1217775

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2008-001

Waste Site Code(s)/Subsite Code(s): 100-D-63

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☐ No Action ☒ Rejected ☐
RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-D-63 waste site, part of the 100-DR-1 Operable Unit, encompasses the clean water pipelines upstream of the 100-D and 100-DR Reactors, including underground pipelines used to transport raw, fire, export, and sanitary water from the river pumphouse to the water treatment facilities and to 100-D Area facilities and fire hydrants. The clean water pipelines are primarily cast iron and steel piping of various sizes. Also included in the 100-D-63 waste site are pipelines that were designed but never installed to service the Plenum Filling Experiment (PFE), a light-water reactor test facility that was never built.

Confirmatory sampling of the pipelines was performed January 26 through March 15, 2010. Fifteen test pits were excavated and samples of the pipeline contents and underlying soil were collected. Confirmatory sampling and comparison of residual contaminant concentrations against cleanup levels have 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 (EPA 1999). The selected remedy 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:

Evaluation of the confirmatory sampling results for the 100-D-63 waste site supports a reclassification of this site to No Action. The current site conditions achieve the remedial action objectives established in the Remaining Sites ROD (EPA 1999). The evaluation (which may include fate-and-transport modeling) of all confirmatory sample data collected from the 100-D-63 waste site resulted in a determination that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted land 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. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-D-63, 100-D/DR Service Water Pipelines* (attached). 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.

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WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2008-001

Waste Site Code(s)/Subsite Code(s): 100-D-63

Regulator comments:

Approval of this WSRF documents regulator agreement that the 100-D-63, 100-D/DR Service Pipelines waste site qualifies for "No Action" under this Interim Action ROD. In addition, Ecology has evaluated the data for this waste site against WAC 173-340 (2007) cleanup levels for direct contact, groundwater protection, and river protection. This evaluation is documented in the letter transmitting Ecology's approval of the waste site's interim reclassification to "No Action."

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:

J. P. Neath		10/15/12
DOE Federal Project Director (printed)	Signature	Date
N. Menard		
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-63, 100-D/DR SERVICE WATER PIPELINES

Attachment to Waste Site Reclassification Form 2008-001

September 2012

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-63, 100-D/DR SERVICE WATER PIPELINES

EXECUTIVE SUMMARY

The 100-D-63, 100-D/DR Service Water Pipelines waste site is assigned to the 100-DR-1 Operable Unit although the pipelines run through both the 100-DR-1 and 100-DR-2 Operable Units. It consists of the service water pipelines upstream of the 100-D and 100-DR Reactors that were not treated with sodium dichromate. The service water pipelines are those that were used to transport raw water (RW), filtered water (FW), sanitary water (SW), and condenser return water (CW). The pipes generally range in size from 5 cm (2 in.) to 122 cm (48 in.) and were typically constructed of cast iron or steel. The primary operational period for these pipelines coincides with the operation of the 105-D and 105-DR Reactors and their support facilities beginning with the construction of the 105-D Reactor in 1943.

The 100-D-63 waste site also includes pipelines associated with the Plenum Filling Experiment (PFE) and pipelines that supplied potable water to the temporary construction camp for the 105-DR Reactor via the fire-protection-loop piping. The PFE pipelines are included with the 100-D-63 service water pipelines in order to document that they were never constructed and require no action. The construction camp temporary water lines were abandoned in place once the 105-DR Reactor was constructed.

The 100-D-63 waste site is identified as a candidate site for confirmatory sampling in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action ROD* (EPA 2009). The 100-D-63 pipelines were stratified into eight service areas based on operational history and water use.

Confirmatory sampling of the 100-D-63 pipelines was initiated on January 26, 2010 and completed on March 15, 2010. Fifteen test pits were excavated and samples of pipe contents and underlying soil were collected. Based on an evaluation of the analytical results and field observations during sampling, residual contaminant concentrations within the pipelines are associated with a minimal amount of material (pipe scale, rust) that does not present a credible risk to environmental receptors, groundwater, or the Columbia River. Access to these materials is prevented because they are encased within the pipelines. Furthermore, metals and other inorganic constituents are at concentrations consistent with sediments and deposits contained within public water distribution pipelines (EPA 2006). Evaluation of the analytical results from sampling the soil underlying the pipelines shows that residual contamination does not preclude future uses (as bounded by the rural-residential scenario) and allows unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep) (Table ES-1). Based on an evaluation of the analytical results and field observations from this sampling, it was determined that the small volume of pipe scale/rust found within the pipelines or the water inside the pipelines does not represent a credible risk associated with the 100-D-63 waste site.

Table ES-1. Summary of Confirmatory Soil Sample Results for the 100-D-63, 100-D/DR Service Water Pipelines. (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.	All detected radionuclides in soil were below background. Radionuclide activities of pipe scale contribute a cumulative dose rate of less than the 15 mrem/yr.	Yes
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	Multiple metals are present in the pipelines interior rust, scale, and concrete linings at concentrations exceeding direct exposure RAGs. However, these constituents are associated with corrosion byproduct of the piping material or deposits of constituents occurring naturally in the incoming water and are consistent with sediments and deposits within public water distribution systems (EPA 2006). Additionally, the material is contained inside of the pipelines and credible pathways do not exist to affect human health or the environment.	Yes
Meet Nonradionuclide Risk Requirements	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 (8.4×10^{-3}) is <1.	
	Attain excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	All individual carcinogen risk values are $<1 \times 10^{-6}$.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk (6.7×10^{-8}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not quantified above groundwater and river protection soil lookup values.	Yes
	Attain National Primary Drinking Water Regulations 4-mrem/yr (beta/gamma) dose standard to target receptor/organ [a].	Radionuclides were not quantified above groundwater and river protection soil lookup values.	
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].	No alpha-emitting radionuclides were detected above groundwater and river protection soil lookup values; therefore, the drinking water standard for alpha emitters has been met.	Yes
	Meet total uranium standard of 21.2 pCi/L [c].	The uranium results were less than background; therefore, the uranium standard of 21.2 pCi/L has been met.	Yes

Table ES-1. Summary of Confirmatory Soil Sample Results for the 100-D-63, 100-D/DR Service Water Pipelines. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Multiple metals are present in the pipelines interior rust, scale, and concrete linings at concentrations exceeding groundwater and river protection soil RAGs. However, these constituents are associated with corrosion byproduct of the piping material or deposits of constituents occurring naturally in the incoming water and are consistent with sediments and deposits within public water distribution systems (EPA 2006). Additionally, the material is contained inside of the pipelines and credible pathways do not exist to affect human health or the environment. Moreover, based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), it is predicted that constituents in soil will not reach groundwater (and thus the Columbia River) within 1,000 years [d].	Yes

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

[b] *Radiation Protection of the Public and 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 2001).

[d] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE/RL 2009b), residual concentrations of lead and zinc in the soil beneath the pipelines have a distribution coefficient of 30 mL/g and are therefore not expected to migrate more than 2 m (6.6 ft) vertically in 1,000 years. The vadose zone underlying the 100-D-63 waste site is more than 20 m (66 ft) thick. Therefore, residual concentrations of lead and zinc are predicted to be protective of groundwater and the Columbia River.

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)

In accordance with this evaluation, a reclassification status of no action has been determined for the 100-D-63 waste site. The site achieves the remedial action objectives (RAOs) and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2,*

100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington (Remaining Sites ROD) (EPA 1999). The results of the confirmatory sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and no institutional controls are required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-D-63 waste site contaminants of concern, contaminants of potential concern, and other constituents and is presented in Appendix A. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for lead, manganese, vanadium, and zinc. Ecological screening levels from *Washington Administrative Code* 173-340 were exceeded for boron, lead, vanadium, and zinc. A summary table showing the maximum contaminant concentration for constituents that exceed ecological screening levels for the 100-D-63 waste site is provided in Appendix A. Because concentrations of manganese and vanadium are below Hanford Site (DOE-RL 2001) or Washington State (Ecology 1994) background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-63, 100-D/DR SERVICE WATER PIPELINES

STATEMENT OF PROTECTIVENESS

The 100-D-63 waste site evaluation and supporting documentation demonstrate that the site meets the remedial action objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual concentrations of contaminants of potential concern (COPCs) do not preclude future uses (as bounded by the rural-residential scenario). The results also demonstrate that residual contaminant concentrations support unrestricted use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 100-D-63 waste site did not extend into the deep zone. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-D-63 waste site contaminants of concern, contaminants of potential concern, and other constituents and is presented in Appendix A. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for lead, manganese, vanadium, and zinc. Ecological screening levels from *Washington Administrative Code* 173-340 were exceeded for boron, lead, vanadium, and zinc. A summary table showing the maximum contaminant concentration for constituents that exceed ecological screening levels for the 100-D-63 waste site is provided in Appendix A. Because concentrations of manganese and vanadium are below Hanford Site (DOE-RL 2001) or Washington State (Ecology 1994) background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-D-63 waste site is assigned to the 100-DR-1 Operable Unit although the pipelines run through both the 100-DR-1 and 100-DR-2 Operable Units. It consists of the service water pipelines upstream of the 100-D and 100-DR Reactors that were not treated with hexavalent chromium. The service water pipelines are those that were used to transport raw water (RW), filtered water (FW), sanitary water (SW), and condenser return water (CW). The pipes generally

ranged in size from 5 cm (2 in.) to 122 cm (48 in.) and were typically constructed of cast iron or steel.

The 100-D-63 waste site also includes pipelines associated with the Plenum Filling Experiment (PFE). The PFE project, a light-water reactor test facility, was cancelled prior to construction. The design of the PFE-related facilities included an above-ground oil pipeline and a process sewer extension. These pipelines are shown on design drawings but were never built. They are included with the 100-D-63 service water pipelines in order to document that they were never constructed and require no action.

The temporary construction camp for the 105-DR Reactor was supplied with potable water via the fire-protection-loop piping. The water lines were abandoned in place once the reactor was constructed. The lines were assigned to the 100-D-50:10 subsite and reclassified as requiring no action on June 29, 2005. Subsequent to the waste site reclassification, the orphan sites evaluation process identified additional sanitary water pipelines on the temporary construction camp drawings. The newly identified pipelines were included within the 100-D-63 waste site to ensure that they are documented and reclassified. All of the temporary construction service water piping was included with the sanitary water piping (even though some of it was technically raw water) since many of these lines were later used to carry sanitary water.

Figures 1 through 6 show the location of the 100-D/DR Area service water pipelines by type (RW, FW, SW, CW, and PFE piping).

History

The 105-D Reactor was constructed between November 1943 and December 1944. It was the second of three original Hanford Site reactors built to irradiate uranium fuel elements to generate plutonium for explosive devices in support of World War II. By 1947, the 105-D Reactor was thought to be nearing the end of its effective operational life due to growth and distortion of its core graphite (Carpenter 1993). The 105-DR Reactor was constructed as a replacement for 105-D, beginning operation in 1950. However, it was subsequently determined that the graphite distortion in 105-D could be controlled and the two reactors were operated simultaneously because production requirements for nuclear materials due to the Cold War with the Soviet Union could not be met by the existing reactors. A new water plant was quickly designed and constructed to permit maximum production from the simultaneous use of the two reactors (105-D and 105-DR). The two reactors were operated until the 105-DR Reactor was deactivated on December 30, 1964 (DeNeal 1965). The 105-D Reactor was shut down 3 years later on June 26, 1967 (DeNeal 1970). The water supply requirements decreased significantly with each of these deactivations. Operations continued at the 185/189-D buildings and other support facilities, including the 184-D Power House. Water was also required for fire protection at the deactivated facilities and for the export water system.

The service water was supplied across the 100-D/DR Area through the process for normal operations as described below. The description pertains to the process while the two reactors were in operation. The flow of water through the system changed over time as new facilities came on line and others were decommissioned.

Figure 1. Raw Water Component of the 100-D-63 Service Water Pipelines.

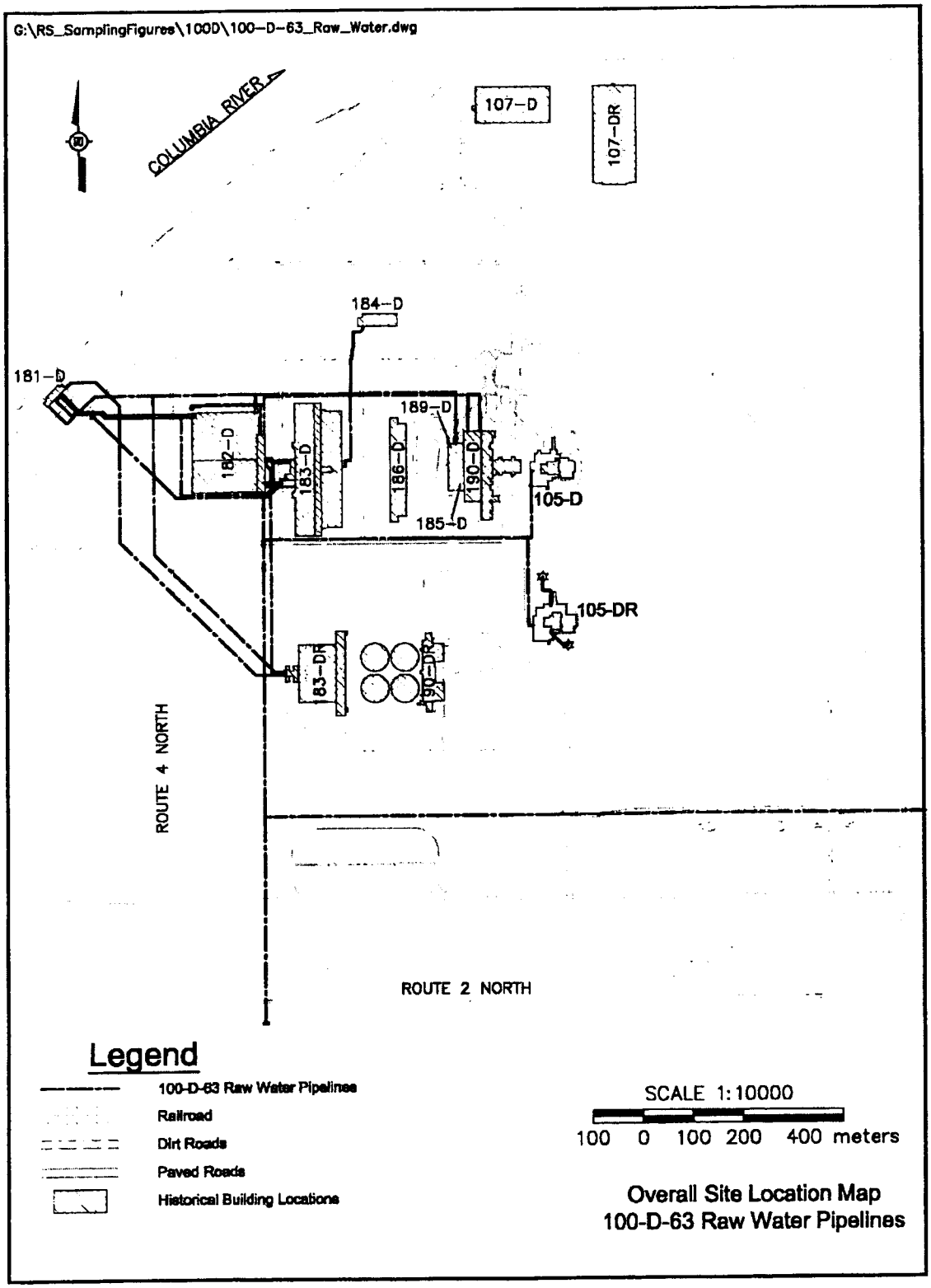


Figure 2. Filtered Water Component of the 100-D-63 Service Water Pipelines.

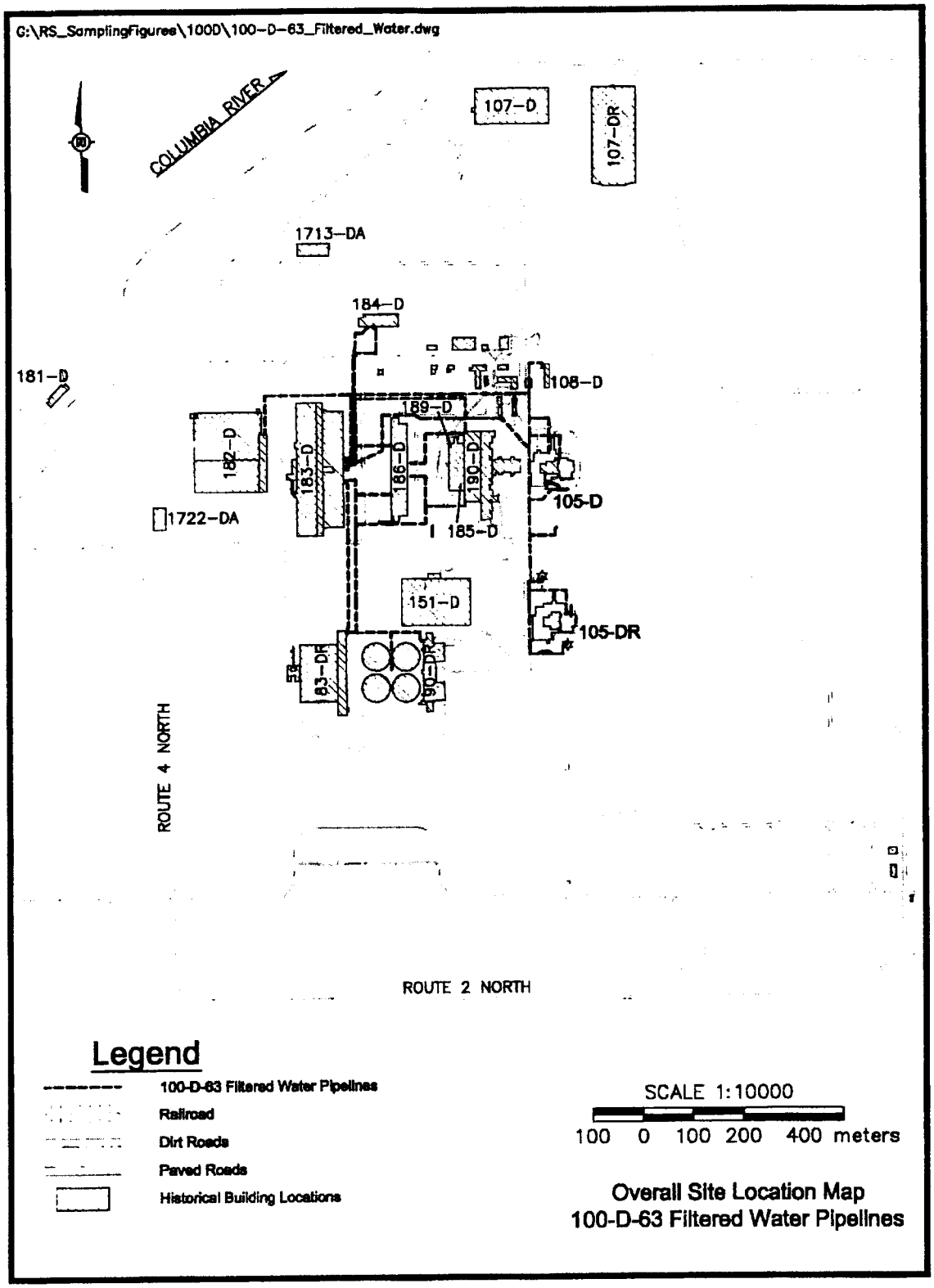


Figure 3. Sanitary Water Component of the 100-D-63 Service Water Pipelines.

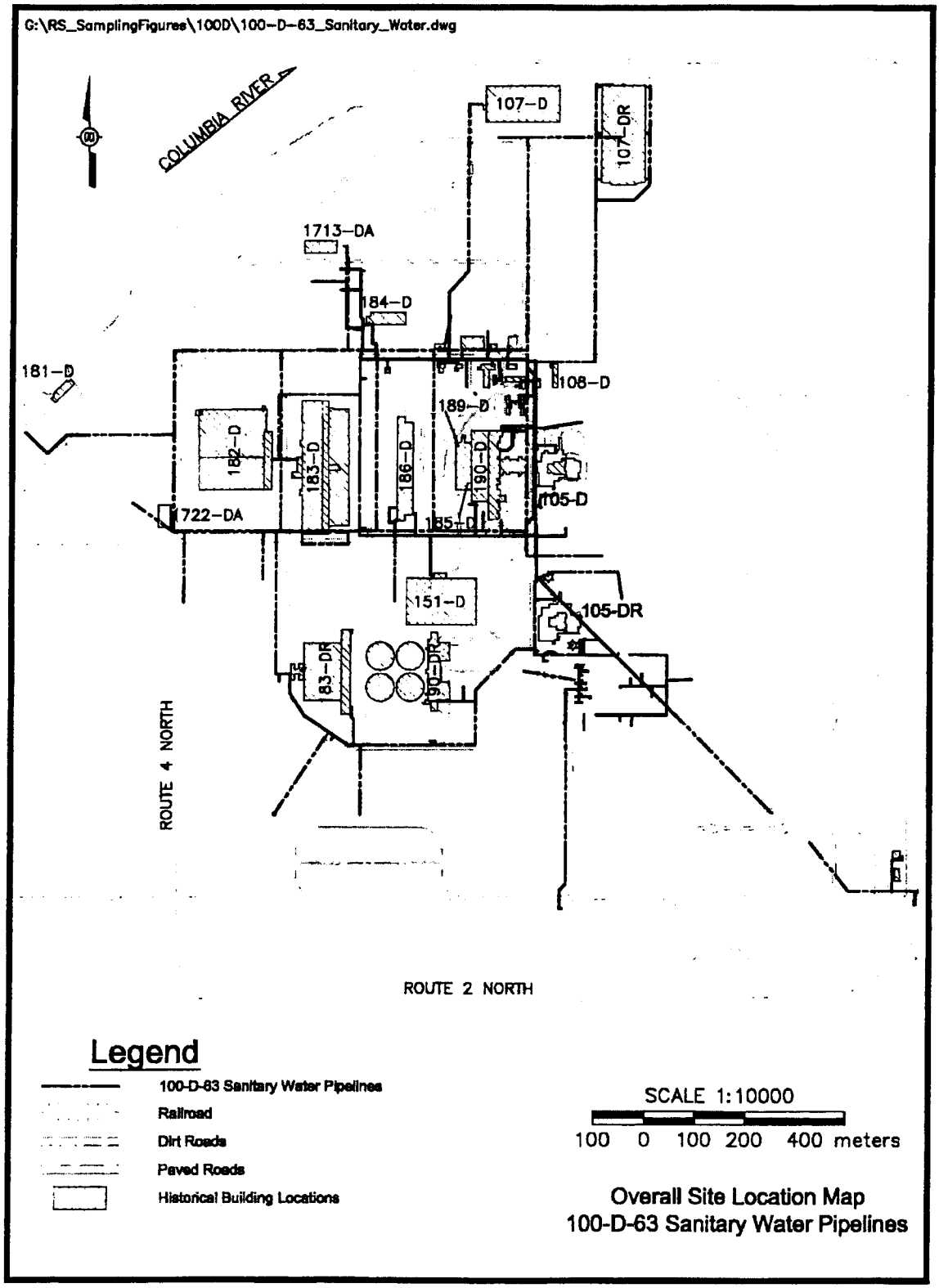


Figure 4. Condenser Return Water Component of the 100-D-63 Service Water Pipelines.

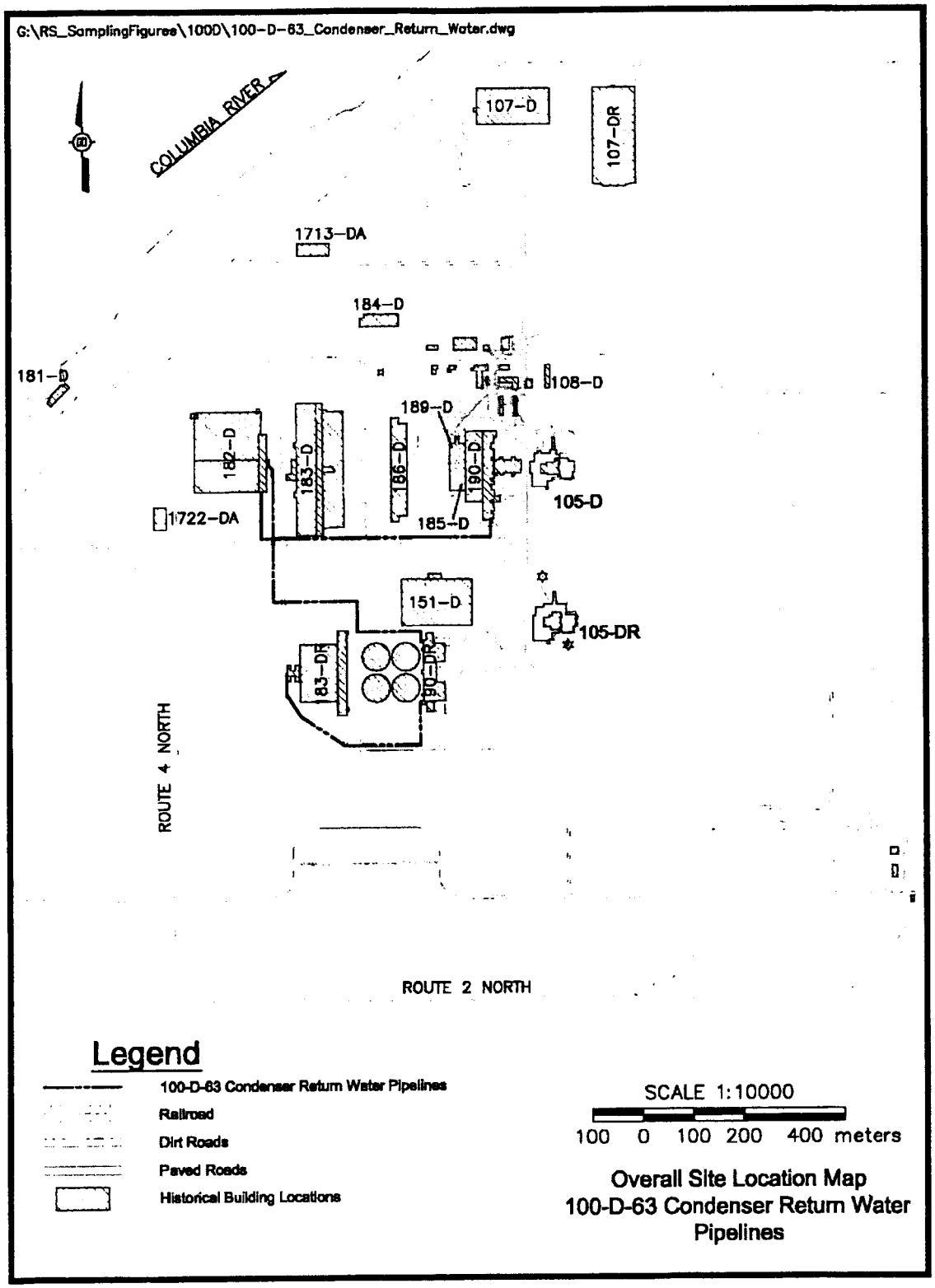


Figure 5. Plenum Filling Experiment Piping Component of the 100-D-63 Service Water Pipelines.

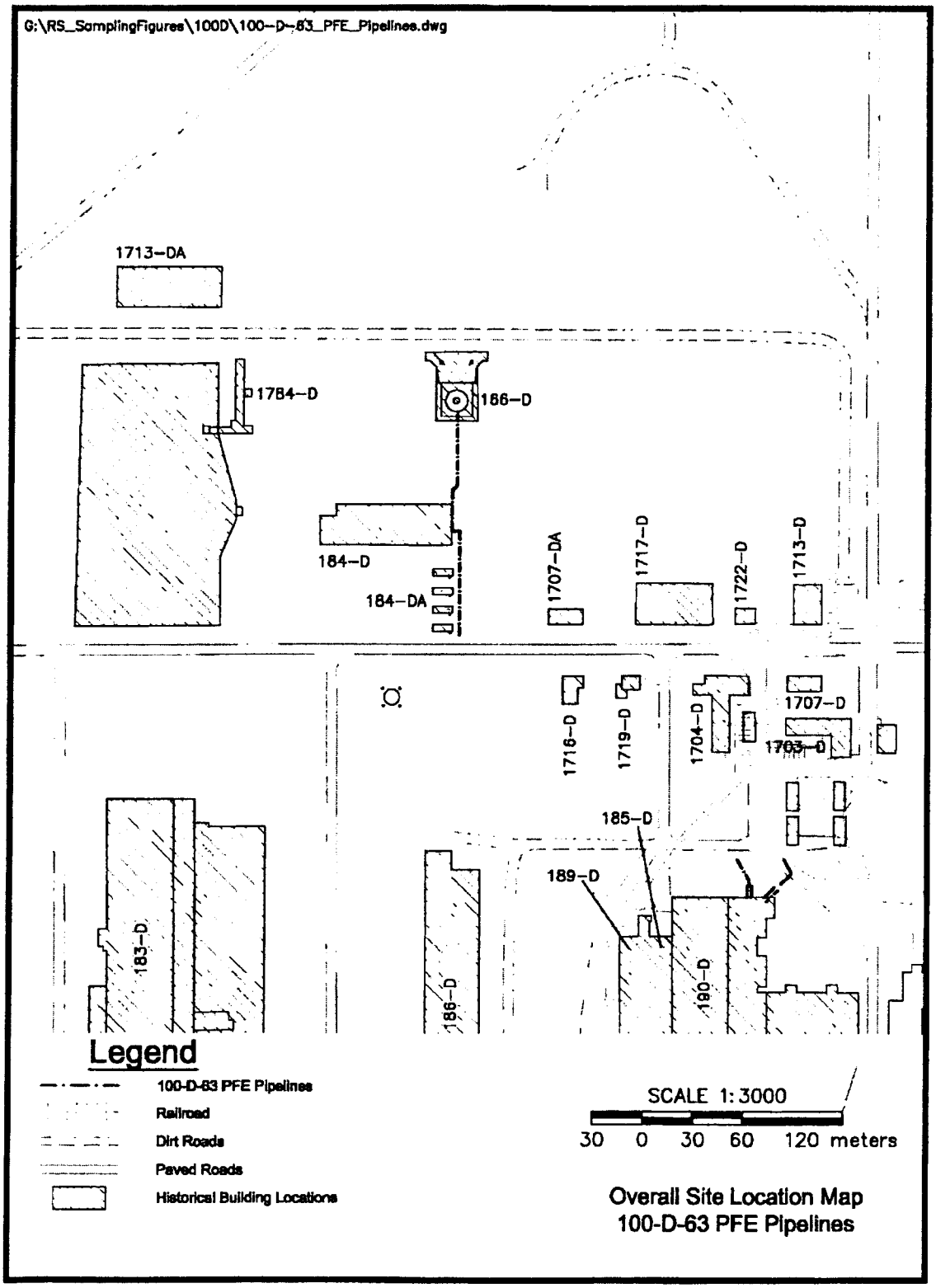
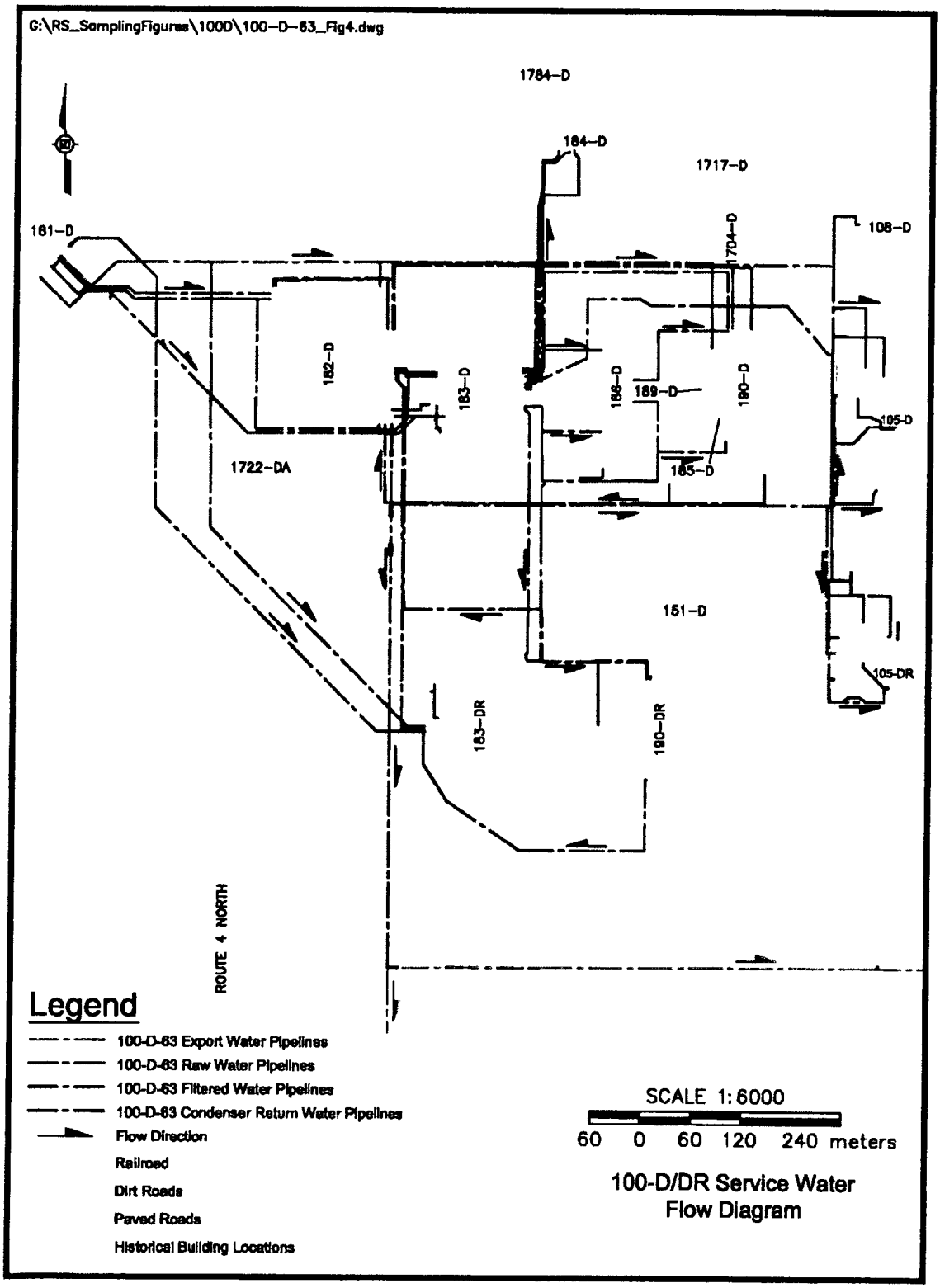


Figure 6. Simplified Schematic Showing Flow of Raw Water, Filtered Water, and Condenser Return Water.



As of May 2012, only three major 100-D Area facilities are still operating at minimal capacity. These include the 181-D River Pumphouse, the 182-D Reservoir and Pumphouse, and the 151-D Electrical Substation. The 151-D Electrical Substation provides the area with 13.8 KV power. The 181-D and 182-D facilities continue to supply raw water to the 100-H and 100-F Areas, as well as the one active fire hydrant in the 100-D/DR Area.

Normal Operation (1950 – 1964)

An enormous quantity of service water (i.e., 243 million gallons per day in June 1960) was required to support the 105-D/DR Reactors and the many supporting facilities in the 100-D/DR Area (GE 1960). Reactor cooling was the single largest use of the water accounting for more than 94% by volume. The majority of the remaining water use was allocated to the steam turbines as condenser water and filter backwash. Less than 1% of the water demand was used by the power house, fire and sanitary supply, and miscellaneous industrial operations.

Raw water originating from the Columbia River was pumped from the 181-D River Pump House to the 182-D Reservoir and Pump House and the 183-DR filter plant (Figure 6).

The 182-D Reservoir and Pump House provided a reserve of raw water for reactor cooling, condenser water for the steam turbines throughout the 100-D/DR Area, and raw water for the 183-D and 183-DR filter plants. It also supplied a backup raw water supply to the export water system.

The 183-D and 183-DR filter plants removed particulate from the raw water by coagulation and filtration. The 183-D filter plant supplied sanitary water to the entire 100-D/DR Area. The plant also supplied filtered water to the 190-D Main Pump House and various buildings throughout the 100-D/DR Area for use where treated water was not desirable or required. The term "treated water" herein refers to filtered water that had sodium dichromate added as a corrosion inhibitor. Sodium dichromate was added to the filtered water at 183-DR and at 190-D (GE 1963). The 183-DR filter plant supplied treated water to the 190-DR Process Water Storage Tanks and Pump House.

The service water supply piping was looped to provide redundancy and minimize stagnant water in the pipelines. Condenser water from 190-D and 190-DR was returned to the storage reservoir (182-D) during the winter. This was done to conserve water and prevent ice formation. During the summer months, the condenser water overflowed to the process sewer after exiting the barometric condensers (AEC-RL 1944).

Significant Operational Changes

This section describes significant operational changes that affected the 105-D/DR Area service water system. These operations were time limited and are described based on the facilities/buildings that the operation affected.

Demineralization and Deaeration Plants

Following treatment in 183-D, water to be used as process water was purified in the 186-D Demineralization Plant by removing naturally occurring dissolved calcium, magnesium, and sodium salts. Water could also be diverted around the 186-D Demineralization Plant through a 91-cm (36-in.) pipe to the inlet header of the 185-D Deaeration Plant. Water could further be diverted around the deaerator through a 61-cm (24-in.) bypass pipe to 190-D. Dissolved gas (carbon dioxide and oxygen) was removed in the 185-D Deaeration Plant. The demineralization and deaeration equipment was used briefly between 1944 and 1945 before its use was permanently discontinued (BHI 1995). The 185-D Deaeration Plant (and the 189-D Refrigeration Building) were converted to a thermal hydraulics laboratory in 1951 and operations ceased in 1988 (BHI 1995).

Refrigeration Building

The 189-D Refrigeration Building supported the 105-D/DR Reactors as a refrigeration unit. The 107-cm (42-in.) raw water pipeline to the refrigeration building was blanked off after the refrigeration process was discontinued and the equipment was dismantled in 1948. The 189-D Refrigeration Building (and the 185-D Deaeration Plant) were converted to a thermal hydraulics laboratory in 1951 and operations ceased in 1988 (BHI 1995).

Plenum Filling Experiment

The 100-D Area was selected in 1973 as the site for the PFE, a new light-water reactor test facility, in part due to the presence of water and steam-generating facilities still in operation (PNL 1973). A considerable amount of design work was completed, including proposed pipeline construction and modification. The pipelines included an above-ground fuel transfer pipeline between the proposed 166-D Fuel Storage Tank and new boilers at 184-D and process piping connections at the northeast end of the 190-D Building (AI 1975, 1976). The project was cancelled in 1976 prior to its construction (Staats 1976).

CONFIRMATORY SAMPLING DESIGN

Contaminants of Potential Concern

Historical information and process knowledge suggested that the 100-D-63 Service Water Pipelines do not contain chemical and radiological contaminants in sufficient quantities to result in a risk to human health or the environment from leaking pipelines or discharges of service water. However, there is evidence that upstream discharges of process effluent were entrained in the raw water intake at 181-D (Carpenter 1993). As such, chromium, hexavalent chromium, and radionuclides were included as contaminants of potential concern (COPCs) for the 100-D-63 waste site. Mercury was included as a COPC since its use during the period was prevalent in water monitoring and pumping equipment used throughout the facility. As noted in the *Work Instruction for Confirmatory Sampling of the 100-D-63, 100-D/DR Service Water Pipelines* (WCH 2009), other metals were expected to be found in the

pipe scale, but were not considered COPCs since they are inherently part of the corrosion byproduct of the piping material. Additionally, these metals may also be present as deposits associated with constituents occurring naturally in the incoming water.

Confirmatory sampling

The confirmatory sampling work instruction stratified the 100-D-63 pipelines into eight service areas based on operational history and water use. A summary of the pipe sizes, materials of construction and lengths for each of the service areas is provided in Appendix B. The eight service areas are as follows:

- 181RW – Pipelines carrying raw water from the 181-D Building
- 182RW – Pipelines carrying raw water from the 182-D Building
- 183FW – Pipelines carrying filtered water from the 183-D Building
- 183SW – Pipelines carrying sanitary water from the 183-D Building
- 186FW – Pipelines carrying filtered water from the 186-D Building
- 190CW – Pipelines carrying condenser return water from the 190-D Building
- 190DRCW – Pipelines carrying condenser return water from the 190-DR Building
- PFE – Pipelines associated with the proposed Plenum Filling Experiment.

Confirmatory sampling was initiated on January 26, 2010 and completed on March 15, 2010. Eighteen test pits were planned for excavation and sampling. However, due to field constraints, one test pit was not excavated, seven of the test pits required relocation, and two test pits were excavated, but not sampled. Figures 7 through 10 show the test pit locations evaluated during the confirmatory sampling activity.

The test pits were excavated, with samples of pipeline contents and underlying soil collected. If water was encountered inside the pipelines, a sample of the water was collected; any water encountered during sampling was left inside the pipelines. A detailed description of the sample design is provided in the confirmatory sampling work instruction (WCH 2009). All sampling was performed in accordance with ENV-1, *Environmental Monitoring and Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). Field observations during sampling are provided in the field logbook (WCH 2010). A summary of the samples collected for the 100-D-63 confirmatory sampling are provided in Table 1.

Figure 7. 100-D-63 Raw Water Test Pit Locations.

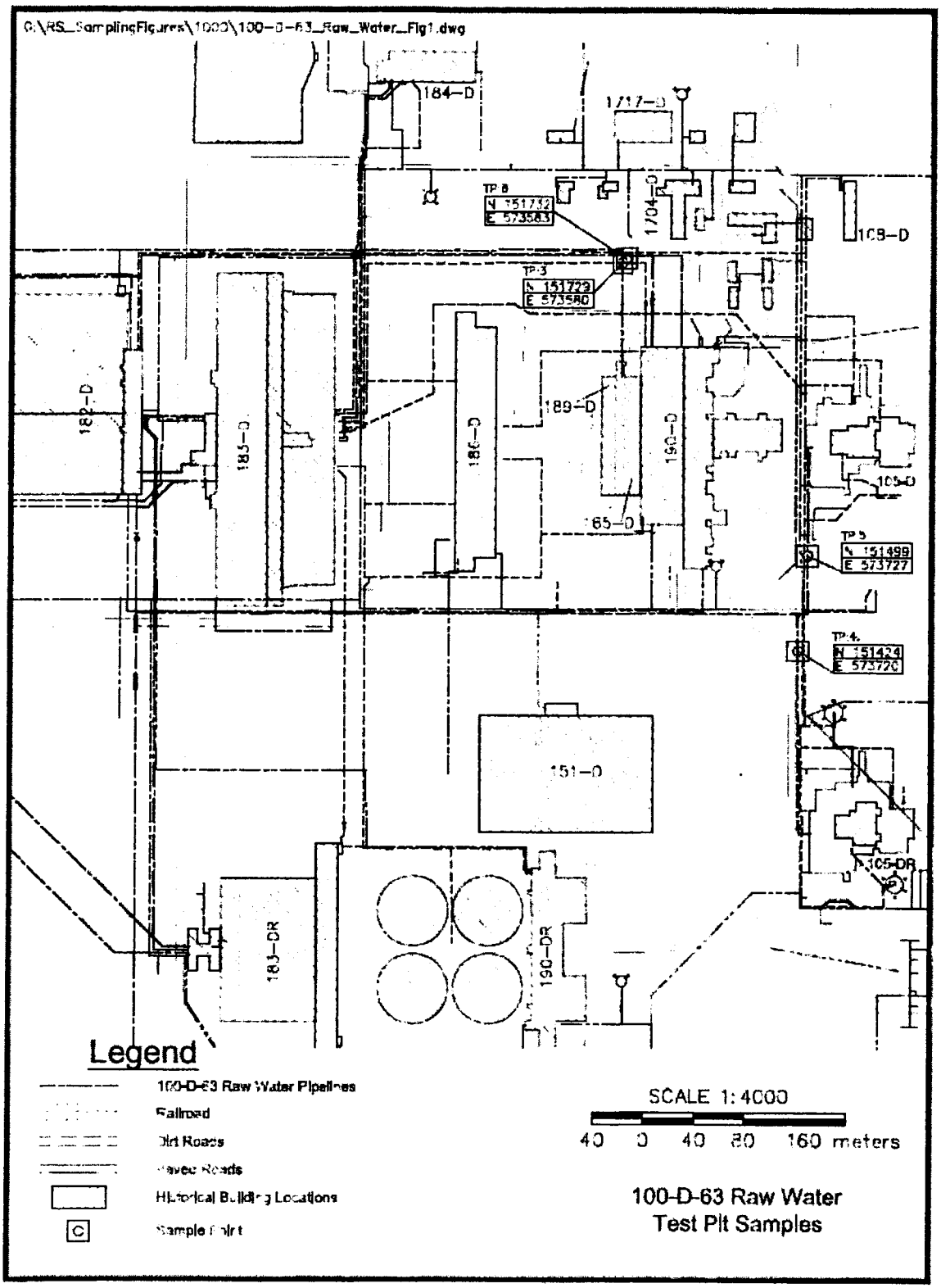


Figure 8. 100-D-63 Filtered Water Test Pit Locations.

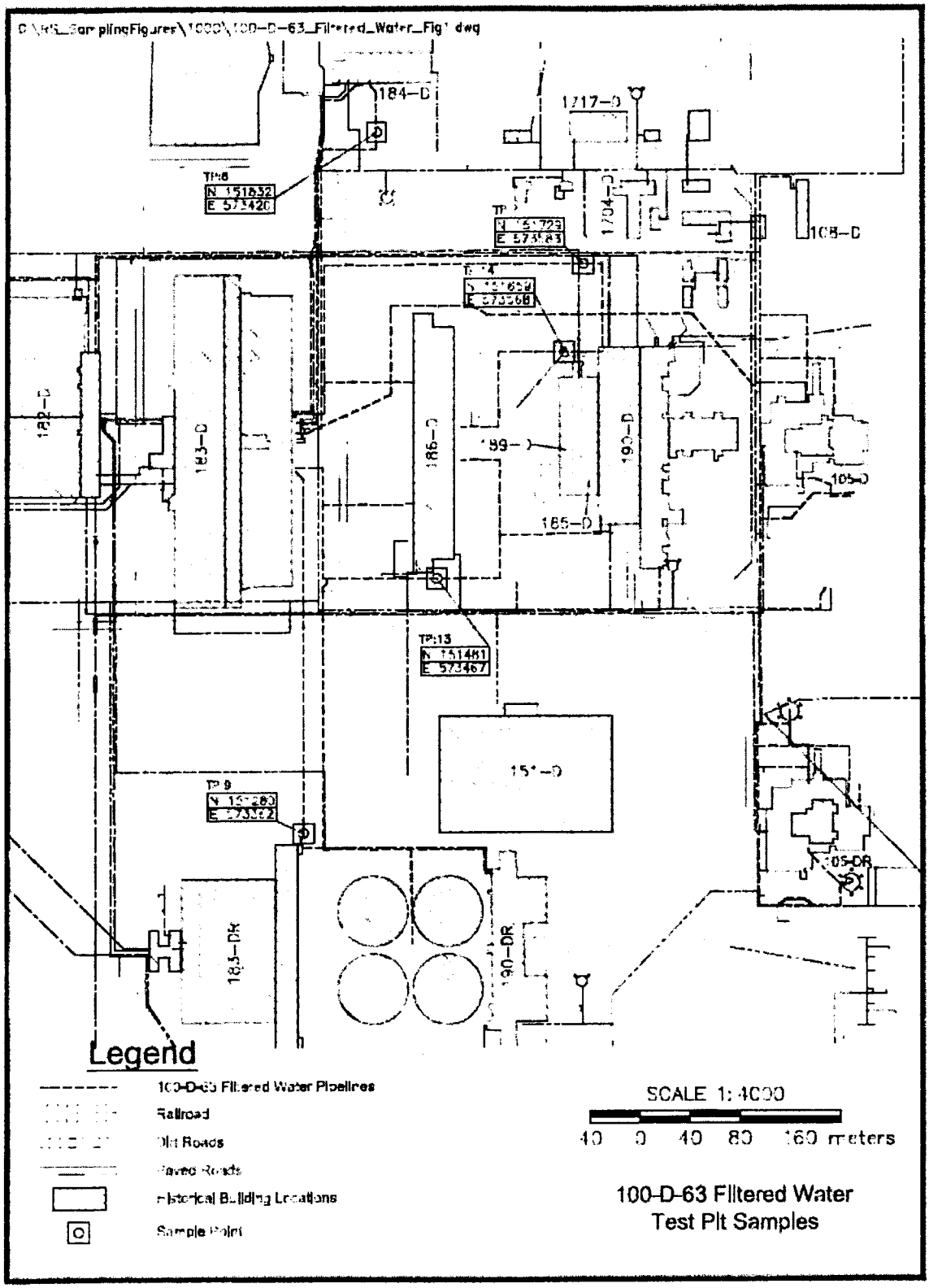


Figure 9. 100-D-63 Sanitary Water Test Pit Locations.

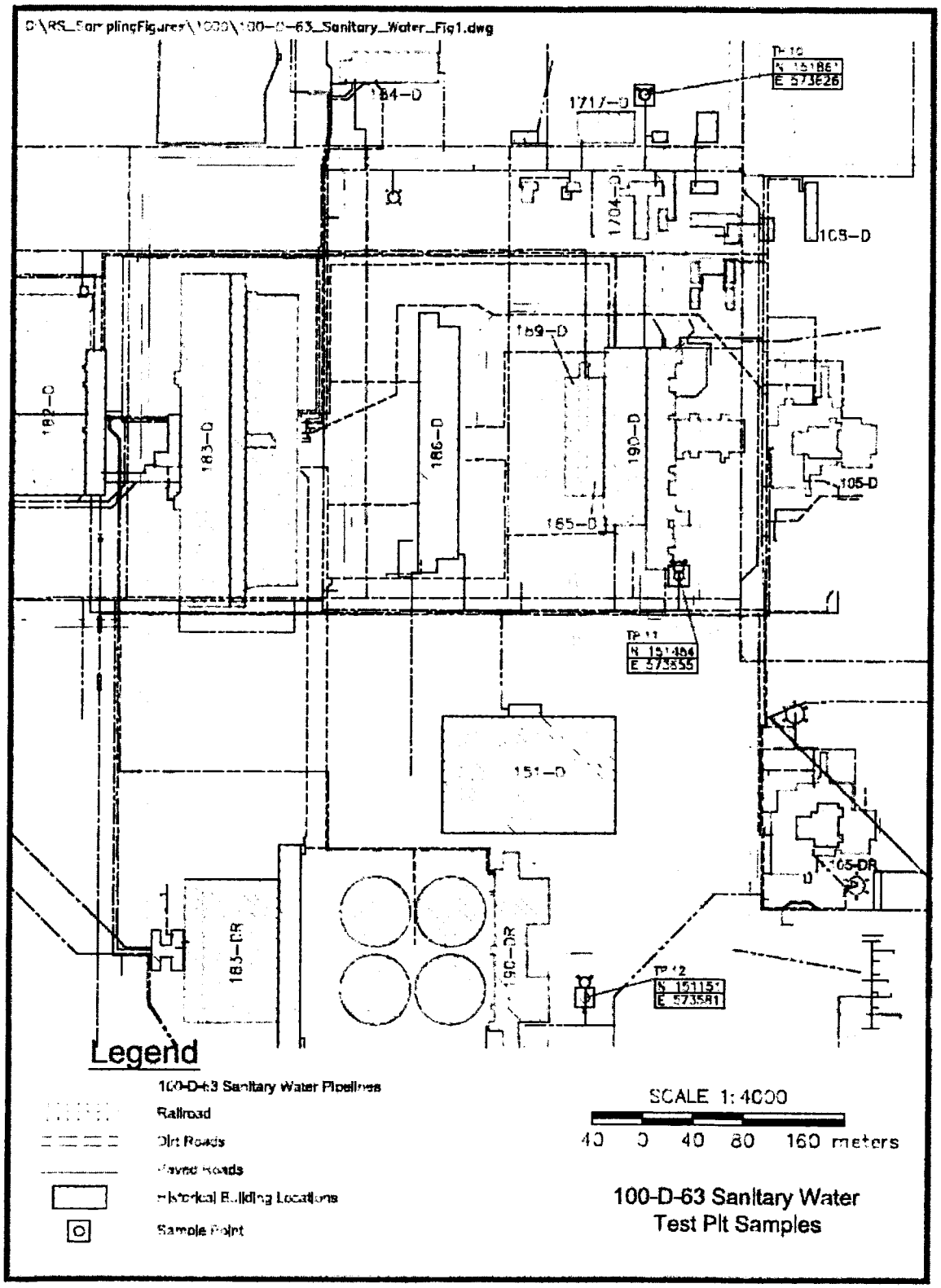


Figure 10. 100-D-63 Condenser Return Water Test Pit Locations.

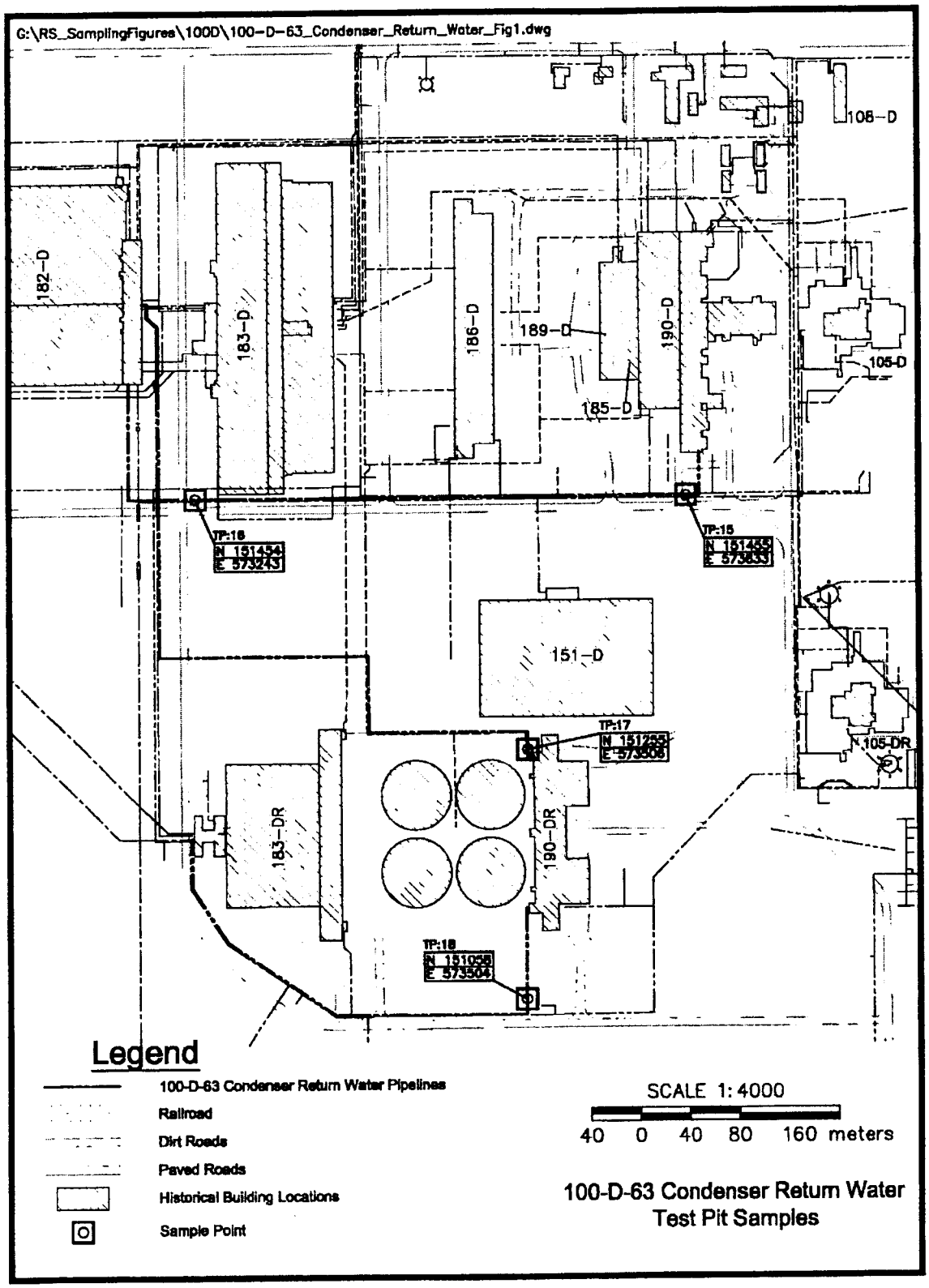


Table 1. 100-D-63 Confirmatory Sample Summary. (3 Pages)

Location Number	Sample Coordinate Locations	Pipeline Depth (bgs)	Sample Collection Date	Sample Media	Sample Number	Sample Analysis
181-D Raw Water						
TP 1	N 151185, E 573191	Pipeline was not sampled due to connection to active waterline via untrustworthy valves.				
TP 2	N 151278, E 573132	Pipeline was not sampled due to connection to active waterline via untrustworthy valves.				
TP 3 [a]	N 151729, E 573580	5 ft	2/11/2010	Pipeline contents - concrete	J19H62	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H77	Hexavalent chromium
				Soil	J19H43	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
182-D Raw Water						
TP 4	N 151424, E 573720	Multiple locations considered; none excavated due to overhead and subsurface power lines.				
TP 5	N 151499, E 573727	6 ft	2/22/2010	Soil	J19H44	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
				Soil (Duplicate)	J19H45	
TP 6 [a]	N 151732, E 573583	10 ft	2/11/2010	Pipeline contents – water	J19H92	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19HB7	Hexavalent chromium
				Soil	J19H41	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
183-D Filtered Water						
TP 7	N 151729, E 573583	10 ft	2/11/2010	Pipeline contents – water	J19H93	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19HB8	Hexavalent chromium
				Soil	J19H42	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP 8 [a]	N 151832, E 573420	4 ft	3/4/2010	Pipeline contents – rust/scale	J19H69	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H83	Hexavalent chromium
				Soil	J19H57	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP 9	N 151280, E 573362	10 ft	3/3/2010	Pipeline contents – sand/ sediment	J19H68	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H82	Hexavalent chromium
				Soil	J19H55	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
				Soil – duplicate	J19H56	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium

Table 1. 100-D-63 Confirmatory Sample Summary. (3 Pages)

Location Number	Sample Coordinate Locations	Pipeline Depth (bgs)	Sample Collection Date	Sample Media	Sample Number	Sample Analysis
183-D Sanitary Water						
TP 10[a]	N 151861, E 573626	4 ft	3/2/2010	Pipeline contents – rust/scale	J19H64	GEA, gross alpha, and gross beta
				Soil	J19H49	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP 11	N 151484, E 573655	10 ft	3/2/2010	Pipeline contents – water	J19H95	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19HC0	Hexavalent chromium
				Soil	J19H47	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP 12	N 151151, E 573581	1 ft	3/3/2010	Pipeline contents – scale	J19H65	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H79	Hexavalent chromium
				Soil	J19H51	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
186-D Filtered Water						
TP13	N 151481, E 573467	7 ft	3/2/2010	Pipeline contents – rust/scale	J19H63	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H78	Hexavalent chromium
				Soil	J19H48	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP14[a]	N 151659, E 573568	4 ft	3/2/2010	Pipeline contents – water	J19H96	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19HC1	Hexavalent chromium
				Soil	J19H50	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
190-D Condenser Water						
TP15	N 151455, E 573633	7 ft	3/15/2010	Pipeline contents – water	J19H97	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19HC2	Hexavalent chromium
				Soil	J19H58	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP16	N 151454, E 573243	6 ft	2/22/2010	Pipeline contents – water	J19H94	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19HB9	Hexavalent chromium
				Soil	J19H46	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium

Table 1. 100-D-63 Confirmatory Sample Summary. (3 Pages)

Location Number	Sample Coordinate Locations	Pipeline Depth (bgs)	Sample Collection Date	Sample Media	Sample Number	Sample Analysis
190-DR Condenser Water						
TP17	N 151255, E 573506	6 ft	3/3/2010	Pipeline contents – rust/scale	J19H67	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H81	Hexavalent chromium
				Soil	J19H53	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
TP18	N 151058, E 573504	10 ft	3/3/2010	Pipeline contents – rust/scale	J19H66	GEA, gross alpha, gross beta, ICP metals [b], and mercury
					J19H80	Hexavalent chromium
				Soil	J19H52	GEA, gross alpha, gross beta, ICP metals [b], mercury, and hexavalent chromium
Equipment blank	NA	NA	3/3/2010	Silica sand	J19H54	ICP metals [b], mercury, and hexavalent chromium

[a] Test pit location was moved due to overhead, surface, or subsurface interferences noted in the field.
[b] The expanded list of ICP metals was performed to include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc in the analytical results package.

bgs = below ground surface
GEA = gamma energy analysis
ICP = inductively coupled plasma
NA = not applicable

Confirmatory sampling data for the 100-D-63 waste site is presented in Appendix C. The laboratory-reported confirmatory data results for all samples and constituents associated with the 100-D-63 waste site are stored in the Environmental Restoration (ENRE) project-specific database prior to archival in the Hanford Environmental Information System (HEIS). A summary of field observations for each test pit excavation is provided below.

181-D Raw Water Service Area

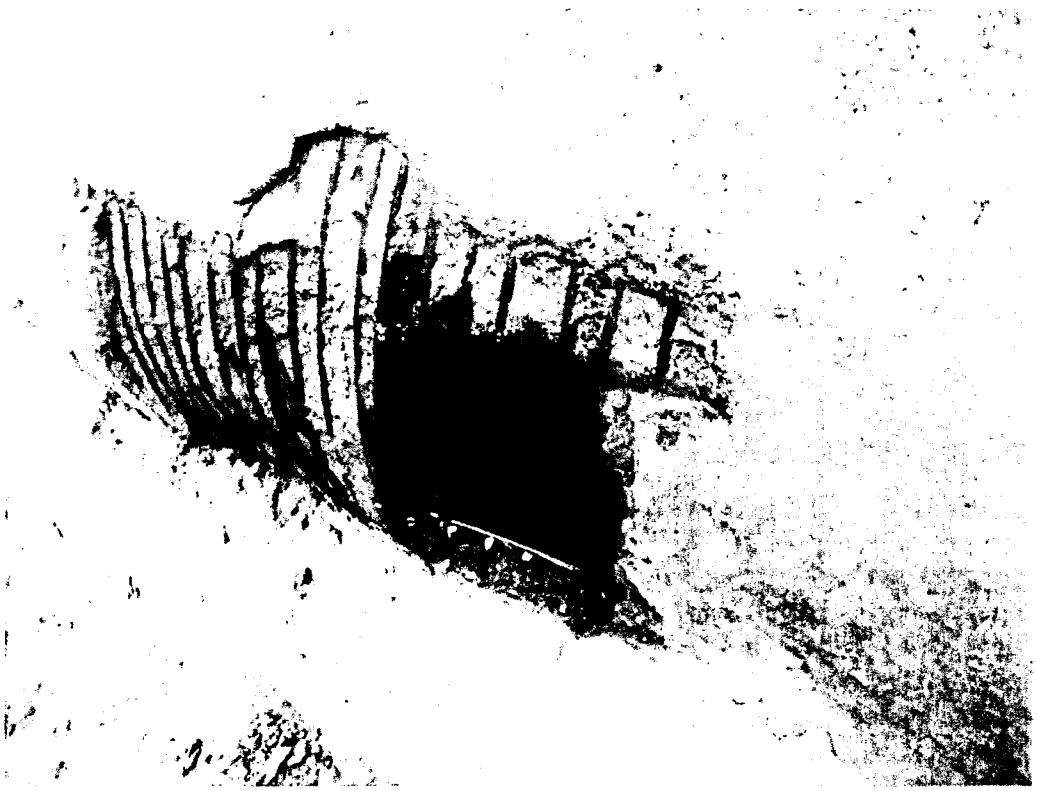
Three test pits were planned for excavation and sampling to evaluate the 181-D raw water pipelines.

- Test pits 1 and 2 were relocated due to proximity to the export waterline and overhead power lines. The test pits were excavated on February 17, 2010; however, upon field inspection, a decision was made not to cut into these pipelines to collect samples since it was possible they may be connected to the active water line.

- Test pit 3 was excavated on February 4 and 9, 2010 and coincided with the excavation for test pits 6 and 7. A 42-in.-diameter, 0.6-cm (1/4-in.)-thick steel pipe, wrapped with 0.95-cm (3/8-in.)-thick wire, was encountered at a depth of approximately 1.5 m (5 ft). The pipeline had an approximate 1.9-cm (3/4-in.)-thick inner and outer concrete lining. The outer lining was slightly damaged, probably from excavating. The inner concrete lining was very broken

up and sloughed to the floor of the pipe, probably from previous heavy equipment work in the area. The entire length of exposed pipeline was underlain with a layer of concrete up to 0.9 m (3 ft) thick. A sample access port was cut into the side of the pipeline on February 10, 2010 (Figure 11). A sample of brown stained concrete from inside the pipeline and a sample of soil adjacent to the outside of the pipeline were collected on February 11, 2010.

Figure 11. Photograph of Pipeline Sampling Access (Test Pit 3).



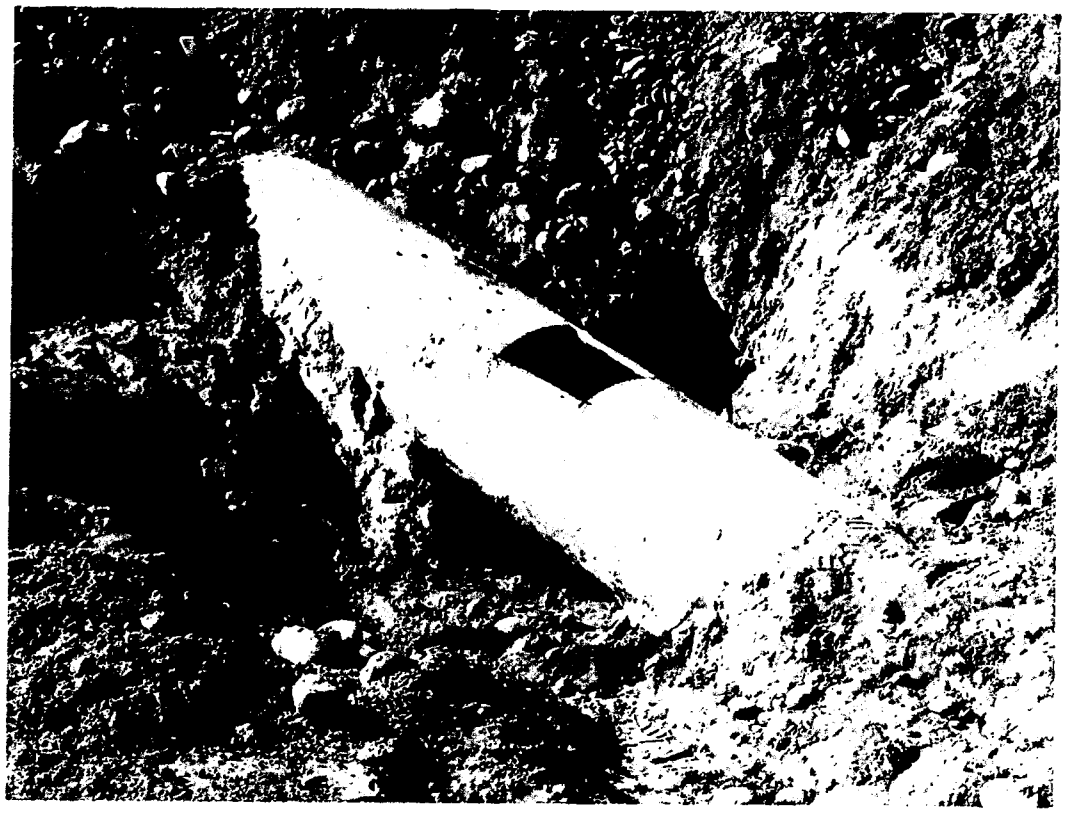
182-D Raw Water Service Area

Three test pits were planned for excavation and sampling to evaluate the 182-D raw water pipelines.

- Test pit 4 was not excavated due to overhead and subsurface power lines.

- Test pit 5 was excavated on February 8 and 17, 2010 and sampled on February 22, 2010. A 21-in.-diameter, 0.5 cm (1/2-in.)-thick steel pipe was located at a depth of 1.8 m (6 ft) and found to be in good condition. A sample access port was cut into the top of the pipeline (Figure 12). Muddy, rust material was visible on the bottom of the pipe; however, insufficient media was present to collect a sample of the contents of the pipe. One soil sample and a duplicate soil sample from below the pipeline were collected for laboratory analyses.

Figure 12. Photograph of Pipeline Sampling Access (Test Pit 5).



- Test pit 6 was excavated on February 4 and 9, 2010 and coincided with the excavation of test pits 3 and 7. A 2.5-cm (1-in.)-thick steel pipe with an estimated diameter of 91 to 107 cm (36 to 42 in.), was encountered at a depth of approximately 3 m (10 ft). A sample access port was cut into the top of the pipeline on February 10, 2010 (Figure 13). Very little rust or scale was present and the pipe was half filled with relatively clear water (Figure 14). A sample of water from inside the pipeline and a sample of soil below the pipeline were collected on February 11, 2010.

Figure 13. Photograph of Pipeline Sampling Access (Test Pit 6).

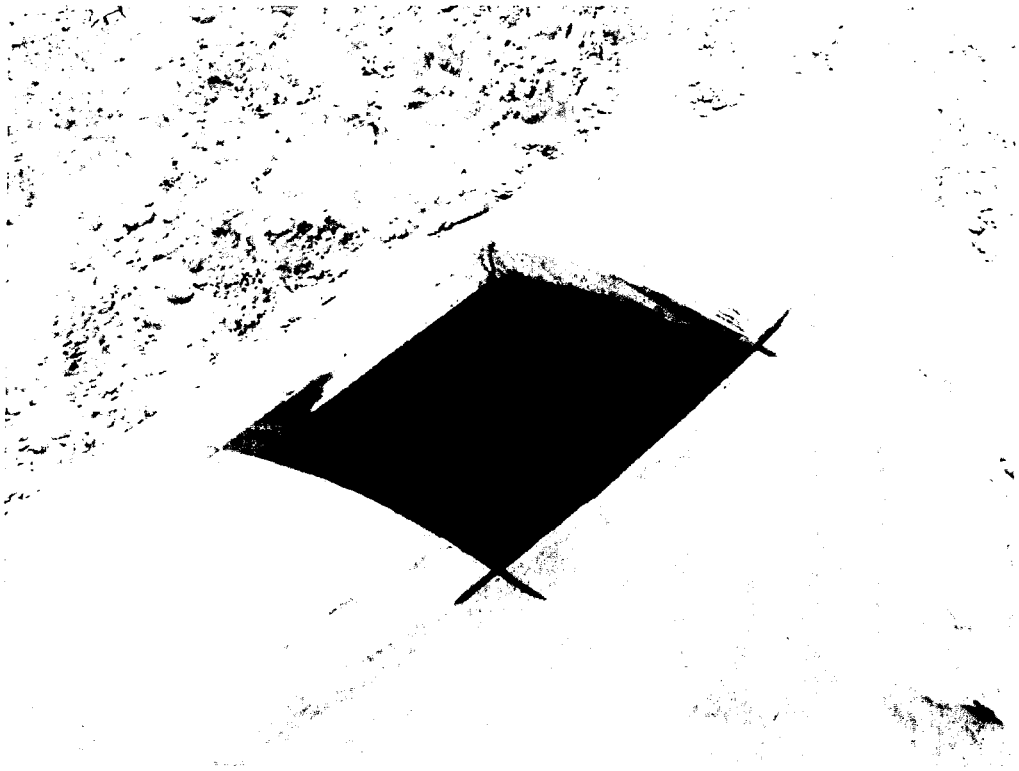


Figure 14. Photograph of Inside of Pipeline (Test Pit 6).

183-D Filtered Water Service Area

Three test pits were excavated and sampled to evaluate the 183-D filtered water pipelines.

- Test pit 7 was excavated on February 4 and 9, 2010, and coincided with the excavation for test pits 3 and 6. A 36-in.-diameter steel pipeline was encountered at a depth of approximately 3 m (10 ft) (Figure 15). A sample access port was cut into the top of the pipeline on February 10, 2010. The pipeline was nearly filled with water (within 8 cm [3 in.] of the top of the pipe). A sample of the water from inside the pipeline and a sample of soil below the pipeline were collected on February 11, 2010. The sample water had some rust color, but otherwise was clear.

Figure 15. Photograph of Exposed Pipeline (Test Pit 7).

- An 11-in.-diameter, 0.4-cm (3/8-in.)-thick iron pipeline associated with test pit 8 was exposed at a depth of approximately 1.2 m (4 ft) in a previous non-related excavation. The pipeline was observed to be in good condition. A sample access port was cut into the top of the pipeline on March 4, 2010 (Figure 16). The pipe was noted as having a rusty, muddy crust/scale inside. A sample of the rust/scale from inside the pipeline and a sample of soil below the pipeline were collected on March 4, 2010.

Figure 16. Photograph of Exposed Pipeline (Test Pit 8).

- Test pit 9 was excavated on February 8 and 16, 2010. A 36-in.-diameter, 2.5-cm (1-in.)-thick cast iron pipe, was encountered at a depth of approximately 3 m (10 ft) (Figure 17). A sample access port was cut into the top of the pipeline on March 3, 2010. Approximately 8 to 10 cm (3 to 4 in.) of muddy sand was present inside the pipe and suspected to be associated with water intrusion from previous remediation or demolition activities. A sample of sediment from inside the pipeline and a sample of soil below the pipeline and a duplicate soil sample were collected on February 11, 2010.

183-D Sanitary Water Service Area

Three test pits were excavated and sampled to evaluate the 183-D sanitary water pipelines.

- Test pit 10 was excavated on February 4, 2010. A 7-in.-diameter rusty steel pipe was encountered at a depth of approximately 1.2 m (4 ft) (Figure 18). A front-end loader was used to break open the pipe. Limited rust was available inside the pipe for sample collection and therefore only radionuclides were analyzed. The rust sample and a sample of soil below the pipeline were collected on March 2, 2010.

- Test pit 11 was excavated on February 5, 2010. A 7-in.-diameter rusty steel pipe, part of the fire loop system, was encountered at a depth of approximately 3 m (10 ft) (Figure 19). The pipe was drilled to obtain access. The pipe was filled with water. A sample of the water from inside the pipe and a sample of soil directly below the pipeline were collected on March 2, 2010.

Figure 17. Photograph of Exposed Pipeline (Test Pit 9).

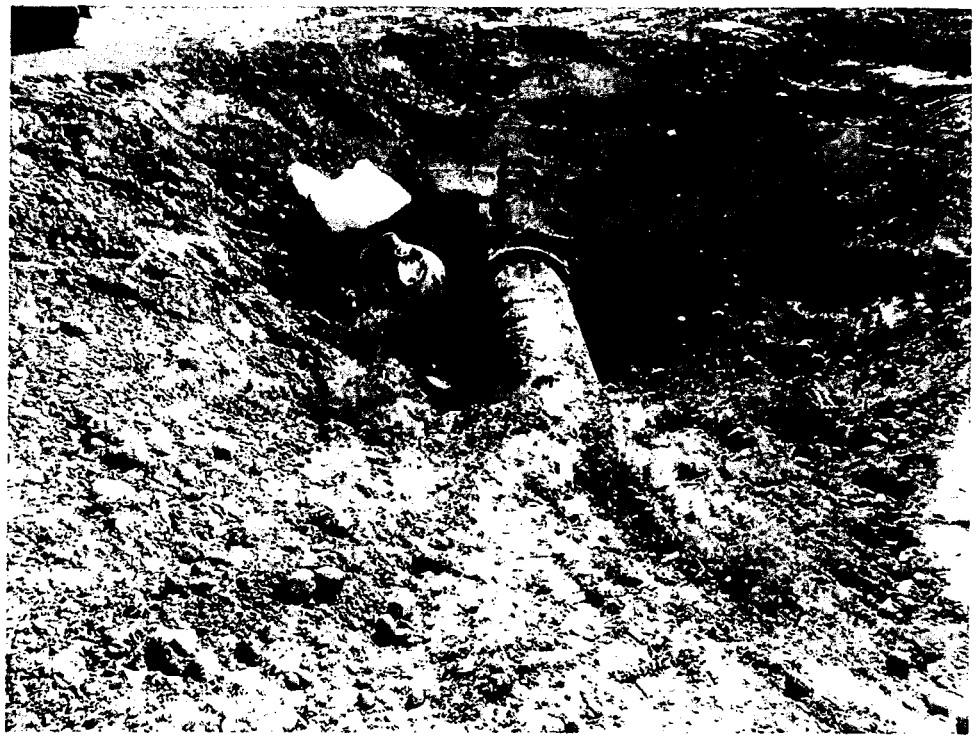
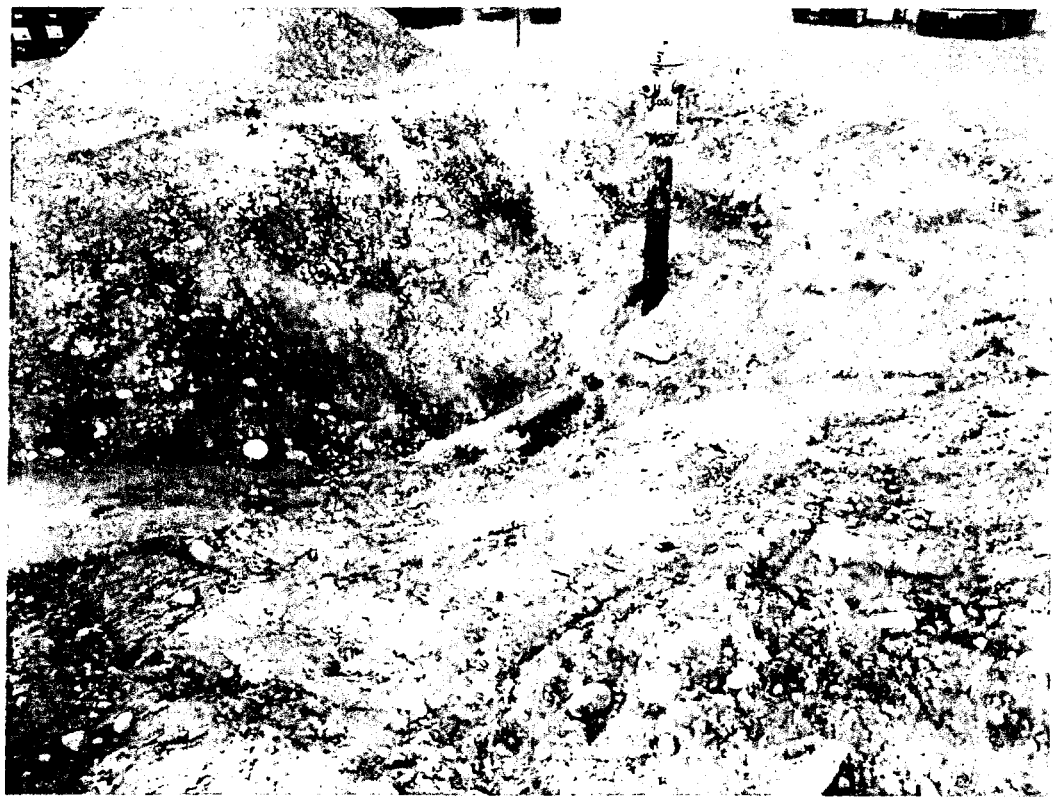


Figure 18. Photograph of Inside of Pipeline (Test Pit 10).

Figure 19. Photograph of Exposed Pipeline (Test Pit 11).



- On February 3, 2010, the pipeline at the test pit 12 location was noted to be broken-up at the surface of the soil to a depth of 0.3 m (1 ft). The broken pipe was approximately 15 cm (6 in.) in diameter, cast iron, and filled with sand (Figure 20). A layer of white, gray solid material was present, coating the inside bottom of the pipe. A sample of this material and one sample of soil below the pipe were collected on March 3, 2010.

186-D Filtered Water Service Area

Two test pits were excavated and sampled to evaluate the 183-D filtered water pipelines.

- Test pit 13 was excavated on February 5, 2010. A 38-in.-diameter, 2.5-cm (1-in.)-thick rusty steel pipe was encountered at a depth of 2.1 m (7 ft). The pipe was tapped and found to be dry. The excavator bucket broke into the pipe and rust and scale was found to be present (Figure 21). A sample of the rust and scale from inside the pipe and a sample of soil directly below the pipeline were collected on March 2, 2010.

- Test pit 14 was excavated on February 4, 2010. A 36-in.-diameter, 0.9-cm (3/8-in.)-thick steel pipe with an inside rubber lining was encountered at a depth of 1.2 m (4 ft). The pipe was heavily damaged and water was present in the pipeline, likely from previous remediation activities. No scale was present inside the pipe (Figure 22). A sample of water from inside the pipe and a sample of soil directly below the pipeline were collected on March 2, 2010.

Figure 20. Photograph of Exposed Pipeline (Test Pit 12).

Figure 21. Contents of Pipeline (Test Pit 13).

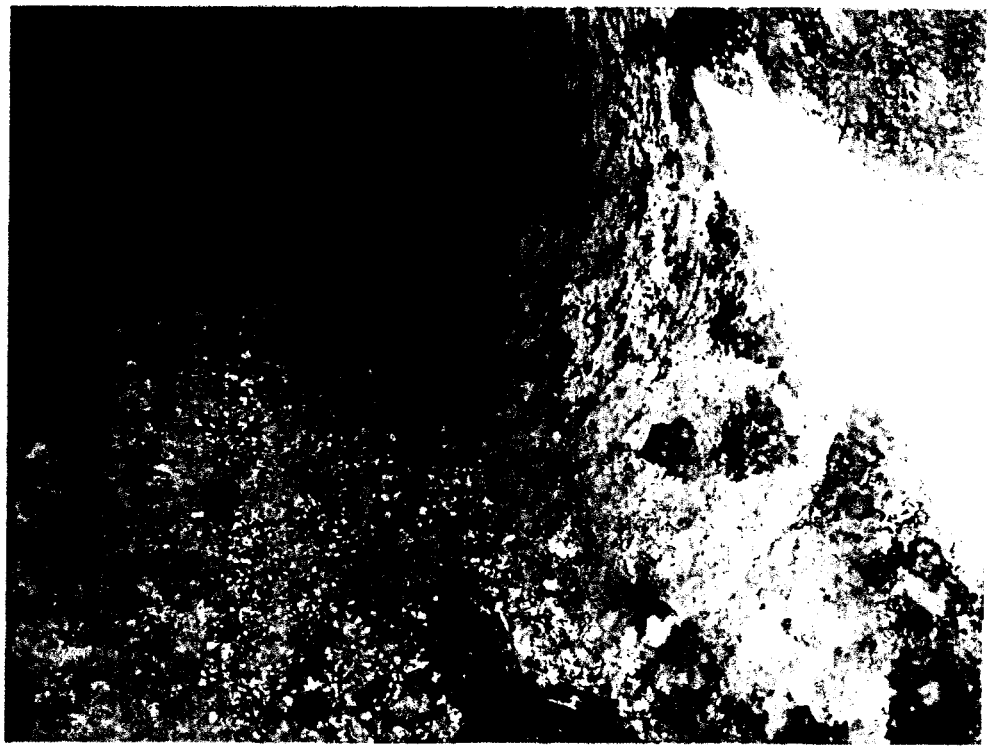
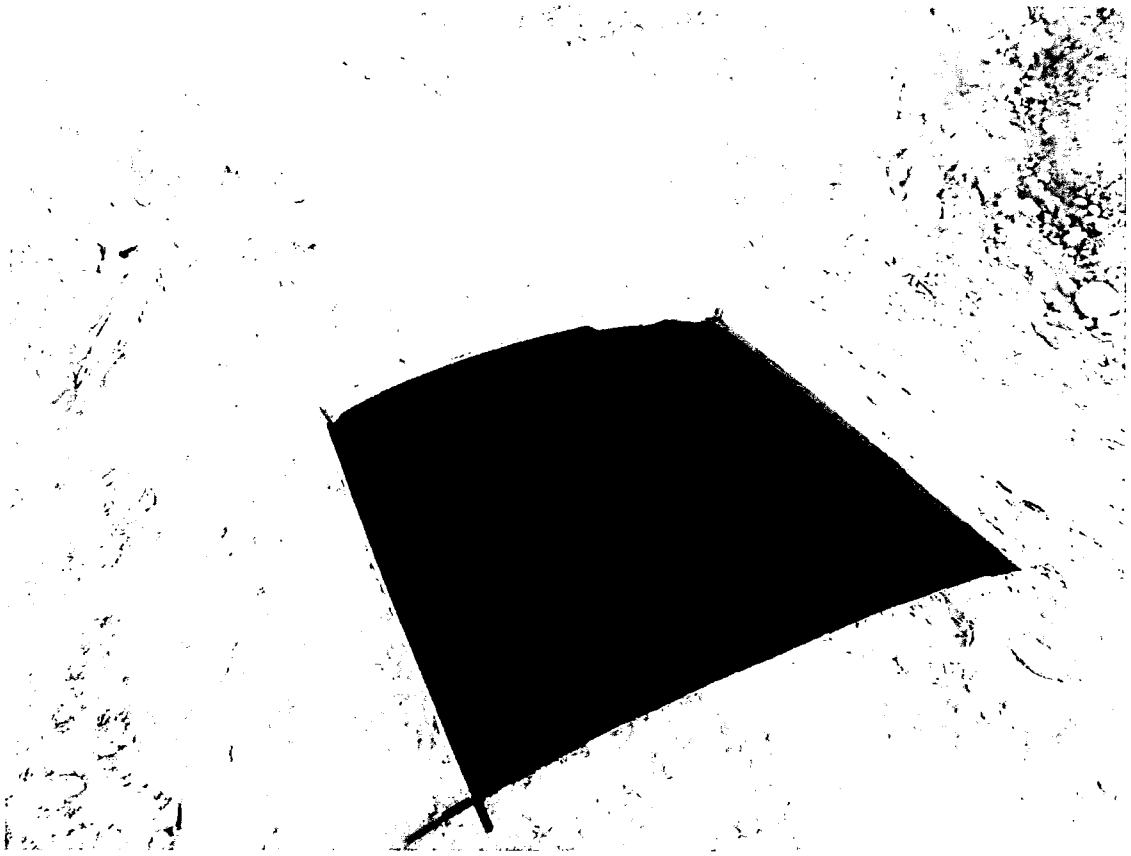


Figure 22. Pipeline Sampling Access (Test Pit 14).



190-D Condenser Water Service Area

Two test pits were excavated and sampled to evaluate the 190-D condenser water pipelines.

- Test pit 15 was excavated and sampled on March 15, 2010. A 20-in.-diameter steel pipe was encountered at a depth of 2.1 m (7 ft) (Figure 23). The pipe was tapped and water under pressure due to head differential was present and sampled. A sample of the water from inside the pipe and a sample of soil directly below the pipeline were collected on March 15, 2010. The sampling port was plugged with a self-tapping screw after completion of sampling.

- Test pit 16 was excavated on February 5 and 9, 2010. A 22-in.-diameter steel pipe was encountered at a depth of 1.8 m (6 ft) (Figure 24). The pipe was tapped and approximately 15 cm (6 in.) of water was present inside the pipeline. A sample of the water from inside the pipe and a sample of soil directly below the pipeline were collected on February 22, 2010.

Figure 23. Pipeline Exposed in Excavation (Test Pit 15).

Figure 24. Pipeline Exposed in Excavation (Test Pit 16).

190-DR Condenser Water Service Area

Two test pits were excavated and sampled to evaluate the 190-DR condenser water pipelines.

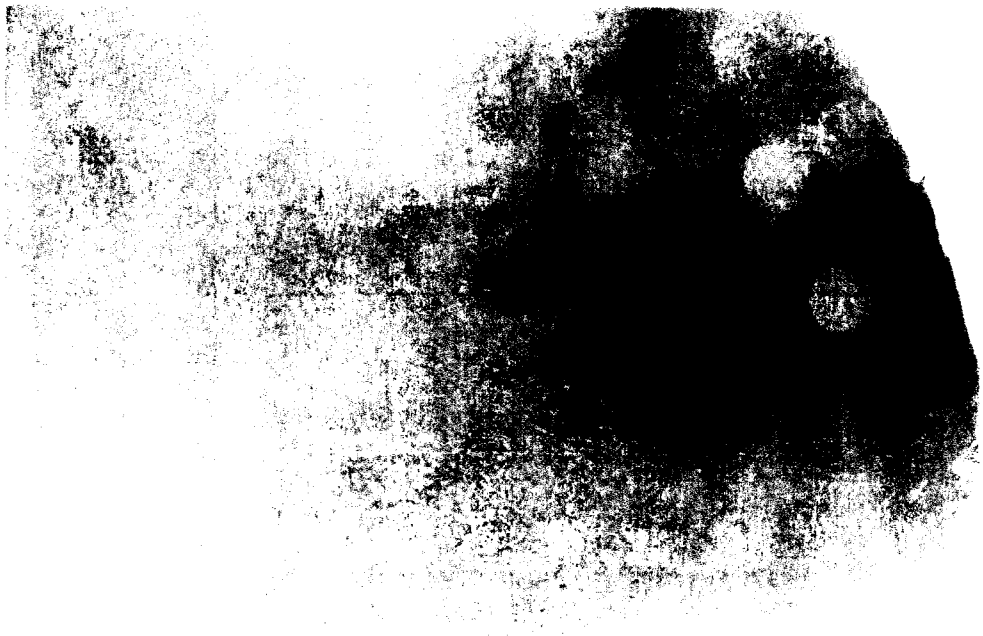
- Test pit 17 was excavated on February 2 and 3, 2010. A 20-in.-diameter, 1.3-cm (1/2-in.)-thick steel pipe with a mastic outer coating was encountered at a depth of 1.8 m (6 ft). The pipe was in good condition. The pipe was tapped and found empty. A saw was used to cut a port for sampling access. Rusty scale was present inside the pipe (Figure 25). A sample of the rusty scale from inside the pipe and a sample of soil directly below the pipeline were collected on March 3, 2010.

Figure 25. Pipeline Sampling Access (Test Pit 17).

- Test pit 18 was excavated on January 26 and 27, 2010 and February 1, 2, and 3, 2010. A 24-in.-diameter, 0.9-cm (3/8-in.)-thick steel pipe with a mastic outer coating was encountered at a depth of 3 m (10 ft). The pipe was in good condition. The pipe was tapped and found empty (Figure 26). A saw was used to cut a port for sampling access. Rust and scale were present inside the pipe (Figure 27). A sample of the rusty scale from inside the pipe and a sample of soil directly below the pipeline were collected on March 3, 2010.

Figure 26. Pipeline Sampling Access (Test Pit 18).

Figure 27. Pipeline Contents (Test Pit 18).



CONFIRMATORY SAMPLE RESULTS

The confirmatory sampling data set for the 100-D-63 pipelines is presented in Appendix C. The laboratory-reported results for all constituents are stored in the ENRE project-specific database prior to archival in the HEIS. The analytical data for the pipeline contents (e.g., water, scale, rust, sediment) and underlying soil were evaluated separately for each of the 100-D-63 service areas and presented in comparison tables. The pipelines were intact and in good condition at all locations except for the 186-D Filtered Water Service Area.

At the 181-D Raw Water Service Area, concrete rubble associated with inner concrete pipe lining was found and sampled in test pit 3 (Figure 3), along with a sample of underlying soil. These sample results are presented in Table 2.

At the 182-D Raw Water Service Area, soil under the pipe (Table 3a) and water from the pipe (Table 3b) were sampled.

At the 183-D Filtered Water Service Area, soil under the pipe and rust, scale, and/or sediment material were sampled. These results are presented in Table 4a. The results of a water sample from this pipeline are presented in Table 4b.

At the 183-D Sanitary Water Service Area, rust and white scale, as well as underlying soil were sampled (Table 5a). Minimal scale material was available for sampling; therefore, only radionuclides were analyzed. Additionally, a water sample was collected from the pipeline (Table 5b).

At the 186-D Filtered Water Service Area, the pipeline was damaged from previous demolition or remediation activities in this area, and water was present in the pipeline that is believed to have originated from those previous activities. Samples were collected from rust/scale and underlying soil (Table 6a), and water from within the pipeline (Table 6b).

At the 190-D Condenser Water Service Area, no pipe contents were available for sampling; therefore, a sample of the underlying soil was collected (Table 7a), and a sample of water from the pipeline was collected (Table 7b).

At the 190-DR Condenser Water Service Area, the underlying soil and rust/scale material were both sampled. The results are presented in Table 8.

Table 2. Comparison of Maximum Values to Remedial Action Goals for the 181-D Raw Water Service Area (J19H43, J19H62, J19H77).

COC/COPC	Maximum Concrete Result (mg/kg)	Maximum Soil Result (mg/kg)	Soil Cleanup Levels (mg/kg)[a]			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling or Other Evaluation?
			Direct Exposure	Groundwater Protection	River Protection		
Antimony	4.7 (<BG)[b]	ND	32	5[c]	5[c]	No	--
Arsenic	43	3.6 (<BG)	20[c]	20[c]	20[c]	Yes	Yes[d]
Barium	110 (<BG)[b]	72 (<BG)	5,600	200	400	No	--
Beryllium	0.92 (<BG)[b]	0.79 (<BG)	10.4[e]	1.51[c]	1.51[c]	No	--
Boron[f]	7	ND	7,200	320	--	No	--
Cadmium	ND	0.094 <(BG)	13.9[e]	0.81[c]	0.81[c]	No	--
Chromium (total)	12 (<BG)[b]	14 (<BG)	80,000	18.5[c]	18.5[c]	No	--
Cobalt	13 (<BG)[b]	6.2 (<BG)	24	15.7	--	No	--
Copper	62	15 (<BG)	2,960	59.2[c]	22.0[c]	Yes	Yes[d]
Lead	4.4 (<BG)[b]	3.9 (<BG)	353	10.2[c]	10.2[c]	No	--
Manganese	290 (<BG)[b]	290 (<BG)	3,760	512[c]	512[c]	No	--
Molybdenum[f]	2	ND	400	8	--	No	--
Nickel	11 (<BG)[b]	13 (<BG)	1,600	19.1[c]	27.4	No	--
Uranium, total	0.93 (<BG)[b]	NA	240	3.21[c]	3.21	No	--
Tin[f]	6.2	NA	48,000	960	--	No	--
Vanadium	42 (<BG)[b]	35 (<BG)	560	85.1[c]	--	No	--
Zinc	190	35 (<BG)	24,000	480	67.8[c]	Yes	Yes[d]

[a] Remedial action goals (RAGs) obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b).

[b] The concrete sample results were conservatively compared against soil background concentrations as a point of reference.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

[d] Multiple metals are present in residual pipe rust/scale at concentrations exceeding groundwater and river protection soil RAGs. The evaluation of these constituents is discussed further in the Data Evaluation section of this document.

[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
NA = not analyzed
ND = not detected
RAG = remedial action goal
RESRAD = RESidual RADioactivity
K_d = distribution coefficient
WAC = *Washington Administrative Code*

Table 3a. Comparison of Maximum Values to Remedial Action Goals for the 182-D Raw Water Service Area (J19H41, J19H44, J19H45).

COC/COPC	Maximum Soil Result (mg/kg)	Soil Cleanup Levels (mg/kg)[a]			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Groundwater Protection	River Protection		
Arsenic	3.3 (<BG)	20[b]	20[b]	20[b]	No	--
Barium	61 (<BG)	5,600	200	400	No	--
Beryllium	0.86 (<BG)	10.4[c]	1.51[b]	1.51[b]	No	--
Cadmium	0.09 (<BG)	13.9[c]	0.81[b]	0.81[b]	No	--
Chromium (total)	12 (<BG)	80,000	18.5[b]	18.5[b]	No	--
Cobalt	6.1 (<BG)	24	15.7[b]	--	No	--
Copper	14 (<BG)	2,960	59.2	22.0[b]	No	--
Lead	4 (<BG)	353	10.2[b]	10.2[b]	No	--
Manganese	280 (<BG)	3,760	512[b]	512[b]	No	--
Molybdenum[d]	0.26	400	8	--	No	--
Nickel	12 (<BG)	1,600	19.1[b]	27.4	No	--
Vanadium	39.3 (<BG)	560	85.1[b]	--	No	--
Zinc	34 (<BG)	24,000	480	67.8[b]	No	--

[a] RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b).
[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.
[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[d] No Hanford Site-specific background or Washington State background available.

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

Table 3b. Comparison of Maximum Values of Water Samples to Groundwater Criteria and MCLs for the 182-D Raw Water Service Area (J19H92, J19HB7).

COPC	Maximum Water Result (µg/L)	Groundwater Cleanup Levels (µg/L)			
		Method B	Primary MCL	Secondary MCL	State MCL/SMCL
Barium	2.4	3,200	2,000	--	2,000
Boron	24	3,200	--	--	--
Copper	2.4	640	1,300[a]	1,000	1,000
Manganese	13	752	--	50	50
Vanadium	1.3	112	--	--	--

[a] Value reflects the primary drinking water standard.

-- = no criteria available
COPC = contaminant of potential concern
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level

Table 4a. Comparison of Maximum Values to Remedial Action Goals for the 183-D Filtered Water Service Area (J19H42, J19H55, J19H56, J19H57, J19H68, J19H69, J19H82, J19H83).

COC/COPC	Maximum Rust/Scale/ Sediment Result (pCi/g)	Maximum Soil Result (pCi/g)	Generic Site Lookup Values (pCi/g)[a]			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling or Other Evaluation?
			Direct Exposure	Groundwater Protection	River Protection		
Radionuclides							
Cesium-137	0.068 (<BG)[b]	ND	6.2	1,465	2,930	No	--
Uranium-233/234	ND	0.107 (<BG)	1.1[c]	1.1[c]	1.1[c]	No	--
Uranium-238	ND	0.113 (<BG)	1.1[c]	1.1[c]	1.1[c]	No	--
Metals							
COC/COPC	**Maximum Rust/Scale/ Sediment Result (mg/kg)**	**Maximum Soil Result (mg/kg)**	**Soil Cleanup Levels (mg/kg)[a]**			**Does the Maximum Result Exceed RAGs?**	**Does the Maximum Result Pass RESRAD Modeling or Other Evaluation?**
			Direct Exposure	**Groundwater Protection**	**River Protection**		
Antimony	7.82	ND	32	5[c]	5[c]	Yes	Yes[d]
Arsenic	23.1	3.0 (<BG)	20[c]	20[c]	20[c]	Yes	Yes[d]
Barium	80.1 (<BG)[b]	75.5 (<BG)	5,600	200	400	No	--
Beryllium	0.214 (<BG)[b]	0.79 (<BG)	10.4[e]	1.51[c]	1.51[c]	No	--
Boron[f]	4.91	1.24	7,200	320	--	No	--
Cadmium	1.88	0.151 <(BG)	13.9[e]	0.81[c]	0.81[c]	Yes	Yes[d]
Chromium (total)	164	11 (<BG)	80,000	18.5[c]	18.5[c]	Yes	Yes[d]
Chromium VI[f]	0.569	ND	2.1[e]	4.8	2	--	--
Cobalt	33.2	7.61 (<BG)	24	15.7[c]	--	Yes	Yes[d]
Copper	414	15.4 (<BG)	2,960	59.2	22.0[c]	Yes	Yes[d]
Lead	27.6	7.42 (<BG)	353	10.2[c]	10.2[c]	Yes	Yes[d]
Manganese	911	354 (<BG)	3,760	512[c]	512[c]	Yes	Yes[d]
Mercury	2.22	0.0100 (<BG)	24	0.33[c]	0.33[c]	Yes	Yes[d]
Molybdenum[f]	29.2	0.536	400	8	--	Yes	Yes[c]
Nickel	152	11 (<BG)	1,600	19.1[c]	27.4	Yes	Yes[d]
Vanadium	33.4 (<BG)[b]	63.6 (<BG)	560	85.1[c]	--	No	--
Zinc	187	48.1 (<BG)	24,000	480	67.8[c]	Yes	Yes[d]

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b).
[b] The rust/scale/sediment sample results were conservatively compared against soil background concentrations as a point of reference.
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.
[d] Multiple metals are present in residual pipe rust/scale at concentrations exceeding groundwater and river protection soil RAGs. The evaluation of these constituents is discussed further in the Data Evaluation section of this document.
[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[f] No Hanford Site-specific background or Washington State background available.

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
ND = not detected
RAG = remedial action goal
RESRAD = RESidual RADioactivity
WAC = Washington Administrative Code

Table 4b. Comparison of Maximum Values of Water Samples to Groundwater Criteria and MCLs for the 183-D Filtered Water Service Area (J19H93, J19HB8).

COPC	Maximum Water Result (µg/L)	Groundwater Cleanup Levels (µg/L)			
		Method B	Primary MCL	Secondary MCL	State MCL/SMCL
Barium	9.3	3,200	2,000	--	2,000
Boron	27	3,200	--	--	--
Chromium (total)	2.7	24,000	100	--	100
Cobalt	1.2	4.8	--	--	--
Copper	2.4	640	1,300[a]	1,000	1,000
Manganese	69	752	--	50	50
Mercury	0.085	4.8	2.00	--	2
Nickel	1.3	320	--	--	100
Uranium	0.095	48	30	--	30
Vanadium	3.2	112	--	--	--

[a] Value reflects the primary drinking water standard.

-- = no criteria available

COPC = contaminant of potential concern

MCL = maximum contaminant level

SMCL = secondary maximum contaminant level

Table 5a. Comparison of Maximum Values to Remedial Action Goals for the 183-D Sanitary Water Service Area (J19H47, J19H49, J19H51, J19H64, J19H65, J19H79, J19H95, J19HCO). (2 Pages)

COC/COPC	Maximum Rust/Scale Result (pCi/g)	Maximum Soil Result (pCi/g)	Generic Site Lookup Values (pCi/g)[a]			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling?
			Direct Exposure	Groundwater Protection	River Protection		
Radionuclides							
Cesium-137	0.12 (<BG)	ND	6.2	1,465	2,930	No	--
Strontium-90	0.294	ND	4.5	27.6	55.2	No	--
Uranium-233/234	ND	0.668 (<BG)	1.1[b]	1.1[b]	1.1[b]	No	--
Uranium-238	ND	0.488 (<BG)	1.1[b]	1.1[b]	1.1[b]	No	--
COC/COPC	**Maximum Rust/Scale Result (mg/kg)**	**Maximum Soil Result (mg/kg)**	**Soil Cleanup Levels (mg/kg)[a]**			**Does the Maximum Result Exceed Lookup Values?**	**Does the Maximum Result Pass RESRAD Modeling?**
			Direct Exposure	**Groundwater Protection**	**River Protection**		
Metals							
Arsenic	7.72	3.12 (<BG)	20[b]	20[b]	20[b]	No	--
Barium	56.3 (<BG)	67.9 (<BG)	5,600	200	400	No	--
Beryllium	0.149 (<BG)[c]	0.176 (<BG)	10.4[d]	1.51[b]	1.51[b]	No	--
Boron[e]	1.35	2.05	7,200	320	--	No	--
Cadmium	0.134 (<BG)[c]	0.158 <(BG)	13.9[d]	0.81[b]	0.81[b]	No	--
Chromium (total)	12.4 (<BG)[c]	10.2 (<BG)	80,000	18.5[b]	18.5[b]	No	--
Chromium VI[e]	0.494	0.14	2.1[d]	4.8	2	No	--
Cobalt	5.81 (<BG)[c]	6.51 (<BG)	24	15.7[b]	--	No	--
Copper	19.5 (<BG)[c]	14.6 (<BG)	2,960	59.2	22.0[b]	No	--
Lead	3.35 (<BG)[c]	300	353	10.2[b]	10.2[b]	Yes	Yes[f]
Manganese	282 (<BG)[c]	276 (<BG)	3,760	512[b]	512[b]	No	--

Table 5a. Comparison of Maximum Values to Remedial Action Goals for the 183-D Sanitary Water Service Area (J19H47, J19H49, J19H51, J19H64, J19H65, J19H79, J19H95, J19HCO). (2 Pages)

COC/COPC	Maximum Rust/Scale Result (mg/kg)	Maximum Soil Result (mg/kg)	Soil Cleanup Levels (mg/kg)[a]			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling?
			Direct Exposure	Groundwater Protection	River Protection		
Mercury	ND	0.0303 (<BG)	24	0.33[b]	0.33[b]	No	--
Molybdenum[e]	0.747	0.335	400	8	--	No	--
Nickel	10.9 (<BG)[c]	10.3 (<BG)	1,600	19.1[b]	27.4	No	--
Vanadium	41.7 (<BG)[c]	44.2 (<BG)	560	85.1[b]	--	No	--
Zinc	34.2 (<BG)[c]	43.6 (<BG)	24,000	480	67.8[b]	No	--

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE/RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B (Ecology 1996), unless otherwise noted.

[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

[c] The rust/scale/sediment sample results were conservatively compared against soil background concentrations as a point of reference.

[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[f] Lead was identified at a concentration exceeding soil RAGs for protection of groundwater and the Columbia River. Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009), residual concentrations of lead having a K_d of 30 mg/L will not migrate more than 2 m (6.6 ft) vertically in 1,000 years. The thickness of the vadose zone underlying the 183-D Sanitary Water pipeline at this location is approximately 25 m (81 ft). Therefore, residual concentrations of lead are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
K_d = distribution coefficient
ND = not detected
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Table 5b. Comparison of Maximum Values of Water Samples to Groundwater Criteria and MCLs for the 183-D Sanitary Water Service Area (J19H95, J19HC0).

COPC	Maximum Water Result (µg/L)	Groundwater Cleanup Levels (µg/L)			
		Method B	Primary MCL	Secondary MCL	State MCL/SMCL
Barium	638	3,200	2,000	--	2,000
Boron	12.7	3,200	--	--	--
Manganese	62.8	752	--	50	50
Molybdenum	5.21	80	--	--	--
Uranium	21.4	48	30	--	30
Vanadium	1.47	112	--	--	--
Zinc	5.4	4,800	--	5,000	5,000

-- = no criteria available
COPC = contaminant of potential concern
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level

Table 6a. Comparison of Maximum Values to Remedial Action Goals for the 186-D Filtered Water Service Area (J19H48, J19H50, J19H63, J19H78).

COC/COPC	Maximum Rust/Scale Result (pCi/g)	Maximum Soil Result (pCi/g)	Generic Site Lookup Values [a]			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling or Other Analysis?
			Direct Exposure	Groundwater Protection	River Protection		
Radionuclides (pCi/g)							
Europium-152	0.744	ND	3.3	-- [b]	-- [b]	No	--
COC/COPC	**Maximum Rust/Scale Result (mg/kg)**	**Maximum Soil Result (mg/kg)**	**Soil Cleanup Levels (mg/kg) [a]**			**Does the Maximum Result Exceed RAGs?**	**Does the Maximum Result Pass RESRAD Modeling?**
			Direct Exposure	**Groundwater Protection**	**River Protection**		
Metals (mg/kg)							
Antimony	6.37	ND	32	5 [c]	5 [c]	Yes	Yes [d]
Arsenic	23.7	3.25 (<BG)	20 [c]	20 [c]	20 [c]	Yes	Yes [d]
Barium	39.8 (<BG) [e]	76.9 (<BG)	5,600	200	400	No	--
Beryllium	ND	0.224 (<BG)	10.4 [f]	1.51 [c]	1.51 [c]	No	--
Boron [g]	1.47	1.15	7,200	320	--	No	--
Cadmium	6.85	0.136 <(BG)	13.9 [f]	0.81 [c]	0.81 [c]	Yes	Yes [d]
Chromium (total)	504	12.1 (<BG)	80,000	18.5 [c]	18.5 [c]	Yes	Yes [d]
Chromium VI [g]	7.84	0.09	2.1 [f]	4.8	2	Yes	Yes [d]
Cobalt	ND	7.15 (<BG)	24	15.7 [c]	--	No	--
Copper	27.5	13.3 (<BG)	2,960	59.2	22.0 [c]	Yes	Yes [d]
Lead	26.0	4.39 (<BG)	353	10.2 [c]	10.2 [c]	Yes	Yes [d]
Manganese	1,320	331 (<BG)	3,760	512 [c]	512 [c]	Yes	Yes [d]
Mercury	5.88	ND	24	0.33 [c]	0.33 [c]	Yes	Yes [d]
Molybdenum [g]	8.67	0.330	400	8	--	Yes	Yes [d]
Nickel	10.5 (<BG) [e]	11.5 (<BG)	1,600	19.1 [e]	27.4	No	--
Silver	0.870	ND	400	8	0.73 [c]	Yes	Yes [d]
Vanadium	70.8 (<BG) [e]	52.8 (<BG)	560	85.1 [c]	--	No	--
Zinc	465	40.5 (<BG)	24,000	480	67.8 [c]	Yes	Yes [d]

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

[b] No value; because the K_d value for this contaminant is 200 mL/g, RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009) predicts that the contaminant will show no migration within the 100 Area vadose zone, and no impact on groundwater or the Columbia River.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

[d] Multiple metals are present in residual pipeline rust/scale at concentrations exceeding groundwater and river protection soil RAGs. The evaluation of these constituents is discussed further in the Data Evaluation section of this document.

[e] The rust/scale/sediment sample results were conservatively compared against soil background concentrations as a point of reference.

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

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

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
K_d = distribution coefficient
ND = not detected
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Table 6b. Comparison of Maximum Values of Water Samples to Groundwater Criteria and MCLs for the 186-D Filtered Water Service Area (J19H96, J19HC1).

COPC	Maximum Water Result (µg/L)	Groundwater Cleanup Levels (µg/L)			
		Method B	Primary MCL	Secondary MCL	State MCL/SMCL
Antimony	5.7	6.4	6	--	6
Arsenic	19.1	5 [a]	10	--	10
Barium	2,970	3,200	2,000	--	2,000
Beryllium	0.432	32	4.0	--	4.0
Boron	126	3,200	--	--	--
Cadmium	1.07	8	5	--	5
Chromium (total)	34.9	24,000	100	--	100
Cobalt	11.3	4.8	--	--	--
Copper	45.5	640	1,300 [b]	1,000	1,300 [b]
Lead	126	--	15.0 [b]	--	15.0 [b]
Manganese	740	752	--	50	50
Mercury	0.735	4.8	2.0	--	2.0
Molybdenum	5.21	80	--	--	--
Nickel	22.9	320	--	--	100
Selenium	4.94	80	50	--	50
Vanadium	50.9	112	--	--	--
Zinc	1,030	4,800	--	5,000	5,000

[a] Method A level based on statewide background concentration.
[b] Value reflects the primary drinking water standard action level.
-- = no criteria available
COPC = contaminant of potential concern
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level

Table 7a. Comparison of Maximum Values to Remedial Action Goals for the 190-D Condenser Water Service Area (J19H46, J19H58, J19H94, J19H97, J19HB9, J19HC2). (2 Pages)

COC/COPC	Maximum Soil Result (mg/kg)	Soil Cleanup Levels (mg/kg) [a]			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Groundwater Protection	River Protection		
Arsenic	2.7 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	74 (<BG)	5,600	200	400	No	--
Beryllium	1.3 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	0.987	7,200	320	--	--	--
Cadmium	0.18 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	11.4 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	7.7 (<BG)	24	15.7 [b]	--	No	--
Copper	15.0 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	5.4 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	297 (<BG)	3,760	512 [b]	512 [b]	No	--
Molybdenum [d]	0.275	400	8	--	No	--

Table 7a. Comparison of Maximum Values to Remedial Action Goals for the 190-D Condenser Water Service Area (J19H46, J19H58, J19H94, J19H97, J19HB9, J19HC2). (2 Pages)

COC/COPC	Maximum Soil Result (mg/kg)	Soil Cleanup Levels (mg/kg)[a]			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Groundwater Protection	River Protection		
Nickel	10.4 (<BG)	1,600	19.1[b]	27.4	No	--
Vanadium	54.2 (<BG)	560	85.1[b]	--	No	--
Zinc	148	24,000	480	67.8[b]	Yes	Yes[e]

[a] RAGs obtained from the RDR/RAWP (DOE-RL 2009) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B (Ecology 1996), unless otherwise noted.
[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.
[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[d] No Hanford Site-specific background or Washington State background available.
[e] Zinc was identified at a concentration exceeding soil RAGs for protection of the Columbia River. Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009), residual concentrations of zinc having a K_d of 30 mg/L will not migrate more than 2 m (6.6 ft) vertically in 1,000 years. The thickness of the vadose zone underlying the 190-D Condenser Water Service Area pipeline at this location is approximately 23 m (76 ft). Therefore, residual concentrations of zinc are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
K_d = distribution coefficient
ND = not detected
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Table 7b. Comparison of Maximum Values of Water Samples to Groundwater Criteria and MCLs for the 190-D Condenser Water Service Area (J19H97, J19HC2, J19H94, J19HB9).

COPC	Maximum Water Result (µg/L)	Groundwater Cleanup Levels (µg/L)			
		Method B	Primary MCL	Secondary MCL	State MCL
Barium	2.62	3,200	2,000	--	2,000
Boron	33	3,200	--	--	--
Hexavalent chromium	11.0	48	--	--	--
Manganese	61	752	--	50	50
Molybdenum	2.26	80	--	--	--
Uranium	0.037	48	30	--	30
Vanadium	1.20	112	--	--	--
Zinc	6.1	4,800	--	5,000	5,000

-- = no criteria available
COPC = contaminant of potential concern
MCL = maximum contaminant level

Table 8. Comparison of Maximum Values to Remedial Action Goals for the 190-DR Condenser Water Service Area (J19H52, J19H53, J19H66, J19H67, J19H80, J19H81).

COC/COPC	Maximum Rust/Scale Result (pCi/g)	Maximum Soil Result (pCi/g)	Generic Site Lookup Values (pCi/g)[a]			Does the Maximum Result Exceed Lookup Values?	Does the Maximum Result Pass RESRAD Modeling or Other Evaluation?
			Direct Exposure	Groundwater Protection	River Protection		
Radionuclides							
Cesium-137	0.822 (<BG)	ND	6.2	1,465	2,930	No	--
Cobalt-60	0.068	ND	1.4	13,900	27,800	No	--
Europium-152	1.04	ND	3.3	--[b]	--[b]	No	--
COC/COPC	**Maximum Rust/Scale Result (mg/kg)**	**Maximum Soil Result (mg/kg)**	**Soil Cleanup Levels (mg/kg)[a]**			**Does the Maximum Result Exceed RAGs?**	**Does the Maximum Result Pass RESRAD Modeling or Other Evaluation?**
			Direct Exposure	**Groundwater Protection**	**River Protection**		
Metals							
Antimony	6.93	ND	32	5[c]	5[c]	Yes	Yes[d]
Arsenic	44.6	3.98 (<BG)	20[c]	20[c]	20[c]	Yes	Yes[d]
Barium	95.8 (<BG)[e]	56.1 (<BG)	5,600	200	400	No	--
Beryllium	ND	0.170 (<BG)	10.4[f]	1.51[c]	1.51[c]	No	--
Boron[g]	ND	1.37	7,200	320	--	No	--
Cadmium	19.2	0.134 <(BG)	13.9[f]	0.81[c]	0.81[c]	Yes	Yes[d]
Chromium (total)	122	11.7 (<BG)	80,000	18.5[c]	18.5[c]	Yes	Yes[d]
Chromium VI[g]	0.346	ND	2.1[f]	4.8	2	No	--
Cobalt	9.15 (<BG)[e]	5.94 (<BG)	24	15.7[c]	--	No	--
Copper	108	13.5 (<BG)	2,960	59.2	22.0[c]	Yes	Yes[d]
Lead	22	4.28 (<BG)	353	10.2[c]	10.2[c]	Yes	Yes[d]
Manganese	3,130	251 (<BG)	3,760	512[c]	512[c]	Yes	Yes[d]
Mercury	5.44	ND	24	0.33[c]	0.33[c]	Yes	Yes[d]
Molybdenum[g]	4.34	0.251	400	8	--	Yes	Yes[d]
Nickel	17.6 (<BG)[e]	10.2 (<BG)	1,600	19.1[c]	27.4	No	--
Vanadium	21.6 (<BG)[e]	40.6 (<BG)	560	85.1[c]	--	No	--
Zinc	943	35.5 (<BG)	24,000	480	67.8[c]	Yes	Yes[d]

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE/RL 2009b).
[b] No value; because the K_d value for this contaminant is 200 mL/g, RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009) predicts that the contaminant will show no migration within the 100 Area vadose zone, and no impact on groundwater or the Columbia River.
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d] (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.
[d] Multiple metals are present in residual pipeline rust/scale at concentrations exceeding groundwater and river protection soil RAGs and arsenic exceeds direct exposure RAGs. The evaluation of these constituents is discussed further in the Data Evaluation section of this document.
[e] The rust/scale/sediment sample results were conservatively compared against soil background concentrations as a point of reference.
[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[g] No Hanford Site-specific background or Washington State background available.

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
K_d = distribution coefficient
ND = not detected
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2010) under *Washington Administrative Code* (WAC) 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COCs/COPCs and are not included in these tables. The radionuclides, potassium-40, radium-226, radium-228, thorium-228, and thorium-232 may have been detected in samples collected at the site, but are not considered within the calculations or following tables. These isotopes are excluded from consideration as contaminants of concern (COCs)/COPCs based on natural occurrence and analogous site information 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.)

DATA EVALUATION

Evaluation of the results provided in Tables 2 through 8 from the confirmatory sampling event indicate that residual contamination concentrations associated with the 100-D-63, 100-D/DR Service Water Pipelines meet the applicable RAOs. Radionuclide COPCs were not detected in soil samples and those detected in scale inside of the pipelines do not exceed cleanup criteria.

Focused sampling of the 100-D-63 service water pipeline contents (scale, rust, sediment) resulted in some nonradionuclide contaminants detected at concentrations exceeding remedial action goals (RAGs) for soil as specified in the RDR/RAWP (DOE-RL 2009b). These contaminants included antimony, arsenic, barium, cadmium, chromium, cobalt, copper, hexavalent chromium, lead, manganese, mercury, molybdenum, nickel, silver, and zinc. However, these metals are associated with corrosion byproduct of the piping material (WCH 2009) or deposits of constituents occurring in the incoming water and are contained in the scale/rust matrix inside of the pipeline and do not present a credible risk to human health and the environment. Furthermore, these contaminant exceedances were expected during confirmatory sampling (WCH 2009) because the accumulation of inorganic constituents in pipeline scale, sediments, and biofilm within public potable water distribution systems has been documented (EPA 2006). This scale is a corrosion product present on the inner pipeline surface that formed due to degradation of the metallic surface by electrochemical reactions. The scale commonly attracts and binds other inorganic constituents present in the water. Detailed discussion of corrosion scales associated with water distribution pipelines is provided in *Inorganic Contaminant Accumulation in Potable Water Distribution Systems* (EPA 2006).

The presence of scale inside the 100-D-63 service water pipelines containing inorganic constituents exceeding soil cleanup criteria does not constitute the presence of a CERCLA hazardous substance that requires remediation because there are no credible pathways for these constituents to reach human or environmental receptors in quantities or at concentrations that are of concern. The remedial action goals (RAGs) for soil are derived using exposure scenarios that assume the contamination is distributed freely within soil and that the overall mass of a contaminant is a function of the measured concentration and the size of the waste site. The exposure criteria do not consider contaminants sequestered inside of a containment feature such

as a pipeline, nor do they account for the small mass of contaminant relative to the overall waste site or relative to the pipeline in which it is contained. Therefore, the use of the maximum contaminant concentrations of the pipeline contents (scale, rust, sediment) would overestimate the impact these constituents would have on the environment.

Based on confirmatory sampling of underlying soil, metals inside the pipelines have not had an impact on the underlying soil. Maximum concentrations of lead and zinc in the soil beneath the pipelines exceed soil criteria for protection of groundwater. Lead and zinc were detected at 300 mg/kg and 148 mg/kg, respectively, exceeding both groundwater and river protection cleanup criteria. Lead and zinc both have a K_d of 30 mL/g, and RESRAD modeling shows that contaminants with a K_d of 30 mL/g will not migrate more than 2 m (6.6 ft) vertically in 1,000 years. The vadose zone thickness beneath the 100-D-63 waste site is more than 20 m (66 ft) thick. Therefore, residual concentrations of lead and zinc are predicted to be protective of groundwater and the Columbia River.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-D-63 waste site is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. Risk values are not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. 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 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. These risk values were conservatively calculated using the maximum analytical values (Appendix C) from the soil samples collected at the 100-D-63 waste site. The calculations (Appendix C) indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-D-63 waste site is 8.4×10^{-3}. The individual carcinogenic risk value for hexavalent chromium, the only carcinogenic contaminant, was 6.7×10^{-8}, less than the required 1×10^{-6}; thus, the cumulative carcinogenic risk is also met. Therefore, all nonradionuclide risk requirements are met.

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

An additional calculation of the hazard quotient and carcinogenic (excess cancer) risk values for the potential impact to groundwater was performed for nonradionuclides. The comparisons for the groundwater pathway include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Risk values were not calculated for constituents that were not detected, were detected at concentrations below Hanford Site background values, or were not predicted to reach groundwater in 1,000 years according to fate and transport modeling. Boron and hexavalent chromium met the criteria for the calculation of a protection of groundwater hazard quotient because they do not have Hanford Site-specific or Washington State background values available and their distribution coefficients are less than that necessary to show no migration to groundwater. For noncarcinogenic constituents, the individual hazard quotients were all less than 1.0 and the cumulative hazard quotient was 3.6×10^{-2}. No carcinogenic constituents met the criteria for groundwater evaluation at the

100-D-63 waste site; therefore, no calculations of excess carcinogenic risk were performed. Nonradionuclide risk requirements related to groundwater are met.

Attainment of Radionuclide Direct Exposure RAGS

All detected radionuclides in soil were below background. Cumulative radionuclide activities in pipe scale were evaluated and determined to be less than the 15 mrem/yr dose rate. Table 9 provides a conservative comparison of the radionuclide results of confirmatory samples collected in pipe scale that exceed background activity to the direct exposure single radionuclide 15 mrem/yr dose-equivalent values and shows the sum of the fractions evaluation for comparison of the total radionuclide dose to the RAG of 15 mrem/yr. The column on the left side of the table provides the maximum radionuclide activity detected in the pipe scale. The third column presents the single radionuclide 15 mrem/yr dose-equivalent activity and the fourth column presents the radionuclide activity divided by the dose-equivalent activity. As demonstrated by the sum of the fractions, the cumulative dose contributed by residual radionuclide contamination in the scale inside the pipelines is conservatively estimated to be less than the 15 mrem/yr RAG.

Table 9. Attainment of Radionuclide Direct Exposure Remedial Action Goals.

COPC	Maximum Radionuclide Value (pCi/g)	Activity Equivalent to 15 mrem/yr Dose[a] (pCi/g)	Fraction
Cesium-137	0.822	6.2	0.133
Cobalt-60	0.068	1.4	0.049
Europium-152	1.04	3.3	0.315
Strontium-90	0.294	4.5	0.065
		Total	0.562
		Equivalent Dose (mrem/yr)	8.43

[a] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b).

COPC = contaminant of potential concern

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and analytical data with the sampling and data requirements specified in the verification work instruction (WCH 2009). The DQA for the 100-D-63 pipeline waste site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The data set was 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 cleanup verification sample analytical data are stored in the ENRE project-specific database for data evaluation prior to its archival in HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR NO ACTION

The 100-D-63 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Confirmatory sampling was performed, and the analytical results indicate that the residual concentrations of COCs/COPCs at this site meet the RAOs for direct exposure, groundwater protection, and river protection. Multiple metals were identified in the pipelines interior rust, scale, and concrete linings at concentrations exceeding soil RAGs. However, these metals are contained in scale deposits inside of the pipelines and do not present a credible risk to human health or the environment. Furthermore, metals and other inorganic constituents are at concentrations consistent with sediments and deposits commonly found in public water distribution pipelines (EPA 2006). Radionuclide COPCs were not detected in soil samples and those detected in scale inside of the pipelines do not exceed cleanup criteria. Furthermore, it is predicted that constituents in soil will not reach groundwater (and thus the Columbia River) within 1,000 years based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b). These results also indicate that residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation are not required. Accordingly, a reclassification to No Action is supported for the 100-D-63 waste site.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-D-63 Waste Site.[a, b]

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels[c]				Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian[d]	Mammalian[d]	
Metals (mg/kg):									
	Background								
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	2.05
Lead	10.2	50	500	118	120	1,700	11	56	300
Manganese	512	1,100	NA	1,500	220	450	4,300	4,000	354 (<BG)
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	63.6 (<BG)
Zinc	67.8	86	200	360	160	120	46	79	148

Note: Cells shaded in gray indicate lowest screening level.

[a] Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site which will include a more complete quantitative ecological risk assessment.

[b] Based on an evaluation of analytical results of soil samples collected at the 100-D-63 waste site.

[c] Available on the internet at (www.epa.gov/ecotox/ecossl).

[d] Wildlife.

-- = not applicable
EPA = U.S. Environmental Protection Agency
NA = not available
WAC = *Washington Administrative Code*

APPENDIX B

100-D-63 SERVICE WATER PIPELINE LIST BY DECISION UNIT

Table B-1. Summary of 100-D-63 Service Water Pipelines by Decision Unit. (2 Pages)

Service Area	Diameter		Construction Material	Length	
	cm	in.		m	ft
181RW	Unknown	Unknown	Unknown	31	102
	7.6	3	Cast iron	58	190
	10.2	4	VCP	5	16
	45.7	18	Unknown	5	16
	76.2	30	Concrete	1,372	4,502
	76.2	30	Steel	279	915
	91.4	36	Steel	1,760	5,775
	106.7	42	Concrete	1,257	4,124
	106.7	42	Galvanized iron	28	92
	106.7	42	Steel	628	2,060
	121.9	48	Steel	437	1,434
182RW	5.1	2	Unknown	204	669
	10.2	4	Steel	145	476
	25.4	10	Cast iron	153	502
	30.5	12	Cast iron	183	600
	35.6	14	Cast iron	153	502
	40.6	16	Cast iron	72	236
	50.8	20	Steel	62	203
	61.0	24	Cast iron	696	2,284
	61.0	24	Steel	451	1,480
	91.4	36	Cast iron	527	1,729
	91.4	36	Steel	50	164
	106.7	42	Concrete	640	2,100
183FW	2.5	1	Galvanized iron	1	3
	2.5	1	Unknown	2	7
	3.8	1.5	Unknown	68	223
	5.1	2	Cast iron	14	46
	5.1	2	Galvanized iron	31	102
	5.1	2	Unknown	28	92
	10.2	4	Cast iron	80	262
	10.2	4	Steel	479	1,572
	10.2	4	Unknown	149	489
	15.2	6	Cast iron	16	52
	15.2	6	Steel	99	325
	15.2	6	Unknown	66	217
	20.3	8	Cast iron	61	200
	20.3	8	Steel	105	345
	25.4	10	Cast iron	446	1,463
	25.4	10	Steel	441	1,447
	30.5	12	Cast iron	178	584
	30.5	12	Steel	274	899
	30.5	12	Unknown	125	410
	40.6	16	Steel	270	886
	50.8	20	Steel	206	676
	61.0	24	Cast iron	2	7
	76.2	30	Cast iron	437	1,434
	76.2	30	Steel	827	2,713
	91.4	36	Cast iron	428	1,404
	91.4	36	Rubber-lined steel	167	548
	91.4	36	Steel	112	367

Table B-1. Summary of 100-D-63 Service Water Pipelines by Decision Unit. (2 Pages)

Service Area	Diameter		Construction Material	Length	
	cm	in.		m	ft
183SW	Unknown	Unknown	Unknown	569	1,867
	1.3	0.5	Unknown	38	125
	2.5	1	Cast iron	45	148
	2.5	1	Galvanized iron	48	157
	2.5	1	Unknown	41	135
	3.8	1.5	Cast iron	84	276
	3.8	1.5	Unknown	153	502
	5.1	2	Cast iron	102	335
	5.1	2	Galvanized iron	95	312
	5.1	2	Unknown	510	1,673
	7.6	3	Cast iron	841	2,759
	10.2	4	Cast iron	399	1,309
	10.2	4	Galvanized iron	13	43
	10.2	4	PVC	53	174
	10.2	4	Steel	28	92
	10.2	4	Unknown	568	1,864
	15.2	6	Cast iron	3,687	12,097
	15.2	6	Steel	32	105
	15.2	6	Unknown	406	1,332
	20.3	8	Cast iron	1,624	5,328
	20.3	8	Steel	91	299
	20.3	8	Unknown	1,014	3,327
	25.4	10	Cast iron	1,741	5,712
	30.5	12	Cast iron	20	66
	40.6	16	Steel	5	16
186FW	91.4	36	Rubber-lined steel	263	863
	91.4	36	Steel	93	305
190 CW	50.8	20	Cast iron	578	1,896
190DRCW	61.0	24	Steel	1,092	3,583
PFE	Unknown	Unknown	Unknown	10	32
	10.2	4	Unknown	138	453
	91.4	36	Corrugated pipe	60	197

PFE = Plenum Filling Experiment
VCP = vitrified clay pipe

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATIONS

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-D-63 Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, Calculation No. 0100D-CA-V0383, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-D-63 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, Calculation No. 0100D-CA-V0384, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-D-63

Discipline: Environmental *Calculation No: 0100D-CA-V0383

Subject: 100-D-63 Relative Percent Difference and Direct Contact Hazard Quotient & Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 8 Attachment 1 = 13 Total = 22	W. S. Thompson	J. D. Skoglie	B. L. Vedder	D. F. Obenauer	9/2/10

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	09/01/10	Calc. No.:	0100D-CA-V0383	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	09/01/10
Subject:	100-D-63 Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No. 1 of 8	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-D-63 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a), the following criteria must be met:

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

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from 100-D-63 confirmatory sampling, as necessary.

GIVEN/REFERENCES:

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

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

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

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

5) WCH, 2010, *Remaining Sites Verification Package for the 100-D-63, 100D/DR Service Water Pipelines*, Attachment to Waste Site Reclassification Form 2008-001, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009a).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009a).

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	09/01/10	Calc. No.:	0100D-CA-V0383	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	09/01/10
Subject:	100-D-63 Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No. 2 of 8	

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

5) Use data from WCH (2010) to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 100-D-63 waste site consisted of the 100-D/DR service water pipelines. The pipelines were divided into eight service areas for confirmatory sampling. Samples of soil directly underlying the pipeline and the contents of the pipelines were collected from each service area. The pipelines contained rust, scale, sediment, and/or water. For the purpose of evaluation of the direct contact hazard quotient, the maximum concentration for each contaminant for the entire set of soil samples was used.

Direct contact hazard quotient and carcinogenic risk calculations for the 100-D-63 waste site were calculated for the entire waste site using the greater of the values for each analyte detected in the soil samples (attachment 1). Lead and zinc were detected above background. However, lead is not included in the calculation based on modeling of child blood levels, which is fundamentally different from the oral reference dose and cancer slope factors used to calculate typical cleanup levels and associated HQs and cancer risks. Boron, molybdenum, and hexavalent chromium require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 2.05 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 2.8×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values is 8.4×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by 1×10^{-6}. For example, the maximum value for hexavalent chromium is 0.14 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is 6.7×10^{-8}. 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 can be obtained by summing the individual values. The excess cancer risk value for hexavalent chromium, the only carcinogenic constituent detected above background levels, is 6.7×10^{-8}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	09/01/10	Calc. No.:	0100D-CA-V0383	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	09/01/10
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5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2009b). Other analytes will have their own pre-determined constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for cleanup verification of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2010), as necessary.

RESULTS:

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

Table 1 shows the results of the HQ calculations.

Table 2 and Table 3 show the results of the RPD calculations for sample delivery groups (SDG) J00751 and K1966, respectively. The evaluation of the QA/QC duplicate RPD calculations is performed within the data quality assessment section of the RSVP.

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Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-D-63 Waste Site.

Contaminants of Concern[a]	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	2.05	7,200	2.8E-04	--	--
Chromium, hexavalent[c]	0.14	240	5.8E-04	2.1	6.7E-08
Lead[d]	300	--	--	--	--
Molybdenum	0.536	400	1.3E-03	--	--
Zinc	148	24,000	6.2E-03	--	--
Totals					
Cumulative Hazard Quotient:			**8.4E-03**		
Cumulative Excess Cancer Risk:					**6.7E-08**

Notes:

[a] = From WCH (2010).

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

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

[d] = Lead is not included in the calculation because it is derived from *Guidance Manual for the Integrated Exposure Uptake Biokenetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D. C.

-- = not applicable

RAG = remedial action goal

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Table 2. Relative Percent Difference Calculations for SDG J00751. (2 Pages)

100-D-63 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Gross beta			Aluminum			Arsenic			Barium		
			pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H44	2/22/2010	21.8		3.45	6300		1.5	3.1		0.66	58.5		0.076
Duplicate of J19H44	J19H45	2/22/2010	20.4		3.41	6420		1.6	3.1		0.66	55.2		0.076

Analysis:

TDL		15	5	10	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		1.9%		5.8%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable

100-D-63 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Beryllium			Cadmium			Calcium			Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H44	2/22/2010	0.84		0.033	0.050	B	0.041	7740		14.1	11.9		0.058
Duplicate of J19H44	J19H45	2/22/2010	0.86		0.033	0.051	B	0.041	7770		14.2	11.8		0.058

Analysis:

TDL		0.2	0.2	100	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD			0.4%	0.8%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H44	2/22/2010	6.1	L	0.10	12.8		0.22	16800		3.8	4.0		0.27
Duplicate of J19H44	J19H45	2/22/2010	6.0	L	0.10	12.6		0.22	17600		3.8	3.5		0.27

Analysis:

TDL		2	1	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		1.6%	4.7%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Magnesium			Manganese			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H44	2/22/2010	4270		3.7	254		0.10	11.3		0.12	1040		40.9
Duplicate of J19H44	J19H45	2/22/2010	4240		3.7	257	0	0.099	11.3		0.12	1070		41.2

Analysis:

TDL		75	5	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	0.7%	1.2%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

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Table 2. Relative Percent Difference Calculations for SDG J00751. (2 Pages)

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H44	2/22/2010	292	LJ	2.1	164		58.9	38.2		0.094	31.3		0.40
Duplicate of J19H44	J19H45	2/22/2010	270	LJ	2.1	164		59.3	39.3		0.094	32.4		0.40

Analysis:

	TDL	2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	7.83%		2.8%	3.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

B = estimated result; result is less than the RL but greater than the MDL
HEIS = Hanford Environmental Information System
L = physical or chemical interference
J = estimated result
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit

Table 3. Relative Percent Difference Calculations for SDG K1966. (3 Pages)

100-D-63 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Gross alpha			Gross beta			Potassium-40			Radium-226		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil	J19H55	3/3/2010	7.06		3.55	14.8		8.2	11.3		0.493	0.517	J	0.125
Duplicate of J19H55	J19H56	3/3/2010	8.58		3.04	21.1		5.19	11.6		0.781	0.225	J	0.185

Analysis:

	TDL	10	15	0.5	0.1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD			2.6%	
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Yes - assess further

100-D-63 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Radium-228			Thorium-228			Thorium-232			Aluminum		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL
Soil	J19H55	3/3/2010	0.556		0.277	0.581		0.084	0.556	J	0.277	5790		3.63
Duplicate of J19H55	J19H56	3/3/2010	0.733		0.274	0.662		0.092	0.733	J	0.274	6240		3.73

Analysis:

	TDL	0.2	1	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD				7.5%
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	Not applicable

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Table 3. Relative Percent Difference Calculations for SDG K1966. (3 Pages)

100-D-63 Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H55	3/3/2010	2.95		0.727	62.0	J	0.363	0.189		0.145	1.24	B	1.45
Duplicate of J19H55	J19H56	3/3/2010	2.91		0.747	74.2	J	0.373	0.198		0.149	0.966	B	1.49

Analysis:

TDL		10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	
	RPD		17.9%		
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H55	3/3/2010	0.119	B	0.145	7370	J	72.7	9.85		0.145	6.12		1.45
Duplicate of J19H55	J19H56	3/3/2010	0.125	B	0.149	7750	J	74.7	10.4		0.149	6.37		1.49

Analysis:

TDL		0.2	100	1	2
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		5.0%	5.4%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H55	3/3/2010	13.0		0.727	17900		14.5	5.81	J	0.363	4190		54.5
Duplicate of J19H55	J19H56	3/3/2010	13.9		0.747	18000		14.9	7.42	J	0.373	4280		56.0

Analysis:

TDL		1	5	5	75
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	6.7%	0.6%		2.1%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Manganese			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H55	3/3/2010	264		3.63	0.264	B	1.45	10.4		2.91	1020		291
Duplicate of J19H55	J19H56	3/3/2010	354		3.73	0.250	B	1.49	10.2		2.99	1010		299

Analysis:

TDL		5	2	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)		No-Stop	No-Stop (acceptable)
	RPD	29.13%			
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable

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Table 3. Relative Percent Difference Calculations for SDG K1966. (3 Pages)

100-D-63 Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H55	3/3/2010	673		1.45	170		36.3	44.4		1.82	37.8		7.27
Duplicate of J19H55	J19H56	3/3/2010	657		1.49	251		37.3	44.9		1.87	37.4		7.47

Analysis:

TDL		2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	2.41%		1.1%	1.1%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

B = estimated result; result is less than the RL but greater than the MDL
HEIS = Hanford Environmental Information System
J = estimated result
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-D-63 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the SAP (DOE-RL 2009b) and the RDR/RAWP (DOE-RL 2009a). The evaluation of the QA/QC duplicate RPD calculations provided in Tables 2 and 3 is performed within the data quality assessment section of the RSVP and indicate the requirements are met. The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 100-D-63 Confirmatory Soil Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Americium-241			Americium-241 GEA			Barium-133			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	pCi/g	Q	MDA
Soil	J19H41	2/11/10				-0.0456	U	0.136	-0.00575	U	0.0365	0.00618	U	0.0300	0.0023	U	0.0293	-0.0457	U	0.0817
Soil	J19H42	2/11/10	0.00779	U	0.047	0.0693	U	0.129	0.00117	U	0.0403	-0.0177	U	0.0386	0.0065	U	0.0396	-0.0164	U	0.0975
Soil	J19H43	2/11/10				-0.0395	U	0.337	-0.0232	U	0.0346	0.0011	U	0.0320	0.0076	U	0.0345	-0.0299	U	0.0803
Soil	J19H44	2/22/10				0.0465	U	0.129				-0.00094	U	0.0386	-0.0143	U	0.0332	-0.0145	U	0.0939
Soil (duplicate)	J19H45	2/22/10				-0.115	U	0.141				-0.00881	U	0.031	0.0032	U	0.0347	-0.0571	U	0.0891
Soil	J19H46	2/22/10				-0.0288	U	0.0729				-0.0141	U	0.0381	-0.0049	U	0.0406	-0.0364	U	0.0983
Soil	J19H47	3/2/10				0.077	U	0.077				0.062	U	0.062	0.064	U	0.064	0.166	U	0.166
Soil	J19H48	3/2/10				0.348	U	0.348				0.077	U	0.077	0.088	U	0.088	0.233	U	0.233
Soil	J19H49	3/2/10	0.088	U	0.323	0.155	U	0.155				0.062	U	0.062	0.049	U	0.049	0.171	U	0.171
Soil	J19H50	3/2/10				0.291	U	0.291				0.062	U	0.062	0.081	U	0.081	0.196	U	0.196
Soil	J19H51	3/3/10				0.194	U	0.194				0.071	U	0.071	0.056	U	0.056	0.176	U	0.176
Soil	J19H52	3/3/10				0.422	U	0.422				0.085	U	0.085	0.105	U	0.105	0.239	U	0.239
Soil	J19H53	3/3/10				0.304	U	0.304				0.066	U	0.066	0.053	U	0.053	0.18	U	0.18
Soil	J19H55	3/3/10				0.195	U	0.195				0.062	U	0.062	0.066	U	0.066	0.208	U	0.208
Soil (duplicate)	J19H56	3/3/10				0.331	U	0.331				0.067	U	0.067	0.071	U	0.071	0.184	U	0.184
Soil	J19H57	3/4/10				0.153	U	0.153				0.060	U	0.060	0.048	U	0.048	0.153	U	0.153
Soil	J19H58	3/15/10				0.185	U	0.185				0.061	U	0.061	0.07	U	0.07	0.193	U	0.193

Note: Gray cells indicate not applicable.

B = estimated result; result is less than the RL but greater than the MDL
J = estimated result
HEIS = Hanford Environmental Information System
L = physical or chemical interference
M = duplicate precision criteria not met
MDA = minimum detectable activity
N = Spike and/or spike duplicate sample recovery outside control limits
PQL = practical quantitation limit
Q = qualifier
R = rejected
U = undetected

Attachment	1	Sheet No.	1 of 13
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Checked	J. D. Skoglie	Date	9/1/10
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Attachment 1. 100-D-63 Confirmatory Soil Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Europium-154			Europium-155			Gross Alpha			Gross Beta			Plutonium-238			Plutonium-239/240		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil	J19H41	2/11/10	0.0423	U	0.107	-0.0162	U	0.100	2.71	U	5.04	21.6		3.08						
Soil	J19H42	2/11/10	0.0153	U	0.137	0.0476	U	0.0967	15.7		7.70	21.2		3.46	0.007	U	0.0419	-0.00175	U	0.0418
Soil	J19H43	2/11/10	0.00225	U	0.102	0.0732	U	0.111	4.83	U	6.96	24.7		3.34						
Soil	J19H44	2/22/10	-0.0150	U	0.136	0.0147	U	0.0954	0.585	U	3.93	21.8		3.45						
Soil (duplicate)	J19H45	2/22/10	-0.0251	U	0.101	-0.0061	U	0.105	0.585	U	7.55	20.4		3.41						
Soil	J19H46	2/22/10	0.0320	U	0.134	-0.034	U	0.0993	2.10	U	9.38	18.4		3.59						
Soil	J19H47	3/2/10	0.218	U	0.218	0.148	U	0.148	6.07		3.07	16.3		5.19						
Soil	J19H48	3/2/10	0.309	U	0.309	0.196	U	0.196	2.99	U	8.67	19.0		5.48						
Soil	J19H49	3/2/10	0.172	U	0.172	0.174	U	0.174	3.76		4.52	18.4		4.3	0.104	U	0.332	-0.035	U	0.265
Soil	J19H50	3/2/10	0.249	U	0.249	0.213	U	0.213	5.81		3.20	18.4		5.36						
Soil	J19H51	3/3/10	0.226	U	0.226	0.201	U	0.201	8.20		3.70	18.1		5.30						
Soil	J19H52	3/3/10	0.354	U	0.354	0.235	U	0.235	4.76		3.87	18.6		4.96						
Soil	J19H53	3/3/10	0.205	U	0.205	0.184	U	0.184	9.80		3.89	21.0		5.63						
Soil	J19H55	3/3/10	0.220	U	0.220	0.224	U	0.224	7.06		3.55	14.8		8.20						
Soil (duplicate)	J19H56	3/3/10	0.219	U	0.219	0.203	U	0.203	8.58		3.04	21.1		5.19						
Soil	J19H57	3/4/10	0.142	U	0.142	0.171	U	0.171	6.86	U	8.45	16.4		5.52						
Soil	J19H58	3/15/10	0.201	U	0.201	0.191	U	0.191	4.94		3.51	13.1		4.92						

Attachment	1	Sheet No.	2 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Soil Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-232			Radioactive Strontium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil	J19H41	2/11/10																		
Soil	J19H42	2/11/10																		
Soil	J19H43	2/11/10																-0.0341	U	0.0989
Soil	J19H44	2/22/10																		
Soil (duplicate)	J19H45	2/22/10																		
Soil	J19H46	2/22/10																		
Soil	J19H47	3/2/10	11.2		0.762	0.373		0.157	0.731		0.262	0.608		0.075	0.731		0.262			
Soil	J19H48	3/2/10	11.2		0.753	0.511		0.157	0.796		0.375	0.744		0.097	0.796		0.375			
Soil	J19H49	3/2/10	11.5		0.859	0.349		0.115	0.501		0.271	0.716		0.134	0.501		0.271	-0.077	U	0.292
Soil	J19H50	3/2/10	13.8		0.731	0.530		0.155	1.04		0.268	0.874		0.135	1.04		0.268			
Soil	J19H51	3/3/10	12.1		0.416	0.409	J	0.090	0.908		0.276	0.625		0.118	0.908	J	0.276			
Soil	J19H52	3/3/10	13.5		0.700	0.52	J	0.168	0.867		0.483	0.765		0.102	0.867	J	0.483			
Soil	J19H53	3/3/10	12.5		0.556	0.428	J	0.136	0.748		0.201	0.604		0.091	0.748	J	0.201			
Soil	J19H55	3/3/10	11.3		0.493	0.517	J	0.125	0.556		0.277	0.581		0.084	0.556	J	0.277			
Soil (duplicate)	J19H56	3/3/10	11.6		0.781	0.225	J	0.185	0.733		0.274	0.662		0.092	0.733	J	0.274			
Soil	J19H57	3/4/10	11.2		0.750	0.403		0.119	0.770		0.202	0.481		0.082	0.770		0.202			
Soil	J19H58	3/15/10	14.4		0.289	0.449		0.133	0.599		0.304	0.621		0.094	0.599		0.304			

Attachment	1	Sheet No.	3 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Soil Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Uranium 233/234			Uranium-234			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	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil	J19H41	2/11/10																		
Soil	J19H42	2/11/10				0.107		0.0288	0.00361	U	0.0340				0.113		0.0288			
Soil	J19H43	2/11/10																		
Soil	J19H44	2/22/10																		
Soil (duplicate)	J19H45	2/22/10																		
Soil	J19H46	2/22/10																		
Soil	J19H47	3/2/10										0.336	U	0.336				8.61	U	8.61
Soil	J19H48	3/2/10										0.432	U	0.432				10.9	U	10.9
Soil	J19H49	3/2/10	0.668		0.197				0.031	U	0.238	0.408	U	0.408	0.488		0.197	6.40	U	6.40
Soil	J19H50	3/2/10										0.396	U	0.396				9.30	U	9.30
Soil	J19H51	3/3/10										0.418	U	0.418				7.42	U	7.42
Soil	J19H52	3/3/10										0.511	U	0.511				11.8	U	11.8
Soil	J19H53	3/3/10										0.352	U	0.352				6.70	U	6.70
Soil	J19H55	3/3/10										0.423	U	0.423				8.20	U	8.20
Soil (duplicate)	J19H56	3/3/10										0.401	U	0.401				8.68	U	8.68
Soil	J19H57	3/4/10										0.365	U	0.365				7.46	U	7.46
Soil	J19H58	3/15/10										0.458	U	0.458				7.86	U	7.86

Attachment	1	Sheet No.	4 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Soil Sample Results - Metals.

Sample Description	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H41	2/11/10	6500		1.7	0.42	U	0.42	3.3		0.73	61		0.084	0.81		0.04	1.1	U	1.1	0.090	B	0.046	8100		16
Soil	J19H42	2/11/10	6400		1.7	0.42	U	0.42	3.0		0.73	58		0.085	0.79		0.04	1.1	U	1.1	0.062	B	0.046	6600		16
Soil	J19H43	2/11/10	7100		1.7	0.42	U	0.42	3.6		0.72	72		0.083	0.79		0.04	1.1	U	1.1	0.094	B	0.045	11000		15
Soil	J19H44	2/22/10	6300		1.5	0.38	UJ	0.38	3.1		0.66	58.5		0.076	0.84		0.03	0.98	U	0.98	0.050	B	0.041	7740		14.1
Soil (duplicate)	J19H45	2/22/10	6420		1.6	0.38	UJ	0.38	3.1		0.66	55.2		0.076	0.86		0.03	0.98	U	0.98	0.051	B	0.041	7770		14.2
Soil	J19H46	2/22/10	6390		1.5	0.38	UJ	0.38	2.7		0.65	74.0		0.075	1.3		0.03	0.97	U	0.97	0.18	B	0.041	7300		14.0
Soil	J19H47	3/2/10	5510		3.87	0.465	U	0.465	2.68		0.775	55.3		0.387	0.169		0.16	0.739	B	1.55	0.129	B	0.155	6720		77.5
Soil	J19H48	3/2/10	6510		3.50	0.421	U	0.421	3.00		0.701	76.9		0.350	0.224		0.140	1.15	B	1.40	0.120	B	0.140	6090		70.1
Soil	J19H49	3/2/10	5510		3.95	0.474	U	0.474	3.12		0.791	67.9		0.395	0.176		0.16	2.05		1.58	0.158	B	0.158	7120		79.1
Soil	J19H50	3/2/10	7080		5.40	0.647	U	0.647	3.25		1.08	71.4		0.540	0.219		0.22	1.03	B	2.16	0.136	B	0.216	4890		108
Soil	J19H51	3/3/10	5220		4.37	0.524	UJ	0.52	2.48		0.874	50.6	J	0.44	0.159	B	0.18	0.906	B	1.75	0.118	B	0.175	5930	J	87.4
Soil	J19H52	3/3/10	5740		3.58	0.430	UJ	0.430	3.98		0.716	55.0	J	0.358	0.170		0.14	0.679	B	1.43	0.103	B	0.143	7570	J	71.6
Soil	J19H53	3/3/10	5180		4.40	0.528	UJ	0.528	3.02		0.880	56.1	J	0.440	0.165	B	0.18	1.37	B	1.76	0.134	B	0.176	7780	J	88.0
Equip Blank	J19H54	3/3/10	163		3.79	0.455	UJ	0.455	0.758	U	0.758	1.89	J	0.379	0.152	U	0.15	1.52	U	1.52	0.152	U	0.152	59.3	BJ	75.8
Soil	J19H55	3/3/10	5790		3.63	0.436	UJ	0.436	2.95		0.727	62.0	J	0.363	0.189		0.15	1.24	B	1.45	0.119	B	0.145	7370	J	72.7
Soil (duplicate)	J19H56	3/3/10	6240		3.73	0.448	UJ	0.448	2.91		0.747	74.2	J	0.373	0.198		0.15	0.966	B	1.49	0.125	B	0.149	7750	J	74.7
Soil	J19H57	3/4/10	5980		4.17	0.500	U	0.500	2.41		0.833	75.5		0.417	0.191		0.17	1.24	B	1.67	0.151	B	0.167	6970		83.3
Soil	J19H58	3/15/10	5970		4.83	0.579	U	0.579	2.65		0.966	64.8		0.483	0.158	B	0.19	0.987	B	1.93	0.129	B	0.193	6980		96.6

Sample Description	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Hexavalent Chromium			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H41	2/11/10	12		0.064	6.0		0.11	14		0.24	0.154	U	0.154	16000		4.2	3.6		0.3	4300		4.1	280		0.11
Soil	J19H42	2/11/10	11		0.065	6.1		0.11	13		0.24	0.150	U	0.150	16000		4.2	3.3		0.3	4300		4.1	270		0.11
Soil	J19H43	2/11/10	14		0.063	6.2		0.11	15		0.24	0.151	U	0.151	17000		4.2	3.9		0.3	4900		4	290		0.11
Soil	J19H44	2/22/10	11.9		0.058	6.1	L	0.10	12.8		0.22	0.154	U	0.154	16800		3.8	4.0		0.27	4270		3.7	254		0.10
Soil (duplicate)	J19H45	2/22/10	11.8		0.058	6.0	L	0.10	12.6		0.22	0.155	U	0.155	17600		3.8	3.5		0.27	4240		3.7	257		0.099
Soil	J19H46	2/22/10	9.5		0.057	7.7	L	0.099	15.0		0.21	0.149	U	0.149	21900		3.8	5.4		0.27	4330		3.7	297		0.99
Soil	J19H47	3/2/10	9.47		0.155	6.51		1.55	12.6		0.775	0.14	B	0.22	18100		15.5	4.03		0.387	4010		58.1	276		3.87
Soil	J19H48	3/2/10	8.90		0.140	7.15		1.40	12.6		0.701	0.21	U	0.21	20400		14.0	4.39		0.350	4470		52.6	314		3.50
Soil	J19H49	3/2/10	10.2		0.158	5.90		1.58	14.6		0.791	0.21	U	0.21	18100		15.8	13.7		0.395	4210		59.3	261		3.95
Soil	J19H50	3/2/10	12.1		0.216	6.78		2.16	13.3		1.08	0.09	B	0.22	20600		21.6	4.18		0.540	4310		80.9	331		5.40
Soil	J19H51	3/3/10	7.69		0.175	5.8		1.75	11.7		0.87	0.22	U	0.22	18600		17.5	300	J	0.44	3750		65.6	244		4.37
Soil	J19H52	3/3/10	11.7		0.143	4.50		1.43	10.8		0.716	0.12	BUJ	0.21	13800		14.3	3.28	J	0.358	4380		53.7	240		3.58
Soil	J19H53	3/3/10	10.4		0.176	5.94		1.76	13.5		0.880	0.14	BUJ	0.21	17200		17.6	4.28	J	0.440	4100		66.0	251		4.40
Equip Blank	J19H54	3/3/10	0.187		0.152	1.52	U	1.52	0.758	U	0.758	0.06	BUJ	0.20	203		15.2	0.417	J	0.379	26.1	B	56.8	5.08		3.79
Soil	J19H55	3/3/10	9.85		0.145	6.12		1.45	13.0		0.727	0.21	U	0.21	17900		14.5	5.81	J	0.363	4190		54.5	264		3.63
Soil (duplicate)	J19H56	3/3/10	10.4		0.149	6.37		1.49	13.9		0.747	0.08	BUJ	0.21	18000		14.9	7.42	J	0.373	4280		56.0	354		3.73
Soil	J19H57	3/4/10	8.07		0.167	7.61		1.67	15.4		0.833	0.21	U	0.21	23200		16.7	4.87		0.417	4060		62.5	308		4.17
Soil	J19H58	3/15/10	11.4		0.193	5.62		1.93	10.9		0.966	0.22	U	0.22	15400		19.3	2.86		0.483	4040		72.4	291		4.83

Attachment	1	Sheet No.	5 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Soil Sample Results - Metals.

Sample Description	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H41	2/11/10	0.0061	U	0.006	0.29	UM	0.29	12		0.14	1100		46	0.96	U	0.96	290		2.3	0.18	U	0.18	530		66
Soil	J19H42	2/11/10	0.0062	U	0.006	0.29	U	0.29	11		0.14	1100		46	0.96	U	0.96	260		2.3	0.18	U	0.18	280		66
Soil	J19H43	2/11/10	0.0060	U	0.0060	0.28	U	0.28	13		0.13	1400		45	0.94	U	0.94	310		2.3	0.17	U	0.17	660		64
Soil	J19H44	2/22/10	0.0056	UN	0.006	0.26	B	0.26	11.3		0.12	1040		40.9	0.86	U	0.86	292	LJ	2.1	0.16	U	0.16	164		58.9
Soil (duplicate)	J19H45	2/22/10	0.0057	U	0.006	0.26	U	0.26	11.3		0.12	1070		41.2	0.86	U	0.86	270	LJ	2.1	0.16	U	0.16	164		59.3
Soil	J19H46	2/22/10	0.0059	U	0.006	0.26	U	0.26	9.9		0.12	1070		40.6	0.85	U	0.85	236	LJ	2.1	0.16	U	0.16	187		58.4
Soil	J19H47	3/2/10	0.0315	U	0.032	0.280	B	1.55	9.93		3.10	854		310	0.232	U	0.23	514		1.55	0.155	U	0.155	152		38.7
Soil	J19H48	3/2/10	0.0305	U	0.031	0.296	B	1.40	9.62		2.80	1200		280	0.210	U	0.210	628		1.40	0.140	U	0.140	298		35.0
Soil	J19H49	3/2/10	0.0303		0.0250	0.335	B	1.58	10.3		3.16	773		316	0.237	U	0.24	455		1.58	0.158	U	0.158	160		39.5
Soil	J19H50	3/2/10	0.0297	U	0.03	0.330	B	2.16	11.5		4.32	1260		432	0.324	U	0.32	845		2.16	0.216	U	0.216	219		54.0
Soil	J19H51	3/3/10	0.0264	U	0.026	0.296	B	1.75	7.78		3.50	903		350	0.262	U	0.26	774		1.75	0.175	U	0.175	160		43.7
Soil	J19H52	3/3/10	0.0272	U	0.027	0.251	B	1.43	10.2		2.86	928		286	0.215	U	0.22	558		1.43	0.143	U	0.143	174		35.8
Soil	J19H53	3/3/10	0.0322	U	0.032	0.246	B	1.76	10.2		3.52	864		352	0.264	U	0.26	547		1.76	0.176	U	0.176	153		44.0
Equip Blank	J19H54	3/3/10	0.0237	U	0.024	1.52	U	1.52	3.03	U	3.03	32.2	B	303	0.227	U	0.23	196		1.52	0.152	U	0.152	37.9	U	37.9
Soil	J19H55	3/3/10	0.0251	U	0.025	0.264	B	1.45	10.4		2.91	1020		291	0.218	U	0.22	673		1.45	0.145	U	0.145	170		36.3
Soil (duplicate)	J19H56	3/3/10	0.0289	U	0.029	0.250	B	1.49	10.2		2.99	1010		299	0.224	U	0.22	657		1.49	0.149	U	0.149	251		37.3
Soil	J19H57	3/4/10	0.0100	B	0.0100	0.536	B	1.67	8.64		3.33	1030		333	0.250	U	0.250	781		1.67	0.167	U	0.167	372		41.7
Soil	J19H58	3/15/10	0.0304	U	0.03	0.275	B	1.93	10.4		3.86	1020		386	0.290	U	0.290	410		1.93	0.193	U	0.193	147		48.3

Sample Description	HEIS Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J19H41	2/11/10	37		0.1	34		0.44
Soil	J19H42	2/11/10	36		0.1	33		0.44
Soil	J19H43	2/11/10	35		0.1	35		0.43
Soil	J19H44	2/22/10	38.2		0.094	31.3		0.40
Soil (duplicate)	J19H45	2/22/10	39.3		0.094	32.4		0.40
Soil	J19H46	2/22/10	54.2		0.093	148		0.39
Soil	J19H47	3/2/10	45.7		1.94	37.4		7.75
Soil	J19H48	3/2/10	52.8		1.75	40.5		7.01
Soil	J19H49	3/2/10	44.2		1.98	43.6		7.91
Soil	J19H50	3/2/10	45.2		2.70	38.4		10.8
Soil	J19H51	3/3/10	43.2		2.19	34.6		8.74
Soil	J19H52	3/3/10	31.4		1.79	30.5		7.16
Soil	J19H53	3/3/10	40.6		2.20	35.5		8.80
Equip Blank	J19H54	3/3/10	0.232	B	1.89	3.78	B	7.58
Soil	J19H55	3/3/10	44.4		1.82	37.8		7.27
Soil (duplicate)	J19H56	3/3/10	44.9		1.87	37.4		7.47
Soil	J19H57	3/4/10	63.6		2.08	48.1		8.33
Soil	J19H58	3/15/10	38.2		2.41	31.8		9.66

Attachment	1	Sheet No.	6 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Other Solid Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Americium-241			Barium-133			Cesium-137			Cobalt-60			Europium-152			Europium-154		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Concrete	J19H62	2/11/10	-0.0505	U	0.152	0.0013	U	0.0294	0.0037	U	0.0314	-0.000625	U	0.0321	0.0413	U	0.0732	0.0428	U	0.110
Rust/scale	J19H63	3/2/10	0.088	U	0.088				0.168	U	0.168	0.075	U	0.075	0.744		0.253	0.236	U	0.236
Rust/scale	J19H64	3/2/10	0.071	U	0.071				0.120		0.035	0.035	U	0.035	0.076	U	0.076	0.075	U	0.075
Scale	J19H65	3/3/10	0.071	U	0.071				0.014	U	0.014	0.013	U	0.013	0.042	U	0.042	0.047	U	0.047
Rust/scale	J19H66	3/3/10	0.112	U	0.112				0.066		0.027	0.027	U	0.027	0.100	U	0.100	0.069	U	0.069
Rust/scale	J19H67	3/3/10	0.026	U	0.026				0.822		0.026	0.068		0.022	1.04		0.049	0.138	U	0.138
Sediment	J19H68	3/3/10	0.139	U	0.139				0.068		0.033	0.031	U	0.031	0.081	U	0.081	0.100	U	0.100
Rust/scale	J19H69	3/4/10	0.082	U	0.082				0.021	U	0.021	0.022	U	0.022	0.123	U	0.123	0.053	U	0.053

Sample Description	HEIS Number	Sample Date	Europium-155			Gross Alpha			Gross Beta			Potassium-40			Radium-226			Radium-228		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Concrete	J19H62	2/11/10	0.00317	U	0.0748	3.12	U	7.23	12.5		3.51									
Rust/scale	J19H63	3/2/10	0.182	U	0.182	5.70		5.44	7.44		5.16	1.55	U	1.55	0.158	U	0.158	0.341	U	0.341
Rust/scale	J19H64	3/2/10	0.076	U	0.076	7.71		6.20	6.66		8.63	1.27		0.270	0.125		0.060	0.178	U	0.178
Scale	J19H65	3/3/10	0.065	U	0.065	6.94		4.19	11.8		6.99	7.29		0.106	0.467		0.028	0.593		0.055
Rust/scale	J19H66	3/3/10	0.057	U	0.057	4.07	U	5.61	0.73	U	5.78	0.611	U	0.611	0.086		0.056	0.114	U	0.114
Rust/scale	J19H67	3/3/10	0.049	U	0.049	5.01	U	5.68	8.82		5.49	1.08		0.163	0.207		0.039	0.098		0.084
Sediment	J19H68	3/3/10	0.079	U	0.079	5.28		3.75	11.7		4.95	10.7		0.346	0.423		0.056	0.565		0.119
Rust/scale	J19H69	3/4/10	0.042	U	0.042	2.41	U	3.80	0.205	U	5.29	0.36	U	0.36	0.107		0.037	0.088	U	0.088

Sample Description	HEIS Number	Sample Date	Silver-108			Thorium-228			Thorium-232			Strontium-90			Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Concrete	J19H62	2/11/10	-0.0095	U	0.0213															
Rust/scale	J19H63	3/2/10				0.132	U	0.132	0.341	U	0.341				0.459	U	0.459	9.59	U	9.59
Rust/scale	J19H64	3/2/10				0.084		0.038	0.178	U	0.178	0.294		0.240	0.165	U	0.165	3.45	U	3.45
Scale	J19H65	3/3/10				0.603		0.022	0.593		0.055				0.110	U	0.110	1.63	U	1.63
Rust/scale	J19H66	3/3/10				0.040	U	0.040	0.114	U	0.114				0.136	U	0.136	3.13	U	3.13
Rust/scale	J19H67	3/3/10				0.074		0.022	0.098		0.084				0.103	U	0.103	2.49	U	2.49
Sediment	J19H68	3/3/10				0.546		0.038	0.565		0.119				0.157	U	0.157	3.67	U	3.67
Rust/scale	J19H69	3/4/10				0.085	U	0.085	0.088	U	0.088				0.099	U	0.099	2.84	U	2.84

Attachment	1	Sheet No.	7 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Other Solids Sample Results - Metals.

Sample Description	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Bismuth			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Concrete	J19H62	2/11/10	10000		1.6	4.7		0.40	43		0.70	110		0.080	0.92		0.035	1.6	B	0.54	7.0		1.0	0.043	U	0.043
Rust/scale	J19H63	3/2/10	13600		12.9	6.37		1.55	23.7		2.59	39.8		1.29	0.517	U	0.517				1.47	B	5.17	6.85		0.517
Scale	J19H65	3/3/10	5930		4.63	0.556	U	0.556	7.72		0.926	56.3		0.463	0.149	B	0.185				1.35	B	1.85	0.134	B	0.185
Rust/scale	J19H66	3/3/10	662		12.9	6.85		1.55	44.6		2.59	34.0		1.29	0.517	U	0.517				5.17	U	5.17	8.48		0.517
Rust/scale	J19H67	3/3/10	1360		10.0	6.93		1.20	12.6		2.00	95.8		1.00	0.400	U	0.400				4.00	U	4.00	19.2		0.400
Sediment	J19H68	3/3/10	7600		3.42	0.411	U	0.411	4.73		0.685	80.1		0.342	0.214		0.137				4.91		1.37	0.302		0.137
Rust/scale	J19H69	3/4/10	1030		27.3	7.82		3.27	23.1		5.45	22.5		2.73	1.09	U	1.09				10.9	U	10.9	1.88		1.09

Sample Description	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium			Iron			Lead			Lithium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Concrete	J19H62	2/11/10	130000		74	12		0.31	13		0.53	62		1.1				17000		4.0	4.4		0.29	8.0		0.32
Rust/scale	J19H63	3/2/10	187	B	259	504		0.517	5.17	U	5.17	27.5		2.59				552000		414	26.0		1.29			
Scale	J19H65	3/3/10	10400		92.6	12.4		0.185	5.81		1.85	19.5		0.926				21700		18.5	3.35		0.463			
Rust/scale	J19H66	3/3/10	3840		259	47.3		0.517	8.39		5.17	108		2.59				421000		414	11.7		1.29			
Rust/scale	J19H67	3/3/10	2980		200	122		0.400	9.15		4.00	25.6		2.00				440000		320	22.0		1.00			
Sediment	J19H68	3/3/10	16000		68.5	13.5		0.137	5.83		1.37	19.3		0.685				19100		13.7	27.6		0.342			
Rust/scale	J19H69	3/4/10	806		545	164		1.09	33.2		10.9	414		5.45				403000		436	2.73	U	2.73			
Concrete	J19H77	2/11/10													0.158	U	0.158									
Rust/scale	J19H78	3/2/10													7.84		0.150									
Scale	J19H79	3/3/10													0.494		0.157									
Rust/scale	J19H80	3/3/10													0.155	U	0.155									
Rust/scale	J19H81	3/3/10													0.346		0.153									
Sediment	J19H82	3/3/10													0.154	U	0.154									
Rust/scale	J19H83	3/4/10													0.569		0.150									

Sample Description	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Molybdenum			Nickel			Phosphorous			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Concrete	J19H62	2/11/10	8000		20	290		0.53	0.0058	U	0.0058	2.0	B	0.27	11	L	0.13	600		1.7	890		43	0.91	U	0.91
Rust/scale	J19H63	3/2/10	32.8	B	194	1320		12.9	5.88		0.265	8.67		5.17	10.5		10.3				1030	U	1030	0.776	U	0.776
Scale	J19H65	3/3/10	4150		69.4	282		4.63	0.0300	U	0.0300	0.747	B	1.85	10.9		3.70				1040		370	0.278	U	0.278
Rust/scale	J19H66	3/3/10	466		194	1630		12.9	5.44		0.290	3.95	B	5.17	17.2		10.3				1030	U	1030	0.776	U	0.776
Rust/scale	J19H67	3/3/10	580		150	3130		10.0	1.07		0.0257	4.34		4.00	17.6		8.00				374	B	800	0.600	U	0.600
Sediment	J19H68	3/3/10	3920		51.4	337		3.42	0.472		0.0300	0.355	B	1.37	10.7		2.74				1580		274	0.205	U	0.205
Rust/scale	J19H69	3/4/10	134	B	409	911		27.3	2.22		0.118	29.2		10.9	152		21.8				2180	U	2180	1.64	U	1.64

Attachment	1	Sheet No.	8 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Other Solids Sample Results - Metals.

Sample Description	HEIS Number	Sample Date	Silicon			Silver			Sodium			Strontium			Thallium			Tin			Titanium			Uranium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Concrete	J19H62	2/11/10	140	M	11	0.17	U	0.17	470		62	160		0.19	0.69	UN	0.69	6.2	B	0.96	1200		0.74	0.93	M	0.0017
Rust/scale	J19H63	3/2/10	2070		5.17	0.870		0.517	129	U	129															
Scale	J19H65	3/3/10	875		1.85	0.185	U	0.185	168		46.3															
Rust/scale	J19H66	3/3/10	1110		5.17	0.517	U	0.517	129	U	129															
Rust/scale	J19H67	3/3/10	1070		4.00	0.400	U	0.400	75.7	B	100															
Sediment	J19H68	3/3/10	638		1.37	0.137	U	0.137	241		34.2															
Rust/scale	J19H69	3/4/10	893		10.9	1.09	U	1.09	273	U	273															

Sample Description	HEIS Number	Sample Date	Vanadium			Zinc			Zirconium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Concrete	J19H62	2/11/10	42		0.50	190		2.1	19	M	1.9
Rust/scale	J19H63	3/2/10	70.8		6.47	465		25.9			
Scale	J19H65	3/3/10	41.7		2.31	34.2		9.26			
Rust/scale	J19H66	3/3/10	21.6		6.47	532		25.9			
Rust/scale	J19H67	3/3/10	21.6		5.00	943		20.0			
Sediment	J19H68	3/3/10	33.4		1.71	62.8		6.85			
Rust/scale	J19H69	3/4/10	13.6	B	13.6	187		54.5			

Attachment	1	Sheet No.	9 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Water Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Americium-241			Antimony-125			Barium-133			Cerium-144			Cesium-134			Cesium-137		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Water	J19H92	2/11/10	1.36	U	6.53	6.46	U	15.5				0.195	U	22.0	1.11	U	6.48	3.12	U	6.27
Water	J19H93	2/11/10	-0.429	U	6.00	2.54	U	14.2				-3.54	U	22.6	4.97	U	7.76	-0.177	U	5.99
Water	J19H94	2/22/10	-18.7	U	52.0	-13.6	U	38.3	-7.77	U	18.8	5.82	U	69.6	2.60	U	16.6	1.63	U	15.7
Water	J19H95	3/2/10	41.4	U	41.4	18.9	U	18.9				36.3	U	36.3	9.39	U	9.39	6.80	U	6.80
Water	J19H96	3/2/10	35.2	U	35.2	21.1	U	21.1				44.7	U	44.7	12.4	U	12.4	8.80	U	8.80
Water	J19H97	3/15/10	64.5	U	64.5	17.4	U	17.4				40.2	U	40.2	8.70	U	8.70	8.23	U	8.23

Sample Description	HEIS Number	Sample Date	Cobalt-60			Europium-152			Europium-154			Europium-155			Gross alpha			Gross beta		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Water	J19H92	2/11/10	2.96	U	6.82	1.06	U	15.0	0.958	U	18.1	-0.0685	U	9.89	0.242	U	0.821	3.80		2.92
Water	J19H93	2/11/10	-1.17	U	5.50	4.71	U	15.6	2.42	U	19.1	-0.847	U	9.88	0.139	U	0.897	4.11		2.82
Water	J19H94	2/22/10	0.296	U	15.0	10.4	U	43.4	12.3	U	44.9	-13.7	U	36.9	0.383	U	0.656	4.81		2.71
Water	J19H95	3/2/10	7.48	U	7.48	19.7	U	19.7	20.6	U	20.6	23.1	U	23.1	1.81		1.01	1.84		1.73
Water	J19H96	3/2/10	10.2	U	10.2	25.4	U	25.4	28.8	U	28.8	25.1	U	25.1	12.5		8.05	73.3		4.68
Water	J19H97	3/15/10	8.46	U	8.46	24.2	U	24.2	24.2	U	24.2	23	U	23	0.146	U	0.773	1.71		1.68

Attachment	1	Sheet No.	10 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Water Sample Results - Radionuclides.

Sample Description	HEIS Number	Sample Date	Niobium-94			Potassium-40			Radium-226			Radium-228			Ruthenium-106			Silver-108		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Water	J19H92	2/11/10	-2.10	U	4.97										11.1	U	56.0			
Water	J19H93	2/11/10	0.0805	U	6.43										23.1	U	57.1			
Water	J19H94	2/22/10	4.63	U	14.7										18.1	U	144	4.53	U	13.0
Water	J19H95	3/2/10	6.58	U	6.58	92.7	U	92.7	18.0	U	18.0	32.2	U	32.2	68.0	U	68.0			
Water	J19H96	3/2/10	8.03	U	8.03	120	U	120	17.3	U	17.3	37.3	U	37.3	89.8	U	89.8			
Water	J19H97	3/15/10	7.37	U	7.37	162	U	162	15.6	U	15.6	35.1	U	35.1	68.7	U	68.7			

Sample Description	HEIS Number	Sample Date	Thorium-228			Thorium-232			Radioactive Strontium			Uranium-235			Uranium-238			Zinc-65		
			pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA	pCi/L	Q	MDA
Water	J19H92	2/11/10																-2.90	U	11.8
Water	J19H93	2/11/10																-9.12	U	11.2
Water	J19H94	2/22/10																-11.1	U	31.4
Water	J19H95	3/2/10	13.6	U	13.6	32.2	U	32.2				41.2	U	41.2	857	U	857	13.0	U	13.0
Water	J19H96	3/2/10	13.5	U	13.5	37.3	U	37.3	-0.028	U	0.676	53.9	U	53.9	1040	U	1040	19.5	U	19.5
Water	J19H97	3/15/10	12.9	U	12.9	35.1	U	35.1				48.4	U	48.4	996	U	996	15.0	U	15.0

Attachment	1	Sheet No.	11 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Water Sample Results - Metals.

Sample Description	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Water	J19H92	2/11/10	0.018	U	0.018	0.0031	U	0.0031	0.0044	U	0.0044	0.0024	BM	0.00058	0.00047	U	0.00047	0.024		0.0016	0.00045	U	0.00045
Water	J19H93	2/11/10	0.14		0.018	0.0031	U	0.0031	0.0044	U	0.0044	0.0093		0.00058	0.00047	U	0.00047	0.027		0.0016	0.00045	U	0.00045
Water	J19H94	2/22/10	0.018	U	0.05	0.0031	U	0.0031	0.0044	U	0.01	0.0016	B	0.0058	0.00047	U	0.00047	0.033	J	0.016	0.00045	U	0.00045
Water	J19H95	3/2/10	0.0364	B	0.05	0.00600	U	0.00600	0.0100	U	0.0100	0.638		0.638	0.00200	U	0.00200	0.0127		0.0100	0.00100	U	0.00100
Water	J19H96	3/2/10	14.600		0.050	0.0057	B	0.00600	0.0191		0.0100	2.970		0.00500	0.000432	B	0.00200	0.126		0.0100	0.00107		0.00100
Water	J19H97	3/15/10	0.106		0.050	0.00600	U	0.00600	0.0100	U	0.0100	0.00262	B	0.00500	0.00200	U	0.00200	0.0259		0.0100	0.00200	U	0.00200

Sample Description	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium			Iron			Lead		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Water	J19H92	2/11/10	3.5		0.034	0.0007	U	0.0007	0.0012	U	0.0012	0.0024	B	0.0014				0.86		0.022	0.0026	U	0.0026
Water	J19H93	2/11/10	20		0.034	0.0027		0.0007	0.0012	B	0.0012	0.018		0.0014				8.6		0.022	0.0026	U	0.0026
Water	J19H94	2/22/10	4.4	J	0.034	0.0007	U	0.0007	0.0012	U	0.0012	0.0014	U	0.0014				0.39		0.022	0.0026	U	0.0026
Water	J19H95	3/2/10	39.900		0.100	0.00200	U	0.00200	0.00200	U	0.00200	0.0100	U	0.0100				0.130		0.0500	0.00500	U	0.00500
Water	J19H96	3/2/10	77.100		0.100	0.0349		0.00200	0.0113		0.00200	0.0455		0.0100				90.200		0.0500	0.126		0.00500
Water	J19H97	3/15/10	5.050		1.000	0.00200	U	0.00200	0.00200	U	0.00200	0.0100	U	0.0100				0.245		0.0500	0.00500	U	0.00500
Water	J19HB7	2/11/10													0.00740	U	0.00740						
Water	J19HB8	2/11/10													0.00370	U	0.00370						
Water	J19HB9	2/22/10													0.0110		0.00740						
Water	J19HC0	3/2/10													0.00740	U	0.00740						
Water	J19HC1	3/2/10													0.00740	U	0.00740						
Water	J19HC2	3/15/10													0.00740	U	0.00740						

Sample Description	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Water	J19H92	2/11/10	2.1		0.011	0.013		0.0003	0.000027	U	0.000027	0.0031	U	0.0031	0.0013	U	0.0013	2.6	B	0.24	0.0049	U	0.0049
Water	J19H93	2/11/10	6.8		0.011	0.069		0.0003	0.000085	B	0.000027	0.0031	U	0.0031	0.0013	B	0.0013	1.7	B	0.24	0.0049	U	0.0049
Water	J19H94	2/22/10	0.62	J	0.11	0.061	J	0.0003	0.000027	U	0.000027	0.0031	U	0.0031	0.0013	U	0.0013	1.2	B	0.24	0.0049	U	0.0049
Water	J19H95	3/2/10	2.630		0.100	0.0628		0.00200	0.000200	U	0.000200	0.00521		0.00200	0.00500	U	0.00500	0.838		0.500	0.0100	U	0.0100
Water	J19H96	3/2/10	10.900		0.100	0.740		0.00200	0.000735		0.000200	0.00784		0.00200	0.0229		0.00500	62.500		0.500	0.00494	B	0.0100
Water	J19H97	3/15/10	0.700	B	0.750	0.0179		0.00500	0.000200	U	0.000200	0.00226		0.00200	0.0400	U	0.0400	1.200	B	4.000	0.0100	U	0.0100

Attachment	1	Sheet No.	12 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Attachment 1. 100-D-63 Confirmatory Water Sample Results - Metals.

Sample Description	HEIS Number	Sample Date	Silicon			Silver			Sodium			Uranium			Vanadium			Zinc		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
Water	J19H92	2/11/10	3.6		0.035	0.0009	U	0.0009	8.1		0.092	0.000020	U	0.000020	0.0013	BM	0.0011	0.0045	U	0.0045
Water	J19H93	2/11/10	1.5		0.035	0.0009	U	0.0009	3.3		0.092	9.5E-05	B	0.00002	0.0032	B	0.0011	0.0045	U	0.0045
Water	J19H94	2/22/10	0.76		0.035	0.0009	U	0.0009	5.4		0.092	3.7E-05	BJM	0.000020	0.0011	U	0.0011	0.0045	U	0.0045
Water	J19H95	3/2/10	0.202		0.0500	0.00200	U	0.00200	2.340		0.100	0.0214	B	0.100	0.00147	B	0.00500	0.0054	B	0.0100
Water	J19H96	3/2/10	34.900		0.0500	0.00200	U	0.00200	269.000		0.100	0.100	U	0.100	0.0509		0.00500	1.030		0.0100
Water	J19H97	3/15/10	1.130		0.0250	0.00200	U	0.00200	5.480		0.500	0.200	U	0.200	0.00120	B	0.0250	0.0061	B	0.0100

Attachment	1	Sheet No.	13 of 13
Originator	W. S. Thompson	Date	9/1/10
Checked	J. D. Skoglie	Date	9/1/10
Calc. No.	0100D-CA-V0383	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0384

Subject: 100-D-63 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	W. S. Thompson	J. D. Skoglie	B. L. Vedder	D. F. Obenauer	9/2/10

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	9/1/2010	Calc. No.:	0100D-CA-V0384	Rev.:	0
Project:	100-D Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	9/1/2010
Subject:	100-D-63 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-D-63 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), the following criteria must be met:

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

GIVEN/REFERENCES:

1) BHI, 2005, *100 Area Analogous Sites RESRAD Evaluation*, Calculation No. 0100X-CA-V0050 Rev 0, Bechtel Hanford, Inc., Richland, Washington.

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

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

4) WAC 173-340-740(3)(a)(ii)(A), "Groundwater Protection."

5) WCH, 2010, *Remaining Sites Verification Package for the 100-D-63, 100-D/DR Service Water Pipelines*, Attachment to Waste Site Reclassification Form 2008-001, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate a HQ for each noncarcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (BHI 2005).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (BHI 2005).

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	9/1/2010	Calc. No.:	0100D-CA-V0384	Rev.:	0
Project:	100-D Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	9/1/2010
Subject:	100-D-63 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	2 of 3

METHODOLOGY:

The 100-D-63 waste site consisted of the 100-D/DR service water pipelines. The pipelines were divided into eight service areas for confirmatory sampling. Samples of soil directly underlying the pipelines and the contents of the pipelines were collected from each service area. The pipelines contained rust, scale, sediment, and/or water. For the purpose of evaluation of the hazard quotient for the protection of groundwater, the maximum concentration for each contaminant for the entire set of soil samples was used.

Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-D-63 waste site were calculated for the entire waste site using the greater of the values for each analyte detected in the soil samples (WCH 2010). Of the contaminants of potential concern (COPCs) for this site, boron and hexavalent chromium were included because they do not have Hanford Site-specific or Washington State background values available and their distribution coefficients are less than that necessary to show no migration to groundwater in 1,000 years using the generic site RESRAD model (BHI 2005). Based on this model and a vadose zone of approximately 22 m (72 ft) thickness, a K_d of 3.4 is required to show no predicted migration to groundwater in 1,000 years using the generic site model. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than 3.4. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (µg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720(3)(a)(ii)(A), 1996) x 100 x 1 mg/1000 µg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii)(A) (1996). For example, the maximum soil value for boron of 2.05 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg, is 6.4×10^{-3}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The two qualifying constituents were boron and hexavalent chromium; thus, the sum of the HQ values is 3.6×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) No carcinogenic constituents met the criteria for evaluation at the 100-D-63 waste site; therefore, no calculations of excess carcinogenic risk were performed.

4) WAC 173-340-740(3)(a)(ii)(1996) provides the "100 times rule" but also states "unless it can be demonstrated that a higher soil concentration is protective of groundwater at the site." When the "100 times rule" values were exceeded, RESRAD was used to demonstrate that higher soil concentrations may be protective of groundwater.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	9/1/2010	Calc. No.:	0100D-CA-V0384	Rev.:	0
Project:	100-D Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	9/1/2010
Subject:	100-D-63 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	3 of 3

RESULTS:

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

Table 1 shows the results of the calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the Protection of Groundwater at the 100-D-63 Waste Site.

Contaminants of Potential Concern	Statistical or Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	2.05	320	6.4E-03	--	--
Chromium, hexavalent	0.14	4.8	2.9E-02	--	--
Totals					
Cumulative Hazard Quotient:			**3.6E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2010).
[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and "100 times" model unless otherwise noted.
-- = not applicable

CONCLUSION:

This calculation demonstrates that the 100-D-63 waste site meets the requirements for the hazard quotients and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A DQA was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (*Work Instruction for Confirmatory Sampling of the 100-D-63, 100D/DR Service Water Pipelines* [WCH 2009]). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample designs (DOE-RL 2009, WCH 2009), the field logbook (WCH 2010), the applicable analytical data packages, and communications between the project and the regulator, has been performed as part of this DQA. All samples were not collected as indicated in the site-specific sample design (WCH 2009). Due to field constraints, test pit 4 was not excavated, seven of the test pits required relocation, and test pits 1 and 2 were excavated, but not sampled. These changes in sample design were discussed and approved in a June 24, 2010 meeting with Ecology and preceded by email correspondence documenting difficulty sampling (Ecology 2009). The remaining sites verification package provides further description of the sampling events.

Though data is not available for test pits 1, 2, and 4, this deficiency does not affect the quality of the data for the remaining test pits nor preclude an evaluation of the overall waste site. This DQA pertains to the data for test pits 3 and 5 through 18.

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

Verification sample data collected at the 100-D-63 waste site were provided by the laboratories in twenty-two sample delivery groups (SDGs): J00722, J00723, J00724, J00725, J00750, J00751, J00766, J00767, J00768, J00769, J00770, J00771, J0772, K1958, K1959, K1960, K1966, K1967, K1973, K1974, K1984, and K1985. SDGs J00751 and K1966 were submitted for third-party validation

Samples in the 100-D-63 data set were analyzed using the following analyses: EPA method 6010 (inductively coupled plasma [ICP] metals), EPA method 7196 (hexavalent chromium), cold vapor atomic absorption (mercury), alpha energy analysis (AEA) (isotopic plutonium, uranium, and americium), beta counting (strontium-90), gamma energy analysis (GEA), and gas proportional counting (GPC) (gross alpha and beta). The ICP metals include: antimony, arsenic,

barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

No major deficiencies were found in any of the SDGs. Minor deficiencies are discussed by SDG as follows below. If no comments are made about a specific analysis it should be assumed that no deficiencies in the quality of the data were found. Unless otherwise noted deficiencies listed below are specific to the individual SDG, but apply to all samples within that SDG. No deficiencies were noted in SDGs J00766, J00768, J00770, J00725, J0772, or K1985.

SDG J00722

This SDG comprises three soil samples (J19H41, J19H42, and J19H43). Minor deficiencies noted in SDG J00722 are as follows:

In the GEA, insufficient sample material was available to prepare a laboratory duplicate of sample J19H41. The duplicate result was obtained by recounting sample J19H41 on a different detector. The data are usable for decision-making purposes.

In the gross alpha analysis, the relative percent difference (RPD) calculated using the laboratory duplicate (61%) was above the acceptable range (0-30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix rather than to analytical variability in the sample extraction or analysis process. The gross alpha results for sample J19H42 may be considered estimated. Estimated data are usable for decision-making purposes.

In the alpha spectroscopy analysis, the RPDs calculated for uranium-234 (41.6%) and uranium-238 (81.5%) were above the acceptable range (0-30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix rather than to analytical variability in the sample extraction or analysis process. The uranium-234 and uranium-238 results for SDG J00722 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries for two analytes were out of project acceptance criteria (70-130%): antimony (65%) and silicon (44%). Results for antimony and silicon in SDG J00722 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J00723

This SDG comprises two other solid samples (J19H77 and J19H62). Minor deficiencies noted in SDG J00723 are as follows:

In the GEA, insufficient sample material was available to prepare a laboratory duplicate of sample J19H62. The duplicate result was obtained by recounting sample J19H62 on a different detector. The data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory performed a serial dilution on the batch for all samples in SDG J00723. The laboratories evaluation of this data indicates physical or chemical interferences of nickel due to the sample matrix. The laboratory has qualified these data with "L" flags to indicate this interference. Analytical results for nickel in all samples in SDG J00723 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for three analytes were out of project acceptance criteria (70-130%): copper (145%), silicon (21%), and zinc (152%). Results for copper, silicon, and zinc in SDG J00723 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPDs calculated for silicon (46%) and zirconium (34%) were above the acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The silicon and zirconium results in SDG J00723 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J00724

This SDG comprises two water samples (J19H92 and J19H93). Minor deficiencies noted in SDG J00724 are as follows:

In the GEA, insufficient sample material was available to prepare a laboratory duplicate of sample J19H92. The duplicate result was obtained by recounting sample J19H92 on a different detector. The data are usable for decision-making purposes.

In the gross beta analysis, contamination was detected in the method blank. All gross beta results in SDG J00724 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, contamination was detected in the method blank for sodium and the field sample results were all within 10 times the method blank results. Due to this, all detected sample results in SDG J00724 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J00750

This SDG comprises two water samples (J19HB9 and J19H94). Minor deficiencies noted in SDG J00750 are as follows:

In the hexavalent chromium analysis, contamination was detected in the method blank. All of the detected hexavalent chromium values in SDG J00750 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, contamination was detected in the method blank for calcium and uranium and the field sample results are all within 10 times the method blank results. Due to

this, detected sample results for calcium and uranium in sample J19H94 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPD for uranium (55%) is above the acceptable range (0-30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix rather than to analytical variability in the sample extraction or analysis process. The uranium results in sample J19H94 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J00751

This SDG comprises three soil samples (J19H44, J19H45, and J19H46) from the 100-D-63 waste site. Sample J19H44 is the main sample for the field duplicate, sample J19H45. SDG J00751 was submitted for formal third-party validation. Minor deficiencies found in SDG J00751 are as follows:

In the GEA, insufficient sample material was available to prepare a laboratory duplicate of sample J19H46. The duplicate result was obtained by recounting sample J19H46 on a different detector. The data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory performed a serial dilution on the batch for all samples in SDG J00751. The laboratory evaluation of this data indicates physical or chemical interferences of cobalt and silicon due to the sample matrix. The laboratory has qualified these data with "L" flags to indicate this interference. Analytical results for cobalt and silicon in all samples in SDG J00751 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control standard (LCS) recovery for silicon was below the acceptance limit (70-130%) at 30%. Third-party validation has qualified all results for silicon as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, MS recoveries for two ICP metals were out of project acceptance criteria (70-130%): antimony (67%) and silicon (26%). Third-party validation has qualified all antimony and silicon results in SDG J00751 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG J00767

This SDG comprises a single other solid sample (J19H78). Minor deficiencies noted in SDG J00767 are as follows:

In the hexavalent chromium analysis, the MS recovery (54.39%) was out of project acceptance criteria (70-130%). The hexavalent chromium results in SDG J00767 may be considered estimated. Estimated data are usable for decision-making purposes.

In the hexavalent chromium analysis, the RPD (39.75%) was above the acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The hexavalent chromium results in SDG J00767 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J00769

This SDG comprises two samples of pipe contents (J19H81 [rust and scale] and J19H82 [sand and sediment]). Minor deficiencies noted in SDG J00769 are as follows:

In the hexavalent chromium analysis, the MS recovery (21%) was out of project acceptance criteria (70-130%). The hexavalent chromium results in SDG J00769 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J00771

This SDG comprises a single sample of pipe contents (J19H83 [rust and scale]). Minor deficiencies noted in SDG J00771 are as follows:

In the hexavalent chromium analysis, the MS recovery (7%) was out of project acceptance criteria (70-130%). The laboratory has demonstrated quantitation of this analyte with the LCS recovery that was acceptable at 94%. These two results imply a reducing capacity in the sample, causing a reaction with the added hexavalent chromium in the MS. The field sample is a rust and scale matrix, which may also be causing a colorimetric interference in the analytical system. In addition, the RPD (62%) was above the acceptance criteria (less than 30%), which also may be attributed to the rust and scale matrix. The hexavalent chromium results in SDG J00771 should be considered estimated. Estimated data are usable for decision-making purposes.

SDG K1958

This SDG comprises four soil samples (J19H47, J19H48, J19H49, and J19H50). Minor deficiencies noted in SDG K1958 are as follows:

In the ICP metals analysis, the MS recovery was out of project acceptance criteria (70-130%) for antimony (56%). Results for antimony in SDG K1958 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K1959

This SDG comprises two other solid samples (J19H63 and J19H64). Minor deficiencies noted in SDG K1959 are as follows:

In the ICP metals analysis, the MS recoveries for seven analytes were out of project acceptance criteria (70-130%): arsenic (138%), cadmium (9%), cobalt (126%), nickel (145%), lead (69%), silicon (3510%), and vanadium (163%). Results for arsenic, cadmium, cobalt, nickel, lead,

silicon, and vanadium in SDG K1959 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K1960

This SDG comprises two water samples (J19H95 and J19H96). Minor deficiencies noted in SDG K1960 are as follows:

In the ICP metals analysis, the contamination was detected in the method blank for molybdenum and potassium and the field sample results were all within 10 times the method blank results. Due to this, detected sample results for molybdenum and potassium in SDG K1960 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K1966

This SDG comprises five soil samples (J19H51, J19H52, J19H53, J19H55, and J19H56). Sample J19H55 is the main sample for the field duplicate, sample J19H56. SDG K1966 was submitted for formal third-party validation. Minor deficiencies noted in SDG K1966 are as follows:

In the GEA, the RPD for thorium-232 (61%) was above acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. Third-party validation has qualified all thorium-232 results in SDG K1966 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony (54%) was out of project acceptance criteria (70-130%). Third-party validation has qualified all antimony results in SDG K1966 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPDs calculated for barium (50%) and lead (31%) were above the acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. Third-party validation has qualified all barium and lead results in SDG K1966 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG K1967

This SDG comprises four other solid samples (J19H65, J19H66, J19H67, and J19H68). Minor deficiencies noted in SDG K1967 are as follows:

In the ICP metals analysis, the MS recoveries for two analytes were out of project acceptance criteria (70-130%): antimony (55%) and magnesium (67%). Results for antimony and magnesium in SDG K1967 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPDs calculated for arsenic (88%) and copper (38%) were above the acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The arsenic and copper results in SDG K1967 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K1973

This SDG comprises a single soil sample (J19H57). Minor deficiencies noted in SDG K1973 are as follows:

In the ICP metals analysis, the MS recoveries for five analytes were out of project acceptance criteria (70-130%): antimony (43%), calcium (38%), magnesium (63%), vanadium (58%), and zinc (70%). Results for antimony, calcium, magnesium, vanadium, and zinc in SDG K1973 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG K1974

This SDG comprises a single other solid sample (J19H69). Minor deficiencies noted in SDG K1974 are as follows:

In the ICP metals analysis, the MS recoveries for three analytes were out of project acceptance criteria (70-130%): antimony (69%), boron (66%), and calcium (143%). Results for antimony, boron, and calcium in SDG K1974 may be considered estimated. Estimated data are usable for decision making purposes.

SDG K1984

This SDG comprises a single soil sample (J19H58). Minor deficiencies noted in SDG K1984 are as follows:

In the gross beta analysis, the LCS recovery (79%) met the project acceptance criteria, but exceeded the laboratory acceptance criteria. All gross beta results in SDG K1984 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery was out of project acceptance criteria (70-130%) for antimony (47%). Results for antimony in SDG K1984 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPDs calculated for barium (31%), manganese (34%), and silicon (31%) were above the acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The barium, manganese, and silicon results in SDG K1984 may be considered estimated. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratories. 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. Two sets of field QA/QC samples (main sample and duplicate) were collected, as documented in the field logbooks (WCH 2010). The first QA/QC set comprises samples J19H44 (main) and J19H45 (duplicate) from test pit 5. The second QA/QC set comprises samples J19H55 (main) and J19H56 (duplicate) from test pit 9.

The entire sample data set, including the duplicate sample data, are presented in Appendix C. RPDs for the field duplicate samples have been calculated and are included in Appendix C.

Field duplicate samples provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s), for each contaminant of concern. No major or minor deficiencies in the RPD calculations were found for the duplicate samples. All RPD results were less than the project acceptance limit (30%) for both test pit 5 and test pit 9.

A secondary check of the data variability was used when one or both of the samples being evaluated (main and duplicate) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ± 2 times the TDL was used (Appendix C) to indicate that a visual check of the data was required by the reviewer. The radium-226 sample results from test pit 9 required this check. A visual inspection of all of the data was also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-D-63 verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling.

The DQA review for the 100-D-63 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of QA and QC deficiencies. The analytical data were found acceptable for decision-making purposes. The verification sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the

Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix C.

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