Limited Field Investigation Report for the 100-HR-3 Operable Unit

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EXECUTIVE SUMMARY

This limited field investigation (LFI) was conducted to assess the applicability of interim remedial measures (IRM) for reducing human health and environmental risks within the 100-HR-3 Groundwater Operable Unit. The 100-HR-3 Operable Unit is comprised of three subareas; the 100 D Area, the 100 H Area and those portions of the 600 Area between the two reactor areas. The operable unit is one of seven operable units associated with the 100 D and H Areas. Operable units 100-DR-1, 100-DR-2, 100-DR-3, 100-HR-1, 100-HR-2 and 100-IU-4 address contaminant sources while 100-HR-3 addresses contamination present in the underlying groundwater.

The primary method of field investigation used during this LFI was the installation and sampling of monitoring wells. Samples were collected from the groundwater and soils, and submitted for laboratory analysis. Boreholes were surveyed for radiological contamination using downhole geophysical techniques to further delineate the locations and levels of contaminants. All samples were screened to ascertain the presence of volatile organic compounds and radionuclides. Analytical data were subjected to validation; all round one, two and three and a minimum of 10% of round four data associated with the LFI were validated.

A screening method was used to identify contaminants of potential concern (COPC). This screening method eliminated from further consideration, constituents that were below background. Constituents which are considered non-toxic to humans were eliminated from the human health evaluation. Data consistency and blank contamination were also evaluated in the screening process. These COPC were then evaluated further in the qualitative risk assessment (QRA).

A human health QRA was performed using conservative (maximum equilibrated contaminant levels from the LFI) analyses. Based on the QRA, the COPC in the groundwater in the 100 D Area are chromium, nitrate, ammonia, manganese, tritium, carbon-14 and strontium-90. The COPC in the groundwater beneath the 100 H Area are tritium, carbon-14, strontium-90, technetium-99, uranium-238, uranium 233/234, americium-241, chromium, chloroform, manganese, fluoride, ammonia, and nitrate. In the 600 Area of the 100-HR-3 Operable Unit, tritium and arsenic are the COPC.

A parallel qualitative ecological risk assessment was performed using a subset of the data used in the human health QRA. This assessment used conservative data from wells located closest to the Columbia River. Chromium concentrations exceeding the ecological risk levels are known to be present in springs discharging to the Columbia River. Chromium was identified as potentially posing an acute or chronic risk to fish.

The ecological risk assessment identified medium risk to aquatic organisms, assuming that the groundwater or spring discharges were the only water to which they were exposed. This scenario is appropriate for development of salmonids from the embryonic through fry stages. Analyses of Columbia River water show that chromium is less than the detection level. Under conditions to which the fish are exposed at the fingerling and later stages, a mixture of groundwater and surface water, a low risk was determined. Because the

environmental hazard quotient exceeds 1.0, the 100-HR-3 Operable Unit is recommended to continue along the IRM path.

The occasional-use scenario of the QRA is used to identify sites potentially in need of an IRM. If risk is determined to be medium or high under this scenario, the site continues along the IRM pathway. Based on the low and very-low risks identified, and the concentrations of contaminants, a human-health driven IRM is not necessary.

ACRONYMS

ARAR	applicable or relevant and appropriate requirements
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulation
COC	contaminant of concern
COPC	contaminants of potential concern
CRBG	Columbia River Basalt Group
DOE	U.S. Department of Energy
EHQ	environmental hazard quotient
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
FR	Federal Regulation
HEIS	Hanford Environmental Information System
HQ	hazard quotient
HSBRAM	Hanford Site Baseline Risk Assessment Methodology
HPPS	Hanford Past-Practice Strategy
ICR	increased cancer risk
IRIS	Integrated Risk Information System
IRM	interim remedial measure
LFI	limited field investigation
LOEL	lowest observable effect level
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MTCA	Model Toxics Control Act
NOEL	no-observable effect level
QRA	qualitative risk assessment
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
TBC	to-be-considered
VOA	volatile organic analytes
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

This limited field investigation (LFI) report is a secondary document summarizing the data collection and analysis activities conducted during the 100-HR-3 Groundwater Operable Unit LFI and the associated qualitative risk assessment (QRA).

1.1 SITE LOCATION

The 100-HR-3 Operable Unit is located in the north-central portion of the Hanford Site along the southern shoreline of the Columbia River (Figure 1-1). The southern boundary of the operable unit is the southern boundary of Sections 21, 22, 23, and 24, Township 14 North, Range 26 East of the Willamette Meridian, and extending east along the southern boundary of Sections 19 and 20, Township 14 North, Range 27 East of the Willamette Meridian, to the Benton County line on the east. The operable unit also includes outfall structures and effluent pipelines which extend into the Columbia River, but excludes that portion of the 116-N-3 Crib and trench which extends north of the southern boundary.

The 100-HR-3 Operable Unit is one of seven operable units associated with the 100 D/DR and 100 H Area at the Hanford Site (Figure 1-2). Three of the 100 D/DR operable units, two of the 100 H Area operable units and the 100-IU-4 Operable Unit are source operable units. The 100-HR-3 Groundwater Operable Unit includes the groundwater below the source operable units plus the adjacent groundwater, surface water, sediments, and aquatic biota impacted by the 100 D/DR and 100 H Area operations. The 100-HR-3 Operable Unit also includes that portion of the 600 Area that lies between the D/DR and H Reactors.

1.2 SITE HISTORY

The 100 D/DR Area was the site of two water-cooled, graphite moderated, plutonium production reactors. The D Reactor operated from 1944 to 1967, and the DR Reactor from 1950 to 1965. The H Area was the site of one water-cooled, graphite moderated, plutonium production reactor. The H Reactor operated from 1949 to 1965. These reactors were used to produce plutonium for nuclear weapons, and used Columbia River water for cooling and other operations activities. The operation of these reactors and their ancillary facilities resulted in the disposal of large quantities of waste.

Within the 600 Area of the 100-HR-3 Operable Unit and approximately midway between the 100 D/DR and 100 H Areas is the 100-IU-4 Operable Unit Sodium Dichromate Barrel Disposal Landfill. This site was eliminated as a suspect source when it was remediated in April 1992 through an expedited response action (ERA). During remediation the underlying soils were determined to be insufficiently contaminated to affect the groundwater.

Of primary concern for this LFI is the liquid waste, because it is believed to have the greatest influence on the groundwater. The major liquid waste disposal sites (Figures 1-3 and 1-4) are:

- The reactor coolant water handling facilities which include the 116-D-7, 116-DR-9, and 116-H-7 Retention Basins; the 116-DR-1, 116-DR-2, 116-H-1, and 116-H-2 Liquid Waste Disposal Trenches; and the 116-DR-3, 116-DR-6, 116-DR-8, and the 116-H-9 Cribs. These sites were contaminated with cooling water which contained low concentrations of radionuclides and potentially hazardous species including chromium.
- The ruptured fuel element effluent disposal facilities, which include the 116-D-2, 116-DR-4, and 116-H-4 Pluto Cribs.
- The decontamination waste stream disposal facilities, which include the 116-D-1A and 116-D-1B Storage Basin Trenches; the 116-D-3, 116-D-4, and 116-H-3 Cribs, and the 116-H-6 Retention basin.
- Any miscellaneous liquid waste facilities which include the 116-D-6 French Drain; the 116-D-7 Crib, and the 120-D-1 Ponds.

These facilities are discussed in more detail in the 100-DR-1 and 100-HR-1 Work Plans (DOE-RL 1992a; DOE-RL 1992b). The work plans for 100-HR-2 and 100-DR-2 are currently being written. The impact on groundwater due to individual waste sites is discussed in the 100-DR-1 and 100-HR-1 LFI reports (DOE-RL 1993a and DOE-RL 1993b).

1.3 LIMITED FIELD INVESTIGATION STRATEGY

To expedite the initiation and reduce the cost of cleaning up contaminated sites at Hanford, the U.S. Department of Energy (DOE), the Washington State Department of Ecology and the U.S. Environmental Protection Agency (EPA) developed the *Hanford Past-Practice Strategy* (HPPS) (DOE-RL 1991). This strategy uses existing data to make decisions and is biased-for-action. If a site poses a risk to human health or the environment, the bias is to take action to clean it up. Figure 1-5 outlines the four decision paths of the HPPS. These paths are:

- Expedited response action is performed when a rapid response is necessary to mitigate an unacceptable health or environmental risk from a site.
- Interim remedial measure (IRM) is performed at a site that is known to pose an unacceptable, non-time critical health or environmental risk.
- Limited field investigation is performed to gather any additional information necessary to determine whether or not an ERA or an IRM is necessary.

- Remedial investigation/feasibility study (RI/FS) is the baseline method of addressing potentially contaminated sites.

The LFI is an integral part of the RI/FS process and functions as a focused RI for selection of IRM. A QRA is performed as part of the LFI, and is focused on the principal risk drivers in the operable unit. The results of this assessment may be used to help determine the need for IRM. If an IRM is not justified, the site is still subject to further investigation and/or remediation. A further discussion of the LFI/IRM process is provided in *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988).

The LFI for the 100-HR-3 Operable Unit was conducted to determine the nature and extent of hazardous/radioactive materials present in the groundwater. This was done by collecting data from existing wells and twenty-two new wells drilled for the RI/FS. The new wells were installed to define the groundwater quality in areas of potential public or environmental exposure (e.g., near seeps and springs along the Columbia River shoreline that are downgradient of contaminant sources), to define the groundwater quality immediately downgradient of priority and potential sources of groundwater contamination, and to define the extent of known contamination. Soil samples were collected for chemical and radioactive analyses and physical property determination. Aquifer tests were also performed and hydraulic heads were measured.

The LFI for the 100-HR-3 Operable Unit included the following tasks:

- geological investigation
- vadose zone investigation
- groundwater investigation
- data evaluation
- risk assessment
- verification of applicable or relevant and appropriate requirements (ARAR)
- LFI reporting.

Several data compilation reports were prepared as part of early characterization activities for the 100 Areas. Lindsey (1992) summarizes the geologic data available and the geologic setting of the 100 Areas. Peterson (1992) provides an inventory of wells, chemical data, and water-level data for the northern Hanford Site. Hartman and Peterson (1992) summarize hydrologic conditions for the 100 Areas, including water table maps, waste indicator constituents, and aquifer hydraulic properties. They include an analysis of existing wells relative to their potential for future use. Lewis and Pearson (1992) present a catalog of historical borehole geophysical data for the 100 Areas. Ledgerwood (1991) summarizes well construction and condition information for existing 100 Area wells.

A limited number of LFI tasks were conducted under a separate 100 Area sitewide effort. These tasks include:

- surface water and sediments investigation
- air investigation
- ecological investigation.

Data compilations and summaries that pertain to these areas include: Dirkes (1992) which provides an extensive annotated bibliography for river-related investigations; Peterson and Johnson (1992) summarize historical riverbank seepage, sediment and nearshore monitoring well data, and relate it to results obtained during September 1991; Campbell et al. (1993) describes the extensive data acquisition capability that exists to gather data for the Hanford Site aquifer/Columbia River interaction investigations (Tri-Party Agreement Milestone M-30); and Weiss and Mitchell (1992) present a synthesis of ecological information for the 100 Areas. The potential ARAR are discussed in the 100 Area FS (DOE-RL 1993c).

1.4 DATA VALIDATION

Data validation was performed by a qualified independent participant contractor. The validation responsibilities are defined in associated statements of work. All validation was performed in compliance with Westinghouse Hanford Company's (WHC) *Sample Management Administration Manual* (WHC 1990), Section 2.1 for inorganic analyses, Section 2.2 for organics analyses, and Sections 2.3 and 2.4 for radionuclide analyses. All data packages were verified. One hundred percent of the first three rounds and 10% of the fourth round of data were validated. The data validation process is presented in:

- *Data Validation Report for the 100-HR-3 Operable Unit Second Quarter Sampling* (WHC 1992a).
- *Data Validation Report for the 100-HR-3 Operable Unit Third Quarter Sampling* (WHC 1992b).
- *Data Validation Report for the 100-HR-3 Operable Unit Fourth Quarter Sampling* (WHC 1993a).
- *Data Validation Report for the 100-HR-3 Operable Unit First Quarter Groundwater Sampling* (Vukelich 1993).

Data used in this investigation was derived directly from the Hanford Environmental Information System (HEIS). Data validation is an ongoing process and may result in changes to the qualification codes associated with individual analyses. All reported data and associated validation qualifiers used in this report conform to those in the HEIS as of October 21, 1993.

Figure 1-1 100 Area Reactor Locations

Figure 1-2 100-HR-3 Operable Unit and 600 Area Well Locations

Figure 1-3 Waste Sites and Well Locations in the 100 D/DR Area

Figure 1-5 Hanford Past-Practice Strategy Decision Tree

2.0 INVESTIGATION ACTIVITIES AND RESULTS

This chapter provides a summary of the activities performed and the data collected during the 100-HR-3 LFI.

2.1 GEOLOGY

During the LFI, one deep well (199-D8-54B) and twenty-one shallow wells (199-H4-45, 199-H4-46, 199-H4-47, 199-H4-48, 199-H4-49, 199-H5-1, 199-H6-1, 199-D2-6, 199-D5-14, 199-D5-15, 199-D5-16, 199-D5-17, 199-D5-18, 199-D5-19, 199-D5-20, 199-D8-53, 199-D8-54A, 199-D8-55, 699-93-48, 699-96-43, and 699-91-46), (Figures 2-2, 2-3 and 2-7) were installed to define the groundwater quality in areas of potential public or environmental exposure, and to define the groundwater quality immediately downgradient of priority and potential sources of groundwater contamination. The justification for each well location is discussed in the 100-HR-3 Work Plan (DOE-RL 1992c). Boreholes were advanced and sampled using cable tool drilling methods and split-spoon or core barrel samplers. Detailed procedures for borehole drilling are described in the *Environmental Investigations and Site Characterization Manual*, Section 6.0 - Drilling (WHC 1988). A summary of the well construction is provided in Table 2-1; these data are also available in HEIS.

Geologic samples were collected at 1.5 m (5 ft) intervals and at major lithologic changes. The shallow wells were drilled approximately 4.5 m (15 ft) below the water table. The deep well was drilled through the water table aquifer and completed in the upper 3 m (10 ft) of the upper confined/semiconfined aquifer.

The following discussions are based on all the data available for the D/DR and H Areas. The geologic discussions are primarily from Lindsey and Jaeger (1993) which presents a detailed description of the 100-HR-3 geology.

2.1.1 Topography

Surface topography of the 100-HR-3 Operable Unit is the product of cataclysmic flood deposition and erosion, post-flood eolian activity, and post-flood erosion and deposition associated with the Columbia River. The 100 D/DR and 100 H Areas lie on an essentially flat semi-arid bench south of the Columbia River. The elevation of the area ranges from approximately 140 m (460 ft) to 116 m (380 ft) amsl. The Columbia River falls approximately 3 m (10 ft) between the 100 D/DR and 100 H Areas. The land surface slopes gradually toward the river, with a bank of up to 9 m (30 ft) at the edge of the river.

East and north of the 100 D/DR Area, a number of indistinct swells and depressions mark the location of glacial flood bars and channels that are arranged somewhat concentrically around the highland of the 100 D/DR Area. These abandoned flood features occupy successively lower elevations, down the present Columbia River channel, resulting in

a "corrugated" surface that slopes gently northerly and easterly from the high ground in the southwest corner of the 100-HR-3 Operable Unit. Additional flood-related landforms are found to the south of the 100-HR-3 southern boundary.

Structurally, Hanford lies in the eastern Yakima Fold Belt. This belt consists of a series of segmented, narrow, asymmetric, and generally east-west trending anticlines. Between these anticlines lie broad, shallow synclines. The Hanford Site is situated in the Pasco Basin, a structural basin. Within the Pasco Basin, the Gable Mountain anticline separates the Wahluke and Cold Creek synclines; the 100-HR-3 Operable Unit is on the north limb of the Wahluke syncline. South of the 100-HR-3 area, basalt flows and the older units of the Ringold Formation dip steeply to the north. Beneath and to the north of the area, those same strata dip at shallow angles to the south.

2.1.2 Stratigraphy

The 100 D/DR and 100 H Areas are underlain (from oldest to youngest) by flows of Columbia River Basalt with intercalated Ellensburg Formation, six units of the Ringold Formation, the Hanford formation, and scattered Holocene deposits (Figure 2-1).

2.1.2.1 Columbia River Basalt Group and Ellensburg Formation. The Columbia River Basalt Group (CRBG) is an assemblage of tholeiitic, continental flood basalts of Miocene age (DOE 1988; Reidel and Hooper 1989). Isotopic age determinations indicate that basalt flows were erupted between approximately 17 to 6 million years ago (Reidel et al. 1989).

The Ellensburg Formation consists of a mix of volcanoclastic and siliciclastic deposits that occur between the basalt flows of the CRBG (DOE 1988; Smith 1988).

2.1.2.2 Ringold Formation. The Ringold Formation beneath the 100 D/DR and 100 H Areas contains most of the Ringold units commonly encountered elsewhere at the Hanford Site (Figure 2-1) (Lindsey 1992). The sediments consist of semi-indurated clay, silt, fine- to coarse-grained sand, and pebble to cobble sized gravel. Five facies of the Ringold Formation are:

1. Fluvial gravel - This facies consists of pebble to cobble sized gravel with a fine- to medium-grained sand matrix. Grain size distributions are often bimodal; coarse-grained sand is rare. The gravels exhibit a wide range of cementation and compaction. Low angle, lenticular bedding is common. Wide, shallow, shifting channels characterize the depositional environment.
2. Fluvial sand - This facies consists of stratified fine- to coarse-grained, quartzo-feldspathic sands. Wide, shallow channels incised into muddy floodplains characterize the depositional environment.
3. Overbank-Paleosol - This facies consists of laminated to massive silty sand, silt, clay and paleosols. Floodplain conditions characterize the depositional environment.

4. Lacustrine - This facies consists of well stratified clay with interbedded silt and silty sand. A lake with deltaic conditions characterizes the depositional environment.
5. Basaltic alluvium - This facies consists of massive to crudely stratified, weathered to unweathered, pebble to cobble basaltic gravel. The gravels commonly have a mud-rich matrix typical of deposition in an alluvial fan setting.

In the 100-HR-3 Operable Unit, a lacustrine mud unit up to 30 m (100 ft) thick forms the base of the Ringold Formation. Overlying the mud unit, fluvial sands and gravels interbedded with overbank-paleosol and lacustrine sediments comprise the remaining Ringold Formation (Lindsey and Jaeger 1993).

In the D Area, the upper 15 m (50 ft) of the Ringold Formation consists of fluvial gravel and overbank or paleosol sediments. Fluvial gravels compose the top of the Ringold Formation except in the area north of the D Area retention basins. Overbank muds and paleosols underlie the gravels. Only Well 199-D8-54B in the D Area penetrates below these muds (Lindsey and Jaeger 1993).

In the H Area, the Ringold Formation is approximately 80 m (260 ft) thick with overbank silts/clays and paleosols forming the upper 30 to 38 m (100 to 125 ft). A sand layer underlies these sediments. Approximately 26 to 30 m (85 to 100 ft) of lacustrine muds (lower mud unit) form the base of the Ringold (Lindsey and Jaeger 1993).

Locally, the Hanford/Ringold contact is difficult to identify because of Ringold Formation rip-up clasts. The contact is highest west of the 100 H Area and slopes toward the Columbia River to the east. Another high is present south of the center of the 100-HR-3 Operable Unit. The axes of these highs parallel the river, suggesting that they were shaped by erosion during cataclysmic Lake Missoula flooding (Lindsey and Jaeger 1993).

2.1.2.3 Hanford Formation. The Hanford formation thickness ranges from near 0 to 24 m (80 ft). The unit is thickest in the west-central part of the 100-HR-3 Operable Unit and thins to the east. This range in thickness is due to differential erosion that occurred during the cataclysmic floods emanating from Lake Missoula. The Hanford formation is typically friable and consists of unconsolidated gravels in a matrix of fine- to coarse-grained quartzo-feldspathic and basalt sand. Hanford formation gravels, in the 100-HR-3 Operable Unit, commonly contain fewer basalt clasts than in other areas on the site. Similar sediments in the 200 Areas contain many basaltic rip-up clasts (Lindsey and Jaeger 1993).

In the 100 D Area, the Hanford formation is approximately 12 to 15 m (40 to 50 ft) thick with Hanford gravels overlying Ringold Formation gravels. The Hanford formation gravels pinch out north and east of the 100 D Area.

In the 100 H Area, the Hanford formation is approximately 9 to 20 m (30 to 65 ft) thick and thickens from north to south. The sediments are mostly gravel with laterally discontinuous layers of sand forming the base of the formation in the southern part of the

100 H Area. The gravels are well stratified, uncemented and highly permeable.

2.1.2.4 Holocene Deposits. The uppermost deposits within the 100-HR-3 Operable Unit consist of a thin, discontinuous layer of Holocene-aged eolian deposits, Columbia River alluvium and man-made backfill. Eolian deposits of fine-grained silty sand < 1 m (< 3 ft) thick, blanket much of the area. Columbia River alluvium consists of channel deposited gravels, coarse-grained sands and overbank silts and sands.

2.1.3 Physical Properties

Ringold and Hanford formation physical properties for the 100 Areas were investigated using samples collected from the H, D/DR, and B/C Areas to help evaluate contaminant migration. Fifty-four physical property samples were collected from eighteen wells. In general, samples were collected from three wells in each reactor area; three samples were collected from each well. One sample was collected from the top half of the well, one from the bottom half and one from below groundwater. In addition, two or three samples were collected from a single boring in each source operable unit (100-HR-1, 100-DR-1, and 100-BC-1). Soil samples were tested for: particle size distribution, moisture content, moisture retention, and saturated hydraulic conductivity. Unsaturated hydraulic conductivity and bulk density were calculated. Due to the difficulty of collecting samples of coarse-grained materials, the physical property results presented in this LFI are biased toward finer-grained soils. Although the cable tool method of drilling was used to advance the boreholes, these soil samples were collected using a drive barrel thus minimizing the effects of the drilling method.

Results of the physical property tests were:

- Density and specific gravity. Hanford formation soils are generally coarser-grained, more dense and have higher specific gravity than Ringold Formation soils.
- Moisture content. Laboratory determined moisture contents are variable and may not be representative of in situ conditions. Water was added to the boreholes during drilling.
- Vertical saturated hydraulic conductivity. These laboratory values are variable and do not necessarily reflect actual field conditions. This variability is due partially to the disturbed nature of sample and partially to the material itself.

2.2 HYDROGEOLOGY

In the 100-HR-3 Operable Unit there is no evidence to indicate that contamination extends beyond the uppermost part of the unconfined aquifer (Peterson 1993). Vertical contaminant migration is retarded by a thick clay/silt layer between the unconfined and the underlying confined to semiconfined aquifer. In addition, the underlying confined aquifers of

the lower Ringold Formation and CRBG provide an upward vertical hydraulic gradient that further retards or prevents downward migration of contaminants. Well 199-H4-2, completed in the CRBG, has a potentiometric head that stands only 3 ft below land surface (McGhan et al. 1985). Measurements of head in this well during 1992 showed a potentiometric surface 14 m above land surface. Slight increases in head with depth have been shown in Wells 199-D8-54A and 199-D8-54B; measurements taken during LFI sampling of these wells showed an increase of head with depth ranging from 0.14 ft to 0.08 ft in May and August 1992.

The unconfined aquifer lies predominantly within the Hanford formation. The saturated portion of the Hanford formation is approximately 4 to 7 m (13 to 24 ft) thick across the operable unit. Hartman and Peterson (1992) and Peterson (1992 and 1993) present a more detailed discussion of the hydrogeology of the 100 H and 100 D Areas.

The Hanford unconfined aquifer is naturally recharged by runoff from surrounding highlands and through precipitation. Where the aquifer is bounded by the Columbia River, recharge through bank storage locally effects flow direction and water quality. Along the western Hanford boundary the unconfined aquifer is artificially recharged by irrigation. In the 200 Areas the aquifer receives artificial recharge from ponds, cribs and trenches used to dispose of waste water. In the 100 D Area the aquifer receives recharge from the 120-D-1 Pond.

The water table in the reactor areas has returned to near pre-Hanford conditions. In the past, reactor operations disposed of large volumes of liquid waste to the soil and thus created groundwater mounds. These mounds greatly affected the near river flow patterns, locally reversing the direction, and caused inland migration of contaminants.

Groundwater flow near the river is strongly influenced by fluctuations in Columbia River stage, which is controlled by dams. River stage can vary from 1.8 to 2.5 m (6 to 8 ft) daily and 2.5 to 3.1 m (8 to 10 ft) seasonally. Hydraulic gradient is greatly increased near the river during periods of low flow. As the river stage increases the gradient flattens as the groundwater responds to a higher discharge elevation. During rising river stage some surface water infiltrates as bank storage. Figures 2-2 through 2-5 illustrate the near river changes in groundwater elevation due to river stage changes.

Figure 2-2 is a water-table elevation map for the 100 D Area for May 1992. Figure 2-3 depicts equivalent data available for the 100 H Area. The May 1992 map is representative of water levels during high river stage. Figures 2-4, 2-5, and 2-6 are water-table elevation maps during July 1992. The July 1992 map is generally representative of water levels during low to normal river stage. Figure 2-7 shows the water table fluctuation in the 100-HR-3 Operable Unit during 1992. River discharge exhibited a lower and earlier than normal peak. Normal peak discharge occurs during June while normal low flow occurs in October and November. These figures illustrate the following:

- the groundwater gradient near the river is approximately 0.002

- the groundwater gradient in the northern area of the operable unit is approximately 0.0006
- groundwater generally flows toward the river
- groundwater flow is parallel to the river in the 100 D Area during high river stage
- river stage commonly influences wells up to 600 m (1,950 ft) inland from the river.

The unconfined aquifer is in the Ringold Formation in the 100 D Area. Groundwater flow velocity (calculated from hydraulic conductivity and gradient, using an effective porosity of 0.2) is <0.3 m/day (1 ft/day) in this unit. In the 100 H Area and in the 600 Area between 100 D and 100 H Areas, the water table is within the Hanford formation where calculated flow velocities range from 0.3 and 2.0 m/day (2 to 6 ft/day). Under reactor operating conditions, when groundwater mounds were present, high gradients near the river may have resulted in groundwater flow velocities of as much as 15 m/day (50 ft/day) (Eliason and Hajek 1967).

A limited number of wells penetrate underlying aquifer units. Well 199-D8-54B is completed beneath a thick clay layer that appears to underlie the entire 100 D/DR Area. Wells 199-H3-2C, 199-H4-12C and 199-H4-15C are screened in lower zones of the less transmissive Ringold Formation. The Ringold Formation consists of sand layers (some of them discontinuous) interbedded with silts and/or clays. The potentiometric surface of these sandy aquifers is generally above that of the unconfined aquifer.

Only one well in the area, 199-H4-2, has been drilled into the upper aquifer of the Columbia River Basalt. This well is free flowing with approximately 14 m (46 ft) of head at the ground surface.

2.2.1 Aquifer Test Results

Aquifer tests were conducted as part of this LFI and provide data to prepare preliminary designs of groundwater remediation alternatives should that be found necessary. These tests consisted of slug tests that were conducted using all new wells. The slug test method was selected to eliminate the need to dispose of large quantities of water. A slug test simulates the addition to or removal from the borehole of a known quantity of water. A blank metal "slug" was used to displace the water in the borehole. The response of the aquifer to this known change is then monitored over time and the results analyzed to determine aquifer properties. The slug tests were performed in accordance with Environmental Investigation Instruction 10.1, Aquifer Testing (WHC 1988).

During these tests, a 3.6 ℓ (0.13 ft^3) slug was rapidly lowered into the unconfined aquifer. The water level rose, saturating previously unsaturated soil. The water level changes were recorded electronically until the water level reached equilibrium (injection

test). The measurements taken during this portion of the test were not analyzed due to the difficulties associated with addressing the saturation of the previously unsaturated soils.

After the water level equilibrated, the slug was rapidly removed and the water levels recorded until the water level again reached equilibrium (withdrawal test). Only the withdrawal tests were analyzed. The data were analyzed using the method of Bouwer and Rice (1976) for unconfined aquifers. Slug tests represent only very near field estimates of hydraulic conductivity and results are order of magnitude estimates at best. The following discussion presents the results of these tests.

Derived hydraulic conductivity values ranged from 3.1 m/d (10 ft/d) to over 170 m/d (530 ft/d) (Table 2-2). This wide range suggests that tests measure true aquifer properties and not sand pack properties. The mean hydraulic conductivity measured in the 100 D Area unconfined aquifer wells is 9.8 m/d (32.1 ft/d) compared to 28.6 m/d (93.8 ft/d) in the 100 H Area wells. This difference is apparently due to measuring Ringold Formation properties in the 100 D Area wells and Hanford formation properties in the 100 H Area wells (see Table 2-2). The value for the 100 D Area does not include hydraulic conductivity values from Wells 199-D8-53, 199-D8-54A and 199-D8-55. The hydraulic conductivity values from these three wells may not represent unaltered D Area conductivities. The large volumes of liquid discharged to the 116-D-7, 116-D-9, 116-DR-1 and 116-DR-2 sites may have altered the natural hydraulic properties of the aquifer in the vicinity of these sites/wells in a manner similar to that evident through the distribution of riverbank springs at the 100 N Area (DOE-RL 1992d).

Two slug test values > 100 m/d (330 ft/d) in Wells 199-D8-53 and 199-D8-54A correlate with an infiltration test result in the 116-DR-1 Trench, located just upgradient of these wells, of 152 m/d (500 ft/d) (Eliason and Hajek 1967). While these tests are not considered indicative of normal aquifer parameters, they support the hypothesis of enhanced hydraulic properties near high volume disposal facilities.

Slug test hydraulic conductivities do not necessarily correlate directly with expected hydraulic conductivities based solely on the geologic logs. For example, the hydraulic conductivity determined for the sandy gravel in Well 199-D5-16 (3.0 m/d [10 ft/d]) was almost two orders of magnitude lower than that of the sand interval in well 699-91-46 (over 100 m/d [330 ft/d]). This difference is likely due to the inherent problems associated with performing slug tests in high hydraulic conductivity formations.

The hydraulic conductivity for the unconfined Hanford/Ringold Formations in the 100 Areas ranges from 4.9×10^{-5} to 2.1 cm/s (0.14 to 5,940 ft/d) (Hartman and Peterson 1992). The data from other aquifer tests performed in the 100 Areas are provided in Hartman and Peterson (1992).

2.3 DOWNHOLE GEOPHYSICS

Gross gamma geophysical logging was performed in twenty-seven boreholes and an additional eleven wells were logged using a spectral gamma tool. Table 2-3 presents the

results of spectral gamma logging for all wells/boreholes investigated with this tool. Man-made gamma emitter radionuclides were present only in Wells 199-D8-2, 199-D8-3, and 199-D8-55. These wells are close to the D/DR retention basins and their associated disposal trenches.

2.4 SOIL CONTAMINATION

Samples of vadose zone soils were collected during the installation of groundwater monitoring wells. These data were used to supplement soil sampling information collected under the ongoing Resource Conservation and Recovery Act (RCRA) investigations in 100 D and 100 H Areas as well as the efforts under the LFI conducted for the 100-DR-1 and 100-HR-1 Operable Units. These samples were analyzed to determine if the soil retained contaminants from exposure to contaminated groundwater or process effluent. Samples were collected from 1.5 m and 3 m (5 ft and 10 ft) above the current water table and at 1.5 m (5 ft) below the water table. In addition to these set sampling depths, samples were to be collected if field screening (photoionization detector and/or gamma or beta) indicated volatile organic compounds of 10 ppm or greater or radiation exceeding twice background. No additional samples were collected due to field screening; all drill cuttings were within the preselected parameter boundaries. Table 2-4 provides a description of the constituents associated with sediments analyzed.

Samples collected during this groundwater LFI confirm the results from data collected during source LFI in the 100 D and 100 H Areas. The LFI reports for these areas are currently being written. Soil contamination is restricted to the immediate vicinity of major liquid disposal facilities. These areas are addressed in conjunction with the sources. In general, the soils do not appear to have been contaminated due to exposure to groundwater. Fluctuating water levels may result in releases of radionuclides to the groundwater.

2.5 GROUNDWATER CONTAMINATION

Twenty-one new wells tapping the unconfined aquifer were drilled and constructed according to strict specification for resource protection wells (WHC 1988) during this LFI. These wells were designed and located to provide data on the quality of groundwater entering the Columbia River and to provide data to evaluate contaminants near known waste sources. Groundwater chemistry data were obtained from wells drilled under this LFI, from wells drilled for the RCRA facility monitoring program, and from other existing wells determined to be "fit-for-use" as monitoring structures (Ledgerwood 1991). Groundwater samples from all existing "fit-for-use" wells and new wells were analyzed during the second, third and fourth quarters of 1992 for Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Contract Laboratory Program target compound list and target analyte list constituents, specific anions that may be present, and for radionuclides. The analyte list for the first quarter of 1993 did not include organic analyses (polychlorinated biphenyls, volatile organic analytes (VOA), semi-VOA and pesticides). The RCRA wells were sampled under a separate program. The detailed results of these analyses are available through the Administrative Record and are not duplicated here. Wells tapping the deeper

aquifers, drilled for this LFI and/or determined as fit-for-use, were sampled to determine if contamination exists at depth. No contamination was found.

2.5.1 Validation/Verification of Historical Groundwater Data

Data regarding the chemical and radiological content of groundwater in the 100-HR-3 Operable Unit have been collected for a number of years. These data were collected under the sitewide environmental monitoring program and specialty programs under RCRA and CERCLA. These data provide a significant resource against which to judge trends and the adequacy of current information. The historical data were compiled and assessed along with the LFI data. This analysis revealed that the LFI derived data generally continue the trends noted historically. Some minor differences are noticeable that reflect the changes in analytical technique as well as temporal changes.

The majority of contaminants at the Hanford Site are radiological. The Hanford sitewide monitoring program has developed and maintained a record of these constituents for over 20 years. The routine radioanalyses included gross alpha, gross beta, tritium, strontium, and uranium. Nonradioactive constituents were commonly limited to nitrate and chromium. These historical data have been used, where possible, to confirm the results of sampling conducted during the LFI and to evaluate data trends. Historical and LFI data follow the same trends indicating that the historical data are probably "valid," in the sense of being usable for this LFI. Some of the differences between current and historical data are the result of progress in analytical techniques and lowering of detection limits. Selected representative plots of concentration versus time are presented for chromium, nitrate, and tritium in Figure 2-8 through 2-10.

2.5.2 Determination of Contaminants of Potential Concern

Historical and LFI-specific data were analyzed following the flow chart illustrated in Figure 2-11. This process was used to determine which analytes were of concern to human health or environmental quality. The following is a brief discussion of that process:

- Determine the maximum concentration for each analyte in the groundwater in both the 100 D/DR and 100 H Areas and the 100-HR-3 600 Area.
- Is the analyte an EPA Region 10 (1991) excluded element (aluminum, calcium, iron, magnesium, potassium, and sodium)? These elements have been determined to be non-toxic for human health and are categorically excluded from the list of contaminants of potential concern (COPC), although they are retained for the ecological risk assessment.
- Are the LFI selected maxima internally and externally consistent? Are the maximum analyte concentrations consistent with duplicate values (internal consistency #1)? Are the concentrations consistent between sampling rounds (internal consistency #2)? Is the contaminant expected based on site operations

or data from the closest nearby wells (external consistency)? (Note: nearest wells were evaluated to help determine if a contaminant was "expected.") If a maximum analyte concentration fails all of these tests then the value is determined to be inconsistent and the next highest concentration value is selected and evaluated.

An example of inconsistency is pyrene in Well 199-D8-1. It was detected in the second round, but it was not detected in the split (internal consistency #1), it was not detected in the other rounds (internal consistency #2), and it was not expected based on site operations (external consistency). Therefore, the value was determined to be inconsistent. Appendix A includes a list of constituents which were eliminated due to inconsistencies and the reasons why they were inconsistent.

- Are the analytes found in laboratory blanks associated with the sample exhibiting the maximum concentration? If the analyte is found in the associated blank, the EPA 5x-10x rule is applied (EPA 1989). For analytes commonly used in the laboratory, the value is eliminated if it is less than ten times the blank concentration. For other analytes, the value is eliminated if it is less than five times the blank concentration.
- Does the maximum concentration exceed Hanford background? Analytes at or below background are excluded from additional consideration. Background values are from Hanford Sitewide characterization of the groundwater (DOE-RL 1992e). The characterization of background involved the determination of the types, and concentrations of selected analytes, that exist naturally in the groundwater at the Hanford Site. Provisional threshold levels (based on a tolerance interval approach - Washington Administrative Code [WAC] 173-340-708) for inorganic analytes, gross alpha, gross beta, total radium, total strontium, total uranium, and selected anions were developed from the characterization effort to represent sitewide background conditions (DOE-RL 1992e).
- These screened data are then passed on to the QRA as COPC. The QRA, in accordance with *Hanford Site Baseline Risk Assessment Methodology* (HSBRAM) (DOE-RL 1993d) further screens the data against risk and ARAR values to provide a refined list of COPC.

This method assures that COPC used in the QRA are the maximum defensible concentrations, thus providing a conservative yet realistic assessment of risk.

This screening method is similar to the method used for the source operable unit LFI. The major difference is that for the source LFI, only one round of data were available, therefore it was not possible to do a consistency check.

Tables 2-5 through 2-19 show the results of the above screening and the constituents identified as human health COPC. The screening process was performed for near river wells

(199-D5-20, 199-D8-4, 199-D8-5, 199-D8-53, 199-D8-54A, 199-D8-55, 199-H4-4, 199-H4-5, 199-H4-10, 199-H4-11, 199-H4-12A, 199-H4-13, 199-H4-15A, 199-H4-45, and 199-H6-1) for the ecological evaluation. In addition, for inorganics, unfiltered data were screened for both the ecological evaluation and human health evaluation. The justification for this is provided in the QRA.

Figure 2-1 Generalized Hydrostratigraphic Column of the 100-HR-3 Operable Unit

Legend

▼ Water Table

Figure 2-2 Water-Table Elevations in the 100 D Area, May 1992

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Figure 2-3 Water-Table Elevations in the 100 H Area, May 1992

Figure 2-4 Water-Table Elevations in the 100 D Area, July 1992

Figure 2-5 Water-Table Elevations in the 100 H Area, July 1992

Figure 2-7 Water-Table Fluctuations in the 100-HR-3 Operable Unit, 1992

Figure 2-8 Historical Trends for Chromium for Well 199-H-49

Figure 2-9 Historical Trends for Nitrate for Well 199-H-32

Figure 2-10 Historical Trends for Tritium for Well 199-H-43

Figure 2-8 Decision Tree for Determining Contaminants of Potential Concern

Table 2-1 Inventory of Wells used in 100-HR-3 LFI
(Page 1 of 4)

WELL NUMBER	DEPTH (ft)	DIA. (in.)	COMPLETION	SCREEN INTERVAL (ft)	SAMPLE METHOD	AQUIFER TEST METHOD	FORMATION
199-H3-1	75	8	Perforated	29-74	P-Hydrost	None	Hanford/Ringold
199-H3-2(A)	56	6	Screen	36-51	P-Hydrost	None	Hanford
199-H3-2(B)	58	6	Screen	50-55	P-Hydrost	None	Hanford
199-H3-2(C)	155	6	Screen	100-110	P-Hydrost	None	Ringold
199-H4-2	386	6	Open	NA	Capped	NA	NA
199-H4-3	55	6	Perforated	34-55	P-Hydrost	None	Hanford
199-H4-4	55	6	Tele-screen	33-43	P-Hydrost	None	Hanford
199-H4-5	60	6	Tele-screen	32-42	P-Hydrost	None	Hanford
199-H4-6	55	6	Tele-screen	39-49	P-Hydrost	None	Hanford
199-H4-7	55	6	Screen	38-53	P-Hydrost	None	Hanford
199-H4-8	55	6	Screen	38-48	P-Hydrost	None	Hanford
199-H4-9	51	6	Screen	36-46	P-Hydrost	None	Hanford
199-H4-10	38	6	Screen	23-38	P-Hydrost	None	Hanford
199-H4-11	53	6	Screen	38-53	P-Hydrost	None	Hanford
199-H4-12(A)	48	6	Screen	33-48	P-Hydrost	None	Hanford
199-H4-12(B)	51	6	Screen	45-50	P-Hydrost	None	Hanford
199-H4-12(C)	220	6	Screen	72-82	P-Hydrost	None	Ringold
199-H4-13	61	6	Screen	37-52	P-Hydrost	None	Hanford/Ringold
199-H4-14	53	6	Screen	38-53	P-Hydrost	None	Hanford
199-H4-15(A)	46	6	Screen	27-42	P-Hydrost	None	Hanford
199-H4-15(B)	44	6	Screen	37-42	P-Hydrost	None	Hanford
199-H4-15(C)	330	2	4 Piezometers	NA	NA	None	

Table 2-1 Inventory of Wells used in 100-HR-3 LFI
(Page 2 of 4)

WELL NUMBER	DEPTH (ft)	DIA. (in.)	COMPLETION	SCREEN INTERVAL (ft)	SAMPLE METHOD	AQUIFER TEST METHOD	FORMATION
199-H4-16	61	6	Screen	42-57	P-Hydrost	None	Hanford
199-H4-17	46.5	6	Screen	35-45	P-Hydrost	None	Hanford
199-H4-18	51	6	Screen	40-50	P-Hydrost	None	Hanford
199-H4-45	54.5	4	Screen	32-52.8	P-Hydrost	Slug	Hanford
199-H4-46	61.5	4	Screen	38.7-59.5	P-Hydrost	Slug	Hanford
199-H4-47	59.9	4	Screen	38.8-59.6	P-Hydrost	Slug	Hanford
199-H4-48	62	4	Screen	39-59.8	P-Hydrost	Slug	Hanford
199-H4-49	60	4	Screen	38-53.7	P-Hydrost	Slug	Hanford
199-H5-1	57	4	Screen	34.8-50.9	P-Hydrost	Slug	Hanford
199-H6-1	56.2	4	Screen	33.9-54.7	P-Hydrost	Slug	Hanford
199-D2-5	95	8	Perforated	36-86	S Pump	None	Ringold
199-D2-6	113	4	Screen	77.2-98.3	Hydrostar	Slug	Ringold
199-D5-12	91	8	Perforated	35-90	S Pump	None	Ringold
199-D5-13 ^b	97	4	Screen	76-97	P-Hydrost	Slug	Ringold
199-D5-14	101	4	Screen	77.1-98.2	P-Hydrost	Slug	Ringold
199-D5-15	101.8	4	Screen	77.4-98.2	P-Hydrost	Slug	Ringold
199-D5-16	99.9	4	Screen	77.4-98.2	P-Hydrost	Slug	Ringold
199-D5-17	115	4	Screen	75.2-96.0	P-Hydrost	Slug	Ringold
199-D5-18	100.4	4	Screen	68.1-93.5	P-Hydrost	Slug	Ringold
199-D5-19	96.6	4	Screen	74.8-95.2	P-Hydrost	Slug	Ringold

Table 2-1 Inventory of Wells used in 100-HR-3 LFI
(Page 3 of 4)

WELL NUMBER	DEPTH (ft)	DIA. (in.)	COMPLETION	SCREEN INTERVAL (ft)	SAMPLE METHOD	AQUIFER TEST METHOD	FORMATION
199-D5-20	103.3	4	Screen	76.2-97	P-Hydrost	Slug	Ringold
199-D8-3	80.5	6	Perforated	35-79	S. Pump	None	Hanford/Ringold
199-D8-4 ^b	103	3	Screen	74-94	P-Hydrost	None	Ringold
199-D8-5 ^b	85	3	Screen	63-83	P-Hydrost	Slug	Ringold
199-D8-6 ^b	110	4	Screen		P-Hydrost	Slug	Ringold
199-D8-53	69.4	4	Screen	45-65.5	P-Hydrost	Slug	Ringold
199-D8-54(A)	78	4	Screen	51.5-72.6	P-Hydrost	Slug	Hanford
199-D8-55	74	4	Screen	48.6-69.4	P-Hydrost	Slug	Ringold
699-89-35 ^a	75	8	Perforated	20-73	NA	NA	NA
699-91-46	-	-	-	NA	-	-	-
699-93-48	83	4	Screen	41.2-62	P-Hydrost	Slug	Hanford
699-93-49(B)	NA	-	-	-	NA	NA	-
699-96-43	50.8	4	Screen	32.4-48.5	P-Hydrost	Slug	Hanford
699-96-49	100	8	Perforated	79-89	S. Pump	NA	Ringold
699-96-52		12	Dug			NA	NA
699-97-43 ^a	100	8	Perforated	25-97	S. Pump	NA	Ringold
699-97-51(A) ^a	39	8	Perforated	12-39	S. Pump	NA	NA
699-97-51(B) ^a	28	12	Dug/perf.	Backfilled	NA	NA	NA
699-98-49(A) ^a	40	10	Dug/perf	Backfilled	NA	NA	NA
699-101-48(A) ^a	50	6	Screen	43-47	NA	NA	NA

Table 2-1 Inventory of Wells used in 100-HR-3 LFI
(Page 4 of 4)

WELL NUMBER	DEPTH (ft)	DIA. (in.)	COMPLETION	SCREEN INTERVAL (ft)	SAMPLE METHOD	AQUIFER TEST METHOD	FORMATION
699-101-48(B) ^a	48	6	Screen	43-47	Pump	NA	NA
699-101-48(C) ^a	77	6	Screen	43-47	NA	NA	NA

^a Data derived from PNL-5397, Hanford Wells

^b Hydrologic and Geologic Data Available for the Region North of Gable Mountain, Hanford Site, Washington

Table 2-2 100-HR-3 Unconfined Aquifer Slug Test Summary

Well Number	Sediment Description - Field Log Sediment Description - Sieve Analysis	Screened Formation	K (ft/d)
199-D2-6	Sandy Gravel Gravelly Sand	Ringold	40
199-D5-14	Sandy Gravel/Gravelly Sand Sand	Ringold	30
199-D5-15	Sandy Gravel Gravel/Sand	Ringold	30
199-D5-16	Clayey Sandy Gravel/Sandy Gravel Sandy Gravel	Ringold	10
199-D5-17	Sandy Gravel/Clayey Sandy Gravel Gravelly Sand	Ringold?	10
199-D5-18	Sandy Gravel Sandy Gravel	Ringold	60
199-D5-19	Gravelly Sand/Clayey Sandy Gravel Sand/Gravel	Ringold	40
199-D5-20	Silty Sandy Gravel Sand	Ringold	40
199-D8-53	Silty Sandy Gravel Sandy Gravel	Ringold?	530
199-D8-54A	Silty Sandy Gravel Slightly Gravelly Sand	Hanford?	400
199-D8-55	Sandy Silty Gravel Gravel/Sand	Ringold?	20
199-H4-45	Sandy Gravel Gravelly Sand	Hanford	100
199-H4-46	Sandy Gravel/Gravelly Sand Gravelly Sand	Hanford	120
199-H4-47	Silty Sandy Gravel Sandy Gravel	Hanford	90
199-H4-48	Sandy Gravel/Gravelly Sand Slightly Gravelly Sand	Hanford	80
199-H4-49	Sandy Gravel Slightly Sandy Gravel	Hanford	90
199-H5-1	Sandy Gravel/Sand Sand	Hanford	110
199-H6-1	Sandy Gravel NA	Hanford	70
699-93-48	Sandy Gravel Sandy Gravel	Hanford	60
699-96-43	Gravelly Sand/Silty Clay Silty Sand	Hanford	50
699-91-46	Sandy Gravel/Gravelly Sand Sand	Hanford	790

K = hydraulic conductivity

NA = not available

Table 2-3 Summary of Spectral Gamma Logging

Borehole or Well	Depth of Survey (ft)	Cs-137		Co-60		Eu-152		Eu-154	
		D ¹	C ²	D ¹	C ²	D ¹	C ²	D ¹	C ²
D8-2	40	40 ³	35	40 ³	30	40 ³	80	30	12
D5-2	86	-	-	-	-	-	-	-	-
D5-12	87	-	-	-	-	-	-	-	-
D8-3	77	8	6	6	1	6	2	6	1
D8-54B	73	-	-	-	-	-	-	-	-
D8-55	68	48	2	-	-	-	-	-	-
H3-1	65	-	-	-	-	-	-	-	-
H4-3	42	-	-	-	-	-	-	-	-
H4-11	45	-	-	-	-	-	-	-	-
H4-13	48	-	-	-	-	-	-	-	-
H4-16	53	-	-	-	-	-	-	-	-
H4-18	47	-	-	-	-	-	-	-	-
H4-45	51	-	-	-	-	-	-	-	-

¹ Depth (in feet) at which maximum concentration encountered² Maximum concentration of radionuclide in pCi/g³ Maximum value at base of borehole, higher concentration may exist at greater depth

Table 2-4 Summary of Sediment Chemical and Radiological Analyses
(Page 1 of 2)

100-HR-3 SOILS CHEMISTRY AND RADIOCHEMISTRY					
Constituent	Range (mg/kg)		Radionuclide	Range (pCi/g)	
	Minimum	Maximum		Minimum	Maximum
Aluminum	1.33E+03	7.68E+03	Carbon-14	1.70E-02	1.32E+01
Antimony	u	5.50E+00	Potassium-40	1.12E+00	1.79E+01
Arsenic	u	2.10E+00	Strontium-90	4.20E-02	1.40E+00
Barium	2.00E+01	1.21E+02	Technetium-99	1.60E-01	6.20E+00
Beryllium	u	1.50E+00	Cesium-137	2.00E-02	2.48E+00
Cadmium	u	1.60E+00	Radium-226	2.40E-01	1.54E+00
Calcium	1.00E+03	2.00E+04	Thorium-228	4.07E-01	1.45E+00
Chromium	u	1.19E+02	Thorium-232	5.00E-01	5.30E-01
Cobalt	u	1.00E+01	Thorium-234	6.00E-01	-
Copper	u	1.66E+01	Uranium 233/244	6.00E-02	4.60E-01
Iron	2.00E+03	1.77E+04	Uranium-235	1.00E-03	4.70E-02
Lead	u	9.80E+00	Uranium-238	5.30E-02	1.40E+00
Magnesium	1.00E+03	6.00E+03	Plutonium 239/24	1.00E-03	7.00E-03
Manganese	1.00E+02	4.50E+02	Americium-241	3.00E-03	1.20E-02
Mercury	u	4.00E-01			
Nickel	u	5.45E+01			
Potassium	u	1.20E+03			
Selenium	u	5.00E-01			
Silver	u	2.30E+00			
Sodium	1.00E+02	5.00E+02			
Thallium	u	4.00E-01			
Vanadium	5.00E+00	4.00E+01			
Zinc	1.00E+01	4.50E+01			
Cyanide	u	5.20E+00			

u = Not Detected

Table 2-4 Summary of Sediment Chemical and Radiological Analyses
(Page 2 of 2)

Semi-Volatile Organic Compounds

Constituent	Number of Detections	Range		Found in Adjacent Soil	Found in Groundwater (same hole)	Comment
		Minimum	Maximum			
Phenol	2	43	160	no	no	
Benzyl alcohol	2	2	4	no	no	in drill water
bis(2-chloroisopropyl)ether	1	380		no	no	
2-Nitroaniline	1	1900		no	no	
Acenaphthene	1	380		no		
Diethylphthalate	2	48	65	no	no	c.l.c.
Pentachlorophenol	3	40	130	no	no	
Carbazole	1	220		no	no	
Di-n-butylphthalate	15	38	2600	-	-	c.l.c.
Butylbenzylphthalate	4	40	3500	-	-	c.l.c.
bis(2-ethylhexyl)phthalate	11	1	5700	-	-	c.l.c.
Benzo(g,h,i)perylene	1	10		no	no	in extraction blank

c.l.c common laboratory contaminant

Volatile Organic Compounds

Constituent	Number of Detections	Range		Found in Adjacent Soil	Found in Groundwater (same hole)	Comment
		Minimum	Maximum			
Chloromethane	1	2		no	no	-
Methylene Chloride	9	2	30	-	-	in field blank
Acetone	19	5	119	-	-	in field blank
1,2-Dichloroethene	2	5	6	no	no	same lab group
Chloroform	5	1	42	-	-	in drill water
Carbon tetrachloride	1	6		no	no	
Bromodichloromethane	1	4		no	no	in drill water
Trichloroethene	4	2	3	yes	no	
2-Hexanone	1	10		no	no	
Toluene	8	1	21	yes	no	

**Table 2-5 D/DR Area LFI Groundwater Volatile and Semivolatile Organic Data
Summary (Page 1 of 3)**

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
1,1,1-Trichloroethane	10 U	NA	X	
1,1,2,2-Tetrachloroethane	10 U	NA	X	
1,1,2-Trichloroethane	10 U	NA	X	
1,1-Dichloroethane	10 U	NA	X	
1,1-Dichloroethene	10 U	NA	X	
1,2-Dichloroethane	10 U	NA	X	
1,2-Dichloroethene	10 U	NA	X	
1,2-Dichloropropane	10 U	NA	X	
2-Butanone	100 U	NA	X	
2-Hexanone	50 U	NA	X	
4-Methyl-2-Pentanone	50 U	NA	X	
Acetone	100 U	NA	X	
Benzene	10 U	NA	X	
Bromodichloromethane	10 U	NA	X	
Bromoform	10 U	NA	X	
Bromomethane	10 U	NA	X	
Carbon Disulfide	10 U	NA	X	
Carbon Tetrachloride	10 U	NA	X	
Chlorobenzene	10 U	NA	X	
Chloroethane	10 U	NA	X	
Chloroform	12	D5-20		X
Chloromethane	10 U	NA	X	
Cis-1,3-Dichloropropene	10 U	NA	X	
Dibromochloromethane	10 U	NA	X	
Ethylbenzene	10 U	NA	X	
Methylenechloride	23 U	NA	X	
Styrene	10 U	NA	X	
Tetrachloroethene	10 U	NA	X	
Toluene	10 U	NA	X	
Trans-1,3-Dichloropropene	10 U	NA	X	
Trichloroethene	10 U	NA	X	
Vinyl Chloride	10 U	NA	X	
Xylenes (total)	10 U	NA	X	

**Table 2-5 D/DR Area LFI Groundwater Volatile and Semivolatile Organic Data
Summary (Page 2 of 3)**

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
1,2,4-Trichlorobenzene	10 U	NA	X	
1,2-Dichlorobenzene	10 U	NA	X	
1,3-Dichlorobenzene	10 U	NA	X	
1,4-Dichlorobenzene	10 U	NA	X	
2,4,5-Trichlorophenol	26 U	NA	X	
2,4,6-Trichlorophenol	10 U	NA	X	
2,4-Dichlorophenol	10 U	NA	X	
2,4-Dimethylphenol	10 U	NA	X	
2,4-Dinitrophenol	150 U	NA	X	
2,4-Dinitrotoluene	10 U	NA	X	
2,6-Dinitrotoluene	10 U	NA	X	
2-Chloronaphthalene	10 U	NA	X	
2-Chlorophenol	10 U	NA	X	
2-Methylnaphthalene	10 U	NA	X	
2-Methylphenol	10 U	NA	X	
2-Nitroaniline	50 U	NA	X	
2-Nitrophenol	10 U	NA	X	
3,3'-Dichlorobenzidine	20 U	NA	X	
3-Nitroaniline	50 U	NA	X	
4,6-Dinitro-2-methylphenol	200 U	NA	X	
4-Bromophenylphenyl ether	10 U	NA	X	
4-Chloro-3-methylphenol	20 U	NA	X	
4-Chloroaniline	20 U	NA	X	
4-Chlorophenylphenyl ether	10 U	NA	X	
4-Methylphenol	10 U	NA	X	
4-Nitroaniline	50 U	NA	X	
4-Nitrophenol	50 U	NA	X	
9H-Carbazole	10 U	NA	X	
Acenaphthene	10 U	NA	X	
Acenaphthylene	10 U	NA	X	
Anthracene	10 U	NA	X	
Benzo(a)anthracene	10 U	NA	X	
Benzo(a)pyrene	10 U	NA	X	
Benzo(b)fluoranthene	10 U	NA	X	
Benzo(ghi)perylene	10 U	NA	X	
Benzo(k)fluoranthene	10 U	NA	X	
Bis(2-chloroethoxy)methane	10 U	NA	X	
Bis(2-chloroethyl)ether	10 U	NA	X	
Bis(2-ethylhexyl)phthalate	3 J	D5-20		X
Bis(2-chloroisopropyl)ether	10 U	NA	X	
Butylbenzylphthalate	10 U	NA	X	
Chrysene	10 U	NA	X	
Di-n-butylphthalate	10 U	NA	X	
Di-n-octylphthalate	10 U	NA	X	
Dibenz[a,h]anthracene	10 U	NA	X	

**Table 2-5 D/DR Area LFI Groundwater Volatile and Semivolatile Organic Data
Summary (Page 3 of 3)**

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
Dibenzofuran	10 U	NA	X	
Diethylphthalate	10 U	NA	X	
Dimethylphthalate	10 U	NA	X	
Fluoranthene	10 U	NA	X	
Fluorene	10 U	NA	X	
Hexachlorobenzene	10 U	NA	X	
Hexachlorobutadiene	10 U	NA	X	
Hexachlorocyclopentadiene	10 U	NA	X	
Hexachloroethane	10 U	NA	X	
Indeno(1,2,3-cd)pyrene	10 U	NA	X	
Isophorone	10 U	NA	X	
N-nitroso-di-n-dipropylamine	10 U	NA	X	
N-Nitrosodiphenylamine	10 U	NA	X	
Naphthalene	10 U	NA	X	
Nitrobenzene	10 U	NA	X	
Pentachlorophenol	100 U	NA	X	
Phenanthrene	10 U	NA	X	
Phenol	10 U	NA	X	
Pyrene	10 U	NA	X	

U: Undetected, Value is detection limit

J: Estimated value

NA: Not applicable; no well had concentration above detection limit

**Table 2-6 D/DR Area LFI Unfiltered Groundwater
Cations and Metals Data Summary**

(ug/L)

Analyte	Max. Conc.	Well #	Non-Toxic[a]	> Bkg. ?[b]	ELIM.	COPC
Aluminum	52.3 B	D5-17	YES	NO	X	
Antimony	200 U	NA	NO	NA	X	
Arsenic	6.2 B	D2-5	NO	NO	X	
Barium	164 B	D5-17	NO	YES		X
Beryllium	3 U	NA	NO	NA	X	
Cadmium	10 U	NA	NO	NA	X	
Calcium	125000	D5-12	YES	YES	X	
Chromium	2090	D5-15	NO	YES		X
Cobalt	20 U	NA	NO	NA	X	
Copper	4.9 B	D2-6	NO	NO	X	
Iron	451	D5-12	YES	YES	X	
Lead	4.5 J	D5-17	NO	NO	X	
Magnesium	27300	D5-19	YES	YES	X	
Manganese	186	D5-17	NO	YES		X
Mercury	0.2 U	NA	NO	NA	X	
Nickel	24.9 B	D5-15	NO	NO	X	
Potassium	8470	D8-3	YES	YES	X	
Selenium	10 U	NA	NO	NA	X	
Silver	20 U	NA	NO	NA	X	
Sodium	21300	D5-17	YES	NO	X	
Thallium	20 U	NA	NO	NA	X	
Vanadium	20.4 B	D5-14	NO	YES		X
Zinc	10 U	NA	NO	NA	X	

[a]: EPA region 10 excluded elements: "Supplemental Guidance for Superfund Risk Assessments in Region 10", August 16, 1991, U.S. Environmental Protection Agency, Region X, Seattle, Washington.

[b]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland, Washington.

NA: Not applicable

U: Not Detected

B: Estimated value, less than the contract detection limit

Table 2-7 D/DR Area LFI Groundwater Pesticide Data Summary

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
4,4'-DDD	0.1 U	NA	X	
4,4'-DDE	0.1 U	NA	X	
4,4'-DDT	0.1 U	NA	X	
Aldrin	0.05 U	NA	X	
Alpha-BHC	0.05 U	NA	X	
Alpha-chlordane	0.5 U	NA	X	
Aroclor-1016	1 U	NA	X	
Aroclor-1221	2 U	NA	X	
Aroclor-1232	1 U	NA	X	
Aroclor-1242	1 U	NA	X	
Aroclor-1248	1 U	NA	X	
Aroclor-1254	1 U	NA	X	
Aroclor-1260	1 U	NA	X	
Beta-BHC	0.05 U	NA	X	
Delta-BHC	0.1 U	NA	X	
Dieldrin	0.1 U	NA	X	
Endosulfan I	0.1 U	NA	X	
Endosulfan II	0.1 U	NA	X	
Endosulfan sulfate	0.5 U	NA	X	
Endrin	0.1 U	NA	X	
Endrin Aldehyde	0.2 U	NA	X	
Endrin Ketone	0.1 U	NA	X	
Gamma-BHC	0.05 U	NA	X	
Gamma-chlordane	0.5 U	NA	X	
Heptachlor	0.05 U	NA	X	
Heptachlor epoxide	1 U	NA	X	
Methoxychlor	2 U	NA	X	
Toxaphene	5 U	NA	X	

U: Undetected, Value is detection limit

NA: Not applicable; no well had concentration above detection limit

Table 2-8 D/DR Area LFI Groundwater Radionuclide Data Summary

(pCi/L)

Analyte	Max. Conc.	Well #	>Bkg.?[a]	Elim.	COPC
Americium 241	0.13 U	NA	NA	X	
Carbon 14	30 J	D5-12	NA		X
Cesium 134	20 U	NA	NA	X	
Cesium 137	20 U	NA	NA	X	
Chromium 51	800 U	NA	NA	X	
Cobalt 60	20 U	NA	NA	X	
Europium 152	30 U	NA	NA	X	
Europium 154	20 U	NA	NA	X	
Gross Alpha	2.7 U	NA	NA	X	
Gross Beta	81	D5-12	Yes		X
Iron 59	90 U	NA	NA	X	
Plutonium 238	0.016 U	NA	NA	X	
Plutonium 239/240	0.017 U	NA	NA	X	
Potassium 40	300 U	NA	NA	X	
Radium 226	100 UJ	NA	NA	X	
Ruthenium 106	72.6	D8-5	NA		X
Strontium 90	41 J	D5-12	NA		X
Technetium 99	4.6 U	NA	NA	X	
Thorium 228	39 U	NA	NA	X	
Thorium 232	88 U	NA	NA	X	
Tritium	78000	D5-17	NA		X
Uranium 233/234	1.5	D5-17	No	X	
Uranium 235	0.042	D8-4	No	X	
Uranium 238	1.4	D5-12	No	X	
Zinc 65	40 U	NA	NA	X	

[a]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland, Washington.

U: Undetected, Value is detection limit

J: Estimated value

NA: Not applicable

Table 2-9 D/DR Area LFI Groundwater Other Constituent Data Summary

(mg/L)

Analyte	Max. Conc.	Well #	Non-toxic?[a]	>Bkg.?[b]	Elim.	COPC
Alkalinity	116 J	D5-14	NO	No	X	
Ammonia	0.75	D5-17	NO	NA		X
Chloride	38.8	D8-54A	NO	Yes	X	
Fluoride	0.5	D5-16	NO	No	X	
Hydrazine	30 U	NA	NA	NA	X	
Nitrate	32.6	D8-3	NO	Yes		X
Phosphate	0.8	D5-18	NA	No	X	
Sulfate	67000	D8-5	NO	Yes		X
Sulfide	1	D5-19	NA	NA		X
TOC	4.8	D5-15	NO	Yes	X	
TOX (ug/L)	64.6	D8-3	NO	NA	X	

[a]: EPA region 10 excluded elements: "Supplemental Guidance for Superfund Risk Assessment in Region 10", August 16, 1991, U.S. Environmental Protection Agency, Region X, Seattle, Washington.

[b]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland, Washington.

U: Undetected, Value is detection limit

J: Estimated value

NA: Not Applicable

Table 2-10 H Area LFI Groundwater Volatile and Semivolatile Organic Data Summary
(Page 1 of 3)

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
1,1,1-Trichloroethane	10 U	NA	X	
1,1,2,2-Tetrachloroethane	10 U	NA	X	
1,1,2-Trichloroethane	10 U	NA	X	
1,1-Dichloroethane	10 U	NA	X	
1,1-Dichloroethene	10 U	NA	X	
1,2-Dichloroethane	10 U	NA	X	
1,2-Dichloroethene	10 U	NA	X	
1,2-Dichloropropane	10 U	NA	X	
2-Butanone	10 U	NA	X	
2-Hexanone	10 U	NA	X	
4-Methyl-2-Pentanone	10 U	NA	X	
Acetone	10 U	NA	X	
Benzene	10 U	NA	X	
Bromodichloromethane	10 U	NA	X	
Bromoform	10 U	NA	X	
Bromomethane	10 U	NA	X	
Carbon Disulfide	10 U	NA	X	
Carbon Tetrachloride	10 U	NA	X	
Chlorobenzene	10 U	NA	X	
Chloroethane	10 U	NA	X	
Chloroform	53	H4-47		X
Chloromethane	10 U	NA	X	
cis-1,3-Dichloropropene	10 U	NA	X	
Dibromochloromethane	10 U	NA	X	
Ethylbenzene	10 U	NA	X	
Methylenechloride	10 U	NA	X	
Styrene	10 U	NA	X	
Tetrachloroethene	10 U	NA	X	
Toluene	10 U	NA	X	
trans-1,3-Dichloropropene	10 U	NA	X	
Trichloroethene	10 U	NA	X	
Vinyl Chloride	10 U	NA	X	
Xylenes (total)	10 U	NA	X	

Table 2-10 H Area LFI Groundwater Volatile and Semivolatile Organic Data Summary
(Page 2 of 3)

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
Diethyl phthalate	10 U	NA	X	
1,2,4-Trichlorobenzene	10 U	NA	X	
1,2-Dichlorobenzene	10 U	NA	X	
1,3-Dichlorobenzene	10 U	NA	X	
1,4-Dichlorobenzene	10 U	NA	X	
2,4,5-Trichlorophenol	25 U	NA	X	
2,4,6-Trichlorophenol	10 U	NA	X	
2,4-Dichlorophenol	10 U	NA	X	
2,4-Dimethylphenol	10 U	NA	X	
2,4-Dinitrophenol	25 U	NA	X	
2,4-Dinitrotoluene	10 U	NA	X	
2,6-Dinitrotoluene	10 U	NA	X	
2-Chloronaphthalene	10 U	NA	X	
2-Chlorophenol	10 U	NA	X	
2-Methylnaphthalene	10 U	NA	X	
2-Methylphenol	10 U	NA	X	
2-Nitroaniline	25 U	NA	X	
2-Nitrophenol	10 U	NA	X	
3,3'-Dichlorobenzidine	10 U	NA	X	
3-Nitroaniline	25 U	NA	X	
4,6-Dinitro-2-methylphenol	10 U	NA	X	
4-Bromophenylphenyl ether	10 U	NA	X	
4-Chloro-3-methylphenol	10 U	NA	X	
4-Chloroaniline	10 U	NA	X	
4-Chlorophenylphenyl ether	10 U	NA	X	
4-Methylphenol	10 U	NA	X	
4-Nitroaniline	25 U	NA	X	
4-Nitrophenol	25 U	NA	X	
9H-Carbazole	10 U	NA	X	
Acenaphthene	10 U	NA	X	
Acenaphthylene	10 U	NA	X	
Anthracene	10 U	NA	X	
Benzo(a)anthracene	10 U	NA	X	
Benzo(a)pyrene	10 U	NA	X	
Benzo(b)fluoranthene	10 U	NA	X	
Benzo(ghi)perylene	10 U	NA	X	
Benzo(k)fluoranthene	10 U	NA	X	
Bis(2-chloroethoxy)methane	10 U	NA	X	
Bis(2-chloroethyl)ether	10 U	NA	X	
Bis(2-chloroisopropyl)ether	10 U	NA	X	
Bis(2-ethylhexyl)phthalate	10 U	NA	X	
Butylbenzylphthalate	10 U	NA	X	
Chrysene	10 U	NA	X	
Di-n-butylphthalate	10 U	NA	X	
Di-n-octylphthalate	10 U	NA	X	

Table 2-10 H Area LFI Groundwater Volatile and Semivolatile Organic Data Summary
(Page 3 of 3)

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
Dibenz[a,h]anthracene	10 U	NA	X	
Dibenzofuran	10 U	NA	X	
Diethylphthalate	10 U	NA	X	
Dimethylphthalate	10 U	NA	X	
Fluoranthene	10 U	NA	X	
Fluorene	10 U	NA	X	
Hexachlorobenzene	10 U	NA	X	
Hexachlorobutadiene	10 U	NA	X	
Hexachlorocyclopentadiene	10 U	NA	X	
Hexachloroethane	10 U	NA	X	
Indeno(1,2,3-cd)pyrene	10 U	NA	X	
Isophorone	10 U	NA	X	
N-nitroso-di-n-dipropylamine	10 U	NA	X	
N-Nitrosodiphenylamine	10 U	NA	X	
Naphthalene	10 U	NA	X	
Nitrobenzene	10 U	NA	X	
Pentachlorophenol	25 U	NA	X	
Phenanthrene	10 U	NA	X	
Phenol	10 U	NA	X	
Pyrene	10 U	NA	X	

U: Not detected

NA: Not applicable; no well had concentration above detection limit

Table 2-11 H Area LFI Unfiltered Groundwater
Cations and Metals Data Summary

(ug/L)

Analyte	Max. Conc.	Well #	Non-Toxic [a]	> Bkg. ? [b]	ELIM.	COPC
Aluminum	88.4 B	H4-48	YES	NO	X	
Antimony	200 U	NA	NO	NA	X	
Arsenic	6.2 B	H4-46	NO	NO	X	
Barium	87.8 B	H5-1A	NO	YES		X
Beryllium	3 U	NA	NO	NA	X	
Cadmium	3.4 B	H5-1A	NO	NO	X	
Calcium	62800	H5-1A	YES	NO	X	
Chromium	360	H4-14	NO	YES		X
Cobalt	20 U	NA	NO	NA	X	
Copper	40	H4-3	NO	YES		X
Iron	173	H5-1A	YES	YES	X	
Lead	5.1	H5-1A	NO	YES		X
Magnesium	23000	H4-3	YES	YES	X	
Manganese	20	H5-1A	NO	NO	X	
Mercury	0.2 U	NA	NO	NA	X	
Nickel	80	H4-3	NO	YES		X
Potassium	9300	H4-3	YES	YES	X	
Selenium	19 U	NA	NO	NA	X	
Silver	20 U	NA	NO	NA	X	
Sodium	200000	H4-3	YES	YES	X	
Thallium	4 U	NA	NO	NA	X	
Vanadium	12.2 B	H4-49	NO	NO	X	
Zinc	195	H5-1A	NO	YES		X

[a]: EPA region 10 excluded elements: "Supplemental Guidance for Superfund Risk Assessments in Region 10",

August 16, 1991, U.S. Environmental Protection Agency, Region X, Seattle, Washington.

[b]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy,
Richland, Washington.

NA: Not applicable

U: Not Detected

B: Estimated value, less than the contract detection limit

Table 2-12 H Area LFI Groundwater Pesticide Data Summary

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
4,4'-DDD	0.1 U	NA	X	
4,4'-DDE	0.1 U	NA	X	
4,4'-DDT	0.1 U	NA	X	
Aldrin	0.05 U	NA	X	
Alpha-BHC	0.05 U	NA	X	
Alpha-chlordane	0.05 U	NA	X	
Aroclor-1016	1 U	NA	X	
Aroclor-1221	2 U	NA	X	
Aroclor-1232	1 U	NA	X	
Aroclor-1242	1 U	NA	X	
Aroclor-1248	1 U	NA	X	
Aroclor-1254	1 U	NA	X	
Aroclor-1260	1 U	NA	X	
Beta-BHC	0.05 U	NA	X	
Delta-BHC	0.05 U	NA	X	
Dieldrin	0.1 U	NA	X	
Endosulfan I	0.05 U	NA	X	
Endosulfan II	0.1 U	NA	X	
Endosulfan sulfate	0.1 U	NA	X	
Endrin	0.1 U	NA	X	
Endrin Aldehyde	0.1 U	NA	X	
Endrin Ketone	0.1 U	NA	X	
Gamma-BHC	0.05 U	NA	X	
Gamma-chlordane	0.5 U	NA	X	
Heptachlor	0.05 U	NA	X	
Heptachlor epoxide	0.05 U	NA	X	
Methoxychlor	0.5 U	NA	X	
Toxaphene	5 U	NA	X	

U: Not detected

NA: Not applicable; no well had concentration above detection limit

Table 2-13 H Area LFI Groundwater Radionuclide Data Summary

(pCi/L)

Analyte	Max. Conc.	Well #	>Bkg.? [a]	Elim.	COPC
Americium-241	0.008 U	NA	NA	X	
Carbon-14	72	H4-45	NA		X
Cesium-134	17 U	NA	NA	X	
Cesium-137	20 U	NA	NA	X	
Chromium-51	800 U	NA	NA	X	
Cobalt-60	21 U	NA	NA	X	
Europium-152	30 U	NA	NA	X	
Europium-154	20 U	NA	NA	X	
Gross Alpha	313	H4-3	YES		X
Gross Beta	490	H4-3	YES		X
Iron-59	100 U	NA	NA	X	
Plutonium-238	0.026 U	NA	NA	X	
Plutonium-239/240	0.027 U	NA	NA	X	
Potassium-40	300 U	NA	NA	X	
Radium-226	90 U	NA	NA	X	
Ruthenium-106	130 U	NA	NA	X	
Strontium-90	33	H4-13	NA		X
Technetium-99	356	H4-4	NA		X
Thorium-228	36 U	NA	NA	X	
Thorium-232	84 U	NA	NA	X	
Tritium	9300	H5-1A	NA		X
Uranium-233/234	2.8	H6-1	YES		X
Uranium-235	2.43	H4-4	YES		X
Uranium-238	18.6	H4-4	YES		X
Zinc-65	52 U	NA	NA	X	

U: Not detected

NA: Not applicable

[a]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23,
U.S. Department of Energy, Richland, Washington.

Table 2-14 H Area LFI Groundwater Other Constituent Data Summary

(mg/L)

Analyte	Max. Conc.	Well #	>Bkg.?[a]	Elim.	COPC
Alkalinity	176	H5-1A	NO	X	
Ammonia	0.29 J	H6-1	NA		X
Chloride	12.9	H5-1A	YES	X	
Fluoride	0.8	H4-4	NO	X	
Hydrazine	30 U	NA	NA	X	
Nitrate	760	H4-3	YES		X
Phosphate	0.4	H6-1	NO	X	
Sulfate	110	H4-3	YES	X	
Sulfide	1	H4-45	NA	X	
TOC	2.8	H5-1A	YES	X	
TOX	58.2 J	H4-47	NA	X	

[a]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland Washington.

U: Not detected

J: Estimated value

NA: Not applicable

**Table 2-15 600 Area LFI Groundwater Volatile and Semivolatile Organic Data
Summary (Page 1 of 3)**

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
1,1,1-Trichloroethane	10 U	NA	X	
1,1,2,2-Tetrachloroethane	10 U	NA	X	
1,1,2-Trichloroethane	10 U	NA	X	
1,1-Dichloroethane	10 U	NA	X	
1,1-Dichloroethene	10 U	NA	X	
1,2-Dichloroethane	10 U	NA	X	
1,2-Dichloroethene	10 U	NA	X	
1,2-Dichloropropane	10 U	NA	X	
2-Butanone	10 U	NA	X	
2-Hexanone	10 U	NA	X	
4-Methyl-2-Pentanone	10 U	NA	X	
Acetone	10 U	NA	X	
Benzene	10 U	NA	X	
Bromodichloromethane	10 U	NA	X	
Bromoform	10 U	NA	X	
Bromomethane	10 U	NA	X	
Carbon Disulfide	10 U	NA	X	
Carbon Tetrachloride	10 U	NA	X	
Chlorobenzene	10 U	NA	X	
Chloroethane	10 U	NA	X	
Chloroform	2 J	96-43		X
Chloromethane	10 U	NA	X	
cis-1,3-Dichloropropene	10 U	NA	X	
Dibromochloromethane	10 U	NA	X	
Ethylbenzene	10 U	NA	X	
Methylenechloride	10 U	NA	X	
Styrene	10 U	NA	X	
Tetrachloroethene	10 U	NA	X	
Toluene	10 U	NA	X	
trans-1,3-Dichloropropene	10 U	NA	X	
Trichloroethene	10 U	NA	X	
Vinyl Chloride	10 U	NA	X	
Xylenes (total)	10 U	NA	X	

**Table 2-15 600 Area LFI Groundwater Volatile and Semivolatile Organic Data
Summary (Page 2 of 3)**

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
1,2,4-Trichlorobenzene	10 U	NA	X	
1,2-Dichlorobenzene	10 U	NA	X	
1,3-Dichlorobenzene	10 U	NA	X	
1,4-Dichlorobenzene	10 U	NA	X	
2,4,5-Trichlorophenol	10 U	NA	X	
2,4,6-Trichlorophenol	10 U	NA	X	
2,4-Dichlorophenol	10 U	NA	X	
2,4-Dimethylphenol	10 U	NA	X	
2,4-Dinitrophenol	26 U	NA	X	
2,4-Dinitrotoluene	10 U	NA	X	
2,6-Dinitrotoluene	10 U	NA	X	
2-Chloronaphthalene	10 U	NA	X	
2-Chlorophenol	10 U	NA	X	
2-Methylnaphthalene	10 U	NA	X	
2-Methylphenol	10 U	NA	X	
2-Nitroaniline	26 U	NA	X	
2-Nitrophenol	10 U	NA	X	
3,3'-Dichlorobenzidine	10 U	NA	X	
3-Nitroaniline	26 U	NA	X	
4,6-Dinitro-2-methylphenol	26 U	NA	X	
4-Bromophenylphenyl ether	10 U	NA	X	
4-Chloro-3-methylphenol	10 U	NA	X	
4-Chloroaniline	10 U	NA	X	
4-Chlorophenylphenyl ether	10 U	NA	X	
4-Methylphenol	10 U	NA	X	
4-Nitroaniline	25 U	NA	X	
4-Nitrophenol	26 U	NA	X	
9H-Carbazole	10 U	NA	X	
Acenaphthene	10 U	NA	X	
Acenaphthylene	10 U	NA	X	
Anthracene	10 U	NA	X	
Benzo(a)anthracene	10 U	NA	X	
Benzo(a)pyrene	10 U	NA	X	
Benzo(b)fluoranthene	10 U	NA	X	
Benzo(ghi)perylene	10 U	NA	X	
Benzo(k)fluoranthene	10 U	NA	X	
Bis(2-chloroethoxy)methane	10 U	NA	X	
Bis(2-chloroethyl)ether	10 U	NA	X	
Bis(2-chloroisopropyl)ether	10 U	NA	X	
Bis(2-ethylhexyl)phthalate	4 J	97-51A		X
Butylbenzylphthalate	10 U	NA	X	
Chrysene	10 U	NA	X	
Di-n-butylphthalate	10 U	NA	X	
Di-n-octylphthalate	10 U	NA	X	
Dibenz[a,h]anthracene	10 U	NA	X	

**Table 2-15 600 Area LFI Groundwater Volatile and Semivolatile Organic Data
Summary (Page 3 of 3)**

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
Dibenzofuran	10 U	NA	X	
Diethyl phthalate	10 U	NA	X	
Dimethylphthalate	10 U	NA	X	
Fluoranthene	10 U	NA	X	
Fluorene	10 U	NA	X	
Hexachlorobenzene	10 U	NA	X	
Hexachlorobutadiene	10 U	NA	X	
Hexachlorocyclopentadiene	10 U	NA	X	
Hexachloroethane	10 U	NA	X	
Indeno(1,2,3-cd)pyrene	10 U	NA	X	
Isophorone	10 U	NA	X	
N-nitroso-di-n-dipropylamine	10 U	NA	X	
N-Nitrosodiphenylamine	10 U	NA	X	
Naphthalene	10 U	NA	X	
Nitrobenzene	10 U	NA	X	
Pentachlorophenol	26 U	NA	X	
Phenanthrene	10 U	NA	X	
Phenol	10 U	NA	X	
Pyrene	10 U	NA	X	

U: Undetected, Value reported is the detection limit

J: Estimated Value

NA: Not applicable; no well had concentration above detection limit

**Table 2-16 600 Area LFI Unfiltered Groundwater
Cations and Metals Data Summary**

(ug/L)

Analyte	Max. Conc.	Well #	Non-Toxic[d]	>Bkg.?[e]	Elim.	COPC
Aluminum	32.8 B[a]	97-51A	Yes	No	X	
Antimony	19 U	NA	NA	NA	X	
Arsenic	11.5	91-46	No	Yes		X
Barium	86.5 B	97-51A	No	Yes		X
Beryllium	.3 U	NA	NA	NA	X	
Cadmium	1 U	NA	NA	NA	X	
Calcium	53900	97-51A	Yes	No	X	
Chromium	170	96-43	No	Yes		X
Cobalt	1.3 U	NA	NA	NA	X	
Copper	3.9 B	98-49A	No	No	X	
Iron	1450	98-49A	Yes	Yes	X	
Lead	3.2 [b]	91-46	No	No	X	
Magnesium	12300	96-43	No	No	X	
Manganese	23.8	98-49A	No	No	X	
Mercury	0.25[c]	97-51A	No	Yes		X
Nickel	27.9 B	98-49A	No	No	X	
Potassium	5180	91-46	Yes	No	X	
Selenium	20 UJ	NA	NA	NA	X	
Silver	2.5 U	NA	NA	NA	X	
Sodium	21500	91-46	Yes	No	X	
Thallium	3.8 U	NA	NA	NA	X	
Vanadium	22.9 B	91-46	No	Yes		X
Zinc	22.3	98-49A	No	No	X	

B: Value below the contract required detection limit NA: Not applicable

U: Undetected, Value shown is detection limit

J: Estimated Value

[a]: Equipment blank value of 34.4

[b]: Equipment blank value of 1.4

[c]: Equipment blank value of .15

[d]: EPA region 10 excluded elements: "Supplemental Guidance for Superfund Risk Assessment in Region 10", August 16, 1991, U.S. Environmental Protection Agency, Region X, Seattle, Washington.

[e]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland, Washington.

Table 2-17 600 Area LFI Groundwater Pesticide Data Summary

(ug/L)

Analyte	Max. Conc.	Well #	Elim.	COPC
4,4'-DDD	0.1 U	NA	X	
4,4'-DDE	0.1 U	NA	X	
4,4'-DDT	0.1 U	NA	X	
Aldrin	0.05 U	NA	X	
Alpha-BHC	0.05 U	NA	X	
Alpha-chlordane	0.05 U	NA	X	
Aroclor-1016	1 U	NA	X	
Aroclor-1221	2 U	NA	X	
Aroclor-1232	1 U	NA	X	
Aroclor-1242	1 U	NA	X	
Aroclor-1248	1 U	NA	X	
Aroclor-1254	1 U	NA	X	
Aroclor-1260	1 U	NA	X	
Beta-BHC	0.05 U	NA	X	
Delta-BHC	0.05 U	NA	X	
Dieldrin	0.1 U	NA	X	
Endosulfan I	0.05 U	NA	X	
Endosulfan II	0.1 U	NA	X	
Endosulfan sulfate	0.1 U	NA	X	
Endrin	0.1 U	NA	X	
Endrin Aldehyde	0.1 U	NA	X	
Endrin Ketone	0.1 U	NA	X	
Gamma-BHC	0.05 U	NA	X	
Gamma-chlordane	0.05 U	NA	X	
Heptachlor	0.05 U	NA	X	
Heptachlor epoxide	0.05 U	NA	X	
Methoxychlor	0.5 U	NA	X	
Toxaphene	5 U	NA	X	

U: Undetected, Value shown is detection limit

NA: Not applicable; no well had concentration above detection limit

Table 2-18 600 Area LFI Groundwater Radionuclide Data Summary

(pCi/L)

Analyte	Max. Conc.	Well #	>Bkg.?[a]	Elim.	COPC
Americium 241	0.014 U	NA	NA	X	
Carbon 14	-10 U	NA	NA	X	
Cesium 134	20 U	NA	NA	X	
Cesium 137	13 U	NA	NA	X	
Chromium 51	700 U	NA	NA	X	
Cobalt 60	98 U	NA	NA	X	
Europium 152	30 U	NA	NA	X	
Europium 154	20 U	NA	NA	X	
Gross Alpha	0.78 U	NA	NA	X	
Gross Beta	7.4 J	91-46	No	X	
Iron 59	100 U	NA	NA	X	
Plutonium 238	0.01 U	NA	NA	X	
Plutonium 239/240	0 U	NA	NA	X	
Potassium 40	900 U	NA	NA	X	
Radium 226	40 U	NA	NA	X	
Ruthenium 106	110 U	NA	NA	X	
Strontium 90	0.912 U	NA	NA	X	
Technetium 99	11.5 U	NA	NA	X	
Thorium 228	21 UJ	NA	NA	X	
Thorium 232	60 U	NA	NA	X	
Tritium	11000	96-43	NA		X
Uranium 233/234	1.7	96-43	No	X	
Uranium 235	0.03 U	NA	NA	X	
Uranium 238	1.4	96-43	No	X	
Zinc 65	40 U	NA	NA	X	

[a]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland, Washington.

J: Estimated value

U: Undetected, Value reported is detection limit

NA: Not applicable

Table 2-19 600 Area LFI Groundwater Other Constituent Data Summary

(mg/L)

Analyte	Max. Conc.	Well #	>Bkg.?[a]	Elim.	COPC
Alkalinity	134	96-43	No	X	
Ammonia	0.05	96-43	NA		X
Chloride	14.7	98-49A	Yes	X	
Fluoride	0.6	91-46	No	X	
Hydrazine	3 U	NA	NA	X	
Nitrate	21000	96-49	Yes		X
Phosphate	0.4	91-46	No	X	
Sulfate	57	98-49A	No	X	
Sulfide	1	91-46	NA	X	
T.O.C.	1	96-43	No	X	
T.O.X.	55.6	96-49	NA	X	

[a]: 95% upper threshold limits: "Hanford Site Groundwater Background", DOE/RL-92-23, U.S. Department of Energy, Richland, Washington.

U: Undetected, Value shown is detection limit

J: Estimated Value

NA: Not Applicable

3.0 QUALITATIVE RISK ASSESSMENT

The QRA for the 100-HR-3 Operable Unit is an evaluation of risk for a predefined set of human and environmental exposure scenarios. The QRA is not intended to replace or be a substitute for a baseline risk assessment. This report includes qualitative assessments of threats to human and ecological receptors from groundwater associated with the 100-HR-3 Operable Unit. The QRA is prepared as agreed upon by the 100 Area Tri-Party unit managers, and as recommended in the HSB RAM (DOE-RL 1993d). This chapter provides a summary of the QRA and uncertainties associated with the results of the QRA.

3.1 SUMMARY OF DATA USED IN THE QUALITATIVE RISK ASSESSMENT

The COPC maximum groundwater concentrations of unfiltered samples from the wells in the upper, unconfined aquifer of the 100-HR-3 Operable Unit were used for the human health evaluation. The human health evaluation consists of separate evaluations for the 100 D/DR, 100 H, and 600 Areas of the 100-HR-3 Operable Unit. However, since human exposure to contaminants in the groundwater is most likely to occur to site trespassers at the river edge, concentrations of contaminants in the spring and the river also are reviewed. In most cases the surface water concentrations are either below maximum representative groundwater concentrations or below background levels. The rationale for using unfiltered sample results is explained in Section 2.1.2 of the QRA (WHC 1993b).

The maximum representative groundwater concentrations of unfiltered samples from the near-river wells in the upper, unconfined aquifer of the 100-HR-3 Operable Unit were used for the ecological evaluation. The ecological evaluation consists of separate evaluations of the near-river portions of the 100 D/DR and 100 H Areas of the 100-HR-3 Operable Unit, and a review of contaminant concentrations in the springs and river.

3.2 HUMAN HEALTH QUALITATIVE RISK ASSESSMENT

The QRA provides estimates of risk that might occur under frequent-use or occasional-use scenarios based on the best available knowledge of current contaminant conditions, but does not represent actual risks since neither frequent-use nor occasional-use of groundwater occurs at the 100-HR-3 Operable Unit. However, there is a potential for human exposure to groundwater discharging to the springs and river by trespassers who may have contact with springs along the river on an occasional basis.

3.2.1 Overview of the Human Health Qualitative Risk Evaluation Process

Two exposure scenarios (frequent- and occasional-use) and two pathways (groundwater ingestion of contaminants and inhalation of volatile organics from groundwater use) for the QRA have been discussed and selected by the 100 Area Tri-Party unit managers for evaluation in the QRA. The frequent-use and occasional-use scenarios were evaluated

using residential and recreational exposure parameters from HSB RAM (DOE-RL 1993d), respectively. Currently, there is no use of groundwater in the 100-HR-3 Operable Unit. The human health evaluation also included a focused analysis of the most probable exposure scenario (occasional-use of springs by trespassers near the river).

The ingestion pathway was evaluated for both frequent-use and occasional-use scenarios. The inhalation pathway was only evaluated in the frequent-use scenario because it is assumed that exposures to volatile compounds would be most significant within the confines of a residence. Other exposure pathways were discussed qualitatively, but actual risks were not calculated.

3.2.2 Results of the Human Health Qualitative Risk Assessment

The qualitative risk estimations are summarized in Tables 3-1, 3-2, and 3-3 for the human health QRA for the 100 D/DR, 100 H, and 600 Areas, respectively. These tables include:

- the qualitative risk estimation
- the key contributors to overall risk for the frequent- and occasional-use scenarios
- the associated pathway for the frequent- and occasional-use scenarios.

Risks are grouped into high (increased cancer risk [ICR] $> 1E-02$) medium (ICR $1E-04$ to $1E-02$), low (ICR $1E-06$ to $1E-04$), and very low (ICR $< 1E-06$) categories for carcinogens. For noncarcinogens, a hazard index above one indicates that an adverse toxic effect in humans could occur. In general, estimated risks for the frequent-use scenario are two to three orders of magnitude greater than the occasional-use scenario.

3.2.2.1 Qualitative Overview of the Human Health QRA for the 100 D/DR Area. The following is a summary of the human health risk assessment for the 100 D/DR Area:

Carcinogenic contaminants - Tritium and strontium-90 each present low carcinogenic risk under the frequent-use scenario, the total risk in this scenario is medium. In the occasional-use scenario, tritium is the only contaminant with a low estimated risk.

Noncarcinogenic Contaminants - Ammonia, chromium, manganese, and nitrate as nitrogen are the key contaminants with individual hazard quotients (HQ) exceeding one in the frequent-use scenario for the ingestion pathway, with the exception of ammonia which is associated with the inhalation pathway. In the occasional-use scenario, all contaminants have HQ < 1.0 . The chromium noncarcinogenic effects are one order of magnitude greater than the estimated effects from any other noncarcinogenic contaminants. It should be noted that the maximum manganese concentration occurs in only one well, and all other manganese detects are at or near background concentrations, therefore, the maximum manganese concentration is probably not representative of groundwater at the 100 D/DR Area.

3.2.2.2 Qualitative Overview of the Human Health QRA for the 100 H Area. The following is a summary of the human health risk assessment for the 100 H Area:

Carcinogenic Contaminants - Eight carcinogenic contaminants (chloroform, tritium, carbon-14, strontium-90, technetium-99, uranium-233/234, uranium-238, and americium-241) individually present low carcinogenic risks under the frequent-use scenario for ingestion; however, the total carcinogenic risk for this scenario is medium. Technetium-99 is the only carcinogenic contaminant associated with a low carcinogenic risk in the occasional-use scenario. Chloroform concentrations may be affected by laboratory contamination. Therefore, the concentrations used to define the ICR for chloroform may not be representative of actual groundwater quality.

Noncarcinogenic Contaminants - The key contaminant for noncarcinogenic effects are ammonia, nitrate as nitrogen, chromium, manganese, and fluoride. The HQ for each of these contaminants is 1 or > 1 in the frequent-use scenario and < 1 in the occasional-use scenario. It should be noted, however, that fluoride is associated with cosmetic effects (e.g., dental mottling), not health-based effects.

3.2.2.3 Qualitative Overview of the Human Health QRA for the 600 Area. The following is a summary of the human health risk assessment for the 600 Area:

Carcinogenic Contaminants - The total carcinogenic risk in the 600 Area is medium in the frequent-use scenario, and low in the occasional-use scenario. The key contaminants in the frequent-use scenario are tritium with a low risk, and arsenic with a medium risk. However, the arsenic background concentration in the 600 Area represents almost 90% of the concentration used in the risk calculation. If the arsenic background concentration is subtracted from the maximum 600 Area arsenic concentration, the incremental carcinogenic risk for arsenic (i.e., risk associated with releases from the facility only, not from naturally-occurring sources) is low in the frequent-use scenario and very low in the occasional-use scenario.

Noncarcinogenic Contaminants - The key contaminants for noncarcinogenic effects are arsenic and chromium in the frequent-use scenario for the ingestion pathway. However, the 600 Area maximum arsenic concentration is only slightly higher than background, and all other arsenic concentrations reported in the 600 Area are at or below background. Furthermore, arsenic was not used in Hanford processes, therefore, arsenic in this area is likely to be attributable to background concentrations. No other contaminants have HQ > 1 .

3.2.3 Summary of Key Uncertainties in the Human Health Qualitative Risk Assessment

3.2.3.1 Uncertainty in Contaminants and Concentrations. Uncertainty in contaminant identification and contaminant concentrations is related to the accuracy of the data used in the QRA. The use of four sampling rounds provides confidence in the types and concentrations of contaminants present in the groundwater, and thus the uncertainty is limited.

There is uncertainty associated with the identification of chloroform as a COPC. Chloroform is considered a common laboratory contaminant, and it is likely that the concentrations reported for this compound are not representative of 100-HR-3 groundwater.

There is uncertainty associated with the identification of arsenic as a contaminant in the 600 Area. There are multiple detects of arsenic below background, but only one detected concentration (0.0115 mg/L) that exceeds background (0.010 mg/L) in the 600 Area. Additionally, arsenic was not used in Hanford processes. Therefore, the risks associated with arsenic are likely related to background.

There is uncertainty associated with the identification of manganese as a contaminant in the 100 D/DR Area because manganese is detected in only one well in that area. All other detected concentrations of manganese are at or near the background concentration, therefore the manganese concentration used in the human health evaluation may be an isolated detect.

There is uncertainty in the evaluation of ammonia. The laboratory analysis and reporting of ammonia may not be the same as the use in the reference concentration reported in the Integrated Risk Information System (IRIS) (EPA 1993). Additional review of the evaluation of ammonia is recommended.

3.2.3.2 Uncertainty in the Exposure Assessment. This report estimates risk that might occur under frequent-use (e.g., residential) or occasional-use (e.g., recreational), which are not current land or water uses in the 100-HR-3 Operable Unit. Uncertainty exists in the exposure assessments because the receptors evaluated for the 100-HR-3 Operable Unit are based on assumed receptors under current contaminant conditions (e.g., assuming no fluctuation in current contaminant conditions). The use of maximum representative contaminant concentrations from different well locations to calculate risks for the QRA results in an over estimation of risk since each receptor would generally be extracting groundwater from a single point rather than multiple locations.

For some radionuclides, radioactive decay over time can significantly reduce the concentrations to which a receptor may be exposed. For example, concentrations of strontium-90 would be reduced to 10%, or an order of magnitude, in 100 years. However, carbon-14 and technetium-99 concentrations and exposures would not be effectively reduced within 100 years due to the extremely long half-lives of these radionuclides.

3.2.3.3 Uncertainty in the Toxicity Assessment. Toxicity values and information to evaluate the inhalation route of exposure for the nonradioactive, volatile contaminants is limited and therefore uncertain. Uncertainty is associated with the lack of specific toxicity information to assess potential adverse effects. For radioactive and nonradioactive contaminants identified at the 100-HR-3 Operable Unit, there is relatively good toxicity information for evaluating potential exposures through the oral routes, therefore, there is little uncertainty.

Lead, although known to be quite toxic to sensitive individuals, does not have either an reference dose or slope factor. Also, because the use of models in the QRA was limited,

EPA's lead model was not applied. The concentrations of lead detected in each area in the 100-HR-3 Operable Unit are less than the EPA assigned maximum concentration limit (MCL) of 0.05 mg/L.

Uncertainty exists as to whether chromium is in the hexavalent or trivalent state. Hexavalent chromium is assumed for the QRA because it provides the most conservative evaluation and was the form used (e.g., sodium dichromate) at some 100 D/DR, 100 H, and 600 Area source operable units.

3.2.3.4 Uncertainty in the Risk Characterization. The estimated risks or hazard quotients by themselves do not fully characterize the risk impacts associated with environmental contamination. Such an evaluation must be understood in light of the uncertainties presented above. The risk estimates are based on single point estimates from LFI data assuming two different sets of exposure assumptions (i.e., frequent-use and occasional-use).

Uncertainty in the risk characterization results from summing cancer risks or HQ across contaminants and pathways which gives equal weight to toxicity information derived from different sources or species. Exposures to multiple contaminants may result in additive effects or effects that are greater or less than additive.

3.3 ECOLOGICAL QUALITATIVE RISK ASSESSMENT

The following section provides an overview, results, and the key uncertainties for the ecological risk assessment. The objective of the ecological QRA is to screen for relative risks and evaluate whether an IRM is necessary from an ecological perspective.

3.3.1 Overview of the Qualitative Ecological Qualitative Risk Assessment Process

The ecological evaluation consists of a problem formulation, analysis, and the risk characterization. It provides estimates of risk that might occur to ecological receptors exposed to contaminants discharged to the Columbia River from groundwater at the 100-HR-3 Operable Unit.

3.3.1.1 Problem Formulation. The objective of the problem formation phase is to demonstrate an understanding of the movement of stressors (contaminants) through the food chain and define the receptors likely to be impacted. It defines the stressors and their environmental characteristics, ecosystems potentially at risk, potential ecological effects and endpoints, and develops the conceptual model. Receptors selected for analysis in the QRA were some of the aquatic and riparian organisms expected to be in or associated with the Columbia River. To achieve the objective of the QRA it was necessary to perform the assessment with limited operable unit-specific analytical and ecological data.

3.3.1.2 Analysis. The analysis phase is an evaluation of the data for the potential receptor response to stressors. Ecological profiles describing the general effects of the stressors are provided in Appendix C of the QRA (WHC 1993b).

3.3.1.3 Ecological Risk Characterization. The likelihood of an adverse effect is expressed in the form of an environmental hazard quotient (EHQ). The EHQ is defined as the ratio of the contaminant dose to some benchmark dose or criterion, as follows:

$$\text{EHQ} = \frac{\text{Organism's Dose}}{\text{Benchmark Dose}}$$

The benchmark dose for radionuclides is defined by DOE Order 5400.5 as 1 rad/day. Criteria for non-radiological contaminants were obtained from lowest observed effect levels (LOEL) or no-observable effect levels (NOEL).

Two approaches were utilized to characterize the risks for the 100-HR-3 Groundwater Operable Unit. The first used the CRITR2 computer model to develop radiological dose rates to a plant, fish, crustacean, duck, and heron. Receptor dose to nonradioactive contaminants was evaluated using ambient water quality criteria (EPA 1986) to determine LOEL.

3.3.2 Results of the Ecological Qualitative Risk Assessment

- No associated aquatic or riparian organism was estimated to have received a dose in excess of the limit of 1 rad/day (Order DOE 5400.5) as presented in Table 3-4.
- Chromium (hexavalent) concentrations in the near-river wells exceed the acute and chronic LOEL, and sulfide concentrations exceed the chronic LOEL as presented in Table 3-5. Chromium also exceeded the acute and chronic LOEL in the springs, but was not detected in river samples. Chromium and sulfide are not expected to pose a real risk to aquatic life because of the large dilution capacity of the Columbia River. However, additional studies are needed to verify this conclusion.
- Iron concentrations in the 100 H Area near-river wells exceed the acute LOEL (see Table 3-5), however this may not represent an actual threat to aquatic life in the river.
- Bis(2-ethylhexyl)phthalate concentrations in the 100 D/DR Area near-river wells exceeded the chronic LOEL (see Table 3-5); however, this parameter is a common laboratory contaminant and the concentrations used in this evaluation may not be representative of actual groundwater quality.

3.3.3 Summary of the Key Uncertainties in the Ecological Risk Assessment

The ecological evaluation models the potential effects of contaminants discharged from the 100-HR-3 Operable Unit on selected aquatic and riparian receptors. The issues of concern for the ecological evaluation are the uncertainties in using an assortment of

environmental variables in risk modeling. This begins with the source term. If this number is not realistic, no amount of modeling will overcome this deficiency. For example, in the case of the ecological evaluation, the maximum near-river representative groundwater concentration was used as the source term and no river dilution was considered.

Uncertainty exists with the conceptual site model which assumes that all contaminants are 100% biologically active, bioavailable, and uniformly distributed in the Columbia River. This assumption represents an upper-bound estimate of exposure which does not account for site-specific environmental conditions. For example, fish are assumed to be continuously exposed to the source term, resulting in significant uncertainty in the exposure scenario because fish are mobile and will not be exposed to uniform concentrations. Therefore, risks developed in the ecological evaluation are not actual risks, but estimates of potential risk under high-frequency use by a few organisms. The actual use is not known, however, it can be safely assumed that exposure would be less than presented in this evaluation.

Uncertainty associated with LOEL and NOEL is significant because these values were developed based on laboratory tests and are extrapolated to the environment. This approach tends to build conservatism into the value.

Risk is expressed as an EHQ, which implies a single conclusion has been reached. As discussed above, this quotient is the result of the interaction, uncertainty and conservatism of many different factors that enter into the risk characterization. The environmental relevancy of the characterization will depend on the accuracy of these factors.

Similar to the discussion in Section 3.2.3 of the QRA (WHC 1993b) the uncertainty in contaminant concentrations is related to the accuracy of the data. For the QRA, uncertainty exists in both contaminants identified and exposure concentration. As for the human health assessment, the maximum representative contaminant concentration was used.

3.4 CONCLUSIONS OF THE QUALITATIVE RISK ASSESSMENT

The results of this report are focused to select sites for IRM. The QRA results suggest that some unacceptable risks might exist from "exposure to groundwater" from the 100-HR-3 Operable Unit. While it is reasonable to use this condition to conservatively estimate the risks from contaminants, none of the estimated risks (human or ecological) are based on current exposure scenarios and future land-use for the site has not been determined.

Table 3-1 Human Health Risk Assessment Summary for the 100 D/DR Area

Contaminant Type	Frequent-Use Scenario ^a			Occasional-Use Scenario ^b		
	Estimated Qualitative Risk	Key Contaminant	Pathway	Estimated Qualitative Risk	Key Contaminant	Pathway
Radioactive	low/medium	tritium, strontium-90	ingestion only ^c	low	tritium	ingestion only ^c
Nonradioactive, Carcinogenic	very low	none	none	very low	none	none
Nonradioactive, Noncarcinogenic	HI > 1	chromium, ammonia, manganese, nitrate	inhalation (ammonia only) ^d and ingestion	HI < 1	none	none
<p>This table is based on maximum contaminant concentrations in groundwater.</p> <p>^a Frequent-use scenario is based on residential exposure parameters.</p> <p>^b Occasional-use scenario is based on recreational exposure parameters.</p> <p>^c The inhalation pathway is evaluated for volatile nonradioactive contaminants only.</p> <p>^d The laboratory analysis and reporting for ammonia may not be the same as the use in the reference dose for ammonia; associated risks may be over-estimated.</p> <p>HI hazard index</p>						

Table 3-2 Human Health Risk Assessment Summary for the 100 H Area

Contaminant Type	Frequent-Use Scenario ^a			Occasional-Use Scenario ^b		
	Estimated Qualitative Risk	Key Contaminant	Pathway	Estimated Qualitative Risk	Key Contaminant	Pathway
Radioactive	low/medium	strontium-90, technetium-99, tritium, uranium-238, carbon-14, uranium-233/234, americium-241	ingestion only ^c	low	technetium-99	none
Nonradioactive, Carcinogenic	low	chloroform ^d	inhalation/ingestion	very low	none	none
Nonradioactive, Noncarcinogenic	HI > 1	nitrate, chromium, manganese, fluoride, ammonia	inhalation (ammonia only) ^e and ingestion	HI < 1	none	none
<p>This table is based on maximum contaminant concentrations in groundwater.</p> <p>^a Frequent-use scenario is based on residential exposure parameters.</p> <p>^b Occasional-use scenario is based on recreational exposure parameters.</p> <p>^c The inhalation pathway is evaluated for volatile nonradioactive contaminants only.</p> <p>^d This compound is a common laboratory contaminant, therefore the concentrations identified for this compound may not be representative of groundwater in the 100 H Area, and the associated risks may be over-estimated.</p> <p>^e The laboratory analysis and reporting for ammonia may not be the same as the use in the reference dose for ammonia; associated risks may be over-estimated.</p> <p>HI hazard index</p>						

Table 3-3 Human Health Risk Assessment Summary for the 600 Area

Contaminant Type	Frequent-Use Scenario ^a			Occasional-Use Scenario ^b		
	Estimated Qualitative Risk	Key Contaminant	Pathway	Estimated Qualitative Risk	Key Contaminant	Pathway
Radioactive	low	tritium	ingestion only ^c	very low	none	none
Nonradioactive, Carcinogenic	medium/low	arsenic ^d	ingestion	low/very low	arsenic ^e	ingestion
Nonradioactive, Noncarcinogenic	HI > 1	arsenic, chromium	ingestion	HI < 1	None	None
<p>This table is based on maximum contaminant concentrations in groundwater.</p> <p>^a Frequent-use scenario is based on residential exposure parameters.</p> <p>^b Occasional-use scenario is based on recreational exposure parameters.</p> <p>^c The inhalation pathway is evaluated for volatile nonradioactive contaminants only.</p> <p>^d The ICR for arsenic include background contribution. The ICR for arsenic subtracting background contribution is 3E-05, or a low risk.</p> <p>^e The ICR for arsenic includes background contribution. The ICR for arsenic subtracting background contribution is 6E-07, or a very low risk.</p> <p>HI hazard index</p>						

Table 3-4 Ecological Risk Assessment Summary For Radionuclides

Radionuclide	Near-River Wells	
	Dose > EHQ	
	100 D/DR	100 H
Americium-241	Not Detected	NO
Carbon-14	Not Detected	NO
Strontium-90	NO	NO
Technetium-99	Not Detected	NO
Tritium	NO	NO
Uranium - 233/234	NO	NO
Uranium-235	Not Detected	NO
Uranium-238	NO	NO
Total Dose	NO	NO

EHQ Environmental Hazard Quotient

Table 3-5 Ecological Risk Assessment Summary for Non-Radionuclides

Chemical	Near River Wells	
	100 D/DR	100 H
Bis(2-ethylhexyl) phthalate	Above Chronic LOEL - Yes	Not Detected
Barium	Above Background - No Value for LOEL	Above Background - No Value for LOEL
Chromium	Above Acute and Chronic LOEL - Yes	Above Acute and Chronic LOEL - Yes
Fluoride	Below Background	No LOEL
Iron	Below Background	Above Acute LOEL
Nitrate as N	No Value for LOEL	No Value for LOEL
Manganese	No Value for LOEL	Below Background
Sulfide	Above Chronic LOEL - Yes	Above Chronic LOEL - Yes
Vanadium	No Value for LOEL	Below Background
Note: All other concentrations were below the Acute and Chronic LOEL or below background levels. LOEL lowest observable effect level		

4.0 CONTAMINANTS OF POTENTIAL CONCERN IN THE GROUNDWATER

Groundwater chemistry data were obtained from analysis of samples collected from wells drilled under this LFI, wells drilled under the RCRA program and, from pre-1991 wells determined to be "fit-for-use" as monitoring structures (Ledgerwood 1991). The following sections discuss the analytes which were detected in the LFI groundwater sampling and identified as COPC in the QRA. Contaminants of potential concern were identified using the initial three sampling rounds; subsequent to that analysis, the fourth round of data became available. The COPC data from the four rounds of LFI sampling are shown in Tables 4-1, 4-2 and 4-3. The discussion is divided into sections discussing 100 D/DR, 100 H, and the 100-HR-3 600 Areas. Only arsenic was identified as a contaminant of concern (COC). Constituents with a medium or high risk were identified through the QRA. Constituents identified as having a HQ > 1 are chromium, ammonia, manganese and nitrate. Bis(2-ethylhexyl)phthalate, chromium, and sulfide exceed chronic LOEL.

4.1 CONTAMINANTS OF POTENTIAL CONCERN IN THE 100 D/DR AREA

Six constituents were identified as COPC based on the risk assessment. The QRA identified ammonia, chromium, manganese, nitrate as nitrogen, tritium and strontium-90 as COPC for human health. Ammonia was identified as a COPC through inhalation only. The QRA identified bis(2-ethylhexyl)phthalate, chromium, and sulfide as a COPC through the ecological evaluation.

Chromium contamination at levels well above the drinking water standard (50 µg/L current, 100 µg/L proposed) is present in the groundwater beneath the 100 D Area (Figure 4-1). Locally the reported levels exceed 2 mg/L, which was the total sodium dichromate concentration of reactor cooling water. This level of contamination is indicative of a concentrated source. Two potential source areas have been identified:

- Pipes leading from the 100 D sodium dichromate supply tanks located north of the 105 D Reactor Building. This facility provided the original feed source for corrosion control for that reactor. Concentrated sodium dichromate was stored in two tanks and then transferred via pressurized lines to the 190 D Building where it was added to the reactor cooling water. Leaks, spills or washdown remnants in the vicinity of the tank would be consistent with normal operating practices. Above background concentrations are found along the pipeline route; this is consistent with leaks in the piping.
- The 100 D/DR sodium dichromate distribution pump. After the 100 DR Reactor was constructed and both reactors were brought on line, the corrosion control chemical system was placed so that both reactors could be serviced. A single pumping station was built next to a railroad spur between the reactors. Lines were constructed leading from this location to the 190 D and DR Buildings. Rail cars containing sodium dichromate were positioned on the siding, connected to the pumping station and emptied directly to the

190 buildings with no supplemental storage. Leaks and rail car washout reportedly occurred at the pump station, as a small french drain was incorporated into the operation. No monitoring wells are located near this site.

Chromium contamination occurs in wells near the D/DR retention basins. Retention basins are not major chromium sources in other reactor areas (H and B/C), suggesting that the chromium concentrations may be the result of a more concentrated source. Groundwater flow direction in the vicinity of the D and DR Reactors is not clearly defined due to the interpreted presence of a "groundwater divide" in the vicinity. The chromium plume within the 100 D Area is likely a single entity. The limited distribution of monitoring wells in this area makes analysis somewhat subjective. The source of this plume appears to be located near the 105-D Reactor.

A separate area of elevated chromium concentration is noted at Well 199-D2-6, suggesting that the 118-D-2 Burial Ground may be a contributing source. No upgradient wells are available to confirm this hypothesis.

Chromium contamination appears to be wide spread, but not well defined, in the 100 D Area. This lack of definition is due to the limited distribution and number of monitoring wells and associated analyses.

Manganese at concentrations yielding a HQ > 1 were identified for Well 199-D5-17. This is the only well exhibiting the elevated concentrations. Wells located near 199-D5-17 yield manganese concentrations indistinguishable from background.

Nitrate concentrations reported as nitrogen are commonly near or above the drinking water standard of 10 mg/L (see Section 4.5) over the entire operable unit. The highest value (32.7 mg/L) was determined for Well 199-D8-3 (Figure 4-2). Other high concentrations are found near the 105 D and 105 DR Reactors, respectively. Nitric acid used for numerous purposes in this area and is the probable source of the nitrates.

Tritium levels are elevated near the DR Reactor (Figure 4-3), at concentrations above the drinking water standard (20,000 pCi/L); ranging up to 78,000 pCi/L in Well 199-D5-17. Well 199-D2-5 provides historical tritium concentration data starting in 1964. During the 1970's tritium concentrations averaged about 25,000 pCi/L; they then declined to a low of about 2,000 pCi/L in 1986. Concentrations have been increasing since then to the levels determined during this investigation. The reason for this increase is not known as there are no ongoing disposals of tritiated water in the area.

Strontium-90 occurs in near-river wells at detectable concentrations up to the drinking water standard of 8 pCi/L immediately north of the 116-DR-9 Retention Basin (Figure 4-4). The near-river wells in which it was detected are D8-53 (8 pCi/L), D8-54A (7 pCi/L) and, D8-3 (5 pCi/L). Strontium-90, above the standard, was reported at a maximum estimated value of "41 pCi/L J" in well 199-D5-12. Well 199-D5-12 is located immediately downgradient of the 116-D-2A Disposal Facility (Pluto Crib) in the 100-DR-1 Operable Unit. The small strontium-90 plume near this well is likely due to the limited disposal to that

facility. Historical records of strontium-90 extend back to 1988; concentrations have remained essentially constant since that time. Strontium-90 was below detection level in all other 100 D wells sampled.

Bis(2-ethylhexyl)phthalate was reported in numerous samples. This compound is a primary component of plastic products where it is used to maintain material pliability. The compound is ubiquitous in the environment and is not indicative of site-specific contamination.

Ammonia was carried through the QRA and found to present a HQ of > 1 based on the inhalation pathway. The maximum reported value was 0.74 mg/L in Well 199-D5-17. There are no known Hanford sources for this constituent. Under reducing conditions, nitrate may be altered to ammonia; this process and the conditions necessary for it to be carried out, have not been demonstrated to be present at Hanford. Ammonia was not carried through as a COPC within the LFI.

Sulfide was reported as present at a maximum concentration of 1 mg/L. The occurrence was not widespread over the area, but may well be due to natural causes. No source of sulfide is known.

4.2 CONTAMINANTS OF POTENTIAL CONCERN IN THE 100 H AREA

In the 100 H Area, contaminants can generally be traced to the facility or facilities from which they originated. Operating history for specific facilities in that area confirm the findings of the groundwater analyses. The QRA identified tritium, carbon-14, strontium-90, technetium-99, uranium-238, uranium-233/234, americium-241, chromium, manganese, ammonia, chloroform, fluoride and nitrate as nitrogen as COPC for human health. Chromium, iron, and sulfide were identified as a COPC for the ecological evaluation because they exceed chronic or acute LOEL.

Tritium was found in most of the wells in the 100 H Area, although at relatively low concentrations. The maximum concentration was 11,000 pCi/L in Wells 199-H4-46 and 199-H4-49. The highest concentrations are found in the southern portion of the H Area and are associated with reactor disposal areas.

Carbon-14 was found in a few wells (199-H4-4, 199-H4-6, 199-H4-11, 199-H4-12A, 199-H4-45, and 199-H4-49) in the 100 H Area. These carbon-14 concentrations have only been observed in one round of sampling, therefore it is uncertain whether or not carbon-14 is actually present in the 100 H Area. The maximum concentration was determined to be 72 pCi/L, sufficient to carry carbon-14 through as a COPC.

Strontium-90 is found almost exclusively associated with groundwater flow downgradient of the retention basins (Figure 4-5). Well 199-H4-13 showed the highest concentration at 33 pCi/L. Other reactor areas show similar strontium-90 distributions.

Technetium-99 is found almost exclusively in conjunction with the uranium plume emanating from the 183-H basins, which no longer contain any hazardous wastes and are being decommissioned (Figure 4-6). Technetium-99 is to be expected here due to the processes involved in producing the wastes disposed to the facility. Maximum concentration of technetium-99 was found in Well 199-H4-4 at 356 pCi/L. Levels of technetium-99 have been declining since the cessation of disposals to these basins.

Uranium-238 was found in low concentrations in several wells in the vicinity of the H Reactor. The highest concentration observed during the LFI sampling was 18.6 pCi/L in Well 199-H4-4. The drinking water standard for uranium-238 is 320 pCi/L. Uranium is known to have been placed in the 183-H Basins, although the uranium-238 results from samples collected in the vicinity of this facility were rejected during data validation. Uranium-234 and -235 were found in the vicinity of the 183-H Solar Evaporation Facility and is attributed to that operation. The QRA did not identify uranium-235 as presenting a risk.

Americium-241 is found in the groundwater adjacent to and downgradient of the 183-H Solar Evaporation Basins. Its occurrence corresponds with the uranium isotopes. The 183-H Basins are the likely source.

Chromium contamination may have come from any of several sources within the 100 H Area (Figure 4-7). The primary source appears to be the 183-H facility used during reactor operations. Chromium as dichromate was disposed of as an incidental waste during the operating period of the reactor. All cooling water was treated to a concentration of 2 mg/L sodium dichromate as a corrosion inhibitor. Concentrated sodium dichromate was stored on site in large tanks and then transferred to the cooling water in either the 183-H Water Treatment Plant or the 190 Pumping Plant before passing through the reactor. This water then followed the normal path for cooling water, eventually being discharged to the Columbia River. High concentrations of chromium were also present in the fuel fabrication wastes placed in the 183-H Solar Evaporation Ponds. (The 183-H facility contained several water clarification and treatment cells that were used for the solar evaporation in the 1970's.) Both sources have contributed to the occurrence of chromium contamination.

Manganese was reported at a maximum concentration of 180 ug/L in Well 199-H4-3. Although this concentration was determined to pose a low risk in the QRA it is probably naturally occurring.

Chloroform was reported in sample analyses associated with the 100 H Area. In the majority of cases these samples were accompanied by blanks that also showed positive chloroform concentrations. Although chloroform was carried through the QRA analysis, it is not considered as a contaminant for this LFI.

The highest concentration of nitrate as nitrogen (760 mg/L) in Well 199-H4-3 is associated with a plume emanating from the solar evaporation ponds at 183-H (Figure 4-8). The 183-H plume is superimposed upon a general site-wide nitrate-nitrogen concentration. This concentrated plume results from disposed nitric acid used during the fuel fabrication

process. High nitrate salts were placed in the facility, the salts are highly soluble and move readily with the groundwater.

A maximum fluoride concentration of 1.3 mg/L was determined for Well 199-H4-3. This concentration is associated with the solar evaporation ponds and is probably a residual product of dissolving fuel rod cladding during their manufacture. Fluoride salts are highly soluble and move readily with the groundwater.

Ammonium ion was determined to be present in seven wells (199-H4-45, 199-H4-46, 199-H4-47, 199-H4-48, 199-H4-49, 199-H5-1A, and 199-H6-1) in the 100 H Area. Concentrations ranged from 0.05 mg/L in four wells to 0.29 mg/L in Well 199-H6-1. This nitrogen compound presents a HQ > 1 for inhalation under the frequent-use scenario. No sources of ammonium ion are known.

Sulfide was reported as present at a maximum concentration of 1 mg/L. The occurrence was not widespread over the area, but may well be due to natural causes. No source of sulfide is known.

Iron concentrations having a maximum representative concentration of 5,400 $\mu\text{g/L}$ in Well 199-H4-3. Iron is a common component of Hanford soils as well as well casings and other area materials. The high values in the vicinity of the 183-H Basins are likely due to disposal activities at that facility.

4.3 CONTAMINANTS OF POTENTIAL CONCERN IN THE 600 AREA

The QRA identified tritium and arsenic as COPC for human health in the 600 Area of 100-HR-3. An ecological assessment of the 600 Area was not made.

Tritium was detected in the six wells sampled in the 600 Area of 100-HR-3 (Figure 4-10). The highest concentration was 11,000 pCi/L in Well 699-96-43. All of the 600 Area well concentrations were well below the 20,000 pCi/L MCL.

Arsenic was defined by the QRA as presenting a medium risk under the frequent-use scenario. Arsenic was a common component of pesticides used in pre-Hanford agriculture. The 600 Area portion of the 100-HR-3 Operable Unit was a prime orchard region prior to government acquisition of the land in the 1940's. No Hanford related use of arsenic compounds is known. Although this element presents a medium risk, it is not carried forward as a COPC in the LFI.

Chromium was defined by the QRA as presenting a medium risk due to its HQ > 1. The distribution of chromium throughout the 600 Area of the 100-HR-3 Operable Unit is shown in Figure 4-9. The distribution is such that no source is readily identifiable.

4.4 CONFINED AQUIFER

Confined aquifers in the 100-HR-3 Operable Unit are found in the Ringold Formation and within the CRBG. A limited number of wells tap these confined units. Sand lenses in the upper portions of the Ringold Formation often act as semiconfined aquifers with vertical leakage occurring in either direction depending on interactions of the unconfined aquifer with the Columbia River. During periods of high river stage, potentials may be downward. During normal and low river stages, potentials are generally upward. Heads increase with depth through the Ringold Formation and into the basalt aquifers of the CRBG.

Contaminants are locally present to the base of the unconfined aquifer in the 100-HR-3 Operable Unit. Wells 199-D8-54B and 199-H4-12C were drilled as part of this LFI to determine if contaminants were present at depth. Following construction, it was determined that well 199-H4-12C is completed in the upper aquifer. Well 199-D8-54B had no contamination. Wells 199-H4-15C and 199-H3-2C also tap the confined aquifer. No water quality data are available for well 199-H4-15C; data for well 199-H3-2C indicate the presence of chromium sporadically beginning in December 1986. Chromium concentrations were reported as high as 93 $\mu\text{g/L}$ in July 1993. Well 199-H3-2C should be reexamined to assure that it is not contributing to contamination of the lower aquifer.

4.5 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED GUIDANCE

Potential chemical-specific ARAR for the 100-HR-3 Operable Unit are discussed in the following sections. Potential location-specific ARAR are identified in the *100 Area Feasibility Study Phases 1 and 2* (DOE-RL 1993c). These location-specific ARAR do not have associated chemical-specific concentrations.

Safe Drinking Water Act. The MCL prescribed in EPA's National Primary Drinking Water Regulations¹ under the Safe Drinking Water Act are relevant and appropriate regulations for the 100-HR-3 Operable Unit. Secondary MCL are to-be-considered (TBC) per the National Contingency Plan. Title 40 Code of Federal Regulations (CFR) 141.16 limits the concentrations of photon and beta particle emitters to levels which would not exceed an annual dose equivalent to the total body or any internal organ of 4 mrem/yr. This section also prescribes a methodology for calculating the concentration of radionuclides using a daily intake of 2 L/day and the 168 hour data listed in *Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposures* (NBS 1963). Primary MCL, maximum contaminant level goals (MCLG), and Secondary MCL are listed in Table 4-4.

Model Toxics Control Act. The Model Toxics Control Act (MTCA) (WAC 173-340) defines ground and surface water standards for both residential and industrial scenarios. The MTCA does not include standards for radionuclides.

¹Title 40 CFR as amended at 56 Federal Regulations (FR) 32113, July 15, 1991; 57 FR 1852, January 15, 1992; 57 FR 22178, May 27, 1992; 57 FR 24747, June 10, 1992; 57 FR 28788, June 29, 1992; 57 FR 31838, July 17, 1992.

Additional ARAR and TBC guidelines are included in Table 4.4. The DOE Order 5400.5 establishes groundwater standards based on a 100 mrem/yr dose. Converting these standards to correspond to a 4 mrem/yr dose (by dividing by 25) results in the following levels:

- tritium - 80,000 pCi/L
- carbon-14 - 2,800 pCi/L
- strontium-90 - 40 pCi/L
- technetium-99 - 4,000 pCi/L
- uranium 233/234 - 10,000 pCi/L
- uranium-238 - 24 pCi/L.

Figure 4-1 Chromium Concentrations in the 100 D/DR Area Groundwater

Figure 4-2 Nitrate Concentrations in the 100 D/DR Groundwater

Figure 4-3 Tritium Concentrations in the 100 D/DR Area Groundwater

Figure 4-4 Strontium-90 Concentrations in the 100 D/DR Area Groundwater

Figure 4-5 Strontium-90 Concentrations in the 100 H Area Groundwater

Figure 4-6 Technetium-99 Concentrations in the 100 H Area Groundwater

Figure 4-7 Chromium Concentrations in the 100 H Area Groundwater

Figure 4-8 Nitrate Concentrations in the 100 H Area Groundwater

Figure 4-9 Chromium Concentrations in the 600 Area Groundwater

Figure 4-10 Tritium Concentrations in the 600 Area Groundwater

Table 4-1 D/DR Area Contaminant of Potential Concern Data
(Page 1 of 5)

Well Number	D2-5						
Date Sampled	May-92	Jul-92	Duplicate	Nov-92	Feb-93	Duplicate	Split
Sample Number[a]	B06CH9	B072G9	B07369	B07L10	B084X7	B08513	B08517
Strontium-90 (pCi/L)	0.45 U	0.28 U	0.15 U	0.59 U	0.28 UJ	0.45 UJ	-0.5 R
Tritium (pCi/L)	41000	39000	40000	38000	36000	36000	29000
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	10 U	24 U	10 U	NA	NA	NA
Chromium (ug/L)[b]	48.5/390	35.8/40.2	34.7/42.6	41.3 U/44.1	37.7/38.6	36.4/43	43.6/42.8
Manganese (ug/L)[b]	1.3 U/4.7 U	7.2 B/14.5 B	6.7 B/13.8 B	4.7 U/4.7 U	1 U/1.7 U	1 U/2.5 B	2 U/2.9 B
Ammonia (mg/L)	NA	0.05	0.05	0.05 UJ	NA	NA	NA
Nitrate (mg/L)	9.7	NA	NA	NA	NA	NA	NA

Well Number	D2-6						
Date Sampled	May-92	Jul-92	Split	Nov-92	Split	Duplicat	Mar-93
Sample Number[a]	B06CJ2	B072K4	B07360	B07L20	B07L94	B07LB5	B084X9
Strontium-90 (pCi/L)	0.016 UJ	0.076 U	-0.35 R	-0.22 U	NA	0.006 U	0.029 U
Tritium (pCi/L)	2400 J	2100	2200 R	2200	NA	2300	2400
Bis(2-ethylhexyl)phthalate (ug/L)	4 J	10 U	10 U	54	10 UJ	10 U	NA
Chromium (ug/L)[b]	122/156	210/266	218/242	178/190	192/200	175/198	156/169
Manganese (ug/L)[b]	86.4/98.2	11.5 B/20.4	12.6 B/17.8	1.5 B/2.8 B	4 U/4 U	1.8 B/2.2 B	3.2 B/6.8 B
Ammonia (mg/L)	NA	0.05 UJ	0.1 U	0.22	0.1 U	0.05	NA
Nitrate (mg/L)	13.5	NA	NA	NA	NA	NA	NA

Well Number	D8-3				
Date Sampled	May-92	Jul-92	Split	Oct-92	Feb-93
Sample Number[a]	B06CL9	B07336	B07356	B07KY5	B084V9
Strontium-90 (pCi/L)	5.3	2.3	2.5	2.5 R	3 J
Tritium (pCi/L)	3300	4100	3900	3600	3500
Bis(2-ethylhexyl)phthalate (ug/L)	20 U	0.9 J	NA	24	NA
Chromium (ug/L)[b]	139/326	173/162 J	190/199 J	167/172	147/146
Manganese (ug/L)[b]	9.8 B/1.7 U	1.3 U/4.4 U	2 U/2 U	1.4 U/4.7 U	1.7 U/1.5 U
Ammonia (mg/L)	NA	0.1 J	0.1 U	0.23	NA
Nitrate (mg/L)	32.6	NA	NA	NA	NA

Table 4-1 D/DR Area Contaminant of Potential Concern Data
(Page 2 of 5)

Well Number	D8-4							
Date Sampled	May-92	Jun-92	Aug-92	Sep-92	Dec-92	Dec-92	Mar-93	Mar-93
Sample Number[a]	B06CF2	B06PF5	B07581	B07814	B07RW7	B07RX7	B08941	B08958
Strontium-90 (pCi/L)	0.011 UJ	NA	-0.438	NA	NA	NA	NA	-0.388 U
Tritium (pCi/L)	NA	-31.7	NA	-181	-181 U	NA	129 U	NA
Bis(2-ethylhexyl)phthalate (ug/L)	4 J	NA	NA	NA	NA	10 U	NA	10 U
Chromium (ug/L)[b]	NA	U/52	NA	20 U/33	20 U/20 U	NA	20 U/84	NA
Manganese (ug/L)[b]	NA	U/56	NA	10 U/11	10 U/20	NA	10 U/43	NA
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (mg/L)	NA	1.8	NA	0.8	2.7	NA	0.9	NA

Well Number	D8-5							
Date Sampled	May-92	Jun-92	Aug-92	Sep-92	Dec-92	Dec-92	Mar-93	Mar-93
Sample Number[a]	B06CF4	B06PG5	B07582	B07819	B07RX2	B07RY3	B08946	B08959
Strontium-90 (pCi/L)	0.22 JU	NA	-0.211	NA	NA	NA	NA	-0.562 U
Tritium (pCi/L)	NA	188	NA	-48	-197 U	NA	119 U	NA
Bis(2-ethylhexyl)phthalate (ug/L)	22	NA	NA	NA	NA	10 U	NA	10 U
Chromium (ug/L)[b]	NA	U/21	NA	20 U/110	20 U/20 U	NA	20 U/83	NA
Manganese (ug/L)[b]	NA	22/25	NA	10 U/13	10 U/10 U	NA	10 U/14	NA
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (mg/L)	NA	2	NA	1.5	1.9	NA	1.4	NA

Well Number	D8-6											
Date Sampled	May-92	Jun-92	Aug-92	Sep-92	Sep-92	Dec-92	Dec-92	Mar-93	Mar-93	Mar-93	Mar-93	Feb-93
Sample Number[a]	B06CF6	B06PH3	B07583	B07824	B07825	B07RX8	B07RY4	B08951	B08952	B08960	B08961	B08956
Strontium-90 (pCi/L)	-0.27 UJ	NA	-0.055	NA	NA	NA	NA	NA	NA	-0.512 U	0.138 U	NA
Tritium (pCi/L)	NA	0	NA	-2.88	-29.8	-164 U	NA	307	281	NA	NA	NA
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	NA	NA	NA	NA	NA	10 U	NA	NA	10 U	10 U	NA
Chromium (ug/L)[b]	NA	U/73	NA	20 U/20 U	20 U/21	20 U/20 U	NA	NA/50	20 U/50	NA	NA	20 U/NA
Manganese (ug/L)[b]	NA	U/23	NA	10 U/10 U	10 U/10 U	10 U/10	NA	NA/10 U	10 U/10 U	NA	NA	10 U/NA
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (mg/L)	NA	1	NA	0.5	0.5	0.8	NA	1.4	1.5	NA	NA	NA

Table 4-1 D/DR Area Contaminant of Potential Concern Data
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Well Number	D5-12				D5-13							
Date Sampled	May-92	Jul-92	Nov-92	Feb-93	May-92	Jun-92	Aug-92	Sep-92	Dec-92	Dec-92	Mar-93	Mar-93
Sample Number[a]	B06CJ5	B072M4	B07KY0	B084W1	B06CF0	B06PF0	B07580	B07809	B07RW2	B07RY5	B08936	B08957
Strontium-90 (pCi/L)	33	37	32 R	41 J	-0.042 UJ	NA	-0.284	NA	NA	NA	NA	-0.555 U
Tritium (pCi/L)	20000	17000	35000	41000	NA	123	NA	70.1	-258 U	NA	167 U	NA
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	50	10 U	NA	10 U	NA	NA	NA	NA	10 U	NA	10 U
Chromium (ug/L)[b]	564/275	540/556 *J	353/325	268/263	NA	24/53	NA	20 U/39	20 U/30	NA	20 U/74	NA
Manganese (ug/L)[b]	2.2 U/1.9 U	6.2 U/6.8 U	3.2 U/4.9 B	3.6 B/15 B	NA	U/U	NA	10 U/10 U	10 U/10 U	NA	10 U/10 U	NA
Ammonia (mg/L)	NA	0.09 J	0.05	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (mg/L)	20	NA	NA	NA	NA	14	NA	12	5.8	NA	12	NA

Well Number	D5-14				D5-15			
Date Sampled	May-92	Jul-92	Oct-92	Feb-93	May-92	Jul-92	Nov-92	Mar-93
Sample Number[a]	B06CJ8	B072C9	B07KX5	B084W3	B06CK1	B072G4	B07L15	B084W5
Strontium-90 (pCi/L)	0.017 U	0.3 U	-0.31 R	0.12 UJ	-0.5 U	1.1 J	1.1 J	1.4 J
Tritium (pCi/L)	300 J	390 J	360 J	620	570	630	1200	660
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	10 U	10 U	NA	10 U	10 U	10 U	NA
Chromium (ug/L)[b]	410 J/483 J	317/343 *J	657/630	917/961	2020/2090	1790/1740	1880/1810	1570/1630
Manganese (ug/L)[b]	110/145	34/32.6	12 B/11.9 B	4.2 U/3.6 B	24.3/27	3.9 B/7.7 B	4.7 U/4.7 U	1.7 U/1 U
Ammonia (mg/L)	NA	0.12 J	0.06	NA	NA	0.05 UJ	0.05 UJ	NA
Nitrate (mg/L)	8.1	NA	NA	NA	10.6	NA	NA	NA

Table 4-1 D/DR Area Contaminant of Potential Concern Data
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Well Number	D5-16				D5-17				D5-18			
Date Sampled	May-92	Jul-92	Oct-92	Feb-93	May-92	Jul-92	Nov-92	Mar-93	May-92	Jul-92	Oct-92	Feb-93
Sample Number[a]	B06CK4	B072J9	B07KX0	B084W7	B06CK7	B07319	B07L30	B084W9	B06CLO	B07341	B07L00	B084X1
Strontium-90 (pCi/L)	-0.25 U	0.048 U	0.13 R	0.23 UJ	1.5 U	-0.52 U	-0.01 U	0.17 U	0.44 U	0.57 U	0.31 R	0.63 UJ
Tritium (pCi/L)	3300	3100	2700	4000	72000	74000	78000	72000	72000	76000	67000	73000
Bis(2-ethylhexyl)phthalate (ug/L)	55 B	10 U	10 U	NA	10 U	10 U	10 U	NA	10 U	10 U	10 U	NA
Chromium (ug/L)[b]	712 J/748 J	811/839 *J	1020/991	907/877	32.9/89.3	41.9/89.8	52/68.4	51/64	65.7 J/139 J	72/122	74.9/87	76/76.8
Manganese (ug/L)[b]	61.8/54.4	17.7/22.8	19.9/18.3	16.5/15.3	167/320	175/186	136/142	102/108	256/385	24.4/44.4	6.3 U/9.1 B	3.2 U/5.5 B
Ammonia (mg/L)	NA	0.23 J	0.23	NA	NA	0.75	0.54	NA	NA	0.05	0.05	NA
Nitrate (mg/L)	7.9	NA	NA	NA	14.5	NA	NA	NA	15	NA	NA	NA

Well Number	D5-19				D5-20				
Date Sampled	May-92	Jul-92	Nov-92	Feb-93	May-92	Jul-92	Duplicate	Nov-92	Mar-93
Sample Number[a]	B06CL3	B072D4	B07L05	B084X3	B06CL6	B07314	B07364	B07K20	B084X5
Strontium-90 (pCi/L)	0.054 UJ	0.24 U	-0.27 R	-0.075 UJ	2.7 U	0.19 U	-1.7 U	0.54 R	0 U
Tritium (pCi/L)	39000 J	40000	39000	38000	250 J	300 J	310 J	260 U	340
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	10 U	10 U	NA	16 B	2 J	2 J	3 J	NA
Chromium (ug/L)[b]	88.1 J/176 J	86.3/127	83.2/98.3	84.9/85	201 J/264 J	205/219	188/235	178/193	194/207
Manganese (ug/L)[b]	134/66.8	5.3 B/11.1 B	1.4 U/4.7 U	1 U/1.9 B	52/61.6	3.2 B/8.2 B	2.5 B/8.4 B	1.5 U/8.8 B	1.3 B/6.8 B
Ammonia (mg/L)	NA	0.05	0.05	NA	NA	0.05 UJ	.05 UJ	0.05	NA
Nitrate (mg/L)	15.4	NA	NA	NA	7.1	NA	NA	NA	NA

Table 4-1 D/DR Area Contaminant of Potential Concern Data
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Well Number	D8-53				D8-54A			
Date Sampled	May-92	Jul-92	Oct-92	Feb-93	May-92	Jul-92	Nov-92	Feb-93
Sample Number[a]	B06CM2	B072C4	B07KW5	B084V1	B06CM5	B072F9	B07KV5	B084V5
Strontium-90 (pCi/L)	6.5 J	7.6	4.8 R	5.4 J	6.9	3.9	2.7 R	7.2 J
Tritium (pCi/L)	8000 J	6900	8800	10000	13000	12000	19000	16000
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	2 J	33	NA	10 U	0.5 J	10 U	NA
Chromium (ug/L)[b]	301 J/443 J	275/373 *J	344/381	331/350	378 J/412 J	350/346 *J	421/425	410/415
Manganese (ug/L)[b]	4 U/25	1.3 U/16.2	0.92 U/7.9 B	1 U/1.7 U	1.6 U/33.1	1.3 U/3.6 U	0.9 U/4.7 U	1 U/1.7 U
Ammonia (mg/L)	NA	0.14 J	0.05	NA	NA	0.24 J	0.05	NA
Nitrate (mg/L)	9.8	NA	NA	NA	11.8	NA	NA	NA

Well Number	D8-54B						D8-55			
Date Sampled	May-92	May-92	May-92	Jul-92	Nov-92	Feb-93	May-92	Jul-92	Oct-92	Feb-93
Sample Number[a]	B06CM8	B06CS0	B06CQ8	B072J4	B07KW0	B084V7	B06CN1	B072L9	B07KV0	B084V3
Strontium-90 (pCi/L)	-0.36 U	0.17 U	0.73 U	-0.97 U	0.024 R	-0.036 UJ	0.18 U	0.096 U	0 R	-0.016 UJ
Tritium (pCi/L)	16 U	-130 U	19 U	18 U	85 U	120 U	260 J	120 U	240 U	160 U
Bis(2-ethylhexyl)phthalate (ug/L)	10 U	10 U	10 U	7 J	10 U	NA	10 U	10 U	10 U	NA
Chromium (ug/L)[b]	5 UJ/95.9 J	5 UJ/85.2 J	7 U/95.4	3.7 U/81.5 *J	4.8 B/33	2.9 B/35.4	9.4 UJ/169 J	15.4 U/159 *J	19.6/68.7	14.6/45.1
Manganese (ug/L)[b]	300/350	356/370	343/393	267/242	223/238	205/222	2.3 U/24.4	1.3 U/18.5	0.92 U/5.5 B	1 U/3 B
Ammonia (mg/L)	NA	NA	NA	0.11 J	0.05	NA	NA	0.26 J	0.05	NA
Nitrate (mg/L)	0.7	0.8	2.8	NA	NA	NA	1.7	NA	NA	NA

[a]: Sample number reported is number for the majority of the analyses,
inorganic filtered samples have different sample numbers

[b]: Filtered/Unfiltered

NA: Not Available

J: Estimated Value

B(inorganics): Estimated value below contract required detection limit

B: Analyte found in blank

U: Undetected

R: Rejected data

*: Duplicate analysis not within control limits

E: Estimated value due to the presence of interference

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-45						
Round Date	Jun-92	Aug-92	Oct-92	Oct-92	Nov-92	Mar-93	Mar-93
Sample Number[a]	B06CN4	B072M9	B07L85	B07L88	B07HZ4	B084Y3	B084Y4
Ammonia (mg/L)	NA	0.07 J	0.05	NA	NA	NA	NA
Fluoride (ug/l)	200	300	200	NA	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	2.6	2.67 J	1.72	NA	NA	2.37	NA
Chloroform (ug/L)	27	26	31	NA	NA	NA	NA
Chromium (ug/L)[b]	8.8/23.5	7.1/22.5	NA/20.2	NA/14.4	NA	NA/13.8	NA/14.4
Manganese (ug/L)	1 U/13.4 B	4.4 U/6.2 U	NA/1.3 B	NA/1.8 B	NA/NA	NA/1 U	NA/1 U
Americium-241 (pCi/L)	0.021 R	0.28 J	0 U	NA	NA	NA	NA
Carbon-14 (pCi/L)	46 J	72	3.7 U	NA	NA	NA	NA
Strontium-90 (pCi/L)	13	11	9.4 R	NA	13.2	13	NA
Technetium-99 (pCi/L)	4.6 J	1.2 U	1.8 U	NA	-0.06 U	NA	NA
Tritium (pCi/L)	620	770	1500	NA	NA	1700	NA
Uranium-233/234 (pCi/L)	0.59 R	0.55	0.45	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.54 R	0.61	0.58	NA	NA	NA	NA

Well Number	H4-46							
Round Date	May-92	Aug-92	Oct-92	Oct-92	Feb-93	Feb-93	Duplicate	Feb-93
Sample Number[a]	B06CN7	B07324	B07L70	B07L73	B084Y6	B084Y5	B08515	B08516
Ammonia (mg/L)	NA	0.05 U	0.05	NA	NA	NA	NA	NA
Fluoride (ug/l)	300	300	400	NA	NA	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	5.1	5.23 J	3.8	NA	NA	6.01	5.58	NA
Chloroform (ug/L)	17	10 U	9 J	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	38/85.9	44.2/54.4	NA/52.7	NA/49.7	NA/44	NA/47.3	NA/48.8	NA/42.8
Manganese (ug/L)	17.6/35.3	4.4 U/1.8 U	NA/5.2 B	NA/2.1 B	NA/1 U	NA/1.7 U	NA/1.7 U	NA/1 U
Americium-241 (pCi/L)	-0.01 R	-0.012 UJ	-0.009 U	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	45 J	4.9 UX	7.2 U	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	1.8	4	0.89 R	NA	NA	2.5 J	2.4 J	NA
Technetium-99 (pCi/L)	4.7 J	1.9 U	0.42 U	NA	NA	NA	NA	NA
Tritium (pCi/L)	7500	8900	11000	NA	NA	8700	8300	NA
Uranium-233/234 (pCi/L)	2.2 R	2.7	2.8	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	1.9 R	2.3	2.2	NA	NA	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-48						
Round Date	Jun-92	Aug-92	Aug-92	Nov-92	Nov-92	Mar-93	Mar-93
Sample Number[a]	B06CP3	B072D9	B072F2	B07L75	B07L78	B084Y9	B084Z0
Ammonia (mg/L)	NA	0.05 U	NA	0.05 U	NA	NA	NA
Fluoride (ug/l)	300	200	NA	300 J	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	1.5	2.21 J	NA	0.25 UJ	NA	0.97	NA
Chloroform (ug/L)	33	25	NA	41	NA	NA	NA
Chromium (ug/L)[b]	7.5 B/30.8	NA/39.4	16.2/NA	NA/4.5	NA/5.7 U	NA/13.8	NA/11.4
Manganese (ug/L)	3.9 U/48.5	NA/25.9	4.4 U/NA	NA/4.7 U	NA/4.7 U	NA/2.5 B	NA/1 U
Americium-241 (pCi/L)	-0.001 R	0 UJ	NA	0.008 U	NA	NA	NA
Carbon-14 (pCi/L)	29 J	-8.7 U	NA	-29 U	NA	NA	NA
Strontium-90 (pCi/L)	0.27 U	-0.12 U	NA	0.42 U	NA	-0.12 U	NA
Technetium-99 (pCi/L)	0.6 U	2.6 U	NA	0.69 U	NA	NA	NA
Tritium (pCi/L)	900	1600	NA	430	NA	900	NA
Uranium-233/234 (pCi/L)	0.57 R	0.58	NA	0.27	NA	NA	NA
Uranium-238 (pCi/L)	0.49 R	0.8	NA	0.31	NA	NA	NA

Well Number	H4-47								
Round Date	May-92	Duplicate	Aug-92	Oct-92	Oct-92	Feb-93	Feb-93	Feb-93	Split
Sample Number[a]	B06CP0	B06CR4	B07346	B07L40	B07L43	B084Y7	B084Y8	B08520	B08519
Ammonia (mg/L)	NA	NA	0.05 U	0.05	NA	NA	NA	NA	NA
Fluoride (ug/l)	300	300	200	300	NA	NA	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	1.3	1.3	1.16 J	0.37	NA	0.63	NA	0.66	NA
Chloroform (ug/L)	41	37	33	53	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	4 B/11.3	3.5 B/10.2	7.1 B/16.6	NA/3.9 B	NA/4.2 B	NA/4.2 U	NA/2.7 U	NA/7 U	NA/7 U
Manganese (ug/L)	4 B/6 B	3.8 B/4.8 B	4.4 U/5.2 U	NA/1.6 B	NA/3 B	NA/1.7 U	NA/1 U	NA/2 U	NA/2 U
Americium-241 (pCi/L)	0.002 R	0.002 R	0.002 UJ	0.008 U	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	15 U	11 U	41 U	-36 U	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	0.3 U	0.1 U	-0.088 U	-0.11 R	NA	0.33 U	NA	NA	0.56 R
Technetium-99 (pCi/L)	0.63 U	2.3 U	3.6 U	0.69 U	NA	NA	NA	NA	NA
Tritium (pCi/L)	700	620	570	410	NA	280 J	NA	NA	180
Uranium-233/234 (pCi/L)	0.4 R	0.44 R	0.48	0.49	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.33R	0.33 R	0.51	0.24	NA	NA	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H6-1							
Round Date	May-92	Split	Jul-92	Oct-92	Oct-92	Oct-92	Mar-93	Mar-93
Sample Number[a]	B06CQ2	B06CQ5	B072N4	B07L50	B07L53	B07HZ5	B08729	B08730
Ammonia (mg/L)	NA	NA	0.29 J	0.05	NA	NA	NA	NA
Fluoride (ug/l)	300	NA	300	300	NA	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	7.2	32	6.9 J	5.51	NA	NA	5.93	NA
Chloroform (ug/L)	11	11	12	11	NA	NA	NA	NA
Chromium (ug/L)[b]	29.1/41.8	35/47.8	24.7/42	NA/45.6	NA/43.5	NA	NA/37.8	NA/39.7
Manganese (ug/L)	66.5/65	66.9/86.8	9.8 B/16.1	NA/2.3 B	NA/1.8 B	NA/NA	NA/1 U	NA/1 U
Americium-241 (pCi/L)	-0.025 R	0.15 R	0 UJ	0 U	NA	NA	NA	NA
Carbon-14 (pCi/L)	12 U	-27 U	5 UX	-33 U	NA	NA	NA	NA
Strontium-90 (pCi/L)	1.5	2.5 R	2.9	4.2 R	NA	2.13 U	6.4	NA
Technetium-99 (pCi/L)	-0.22 U	-0.14 U	6.5	3 U	NA	-0.587 U	NA	NA
Tritium (pCi/L)	7100	5500 R	5900	6600	NA	NA	6700	NA
Uranium-233/234 (pCi/L)	2.7 R	NA	2.4	2.8	NA	NA	NA	NA
Uranium-238 (pCi/L)	2.1 R	14 R	1.8	1.9	NA	NA	NA	NA

Well Number	H4-49						H5-1A					
Round Date	Jun-92	Aug-92	Oct-92	Mar-93	Mar-93	Mar-93	May-92	Aug-92	Nov-92	Nov-92	Feb-93	Feb-93
Sample Number[a]	B06CP6	B072H4	B07L80	B07L83	B084Z1	B084Z2	B06CP9	B072K9	B07L48	B07L45	B084Y2	B084Y1
Ammonia (mg/L)	NA	0.05 U	0.05	NA	NA	NA	NA	0.1 J	NA	NA	NA	NA
Fluoride (ug/l)	300	300	400	NA	NA	NA	500	300	NA	400	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	4.5	1.51 J	2.91	NA	3.3	NA	8.4	6.32 J	NA	4.82	NA	6.89
Chloroform (ug/L)	12	24	1 J	NA	NA	NA	10 U	10 U	NA	1 J	NA	NA
Chromium (ug/L)[b]	26.5/87.9	7.8 B/45.3	NA/66.1	NA/46.2	NA/30.1	NA/26.6	44.8/127	66.3/74.9	NA/72.2	NA/84.4	NA/71	NA/99.9
Manganese (ug/L)	112 J/139	14.2 B/18.4	NA/11.6 B	NA/10.3 B	NA/1 U	NA/5.8 B	175/206	53/56.2	NA/20	NA/18	NA/9.1 B	NA/18.3
Americium-241 (pCi/L)	0.14 R	0.002 UJ	-0.006 U	NA	NA	NA	-0.001 UJ	-0.005 UJ	NA	0.004 U	NA	NA
Carbon-14 (pCi/L)	-32 U	36 J	2.4 U	NA	NA	NA	66 J	14 UX	NA	23 U	NA	NA
Strontium-90 (pCi/L)	0.39 U	0.13 U	0.18 R	NA	0.14 U	NA	0.5 U	-0.16 U	NA	1.4 R	NA	-0.009 U
Technetium-99 (pCi/L)	044 U	1.7 U	0.58 U	NA	NA	NA	0.14 U	3.4 U	NA	0.3 U	NA	NA
Tritium (pCi/L)	9300	3000	11000	NA	5300	NA	9900 J	9300	NA	9100	NA	9300
Uranium-233/234 (pCi/L)	2.1	0.99	1.9	NA	NA	NA	1.8 J	2	NA	1.9	NA	NA
Uranium-238 (pCi/L)	1.4 J	0.96	2	NA	NA	NA	1.6 J	1.6	NA	2.2	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H3-2A						H3-2B		H3-2C				
Round Date	May-92	Jul-92	Oct-92	Jan-93	Apr-93	Apr-93	May-92	Jul-92	May-92	Jul-92	Oct-92	Jan-93	Apr-93
Sample Number[a]	B06CT5	B07058	B07HZ6	B07TL4	B08CNO	B08CP8	B06CT7	B07062	B06CV5	B07065	B07HZ7	B07TL5	B08CN1
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	200	300	200	200	NA	NA	200	NA	400	300	400	400
Nitrate, Nitrite/Nitrate (mgN/L)	NA	25	12	6.6	12	NA	NA	23	NA	2.8	2.7	2.6	2.9
Chloroform (ug/L)	2 J	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	63/NA	NA/50	NA/30	NA/40	NA/NA	NA/NA	62/NA	NA/NA	NA/NA	NA/20	NA/20 U	NA/30
Manganese (ug/L)	NA/U	U/NA	NA/10 U	NA/10 U	NA/10 U	NA/NA	NA/NA	U/NA	NA/NA	U/NA	NA/10 U	NA/10 U	NA/10 U
Americium-241 (pCi/L)	-0.01 R	NA	NA	NA	NA	NA	-0.022 R	NA	0.003 R	NA	NA	NA	NA
Carbon-14 (pCi/L)	6.6 U	NA	NA	NA	NA	NA	17 U	NA	20 U	NA	NA	NA	NA
Strontium-90 (pCi/L)	-0.059 U	NA	NA	NA	NA	NA	0 U	NA	0 U	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	-0.018	3.85 U	0.227 U	-0.521 U	NA	NA	-0.521	NA	0.516	-2.67 U	-1.47 U	-1.07 U
Tritium (pCi/L)	2200	NA	NA	NA	NA	2120	2600	NA	-84 U	NA	NA	NA	NA
Uranium-233/234 (pCi/L)	1 R	NA	NA	NA	NA	NA	1.1 R	NA	0.62 R	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.86 R	NA	NA	NA	NA	NA	0.89 R	NA	0.45 R	NA	NA	NA	NA

4-T-2d

Well Number	H4-3														
Round Date	May-92	May-92	Jun-92	Aug-92	Jul-92	Aug-92	Sep-92	Oct-92	Nov-92	Dec-92	Jan-93	Feb-93	Jan-93	Mar-93	Apr-93
Sample Number[a]	B06CT9	B06M64	B06PG1	B075G1	B070B8	B07419	B07831	B07J11	B07LG7	B07R04	B07TM7	B08528	B07TN5	B08969	B08CPO
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	400	700	NA	700	500	400	500	500	600	400	1000	NA	700	1300
Nitrate, Nitrite/Nitrate (mgN/L)	NA	110	100	NA	110	110	73	420	410	88	100	460	NA	570	760
Chloroform (ug/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	34/NA	42/NA	NA/NA	56/NA	49/NA	41/NA	NA/44	NA/36	NA/70	NA/130	NA/290	NA/230	NA/200	NA/250
Manganese (ug/L)	NA/NA	U/NA	U/NA	NA/NA	U/NA	U/NA	10 U/NA	NA/10 U	NA/10 U	NA/U	NA/20	NA/30	NA/NA	NA/10	NA/180
Americium-241 (pCi/L)	-0.057 R	NA	NA	0.0008	NA	NA	NA	-0.008 U	NA	NA	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	18 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	0.065 U	NA	NA	0.049	NA	NA	NA	-0.085 U	NA	NA	NA	NA	-0.303U	NA	NA
Technetium-99 (pCi/L)	NA	NA	NA	NA	399	NA	NA	183	NA	NA	525	NA	NA	NA	2270
Tritium (pCi/L)	300 J	NA	NA	431	NA	NA	NA	389 U	NA	NA	NA	NA	2230	NA	NA
Uranium-233/234 (pCi/L)	8.4 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	6.3 R	NA	NA	9.84	NA	NA	NA	7.22	NA	NA	NA	NA	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-4												
Round Date	Jun-92	May-92	May-92	Jun-92	Aug-92	Jul-92	Aug-92	Aug-92	Sep-92	Oct-92	Nov-92	Nov-92	Dec-92
Sample Number[a]	B08CV1	B06M95	B06M68	B06PG6	B075G3	B070C0	B073T5	B07426	B07833	B07J12	B07MF8	B07LG8	B07R05
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	600	600	400	NA	300	400	400	300	500	700	800	600
Nitrate, Nitrite/Nitrate (mgN/L)	NA	140	140	76	NA	110	110	100	120	120	110	110	62
Chloroform (ug/L)	1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	NA/NA	100/NA	75/NA	NA/NA	100/NA	NA/NA	100/NA	100/NA	NA/110	NA/NA	NA/110	NA/80
Manganese (ug/L)	NA/NA	NA/NA	U/NA	U/NA	NA/NA	U/NA	NA/NA	10 U/NA	10 U/NA	NA/10 U	NA/NA	NA/10 U	NA/U
Americium-241 (pCi/L)	0.046 R	NA	NA	NA	0.0007	NA	NA	NA	NA	0.001 U	NA	NA	NA
Carbon-14 (pCi/L)	40 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	0.17 U	NA	NA	NA	1.69	NA	NA	NA	NA	2.04 U	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	NA	NA	NA	356	NA	NA	NA	500	NA	NA	NA
Tritium (pCi/L)	1700	2550	NA	NA	2370	NA	2220	NA	NA	2130	1990	NA	NA
Uranium-233/234 (pCi/L)	0.28 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.23 R	NA	NA	NA	18.1	NA	NA	NA	NA	18.6	NA	NA	NA

Well Number	H4-4						H4-5						
Round Date	Jan-93	Jan-93	Feb-93	Mar-93	Mar-93	Apr-93	May-92	Aug-92	Jul-92	Oct-92	Jan-93	Jan-93	Apr-93
Sample Number[a]	B07TN6	B07TN0	B08531	B086N5	B08970	B08CP1	B08CV7	B075G4	B070C2	B07J13	B07TN7	B07TN2	B08CP2
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	300	600	NA	600	600	NA	NA	200	300	NA	200	200
Nitrate, Nitrite/Nitrate (mgN/L)	NA	87	58	NA	88	93	NA	NA	32	23	NA	25	30
Chloroform (ug/L)	NA	NA	NA	NA	NA	NA	2 BJ	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	NA/170	NA/100	NA/NA	NA/110	NA/130	NA/NA	NA/NA	100/NA	NA/80	NA/NA	NA/140	NA/210
Manganese (ug/L)	NA/NA	NA/30	NA/10 U	NA/NA	NA/10 U	NA/20	NA/NA	NA/NA	U/NA	NA/10 U	NA/NA	NA/10 U	NA/10
Americium-241 (pCi/L)	NA	NA	NA	NA	NA	NA	0.008 U	0.002	NA	-0.004 U	NA	NA	NA
Carbon-14 (pCi/L)	NA	NA	NA	NA	NA	NA	35 U	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	0.967 U	NA	NA	NA	NA	NA	0.31 U	-0.171 U	NA	-0.522 U	-0.472 U	NA	NA
Technetium-99 (pCi/L)	NA	319	NA	NA	NA	340	NA	NA	5.41	9.46 U	NA	4.24	2.21 U
Tritium (pCi/L)	1730	NA	NA	1570	NA	NA	1500 J	3120	NA	2270	2760	NA	NA
Uranium-233/234 (pCi/L)	NA	NA	NA	NA	NA	NA	1.7 R	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	NA	NA	NA	16.8	NA	NA	1.5 J	1.47	NA	1.21	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-8					
Round Date	May-92	Jul-92	Oct-92	Jan-93	Apr-93	Apr-93
Sample Number[a]	B06CW3	B070C8	B07J03	B07TM2	B08CQ8	B08CP5
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	200	300	200	NA	200
Nitrate, Nitrite/Nitrate (mgN/L)	NA	33	30	30	NA	31
Chloroform (ug/L)	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	110/NA	NA/130	NA/120	NA/NA	NA/180
Manganese (ug/L)	NA/NA	U/NA	NA/10 U	NA/10 U	NA/NA	NA/20
Americium-241 (pCi/L)	-0.014 R	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	-9.9 U	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	-0.54 U	NA	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	0.104	-1.74 U	-1.75 U	NA	-0.237 U
Tritium (pCi/L)	4100	NA	NA	NA	3750	NA
Uranium-233/234 (pCi/L)	1.5 R	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	1.5 R	NA	NA	NA	NA	NA

Well Number	H4-6							H4-7					
Round Date	Jun-92	Aug-92	Jul-92	Oct-92	Jan-93	Jan-93	Apr-93	May-92	Jul-92	Oct-92	Jan-93	Apr-93	Apr-93
Sample Number[a]	B06CV9	B075G5	B070C4	B07J14	B07TN8	B07TN4	B08CP3	B06CW1	B070C6	B07J02	B07TM0	B08CQ8	B08CP4
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	NA	200	300	NA	300	200	NA	200	200	200	NA	200
Nitrate, Nitrite/Nitrate (mgN/L)	NA	NA	37	30	NA	31	29	NA	30	28	27	NA	28
Chloroform (ug/L)	1 J	NA	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	NA/NA	97/NA	NA/110	NA/NA	NA/130	NA/240	NA/NA	100/NA	NA/110	NA/120	NA/NA	NA/150
Manganese (ug/L)	NA/NA	NA/NA	54/NA	NA/40	NA/NA	NA/70	NA/40	NA/NA	U/NA	NA/10 U	NA/10 U	NA/NA	NA/10
Americium-241 (pCi/L)	0.005 R	0.0025	NA	0.007 U	NA	NA	NA	-0.002 U	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	56 J	NA	NA	NA	NA	NA	NA	21 U	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	-0.4 U	0.0396	NA	-0.454 U	NA	NA	NA	0.032 U	NA	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	0.398	-0.469 U	NA	0.147 U	-0.081 U	NA	-0.568	-0.564 U	-1.62 U	NA	-0.242 U
Tritium (pCi/L)	4700	5200	NA	4770	5000	NA	NA	3500 J	NA	NA	NA	3670	NA
Uranium-233/234 (pCi/L)	2.1 R	NA	NA	NA	NA	NA	NA	1.3 R	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	1.8 R	1.57	NA	1.69	NA	NA	NA	1.2 J	NA	NA	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-9										
Round Date	May-92	Jun-92	Jul-92	Sep-92	Oct-92	Nov-92	Nov-92	Jan-93	Feb-93	Feb-93	Mar-93
Sample Number[a]	B08CW5	B06PH0	B070D0	B07835	B07J04	B07LG9	B07LH0	B07TM4	B08532	B085B8	B08971
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	200	300	200	200	300	200	300	300	NA	200
Nitrate, Nitrite/Nitrate (mgN/L)	NA	15	21	NA	4.7	5.3	7.9	17	27	NA	31
Chloroform (ug/L)	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	41/NA	21/NA	20 U/NA	NA/20 U	NA/75	NA/69	NA/50	NA/80	NA/NA	NA/110
Manganese (ug/L)	U/NA	U/NA	U/NA	10 U/NA	NA/10 U	NA/12	NA/12	NA/10 U	NA/10 U	NA/NA	NA/10 U
Americium-241 (pCi/L)	0.005 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	0.12 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	68.2	NA	12.5 U	NA	NA	17.2	NA	NA	NA
Tritium (pCi/L)	570 J	NA	NA	NA	NA	NA	NA	NA	NA	1460	NA
Uranium-233/234 (pCi/L)	0.91 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.75 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Well Number	H4-10			H4-11							
Round Date	May-92	Jun-92	Jul-92	Jun-92	Jul-92	Aug-92	Oct-92	Jan-93	Jan-93	Apr-93	Apr-93
Sample Number[a]	B06CW7	B06P89	B07068	B06CW9	B07073	B075F7	B07J07	B07TL9	B07TM6	B08CN2	B08CN3
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	NA	300	NA	100	NA	100	100	NA	100	100
Nitrate, Nitrite/Nitrate (mgN/L)	NA	NA	14	NA	34	NA	27	27	NA	NA	27
Chloroform (ug/L)	2 BJ	NA	NA	1 J	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	NA/NA	46/NA	NA/NA	190/NA	NA/NA	NA/110	NA/150	NA/NA	NA/100	NA/90
Manganese (ug/L)	NA/NA	NA/NA	U/NA	NA/NA	U/NA	NA/NA	NA/10 U	NA/10 U	NA/NA	NA/10	NA/10 U
Americium-241 (pCi/L)	0.005 UJ	NA	NA	0.017 R	NA	0.005	0.001 U	NA	NA	NA	NA
Carbon-14 (pCi/L)	31 U	NA	NA	69 J	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	-0.33 U	NA	NA	26	NA	23.7	26	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	0.142	NA	NA	36.4	5.15 U	29.7	NA	-0.265 U	1.08 U
Tritium (pCi/L)	3200 J	1880	NA	2400	NA	2480	1940	NA	2040	NA	NA
Uranium-233/234 (pCi/L)	0.43 J	NA	NA	2.2 R	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.24 J	NA	NA	1.8 R	NA	2.09	1.57	NA	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-13							
Round Date	May-92	Jun-92	Aug-92	Jul-92	Oct-92	Jan-93	Jan-93	Apr-93
Sample Number[a]	B06CX7	B06P91	B075F8	B07086	B07J08	B07TM8	B07TM1	B08CN6
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	NA	NA	200	100	NA	100	100 U
Nitrate, Nitrite/Nitrate (mgN/L)	NA	NA	NA	21	19	NA	14	18
Chloroform (ug/L)	10 U	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	NA/NA	NA/NA	65/NA	NA/84	NA/NA	NA/80	NA/90
Manganese (ug/L)	NA/NA	NA/NA	NA/NA	U/NA	NA/10 U	NA/NA	NA/10 U	NA/10 U
Americium-241 (pCi/L)	0 UJ	NA	-0.0001	NA	-0.003 U	NA	NA	NA
Carbon-14 (pCi/L)	3.4 U	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	29 J	NA	29.6	NA	33	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	NA	-0.478	2.71 U	NA	1.76 U	-0.194 U
Tritium (pCi/L)	1800 J	1680	1950	NA	1820	1620	NA	NA
Uranium-233/234 (pCi/L)	1.3 J	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	1.2 J	NA	1.04	NA	1.21	NA	NA	NA

Well Number	H4-12A						H4-12B		H4-12C			
Round Date	May-92	Jul-92	Oct-92	Jan-93	Apr-93	Apr-93	May-92	Jul-92	May-92	Jul-92	Oct-92	Jan-93
Sample Number[a]	B06CX1	B07076	B07HZ8	B07TL6	B08CP9	B08CN4	B06CX3	B07079	B06CX5	B07082	B07HZ9	B07TL7
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	200	200	200	NA	200	NA	200	NA	100	100	100
Nitrate, Nitrite/Nitrate (mgN/L)	NA	51	43	9.8	NA	36	NA	23	NA	6.3	5.7	7.2
Chloroform (ug/L)	2 BJ	NA	NA	NA	NA	NA	2 BJ	NA	10 U	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	50/NA	NA/43	NA/30	NA/NA	NA/30	NA/NA	44/NA	NA/NA	280/NA	NA/290	NA/490
Manganese (ug/L)	NA/NA	U/NA	NA/10 U	NA/10 U	NA/NA	NA/10 U	NA/NA	U/NA	NA/NA	U/NA	NA/10 U	NA/20
Americium-241 (pCi/L)	-0.01 R	NA	NA	NA	NA	NA	0 UJ	NA	-0.008 R	NA	NA	NA
Carbon-14 (pCi/L)	52	NA	NA	NA	NA	NA	30 U	NA	-14 J	NA	NA	NA
Strontium-90 (pCi/L)	0.095 U	NA	NA	NA	NA	NA	0.33 U	NA	0 U	NA	NA	NA
Technetium-99 (pCi/L)	NA	102	97	-1.73 U	NA	46.9	NA	30.8	NA	0.303	-2.49 U	2.92
Tritium (pCi/L)	1800	NA	NA	NA	440	NA	740 J	NA	72 U	NA	NA	NA
Uranium-233/234 (pCi/L)	2.2 R	NA	NA	NA	NA	NA	2.2 J	NA	1 R	NA	NA	NA
Uranium-238 (pCi/L)	1.9 R	NA	NA	NA	NA	NA	1.8 J	NA	0.71 R	NA	NA	NA

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Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-15A										H4-15B									
Round Date	May-92	Aug-92	Jul-92	Oct-92	Jan-93	Jan-93	Apr-93	May-92	Jun-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92	Jul-92
Sample Number	B06CY1	B075G0	B07094	B07J10	B07JN3	B07TM5	B08CN8	B06CY3	B06P93	B070B1	B07096	B07097								
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	NA	NA	100	NA	200	200	NA	NA	NA	100	100	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	NA	NA	27	25	NA	20	26	NA	NA	NA	24	24	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform (ug/L)	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)(b)	NA/NA	NA/NA	110/NA	NA/120	NA/NA	NA/100	NA/140	NA/NA	NA/NA	120/NA	NA/NA	120/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA
Manganese (ug/L)	NA/NA	NA/NA	U/NA	NA/10 U	NA/NA	NA/10 U	NA/10 U	NA/NA	NA/NA	U/NA	U/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA
Americium-241 (pCi/L)	-0.003 R	-0.004	NA	0.002 U	NA	NA	NA	NA	-0.005 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	-9.2 UJ	NA	NA	NA	NA	NA	NA	NA	14 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	0 U	0.199	NA	-0.258 U	NA	NA	NA	NA	0.22 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	-0.223	1.76 U	NA	-0.933 U	-0.744 U	NA	NA	2100 J	2060	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tritium (pCi/L)	2300	2750	NA	2770	2590	NA	NA	NA	2100 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234 (pCi/L)	0.96 R	NA	NA	NA	NA	NA	NA	NA	1.1 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.68 R	0.957	NA	1.1	NA	NA	NA	NA	0.9 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Well Number	H4-14										H3-1									
Round Date	Jun-92	Jun-92	B075F9	B07090	Jul-92	Oct-92	Jan-93	Jan-93	Jan-93	B07M3	B08CN7	B06CV3	B07053							
Sample Number	B06CX9	B075F9	B07090	B07J09	B07TN1	B07M3	B08CN7	B06CV3	B07053											
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	NA	NA	100	NA	200	200	200	NA	NA	21	400	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate, Nitrite/Nitrate (mgN/L)	NA	NA	18	16	NA	13	14	NA	21	NA	21	400	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform (ug/L)	10 U	NA	NA	NA	NA	NA	NA	NA	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)(b)	NA/NA	NA/NA	410/NA	NA/360	NA/NA	NA/330	NA/360	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA
Manganese (ug/L)	NA/NA	NA/NA	U/NA	NA/10 U	NA/NA	NA/10 U	NA/10 U	NA/NA	U/NA	NA/NA	U/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA	NA/NA
Americium-241 (pCi/L)	-0.009 R	0.0005	NA	0.004 U	NA	NA	NA	NA	0 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	-6.7 J	NA	NA	NA	NA	NA	NA	NA	42 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	-0.21 U	0.0878	NA	-0.563 U	NA	NA	NA	NA	0.012 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	NA	0.625	0.052 U	NA	NA	-1.41 U	-0.966 U	NA	NA	-0.516	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tritium (pCi/L)	2400	2100	NA	1790	1520	NA	NA	NA	1100 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-233/234 (pCi/L)	1.1 R	NA	NA	NA	NA	NA	NA	NA	1.1 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	0.95 R	0.868	NA	0.897	NA	NA	NA	NA	0.9 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-16					H4-17		
Round Date	May-92	Jun-92	Jul-92	Oct-92	Nov-92	May-92	Jun-92	Jul-92
Sample Number[a]	B06CY7	B06P95	B070B2	B07HZ3	B07H23	B06CY9	B06P97	B070B4
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	NA	100	NA	NA	NA	NA	200
Nitrate, Nitrite/Nitrate (mgN/L)	NA	NA	15	NA	NA	NA	NA	38
Chloroform (ug/L)	10 U	NA	NA	NA	NA	10 U	NA	NA
Chromium (ug/L)[b]	NA/NA	NA/NA	57/NA	NA/NA	NA/NA	NA/NA	NA/NA	90/NA
Manganese (ug/L)	NA/NA	NA/NA	U/NA	NA/NA	NA/NA	NA/NA	NA/NA	U/NA
Americium-241 (pCi/L)	-0.004 UJ	NA	NA	NA	NA	0 UJ	NA	NA
Carbon-14 (pCi/L)	23 U	NA	NA	NA	NA	29 U	NA	NA
Strontium-90 (pCi/L)	3.7 J	NA	NA	4.78 U	NA	0.11 U	NA	NA
Technetium-99 (pCi/L)	NA	NA	-0.303	-0.881 U	NA	NA	NA	-0.838
Tritium (pCi/L)	2300 J	1950	NA	NA	NA	4000 J	4130	NA
Uranium-233/234 (pCi/L)	1.1 J	NA	NA	NA	NA	1.6 R	NA	NA
Uranium-238 (pCi/L)	0.88 J	NA	NA	NA	NA	1.5 J	NA	NA

Table 4-2 H Area Contaminant of Potential Concern Data
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Well Number	H4-18						
Round Date	May-92	Jul-92	Oct-92	Oct-92	Jan-93	Apr-93	Apr-93
Sample Number[a]	B06CZ1	B07OB6	B07J00	B07J01	B07TL8	B08CQ1	B08CN9
Ammonia (mg/L)	NA	NA	NA	NA	NA	NA	NA
Fluoride (ug/l)	NA	200	300	200	200	NA	200
Nitrate, Nitrite/Nitrate (mgN/L)	NA	50	22	22	NA	NA	22
Chloroform (ug/L)	NA	NA	NA	NA	NA	NA	NA
Chromium (ug/L)[b]	NA/NA	150/NA	NA/200	NA/210	NA/170	NA/NA	NA/180
Manganese (ug/L)	NA/NA	U/NA	NA/10 U	NA/10 U	NA/10 U	NA/NA	NA/10 U
Americium-241 (pCi/L)	-.025 R	NA	NA	NA	NA	NA	NA
Carbon-14 (pCi/L)	NA	NA	NA	NA	NA	NA	NA
Strontium-90 (pCi/L)	NA	NA	NA	NA	NA	NA	NA
Technetium-99 (pCi/L)	NA	139	9.57 U	9.91 U	11.5	NA	7.74
Tritium (pCi/L)	NA	NA	NA	NA	NA	1510	NA
Uranium-233/234 (pCi/L)	NA	NA	NA	NA	NA	NA	NA
Uranium-238 (pCi/L)	NA	NA	NA	NA	NA	NA	NA

[a]: Sample number reported is number for the majority of the analyses,
inorganic filtered samples have different sample numbers

[b]: Filtered/Unfiltered

NA: Not Available

J: Estimated Value

U: Undetected

R: Rejected Value

B(inorganics): Estimated value below contract required detection limits

*: Duplicate analysis not within control limits

Table 4-3 600 Area Contaminant of Potential Concern Data

Well Number	93-48					
Round Number	May-92	Jul-92	Oct-92	Oct-92	Oct-92	Feb-93
Sample Number [a]	B06CG4	B072F4	B07L35	B07L90	B07LB0	B084Z5
Arsenic (ug/l)[b]	NA/NA	5.2 U/7.4 WUJ	3.9 WJ/3.1 WB	4.7 U/3.6 U	3.8 B/2.9 WU	5.1 B/3.9 U
Chromium (ug/l)[b]	NA/NA	18.1/61.4	17.4/43.5	20 U/41.5 U	18.6/50.4	16.8 U/28.4
Tritium (pCi/L)	NA	3600	3600	NA	3700	3300

Well Number	96-43				
Round Number	May-92	May-92	Jul-92	Nov-92	Feb-93
Sample Number [a]	B06CF8	B06CR7	B072L4	B07L25	B08503
Arsenic (ug/l)[b]	3.4 J/5.2 B	3.3 B/4.6 B	2.4 U/4.4 WJ	3.9 WB/1.9 WU	3.9 WU/3.8 B
Chromium (ug/l)[b]	145/170	139/165	156/158	160/158	156/159
Tritium (pCi/L)	11000	11000	11000	11000	11000

Well Number	96-49						97-43					
Round Number	May-92	Aug-92	Aug-92	Nov-92	Feb-93	Feb-93	May-92	May-92	Aug-92	Aug-92	Nov-92	Mar-93
Sample Number [a]	B06CG7	B073Q0	B07354	B07L55	B084Z9	B08511	B06CH0	B06CR1	B073Q4	B072N9	B07L65	B084Z7
Arsenic (ug/l)[b]	8.3 U/8.1 B	NA/NA	3.1 U/2.8 B	4.5 WB/2.8 WB	2.9 B/3.9 U	3.4 B/3.9 U	2.4 U/1.7 U	2 U/2 U	NA/NA	3.4 UWJ/2.6 U	2.9 WU/3.2 WU	2U/2 U
Chromium (ug/l)[b]	49.8/50.1	49/NA	47.6/34.4	51.3/46.5	46/42.2	41.7/42.8	163/162	156/166	170/NA	156/141	166/162	166/162
Tritium (pCi/L)	9000	9530	NA	8700	7900	8100	9100	8700	8920	NA	9200	9300

Well Number	97-51A					91-46			
Round Number	May-92	Aug-92	Aug-92	Nov-92	Feb-93	May-92	Jul-92	Nov-92	Feb-93
Sample Number [a]	B06CH3	B073Q7	B07387	B07L60	B08501	B06CG1	B072H9	B07KZ5	B084Z3
Arsenic (ug/l)[b]	1.9 U/1 U	NA/NA	2.6 U/2.2 U	3.2 U/9.5 WU	4.1 B/4.5 B	8.4 J/11.5	8.4 B/7.7 WJ	7.1 B/5.2 WB	8.3 B/9.9 SB
Chromium (ug/l)[b]	49.3/50.1	U/NA	58.6/50	68.7/62.2	58.7/72.7	12.5/63.3	11.7/36	14.1/26.9	8.8 B/16.1
Tritium (pCi/L)	9300	8370	8400	9200	8800	7300 J	7200	6900	6500

[a] : Sample number reported is for the majority of the analyses, inorganic filtered sample numbers differ

[b]: Filtered/Unfiltered

J: Estimated Value

NA: Not Available

U: Undetected, Value reported is detection limit

W: AA analysis out of control limits

B(inorganics): Estimated value below contract required detection limits

Table 4-4 Potential Chemical-Specific ARAR and TBC

Constituent	Safe Drinking Water Act				RCRA Subpart F (e)	MTCA (groundwater/s surface water) (f)	EPA Water Quality Criteria (chronic/acute) (g)	Washington Water Quality Standards (chronic/acute) (h)
	Primary MCL (a)	MCLG (b)	Secondary MCL (c)	Proposed MCL (d)				
Tritium	20,000			60,900				
Carbon-14	6,400			3,200				
Strontium-90	8			42				
Technetium-99	2,400			3,790				
Uranium-233/234	240			13.8				
Uranium-238	320	0 (i)		14.6				
Americium-241	56			6.34				
Chromium	100	100			50	80 / 810	11/16	11/16
Fluoride	4000	4000	2000			960		
Lead	15 (j)	0			50			(k)
Iron			300					
Ammonia								(l)
Nitrate-(N)	10,000	10,000						
Chloroform	100					7.17 / 283		
Bis(2 ethylhexyl) phthalate						6.25 / 6.56		

NOTE: All units for radionuclides in pCi/L; all other units in ug/L.

- (a) 40 Code of Federal Regulations (CFR) 141.16 (radionuclides), 40 CFR 141.61 (organics), 40 CFR 141.62 (inorganics), as amended at 56 Federal Regulations (FR) 31838 July 17, 1992
- (b) 40 CFR 141.50 and 51 as amended at 56 FR 31838 July 17, 1992
- (c) 40 CFR 143.3 as amended at 56 FR 3597 January 30, 1991 - To be considered (TBC) under federal regulations, possible applicable or relevant and appropriate requirements (ARAR) under the Model Toxics Control Act (MTCA)
- (d) 56 FR 33120 July 18, 1991 - Proposed rules - TBC
- (e) 40 CFR 264.94
- (f) Washington Administrative Code (WAC) 173-340-720, Model Toxics Control Act, Groundwater Cleanup Standards, Method B and WAC 173-340-730 Surface Water Cleanup Standards, Method B
- (g) U.S. Environmental Protection Agency's (EPA) "Quality Criteria for Water 1986" and EPA's "Update #2 to Quality Criteria for Water 1986" - TBCs for surface waters only
- (h) WAC 173-201-047, Toxic Substances - applies to surface waters only
- (i) Proposed maximum contaminant level goal (MCLG), 56 FR 33051 July 18, 1991 - Proposed rules - TBC
- (j) Action level as prescribed in 40 CFR 141.80
- (k) $\leq e^{(1.275 [\ln (\text{hardness})] - 4.705)} / \leq e^{(1.275 [\ln (\text{hardness})] - 1.460)}$
- (l) $\leq 0.80/\text{FT}/\text{FPH}/\text{RATIO}$ (chronic) / $\leq 0.52/\text{FT}/\text{FPH}/2$ (acute) - see WAC 173-201
- MCL maximum contaminant level RCRA Resource Conservation and Recovery Act

5.0 CONCLUSIONS

The LFI for the 100-HR-3 Operable Unit was conducted to determine the nature and extent of hazardous/radioactive materials present in the groundwater. The analytical results from the groundwater sampling were compared to Hanford Site background values as well as calculated risk values and potential groundwater ARAR to determine COPC.

Based on the QRA and data presented in Chapter 4, tritium, strontium-90, chromium, and nitrate have been identified as COPC for human health in the 100 D/DR Area. The risks for the occasional- and frequent-use scenarios are low to very low. Chromium and sulfide have been identified as COPC from the ecological evaluation in the 100 D/DR Area based on near river wells. Chromium poses a potential chronic or acute risk from spring concentrations. Chromium was not detected in the Columbia River samples.

The QRA and data in Chapter 4 identified chloroform, chromium, nitrate, tritium, carbon-14, strontium-90, technetium-99, uranium-233/234, uranium-238, and americium-241 as COPC for human health in the 100 H Area. The risks for the occasional- and frequent-use scenarios are low to very low. Chromium and sulfide were identified as COPC from the ecological evaluation based on near river well concentration. These constituents exceed the chronic LOEL. Neither chromium nor arsenic were detected in Columbia River samples, although chromium was present in the springs. Iron was present in both the Columbia River and spring samples above the LOEL.

The QRA identified arsenic and tritium as COPC for human health in the 600 Area of 100-HR-3. The risks for the occasional- and frequent-use scenarios are medium to low/very low. The 600 Area wells were not evaluated for ecological risk, as none of the wells are near the river. The medium risk is due to arsenic, a non-Hanford constituent.

The results of the LFI confirm that groundwater contamination has resulted from previous activities in the 100-HR-3 Area. No IRM is recommended based on human health concerns because no COC attributable to Hanford activities were identified (i.e., low risk related to the current site usage and to occasional-use scenarios). An ecologically driven remedial action may be necessary based on the chromium concentrations in the near river wells, springs and/or the Columbia River. Identification and characterization of contaminants in the groundwater should continue through the FS or focused feasibility study process. Any remedial action should follow the final remedy path FS. This effort should be coordinated with activities (source operable unit record of decision and decommissioning and decontamination) addressing operable units overlying the 100-HR-3 Area. Monitoring of key groundwater contaminants should be continued until remedial actions associated with the source operable units are completed. The extent of groundwater contamination should then be reevaluated as well as the associated risk.

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APPENDIX A

Maximum Concentration Screening Logic

This appendix presents those data that were rejected during the screening process described in Section 2.5.2. Data were screened for internal and external consistency. Internal consistency refers to a constituent occurring in multiple samplings of a given well at levels found to be reasonably constant or increasing. External consistency refers to a constituent that might reasonably be expected to occur at a well location based on its presence in nearby wells or due to the proximity of the well to a waste site that could contribute that constituent to the groundwater.

These screening tests were implemented to account for the chemical alterations that take place in aquifer materials when they are disrupted during the well construction process and variability in laboratory results. It has served to draw focus on constituents that represent true alterations of groundwater chemistry resulting from past operable unit activities.

Screening was accomplished from the highest concentration down (i.e., the appendix only presents those data which represent sample concentrations above those used for the LFI and QRA analyses). For radiological contaminants the concentration was considered a nondetect if the two sigma error bound equalled or exceeded the reported value. Due to the statistical nature of radiological analyses some values reported by the laboratory are negative; these values were considered nondetections. For all constituents, if the laboratory reported a nondetection (qualifier = U) those were considered as not present.

Terms used to describe the reasons for rejection of specific analyses include:

Not consistent between rounds:

This means one of two things; either the reported concentrations differ greatly between rounds or that the constituent is present in only one of the four rounds of LFI sampling.

Not equilibrated:

As a result of physical and chemical changes due to well installation the constituent concentration is much higher in the first sample period and then rapidly reduces to a relatively consistent values. Those concentrations interpreted as being nonrepresentative due to well construction were eliminated. The highest concentration following equilibration was used in the LFI and in the QRA.

Externally inconsistent:

An analyte is reported for a single well in one or two rounds and all surrounding and downgradient wells show no detects. If there is no known or suspected source for the analyte, the reported value is found externally inconsistent.

Error bound exceeds value:

This descriptor refers solely to radionuclide analyses. Radiochemical analyses are statistically generated based on the sample count and a parallel background count. At low concentrations it is common that the statistical error bound exceeds the determined sample concentration. These analyses have been rejected as non detections.

Volatiles (ug/L)

Analyte	Value	Well	Round	Logic behind rejection
1,1,2,2-Tetrachloroethane	2 J	D5-16	2	Not consistent between duplicate and rounds
4-Methyl-2-pentanone	3 J	D5-16	2	Not consistent between duplicate and rounds
Acetone	4 BJ	D2-6	3	Inconsistent between duplicate and rounds, in blank
Chloroform	13 - 1	numerous	all	Values less than 5x the blank concentrations
Methylene chloride	4 J	D8-3	3	Not consistent between rounds, C.L.C.
	4 J	D5-16	3	Not consistent between rounds, C.L.C.
	3 J	D5-19	3	Not consistent between rounds, C.L.C.
	3 J	D5-18	3	Not consistent between rounds, C.L.C.
	3 J	D5-14	3	Not consistent between rounds, C.L.C.
	3 J	D5-12	3	Not consistent between rounds, C.L.C.
	2.2 B	D8-4	4	Not consistent between rounds, in blank, C.L.C.
	2.2 B	D8-6	4	Not consistent between rounds, in blank, C.L.C.
	2.10 B	D5-13	4	Not consistent between rounds, in blank, C.L.C.
	2.10 B	D8-5	4	Not consistent between rounds, in blank, C.L.C.

Semi-Volatiles (ug/L)

Analyte	Value	Well	Round	Logic behind rejection
Bis(2-ethylhexyl)phthalate	55 B	D5-16	1	Not consistent between rounds
	54	D2-6	3	Not consistent between duplicate and rounds
	50	D5-12	1	Not consistent between rounds
	33	D8-53	3	Not consistent between rounds
	24	D8-3	3	Not consistent between rounds
	22	D8-5	1	Not consistent between rounds
	16 B	D5-20	1	Not consistent between rounds
	4 J	D2-6	1	Not consistent between rounds
	4 J	D8-4	1	Not consistent between rounds
Diethylphthalate	2J	D2-6	1	Not consistent between rounds
	2 J	D5-19	1	Not consistent between rounds
Di-n-butylphthalate	2.3 J	D8-4	3	Not consistent between rounds
	1 J	D5-13	1	Not consistent between rounds
	1 J	D8-5	1	Not consistent between rounds
	0.6 J	D8-4	1	Not consistent between rounds
Phenol	2 J	D8-3	1	Not consistent between split and rounds

100-HR-3 D Area Rejected Maximum Detected Concentrations and Logic

				Radioisotopes (pCi/L)
Analyte	Value	Well	Round	Logic behind rejection
Americium-241	R*		1,2,3	Rejected values due to low chemical yields, error exceeds value
	0.0097	D5-13	2	Inconsistent, this round only detects
	0.0033	D8-5	2	Inconsistent, this round only detects
	0.0008	D8-6	2	Inconsistent, this round only detects
Carbon-14	68 R	D5-17	1	Rejected value, inconsistent between rounds
	50	D2-6	2	Rejected value, inconsistent between rounds
Cesium-134	6 R	D2-6	2	Rejected for QC deficiencies, undetected in other rounds
Cesium-137	R	D2-6	2	Rejected value, undetected by laboratory
	3.37	D8-6	2	Not consistent between rounds, error exceeds value
Cobalt-60	R	D2-6	2	Rejected value, undetected by laboratory
Iron-59	R	D2-6	2	Rejected value, not present in other rounds
Plutonium-238	R		2	Rejected value
	0.012 J	D5-19	1	Not consistent between rounds
	0.0042	D8-4	2	Not consistent between rounds
Plutonium-239/240	0.019 J	D8-3	2	Not consistent between rounds
	.088 R	D5-17	2	Rejected value, undetected in other rounds
	0.009 J	D5-19	1	Not consistent between rounds
	0.004	D5-13	2	Not consistent between rounds
	0.002	D8-5	2	Not consistent between rounds
Potassium-40	150	D2-5	1	Not consistent between rounds
	120	D5-12	1	Not consistent between rounds
	84.2 R	D2-6	2	Rejected value, not consistent between rounds

Radioisotopes (pCi/L)

Analyte	Value	Well	Round	Logic behind rejection
Radium-226	5.9 R	D2-6	2	Rejected value, not consistent between rounds
Ruthenium-106	72.6	D8-5	2	Not consistent between rounds
Technetium-99	14	D5-20	1	Not consistent between rounds
	7	D8-55	1	Not consistent between rounds
	5.9 R	D8-54A	1	Rejected value, error exceeds value, inconsistent
	3.8 J	D5-20	1	Not consistent between rounds
	2.5	D5-16	1	Not consistent between rounds
	0.834	D8-5	2	Not consistent between rounds
	0.777	D8-4	2	Not consistent between rounds
	0.549	D5-13	2	Not consistent between rounds
	0.208	D8-6	2	Not consistent between rounds
Thorium-228	37	D5-16	2	Not consistent between rounds
	36	D5-20	3	Not consistent between rounds
	25 J	D8-53	1	Not consistent between rounds
	22	D5-17	1	Not consistent between rounds
Uranium-235	0.11 J	D5-17	3	Not consistent between rounds
	0.082 J	D5-19	1	Not consistent between rounds
	0.075 J	D2-6	1	Not consistent between rounds
	0.061 J	D8-53	1	Not consistent between rounds
	0.049	D8-4	4	Inconsistent, other rounds non detect
Zinc-65	10	D2-6	2	Not consistent between rounds

100-HR-3 D Area Rejected Maximum Detected Concentrations and Logic

Analyte	Value	Well	D Area Unfiltered Inorganics (ug/L)	
			Round	Logic behind rejection
Aluminum	6310	D5-17	1	Not equilibrated
	511	D5-17	2	Not equilibrated
	2580	D5-18	1	Not equilibrated
	1480	D5-20	1	Not equilibrated
	1140	D5-19	1	Not equilibrated
	1060	D8-53	1	Not equilibrated
	174 B	D8-53	2	Not equilibrated
	77.5 B	D8-53	2	Not equilibrated
	579	D8-54A	1	Not equilibrated
	311	D5-14	1	Not equilibrated
	200	D8-55	1	Not equilibrated
	110 B	D8-55	2	Not equilibrated
	116 B	D5-16	1	Not consistent between rounds
Antimony	21.2 B	D5-17	3	Only positive value reported
Beryllium	.58 B	D5-20	4	Not consistent , not anticipated in area
Cadmium	1.9 B	D8-55	3	Inconsistent detect in single sample round
	1.6 B	D8-53	3	Inconsistent detect in single sample round
	1.6 B	D2-6	3	Inconsistent detect in single sample round
	1.5 B	D5-14	3	Inconsistent detect in single sample round
	1.2 B	D5-16	3	Inconsistent detect in single sample round
	1.2 B	D5-18	3	Inconsistent detect in single sample round
	1.1 B	D5-19	3	Inconsistent detect in single sample round
Cobalt	3.6 B	D5-16	3	Inconsistent detect in single sample round
	3 B	D5-14	3	Inconsistent detect in single sample round
	3 B	D8-53	3	Inconsistent detect in single sample round
Copper	20.2 B	D5-17	1	All values below contract D.L. and below background
	6 B	D5-17	4	All values below contract D.L. and below background
	14.7 B	D5-18	1	All values below contract D.L. and below background
	10.2 B	D5-19	1	All values below contract D.L. and below background
	7.5 B	D5-15	4	All values below contract D.L. and below background
	6.4 B	D5-20	4	All values below contract D.L. and below background
	5.8 B	D5-12	4	All values below contract D.L. and below background

100-HR-3 D Area Rejected Maximum Detected Concentrations and Logic

D Area Unfiltered Inorganics (ug/L)				
Analyte	Value	Well	Round	Logic behind rejection
Iron	8760 J	D5-17	1	Not equilibrated
	906	D5-17	2	Not equilibrated
	5570	D5-18	1	Not equilibrated
	2490	D5-20	1	Not equilibrated
	2240	D5-19	1	Not equilibrated
	1740	D8-53	1	Not equilibrated
	663	D8-53	2	Not equilibrated
	1600	D8-4	1	Not equilibrated
	800	D8-4	4	Not equilibrated
	520	D8-4	3	Not equilibrated
	1440	D8-54A	1	Not equilibrated
	996	D8-55	1	Not equilibrated
	773	D8-55	2	Not equilibrated
	870	D8-6	1	Not equilibrated
	762	D5-14	1	Not equilibrated
Manganese	385	D5-18	1	Not consistent between rounds
	320	D5-17	1	Not equilibrated
Nickel	89.7	D8-55	1	Not consistent between rounds
	80.3	D8-55	2	Not consistent between rounds
	67	D5-13	1	Not consistent between rounds
	58.9	D5-19	1	Not consistent between rounds
	57.3	D8-54A	1	Not consistent between rounds
	56.2	D8-53	2	Not consistent between rounds
	45	D8-5	2	Not consistent between rounds
	43.9	D5-17	1	Not consistent between rounds
	39.2 B	D5-18	1	Not consistent between rounds
	39	D8-6	1	Not consistent between rounds
Silver	4 B	D8-55	3	Detected in single round only
	3.4 B	D5-16	3	Detected in single round only
	3.4 B	D8-3	3	Detected in single round only
	2.8 B	D8-54A	3	Detected in single round only
Thallium	0.9	D2-6	2	Not consistent between rounds
	1.4	D8-3	2	Not consistent between rounds

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100-HR-3 D Area Rejected Maximum Detected Concentrations and Logic

D Area Unfiltered Inorganics (ug/L)				
Analyte	Value	Well	Round	Logic behind rejection
Zinc	209	D5-17	1	Not equilibrated
	78	D5-18	1	Not equilibrated
	54.4	D8-53	1	Not equilibrated
	36.1	D5-20	1	Not equilibrated
	32	D5-19	1	Not equilibrated
	26	D8-54A	1	Not equilibrated
	26 B	D8-54A	1	Not equilibrated

Wet Chemistry and Anions (mg/L)				
Analyte	Value	Well	Round	Logic behind rejection
Fluoride	200	D5-13	4	Not consistent between rounds
	100	D8-4	3	Not consistent between rounds
TOC	13.4	D2-6	3	Not consistent between duplicate and rounds
TOX	64.6	D8-3	1	Found in split sample only
	0.138 R	D8-3	2	Rejected value, holding time grossly exceeded

100 THT 5-11 Area Rejected Maximum Detected Concentrations and Logic

Radioisotopes (pCi/L)

Analyte	Value	Well	Round	Logic behind rejection
Cesium-137	7.89	H4-4	2	Not consistent with other rounds
	7.25	H4-6	2	Not consistent with other rounds
Cobalt-60	8.069	H4-13	2	Not consistent with other rounds
Potassium-40	120	H4-11	1	Not consistent with other rounds
Radium-226	18	H4-47	2	Not consistent with other rounds
Ruthenium-106	60.29	H4-14	2	Inconsistent, internal and external
	59.4	H4-16	3	Inconsistent, internal and external
	49.29	H4-4	4	Inconsistent, internal and external
Thorium-232	53	H6-1	1	Not consistent with other rounds

Wet Chemistry (mg/L)

Analyte	Value	Well	Round	Logic behind rejection
Sulfides	26	H4-45	2	Not consistent with other rounds

Volatile Organics (ug/L)

Analyte	Value	Well	Round	Logic behind rejection
Acetone	53	H4-46	1	Not consistent with other rounds
	24 B	H6-1	1	Not consistent with other rounds
	20	H4-45	3	Not consistent with other rounds
Benzene	2 J	H4-47	3	Not consistent with other rounds
	1 J	H4-49	3	Not consistent with other rounds
Methylene chloride	59 B	H3-2A	1	Blank contaminated, C.L.C.
	55	H4-11	1	Not consistent with other rounds
	51 B	H3-2B	1	Blank contaminated, C.L.C.
	25 B	H4-7	1	Blank contaminated, C.L.C.
	16 B	H4-13	1	Blank contaminated, C.L.C.
	15 B	H4-10	1	Blank contaminated, C.L.C.
	15 B	H4-12A	1	Blank contaminated, C.L.C.
	15 B	H4-12B	1	Blank contaminated, C.L.C.
	15 B	H4-5	1	Blank contaminated, C.L.C.
	12 B	H6-1	1	Blank contaminated, C.L.C.
	11 B	H6-1	1	Blank contaminated, C.L.C.
Toluene	28 BJ	H5-1A	1	Not consistent with other rounds

100-HR-3 H-Area Rejected Maximum Detected Concentrations and Logic

Analyte	Value	Well	Round	Unfiltered Inorganics (ug/L)
				Logic behind rejection
Aluminum	2170	H4-48	1	Not equilibrated
	1140 J	H5-1	1	Not equilibrated
	960	H4-48	2	Not equilibrated
	473	H4-46	1	Not equilibrated
	335	H4-45	1	Not equilibrated
	272	H4-49	1	Not equilibrated
	181 B	H6-1	2	Not equilibrated
	155 B	H6-1	1	Not equilibrated
Beryllium	.36 B	H4-45	2	Infrequent detection, one only
Cobalt	5.3 B	H4-46	4	Infrequent detection, one only
	4.3 B	H5-1A	3	Infrequent detection, one only
	2.8 B	H4-48	4	Infrequent detection, one only
	1.4 B	H4-45		Infrequent detection, one only
	1.4 B	H4-47	3	Infrequent detection, one only
	1.4 B	H6-1	3	Infrequent detection, one only
Iron	18000	H4-4	3	Not consistent with other rounds
Lead	6.8 R	H6-1	2	Rejected due to laboratory problems
Manganese	206	H5-1A	1	Not equilibrated
Mercury	0.4	H4-46	2	Infrequent detection, one only
	.13 B	H4-47	2	Infrequent detection, one only
Nickel	120	H4-12C	3	Not consistent with other rounds
	90	H4-6	4	Not consistent with other rounds
Zinc	684 J	H5-1A	1	Not consistent with other rounds

Volatiles (ug/L)

Analyte	Value	Well	Round	Logic behind rejection
Acetone	6 BJ	97-43	3	Not consistent between rounds
Chloroform	2 - 1	numerous	1,2	Values less than 5x the blank hits
Methylenechloride	5 JB	93-48	3	Not consistent between rounds and in blank
	4 J	91-46	3	Not consistent between rounds
	4 BJ	96-43	3	Not consistent between rounds and in blank
	3 J	93-48	3	Not consistent between rounds
Toluene	1 JB	96-43	1	Not consistent between duplicate and rounds, in blank

Semi-Volatile Organics (ug/l)

Analyte	Value	Well	Round	Logic behind rejection
Bis(2-EthylHexyl)phthalate	17	97-43	2	In split only
	5 J	91-46	1	Not consistent between rounds
	4 J	97-51A	3	Not consistent between rounds
	3 J	93-48	3	Inconsistent, not supported by split
Di-n-butylphthalate	1	97-43	1	In split only
	.7 J	93-48	3	Not consistent between duplicate and rounds

Wet Chemistry and Anions (mg/L)

Analyte	Value	Well	Round	Logic behind rejection
Ammonia	0.12	91-46	2	Not consistent between rounds

100-HR-3 600 Area Rejected Maximum Detected Concentrations and Logic

Unfiltered Inorganics (ug/l)				
Analyte	Value	Well	Round	Logic behind rejection
Aluminum	2970	91-46	1	Not consistent between rounds
	607	93-48	2	Well not stabilized
	446	96-43	1	Not consistent between rounds
	339	91-46	2	Not consistent between rounds
	331	96-43	1	Not consistent between rounds
	196 B	93-48	3	Well not stabilized
	159 B	93-48	3	Well not stabilized
Beryllium	.37 B	96-43	3	Not consistent between rounds
	1	97-43	1	Not consistent, in split only
Cadmium	1.6 B	97-51A	4	Not consistent between rounds
	1.2 B	91-46	3	Not consistent between rounds
	1.2 B	93-48	3	Not consistent between rounds
	1.1 B	93-48	3	Not consistent between rounds
	1 B	96-43	1	Not consistent between rounds
Calcium	160000	97-43	1	Not internally nor externally consistent
Cobalt	4.4 B	91-46	1	Not consistent between rounds
	3.5	96-43	2	Not consistent between rounds
Copper	27.6	91-46	1	Not internally consistent
	6.8 B	93-48	3	Not consistent between rounds
	6.7 B	96-43	1	Not consistent between rounds
Iron	4540	91-46	1	Not equilibrated
	4400	91-46	2	Not equilibrated
	1880	96-49	2	Not equilibrated
	1080	93-43	2	Not equilibrated
	792	97-51A	2	Inconsistent value in general trend
	607	91-46	2	Not equilibrated
	544	96-43	1	Not equilibrated
	386	93-48	2	Not equilibrated
	355	93-48	2	Not equilibrated
	321	93-48	2	Value from split, well not equilibrated
	287	97-43	1	Not equilibrated
	263	97-43	2	Not equilibrated
	176	97-57A	2	Not equilibrated
	131	96-49	1	Not equilibrated

Unfiltered Inorganics (ug/l)

Analyte	Value	Well	Round	Logic behind rejection
Manganese	280	97-51A	2	Not internally consistent
	204	91-46	1	Not equilibrated
	67.8	91-46	2	Not equilibrated
	40	93-48	2	Not equilibrated
Silver	2.9 B	93-48	3	Not consistent between rounds
Zinc	395	91-46	1	Well not stabilized
	84.7	91-46	2	Well not stabilized
	52.5	93-48	2	Well not stabilized
	23.2	96-43	1	Well not stabilized
	15.9	97-51A	2	Inconsistent between rounds

Radioisotopes (pCi/L)

Analyte	Value	Well	Round	Logic behind rejection
Americium-241	.017 J	91-46	2	Not consistent between rounds
	.12 R	96-43	1	Rejected value, inconsistent between rounds
Carbon-14	200	97-43	2	Inconsistent between rounds
	110	93-48	2	Inconsistent between rounds
	21	97-43	1	Inconsistent between rounds
Gross Beta	71	93-48	3	Not consistent between duplicate and rounds
Plutonium-238	0.66	97-43	1	Inconsistent, only single detect
Uranium-235	.15 J	93-48	3	Not consistent between rounds
	.1 R	96-43	1	Rejected Value, inconsistent between rounds
	0.061	91-46	1	Not consistent between rounds
Uranium-238	1.6	97-43	1	Present only in split

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