| Date Submitted: 05/21/08<br>Originator: J. M. Capron<br>Phone: 372-9227 | **WASTE SITE RECLASSIFICATION FORM**<br>Operable Unit(s): 100-FR-1<br>Waste Site Code: 100-F-52<br>Type of Reclassification Action:<br>Closed Out ☐ Interim Closed Out ☐ No Action ☒<br>RCRA Postclosure ☐ Rejected ☐ Consolidated ☐ | Control Number: 2008-022 |
|---|---|---|

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 100-F-52 waste site consisted of the soil under and around the former 146-FR Radioecology and Aquatic Biology Laboratory. The laboratory was used for studies of the effects of pre-reactor and post-reactor process water on fish eggs, young fish, and other small river creatures of interest. Confirmatory sampling of this site has been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100 DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington (Remaining Sites ROD)*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved: (1) evaluating the site using available process information, (2) demonstrating through confirmatory sampling that cleanup goals have been achieved, and (3) proposing the site for reclassification to No Action.

Basis for reclassification:

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD. The results of confirmatory sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil* (attached).

Waste Site Controls:
Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M requirements: Yes ☐ No ☒
If any of the Waste Site Controls are checked Yes specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.

| | | |
|---|---|---|
| R. F. Guercia<br>DOE Federal Project Director (printed) | Signature | 6/5/08<br>Date |
| N/A<br>Ecology Project Manager (printed) | Signature | Date |
| R. A. Lobos<br>EPA Project Manager (printed) | Signature | 6/27/08<br>Date |

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-52, 146-FR RADIOECOLOGY AND AQUATIC BIOLOGY LABORATORY SOIL

**Attachment to Waste Site Reclassification Form 2008-022**

**April 2008**

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-52, 146-FR RADIOECOLOGY AND AQUATIC BIOLOGY LABORATORY SOIL

## EXECUTIVE SUMMARY

The 100-F-52 waste site consists of the soil under and around the former 146-FR Radioecology and Aquatic Biology Laboratory. Completed in 1952, the 146-FR Radioecology and Aquatic Biology Laboratory was a single story, concrete-block building with a concrete foundation used for studies of the effects of pre-reactor and post-reactor process water on fish eggs, young fish, and other small river creatures of interest. It contained offices, laboratories, hatcheries, rearing troughs, and 12 large, rectangular operating ponds. A drainage trench and walkway was located in the operating pond area of the facility. Currently the site is level to grade with no visual indication of the former facility.

Several different remediation efforts have partially overlapped the 100-F-52 waste site. A small area along the northern edge of the 146-FR Laboratory footprint was removed along with pipelines associated with the 100-F-33 and 100-F-19 waste sites (WCH 2006). Soils that were adjacent to the eastern edge of the 146-FR Laboratory footprint were excavated when pipelines associated with the 1607-F6 waste site were removed (BHI 2001a). When pipelines associated with the 100-F-19 waste site were removed, the entire southern edge of the 146-FR Laboratory footprint was removed (BHI 2001b). Excavation associated with the 100-F-26:12 Main Process Sewer Pipeline removed soils underlying the entire southern edge of the 146-FR Laboratory footprint.

Confirmatory sampling at the 100-F-52 waste site was performed on November 28, 2007 and February 20, 2008 in accordance with *Work Instruction for Confirmatory Sampling of the 100-F-52 (146-FR) Radioecology and Aquatic Biology Laboratory Soil* (WCH 2007c). A 5 cm (2-in.) diameter carbon steel pipe was discovered in each of two trenches; however, neither pipe was breached at that time. Both trenches were sampled and backfilled. On February 20, 2008, the trenches were re-excavated and the pipes breached. Only the pipe in trench 2 contained scale or sediment; this material was sampled (WCH 2007a, 2008). A summary of the analytical results compared against the remedial action goals is presented in Table ES-1.

The results of the confirmatory sampling are used to make reclassification decisions for the 100-F-52 waste site in accordance with the TPA-MP-14 (DOE-RL 2007) procedure. In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD)(EPA 1999). The results of confirmatory sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are

protective of groundwater and the Columbia River. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Though not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. Screening levels were not exceeded, with the exception of boron, cadmium, chromium (total), copper, manganese, molybdenum, nickel, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). The remaining constituents that exceeded screening levels will be evaluated in the context of additional lines of evidence as part of the baseline risk assessment for the river corridor portion of the Hanford Site.

**Table ES-1. Summary of Remedial Action Goals for the 100-F-52 Waste Site. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Direct Exposure Radionuclides | Attain 15 mrem/yr dose rate above background over 1,000 years. | Scale from inside a 0.051 m (2-in.) diameter pipe had a maximum U-233/234 analysis of 1.34 pCi/g, which is within the range of Hanford Site background (maximum background analysis is 1.51 pCi/g).[d] Therefore, this material is not regarded as a threat to human health or the environment. | Yes |
| Direct Exposure Nonradionuclides | Attain individual COC/COPC RAGs. | All individual COC/COPC concentrations are below the direct exposure criteria. | Yes |
| Risk Requirements Nonradionuclides | Attain a hazard quotient of <1 for all individual noncarcinogens. | All individual hazard quotients are < 1. | Yes |
| | Attain a cumulative hazard quotient of <1 for noncarcinogens. | The cumulative hazard quotient ($3.3 \times 10^{-1}$) is < 1. | |
| | Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens. | The excess cancer risk values for individual carcinogens are $< 1 \times 10^{-6}$. | |
| | Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens. | The total excess cancer risk value ($1.0 \times 10^{-6}$) is $< 1 \times 10^{-5}$. | |
| Groundwater/ River Protection – Radionuclides | Attain single COC/COPC groundwater and river protection RAGs. | Scale from inside a 0.051 m (2-in.) diameter pipe had a maximum U-233/234 analysis of 1.34 pCi/g, which is within the range of Hanford Site background (maximum background analysis is 1.51 pCi/g).[d] Therefore, this material is not regarded as a threat to human health or the environment. | Yes |

## Table ES-1. Summary of Remedial Action Goals for the 100-F-52 Waste Site. (2 Pages)

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Groundwater/ River Protection – Radionuclides | Attain national primary drinking water regulations:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. | There are no COCs/COPCs that contribute to the 4 mrem/yr drinking water dose limitation. | |
| | Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide from DOE Order 5400.5.[b] | There are no non-uranium alpha-emitting radionuclide COCs/COPCs. | |
| | Meet total uranium standard of 21.2 pCi/L.[c] | Scale from inside a 0.051 m (2-in.) diameter pipe had a maximum U-233/234 analysis of 1.34 pCi/g, which is within the range of Hanford Site background (maximum background analysis is 1.51 pCi/g).[d] Therefore, this material is not regarded as a threat to human health or the environment. | |
| Groundwater/ River Protection – Nonradionuclides | Attain individual nonradionuclide groundwater and river cleanup requirements. | All the groundwater and river RAOs have been attained. | Yes |

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).
[c] Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001a).
[d] *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE-RL 1996).

COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RAO = remedial action objective

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-52, 146-FR RADIOECOLOGY AND AQUATIC BIOLOGY LABORATORY SOIL

## STATEMENT OF PROTECTIVENESS

The 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory waste site confirmatory sample results demonstrate that the site achieves the remedial action objectives and remedial action goals (RAGs) established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Though not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern (COPCs) and other constituents. Screening levels were not exceeded with the exception of boron, cadmium, chromium (total), copper, manganese, molybdenum, nickel, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). The remaining constituents that exceeded screening levels will be evaluated in the context of additional lines of evidence as part of the baseline risk assessment for the river corridor portion of the Hanford Site.

## GENERAL SITE INFORMATION AND BACKGROUND

The 100-F-52 site (Figure 1) consists of the soil under and around the former 146-FR Radioecology and Aquatic Biology Laboratory. The 146-FR Radioecology and Aquatic Biology Laboratory was a single story, concrete-block building that was 25 m (82 ft) wide by 35 m (115 ft) long, with a concrete foundation (Figures 2 and 3). It contained offices, laboratories, hatcheries, rearing troughs, and 12 large, rectangular operating ponds. A drainage trench and walkway were located in the operating pond area of the facility. Currently the site is level to grade with no visual indication of the former facility. Appendix A contains additional historical photographs.

The 146-FR Radioecology and Aquatic Biology Laboratory was located approximately 457 m (1,500 ft) northeast of the 105-F Reactor Building and about 12 m (400 ft) southwest of the

**Figure 1. 100-F-52 Site Location Map.**

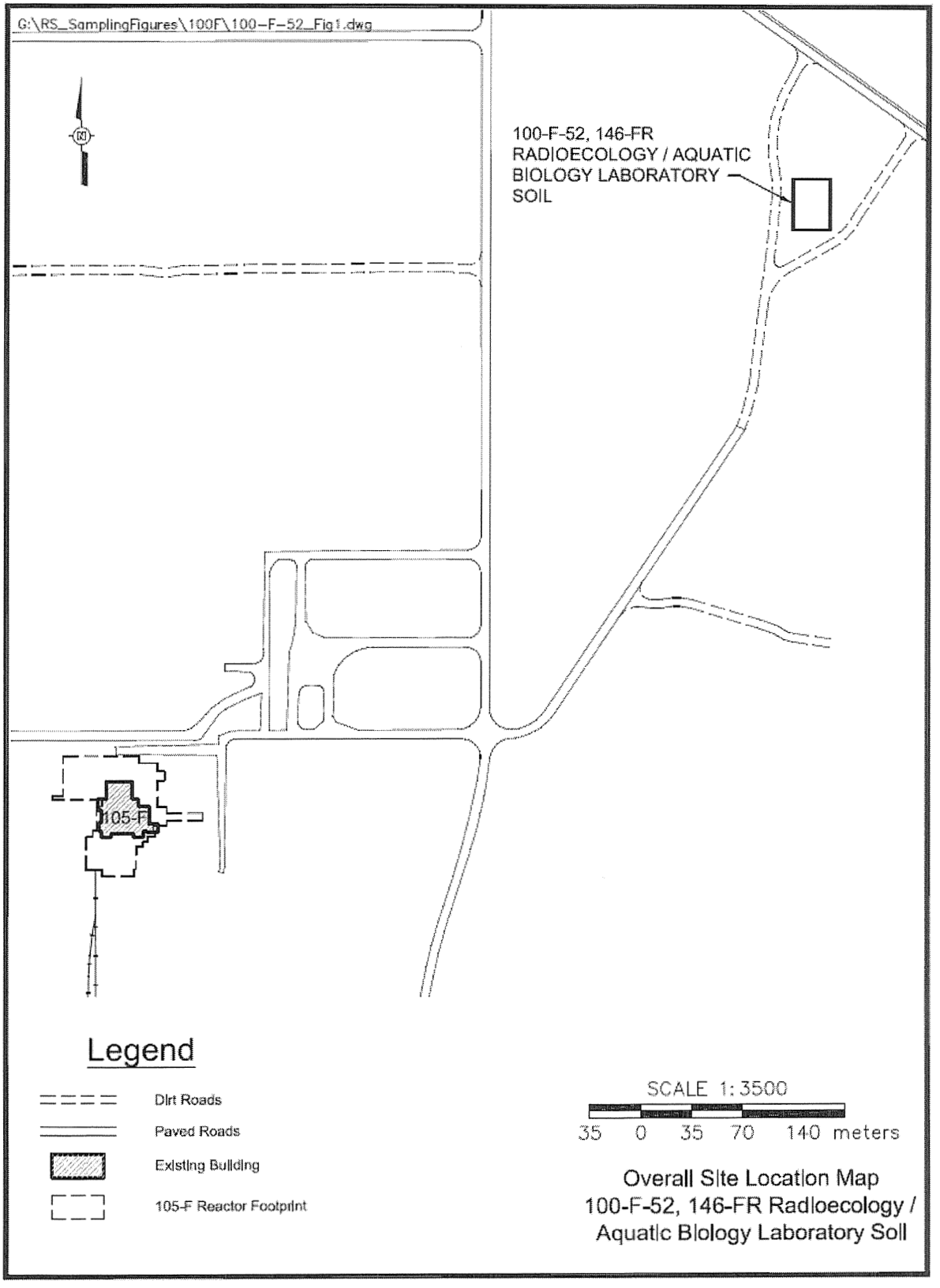


**Figure 2. Construction of the 146-FR Radioecology and Aquatic Biology Laboratory.**

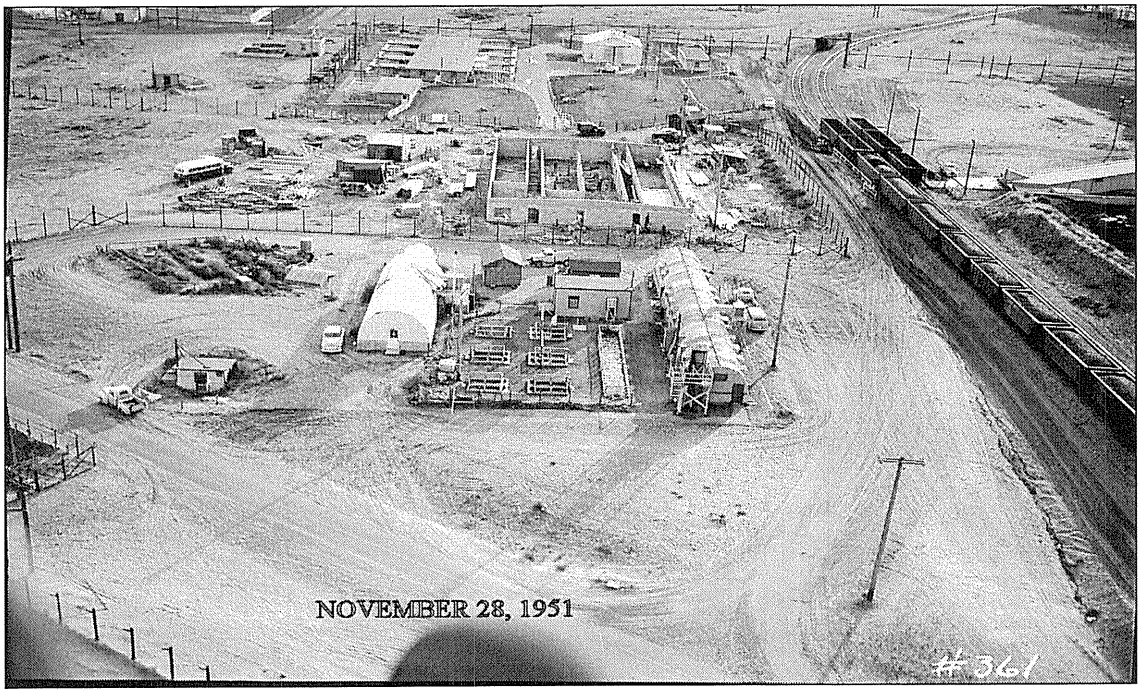
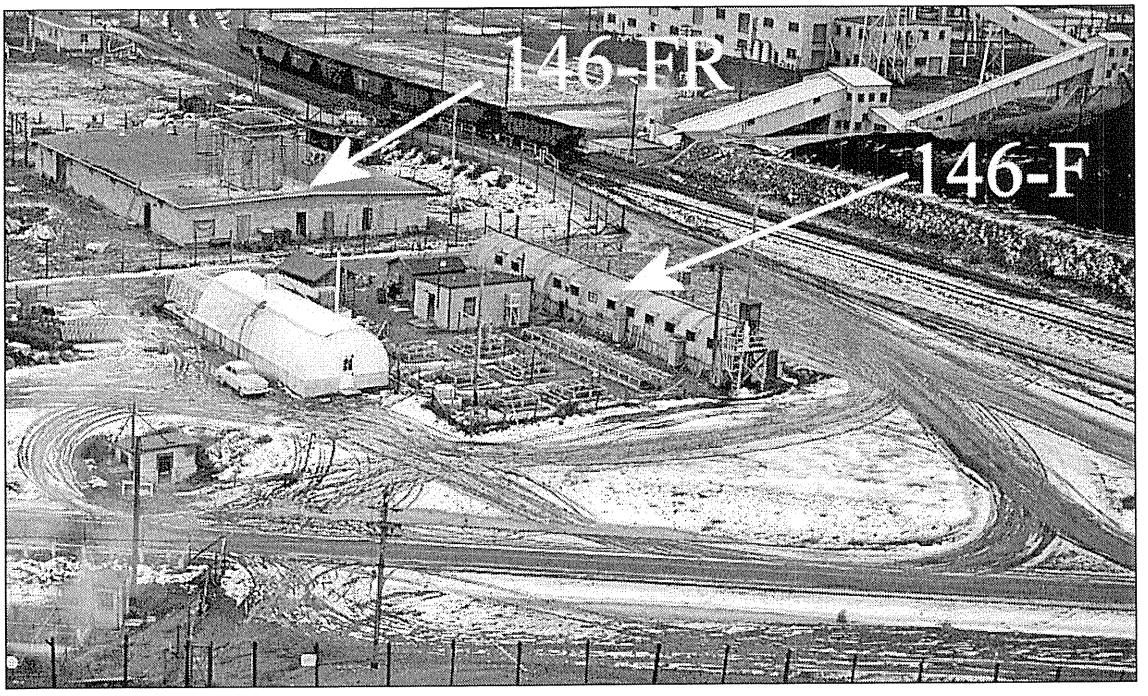



**Figure 3. Photograph Showing the 146-FR Radioecology and Aquatic Biology Laboratory.**



1904-F Outfall. The corners of the building were at Washington State plane coordinates N 148033, E 580897; N 148033, E 580922; N 147998, E 580922; and N 147998, E 580987.

The 146-FR Radioecology and Aquatic Biology Laboratory functionally replaced the 146-F Fish Laboratory and associated outdoor ponds. Process liquids were supplied to the 146-FR Radioecology and Aquatic Biology Laboratory from several sources. Raw water was pumped from the 181-F River Pump House; chemically treated, pre-reactor process water was pumped from the 190-F Main Process Pump House and Annex; and reactor effluent process water was pumped from the 107-F Retention Basin into this building.

Aquatic species were exposed to varying amounts of radiological and nonradiological contamination from process wastes derived from operations in the 100-F Area. Spilled liquids around the operating ponds and possibly other laboratory liquid wastes were collected in a trench in the floor that sloped to the south end of the facility. These liquids were sent via a pipeline to the 1904-F outfall where they were discharged into the Columbia River.

In November 1964, a fire destroyed the roof over the operating ponds. The building was repaired, although the roof over the operating pond section of the building was not replaced. By June 1975, the building and concrete foundation of the 146-FR Radioecology and Aquatic Biology Laboratory had been removed (WCH 2007c).

In recent years, several different remediation efforts have partially overlapped the 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory waste site (Figure 4). When pipelines associated with the 100-F-33 and the 100-F-19 waste sites were removed, a small area along the northern edge of the 146-FR Laboratory footprint was also removed (WCH 2006). When pipelines associated with the 1607-F6 waste site were removed, the excavation removed soils adjacent to the eastern edge of the 146-FR Laboratory footprint (BHI 2001a). When pipelines associated with the 100-F-19 waste site were removed, the entire southern edge of the 146-FR Laboratory footprint was removed (BHI 2001b). Excavation associated with the 100-F-26:12 Main Process Sewer Pipeline has removed soils underlying the entire southern edge of the 146-FR Laboratory footprint.

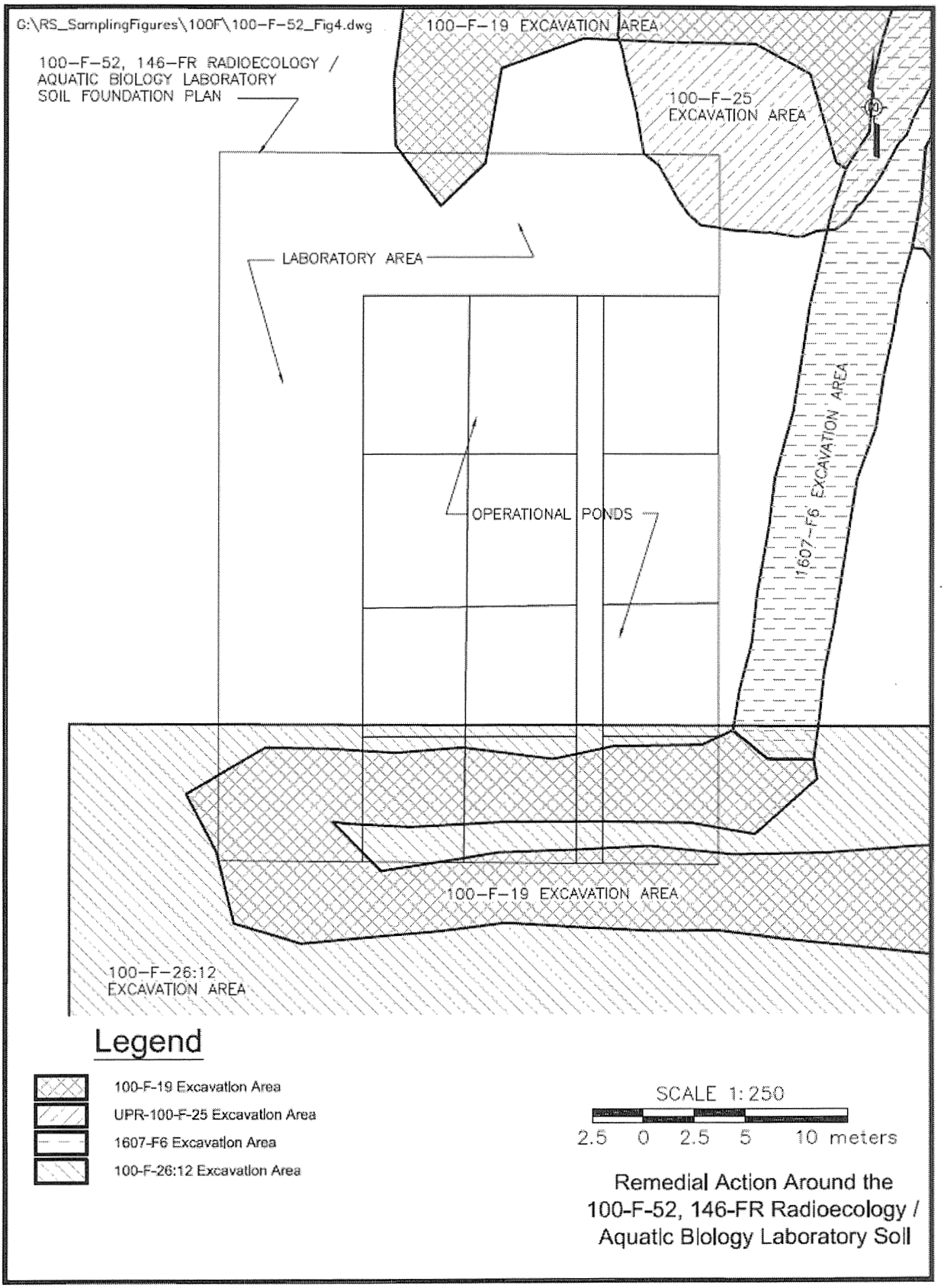
The 146-F and 146-FR Laboratories shared two drywells that were just off of the northeast corner of the 146-FR Laboratory. Coincident with the drywells was a mercury spill, designated UPR-100-F-3. The drywells and the mercury spill were remediated under the waste site code 100-F-25. The 100-F-25 remediation (BHI 2003) resulted in the excavation and removal of soils underlying the northeast corner of the 146-FR Laboratory footprint.

## CONFIRMATORY SAMPLING ACTIVITIES

### Nonintrusive Investigation Results

The project team conducted a site visit in 2005. The objective of the site visit was to evaluate the current field conditions. It was observed that the area was leveled to grade and there was no visible indication of the former facility or concrete footprint.

**Figure 4. Remedial Action Around the 100-F-52 Waste Site.**



On a second site visit in March 2007, no indication of the former facility or concrete footprint was found. The site was partially covered with excavation stockpiles derived from the 100-F-26:12 Main Process Sewer Pipeline excavation. That excavation has removed all of the shallow zone soils from the southern 5 m (16 ft) of the 146-FR Laboratory footprint.

Geophysical surveys over several sections of the 146-FR Radioecology and Aquatic Biology Laboratory footprint were performed as part of the investigations of adjacent waste sites. In order to get a complete survey for the site, an additional survey was conducted in February 2007. These surveys were merged and an overall geophysical interpretation map of the 100-F-52 waste site (Figure 5) was developed.

The resulting geophysical survey shows an area of scattered debris and three pipeline segments. Two of the pipeline segments are just outside of the 146-FR Laboratory footprint. Those two pipeline segments are part of the 100-F-41 pipeline site and were rejected as a waste site because they were used for treated water (WCH 2007b). A third section of pipe, within the footprint of the 146-FR Laboratory, is approximately 22 m (72 ft) long and 2 m (3.3 ft) below ground surface. This section of pipe may also belong with 100-F-41; however, its location was not well documented. Therefore, this pipe was included as part of the 100-F-52 waste site.

A circular subsurface feature, approximately 12 m (39 ft) north of the 146-FR Laboratory, can also be seen in the geophysical interpretation. The location of the circular subsurface feature clearly identifies it as the remnants of the circular pond that was closed as part of the 100-F-33 waste site (BHI 2004).

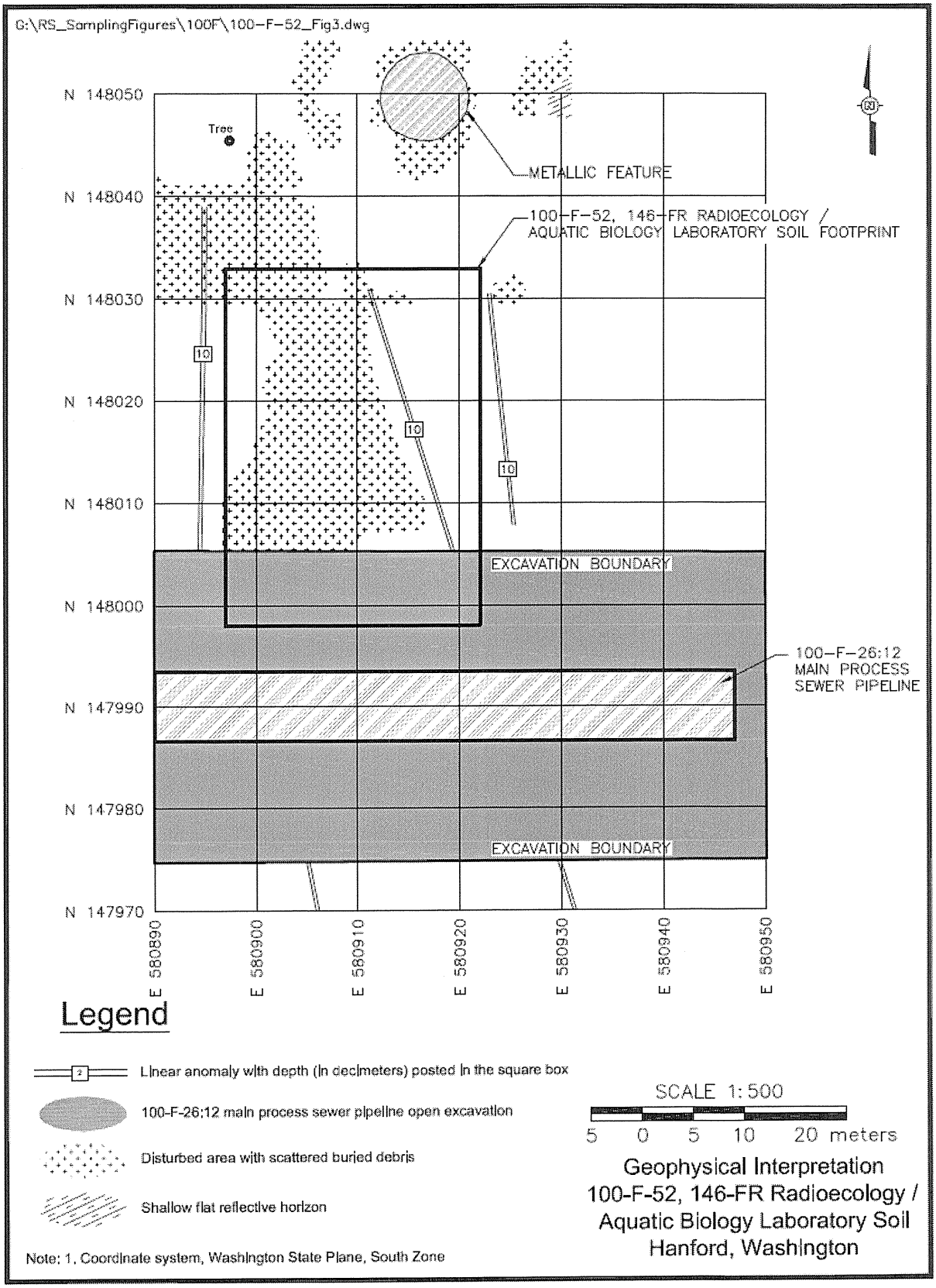
**Contaminants of Potential Concern**

Contaminants of potential concern (COPCs) for the 100-F-52 waste site were identified based on COPCs developed for the 100-F-33, 146-F Aquatic Biology Fish Ponds (BHI 2004) utilizing the protocol in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2005a) and historical information about activities at the 146-F Fish Laboratory and 146-F Aquatic Biology Fish Ponds (GE 1948, 1953). COPCs are cobalt-60, cesium-137, europium-152, europium-154, europium-155, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235, hexavalent chromium, mercury, lead, and polycyclic aromatic hydrocarbons (PAHs). Further site-specific evaluation identified arsenic, barium, cadmium, total chromium, selenium, silver, and polychlorinated biphenyls (PCBs) as COPCs. Carbon-14 and nickel-63 were also identified as COPCs due to the use of reactor process water at these facilities. Also, petroleum hydrocarbons were added due to the repeated mention of the use of water-soluble lubricating oil (Calol) in the reactor process water (GE 1946).

**Confirmatory Sampling**

Confirmatory sampling was performed at the 100-F-52 waste site (Figure 4) in accordance with *Work Instruction for Confirmatory Sampling of the 100-F-52 (146-FR) Radioecology and aquatic Biology Laboratory Soil* (WCH 2007c) on November 28, 2007 and February 20, 2008 (WCH 2007a, 2008). The 100-F-52 waste site confirmatory sampling data were evaluated to

**Figure 5. Geophysical Interpretation for the 100-F-52 Waste Site.**



objectives for the site. The following subsections provide additional discussion of the information used to develop the confirmatory sampling design. The results of confirmatory sampling have been summarized to support a No Action decision of the site.

## Field Screening

Field screening consisted of a Radiological Control Technician (RCT) and an Industrial Health Technician (IH) using hand-held instrumentation during trench excavation and pipe breaching activities. The RCT utilized instruments that were capable of detecting alpha, beta, and gamma radiation and the IH used an organic vapor monitor. No radioactivity was detected above background levels and no organic vapors were detected.

## Confirmatory Sampling Design

The sampling design for the 100-F-52 waste site was developed in accordance with the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2005a). The site consisted of pipeline segments that were under and adjacent to the laboratory footprint, approximately 1 m (3.3 ft) below ground surface. Two test trenches were excavated to a depth of 1 m (3.3 ft) to access soil that was in place during facility operation (WCH 2007a). A total of six samples were collected at this site (two from the bottom of Trench 2 [including the duplicate], two from the pipe located in Trench 2, one from the bottom of Trench 1, and one equipment blank). The samples were analyzed by gamma energy analysis and for plutonium-238, plutonium-239/240, uranium-234, uranium-235, uranium-238, strontium-90, nickel-63, carbon-14, metals by inductively coupled plasma, mercury, hexavalent chromium, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and petroleum hydrocarbons (TPH) per the confirmatory sampling work instruction (WCH 2007c).

Test trench 1 was approximately 1 m (3.3 ft) deep. It ran in a north-south direction beginning on the north end of the facility and extending 10 m (33 ft) through an area that was highly disturbed and contained debris. This area had not been previously excavated as part of a remediation effort around the former 146-FR laboratory; therefore, it was believed the subsurface disturbance was the result of either the original facility installation or the removal of the concrete footprint of the building. The debris was believed to be associated with the concrete footprint. One soil sample consisting of 25 aliquots spread across the bottom of the trench was collected for analysis. The 0.051 m (2-in.) diameter pipeline that had been encountered during excavation was breached; however, it was empty and no sample was collected (WCH 2007b, 2008).

Test trench 2 was approximately 1 m (3.3 ft) deep. It ran in a north-south direction and was located directly under the drainage trench/walkway and centered on a pipeline segment that was identified in the geophysical interpretation (Figure 6). The drainage trench/walkway serviced the operational ponds portion of the 146-FR facility, drained to the south end of the facility, and then into a process sewer. One soil sample consisting of 25 aliquots spread across the bottom of the trench was collected for analysis. The 0.051 m (2-in.) diameter pipeline that had been encountered during excavation was breached and a sample of the scale was collected (WCH 2007b, 2008). Table 1 summarizes sample location, media, and requested analyzes.

**Figure 6. 100-F-52 Test Trench Location Map.**

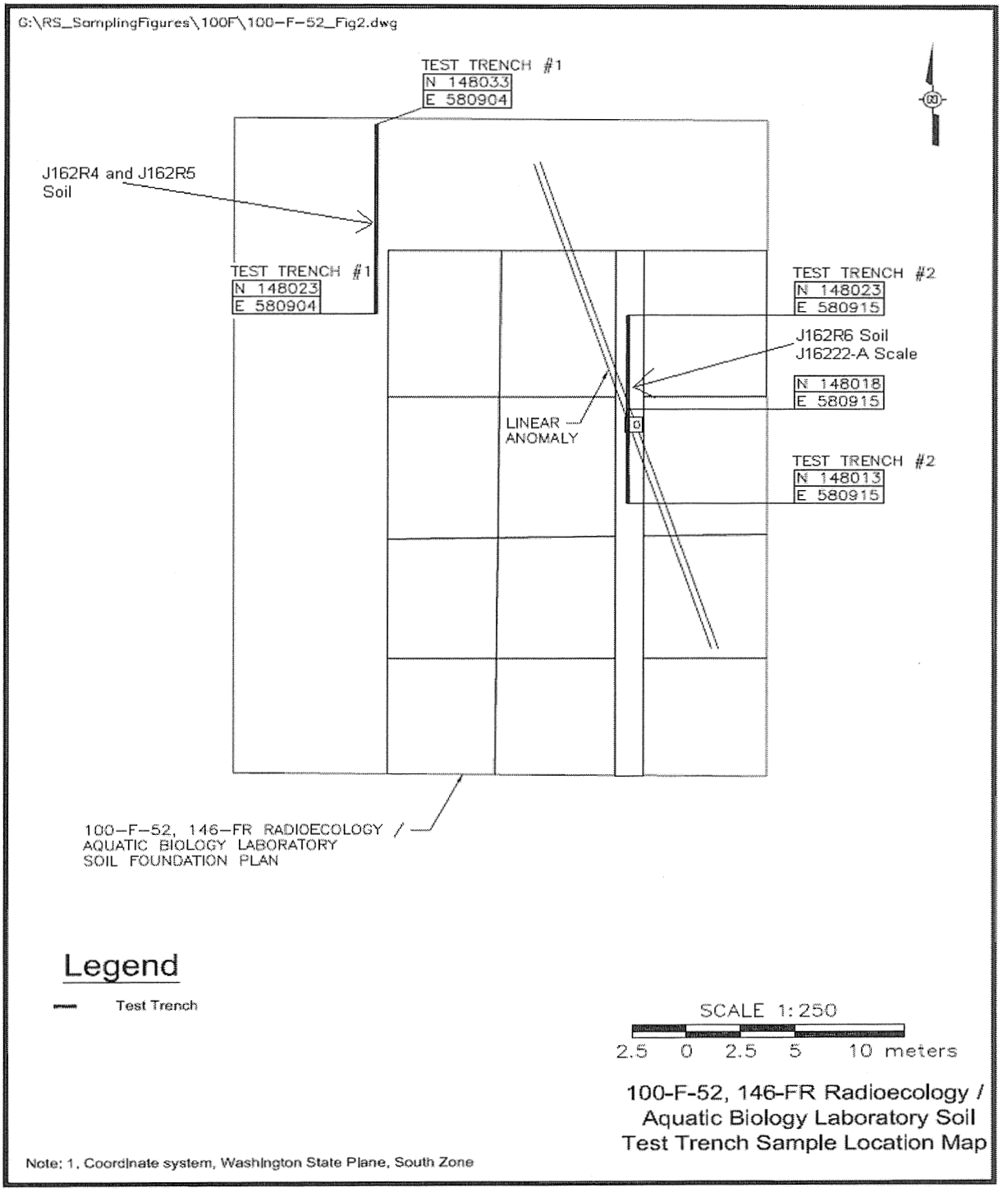


**Table 1. 100-F-52 Sample Summary Table***

| Sample Location | Sample Media | HEIS Number | Coordinate Locations | Depth | Sample Analysis |
|---|---|---|---|---|---|
| Test Trench 1 | Subsurface Soil | J162R4 | N 148033, E 580904 to N 148023, E 580904 | 1 m | ICP metals,[c] mercury, hexavalent chromium, GEA, gross alpha,[d] gross beta,[e] Ni-63, C-14, isotopic uranium, PCBs, TPH, SVOAs |
| | Duplicate of Subsurface Soil | J162R5 | | | |
| Test Trench 2 | Soil | J162R6 | N 148023, E 580915 to N 148013, E 580915 | 1.3 m | ICP metals,[c] mercury, hexavalent chromium, GEA, gross alpha,[d] gross beta,[e] Ni-63, C-14, isotopic uranium, PCBs, TPH, SVOAs |
| | Pipe Scale | J16222-A J16B16 | | | |
| Equipment Blank | Associated with J162R6 | J162P6 | NA | NA | ICP metals,[c] mercury, hexavalent chromium, GEA, gross alpha,[d] gross beta,[e] Ni-63, C-14, isotopic uranium, PCBs, TPH, SVOAs |

* See also field log book EL-1601, page 99 and EL-1601-2, pages 12 and 46-47.

Both pipe segments encountered in the test trenches were breached using the "hot tap" method. The hot tap method is used on unknown pipelines that have the potential to be pressurized. The hot tap method consists of drilling a hole into a pipeline and allowing it to vent. This method also confirms the presence or absence of liquids in the pipeline prior to cutting the pipe open. Figures 7 through 12 are photographs of the 100-F-52 waste site sampling event. Additional photographs, including historical and aerial photographs, are shown in Appendix A.

**Figure 7. Test Trench 1 at the 100-F-52 Waste Site. Unknown Pipe Discovered.**

**Figure 8. Test Trench 2 at the 100-F-52 Waste Site.**

**Figure 9. Collecting Sample Material from Trench Bottom at 100-F-52.**

**Figure 10. Hot Tap Set Up at 100-F-52 Test Trench 1.**

**Figure 11. Cutting Open Pipe with Band Saw at 100-F-52.**

**Figure 12. Rust and Scale Inside Pipe in Test Tench 2 at 100-F-52.**

## Confirmatory Sampling Results

Confirmatory samples were analyzed using U.S. Environmental Protection Agency-approved analytical methods. The laboratory-reported data results for all constituents are stored in the Environmental Remediation System (ENRE) project-specific database prior to submission for archival in the Hanford Environmental Information System (HEIS) site-wide database and are summarized in Appendix B.

Comparisons of the confirmatory results for analytes with the shallow zone RAGs are summarized in Table 2. Both test trenches and pipeline are evaluated using direct exposure and groundwater/river protection soil cleanup criteria. Contaminants that were not detected by laboratory analysis are excluded from this table. Calculated cleanup levels are not presented in the *Cleanup Levels and Risk Calculations Database* (Ecology 2005) under *Washington Administrative Code* (WAC) 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in samples collected at the site, but are not considered within statistical calculations or the following table, as these isotopes are not related to the operational history of the site and were detected below background levels (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

**Table 2. Comparison of Statistical Contaminant Concentrations to Action Levels for the 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil Sampling Event. (2 Pages)**

| COC/COPC | Maximum Result (pCi/g) | Generic Site Lookup Values[a] (pCi/g) | | | Does the Maximum Result Exceed RAGs? | Does the Result Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Shallow Zone Lookup Value | Groundwater Protection Lookup Value | River Protection Lookup Value | | |
| Uranium-233/234 | 1.34 | 1.1[b] | 1.1[b] | 1.1[b] | No[c] | -- |
| Uranium-238 | 1.02 (<BG) | 1.1[b] | 1.1[b] | 1.1[b] | No | -- |
| **COC/COPC** | **Maximum Result (mg/kg)** | **Remedial Action Goals[a] (mg/kg)** | | | **Does the Maximum Result Exceed RAGs?** | **Does the Result Pass RESRAD Modeling?** |
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| Antimony[d] | 3.3 (<BG) | 32 | 5[e] | 5[e] | No | -- |
| Arsenic | 15.7 | 20 | 20 | 20 | No | -- |
| Barium | 67.6 (<BG) | 5,600 | 132[e] | 224 | No | -- |
| Beryllium | 0.49 (<BG) | 10.4[f] | 1.51[e] | 1.51[e] | No | -- |
| Boron[g] | 1.5 | 16,000 | 320 | --[h] | No | -- |
| Cadmium[d] | 5 | 13.9[f] | 0.81[e] | 0.81[e] | Yes | Yes[i] |
| Chromium (total) | 70 | 80,000 | 18.5[e] | 18.5[e] | Yes | Yes[i] |
| Cobalt | 9.7 (<BG) | 1,600 | 32 | --[h] | No | -- |
| Copper | 59.8 | 2,960 | 59.2 | 22.0[e] | Yes | Yes[i] |
| Hexavalent chromium | 1.1 | 2.1 | 4.8[j] | 2 | No | -- |
| Lead | 5.2 (<BG) | 353 | 10.2[e] | 10.2[e] | No | -- |
| Manganese | 1760 | 11,200 | 512[e] | 512[e] | Yes | Yes[i] |
| Mercury | 0.06 (<BG) | 24 | 0.33[e] | 0.33[e] | No | -- |
| Molybdenum[g] | 15.2 | 400 | 8 | --[h] | Yes | Yes[i] |
| Nickel | 50.5 | 1,600 | 19.1[e] | 27.4 | Yes | Yes[i] |
| Silver | 0.75 | 400 | 8 | 0.73[e] | Yes | Yes[i] |
| Vanadium | 35.1 (<BG) | 560 | 85.1[e] | --[h] | No | -- |
| Zinc | 244 | 24,000 | 480 | 67.8[e] | Yes | Yes[i] |
| Benzo(a)pyrene | 0.019 | 0.33[k] | 0.33[k] | 0.33[k] | No | -- |
| Bis(2-ethylhexyl) phthalate | 0.24 | 71.4 | 0.6 | 0.36 | No | -- |
| Di-n-butylphthalate | 0.33 | 8000 | 160 | 540 | No | -- |

**Table 2. Comparison of Statistical Contaminant Concentrations to Action Levels for the 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil Sampling Event. (2 Pages)**

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) or calculated per WAC-173-340-720, WAC-173-340-730, and WAC-173-340-740, Method B, 1996, unless otherwise noted.

[b] The remedial action goal is below the Hanford-specific soil background concentration. The value presented is the Hanford-specific soil background concentration.

[c] The maximum uranium-233/234 analysis (1.34 pCi/g) is within the range of Hanford Site background (maximum background analysis is 1.51 pCi/g) and is of a sample of scale from inside a 0.051 m (2-in.) diameter pipe. Therefore, this material is not regarded as a threat to human health or the environment.

[d] Hanford Site-specific background not available. Value is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[e] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996 and DOE-RL 2005b).

[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) and an airborne particulate mass-loading rate of 0.0001 $g/m^3$ (WDOH 1997).

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

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

[i] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), residual concentrations are not expected to migrate more than 2 m (6.6 ft) in 1,000 years based on the lowest soil-partitioning coefficient (for molybdenum [20 mL/g]). The vadose zone underlying the remediation footprint is approximately 12 m (40 ft) thick. Therefore, residual concentrations of contaminants listed above that exceeded RAG values are predicted to be protective of groundwater and the Columbia River.

[j] Calculated cleanup level (per WAC 173-340-720(3), 1996 [Method B for groundwater] and WAC 173-340-740(3)(a)(ii)(A), 1996 ["100 times rule"]) presented is lower than that presented in the RDR/RAWP (DOE-RL 2005b), based on updated oral reference dose value (as provided in the Integrated Risk Information System) (EPA 2006).

[k] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).

| | | | |
|---|---|---|---|
| -- | = not applicable | RAG | = remedial action goal |
| BG | = background | RESRAD | = RESidual RADioactivity (dose assessment model) |
| COC | = contaminant of concern | WAC | = *Washington Administrative Code* |
| COPC | = contaminant of potential concern | | |

## DATA EVALUATION

Evaluation of the results listed in Table 2 from confirmatory sampling at the 100-F-52 waste site indicates that residual concentrations of all detected site COPCs are below soil shallow zone remedial action goals (RAGS), except for cadmium, chromium (total), copper, manganese, molybdenum, nickel, silver, zinc, and benzo(a)pyrene which exceed RAGs for groundwater and/or river protection. Data were not collected on the vertical extent of residual contamination; however, given the soil-partitioning coefficients ($K^d$ values) for the above listed analytes (molybdenum is the lowest, at 20 mL/g), RESidual RADioactivity (RESRAD) modeling predicts that these contaminants will not migrate more than 2 m (6.6 ft) vertically in 1,000 years (BHI 2005). The vadose zone underlying the soil below the 100-F-52 waste site is approximately 12 m (40 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

Assessment of the risk requirements for the 100-F-52 waste site is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix C. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant

carcinogenic risk of less than $1.0 \times 10^{-6}$, and a cumulative excess carcinogenic risk of less than $1.0 \times 10^{-5}$. These risk values were conservatively calculated for the entire waste site using the highest values from the test trench or pipeline. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicated that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-F-52 waste site is $3.3 \times 10^{-1}$. All individual cumulative carcinogenic risk values are less than $1 \times 10^{-6}$. The cumulative carcinogenic risk value is $1.0 \times 10^{-6}$. Therefore, nonradionuclide risk requirements are met.

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. However, this test is not applicable to the confirmatory sampling results since the maximum detected concentrations are used as the compliance basis and evaluated individually against the cleanup criteria.

For radionuclide contaminants listed in Table 2, uranium-233/234 was detected above the statistical background level (DOE-RL 1996). Sample J16222-A was reanalyzed to determine whether uranium-233/234 was a result of low-level uranium contamination or if the result was actually an elevated background reading. Results (1.12 pCi/g) from the reanalysis were lower than the original results, indicating that the uranium-233/234 readings were elevated background levels. In addition, the original uranium-233/234 level of 1.34 pCi/g is within the range of Hanford Site background presented in the *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE-RL 1996).

## DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 100-F-52 waste site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The detailed DQA is presented in Appendix D.

## SUMMARY FOR NO ACTION DECISION

The 100-F-52 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2005b). Confirmatory sampling was performed to determine whether the site met cleanup objectives for direct exposure, groundwater protection, and river protection; or if the site required remediation. Analytical results were shown to meet the remedial action objectives; therefore, a No Action reclassification is supported for the 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil site. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

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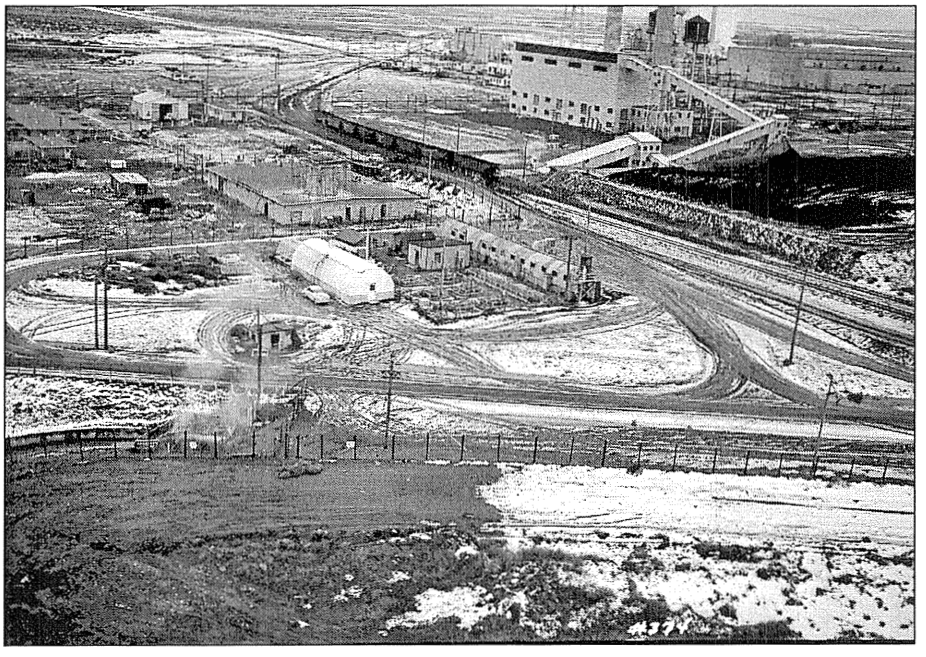
# APPENDIX A

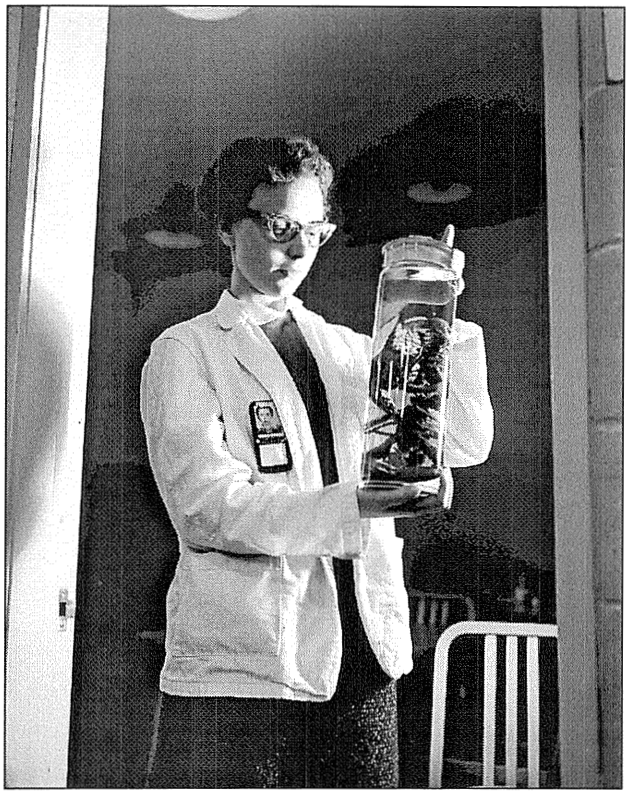
# 100-F-52 SITE PHOTOGRAPHS

**146-FR Laboratory Under Construction in 1951.**

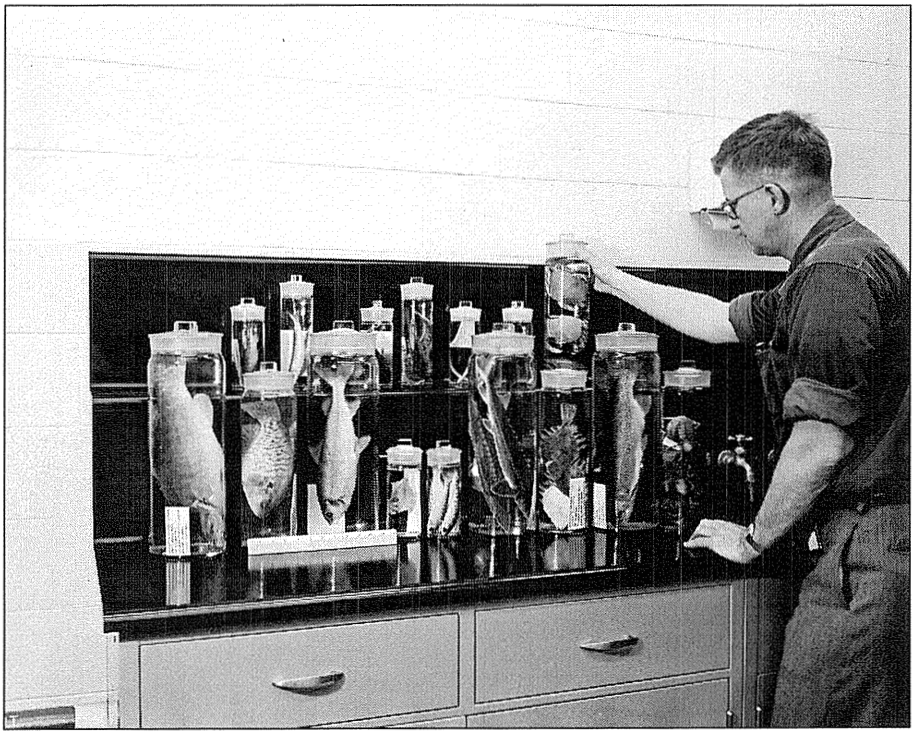
**146-FR Laboratory in January 1952.**



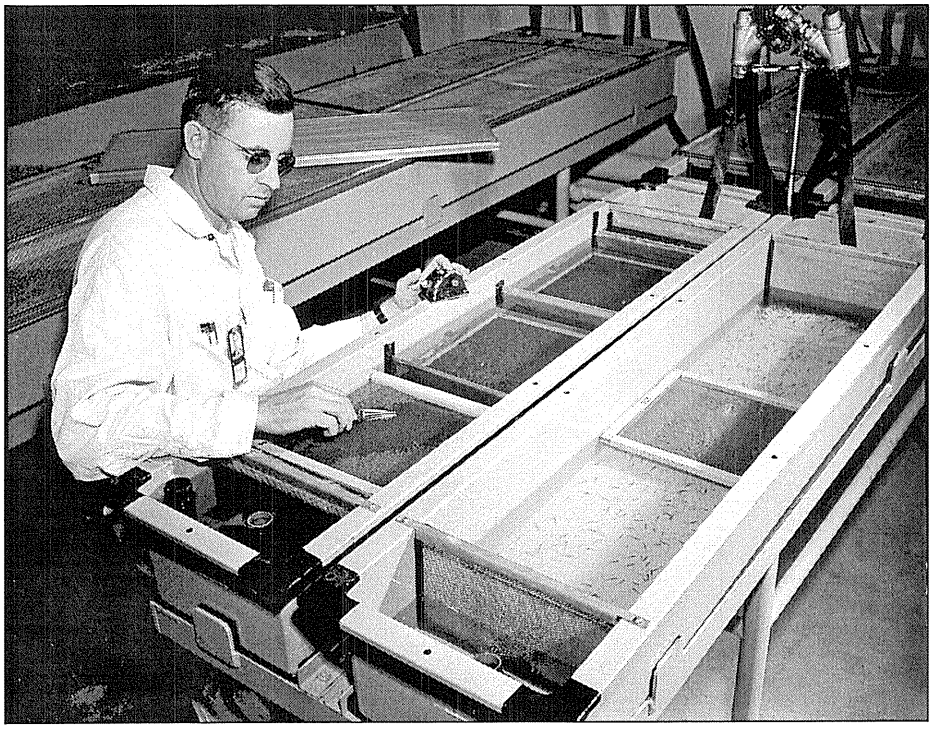
**146-FR Laboratory. Inside the 146-FR Laboratory.**



**146-FR Laboratory. Inside the Laboratory Checking Fish Specimens.**

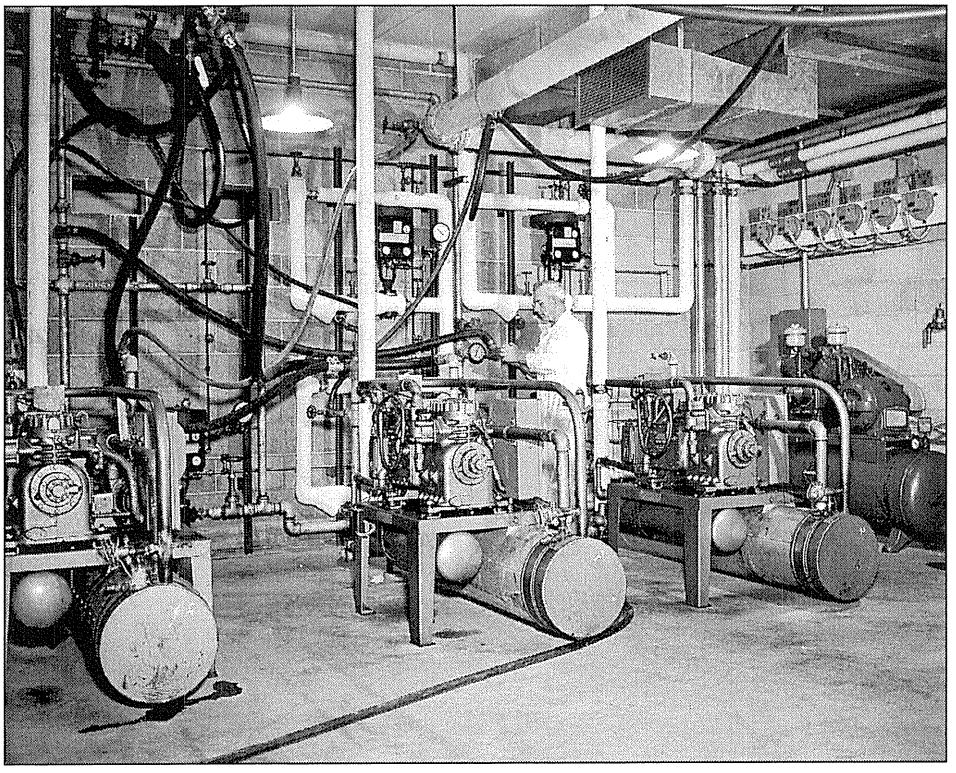


**146-FR Laboratory. Counting Fish Eggs.**



**146-FR Laboratory. Netting and Measuring Fish.**

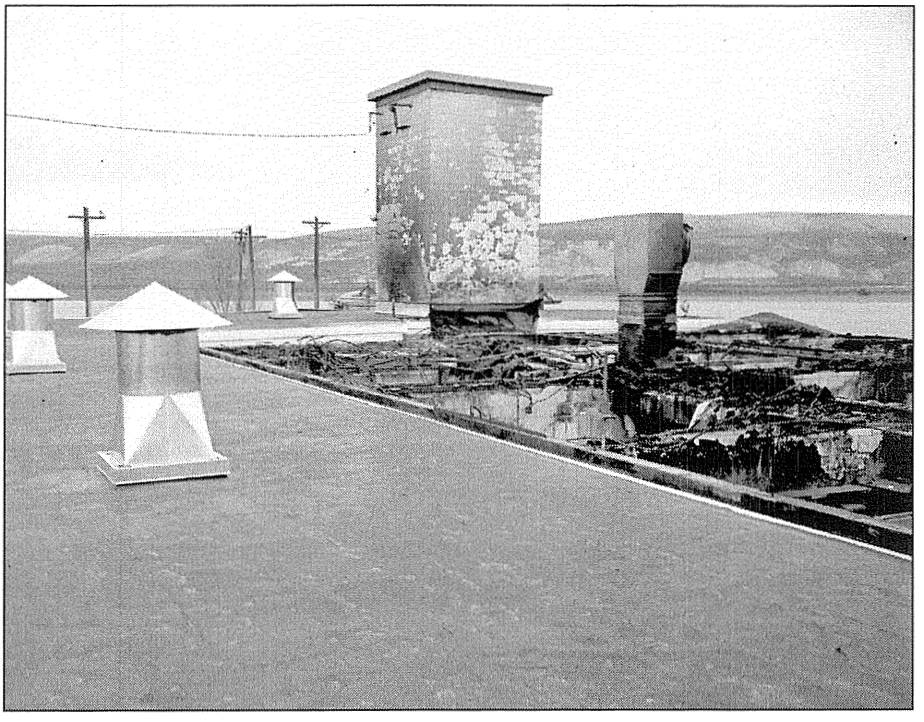
**146-FR Laboratory. Pumping Equipment Used in the Facility.**



**146-FR Laboratory. 1964 Fire that Burned the Facility.**

**146-FR Laboratory. 1964 Fire that Destroyed Roof of Facility.**

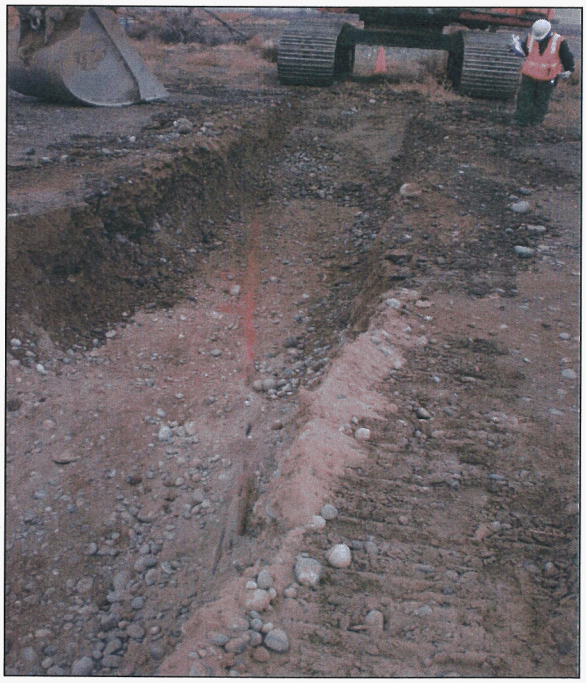
**146-FR Laboratory. Another View of Burned Roof of Facility.**



**100-F-52. Test Trench 1.**

**100-F-52. Test Trench 1 with Unknown Pipe.**

**100-F-52. Test Trench 2.**



**100-F-52. Test Trench 2 with Pipe.**

**Collecting Material from Bottom of Trench.**

**Hot Tap in Progress.**

**Pressure Testing Hot Tap.**

**Allowing Hot Tap to Drain.**

**Dis-assembling Hot Tap in Level B PPE.**

**Cutting Open Pipe Using Band Saw.**

**Pipe Cut Open After Hot Tap Removed.**

**Scale Inside Pipe in Test Trench 2.**

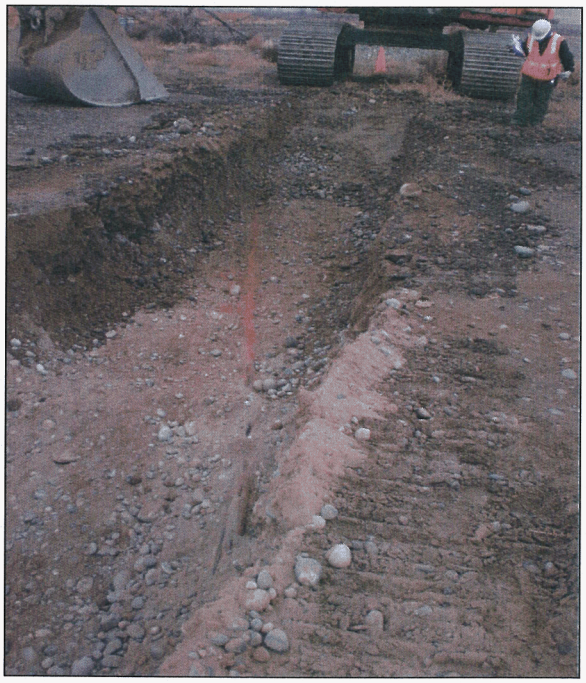
**Rust-Scale Sample Material from Inside Pipe.**

**Placing Material into Sample Containers.**

**100-F-52. Test Trench 1.**

**100-F-52. Test Trench 1 with Unknown Pipe.**

**100-F-52. Test Trench 2.**



**100-F-52. Test Trench 2 with Pipe.**

**Collecting Material from Bottom of Trench.**

**Hot Tap in Progress.**

**Pressure Testing Hot Tap.**

**Allowing Hot Tap to Drain.**

**Dis-assembling Hot Tap in Level B PPE.**

**Cutting Open Pipe Using Band Saw.**

**Pipe Cut Open After Hot Tap Removed.**

**Scale Inside Pipe in Test Trench 2.**

**Rust-Scale Sample Material from Inside Pipe.**

**Placing Material into Sample Containers.**

# APPENDIX B

# 100-F-52 LABORATORY SOIL CONFIRMATORY DATA SUMMARY TABLES

Table B-1. 100-F-52 Radionuclide Data Results (2 pages).

| Sample location | HEIS Number | Sample Date | Americium-241 GEA | | | Carbon-14 | | | Cesium-137 | | | Cobalt-60 | | | Europium-152 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Trench (TT2) | J162R4 | 11/28/07 | 0.151 | U | 0.151 | 0.898 | U | 3.05 | 0.02 | U | 0.024 | 0.024 | U | 0.024 | 0.061 | U | 0.061 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 0.301 | U | 0.301 | 1 | U | 3.01 | 0.04 | U | 0.035 | 0.039 | U | 0.039 | 0.088 | U | 0.088 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 0.037 | U | 0.037 | 0.7 | U | 3.1 | 0.03 | U | 0.032 | 0.033 | U | 0.033 | 0.082 | U | 0.082 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 0.02 | U | 0.02 | -2.27 | U | 4.73 | 0.02 | U | 0.02 | 0.02 | U | 0.02 | 0.055 | U | 0.055 |

| Sample location | HEIS Number | Sample Date | Europium-154 | | | Europium-155 | | | Nickel-63 | | | Potassium-40 | | | TOT beta radiostrontium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Trench (TT2) | J162R4 | 11/28/07 | 0.074 | U | 0.074 | 0.079 | U | 0.079 | 0.93 | U | 3.38 | 14.5 | | 0.227 | | | |
| Duplicate (TT2) | J162R5 | 11/28/07 | 0.137 | U | 0.137 | 0.112 | U | 0.112 | 0.59 | U | 3.44 | 13.8 | | 0.414 | | | |
| Test Trench (TT1) | J162R6 | 11/28/07 | 0.11 | U | 0.11 | 0.08 | U | 0.08 | 1.34 | U | 3.56 | 14.8 | | 0.33 | | | |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 0.063 | U | 0.063 | 0.042 | U | 0.042 | -1.38 | U | 2.26 | 1.16 | | 0.237 | 0.015 | U | 0.23 |

| Sample location | HEIS Number | Sample Date | Radium-226 | | | Radium-228 | | | Thorium-228 GEA | | | Thorium-232 GEA | | | Uranium-233/234 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Trench (TT2) | J162R4 | 11/28/07 | 0.567 | | 0.049 | 0.837 | | 0.105 | 0.73 | | 0.034 | 0.837 | | 0.105 | 0.322 | U | 0.352 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 0.566 | | 0.071 | 0.793 | | 0.183 | 0.9 | | 0.072 | 0.793 | | 0.183 | 0.407 | | 0.195 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 0.542 | | 0.061 | 0.809 | | 0.125 | 0.88 | | 0.046 | 0.809 | | 0.125 | 0.551 | | 0.301 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 0.148 | | 0.043 | 0.15 | U | 0.15 | 0.07 | | 0.026 | 0.15 | U | 0.15 | 1.32 | | 0.177 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | Re-analyzed for uranium only | | | | | | | | | | | | 1.12 | | 0.186 |

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

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

B = blank contamination (organic compounds)
C = blank contamination (inorganic compounds)
D = diluted
I = interference during analysis
J = estimate value
ND = not detected
U = undetected

GEA = Gamma Energy Analysis
HEIS = Hanford Environmental Information System
MDA = Minimum Detectable Activity
PQL = Practical Quantitation Limit
TPH = Total Petroleum Hydrocarbons
QUAL = qualifier

Table B-1. 100-F-52 Radionuclide Data Results (2 pages).

| Sample location | HEIS Number | Sample Date | Uranium-235 | | | Uranium-235 GEA | | | Uranium-238 | | | Uranium-238 GEA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Trench (TT2) | J162R4 | 11/28/07 | 0.056 | U | 0.427 | 0.107 | U | 0.107 | 0.88 | | 0.352 | 3.06 | U | 3.06 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 0 | U | 0.236 | 0.167 | U | 0.167 | 0.43 | | 0.195 | 4.84 | U | 4.84 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 0 | U | 0.365 | 0.183 | U | 0.183 | 0.51 | | 0.301 | 4.02 | U | 4.02 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 0.056 | U | 0.215 | 0.119 | U | 0.119 | 0.72 | | 0.177 | 4.72 | U | 4.72 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 0 | U | 0.226 | | | | 1.02 | | 0.186 | | | |

| Sample location | HEIS Number | Sample Date | Gross alpha | | | Gross beta | | |
|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Trench (TT2) | J162R4 | 11/28/07 | 7.76 | U | 10.6 | 20.8 | | 5.61 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 15.4 | | 7.88 | 14.6 | | 5.56 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 10 | | 9.7 | 13.8 | | 8.98 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 4.44 | U | 8.31 | 3.67 | U | 7.87 |

## Table B-2. 100-F-52 Inorganic Data Results. (2 Pages)

| Sample Location | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Equip Blank (TT1) | J162P6 | 11/28/07 | 56.8 | | 12.3 | 0.28 | U | 0.92 | 0.47 | U | 1.5 | 1.4 | | 0.31 | 0.05 | U | 0.15 |
| Test Trench (TT2) | J162R4 | 11/28/07 | 6020 | | 11.7 | 0.92 | U | 0.87 | 2.5 | | 1.5 | 57.2 | | 0.29 | 0.48 | | 0.15 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 5870 | | 11.9 | 0.87 | U | 0.89 | 2.7 | | 1.5 | 52.6 | | 0.3 | 0.49 | | 0.15 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 5210 | | 3.7 | 0.89 | U | 0.28 | 3.1 | | 0.47 | 67.6 | | 0.09 | 0.49 | | 0.05 |
| Pipe Scale (TT2) | J16B16 | 02/20/08 | | | | | | | | | | | | | | | |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 235 | | 21.6 | 3.3 | | 1.6 | 15.7 | | 2.7 | 63.9 | | 0.54 | 0.27 | U | 0.27 |

| Sample Location | HEIS Number | Sample Date | Boron | | | Cadmium | | | Calcium | | | Chromium | | | Hexavalent Chromium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Equip Blank (TT1) | J162P6 | 11/28/07 | 0.47 | U | 1.5 | 0.05 | U | 0.15 | 23.5 | C | 12.3 | 0.19 | U | 0.62 | | | |
| Test Trench (TT2) | J162R4 | 11/28/07 | 1.5 | U | 1.5 | 0.15 | U | 0.15 | 3840 | C | 11.7 | 9 | | 0.58 | 0.21 | U | 0.21 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 1.5 | U | 1.5 | 0.15 | U | 0.15 | 3810 | C | 11.9 | 8.9 | | 0.59 | 0.8 | | 0.21 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 1.5 | | 0.47 | 0.15 | U | 0.05 | 4090 | C | 3.7 | 6.7 | | 0.19 | 1.1 | | 0.21 |
| Pipe Scale (TT2) | J16B16 | 02/20/08 | | | | | | | | | | | | | 0.35 | U | 0.35 |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 2.7 | U | 2.7 | 5 | | 0.27 | 3950 | | 21.6 | 70 | | 1.1 | | | |

| Sample Location | HEIS Number | Sample Date | Cobalt | | | Copper | | | Iron | | | Lead | | | Magnesium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Equip Blank (TT1) | J162P6 | 11/28/07 | 0.19 | U | 0.62 | 0.19 | U | 0.62 | 135 | C | 13.8 | 0.28 | | 0.92 | 8.1 | | 7.7 |
| Test Trench (TT2) | J162R4 | 11/28/07 | 5.4 | | 0.58 | 13.6 | | 0.58 | 14200 | C | 13.1 | 4.4 | | 0.87 | 3740 | | 7.3 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 5.3 | | 0.59 | 13.8 | | 0.59 | 14800 | C | 13.4 | 3.9 | | 0.89 | 3850 | | 7.4 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 4.9 | | 0.19 | 11.6 | | 0.19 | 12200 | C | 4.2 | 5.2 | | 0.28 | 3150 | | 2.3 |
| Pipe Scale (TT2) | J16B16 | 02/20/08 | | | | | | | | | | | | | | | |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 9.7 | | 1.1 | 59.8 | | 1.1 | 550000 | | 97.3 | 2.2 | | 1.6 | 341 | | 13.5 |

## Table B-2. 100-F-52 Inorganic Data Results. (2 Pages)

| Sample Location | HEIS Number | Sample Date | Manganese | | | Mercury | | | Molybdenum | | | Nickel | | | Potassium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Equip Blank (TT1) | J162P6 | 11/28/07 | 3.8 | | 0.12 | 0.01 | U | 0.01 | 0.28 | U | 0.92 | 0.19 | U | 0.62 | 28.5 | | 12.3 |
| Test Trench (TT2) | J162R4 | 11/28/07 | 268 | | 0.12 | 0.01 | | 0.01 | 0.92 | U | 0.87 | 10.9 | | 0.58 | 946 | | 11.7 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 268 | | 0.12 | 0.01 | | 0.01 | 0.87 | U | 0.89 | 10.8 | | 0.59 | 975 | | 11.9 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 270 | | 0.04 | 0.009 | U | 0.01 | 0.89 | U | 0.28 | 8.6 | | 0.19 | 1110 | | 3.7 |
| Pipe Scale (TT2) | J16B16 | 02/20/08 | | | | | | | | | | | | | | | |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 1760 | | 0.22 | 0.06 | | 0.01 | 15.2 | | 1.6 | 50.5 | | 1.1 | 72.9 | | 21.6 |

| Sample Location | HEIS Number | Sample Date | Selenium | | | Silicon | | | Silver | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Equip Blank (TT1) | J162P6 | 11/28/07 | 0.56 | U | 1.8 | 71.9 | | 12.3 | 0.09 | U | 0.31 | 12 | | 6.2 | 0.13 | U | 0.43 |
| Test Trench (TT2) | J162R4 | 11/28/07 | 1.8 | U | 1.7 | 2590 | | 11.7 | 0.31 | U | 0.29 | 188 | | 5.8 | 35.1 | | 0.41 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 1.7 | U | 1.8 | 1600 | | 11.9 | 0.29 | U | 0.3 | 174 | | 5.9 | 34.3 | | 0.42 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 1.8 | U | 0.56 | 2910 | | 3.7 | 0.3 | U | 0.09 | 174 | | 1.9 | 26.5 | | 0.13 |
| Pipe Scale (TT2) | J16B16 | 02/20/08 | | | | | | | | | | | | | | | |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 3.2 | U | 3.2 | 1150 | | 21.6 | 0.75 | | 0.54 | 26.6 | | 10.8 | 0.76 | U | 0.76 |

| Sample Location | HEIS Number | Sample Date | Zinc | | | TPH | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Equip Blank (TT1) | J162P6 | 11/28/07 | 1.5 | C | 1.8 | | | |
| Test Trench (TT2) | J162R4 | 11/28/07 | 35.8 | C | 1.7 | 138 | U | 138 |
| Duplicate (TT2) | J162R5 | 11/28/07 | 34.9 | C | 1.8 | 137 | U | 137 |
| Test Trench (TT1) | J162R6 | 11/28/07 | 36.1 | C | 0.56 | 138 | U | 138 |
| Pipe Scale (TT2) | J16B16 | 02/20/08 | | | | | | |
| Pipe Scale (TT2) | J16222-A | 02/20/08 | 244 | | 3.2 | 133 | U | 133 |

**Table B-3. 100-F-52 Inorganic Data Results. (2 Pages)**

| CONSTITUENT | J162P6 Equip Blank (TT1) Sample Date 11/28/07 | | | J162R4 Test Trench (TT2) Sample Date 11/28/07 | | | J162R5 Duplicate (TT2) Sample Date 11/28/07 | | | J162R6 Test Trench (TT1) Sample Date 11/28/07 | | | J16222-A Pipe Scale (TT2) Sample Date 02/20/08 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL |
| Polychlorinated Biphenyls | | | | | | | | | | | | | | | |
| Aroclor-1016 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| Aroclor-1221 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| Aroclor-1232 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| Aroclor-1242 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| Aroclor-1248 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| Aroclor-1254 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| Aroclor-1260 | N/A | | N/A | 14 | U | 14 | 14 | U | 14 | 14 | U | 14 | 200 | U | 200 |
| CONSTITUENT | J162P6 Equip Blank (TT1) Sample Date 11/28/07 | | | J162R4 Test Trench (TT2) Sample Date 11/28/07 | | | J162R5 Duplicate (TT2) Sample Date 11/28/07 | | | J162R6 Test Trench (TT1) Sample Date 11/28/07 | | | J16222-A Pipe Scale (TT2) Sample Date 02/20/08 | | |
| | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL |
| Semi-Volatile Organic Compounds | | | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 1,2-Dichlorobenzene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 1,3-Dichlorobenzene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 1,4-Dichlorobenzene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2,4,5-Trichlorophenol | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| 2,4,6-Trichlorophenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2,4-Dichlorophenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2,4-Dimethylphenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2,4-Dinitrophenol | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| 2,4-Dinitrotoluene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2,6-Dinitrotoluene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2-Chloronaphthalene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2-Chlorophenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2-Methylnaphthalene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2-Methylphenol (cresol, o-) | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 2-Nitroaniline | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| 2-Nitrophenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 3+4 Methylphenol (cresol, m+p) | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 3,3'-Dichlorobenzidine | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 3-Nitroaniline | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| 4,6-Dinitro-2-methylphenol | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| 4-Bromophenylphenyl ether | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 4-Chloro-3-methylphenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 4-Chloroaniline | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 4-Chlorophenylphenyl ether | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| 4-Nitroaniline | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| 4-Nitrophenol | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| Acenaphthene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Acenaphthylene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Anthracene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Benzo(a)anthracene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Benzo(a)pyrene | 330 | U | 330 | 19 | J | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Benzo(b)fluoranthene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Benzo(ghi)perylene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Benzo(k)fluoranthene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Bis(2-chloro-1-methylethyl)ether | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Bis(2-Chloroethoxy)methane | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Bis(2-chloroethyl) ether | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Bis(2-ethylhexyl) phthalate | 79 | JB | 330 | 200 | JB | 340 | 100 | JB | 340 | 240 | JB | 350 | 18 | JB | 330 |
| Butylbenzylphthalate | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |

**Table B-3. 100-F-52 Inorganic Data Results (2 pages).**

| CONSTITUENT | J162P6 Equip Blank (TT1) | | | J162R4 Test Trench (TT2) | | | J162R5 Duplicate (TT2) | | | J162R6 Test Trench (TT1) | | | J16222-A Pipe Scale (TT2) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL |
| Semi-Volatile Organic Compounds | | | | | | | | | | | | | | | |
| Carbazole | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Chrysene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Di-n-butylphthalate | 44 | J | 330 | 31 | J | 340 | 340 | U | 340 | 350 | U | 350 | 330 | J | 330 |
| Di-n-octylphthalate | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Dibenz[a,h]anthracene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Dibenzofuran | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Diethylphthalate | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Dimethyl phthalate | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Fluoranthene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Fluorene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Hexachlorobenzene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Hexachlorobutadiene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Hexachlorocyclopentadiene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Hexachloroethane | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Indeno(1,2,3-cd)pyrene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Isophorone | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| N-Nitroso-di-n-dipropylamine | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| N-Nitrosodiphenylamine | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Naphthalene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Nitrobenzene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Pentachlorophenol | 830 | U | 830 | 860 | U | 860 | 860 | U | 860 | 870 | U | 870 | 830 | U | 830 |
| Phenanthrene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Phenol | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |
| Pyrene | 330 | U | 330 | 340 | U | 340 | 340 | U | 340 | 350 | U | 350 | 330 | U | 330 |

# APPENDIX C

# CALCULATION BRIEFS

# APPENDIX C

## CALCULATION BRIEFS

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

*100-F-52 Waste Site Hazard Quotient and Carcinogenic Risk Calculations*, Calculation No. 0100F-CA-V0348, Rev. 0.

**DISCLAIMER FOR CALCULATIONS**

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

Acrobat 8.0

# CALCULATION COVER SHEET

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

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0348

Subject: 100-F-52 Waste Site Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

| Rev. | Sheet Numbers | Originator | Checker | Reviewer | Approval | Date |
|---|---|---|---|---|---|---|
| 0 | Total = 4 | C.R. Martinez | L.D. Habel | | J.M. Capron | 3/27/08 |
| | | C.R. Martinez | | | | |
| | | | | | | |
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## SUMMARY OF REVISION

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WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | C. R. Martinez | Date: | 3/27/08 | Calc. No.: | 0100F-CA-V0348 | Rev.: | 0 |
| Project: | 100-F Field Remediation | Job No: | 14655 | Checked: | L. D. Habel | Date: | 3/27/08 |
| Subject: | 100-F-52 Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 1 of 3 | |

## PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk values for the 100-F-52 Radioecology and Aquatic Biology Laboratory Soil site remedial action. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), the following criteria must be met:

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

## GIVEN/REFERENCES:

1) DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) WCH, 2008, *Remaining Sites Verification Package for 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil,*, Attachment to Waste Site Reclassification Form 2008-022, March 2008, Washington Closure Hanford, Richland, Washington.

## SOLUTION:

1) Calculate an HQ for each noncarcinogenic constituent detected above background and compare it to the individual HQ of <1.0 (DOE-RL 2005).

2) Sum the HQs and compare to the cumulative HQ criterion of <1.0.

3) Calculate an excess cancer risk value for each carcinogenic constituent detected above background and compare it to the individual excess cancer risk criterion of $<1 \times 10^{-6}$ (DOE-RL 2005).

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

Washington Closure Hanford CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | C. R. Martinez | Date: | 3/27/08 | Calc. No.: | 0100F-CA-V0348 | Rev.: | 0 |
| Project: | 100-F Field Remediation | Job No: | 14655 | Checked: | L. D. Habel | Date: | 3/27/08 |
| Subject: | 100-F-52 Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 2 of 3 | |

## METHODOLOGY:

HQ and carcinogenic risk calculations were calculated for the entire 100-F-52 Radioecology and Aquatic Biology Laboratory Soil site using the higher value for each analyte from the two test trenches and scale from the pipeline in test trench two. Boron, cadmium, total chromium, hexavalent chromium, copper, manganese, molybdenum, nickel, silver, zinc, and a number of semivolatile organic compounds required the HQ and risk calculations because these COPCs were detected. Several of the metals exceeded background values; while for others, a Washington State or Hanford Site background value either was not available, or was not applicable. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum result for molybdenum (15.2 mg/kg), divided by the noncarcinogenic RAG value of 400 mg/kg (calculated in accordance with the noncarcinogenic toxic effects WAC 173-340-740[3]), is $3.8 \times 10^{-2}$. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculations are completed for the appropriate analytes, the cumulative HQ is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values is $3.3 \times 10^{-1}$. Comparing this values to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then, multiplied by $1 \times 10^{-6}$. For example, the maximum value for hexavalent chromium is 1.1 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is $5.2 \times 10^{-7}$. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk is obtained by summing the individual values. The sum of the excess cancer risk values is $1.0 \times 10^{-6}$. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

## RESULTS:

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

Table 1 shows the results of the calculation.

Washington Closure Hanford CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | C. R. Martinez | Date: | 3/27/08 | Calc. No.: | 0100F-CA-V0348 | Rev.: | 0 |
| Project: | 100-F Field Remediation | Job No: | 14655 | Checked: | L. D. Habel | Date: | 3/27/08 |
| Subject: | 100-F-52 Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 3 of 3 | |

**Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil Site.**

| Contaminants of Potential Concern | Maximum Value[a] (mg/kg) | Noncarcinogen RAG[b] (mg/kg) | Hazard Quotient | Carcinogen RAG[b] (mg/kg) | Carcinogen Risk |
|---|---|---|---|---|---|
| ***Metals*** | | | | | |
| Boron | 1.5 | 16,000 | 9.4E-05 | -- | -- |
| Cadmium | 5.0 | 80 | 6.3E-02 | 13.9 | 3.6E-07 |
| Chromium, total | 70.0 | 80,000 | 8.8E-04 | | |
| Chromium, hexavalent[c] | 1.1 | 240 | 4.6E-03 | 2.1 | 5.2E-07 |
| Copper | 59.8 | 2,960 | 2.0E-02 | -- | -- |
| Manganese | 1760 | 11,200 | 1.6E-01 | -- | -- |
| Molybdenum | 15.2 | 400 | 3.8E-02 | -- | -- |
| Nickel | 50.5 | 1,600 | 3.2E-02 | -- | -- |
| Silver | 0.75 | 400 | 1.9E-03 | -- | -- |
| Zinc | 244 | 24,000 | 1.0E-02 | -- | -- |
| ***Semivolatiles*** | | | | | |
| Benzo(a)pyrene | 0.019 | -- | -- | 0.137 | 1.4E-07 |
| Bis(2-ethylhexyl) phthalate | 0.240 | 1,600 | 1.5E-04 | 71.4 | 3.4E-09 |
| Di-n-butylphthalate | 0.33 | 8,000 | 4.1E-05 | -- | -- |
| ***Polychlorinated Biphenyls*** | | | | | |
| ***Totals*** | | | | | |
| **Cumulative Hazard Quotient:** | | | **3.3E-01** | | |
| **Cumulative Excess Cancer Risk:** | | | | | **1.0E-06** |

Notes:
RAG = remedial action goal
-- = not applicable
[a] = From Table 1, WCH 2008
[b] = Value obtained from *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.
[c] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway (WAC) 173-340-750(3), 1996.

## CONCLUSION:

This calculation demonstrates that the 100-F-52 Radioecology and Aquatic Biology Laboratory Soil site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).

# APPENDIX D

# DATA QUALITY ASSESSMENT

## CONFIRMATORY SAMPLING DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (WCH 2007, DOE-RL 2005b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan*( SAP) (DOE-RL 2005a).

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000a, BHI 2000b) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., evaluate against cleanup criteria to support a no action or remedial action decision). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

A review of the sample design (WCH 2007), the field logbooks (WCH 2008a, 2008b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. Confirmatory sample data collected at the 100-F-52 waste site were provided by the laboratory in three sample delivery groups (SDGs): SDG K1034, SDG K1129, and SDG J00161. SDG K1034 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed below.

### SDG K1034

This SDG comprises one field duplicate pair (J162R4/J162R5) collected from the subsurface soil within test trench 1, and one field sample (J162R6) and one equipment blank (J162P6) collected from the subsurface soil within test trench 2 of the 100-F-52 waste site. These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), semivolatile organic compounds (SVOCs), gross alpha and gross beta by proportional counting, strontium-90, nickel-63, carbon-14, isotopic uranium, and by gamma spectroscopy. SDG K1034 was submitted for third-party validation. No major deficiencies were found in SDG K1034. Minor deficiencies found in SDG K1034 are as follows:

All of the carbon-14 data in SDG K1034 were qualified by third-party validation as estimated with "J" flags, due to lack of a matrix spike (MS) analysis for the analyte. Estimated, or "J"-flagged, data are acceptable for decision-making purposes.

In the SVOC analysis, the common laboratory contaminant bis(2-ethylhexyl)phthalate is detected in the method blank (MB). Third-party validation raised the reported value for all detected bis(2-ethylhexyl)phthalate results within SDG K1034 to the required quantitation limit of 660 µg/kg and qualified the result as undetected and flagged "U". The data are useable for decision-making purposes.

In the SVOC analysis, 3 of 128 MS recoveries are outside the acceptance criteria. The MS recovery for 2,4-dinitrophenol is 19%. The MS and matrix spike duplicate (MSD) recoveries for 4,6-dinitro-2-methylphenol are 30% and 33%, respectively. The results for these analytes were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

In the SVOC analysis, 6 of 64 laboratory control sample (LCS) recoveries are outside the acceptance criteria. The recovery for bis(2-chloroethyl)ether is 47%. The recovery for 2,2'-oxybis(1-chloropropane) is 42%. The recovery for 4,6-dinitro-2-methylphenol is 24%, and the recovery for 2,4-dinitrophenol is 19%. The recoveries for 4-chloroanaline and pentachlorophenol are 43% and 45%, respectively. The results for these analytes were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

Also in the SVOC analysis, the laboratory duplicate relative percent differences (RPDs) for 4-chloroanaline and dibenz(a,h)anthrene are above the acceptance criteria (30%) at 35% and 30.7%, respectively. All 4-chloroanaline and dibenz(a,h)anthrene results in SDG K1034 were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the calcium, sodium, and zinc results for sample J162P6 (the equipment blank) are of similar magnitude as the method blank results, and were qualified as undetected estimates and flagged "UJ" by third-party validation due to method blank contamination. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for four ICP metals (aluminum, iron, antimony, and silicon) are out of acceptance criteria. For most of these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post-digestion spikes (PDSs) and serial dilutions were prepared for all four analytes with acceptable results. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 73.7%. All antimony results in SDG K1034 may be considered estimated. Estimated data are useable for decision-making purposes.

The laboratory duplicate RPD for arsenic is above the acceptance criteria (30%) at 43.8%. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. The data are useable for decision-making purposes.

**SDG K1129**

This SDG comprises one field sample (J16222-A) of sediment from the pipe located in trench 2 at the 100-F-52 waste site. This sample was analyzed for ICP metals, mercury, SVOCs, PCBs, TPH, strontium-90, nickel-63, carbon-14, isotopic uranium, and by gamma spectroscopy. No major deficiencies were found in SDG K1129. Minor deficiencies found in SDG K1129 are as follows:

All of the carbon-14 data in SDG K1129 may be considered estimated due to lack of a MS analysis for the analyte. Estimated data are acceptable for decision-making purposes.

In the SVOC analysis, 1 of 24 surrogate recoveries is outside the acceptance criteria. The secondary criterion for surrogate recoveries is met, as there is no more than one outlier for the sample. The data are useable for decision-making purposes.

Twenty-eight of 128 MS recoveries in the SVOC analysis are outside the acceptance criteria. The MS recoveries for 2-methylphenol and 3,4-methylphenol are both 59%. The MS recovery for 2,2'-oxybis(1-chloropropane) is 43%. The 2-chlorophenol MS and MSD recoveries are 47% and 43%, respectively. The n-nitroso-di-n-propylamine MS and MSD recoveries are 49% and 45%, respectively. The nitrobenzene MS and MSD recoveries are 42% and 41%, respectively. The isophorone MS and MSD recoveries are 49% and 48%, respectively. The 2,4-dimethylphenol MS and MSD recoveries are 49% and 45%, respectively. The 1,2,4-trichlorobenzene MS and MSD recoveries are 51% and 48%, respectively. The 4-chlor-3-methylphenol MS recovery is 56%. The 2-methylnaphthalene MS and MSD recoveries are 54% and 52%, respectively. The MSD for hexachloroethane is 48% and the MSD for 2-nitrophenol is 45%. The acenaphthylene MS and MSD recoveries are 58% and 57%, respectively. The 4,6-dinitro-2-methylphenol MS and MSD recoveries are 19% and 11%, respectively. The pentachlorophenol MS and MSD recoveries are 26% and 19%, respectively. All results for analytes with low MS recoveries and all detected results for analytes with high MS or MSD recoveries may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for eight ICP metals (aluminum, calcium, chromium, copper, iron, manganese, silicon, and zinc) are out of acceptance criteria. For four of these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, PDSs and serial dilutions were prepared for all three analytes with acceptable results. Aluminum, calcium, chromium, and copper did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for aluminum, chromium, and copper were high, indicating a potential high bias to the data. The original MS recovery for calcium was low at 36.1%. The calcium result in SDG K1129 may be considered estimated. Estimated data are useable for decision-making purposes.

Also, in the ICP metals analysis, the LCS recovery for silicon is below the acceptance criteria at 12.4%. The associated sample result for silicon is likely biased low. Silicon is not a COPC for the 100-F-52 waste site.

The RPDs calculated for aluminum, cobalt, potassium, and lead in the laboratory duplicate pair are above the acceptance criteria (30%) at 61.1%, 45.6%, 32.9%, and 94%, respectively. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. The data are useable for decision-making purposes.

**SDG J00161**

This SDG comprises one field sample (J16B16) collected from sediment in the pipe located in trench 2 at the 100-F-52 waste site. This sample was analyzed for hexavalent chromium. This SDG also reports the results from sample J169K0 associated with the 100-F-51 confirmatory sampling event. This DQA review is limited to the results from the 100-F-52 confirmatory sampling event. No major deficiencies were found in SDG J00161. Minor deficiencies found in SDG J00161 are as follows:

In the hexavalent chromium analysis, the MS recovery is below the acceptance criteria at 66.8%. The results for hexavalent chromium may be considered estimated. Estimated data are useable for decision-making purposes.

## FIELD QUALITY ASSURANCE/QUALITY CONTROL

RPD evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies in those calculations are reported by SDG in the previous sections.

Field quality assurance/quality control (QA/QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2008a), are the primary and duplicate samples (J162R4/J162R5) collected from the subsurface soil within test trench 1. The results of the field duplicate RPD calculation for the samples were reported in the final validation package for SDG K1034. The main and QA/QC sample results are presented in Appendix C.

The RPD calculated for silicon was 45%. This RPD exceeded the acceptance criteria of 30%. Elevated RPDs such as this, in the analysis of environmental soil samples, are largely attributed to heterogeneities in the soil matrix and only in small part attributed to precision and accuracy issues at the laboratory. The data are useable for decision-making purposes.

A visual inspection of all the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

## SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-F-52 confirmatory sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 100-F-52 waste site concludes that the data are of the right type, quality, and quantity to support the intended use. The confirmatory sample analytical data are stored in the Environmental Restoration (ENRE) project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System (HEIS) database. The confirmatory sample analytical data are also summarized in Appendix C.

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