluating Solid Waste: Physical and Chemical Methods*, SW-846, 3rd Edition, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1993, *Declaration of the Record of Decision, U.S. Department of Energy, Hanford 1100 Area*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2000, *Guidance for Data Quality Assessment*, EPA QA/G-9, EPA/600/R-96/084, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2005, *Memo-to-File Documenting Non-Significant Changes to the 1100 Area Record of Decision, Hanford Site, Benton County, Washington*, dated May 12, 2005, D. D. Opalski, Director, Office of Environmental Cleanup, U.S. Environmental Protection Agency, Region 10, Seattle Washington to Administrative Record (1100 Area).

Poston, T. M., R. W. Hanf, R. L. Dirkes, and L. F. Morasch, 2004, *Hanford Site Environmental Report for Calendar Year 2003*, PNNL-14687, Pacific Northwest Laboratory, Richland, Washington.

Roy, R. R., 1998, *Report of the Preliminary Findings of the Level III Preacquisition Environmental Contaminants Survey for the Hanford North (Wahluke) Slope and the Arid Lands Ecology Reserve, Hanford Reservation, Washington*, U.S. Fish and Wildlife Service, Upper Columbia River Basin Field Office, Moses Lake, Washington.

Thompson, W. S., 2001, *Sampling and Analysis Instruction for Evaluation of Residual DDT, DDE, and DDD at the Horseshoe Landfill*, BHI-01529, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996, 2001.

APPENDIX A

LABORATORY ANALYTICAL RESULTS

Table A-1. Verification Sample Results for Clean Backfill Material. (5 Pages)

Sample Location	HEIS 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
Backfill Material	J03CH3	6/7/2005	1.9	UJ	1.9	2.7		2.1	90.1	C	0.09	0.38		0.05	2.4		1.1	0.14	U	0.14
Equipment Blank	J03CJ9	6/7/2005	0.31	UJ	0.31	0.35	U	0.35	0.99	C	0.02	0.02		0.008	0.49		0.18	0.02	U	0.02

Sample Location	HEIS 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
Backfill Material	J03CH3	6/7/2005	9		0.33	8.1		0.43	12.7		0.38	4.7		1.2	391	C	0.09	0.02	U	0.02
Equipment Blank	J03CJ9	6/7/2005	0.13		0.05	0.09		0.07	0.13		0.06	0.19	U	0.19	2.3	C	0.02	0.01	U	0.01

Sample Location	HEIS 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
Backfill Material	J03CH3	6/7/2005	0.76	U	0.76	11.4		1	2.3	U	2.3	0.43	U	0.43	51.9		0.28	46.6	C	0.24
Equipment Blank	J03CJ9	6/7/2005	0.12	U	0.12	0.17	U	0.17	0.38	U	0.38	0.07	U	0.07	0.13		0.05	1.7	C	0.04

Note: Data qualified with C, I, and/or J are considered acceptable values.
C = blank contamination
HEIS = Hanford Environmental Information System
I = interference
J = estimate
PQL = practical quantification limit
Q = qualifier
U = Undetected

Table A-1. Verification Sample Results for Clean Backfill Material. (5 Pages)

Constituent	Backfill Material J03CH3 06/07/05			Equipment Blank J03CJ9 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Herbicides						
2,4,5-Trichlorophenoxyacetic acid	17	U	17	17	U	17
2,4-Dichlorophenoxyacetic acid	34	U	34	33	U	33
2-(2,4,5-Trichlorophenoxy)propionic acid	17	U	17	17	U	17
2-secButyl-4,6-dinitrophenol(DNBP)	17	U	17	17	U	17
4-(2,4-Dichlorophenoxy)butanoic acid	170	U	170	170	U	170
Dalapon	170	U	170	170	U	170
Dicamba	68	U	68	67	U	67
Dichloroprop	170	U	170	170	U	170
PCBs						
Aroclor-1016	14	U	14	13	U	13
Aroclor-1221	14	U	14	13	U	13
Aroclor-1232	14	U	14	13	U	13
Aroclor-1242	14	U	14	13	U	13
Aroclor-1248	14	U	14	13	U	13
Aroclor-1254	14	U	14	13	U	13
Aroclor-1260	14	U	14	13	U	13
Pesticides						
Aldrin	1.7	U	1.7	1.7	U	1.7
Alpha-BHC	1.7	U	1.7	1.7	U	1.7
alpha-Chlordane	1.7	U	1.7	1.7	U	1.7
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.7	U	1.7	1.7	U	1.7
Delta-BHC	1.7	U	1.7	1.7	U	1.7
Dichlorodiphenyldichloroethane	3.4	U	3.4	3.3	U	3.3
Dichlorodiphenyldichloroethylene	3.4	U	3.4	3.3	U	3.3
Dichlorodiphenyltrichloroethane	3.4	U	3.4	3.3	U	3.3
Dieldrin	1.7	U	1.7	1.7	U	1.7
Endosulfan I	1.7	U	1.7	1.7	U	1.7
Endosulfan II	3.4	U	3.4	3.3	U	3.3
Endosulfan sulfate	3.4	U	3.4	3.3	U	3.3
Endrin	3.4	U	3.4	3.3	U	3.3
Endrin aldehyde	3.4	U	3.4	3.3	U	3.3
Endrin ketone	3.4	U	3.4	3.3	U	3.3
Gamma-BHC (Lindane)	1.7	U	1.7	1.7	U	1.7
gamma-Chlordane	1.7	U	1.7	1.7	U	1.7
Heptachlor	1.7	U	1.7	1.7	U	1.7
Heptachlor epoxide	1.7	U	1.7	1.7	U	1.7
Methoxychlor	17	U	17	17	U	17
Toxaphene	170	UJ	170	170	UJ	170

Table A-1. Verification Sample Results for Clean Backfill Material. (5 Pages)

Constituent	Backfill Material J03CH3 06/07/05			Equipment Blank J03CJ9 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
VOCs						
1,1,1-Trichloroethane	5	U	5	6	U	6
1,1,2,2-Tetrachloroethane	5	U	5	6	U	6
1,1,2-Trichloroethane	5	U	5	6	U	6
1,1-Dichloroethane	5	U	5	6	U	6
1,1-Dichloroethene	5	U	5	6	U	6
1,2-Dichloroethane	5	U	5	6	U	6
1,2-Dichloroethene(Total)	5	U	5	6	U	6
1,2-Dichloropropane	5	U	5	6	U	6
2-Butanone	10	U	10	12	U	12
2-Hexanone	10	U	10	12	U	12
4-Methyl-2-Pentanone	10	U	10	12	U	12
Acetone	10	U	10	12	U	12
Benzene	5	U	5	6	U	6
Bromodichloromethane	5	U	5	6	U	6
Bromoform	5	U	5	6	U	6
Bromomethane	10	U	10	12	U	12
Carbon disulfide	5	U	5	6	U	6
Carbon tetrachloride	5	U	5	6	U	6
Chlorobenzene	5	U	5	6	U	6
Chloroethane	10	U	10	12	U	12
Chloroform	5	U	5	6	U	6
Chloromethane	10	U	10	12	U	12
cis-1,2-Dichloroethylene	5	U	5	6	U	6
cis-1,3-Dichloropropene	5	U	5	6	U	6
Dibromochloromethane	5	U	5	6	U	6
Ethylbenzene	5	U	5	6	U	6
Methylenechloride	10	U	5	10	U	6
Styrene	5	U	5	6	U	6
Tetrachloroethene	5	U	5	6	U	6
Toluene	5	U	5	6	U	6
trans-1,2-Dichloroethylene	5	U	5	6	U	6
trans-1,3-Dichloropropene	5	U	5	6	U	6
Trichloroethene	5	U	5	6	U	6
Vinyl chloride	10	U	10	12	U	12
Xylenes (total)	5	U	5	6	U	6

Table A-1. Verification Sample Results for Clean Backfill Material. (5 Pages)

Constituent	Backfill Material J03CH3 06/07/05			Equipment Blank J03CJ9 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
SVOCs						
1,2,4-Trichlorobenzene	340	U	340	330	U	330
1,2-Dichlorobenzene	340	U	340	330	U	330
1,3-Dichlorobenzene	340	U	340	330	U	330
1,4-Dichlorobenzene	340	U	340	330	U	330
2,4,5-Trichlorophenol	850	U	850	840	U	840
2,4,6-Trichlorophenol	340	U	340	330	U	330
2,4-Dichlorophenol	340	U	340	330	U	330
2,4-Dimethylphenol	340	U	340	330	U	330
2,4-Dinitrophenol	850	UJ	850	840	UJ	840
2,4-Dinitrotoluene	340	U	340	330	U	330
2,6-Dinitrotoluene	340	U	340	330	U	330
2-Chloronaphthalene	340	U	340	330	U	330
2-Chlorophenol	340	U	340	330	U	330
2-Methylnaphthalene	340	U	340	330	U	330
2-Methylphenol (cresol, o-)	340	U	340	330	U	330
2-Nitroaniline	850	U	850	840	U	840
2-Nitrophenol	340	U	340	330	U	330
3+4 Methylphenol (cresol, m+p)	340	U	340	330	U	330
3,3'-Dichlorobenzidine	340	U	340	330	U	330
3-Nitroaniline	850	U	850	840	U	840
4,6-Dinitro-2-methylphenol	850	U	850	840	U	840
4-Bromophenylphenyl ether	340	U	340	330	U	330
4-Chloro-3-methylphenol	340	U	340	330	U	330
4-Chloroaniline	340	U	340	330	U	330
4-Chlorophenylphenyl ether	340	U	340	330	U	330
4-Nitroaniline	850	U	850	840	U	840
4-Nitrophenol	850	U	850	840	U	840
Acenaphthene	340	U	340	330	U	330
Acenaphthylene	340	U	340	330	U	330
Anthracene	340	U	340	330	U	330
Benzo(a)anthracene	340	U	340	330	U	330
Benzo(a)pyrene	340	U	340	330	U	330
Benzo(b)fluoranthene	340	U	340	330	U	330
Benzo(ghi)perylene	340	U	340	330	U	330
Benzo(k)fluoranthene	340	U	340	330	U	330
Bis(2-chloro-1-methylethyl)ether	340	U	340	330	U	330
Bis(2-Chloroethoxy)methane	340	U	340	330	U	330
Bis(2-chloroethyl) ether	340	U	340	330	U	330
Bis(2-ethylhexyl) phthalate	660	U	340	660	U	330

Table A-1. Verification Sample Results for Clean Backfill Material. (5 Pages)

Constituent	Backfill Material J03CH3 06/07/05			Equipment Blank J03CJ9 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
SVOCs						
Butylbenzylphthalate	340	U	340	330	U	330
Carbazole	340	U	340	330	U	330
Chrysene	340	U	340	330	U	330
Di-n-butylphthalate	340	U	340	660	U	330
Di-n-octylphthalate	340	U	340	330	U	330
Dibenz[a,h]anthracene	340	U	340	330	U	330
Dibenzofuran	340	U	340	330	U	330
Diethylphthalate	340	U	340	660	U	330
Dimethyl phthalate	340	U	340	330	U	330
Fluoranthene	340	U	340	330	U	330
Fluorene	340	U	340	330	U	330
Hexachlorobenzene	340	U	340	330	U	330
Hexachlorobutadiene	340	U	340	330	U	330
Hexachlorocyclopentadiene	340	U	340	330	U	330
Hexachloroethane	340	U	340	330	U	330
Indeno(1,2,3-cd)pyrene	340	U	340	330	U	330
Isophorone	340	U	340	330	U	330
N-Nitroso-di-n-dipropylamine	340	U	340	330	U	330
N-Nitrosodiphenylamine	340	U	340	330	U	330
Naphthalene	340	U	340	330	U	330
Nitrobenzene	340	U	340	330	U	330
Pentachlorophenol	850	U	850	840	U	840
Phenanthrene	340	U	340	330	U	330
Phenol	340	U	340	330	U	330
Pyrene	340	U	340	330	U	330

Table A-2. Phase I Pesticide Verification Sample Results. (3 Pages)

Constituent	J03CH4 06/07/05			J03CH5 06/07/05			J03CH6 06/07/05			J03CH7 06/07/05			J03CH8 06/07/05			J03CH9 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Pesticides																		
Aldrin	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Alpha-BHC	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
alpha-Chlordane	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Delta-BHC	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Dichlorodiphenyldichloroethane	7.4	J	3.4	2.7	J	3.3	9.5	J	3.5	150	J	3.5	69	J	3.4	7.8	J	3.3
Dichlorodiphenyldichloroethylene	150		3.4	78		3.3	190		3.5	1300		3.5	460		3.4	150		3.3
Dichlorodiphenyltrichloroethane	82		3.4	27		3.3	140		3.5	1700		3.5	420		3.4	92		3.3
Dieldrin	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Endosulfan I	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	36		1.8	1.7	U	1.7	1.7	U	1.7
Endosulfan II	3.4	U	3.4	3.3	U	3.3	3.5	U	3.5	3.5	U	3.5	3.4	U	3.4	3.3	U	3.3
Endosulfan sulfate	3.4	U	3.4	3.3	U	3.3	3.5	U	3.5	3.5	U	3.5	3.4	U	3.4	3.3	U	3.3
Endrin	3.4	U	3.4	3.3	U	3.3	3.5	U	3.5	3.5	U	3.5	3.4	U	3.4	3.3	U	3.3
Endrin aldehyde	3.4	U	3.4	3.3	U	3.3	3.5	U	3.5	3.5	U	3.5	2.3	J	3.4	3.3	U	3.3
Endrin ketone	3.4	U	3.4	3.3	U	3.3	3.5	U	3.5	3.5	U	3.5	3.4	U	3.4	3.3	U	3.3
Gamma-BHC (Lindane)	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
gamma-Chlordane	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Heptachlor	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Heptachlor epoxide	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8	1.7	U	1.7	1.7	U	1.7
Methoxychlor	17	U	17	17	U	17	18	U	18	18	U	18	17	U	17	17	U	17
Toxaphene	170	UJ	170	170	UJ	170	180	UJ	180	180	UJ	180	170	UJ	170	170	UJ	170

Table A-2. Phase I Pesticide Verification Sample Results. (3 Pages)

Constituent	J03CJ0 06/07/05			J03CJ1 06/07/05			J03CJ2 06/07/05			J03CJ3 06/07/05			J03CJ4 06/07/05			J03CJ5 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Pesticides																		
Aldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Alpha-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
alpha-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Delta-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Dichlorodiphenyldichloroethane	3.3	U	3.3	8.1	J	3.3	1.9	J	3.3	2.6	J	3.3	5.9	J	3.3	1.9	J	3.3
Dichlorodiphenyldichloroethylene	26		3.3	310		3.3	51		3.3	64		3.3	150		3.3	140		3.3
Dichlorodiphenyltrichloroethane	9.1		3.3	110		3.3	24		3.3	25		3.3	70		3.3	23		3.3
Dieldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Endosulfan I	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Endosulfan II	3.3	U	3.3	3.4	U	3.4	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4
Endosulfan sulfate	3.3	U	3.3	3.4	U	3.4	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4
Endrin	3.3	U	3.3	3.4	U	3.4	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4
Endrin aldehyde	3.3	U	3.3	2.4	J	2.4	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4
Endrin ketone	3.3	U	3.3	3.4	U	3.4	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4
Gamma-BHC (Lindane)	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
gamma-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Heptachlor	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Heptachlor epoxide	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Methoxychlor	17	U	17	17	U	17	17	U	17	17	U	17	17	U	17	17	U	17
Toxaphene	170	UJ	170	170	UJ	170	170	UJ	170	170	UJ	170	170	UJ	170	170	UJ	170

Table A-2. Phase I Pesticide Verification Sample Results. (3 Pages)

Constituent	J03CJ6 06/07/05			J03CJ7 06/07/05			J03CJ8 06/07/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Pesticides									
Aldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Alpha-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
alpha-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Delta-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Dichlorodiphenyldichloroethane	6.3	J	3.3	12	J	3.3	13	J	3.3
Dichlorodiphenyldichloroethylene	220		3.3	540		3.3	640		3.3
Dichlorodiphenyltrichloroethane	110		3.3	170		3.3	210		3.3
Dieldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Endosulfan I	1.7	U	1.7	1.7	U	1.7	8.2		1.7
Endosulfan II	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Endosulfan sulfate	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Endrin	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Endrin aldehyde	3.3	U	3.3	4.5		3.3	3.3	U	3.3
Endrin ketone	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Gamma-BHC (Lindane)	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
gamma-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Heptachlor	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Heptachlor epoxide	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Methoxychlor	17	U	17	17	U	17	17	U	17
Toxaphene	170	UJ	170	170	UJ	170	170	UJ	170

Table A-3. Phase II Pesticide Verification Sample Results. (2 Pages)

Constituent	J03W22 08/03/05			J03W23 08/03/05			J03W24 08/03/05			J03W25 08/03/05			J03W26 08/03/05			J03W27 08/03/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Pesticides																		
Aldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Alpha-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
alpha-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Delta-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Dichlorodiphenyldichloroethane	16		3.3	150		3.4	400		3.3	420		3.3	160		3.3	960		3.3
Dichlorodiphenyldichloroethylene	100		3.3	3.4	U	3.4	890		3.3	930		3.3	590		3.3	3.3	U	3.3
Dichlorodiphenyltrichloroethane	160		3.3	780	I	3.4	780	I	3.3	780	I	3.3	100		3.3	3.3	U	3.3
Dieldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	17		1.7	13		1.7
Endosulfan I	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Endosulfan II	3.3	U	3.3	29		3.4	18		3.3	15		3.3	11		3.3	3.3	U	3.3
Endosulfan sulfate	3.3	U	3.3	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Endrin	3.3	U	3.3	3.4	U	3.4	4.4		3.3	4.3		3.3	3.3	U	3.3	3.3	U	3.3
Endrin aldehyde	3.3	U	3.3	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Endrin ketone	3.3	U	3.3	3.4	U	3.4	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3	3.3	U	3.3
Gamma-BHC (Lindane)	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
gamma-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Heptachlor	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Heptachlor epoxide	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7
Methoxychlor	17	U	17	17	U	17	17	U	17	17	U	17	17	U	17	6.5	I	6.5
Toxaphene	170	U	170	170	U	170	170	U	170	170	U	170	170	U	170	170	U	170

Table A-3. Phase II Pesticide Verification Sample Results. (2 Pages)

Constituent	J03W28 08/03/05			J03W29 08/03/05			J03W30 08/03/05			J03W31 08/03/05			J03W32 08/03/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Pesticides															
Aldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Alpha-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
alpha-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Delta-BHC	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Dichlorodiphenyldichloroethane	48		3.3	3.3	U	3.3	3.4	U	3.4	4.8		3.5	3.2	J	3.6
Dichlorodiphenyldichloroethylene	130		3.3	13		3.3	62		3.4	250		3.5	170		3.6
Dichlorodiphenyltrichloroethane	160		3.3	8.2		3.3	29		3.4	120		3.5	93		3.6
Dieldrin	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Endosulfan I	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Endosulfan II	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4	3.5	U	3.5	3.6	U	3.6
Endosulfan sulfate	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4	3.5	U	3.5	3.6	U	3.6
Endrin	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4	3.5	U	3.5	3.6	U	3.6
Endrin aldehyde	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4	3.5	U	3.5	3.6	U	3.6
Endrin ketone	3.3	U	3.3	3.3	U	3.3	3.4	U	3.4	3.5	U	3.5	3.6	U	3.6
Gamma-BHC (Lindane)	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
gamma-Chlordane	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Heptachlor	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Heptachlor epoxide	1.7	U	1.7	1.7	U	1.7	1.7	U	1.7	1.8	U	1.8	1.8	U	1.8
Methoxychlor	17	U	17	17	U	17	17	U	17	18	U	18	18	U	18
Toxaphene	170	U	170	170	U	170	170	U	170	180	U	180	180	U	180

Table A-4. Phase III Pesticide Verification Sample Results.

Constituent	J03X76 08/24/05			J03X77 08/24/05		
	µg/kg	Q	µg/kg	µg/kg	Q	µg/kg
Pesticides						
Aldrin	1.8	U	1.8	1.8	U	1.8
Alpha-BHC	1.8	U	1.8	1.8	U	1.8
alpha-Chlordane	1.8	U	1.8	1.8	U	1.8
beta-1,2,3,4,5,6-Hexachlorocyclohexane	1.8	U	1.8	1.8	U	1.8
Delta-BHC	1.8	U	1.8	1.8	U	1.8
Dichlorodiphenyldichloroethane	3.2		3.7	4.0		3.6
Dichlorodiphenyldichloroethylene	3.7	U	3.7	3.6	U	3.6
Dichlorodiphenyltrichloroethane	24		3.7	33		3.6
Dieldrin	1.8	U	1.8	1.8	U	1.8
Endosulfan I	8.9		1.8	15		1.8
Endosulfan II	3.7	U	3.7	3.6	U	3.6
Endosulfan sulfate	3.7	U	3.7	3.6	U	3.6
Endrin	3.7	U	3.7	3.6	U	3.6
Endrin aldehyde	3.7	U	3.7	3.6	U	3.6
Endrin ketone	3.7	U	3.7	3.6	U	3.6
Gamma-BHC (Lindane)	1.8	U	1.8	1.8	U	1.8
gamma-Chlordane	1.8	U	1.8	1.8	U	1.8
Heptachlor	1.8	U	1.8	1.8	U	1.8
Heptachlor epoxide	1.8	U	1.8	1.8	U	1.8
Methoxychlor	18	U	18	18	U	18
Toxaphene	180	U	180	180	U	180

DISTRIBUTION

U.S. Department of Energy
Richland Operations Office

J. Zeisloft (5)	A3-04

Washington Closure Hanford

K. A. Anselm	H9-02
R. A. Carlson	X0-17
K. E. Cook	X0-17
L. A. Dietz	H0-23
L. M. Dittmer	H9-02
J. A. Donnelly	X0-17
R. L. Donahoe	X0-17
K. A. Fecht	H9-01
E. T. Feist	X0-17
L. R. Miller	X3-40
D. N. Strom	X3-40
W. S. Thompson (2)	H9-02
J. E. Thomson	H0-23

Records and Document Control	H0-30
DOE-RL Public Reading Room	H2-53
Hanford Technical Library	P8-55