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APPROVAL PAGE

600-270 Horseshoe Landfill

Verification Work Instruction No. 0600X-WI-G0012

Approved By:

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WORK INSTRUCTION

FOR

VERIFICATION SAMPLING OF

THE 600-270 HORSESHOE LANDFILL

BHI-DIS BB 6/2/05

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HANFORD	RICHLAND ENVIRONMENTAL RESTORATION PROJECT	Job No. 22192
		Work Instruction No. 0600X-WI-G0012
		Sheet 1 of 27

1.0 PURPOSE

This work instruction provides the sampling and analytical requirements for verification sampling of the 600-270 Horseshoe Landfill site after removal of soil containing residual concentrations of dichlorodiphenyl trichloroethane (DDT) and its breakdown products dichlorodiphenyl dichloroethylene (DDE) and dichlorodiphenyl dichloroethane (DDD). Sampling and analysis will be performed in accordance with the applicable portions of the "Remedial Design Field Sampling Plan for the 1100 Area Hanford Site" and "Quality Assurance Project Plan for Field Investigations Supporting Remedial Design/Remedial Action Activities in the 1100 Area" provided in the *Remedial Design and Remedial Action Plan for the 1100 Area Hanford Site* (DOE-RL 1994b) and the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005), with site specific sampling and analytical requirements provided in this work instruction. In order to assure an evaluation of the applicable quality assurance (QA) and quality control requirements (QC) specified in DOE 1994b are considered, a crosswalk comparing the document with the analytical requirements specified in the 100 Area SAP (DOE-RL 2005) is provided in Appendix B.

2.0 SITE DESCRIPTION

The Horseshoe Landfill is a former *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) waste site that was part of the 1100-IU-1 Operable Unit. It was remediated as part of the activities outlined in the Record of Decision for the 1100 Area National Priorities List site (EPA 1993) and was removed from the National Priorities List in 1996 (61 *Federal Register* 510019). The primary contaminant of concern (COC) at this site was DDT. Post-closure biota sampling and soil sampling performed at the site indicate that concentrations of DDT and its breakdown products DDE and DDD are present in low concentrations within the landfill surface soils (DOE-RL 2002).

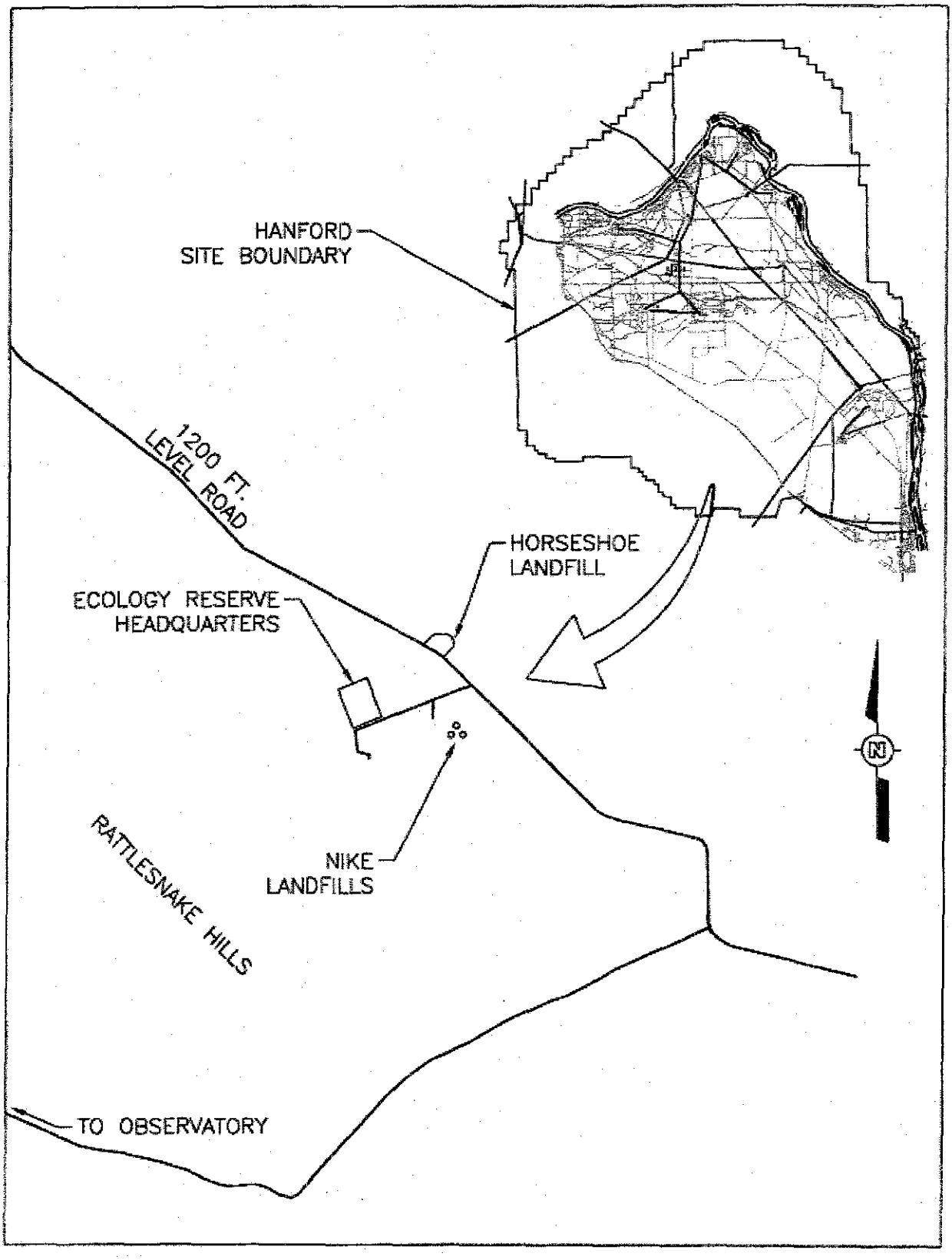
2.1 Location

The Horseshoe Landfill is located on the Fitzner-Eberhardt Arid Lands Ecology (ALE) 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, 2,230 m^3 (2,916 yd^3) of soil contaminated with DDT and other hazardous material and debris were excavated from the landfill. The remediated area of 0.25 ha (0.6 ac) was revegetated with native grasses and sagebrush. The wild fire of 2000 burned the vegetation at the site; however, the perennial grasses and forbs remain and are beginning to recover.

3.0 PREVIOUS INVESTIGATIONS

In 1994, electromagnetic profiling, magnetics, and ground-penetrating radar surveys were performed at the Horseshoe Landfill to identify areas of buried waste. Six anomalous zones were identified, and each anomaly was 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

Figure 1. Location of Horseshoe Landfill



encountered during excavation were segregated, inventoried, and stockpiled near the excavation site on plastic sheeting. At the anomaly designated as "A-6," DDT-contaminated soil was discovered. Field screening (using the EnviroGard™ field test kits) was used to evaluate the soil for DDT contamination and guide the extent of remediation at anomaly A-6. 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 1994a, CDM 1995). The total volume of excavated soil was 1,836 m^3 (2,401 yd^3). 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 *Model Toxics Control Act* (MTCA) Method A (*Washington Administrative Code* [WAC] 173-340). The site was then backfilled with clean material, returned to original grade, and re-vegetated.

In 1998, the U.S. Fish and Wildlife Service (USFWS) conducted a Level III preacquisition environmental contaminants survey for the Hanford North Slope (Wahluke Slope) and the ALE 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 µg/g, 0.02 µg/g, and 0.06 µg/g) and DDE (0.89 µg/g, 0.75 µg/g, and 2.01 µg/g). Three samples of deer mice were collected and exhibited 0.12 µg/g, 2.26 µg/g, and 0.45 µg/g 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 µg/g and DDE present at 45.5 µg/g. The study recommended additional organochlorine pesticide (primarily DDT and breakdown products) exposure monitoring in biota and in surface soil (0-2") on/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 COCs 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 µg/g). The average concentration of DDE in insects at the Horseshoe Landfill was 0.68 µg/g. An egg collected at the site contained 1.8 µg/g 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 45 µg/g observed in a horned lark egg sampled by the USFWS in 1998. The study concluded that although residual concentrations of DDE are present, it is not likely that the levels are high enough to cause lethal or sub-lethal effects to individuals, and it is impossible to have population-level impacts.

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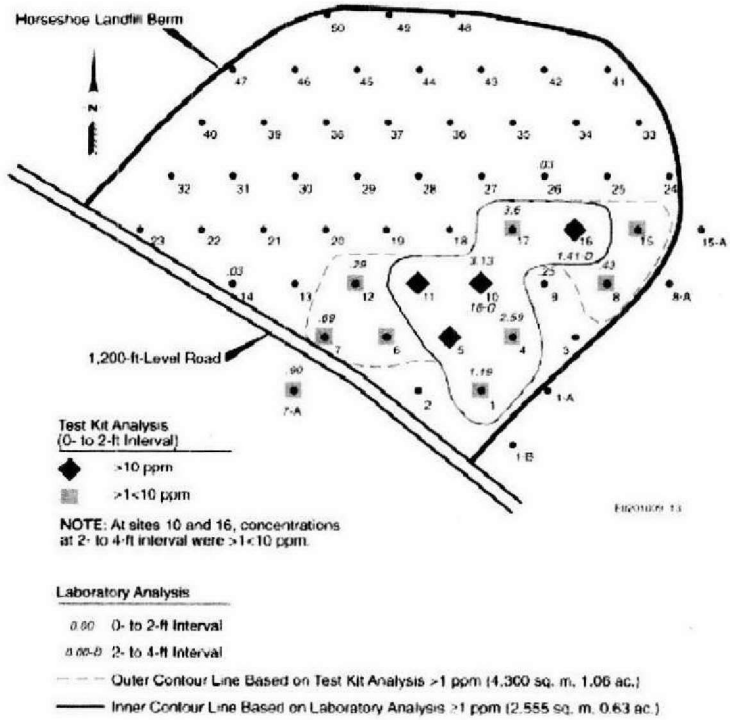
On October 28, 1999, the Washington State Department of Ecology collected three soil samples from the landfill for analysis of DDT, DDE, and DDD. A duplicate sample of each soil sample was also analyzed. The results for DDT were 0.014 mg/kg, 1.1 mg/kg, and 1.6 mg/kg. The results for DDE were 0.12 mg/kg, 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 though 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 (2 ft) interval with additional soil samples collected from the 0.6- to 1.2-m (2- to 4-ft) depth based upon 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 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.

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



In 2003, soil and biota samples were collected and analyzed to reconfirm concentrations of residual DDT, DDE, and DDD at the Horseshoe Landfill (PNNL 2004). Four soil samples from the southern portion of the landfill contained concentrations of DDT/DDD/DDE 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 from the landfill contained detectable concentrations of DDT/DDD/DDE ranging from 0.01 to 0.95 mg/kg. Concentrations in soil samples obtained during 2003 were consistent with concentrations measured in previous assessments, with samples collected from the southern region of the landfill having the highest concentrations of DDT/DDD/DDE.

4.0 SURFACE SOIL REMEDIATION

Removal of soil will be performed to a depth of approximately 1.22 m (4 ft) in the southern area indicated in Figure 2 as having residual DDT, DDD, and DDE contamination. After remediation is completed, verification soil sampling will be performed as described in Section 5.0.

5.0 VERIFICATION SAMPLE DESIGN

5.1 Contaminants of Concern

The results from previous investigations (DOE/RL 2002) have identified DDT and its breakdown products (DDD and DDE) as COCs for verification sampling.

5.2 Sample Design Selection and Basis

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples to collect. The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the upper 95% confidence limit 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 study area (site) is uncertain. The Washington State Department of Ecology (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 known by Ecology as "area-wide sampling."

Visual Sampling Plan[1] (VSP) was used as a tool to develop the statistical sampling design for the verification sampling. The area identified in Figure 2 as having residual DDT/DDD/DDE contamination was delineated in VSP and used as the basis for location of a systematic grid for

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

verification soil sample collection. A total of 14 soil samples will be collected on a random-start, triangular grid. A triangular grid was selected for this investigation based on studies that indicate triangular grids are superior to square grids (Gilbert 1987). Additional details concerning the use of VSP to develop the statistical sampling design and derive the number of verification samples to collect is discussed in Appendix A.

5.3 Sampling Methods

Figure 3 provides a map of the 14 soil sample locations that will be collected for verification sampling. The soil sample locations will be global positional surveyed and staked prior to sample collection. All sampling will be performed in accordance with BHI-EE-01, *Environmental Investigations Procedures*. One soil sample will be collected at each location and will consist of approximately 25 aliquots collected to a depth of approximately 5 cm (2 in) and distributed in an estimated 1 meter square grid surrounding the surveyed sample location. The 25 aliquots will be combined into one sample for laboratory analysis for a total of 14 soil samples. Each sample will be analyzed for DDT, DDD, and DDE using EPA Method 8081.

5.4 Field Quality Control

One equipment blank will be collected to verify the cleanliness of equipment and supplies used for sample collection. The equipment blank will be collected using silica sand (e.g., Colorado silica sand) that is poured over the sampling equipment which will come in direct contact with the sample media submitted for laboratory analysis. The sample analyses for the equipment blank will performed for DDT, DDD, and DDE using EPA Method 8081.

One field duplicate sample will be collected to verify the precision (reproducibility) of the laboratory analysis. The duplicate sample will be collected at a location selected at the discretion of the field sampler. The field duplicate will be collected by first homogenizing the sample media and then distributing approximately equal portions of sample media to the appropriate sample containers as required by the sample authorization form.

5.5 Analytical Methods

The laboratory analytical requirements for soil sample analysis are provided in Table 1.

Table 1. Analytical Performance Requirements.

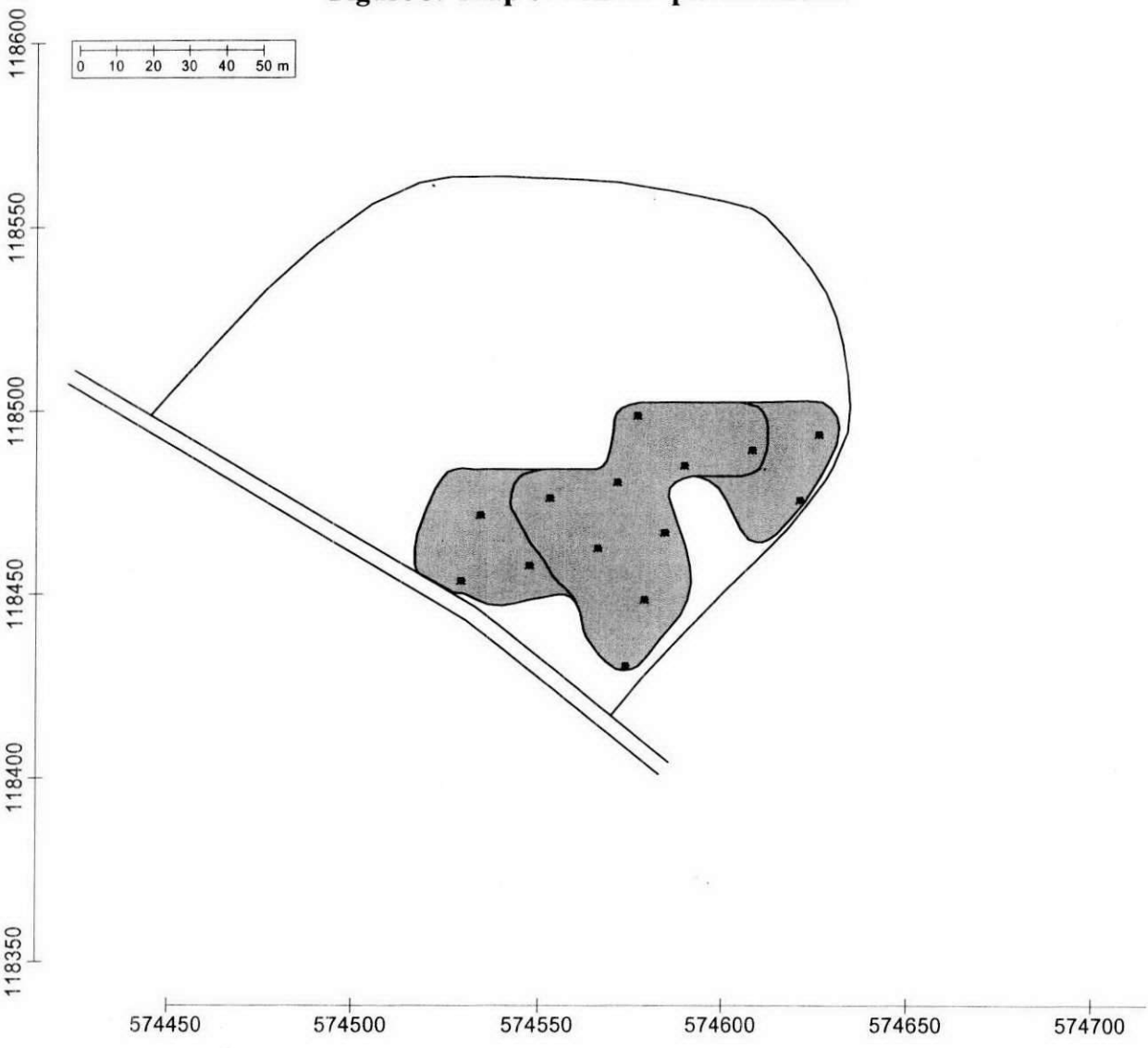
Analytical Method	Analytical Parameter	Detection Limit (mg/kg)	Accuracy (% recovery)	Precision (% RPD)
SW-846 Method 8081	4,4'-DDT	0.0033	50-150	±30
	4,4'-DDE	0.0033	50-150	±30
	4,4'-DDD	0.0033	50-150	±30

5.6 Data Quality Assessment

Post-data collection activities generally will follow those outlined in *Statistical Guidance for Ecology Site Managers* (Ecology 1992) and the U.S. Environmental Protection Agency's *Guidance for Data Quality Assessment* (EPA 2000). The data analyst will be familiar with the

context of the site remedial action and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of the statistical analyses that were performed as well as to achieve a general understanding of the verification sampling data. The data will be used to assess whether they are adequate in both quality and quantity to support the primary objective of demonstrating that the site meets the cleanup criteria. Because the primary objective is to compare the site mean value with threshold cleanup values, the data will be assessed in this context.

Figure 3. Map of Soil Sample Locations.



6.0 BACKFILL MATERIAL SAMPLING DESIGN

Backfill source material used as clean fill for the excavation will be sampled and analyzed as required by DOE-RL 1994b to verify suitability for use and that there are no constituents present

at concentrations above those defined by WAC 173-340. The stockpile of backfill material delivered to the site will be sampled by collecting 30 aliquots of soil over the surface of the stockpile and combining the aliquots into one soil sample for laboratory analysis. The sample will be analyzed for volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, and metals. The laboratory analytical requirements for the laboratory analysis for this sample are provided in Table 2.

Table 2. Analytical Performance Requirements.

Analytical Method	Analytical Parameter	Detection Limit (mg/kg)	Accuracy (% recovery)	Precision (% RPD)
SW-846 Method 6010	Antimony	0.6	70-130	±30
	Arsenic	10	70-130	±30
	Barium	2	70-130	±30
	Beryllium	0.5	70-130	±30
	Boron	2	70-130	±30
	Cadmium	0.5	70-130	±30
	Chromium	1	70-130	±30
	Cobalt	2	70-130	±30
	Copper	1	70-130	±30
	Lead	5	70-130	±30
	Manganese	5	70-130	±30
	Molybdenum	2	70-130	±30
	Nickel	4	70-130	±30
	Selenium	1	70-130	±30
	Silver	0.2	70-130	±30
	Vanadium	2.5	70-130	±30
	Zinc	1	70-130	±30
SW-846 Method 7471	Mercury	0.33	70-130	±30
SW-846 Method 8260	VOCs	Compound specific	50-150	±30
SW-846 Method	SVOCs	Compound specific	50-150	±30
SW-846 Method 8082	PCBs	0.017	50-150	±30
SW-846 Method 8081	Aldrin	0.00165	50-150	±30
	alpha BHC	0.00165	50-150	±30
	beta BHC	0.00165	50-150	±30
	delta BHC	0.00165	50-150	±30
	gamma BHC	0.00165	50-150	±30
	Chlordane (alpha, gamma)	0.0165	50-150	±30
	4,4'-DDT	0.0033	50-150	±30
	4,4'-DDE	0.0033	50-150	±30
	4,4'-DDD	0.0033	50-150	±30
	2,4 -Dichlorophenoxyacetic acid	0.4	50-150	±30
	Dieldrin	0.003	50-150	±30
	Endosulfan (I, II, sulfate)	0.003	50-150	±30
	Endrin (ketone, aldehyde)	0.003	50-150	±30
	Heptachlor	0.002	50-150	±30

Table 2. Analytical Performance Requirements.

Analytical Method	Analytical Parameter	Detection Limit (mg/kg)	Accuracy (% recovery)	Precision (% RPD)
	Heptachlor epoxide	0.002	50-150	±30
	Methoxychlor	0.02	50-150	±30
	Toxaphene	0.2	50-150	±30

7.0 REFERENCES

40 CFR, 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, as amended.

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

APPENDIX A

SUMMARY OF STATISTICAL DESIGN FOR VERIFICATION SAMPLING
(8 pages)

SUMMARY OF STATISTICAL DESIGN FOR VERIFICATION SAMPLING

A.1 Summary

This appendix summarizes the sampling design used and associated statistical assumptions, as well as general guidelines to be used for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. Requirements for how to collect and analyze the samples are provided in Section 5.0 of the work instruction.

A.2 Primary Sampling Objective

The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the upper 95% confidence limit on the sample mean, with the cleanup level. The working hypothesis (or "null" hypothesis) is that the median (mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median (mean) value is less than the threshold. Visual Sampling Plan[2] (VSP) calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation. Additionally, the Washington State Department of Ecology (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. Therefore, a systematic grid sampling design with a random start was selected for use in VSP.

A.3 Selected Sampling Approach

A nonparametric systematic sampling approach with a random start was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site) indicate that typical parametric assumptions may not be true.

Both parametric and nonparametric equations rely on assumptions about the population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

The 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. Therefore, a systematic grid sampling design with a random start was selected for

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

use in VSP. Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used. One disadvantage of systematically collected samples is that spatial variability or patterns may not be discovered if the grid spacing is large relative to the spatial patterns.

A.4 Number of Total Samples: Calculation Equation and Inputs

The equation used to calculate the number of samples is based on a Sign test (see Gilbert et al. 2001 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median (mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is as follows:

$$n = 1.20\left[\frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{4(SignP - 0.5)^2}\right]$$

where

$$SignP = \Phi\left[\frac{\Delta}{\left(s^2_{sample} + \frac{s^2_{analytical}}{r}\right)^{1/2}}\right]$$

$\Phi(z)$ = the cumulative standard normal distribution on $(-\infty,z)$ (see Gilbert et al. 2001 for details)

n = the number of samples

S = the estimated standard deviation of the measured values including analytical error

Δ = the width of the gray region

α = the acceptable probability of incorrectly concluding the site median (mean) is less than the threshold

β = the acceptable probability of incorrectly concluding the site median (mean) exceeds the threshold

$Z_{1-\alpha}$ = the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$

$Z_{1-\beta}$ = the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

NOTE: The *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (EPA et al. 2000) suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in MARSSIM (EPA et al. 2000, p. 5-33).

The values of these inputs that result in the calculated number of sampling locations are summarized in Table A-1.

Table A-1. VSP User Inputs.

Parameter	Value	Basis
S	0.17	Standard deviation for DDT based on evaluation of the possible range of concentrations after completion of remediation.
Δ	0.2	Set at slightly more than 25% of the action level of 0.75 mg/kg for DDT.
α	5%	False rejection rate specified in WAC 173-340-740.
β	20%	False acceptance rate consistent with Hanford remedial actions.
$Z_{1-\alpha}$	1.64485	This value is automatically calculated by VSP based on the user-defined value of α.
$Z_{1-\beta}$	0.841621	This value is automatically calculated by VSP based on the user-defined value of β.
MARSSIM Overage	20%	User defined sample increase factor.

DQO = data quality objective
MARSSIM = *Multi-Agency Radiation Survey and Site Investigation Manual*
VSP = Visual Sample Plan

In order to use VSP to calculate the appropriate number of samples, *n*, to collect for estimating the mean, it is necessary to have some prior estimate of the sample standard deviation. In general, estimates made from samples tend to more closely approximate the true population mean as the number of samples increases. However, for the Horseshoe Landfill, the only data available to estimate a standard deviation are the results for previous soil sampling prior to remediation (DOE/RL 2002). Using the standard deviation anticipated after remedial action of the residual DDT contaminated surface soil is performed and the applicable action level of 0.75 mg/kg with associated "gray region" for DDT resulted in the selection of a sample design that will collect 14 soil samples. Table A-2 summarizes the sampling design that was developed. Table A-3 lists sampling location coordinates. Figure A-1 shows sampling locations in the field.

Table A-2. Summary of Sampling Design.

Primary objective of design	Compare a site mean or median to a fixed threshold
Type of sampling design	Nonparametric
Sample placement (location) in the field	Systematic with a random start location
Working (null) hypothesis	The median (mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign test – MARSSIM version
Calculated total number of samples	14
Number of samples on map[a]	14
Number of selected sample areas[b]	1
Specified sampling area[c]	4329.83 m^2
Size of grid/area of grid cell[d]	18.9 m / 309.3 m^2
Grid pattern	Triangular

[a] This number may differ from the calculated number because of (1) grid edge effects, (2) adding judgment samples, or (3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of shaded areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected shaded sample areas on the map of the site.
[d] Size of grid/area of grid cell gives the linear and square dimensions of the grid used to systematically place samples.
MARSSIM = *Multi-Agency Radiation Survey and Site Investigation Manual*

Table A-3. Sample Location Coordinates.

X Coordinate	Y Coordinate	Type
574573.4	118430.5	Systematic
574578.8	118448.6	Systematic
574529.1	118453.5	Systematic
574547.5	118457.9	Systematic
574565.8	118462.3	Systematic
574584.2	118466.7	Systematic
574621.0	118475.4	Systematic
574534.5	118471.6	Systematic
574552.9	118476.0	Systematic
574571.2	118480.4	Systematic
574589.6	118484.8	Systematic
574608.0	118489.2	Systematic
574626.3	118493.6	Systematic
574576.6	118498.5	Systematic

Figure A-1. Map of Sample Locations.

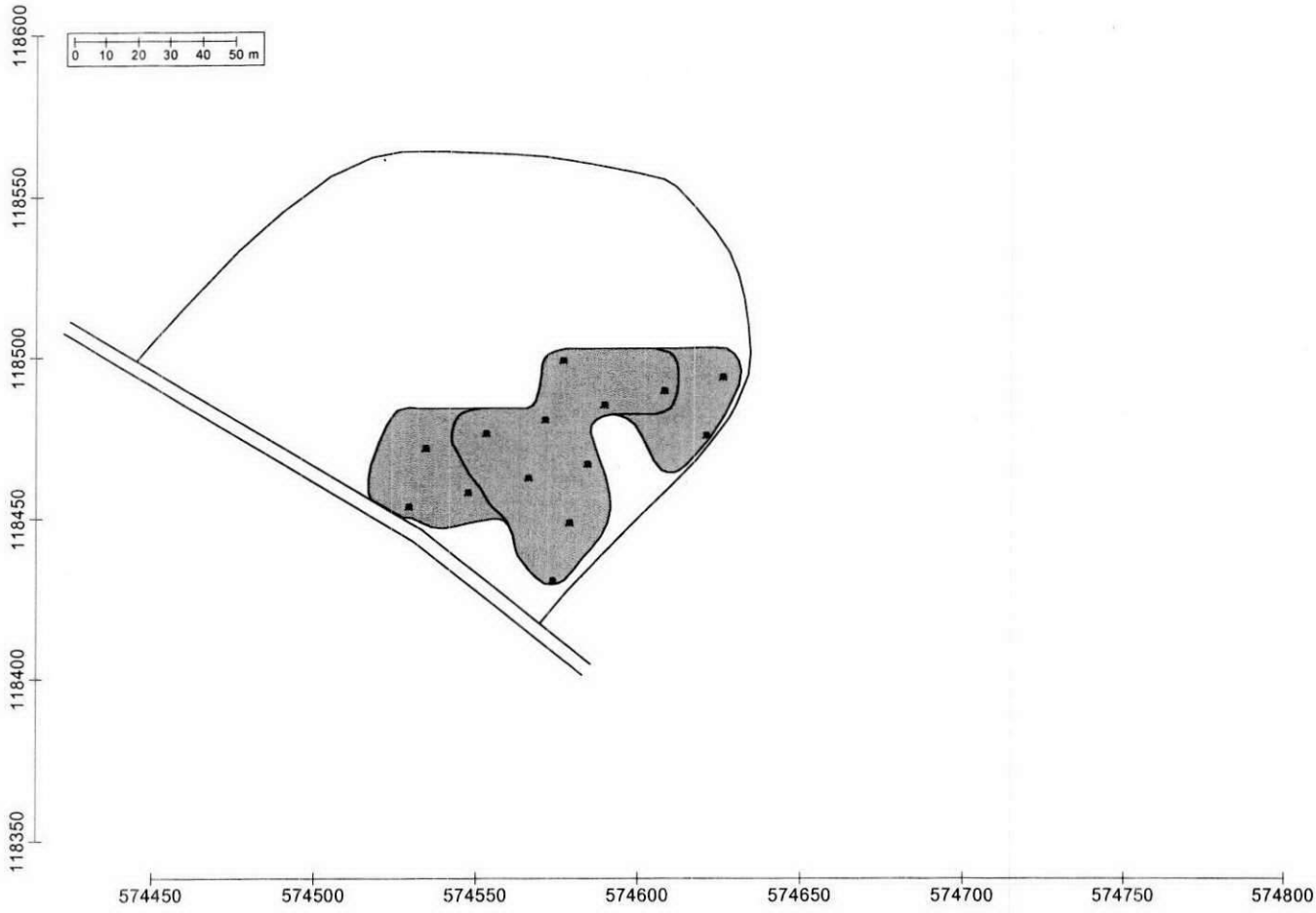


Figure A-2 is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA 2000b). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median (mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The solid vertical line to the right of the gray region is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to Δ; the upper horizontal dashed line is positioned at $1-\alpha$ on the vertical axis; the lower horizontal dashed line is positioned at β on the vertical axis. The short vertical line in the gray region to the left of the action level is positioned at one standard deviation below the threshold. The shape of the curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at $1-\alpha$. If any of the inputs change, the number of samples that result in the correct curve changes.

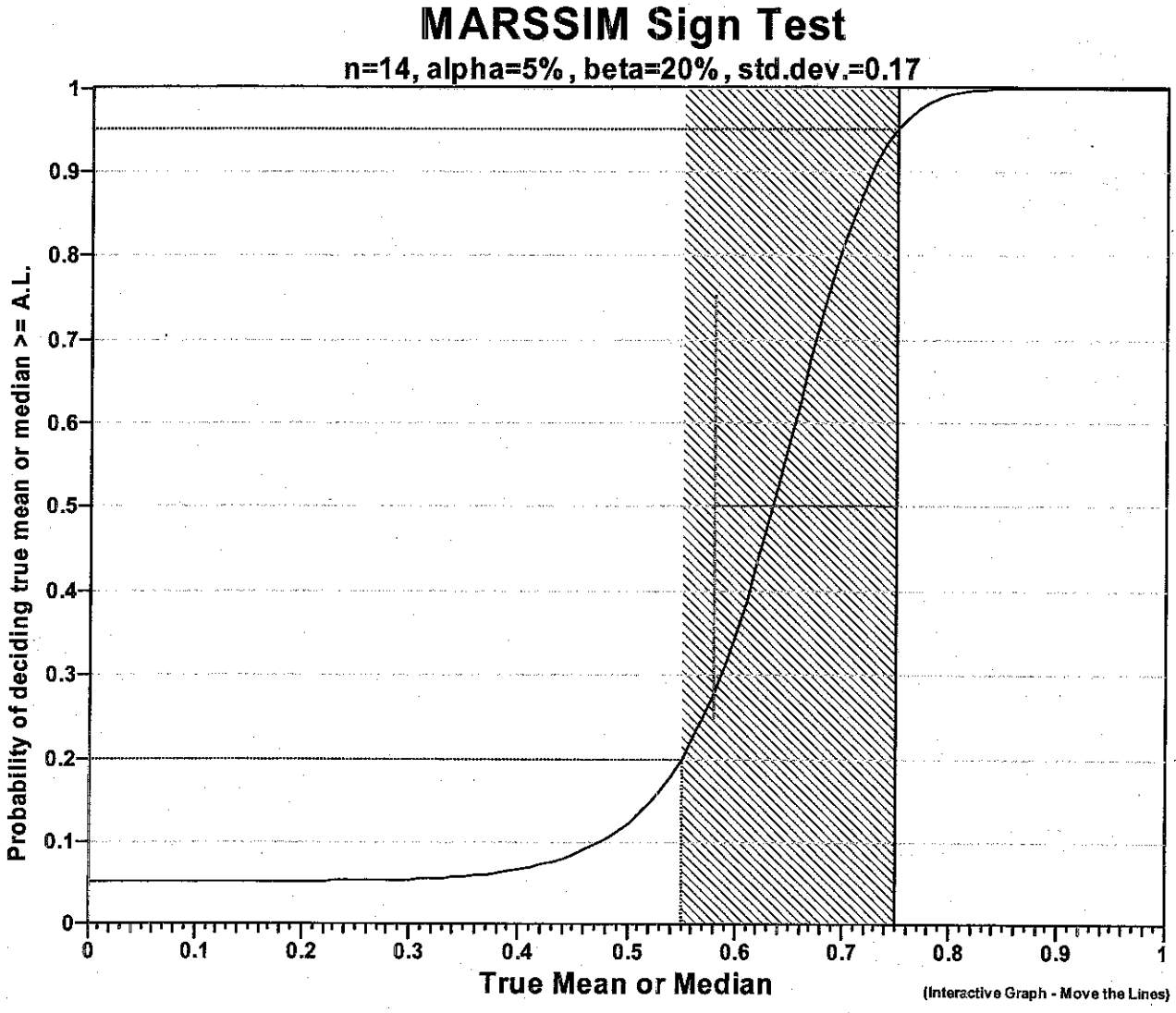
A.5 Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples is as follows:

1. The computed Sign test statistic is normally distributed,
2. The variance estimate, S^2, is reasonable and representative of the population being sampled,
3. The population values are not spatially or temporally correlated, and
4. The sampling locations will be selected probabilistically.

The first three assumptions will be assessed in a post-data collection analysis. The last assumption is valid because the gridded sample locations were selected based on a random start.

Figure A-2. Performance Goal Diagram.



A.6 Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying s, LBGR, β and α and examining the resulting changes in the number of samples. The following table shows the results of this analysis.

		Number of Samples					
AL=0.75		α=5		α=10		α=15	
		s=0.34	s=0.17	s=0.34	s=0.17	s=0.34	s=0.17
LBGR=90	β=15	284	75	213	57	170	45
	β=20	244	65	178	47	140	38
	β=25	213	57	152	40	117	32
LBGR=80	β=15	75	23	57	17	45	15
	β=20	65	20	47	15	38	12
	β=25	57	17	40	12	32	10
LBGR=70	β=15	36	14	28	11	22	9
	β=20	32	12	23	9	18	8
	β=25	28	11	20	8	16	6

s = standard deviation
LBGR = lower bound of gray region (% of action level)
β = beta (%), probability of mistakenly concluding that $\mu >$ action level
α = alpha (%), probability of mistakenly concluding that $\mu <$ action level
AL = action level (threshold)

A.7 Recommended Data Analysis Activities

Post-data collection activities generally follow those outlined in EPA's *Guidance for Data Quality Assessment* (EPA 2000a). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the site median (mean) value with a threshold value, the data will be assessed in this context. Assuming the data are adequate, at least one statistical test will be done to perform a comparison between the data and the threshold of interest. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.

A.8 References

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.

Ecology, 1995, *Guidance on Sampling and Data Analysis Methods*, Publication No. 94-49, Washington State Department of Ecology, Olympia, Washington.

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

EPA, 2000b, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, EPA/600/R-96/055, U.S. Environmental Protection Agency, Washington, D.C.

EPA, DOD, DOE, and NRC, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EWH-0624, Rev. 1, U.S. Environmental Protection Agency, U.S. Department of Defense, U.S. Department of Energy, and U.S. Nuclear Regulatory Commission, Washington, D.C.

Gilbert R. O., J. R. Davidson, J. E. Wilson, and B. A. Pulsipher, 2001, *Visual Sample Plan (VSP) Models and Code Verification*, PNNL-13450, Pacific Northwest National Laboratory, Richland, Washington.

APPENDIX B

CROSSWALK TABLE
(6 Pages)

CROSSWALK BETWEEN DOE/RL-94-08 (Rev. 0) and DOE/RL-96-22 (Rev. 4) REQUIREMENTS

REQUIREMENT	DOE/RL-94-08	DOE/RL-96-22	APPLICABLE APPROACH
Quality Assurance Project Plan	Appendix B. Based on QAMS 005/80 – *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1980).	Part II. Based on EPA QA/R-5 (EPA/240/B-01/003)– *EPA Requirements for Quality Assurance Project Plans* (EPA 2001)	Use Part II of DOE/RL-96-22. QAMS 005/80 is a predecessor to EPA QA/R-5 which meets current QA/QC standards.
Quality Assurance Program	Appendix B, section 1.3. Uses U.S. Army Corp of Engineers Quality Assurance Program Plan (CEQAPP).	Part II. Uses BHI-QA-01 and BHI-QA-03 procedures.	Work is being performed by ERC, therefore use BHI QA Program.
Data Quality Objectives	Appendix B, section 3.0. Based on EPA/540/G-87/003 – *Data Quality Objectives for Remedial Response Activities* (EPA 1987).	Figure I-1 (Several BHI DQO documents). Based on EPA QA/G-4 (EPA/600/R-96/055)- *Guidance for the Data Quality Objectives Process* (EPA 1994) with updates for EPA 2001 process.	Use DOE/RL-96-22 DQOs which will meet DOE/RL-94-08 DQOs and were developed using the newer EPA DQO process.
COCs	Appendix A, table 3-1. VOCs, SVOCs, metals, pesticides/PCBs	Section II.3.1.1. Allows use of site specific sampling design appropriate for each site for regulatory agency approval with selection of COCs.	Use DOE/RL-96-22 and prepare site specific work instruction with DDT, DDE and DDD as COCs.
Analytical Method	Appendix A, section 3.1.5.3; Appendix B, table 3-1 and section 6.0. Uses SW-846 Method 8080. Detection limits: DDD - 7.4 ug/kg, DDE – 2.7 ug/kg, DDT – 8.0 ug/kg	Table II-1. Uses SW-846, Method 8081. Detection limits: DDD – 3.3 ug/kg, DDE – 3.3 ug/kg, DDT – 3.3 ug/kg.	The MTCA ecological indicator soil concentration for protection of terrestrial plants and animals is 0.75 mg/kg for DDT/DDD/DDE (total) – WAC 173-340-900, Table 749-3. Use Method 8081 as detection limits are well below cleanup level.
Confirmatory Sampling	Appendix A, section 3.2.5. Judgmental sample design. Confirmation samples collected from each side and the bottom of the excavation with a minimum of one sample collected from each wall and the bottom of the excavation.	Section II.3.1.1and III.2. Allows use of site specific sampling design appropriate for each site for regulatory agency approval. Statistical sampling is recommended because there is no logic for locating judgmental samples. Additionally, MTCA prefers area-wide sampling (statistical) with calculation of 95% UCL and use of three-part test.	Use DOE/RL-96-22 and develop statistical sample design for cleanup verification. Will allow for use of MTCA three part test and calculation of 95% UCL to demonstrate cleanup objectives are met.
Data Use (Compliance Demonstration)	Not described in document. It is assumed judgmental samples are directly compared to cleanup level with maximum value used.	I.1.9.2 references use of the RDR/RAWP (DOE/RL-96-17, Rev. 5) which directs use of the MTCA three part test including calculation of 95% UCLs.	Use DOE/RL-96-22 and calculate 95% UCL of statistically collected samples with use of the MTCA three part test for compliance.

REQUIREMENT	DOE/RL-94-08	DOE/RL-96-22	APPLICABLE APPROACH
Backfill Material	Appendix A, section 3.2.5. Clean fill is analyzed for VOCs, SVOCs, pesticides/PCBs, and metals.	I.5.4. No sampling required. Knowledge of the prospective borrow areas is used.	Use DOE/RL-94-08. Collect one composite soil samples of clean fill material and analyze for VOCs, SVOCs, pesticides, PCBs, and metals.
Sample Identification	Appendix A, section 4.3 and 4.6. Two numbers used per sample (unique project code and HEIS #). Names individuals/companies to contact for HEIS numbers that are no longer applicable.	III.5.2. Sample numbers obtained from HEIS during "Sample Event Coordination" (BHI procedures).	Use DOE/RL-96-22. Only need to use HEIS for sample identification. Out of date contacts in DOE/RL-94-08.
QA/QC Samples	Appendix A, section 4.5 and 5.3.5. Calls for trip blanks, equipment blanks, blind duplicate and replicates, field duplicates, and matrix spike/matrix spike duplicates.	Table II-5. Only need to collect equipment blanks and field duplicates.	Use DOE/RL-96-22. Professional experience since 1994 indicates that only equipment blanks and field duplicates are needed.
Sampling Equipment	Appendix A, section 5.3.3. Uses stainless steel hand trowel or hand auger. If excavation 4 ft or less in depth, sampler enters excavation for sample collection. If deeper than 4 ft, soil samples may be collected from excavator bucket.	III.3. Uses BHI procedures. Soil samples may be collected using stainless steel or pre-cleaned disposable plastic.	Use DOE/RL-96-22. Pre-cleaned plastic disposable scoops will be used to collect soil samples. Professional experience with sampling has shown this equipment to be suitable for use and eliminates decontamination cost associated with use of stainless steel equipment.
Soil Sampling Procedures	Appendix A, section 5.3.3.1 and Appendix B, section 4. Uses Army Corp sampling procedures specified in CEPNW-EN PL, *Engineering Division Policy Letters* (CEPNW 1988).	III.3. Uses BHI procedure 4.1, "Soil and Sediment Sampling" specified in BHI-EE-01, *Environmental Investigation Procedures*.	Use DOE/RL-96-22 and applicable BHI procedures. These procedures are current with EPA sampling requirements. The 1988 Army Corp procedures may be out of date, conflict with current EPA practices, and difficult to implement by BHI from a practicality standpoint.
Chain of Custody	Appendix A, section 6.2.2 and figure 6-1, Appendix B, section 5.0 and table 4-1. Footnote d of table 4-1 specifies use of Army Corp procedures specified in CEPNW 1988.	III.5.1. Uses BHI procedure 3.0 specified in BHI-EE-01, *Environmental Investigation Procedures*.	Use DOE/RL-96-22 and BHI procedure 3.0 for Chain of Custody. The 1988 Army Corp procedure and COC form may be out of date, conflict with current EPA practices, and not practical to implement by BHI samplers.

REQUIREMENT	DOE/RL-94-08	DOE/RL-96-22	APPLICABLE APPROACH
Sampling Equipment Decontamination	Appendix A, section 5.3.3.2. Uses decontamination procedure specified in the Army Corp sampling procedure (CEPNW 1988).	III.3. Uses BHI procedures specified in BHI-EE-01, *Environmental Investigation Procedures*.	Use DOE/RL-96-22. Pre-cleaned plastic disposable scoops will be used to collect soil samples. Professional experience with sampling has shown this equipment to be suitable for use and eliminates decontamination and cost associated with use of stainless steel equipment.
Excavator Decontamination	Appendix A, section 5.3.1.2. States "Any large soil deposits will be scraped off with a shovel. The excavator will then be decontaminated with a high pressure steam cleaner. Only the portions of the excavator contacting the soil will require decontamination. All decontamination procedures will be conducted over a temporary decontamination pad which will be shaped to contain all fluids generated during the process.	Section 3.1.5 of DOE/RL-96-17, Rev. 5. Uses Best Management Practices that are extensively detailed.	Use DOE/RL-96-17, Rev. 5. Provides use of EPA and Ecology approved best management practices for decontamination that are more detailed than DOE/RL-94-08 and based on professional experience and lessons learned from previous Hanford equipment decontamination activities.
Sample Labeling	Appendix A, section 5.3.4. Description of labeling requirements.	III.3. Uses BHI procedures specified in BHI-EE-01, *Environmental Investigation Procedures*.	Use DOE/RL-96-22 and BHI procedures. Equivalent to description of labeling requirements in DOE/RL-94-08.
Sample Containers, Preservatives and Holding Times	Appendix A, section 6.1, Table 6-1 and containers specified by CENPW contracted laboratories.	III.5.2 and BHI-EE-01, *Environmental Investigation Procedures*, Procedure 2.0, "Sample Event Coordination". Uses containers specified by BHI contracted laboratories.	Use DOE/RL-96-22. BHI contracted laboratories are available and have been extensively audited. Army Corp contracted laboratories will not be used.
Sample Handling	Appendix A, section 6.2.1.	III.3. Uses Procedure 3.1, "Sample Packaging and Shipping, specified in BHI-EE-01, *Environmental Investigation Procedures*.	Use DOE/RL-96-22 and BHI procedure. Equivalent to description of sample handling in DOE/RL-94-08.
Sample Shipping	Appendix A, section 6.2.3. Personnel and company referenced is out of date.	III.5.3. Uses Procedure 3.1, "Sample Packaging and Shipping, specified in BHI-EE-01, *Environmental Investigation Procedures*.	Use DOE/RL-96-22 and BHI procedure. Is more robust than description provided in DOE/RL-94-08 and will ensure sample shipments are performed in accordance with DOT and IATA requirements.

REQUIREMENT	DOE/RL-94-08	DOE/RL-96-22	APPLICABLE APPROACH
Field Logbook	Appendix A, section 6.3.1. Appendix A, section 6.3.2 describes use of an additional three-ring bound field notebook to be maintained during remedial action. This notebook is used to store copies of Chain of Custody Forms and sampling forms. It also requires the use of sampling forms.	III.5.4. Uses Procedure 1.5, "Field Logbooks".	Use DOE/RL-96-22 and BHI procedure. Very detailed procedure on use of field logbooks to ensure documentation meets EPA, DOE and BHI requirements. More robust than description in DOE/Rl-94-08. Additionally, sampling forms will not be used by BHI, rather all field sampling information will be recorded in a bound field logbook.
Remediation Documentation	Appendix A, section 6.3.3 and Figure 6-3 (Site Remediation Form). This form requires completion to document sampling information and volume of contaminated soil.	III.5.4. Uses Procedure 1.5, "Field Logbooks" and DOE/RL-96-17, Rev. 5 (section 3.4 and 3.7) requirements for documentation of remedial action.	Use DOE/RL-96-17 and DOE/RL-96-17 as these are current with EPA, DOE, and BHI requirements for remedial action documentation.
Project Organization & Responsibilities	Appendix B, section 2.0 and Figure 7 of the Work Plan.	II.2 and BHI-MA-01, *ERC Policies, Organization, and Responsibilities*	Use DOE/RL-96-22 and BHI procedures to be consistent with BHI performing the remedial action and managing the remedial action subcontractor.
Quality Assurance Objectives for Measurements	Appendix B, section 3.0 and table 3-1. Based on EPA 1987 DQO process.	II.2.4 and table II-1. Based on 1994 DQO process with updates for 2000 DQO process.	Use DOE/RL-96-22. Consistent with current EPA, DOE and BHI requirements and specifies EPA SW-846 Method 8081 for pesticide analysis with associated requirements for BHI contracted laboratories. Army Corp contracted laboratories will not be used.
Change Control	Appendix B, section 4.3, figure 4-1, and figure 4-2. Describes process and forms for making field changes. Also states that if the remedial action contractor wishes to propose the use of other procedures than those defined in Table 4-1 (includes soil sampling, H&S monitoring, and hazardous waste site entry), they need to be submitted with appropriate justification for CENPW approval prior to submittal to DOE-RL, EPA, and Ecology for concurrence.	DOE/RL-96-17, Rev. 5, section 3.5 and BHI procedures describes change management.	Use DOE/RL-96-17 and BHI procedures that describe how BHI implements change control. DOE/RL-96-17 has been approved by DOE-RL, EPA, and Ecology and does not require Army Corp approval.

REQUIREMENT	DOE/RL-94-08	DOE/RL-96-22	APPLICABLE APPROACH
Calibration Procedures	Appendix B, section 6.0. Uses CENPW approved procedures.	II.3.7 and BHI procedures.	Use DOE/RL-96-22 and BHI procedures. Current with DOE/RL, EPA and Ecology requirements.
Data Reduction, Validation, and Reporting	Appendix B, section 8.0 and figure 8-1. References outdated Westinghouse validation procedures. 10% of all data packages receive full validation. Figure 8-1 shows data management flow used by Army Corp.	II.5.1 and figure II-8. Uses current validation procedures. 5% of all data packages receive validation. Figure II-8 shows data management process flow used by BHI.	Use DOE/RL-96-22 and BHI procedures that are current with DOE/RL, EPA and Ecology requirements and are routinely implemented by ERC. Since verification samples are collected within a short time frame, it is likely that the entire data set will be in one data package and therefore will be entirely validated; if not, 5% of the data packages will be validated.
Assessments and Audits	Appendix B, section 10.0. Performed by Army Corp in accordance with their procedures. At least one performance audit sample per analytical method is submitted to the offsite laboratory at direction of Army Corp Laboratory Technical Manager. At least one system audit of each phase of the field activities is required to be conducted in accordance with Army Corp procedures.	II.4. BHI QA staff performs random surveillances and audits to verify compliance with requirements. The laboratories are routinely audited by BHI, DOE and other Hanford Site contractor QA staff as part of integrated audits. The laboratories participate in performance evaluation sample rounds as specified in laboratory contracts.	Use DOE/RL-96-22 and BHI assessment and audit process.
Preventative Maintenance	Appendix B, section 11.0. Uses Army Corp procedures and Army Corp contracted laboratory procedures.	II.3.6. Uses manufacturer instrument manuals, BHI procedures and contracted laboratory's procedures.	Use DOE/RL-96-22. It is current with EPA, DOE, and Ecology requirements and is applicable to ERC and contracted laboratory's processes and requirements.
Data Assessment Procedures	Appendix B, section 12.	II.5.2.	Use DOE/RL-96-22. It is current with EPA, DOE, and Ecology requirements and is applicable to ERC processes and requirements.
Corrective Action	Appendix B, section 13. Uses Army Corp procedures and processes.	BHI procedures identified in BHI-QA-01 and BHI-QA-03.	Use DOE/RL-96-22 and BHI QA procedures which are applicable to ERC performing remedial action activities.
Quality Assurance Reports	Appendix B, section 14.	II.4.2	Use DOE/RL-96-22 and BHI QA procedures which are applicable to ERC performing remedial action activities.

REFERENCES

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

DOE-RL, 1994, *Remediation Design and Remedial Action Work Plan for the 1100 Area Hanford Site*, DOE/RL-94-08, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-22, Rev. 5, 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, 1987, *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1994, *Guidance for Data Quality Objectives Process*, EPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, U.S. Environmental Protection Agency, Washington, D.C.

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

Work Instruction Distribution Sheet

600-270 Horseshoe Landfill

Work Instruction Number 0600X-WI-G0012

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Isom, Debra A (Debbi)

From: Zeisloft, Jamie
Sent: Thursday, August 04, 2005 5:49 PM
To: Morrison, Ronald D (Ron); Isom, Debra A (Debbi)
Cc: Wilcox, Debra; Donnelly, Jack W; Bazzell, Kevin D
Subject: RE: Placing the 1100 Area ROD Change Documents in the AR.

Debbi,

After much debate, RL has decided that it would be in our best interest to place the EPA "Memo-to-File Documenting Non-Significant Changes to the 1100 Area ROD" in the admin record. Jack Donnelly (BHI) has a copy of the memo and will get it to you. Thanks for your patience and support.

Jamie

From: Morrison, Ronald D (Ron)
Sent: Thursday, July 21, 2005 11:40 AM
To: Zeisloft, Jamie
Subject: Placing the 1100 Area ROD Change Documents in the AR.

Hi Jamie,

Hope all is well. Regarding the Non Significant Changes to the 1100-EM-1 ROD, you were going to send Debbi Isom (keeper of the AR) a one liner on the decision to place the documents in the AR (and not the Post Decisional File). Know you are swamped but, could you send her something for her files.

Thanks, Ron