PNNL-16454 Rev. 0

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

# Current Conditions Risk Assessment for the 300-FF-5 Groundwater Operable Unit

T.B. Miley
A.L. Bunn
B.A. Napier
R.E. Peterson
J.M. Becker

November 2007

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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# 300-FF-5 Groundwater Operable Unit Current Conditions Baseline Risk Assessment

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November 2007

Prepared for
The U.S. Department of Energy
Under Contract DE-AC05-76RL01839

Pacific Northwest National Laboratory
Richland, Washington 99352

# Summary

The 300-FF-5 Groundwater Operable Unit includes groundwater beneath the 300 Area and beneath two outlying subregions: the 618-11 burial ground and the 316-4 cribs/618-10 burial ground. This report updates the current conditions portion of a baseline risk assessment for the 300 Area that was prepared during the initial remedial investigation for the operable in the early 1990s. The update includes consideration of changes in contaminants of interest and in the environment that have occurred during the period of interim remedial action, i.e., 1996 to 2005. It also provides an initial current conditions risk assessment for the two outlying subregions that were added to the operable unit in 2000 and have not yet been part of a remedial investigation. An additional risk assessment will be conducted after remedial actions are complete in support of a final Record of Decision (ROD). The risk assessment in support of the final ROD will address future environmental conditions and future use scenarios.

In 1996, a ROD stipulated interim remedial action for groundwater affected by releases from 300 Area sources as follows: (a) continued monitoring of groundwater that is contaminated above health-based levels to ensure that concentrations continue to decrease, and (b) institutional controls to ensure that groundwater use is restricted to prevent unacceptable exposure to groundwater contamination. In 2000, the groundwater beneath the two outlying subregions was added to the operable unit. In 2001, the first 5-year review of the ROD found that the interim remedy and remedial action objectives were still appropriate, although the review called for additional characterization activities. In 2006, the second 5-year review concluded that the remedy is not protective and states that follow up actions are necessary to determine long-term protectiveness.

This report includes a current conditions baseline ecological and human health risk assessment using maximum concentrations in the environmental media of the 300-FF-5 Groundwater Operable Unit and downstream conditions at the City of Richland, Washington. The scope for this assessment includes only current measured environmental concentrations and potential scenarios under current access restrictions. Environmental concentrations used in this report were collected from 1994 through 2005. Future environmental concentrations and future land uses are not considered in this assessment. A major result of this decision is that direct exposure to groundwater is not a completed pathway in any of the current exposure scenarios. The only exposure pathways involving groundwater are via discharge of contaminated groundwater at riverbank springs and through riverbed sediment to the Columbia River and plant uptake of groundwater in the riparian zone near the river.

Three major conclusions result from this risk assessment:

1. The results of this risk assessment are consistent with the 1994 baseline risk assessment for those constituents of concern included in the 1996 ROD and for current exposure scenarios.
2. Uranium was the primary contributor to ecological and human health impacts under current conditions in the 300 Area. This was due to the migration of uranium-contaminated groundwater to surface water exposure points where direct ingestion occurred and also where uranium was incorporated into the food chain.
3. Currently, direct exposure to groundwater is prevented by access restrictions in the 300-FF-5 Groundwater Operable Unit. If access restrictions are not imposed, direct ingestion of groundwater may yield hazards and risks that exceed threshold levels.

This assessment includes both deterministic and stochastic model runs for estimating ecological and human health risk. The deterministic analyses were made with the maximum environmental concentrations and the best-estimate ecological and human parameters. The stochastic assessment includes 100 model runs with a stochastic environmental database that was generated from the range of environmental concentrations. This was done in order to show the uncertainty associated with the environmental concentrations. However, parameters internal to the ecological and human health models were held constant at best-estimate values for the stochastic calculations.

The contaminants of interest for the 300-FF-5 Groundwater Operable Unit current conditions risk assessment were based on: (a) the contaminants listed in the ROD, (b) an analysis of constituents that have exceeded the Environmental Protection Agency's drinking water standards in groundwater, and (c) useful indicators of contamination that are considered as contaminants of potential concern for the operable unit. These include: nitrate, uranium (chemical and isotopic, i.e., uranium-234, uranium-235, and uranium-238), cis-1,2-dichloroethene, tetrachloroethene, tributyl phosphate, trichloroethylene, strontium-90, technetium-99, and tritium.

The ecological and human health risk assessments were based on the most common organisms and human activities in the aquatic and riparian environment. The ecological risk assessment evaluated 77 animals and plants. The human health risk assessment was based on the following scenarios: industrial, casual recreation, avid recreation, child recreation, offsite residential farmer, and drinking groundwater or surface water. No biota sampling was done for this assessment; however, some biota sampling from 1994 through 2005 were used for assessing the ecological risk model.

Under current environmental conditions and current use scenarios, the ecological hazards and human health hazards and risks that can be attributed to 300-FF-5 Groundwater Operable Unit contamination are due to uranium. Because the depth to contaminated groundwater is below the rooting and burrowing depths of the species considered, hazards were estimated only for the 300 Area subregion, not the outlying 618-10/316-4 and 618-11 subregions. The ecological hazard from uranium at the 300 Area subregion is from root uptake in benthic aquatic plants and food chain accumulation of the contaminated aquatic plants in the American coot. The human health hazard from uranium at the 300 Area is through consumption of contaminated waterfowl. Human health risks from uranium are through ingestion of uranium isotopes through waterfowl and ingestion of surface water.

Strontium-90 is a contributor to risk for the avid and casual recreation scenarios at the 300 Area. Risk is through consumption of contaminated game and waterfowl for avid recreation and through consumption of contaminated game for casual recreation. The strontium-90 contamination in the game and waterfowl is associated with surface soil contamination. These soil samples are from a location coincident with air sampling stations. The strontium-90 risk is not attributable to the 300-FF-5 Groundwater Operable Unit.

Institutional controls prevent the ingestion of groundwater at the three 300 Area subregions. In the absence of a groundwater consumption pathway, the hazards and risks associated with current scenarios result from accumulation through the food chain. A hypothetical scenario was assessed to estimate the human health impacts associated with drinking unfiltered groundwater at the maximum concentrations occurring in the three 300 Area subregions. If access to unfiltered groundwater was allowed to occur, human health hazard and risk thresholds would be exceeded at all three 300 Area subregions. The hazard associated with consumption of groundwater is from uranium at all three subregions and from nitrate at the 300 Area subregion. Carcinogenic risk at the 300 Area subregion is from uranium isotopes (uranium-234 and uranium-238) and from trichloroethylene. Carcinogenic risk at the 618-10/316-6 subregion is from tributyl phosphate, and carcinogenic risk at the 618-11 subregion is from tritium.

The loss of institutional controls on the use of groundwater could potentially impact ecological hazard. There is currently no pathway to groundwater at the 618-10/316-4 and 618-11 subregions. If groundwater were brought to the surface through irrigation, plant uptake and subsequent food chain uptake could result in both ecological hazard and human health hazard and risk through consumption of contaminated food products.

# Acknowledgements

We would like to thank the many people who contributed to this report. We received tremendous support from Groundwater Performance Assessment Project staff, including: Tom Naymik, Ron Smith, JoAnne Rieger, and Evan Dresel. In addition, the Surface Environmental Surveillance Program staff assisted us, including: Lynn Bisping, Ted Poston, Greg Patton, and Amanda Stegen. Rosalind Schrempf provided technical editing. Charlie Brandt and Pam Doctor provided technical peer review of the report.

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# 1.0 Introduction

During 2004, the U.S. Department of Energy (DOE) initiated an expanded investigation of uranium contamination in groundwater beneath the 300 Area of the Hanford Site. Predictions made during the original remedial investigation as to the attenuation of this contamination had not been realized, and the first 5-year review of a 1996 interim Record of Decision (ROD) (EPA 1996) for the 300-FF-5 Groundwater Operable Unit acknowledged that additional investigation of the features and processes associated with uranium in the 300 Area was warranted (EPA 2001a). Following discussion with the U.S. Environmental Protection Agency (EPA), a new Tri-Party Agreement Milestone was developed (M-016-68) that specified a course of action, which includes conducting a new feasibility study for remedial action alternatives and a draft proposed plan for a path forward. Subsequently, a work plan was developed to guide the new feasibility study (DOE 2005a).

The work plan for the Phase III Feasibility Study contains six specific objectives, one of which is to update the risk assessment information that was developed during the original remedial investigation (Phase I) (results are described in DOE 1994a). The Phase I/II Feasibility Study report (DOE 1994b) evaluated remedial alternatives that were incorporated into the interim remedial action specified in the 1996 ROD (EPA 1996). The Phase III Feasibility Study is addressing the changes to the 300-FF-5 Groundwater Operable Unit since the ROD. This report is an update to the current conditions portion of the 1994 risk assessment. The report includes consideration of changes in contaminants of interest and in the environment that have occurred during the period of interim remedial action, i.e., 1996 to the present. The update also includes consideration of current conditions risk associated with additional geographic areas that were assigned to the 300-FF-5 Operable Unit in 2000 (EPA 2000a), for which no initial risk assessments have been conducted.

## 1.1 Scope of Work

The scope of work for the update to the 300-FF-5 Operable Unit risk assessment is described in the Phase III Feasibility Study work plan (DOE 2005a, pp. 19-22). The operable unit contains three subregions: 300 Area, 618-11 burial ground subregion, and the 618-10 burial ground/316-4 cribs subregion (Figure 1.1). A baseline qualitative risk assessment has only been conducted for the 300 Area. Remedial investigations and qualitative risk assessments have not been conducted for the groundwater beneath the two outlying subregions. The scope for this assessment includes only current measured environmental concentrations and current use scenarios. Future environmental concentrations and future land uses are not considered in this assessment. An additional risk assessment will be conducted after remedial actions are complete in support of a final ROD. This risk assessment will address future environmental conditions and future use scenarios.

This assessment includes both deterministic and stochastic model runs. The deterministic runs were made with the maximum environmental concentrations and the best-estimate human and ecological parameters. The stochastic assessment includes 100 model runs with a stochastic environmental database that was generated from the range of environmental concentrations. In order to show only the uncertainty associated with the environmental concentrations, parameters internal to the ecological and human health models were held constant at best-estimate values for the stochastic calculations.

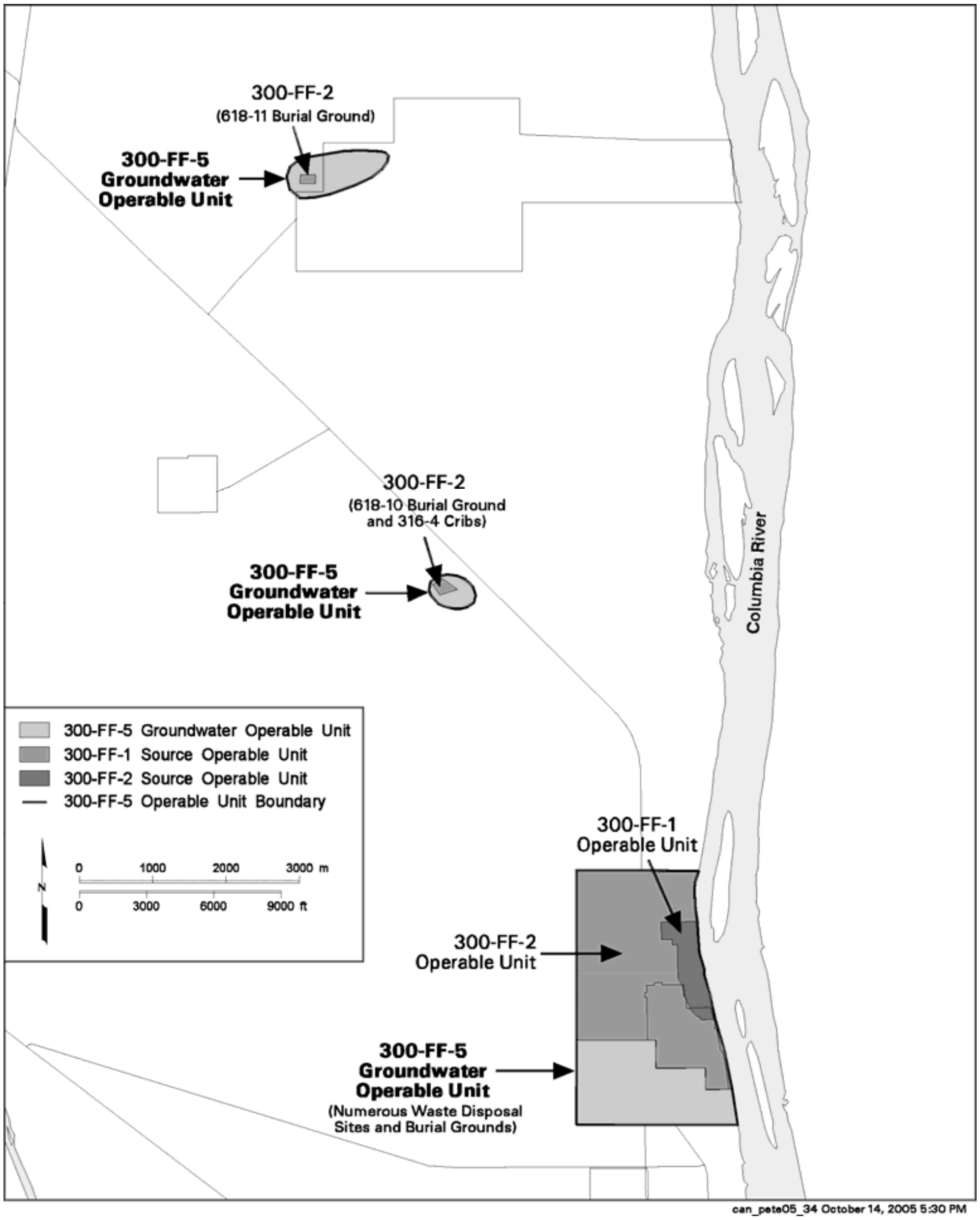


**Figure 1.1**. 300-FF-5 Groundwater Operable Unit Boundaries

### 1.1.1 Spatial Extent

The spatial extent of the 300-FF-5 Groundwater Operable Unit current conditions risk assessment encompass the areas evaluated in the Baseline Risk Assessment (DOE 1994a) and the groundwater beneath the outlying 300-FF-2 source sites and burial grounds 618-11 and 618-10/316-4. The outlying areas and burial grounds were added to the 300-FF-5 Groundwater Operable Unit in the Explanation of Significant Difference (ESD) for the 300-FF-5 Groundwater Operable Unit ROD (ESD-ROD – EPA 2000a). Figure 1.1 illustrates the spatial extent of the 300-FF-5 Groundwater Operable Unit that is considered in this risk assessment.

### 1.1.2 Time Frame

The 300-FF-5 Groundwater Operable Unit baseline risk assessment update addresses conditions as of 2005, and is based on data collected between 1994 and 2005. The initial baseline risk assessment for the 300-FF-5 Groundwater Operable Unit was based on data collected over four quarters in 1992 (DOE 1994a). Risks to human health and the environment were evaluated using the 1992 data. Human health risk in DOE (1994a) was also computed for predicted concentrations for 2018 based on a simple groundwater transport model and radioactive decay.

The 300-FF-5 Groundwater Operable Unit baseline risk assessment update evaluated human health and ecological risk for current conditions only. For groundwater data, the period considered representative of current conditions spanned November 2002 to October 2005. This time interval contained a sufficiently large number of results to cover the range in conditions that occurs because of seasonal influences. For non-groundwater data, such as data for surface water and sediment, a longer time period was needed to produce a sufficiently large data set (i.e., 1994 to 2005).

### 1.1.3 Determination of Contaminants of Interest

The determination of contaminants of interest for the risk assessment was documented in *Contaminants of Potential Concern in the 300-FF-5 Operable Unit: Expanded Annual Groundwater Report for Fiscal Year 2004* (Peterson 2005). This report was a thorough reevaluation of groundwater conditions in the expanded 300-FF-5 Groundwater Operable Unit and satisfied an operations and maintenance plan requirement to provide an expanded annual report on groundwater conditions for fiscal year 2004. It includes additional contaminants associated with the 618-11 and 618-10/316-4 subregions and the 300 Area proper that were not listed in the original 300-FF-5 ROD or the ESD-ROD.

Based on Peterson (2005), the contaminants of interest in the groundwater at the 300 Area, as defined by the ROD (EPA 1996, pg. ii), include uranium, cis-1,2-dichloroethene, and trichloroethylene (TCE). Additional contaminants of interest, as identified during the remedial investigation (DOE 1995) or in Resource Conservation and Recovery Act (RCRA) corrective measures monitoring plans (Lindberg et al. 1995; Lindberg and Chou 2001) are tetrachloroethene, strontium-90, tritium, and nitrate.

The ESD-ROD expanded the 300-FF-5 Groundwater Operable Unit to include the groundwater beneath the 618-11 burial ground. This subregion of the 300-FF-5 Groundwater Operable Unit contains contaminants associated with the site-wide plume, which originates in the 200 East Area (200-PO-1 Operable Unit), and the burial ground. The ESD-ROD identified new analysis for tritium at wells added in 1995 as part of the 300-FF-2 *Limited Field Investigation for the 300-FF-2 Operable Unit* (DOE 1996). Tritium concentrations were significantly higher than other regional wells and localized near the 618-11 burial ground (EPA 2000a). While the ESD-ROD did not identify any additional contaminants of concern (COC) in this subregion, Peterson (2005) identified several other constituents that have exceeded the EPA drinking water standards in groundwater near the 618-11 burial ground or are useful indicators of contamination and are, therefore, carried as contaminants of potential concern (COPC) for the operable unit.

The ESD-ROD also added the groundwater beneath the 316-4 cribs and the 618-10 burial ground to the 300-FF-5 Groundwater Operable Unit. The ESD-ROD identified groundwater plumes in this area containing uranium and tributyl phosphate. According to Peterson (2005), the contaminants in the area are associated with discharges to the cribs that were disturbed in 1995 during the refurbishment of a well. There are also constituents associated with the site-wide plume present in the vicinity. Peterson (2005) identified nitrate, technetium-99, and tritium as COPC in the 316-4/618-10 subregion.

Any chemical identified as either a COC or COPC in Peterson (2005) was retained as a contaminant of interest for this risk assessment. A summary of the contaminants of interest for the subregions of the 300 Area is provided in Table 1.1. The list of contaminants have changed from the 1994 report based on evaluations as part of the original ROD and 5-year reviews, as discussed above.

**Table 1.1**. Summary of Contaminants of Interest

| | ROD | ESD-ROD | | | Peterson (2005) Report | | |
|---|---|---|---|---|---|---|---|
| Analyte Name | 300 Area | 300 Area | 618-11 Subregion | 618-10/316-4 Subregion | 300 Area | 618-11 Subregion | 618-10/316-4 Subregion |
| Nitrate | | | | | COPC | COPC | COPC |
| Uranium | COC | COC | | COPC | COC | COPC | COPC |
| cis-1,2-Dichloroethene | COC | COC | | | COPC | | |
| Tetrachloroethene | | | | | COPC | | |
| Tributyl Phosphate | | | | COPC | | | COPC |
| Trichloroethylene | COC | COC | | | COPC | | |
| Strontium-90 | | | | | COPC | | |
| Technetium-99 | | | | | | COPC | COPC |
| Tritium | | | COPC | | COPC | COPC | COPC |
| Uranium-234 | COC* | COC* | | COC* | COC* | COPC* | COPC* |
| Uranium-235 | COC* | COC* | | COC* | COC* | COPC* | COPC* |
| Uranium-238 | COC* | COC* | | COC* | COC* | COPC* | COPC* |
| * Uranium isotopes are assessed for all locations where uranium is identified as a COC or COPC. | | | | | | | |

## 1.2 Relationship to Other Hanford Site Risk Assessment Activities

Following start up of the 300-FF-5 Groundwater Operable Unit risk assessment update, a comprehensive assessment of human health and ecological risk for the entire Columbia River corridor on the Hanford Site began with planning stages in 2004. The comprehensive assessment is referred to as the River Corridor Baseline Risk Assessment (RCBRA) and is subdivided into two components: 1) the 100 Area and 300 Area, and 2) the Columbia River. As stated in the work plan for the 100 Area and 300 Area component of RCBRA (DOE 2004), "the purpose for the baseline risk assessment is to characterize the current and potential threats to human health and the environment that may be posed by residual, post-remediation contaminants under current and reasonably anticipated future site conditions." The RCBRA activity focuses on threats posed by contamination remaining in the environment adjacent to remediated waste sites (e.g., liquid waste disposal trenches; solid waste burial grounds) and includes current groundwater and surface water conditions in its analysis of risk. The output of the RCBRA will support remedial action decisions at a scale that considers the combined effects of residual contamination at waste sites, the underlying vadose zone, and groundwater impacted by releases from waste sites.

The work conducted under the 300-FF-5 Groundwater Operable Unit risk assessment has been done for a somewhat different purpose and to fulfill a more immediate need, i.e., to support a current feasibility study and proposed plan for the operable unit. However, the product of the 300-FF-5 Groundwater Operable Unit current conditions risk assessment is likely to complement the results from the river corridor assessment.

## 1.3 Report Organization

The 300-FF-5 Groundwater Operable Unit current conditions baseline risk assessment is organized as follows:

- Chapter 2 – Site Description: summarizes the physical setting, site history, and the current and proposed land uses for the operable unit.
- Chapter 3 – Data Used in the Risk Assessment: provides a description of the abiotic media needed for the report and the values for each media selected for the risk assessment.
- Chapter 4 – Ecological Risk Assessment: provides a summary of the ecological risk assessment, organized similarly to EPA's *Guidelines for Ecological Risk Assessment* (EPA 1998). The chapter identifies the species selected, the computer model used in the assessment, the exposure and effects analysis, the results of the ecological risk assessment, and the uncertainties in the assessment.
- Chapter 5 – Human Health Risk Assessment: provides a summary of the human health risk assessment, organized similar to EPA's *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors* (EPA 1991a). The chapter identifies the assessment approach, exposure assessment (scenarios), toxicity assessment, the results of the human health hazard and risk assessment, and the uncertainties in the assessment.
- Chapter 6 – Conclusions, provides a summary of the ecological and human health risk assessments, comparison to the 1994 baseline current conditions risk assessment, and human health risk from drinking water set to the uranium drinking water standard.
- Appendix A – Data for the Risk Assessment: provides detailed data tables and charts of the environmental concentration data used for the risk assessment.
- Appendix B – Toxicology Data for the Ecological Assessment: provides the calculation methods and the benchmark data used in setting the ecological reference concentrations for use in calculating ecological hazard quotients (EHQ).

# 2.0 Site Description

This section describes the 300-FF-5 Groundwater Operable Unit, consistent with the ESD-ROD, including site history, physical setting, and land use.

## 2.1 Site History

The Hanford Site (Figure 2.1) occupies an area of about 1517 $km^2$ (about 586 $mi^2$) north of the confluence of the Yakima River with the Columbia River in Southcentral Washington State. The Hanford Site is about 50 km (30 mi) from north to south and 40 km (24 mi) from east to west. It was established in 1943 to produce plutonium for nuclear weapons and was the first nuclear production facility in the world. The U.S. Army Corps of Engineers selected the Hanford Site because it was remote from major populated areas, had ample electrical power from Grand Coulee Dam, a functional railroad, clean water available from the Columbia River, and plenty of sand and gravel available onsite for construction. The Hanford Site was divided into a number of operational areas (e.g., 100, 200, 300, and 400 Areas) associated with the different steps in the plutonium production process (DOE 1998a, b). Plutonium production continued throughout the cold war and was shut down in 1989 in response to the collapse of the Soviet Union and the end of the cold war. Now, the mission of the Hanford Site is environmental cleanup. This site, with its restricted public access, provides a buffer for the smaller areas currently used for storage of nuclear materials, waste treatment, and waste storage and/or disposal.

The 300 Area, in the southeastern corner of the Hanford Site, is located just north of the City of Richland and covers 1.5 $km^2$ (0.6 $mi^2$). Much of the land was used for industrial activities associated with the Manhattan Project and Cold War weapons production. Most research and development (R&D) activities were carried out in the 300 Area, and it was also the location of nuclear fuel fabrication. Nuclear fuel in the form of pipe-like cylinders (fuel slugs) was fabricated from purified uranium shipped in from offsite production facilities. The fabricated fuel slugs were shipped by rail from the 300 Area to the nuclear reactors in the 100 Area, located at the northern portion of the site on the shore of the Columbia River, where up to nine nuclear reactors were in operation. The first eight reactors were constructed between 1944 and 1955. The ninth reactor, N Reactor, was completed in 1963. The irradiated fuel produced in the 100 Area reactors was transported by rail to the 200 Areas, where the plutonium was recovered.

Before the start of the Manhattan Project, the 300 Area was used by Native Americans and early white settlers. The Native Americans used the area as a camp location because of its proximity to the Columbia River and its resources. In the late 1800s, white settlers developed a farming community known as Fruitvale at the location. When the Manhattan Project began, the Native Americans and members of the farming community were moved off the site. Many archaeological resources associated with both of these cultural landscapes are located along the river shore outside of the 300 Area fence, having eluded the construction activities. Subsurface archaeological deposits are likely to be located underneath existing 300 Area facilities in pockets of undisturbed ground.

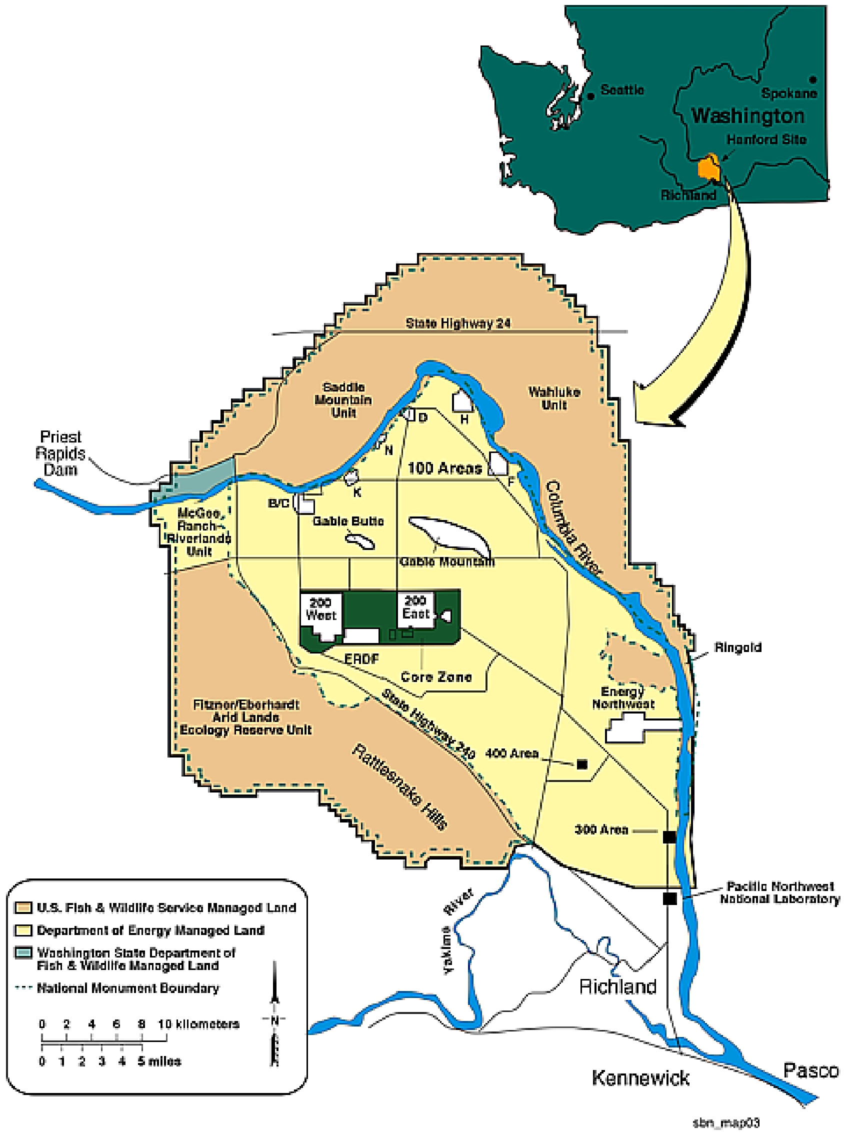


**Figure 2.1**. Location of the U.S. Department of Energy's Hanford Site

## 2.2 Physical Setting

The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the site's eastern boundary. The Yakima River runs near the southern boundary of the Hanford Site and joins the Columbia River at the City of Richland, which bounds the Hanford Site on the southeast. Rattlesnake Mountain, Yakima Ridge, and Umtanum Ridge form the southwestern and western boundaries, and Saddle Mountain forms the northern boundary of the Hanford Site. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau of the central part of the Hanford Site. Adjoining lands to the west, north, and east are principally range and agricultural land. The cities of Kennewick, Pasco, and Richland (the Tri-Cities), and the city of West Richland constitute the nearest population centers and are located south-southeast of the Hanford Site.

According to the Hanford Site National Environmental Policy Act (NEPA) characterization report (Neitzel et al. 2005), the 300 Area lies next to the Columbia River and sits on the Hanford formation, which in turn overlies the Ringold Formation and Columbia River Basalt Group. The Columbia River Basalt Group and Ringold Formation beneath the 300 Area are folded into the Cold Creek synclinal valley that lies near the intersection of the Yakima Fold Belt and the un-deformed Palouse Slope (Figure 2.2). The uppermost basalt flows belong to the Elephant Mountain Member over most of the Hanford Site; however, near the 300 Area younger flows belonging to the Ice Harbor Member of the Saddle Mountains Basalt are present, causing the overlying sediment layers to be relatively thin. Both Ringold Formation and Hanford formation sediment is found in the 300 Area.

The description of the groundwater flow in the 300 Area is taken from Hartman et al. (2005). Groundwater flow in the unconfined aquifer beneath the 300-FF-5 Groundwater Operable Unit groundwater interest area, including the 300 Area, is generally to the east and southeast. Flow into the 300 Area converges from regions to the northwest, west, and southwest, with ultimate discharge to the Columbia River (Figure 2.3). During fiscal year (FY) 2005, in the north and central portions of the 300 Area, flow direction was southeast during March 2004, and east in the south portion of the 300 Area, as inferred from water-table elevations. These are typical directions for groundwater flow when the river is at low-to-medium stage. As the river stage rises during late May or June, the direction of groundwater flow can temporarily shift to a more southward direction in the north portion of the 300 Area in the vicinity of the 316-5 process trenches. Changes in river-stage elevation are correlated to changes in water-level elevations at wells located inland as much as 360 m (1181 ft) from the river.

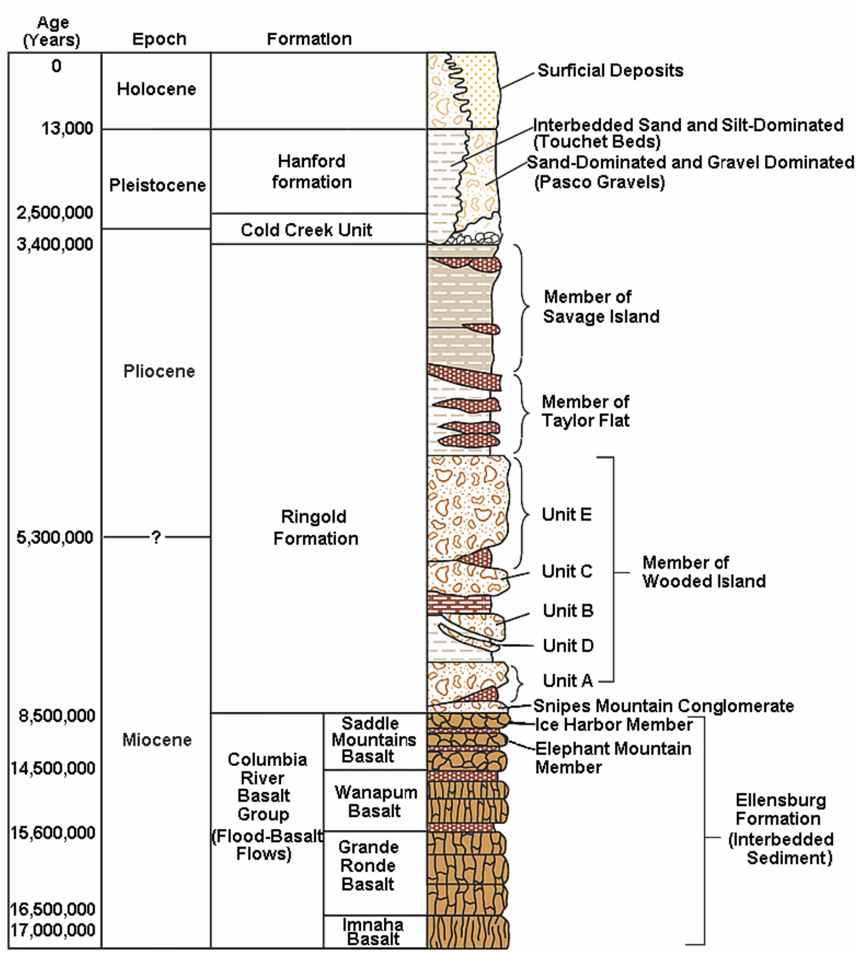


**Figure 2.2**. Strata of Rocks and Sediment at the Hanford Site

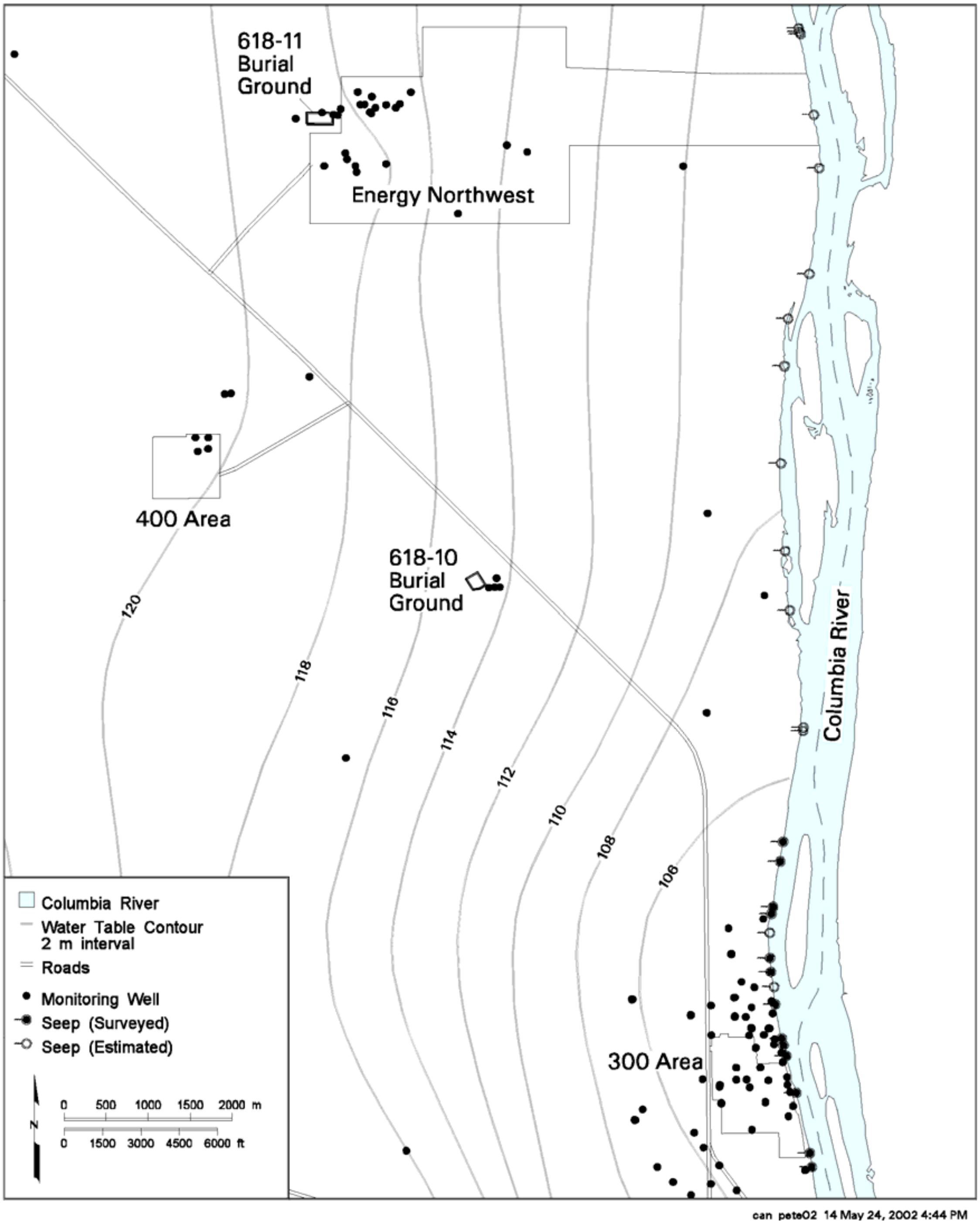


**Figure 2.3**. Water-Table Map for the 300-FF-5 Groundwater Operable Unit, May 2002

### 2.2.1 Archaeological Resources

Five recorded archaeological sites including campsites, house pits, and a historic trash scatter are located at least partially within the 300 Area. Many more may be located in subsurface deposits. Twenty-three archaeological sites and 10 isolated artifacts have been recorded within 1 km (0.6 mi) of the 300 Area fence. Archaeological site 45BN162 has been determined eligible for listing in the National

Register. Several archaeological sites in this area are in the Hanford South Archaeological District, which is listed in the Washington Heritage Register. Archaeological sites associated with the early settlers/ farming cultural landscape in the 300 Area mainly comprise domestic debris scatters and roadbeds associated with farmsteads. A documented historic Wanapum cemetery is located near the 300 Area.

The 300 Area was the location of most of the Hanford Site's R&D laboratories. One hundred fifty-nine buildings/structures in the 300 Area have been documented on historic property inventory forms. Of that number, 47 were selected as representative examples of buildings and structures eligible for the National Register as contributing properties within the Historic District recommended for individual documentation.

## 2.3 Characterization of Land Use

The future land uses of the Hanford 300 Area depend on post-closure cleanup levels in the soil and groundwater and ownership of the land. The currently selected remedial alternative for the 300 Area groundwater is monitored natural attenuation. However, after 5 years, the remedy is not achieving the remedial action objectives established in the ROD for the uranium contamination in the groundwater. At the present time, institutional controls are in place to prevent use of the groundwater. The current objective is to remediate the 300 Area groundwater so that uranium is below the drinking water standard of 30 μg/L.

### 2.3.1 Current Uses of the 300 Area

As mentioned previously, the 300 Area is located just north of the City of Richland and covers 1.5 $km^2$ (0.6 $mi^2$). The 300 Area is the site of former reactor fuel fabrication facilities and is also the principal location of nuclear R&D facilities serving the Hanford Site (DOE 1999). Currently, most of the 300 Area facilities are vacant except for those housing Pacific Northwest National Laboratory (PNNL) research activities and various support activities. While industrial use of the 300 Area is ongoing, institutional controls are in place to prevent use of the groundwater for those activities (there is no current use of groundwater as a potable water source). The Columbia River is used at the 300 Area for industrial process water, boating, fishing, and hunting. The Columbia River is used as a supply of drinking water three miles downstream of the 300 Area at the City of Richland's water treatment plant pumphouse.

### 2.3.2 Proposed Future Land Use

The DOE has outlined the future uses of the Hanford Site in two major documents, the *Final Hanford Comprehensive Land-Use Plan Environment Impact Statement* (DOE 1999) and the *Hanford Site End State Vision* (DOE 2005b). These documents were written to define the future vision for site land use and to focus DOE on conducting cleanup that protects human health and the environment for the planned uses.

The current baseline end state for the 300 Area is industrial restricted surface use. Until final RODs are produced for the 300 Area, remediated sites will be backfilled to support unlimited surface use. Irrigation and groundwater use may be restricted based on the success of future groundwater cleanup activities (DOE 2005b).

Most of the 300 Area lies within the City of Richland's Urban Growth Boundary as identified by Washington's Growth Management Act. Therefore, the City has identified a plan for the redevelopment of the site to support the remediation process and to plan for the City's future growth. In March 2005, the City of Richland issued the results of the *Preliminary Assessment of Redevelopment Potential for the Hanford 300 Area* (HDR/EES 2005). The City of Richland 300 Area Reuse Committee developed two potential reuse options. Both of these reuse options involve mixed industrial, residential, and recreational use. The guiding principles used by the City in developing these potential reuse options are as follows (HDR/EES 2005):

- This is valuable riverfront/river view property that is unique from other industrial properties in the area and other Hanford lands that have been or are currently being remediated; therefore, the current blanket industrial designation needs to be revisited.
- A riverfront buffer needs to be established to protect cultural resources, provide for a bike path/trail, and to maintain riparian habitat functions and values. Buffer widths discussed were 61 to 122 m (200 to 400 ft), recognizing the buffer may be wider in some places to ensure cultural resources protection.
- A mixed land-use scenario is appropriate for the site considering its size (nearly 4 km [1000 acres]), the potential facilities that might remain, and location/proximity to the river and the business park to the south, including the following uses: business/research park, recreational, commercial, light industrial and residential.
- Long-term build-out would likely include a mix of public and private land ownership and should reserve a certain amount of land for future federal mission opportunities.
- A federal incentive will be needed as a catalyst for spurring redevelopment and could involve increased investment with federal R&D related to existing facilities (biology or other new R&D mission) or other major federal incentive to help attract private investment.
- This site is a good local gateway to the Hanford Site and Hanford Reach Monument. As such, a park like Leslie Groves with a boat launch, path, and other park amenities could be appropriate here. In the long term, once Columbia Point is built out, this could be an area for a potential Columbia Point II location, with an additional golf course and river recreational amenities perhaps including a hotel and restaurant(s).

In his April 2005 letter to City of Richland manager John Darrington, DOE Richland Operations Manager Keith Klein expressed concern with the City of Richland's 300 Area reuse proposals. There were two key points raised in this letter. The first concern is that potential future high-water use in the 300 Area would mobilize uranium contamination in the deep vadose zone, causing groundwater to exceed drinking water standards. Mr. Klein's comment follows:

> "The proposed multiple land-uses such as residential and golf courses would be inconsistent with the selected cleanup remedy allowing a significant increase in infiltration/percolation (i.e., recharge from irrigation percolating through the uranium-contaminated deep vadose zone such as that from irrigation of a golf course, or residential uses). This would likely result in a higher flux of uranium to groundwater. It is the goal of the Tri-Party agencies not to allow uranium from the soils to reach groundwater at a flux that will result in groundwater levels exceeding drinking water standards."

The second concern raised by Mr. Klein on behalf of the DOE is that no decision has been made to transfer control of the 300 Area out of DOE's administration. Mr. Klein's comment concerning potential land transfer follows:

"DOE may have future missions for the 300 Area and no decision has been made to transfer this parcel of land out of DOE's administration in the foreseeable future.  As you know, DOE recently assigned to the Office of Science for potential future use by Pacific Northwest National Laboratory, a triangular shaped area of land to the south of the Cypress Street.  In the 50-year time horizon that DOE uses for land use planning, it is reasonable to project that the adjacent 300 Area property may be needed to support the expansion of this, other related federal missions, or spin-off activities associated with the National Laboratories."

# 3.0 Data Used in the Risk Assessment

Environmental data to support assessment of ecological and human health impacts were assembled from existing monitoring data. The assessment locations are the three subsections of the 300-FF-5 Groundwater Operable Unit shown in Figure 1.1, and a location at the City of Richland. Data assembled have been measured since the Remedial Investigation in 1994.

## 3.1 Abiotic Media Data Needed for the Risk Assessment

The 300-FF-5 Groundwater Operable Unit current conditions risk assessment is focused on impacts from the contamination currently existing in the groundwater beneath the 300-FF-1 and 300-FF-2 Source Operable Units. The groundwater flow system beneath the Hanford Site represents a primary environmental pathway for contaminant movement away from source areas. This pathway ultimately discharges into the Columbia River. Near the river, the groundwater flow system is influenced by the river flow system in a zone of groundwater/river interaction (ZOI) (Peterson and Connelly 2001). The principal features and terminology associated with the ZOI are illustrated in Figure 3.1.

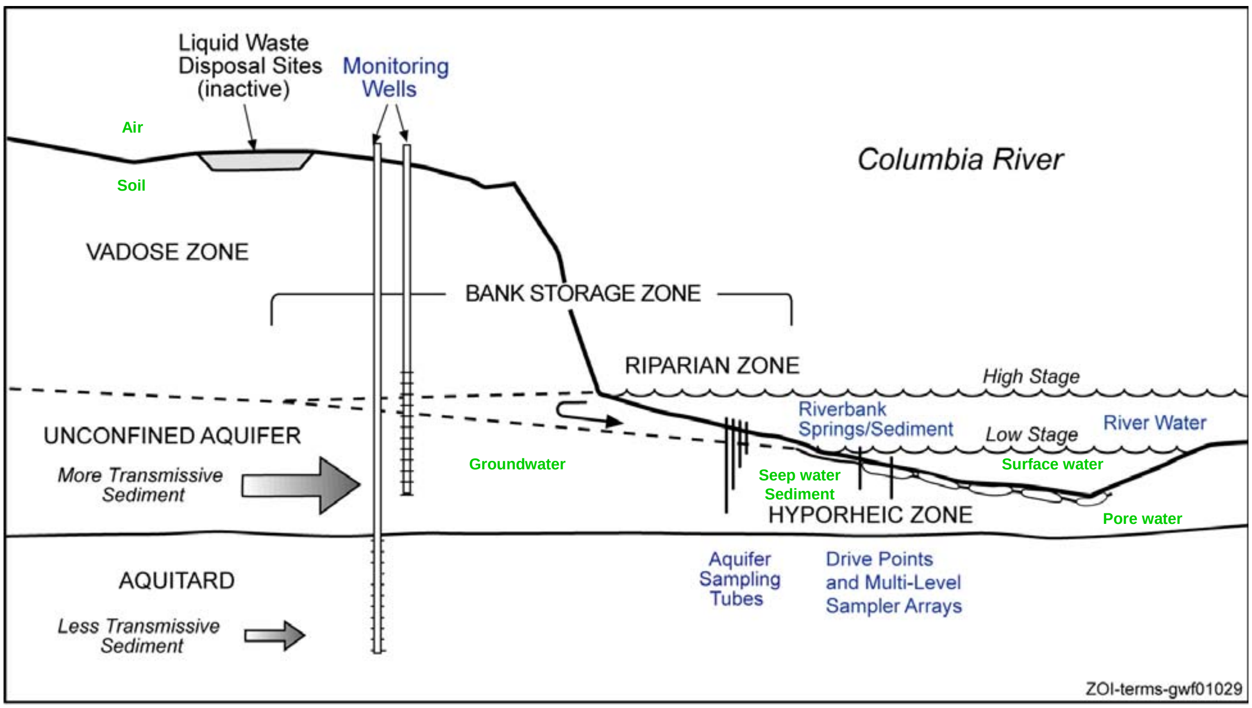


**Figure 3.1**. Diagram of the Groundwater/River Water Zone of Interaction

To fully assess the ecological and human health impacts, contaminant concentration data from the media represented in Figure 3.1 are needed as input into the calculations. Figure 3.2 presents the conceptual model used for this assessment from the primary contaminated medium through exposure to ecological receptors and humans.

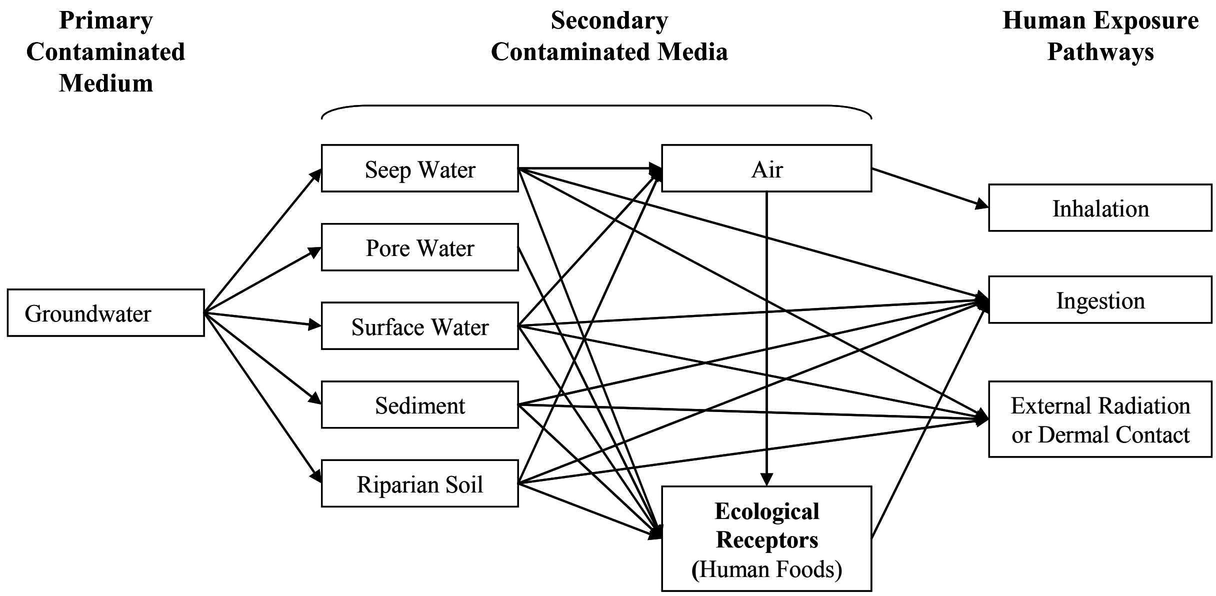


**Figure 3.2**. Conceptual Model of Contaminated Media and Human and Ecological Receptor Exposure Under Current Conditions

Measured concentrations will be used for the abiotic media. Food concentrations will be estimated using the ecological risk model.

## 3.2 Summary of Analytical Results in Abiotic Media

The full abiotic media dataset used for the 300-FF-5 Groundwater Operable Unit risk assessment can be found in Appendix A. Several different sources were used to collect information for the abiotic media. This section presents the process for selecting the maximum observed concentrations for each medium.

### 3.2.1 Groundwater

Maximum observed values for constituents of interest (Table 1.1) in 300-FF-5 groundwater were extracted from the Hanford Environmental Information System (HEIS) groundwater database using the groundwater project's Data Visualization and Evaluator (DaVE) interface software. All groundwater results are from unfiltered samples. Expert judgment, based on the goal of only using data that are representative of aquifer conditions, is part of screening analytical results. Results suspected to contain errors and values evaluated as being nonrepresentative of aquifer conditions have been excluded. The criteria for exclusion of sample results include consistency with established trends, expectations based on groundwater conditions in the general area, and obvious reporting errors (e.g., decimal point errors, incorrect CAS assignments, typos, and inappropriate laboratory qualifiers). Also, values with a "nondetect" laboratory qualifier were excluded. The date range represented is November 1, 2002 through October 5, 2005, which is a long enough interval to have a reasonable number of results for descriptive statistics yet still short enough to be representative of recent conditions. A TCE plume discovered in 2006 was documented in the operable unit, but the samples were taken after the stated time frame, and it is not included in this report. Risk assessment activities in support of a final ROD will consider this TCE plume. The list of constituents includes (a) COC as identified in CERCLA decision documents, (b) additional COPC associated with RCRA monitoring at the 300 Area Process Trenches, and (c) other mobile waste constituents that are relevant to characterizing the groundwater as a source for drinking water. (Note: not all constituents used to qualify groundwater as meeting drinking water standards are listed). More detailed groundwater results by well are given in Table A.1 in Appendix A.

### 3.2.2 Other Abiotic Media

Other abiotic media concentrations were obtained from the Surface Environmental Surveillance Project (SESP) conducted by PNNL. The SESP is a multimedia environmental monitoring effort to measure the concentration of radionuclides and chemicals in environmental media and assess the integrated effects of these materials on the environment and the public. Project personnel collect samples of air, surface water, sediments, soil and natural vegetation, agricultural products, fish, and wildlife. Samples are analyzed for very low environmental concentrations of radionuclides and nonradiological chemicals including metals, anions, and volatile organic compounds (DOE 2000). The project focuses on routine releases from DOE facilities on the Hanford Site; however, the project is also responsive to unplanned releases and releases from non-DOE operations on and near the site. Surveillance results are provided annually through the *Hanford Site Environmental Report* (e.g., Poston et al. 2006).

The abiotic media assembled for this assessment are only for the contaminants of interest identified in Table 1.1. The time period for the abiotic data is from 1994 through the fall 2005 sampling. The data for the abiotic media are given in Appendix A.

### 3.2.3 Calculation of Exposure Point Concentrations

The exposure concentrations for the various environmental media were calculated using the abiotic media data described above. These calculations relied upon a number of assumptions regarding interconverting chemical concentrations and isotopic concentrations for uranium, the appropriateness of near-shore aquifer tube and drive point data for use as pore water, and surrogation to fill in for missing media data.

Uranium is the primary contaminant of interest for groundwater in the 300 Area. While the interim cleanup standard for uranium is based on chemical uranium, it is important in a human health assessment to consider the carcinogenic effects of uranium isotopes, e.g., uranium-234, -235, and -238. Health effects are a function of concentration and radioactivity. Uranium isotopes have very long half-lives: 244,000 years for uranium-234; 710 million years for uranium-235; and 4.5 billion years for uranium-238. More radiation is released per unit time from a given quantity of the shorter half-life isotope compared to the longer half-life isotope. That is, if you have one gram of each isotope side by side, the uranium-234 will be about 20,000 times more radioactive, and the uranium-235 will be 6 times more radioactive than the uranium-238 (ATSDR 1999). The natural abundance of uranium isotopes is 99.27% uranium-238, 0.72% uranium-235, and 0.0055% uranium-234 (Lide 2000). One gram of natural uranium having this relative isotopic abundance has an activity of 0.67 μCi. From this activity of natural uranium, 48.9% of the activity is attributable to uranium-234, 2.2% of the activity is attributable to uranium-235, and 48.9% of the activity is attributable to uranium-238. Although the relative mass abundance of uranium-234 is only 0.0055%, this accounts for exactly one-half of the total activity (ATSDR 1999). Thus, all the isotopes of uranium are important to consider in a health assessment.

Some of the media in the 300 Area did not have measured data for both chemical and isotopic uranium. For example, the RCRA groundwater program analyzes uranium only as a chemical. Since uranium is the primary contaminant of concern in the 300 Area groundwater, the failure to include both chemical and isotopic uranium in all media would have underestimated the human health and ecological hazard and risk. Where isotopic uranium values were not provided, specific activity and natural abundance were used to estimate isotopic uranium values. Where chemical uranium values were not provided, uranium-238 specific activity and natural abundance were used to estimate chemical uranium values. No values were surrogated if measured values were available. The uranium isotopic compositions in groundwater samples taken south of the 300 Area were not significantly different from natural ratios (Dresel et al. 2002). According to Table B.4 in Patton et al. (2003), the uranium isotopic ratios in the 300 Area seeps were similar for all locations and did not reveal isotopic enrichment from fuel production processes in the 300 Area.

Pore water, the interstitial water in the riverbed sediments, is the critical medium for impacts to aquatic organisms. Through food chain impacts, pore water exposure is also important to terrestrial animals and humans. While it is well known that there is a zone of groundwater/river water interaction, the relative proportion of groundwater to surface water at any point within the ZOI is not well known and has been shown to vary with time. Rather than use a ratio of the groundwater and surface water to estimate the pore water concentration, direct measurements made through aquifer tubes and drive point samples were used (Figure 3.1).

The depth to which river water becomes entrained in riverbed sediment can vary widely, along with the degree of contaminant dilution that might occur when river water mixes with upwelling groundwater. Because no new field data were collected for this study, surrogate data for groundwater in riverbed habitat were used. The surrogate data were maximum values for observations from aquifer tubes located along the shoreline, which typically provide samples from the aquifer at depths below ground surface ranging from 2 to 8 m, and from drive points positioned offshore in the riverbed, with sample port at depths less than 2 m below the riverbed surface. In essentially all instances, the maximum value for a contaminant of interest would come from an aquifer tube sample since those samples rarely show dilution by river water except for occasional dilution at the shallowest of the tube completions. The data plots in Appendix A show that the aquifer tube and drive point data appear to represent nearly the same subsurface conditions, with some evidence for dilution of contaminant concentrations in the drive point data. Consequently, the data from the two types of sampling sites were combined to develop the pore water dataset.

The third data issue regards preparing surrogation between media when some analytes were not measured in all media. The relationships in Figure 3.1 were used to relate media. In the case where groundwater and pore water were measured but seep water was not measured, the seep water concentration was set to the maximum of the groundwater and pore water concentrations. This was done for uranium in seep water at the 300 Area. In the case where seep water and surface water were measured but pore water was not measured, the pore water concentration was set to the maximum of the seep water and surface water concentrations. This was done for strontium-90 in pore water at the 300 Area.

The point concentrations for groundwater at the 300-FF-5 Groundwater Operable Unit were collected in accordance with the update to the sampling and analysis plan (Peterson 2005). The maximum analyte concentrations in groundwater in the 300 Area subregions are given in Table 3.1. The values of the concentrations that are highlighted and in italics are calculated from total uranium concentrations based on the assumptions for estimating isotopic activities from measured total uranium. Detailed data tables and plots of media concentrations over time can be found in Appendix A.

**Table 3.1**. Summary of Maximum Groundwater Concentrations

| | 300 Area | 618-11 Burial Ground | 316-4 Cribs/618-10 Burial Ground |
|---|---|---|---|
| **Nonradionuclides (µg/L)** | | | |
| cis-1,2-Dichloroethene | 200 | | |
| Nitrate | 129,000 | 134,000 | 49,100 |
| Tetrachloroethene | 0.59 | | |
| Tributyl phosphate | | | 160 |
| Trichloroethylene | 8.3 | | |
| Uranium | 235 | 11 | 42 |
| **Radionuclides (pCi/L)** | | | |
| Strontium-90 | 4.03 | | |
| Technetium-99 | 26.7 | 319 | 40.3 |
| Uranium-234 | *80.49* | *3.767* | *14.38* |
| Uranium-235 | *3.66* | *0.171* | *0.654* |
| Uranium-238 | *78.4* | *3.67* | *14.0* |
| Tritium | 15,100 | 3,620,000 | 17,800 |
| (grey) | Not a contaminant of interest for this subregion | | |
| (orange) | Values estimated based on surrogation rules | | |

The maximum concentrations for 300 Area subregion groundwater and all other abiotic media are provided in Table 3.2. Concentrations that are highlighted and in italics are calculated from other values based on the assumptions for estimating isotopic activities and total uranium from the measured value, and surrogating from strontium-90 pore water based on measured surface water values. Detailed data tables and plots of media concentrations over time can be found in Appendix A.

**Table 3.2**. Summary of 300 Area Subregion Maximum Media Concentrations

| | Groundwater | Seep Water | Pore Water | Surface Water | Sediment | Riparian Soil |
|---|---|---|---|---|---|---|
| **Nonradionuclides** | (µg/L) | | | | (µg/g) | |
| cis-1,2,-Dichloroethene | 200 | 0.4 | 0.23 | 0.47 | no data | no data |
| Nitrate | 129000 | 23000 | 67300 | 3900 | no data | no data |
| Tetrachloroethene | 0.59 | 0.7 | 0.27 | 0.35 | no data | no data |
| Trichloroethylene | 8.3 | 2.3 | 6.8 | 0.8 | no data | no data |
| Uranium | 235 | *241* | 241 | 8.91 | *29.9* | *1.83* |
| **Radionuclides** | (pCi/L) | | | | (pCi/g) | |
| Strontium-90 | 4.03 | 0.325 | *1.37* | 1.37 | 0.0267 | 0.171 |
| Technetium-99 | 26.7 | 15.6 | 25.9 | 0.663 | no data | no data |
| Tritium | 15100 | 11700 | 10100 | 2660 | no data | no data |
| Uranium-234 | *80.49* | 111 | 91.2 | 30.5 | 11.3 | 0.49 |
| Uranium-235 | *3.66* | 3.88 | 4.81 | 1.14 | 0.406 | 0.168 |
| Uranium-238 | *78.4* | 99.3 | 84.2 | 27.8 | 9.97 | 0.611 |
| (orange) | Values estimated based on surrogation rules | | | | | |

The minimum, average, and maximum concentrations for groundwater used in the stochastic assessment are provided in Table 3.3. Values are from the HEIS database for the period November 1, 2002 through October 5, 2005. Summary statistics were prepared using PNNL's DaVE interface with HEIS. A triangular distribution was used for the stochastic analysis with the average as the central value and the minimum and maximum as the ends of the distribution. Concentrations that are highlighted and in italics are calculated from other values based on the assumptions for estimating isotopic activities from measured total uranium. Detailed data tables and plots of media concentrations over time can be found in Appendix A.

Table 3.4 contains a summary of contaminant concentrations in seep water, pore water, and surface water for the 300 Area. Concentrations that are highlighted and in italics are calculated from other values based on the assumptions for estimating isotopic activities and total uranium from the measured value, and surrogating from strontium-90 pore water based on measured surface water values. Detailed data tables and plots of media concentrations over time can be found in Appendix A.

Table 3.5 contains a summary of contaminant concentrations in surface soil and sediment for the 300 Area. Concentrations that are highlighted and in italics are calculated from other values based on the assumptions for estimating total uranium from measured isotopic activities. Detailed data tables and plots of media concentrations over time can be found in Appendix A.

**Table 3.3**. Summary of Groundwater Concentrations by Subregion

| | 300 Area | | | 618-11 Burial Ground | | | 316-4 Cribs/618-10 Burial Ground | | |
|---|---|---|---|---|---|---|---|---|---|
| **Nonradionuclides (µg/L)** | Min | Ave | Max | Min | Ave | Max | Min | Ave | Max |
| cis-1,2-Dichloroethene | 0.13 | 63.6 | 200 | | | | | | |
| Nitrate | 4,430 | 34,800 | 129,000 | 97 | 55,786 | 134,000 | 23,500 | 33,800 | 49,100 |
| Tetrachloroethene | 0.12 | 0.32 | 0.59 | | | | | | |
| Trichloroethylene | 0.16 | 1.14 | 8.3 | | | | | | |
| Uranium | 3.64 | 43.29 | 235 | 3.68 | 8.24 | 11 | 3.8 | 18.2 | 42 |
| **Radionuclides (pCi/L)** | | | | | | | | | |
| Strontium-90 | 3.19 | 3.54 | 4.03 | | | | | | |
| Technetium-99 | 19 | 22.85 | 26.7 | 12 | 96 | 319 | 20.2 | 29 | 40.3 |
| Tritium | 13.4 | 2,327 | 15,100 | 32 | 696,000 | 3,620,000 | 11,400 | 14,925 | 17,800 |
| Uranium-234 | *1.25* | *14.8* | *80.5* | *1.26* | *2.8* | *3.8* | *1.30* | *6.23* | *14.4* |
| Uranium-235 | *0.0567* | *0.674* | *3.66* | *0.0573* | *0.128* | *0.17* | *0.0592* | *0.283* | *0.65* |
| Uranium-238 | *1.22* | *14.5* | *78.4* | *1.23* | *2.8* | *3.7* | *1.27* | *6.08* | *14.0* |
| (grey) | Analyte is not a contaminant of interest for this subregion. | | | | | | | | |
| (orange) | Value estimated based on surrogation rules | | | | | | | | |

**Table 3.4**. Summary of Other Water Concentrations for the 300 Area

| | Seep Water Concentrations 300 Area | | | Pore Water Concentrations 300 Area | | | Surface Water Concentrations 300 Area | | |
|---|---|---|---|---|---|---|---|---|---|
| **Nonradionuclides (µg/L)** | Min | Ave | Max | Min | Ave | Max | Min | Ave | Max |
| cis-1,2-Dichloroethene | 0.06 | 0.23 | 0.4 | 0.23 | 0.23 | 0.23 | 0.47 | 0.47 | 0.47 |
| Nitrate | 6,600 | 17,200 | 23,000 | 1,340 | 18,723 | 67,300 | 100 | 520 | 3,900 |
| Tetrachloroethene | 0.08 | 0.30 | 0.7 | 0.26 | 0.27 | 0.27 | 0.35 | 0.35 | 0.35 |
| Trichloroethylene | 0.09 | 0.92 | 2.3 | 0.29 | 1.52 | 6.8 | 0.39 | 0.49 | 0.8 |
| Uranium | *3.53* | *70.98* | *241* | 3.53 | 70.98 | 241 | 0.482 | 2.25 | 8.91 |
| **Radionuclides (pCi/L)** | | | | | | | | | |
| Strontium-90 | 0 | 0.176 | 0.325 | *0* | *0.081* | *1.37* | 0 | 0.081 | 1.37 |
| Technetium-99 | 1.22 | 9.88 | 15.6 | 9.1 | 13.6 | 25.9 | 0 | 0.146 | 0.663 |
| Tritium | 1,310 | 8,491 | 11,700 | 4.74 | 5,685 | 10,100 | 25 | 144 | 2,660 |
| Uranium-234 | 2.58 | 37.5 | 111 | 1.09 | 37.3 | 91.2 | 0.0565 | 0.783 | 30.5 |
| Uranium-235 | 0.0576 | 1.51 | 3.88 | 0.0451 | 1.59 | 4.81 | 0 | 0.0308 | 1.14 |
| Uranium-238 | 2.21 | 32.5 | 99.3 | 1.06 | 31.99 | 84.2 | 0.0681 | 0.713 | 27.8 |
| | Values estimated based on surrogation rules | | | | | | | | |

**Table 3.5**. Summary of Soil and Sediment Concentrations for the 300 Area

| | Sediment Concentrations 300 Area | | | Riparian Soil Concentrations 300 Area | | |
|---|---|---|---|---|---|---|
| **Non-Radionuclides (µg/g)** | Minimum Value | Average Value | Maximum Value | Minimum Value | Average Value | Maximum Value |
| Uranium | *0.152* | *6.95* | *29.9* | *0.509* | *1.08* | *1.83* |
| **Radionuclides (pCi/g)** | | | | | | |
| Strontium-90 | 0 | 0.00513 | 0.0267 | 0.00281 | 0.0963 | 0.171 |
| Uranium-234 | 0.0706 | 2.34 | 11.3 | 0.177 | 0.311 | 0.49 |
| Uranium-235 | 0.00287 | 0.111 | 0.406 | 0.00544 | 0.0379 | 0.168 |
| Uranium-238 | 0.0506 | 2.32 | 9.97 | 0.17 | 0.362 | 0.611 |
| | Values estimated based on surrogation rules | | | | | |

Table 3.6 contains a summary of contaminant concentrations in surface water for the City of Richland location. The measuring point for surface water is at the City of Richland's pumphouse for collection of river water for the water treatment plant. Concentrations that are highlighted and in italics are calculated from other values based on the assumptions for estimating isotopic activities and total uranium from the measured value. The surface water data were used as a surrogate for pore water concentrations since groundwater at the City of Richland is assumed to be uncontaminated. Detailed data tables and plots of media concentrations over time can be found in Appendix A.

**Table 3.6**. Summary of Other Water Concentrations for the 300 Area

| | | Surface Water Concentrations | | |
|---|---|---|---|---|
| | | | Richland | |
| **Nonradionuclides (µg/L)** | | Minimum Value | Average Value | Maximum Value |
| cis-1,2,-Dichloroethene | | 0.06 | 0.2453846 | 0.47 |
| Nitrate | | 200 | 684 | 1500 |
| Tetrachloroethene | | 0.08 | 0.3061538 | 0.57 |
| Trichloroethene | | 0.09 | 0.275 | 0.48 |
| Uranium | | *0.000734* | *0.642* | *1.58* |
| **Radionuclides (pCi/L)** | | | | |
| Strontium-90 | | 0 | 0.0767715 | 0.305 |
| Technetium-99 | | 0 | 0.0645672 | 1.15 |
| Tritium | | 15.4 | 73.234579 | 594 |
| Uranium-234 | | *0.000251* | *0.220* | *0.542* |
| Uranium-235 | | 0 | 0.0084678 | 0.1 |
| Uranium-238 | | 0.000245 | 0.2142708 | 0.528 |

# 4.0 Ecological Risk Assessment

This section presents the ecological risk assessment. The problem formulation section describes the ecological setting and the species selection process. The analysis section describes the exposure modeling and endpoints for protection of ecological resources. The results section presents the results of the exposure and effects assessment and uncertainty in that assessment.

## 4.1 Problem Formulation

There are two purposes for the ecological risk assessment. The first purpose is to characterize the potential ecological risks from the groundwater pathway and provide information to support technically defensible and feasible risk management decisions for the 300-FF-5 Groundwater Operable Unit. The second purpose is to estimate contaminant concentrations in food items (e.g., fish, fruit) from the area that are then evaluated in some of the human health scenarios. The ecological setting and selection of species to be evaluated are described below.

### 4.1.1 Ecological Setting

To determine the scope for assessing ecological risk from the 300-FF-5 Groundwater Operable Unit groundwater, the ability for ecological receptors to reach the groundwater was investigated. The depth to the water table in the upland portion of the three 300 Area subregions, as obtained from HEIS, varies from 8.6 to 20.3 m (28 to 67 ft) (Table 4.1).

**Table 4.1**. Depth from Land Surface to Groundwater Table (m)

| Subregion | Min | Max |
|---|---|---|
| 300 Area | 8.61 | 19.4 |
| 618-11 | 9.9 | 19.5 |
| 618-10/316-4 | 16.1 | 20.3 |

A 1985 study of root depths at the 200 area (Klepper et al. 1985) concluded that the two deepest-rooted plants were antelope bitterbrush and sagebrush with average depths of 2.96 m (9.71 ft) and 2 m (6.56 ft), respectively. The results of a literature survey show that virtually all animals that currently inhabit the Hanford Site normally do not have a need to burrow deeper than 1 m (3.3 ft) (Gano and States 1982). These depths are much less than the more than 8 m (26 ft) depth to groundwater in the upland portion of any of the 300 Area subregions.

Because the depth to groundwater is deeper than plants and animals can access, no upland ecological impacts were calculated. Ecological impacts were estimated only for the riparian zone along the river shore and within the river. While riparian species were evaluated at both the 300 Area and at the City of Richland, the only medium at the City of Richland location containing contaminants from the 300 Area is surface water. The 300 Area location has contaminants in all media.

### 4.1.2 Species Selection

Species appropriate for the risk assessment are those that are known or likely to occur in the aquatic and riparian environment in the 300 Area and those that are part of the human health scenarios. The first set of species chosen includes those associated with the *Columbia River Comprehensive Impact Assessment: Screening Assessment and Requirements for a Complete Assessment.* (DOE 1998a) as species known or likely to occur in the area of concern. Additional species were included to link the ecological risk to the human health assessment and to include species specified for ecological risk assessment by the State of Washington's *Model Toxics Control Act* (WAC 1996), as documented in the Hanford Remediation Assessment Project (Kincaid et al. 2004). The process of linking the ecological and human health assessment tools allowed the concentrations within the tissues of species (body burdens) that are consumed by humans to be transferred directly from the ecological risk assessment tool to the human health assessment tool.

A key feature to evaluating the ecological risk for the 300-FF-5 Groundwater Operable Unit is the consideration of the food web for all species of concern. A complete assessment of the ingestion exposure pathway for species of concern should include all the species that are likely to be consumed by that organism. The species are evaluated for the uptake of contaminants directly from exposure to environmental media as well as in the organisms that they consume. Figure 4.1 illustrates the food web for the species considered in the aquatic and riparian environment.

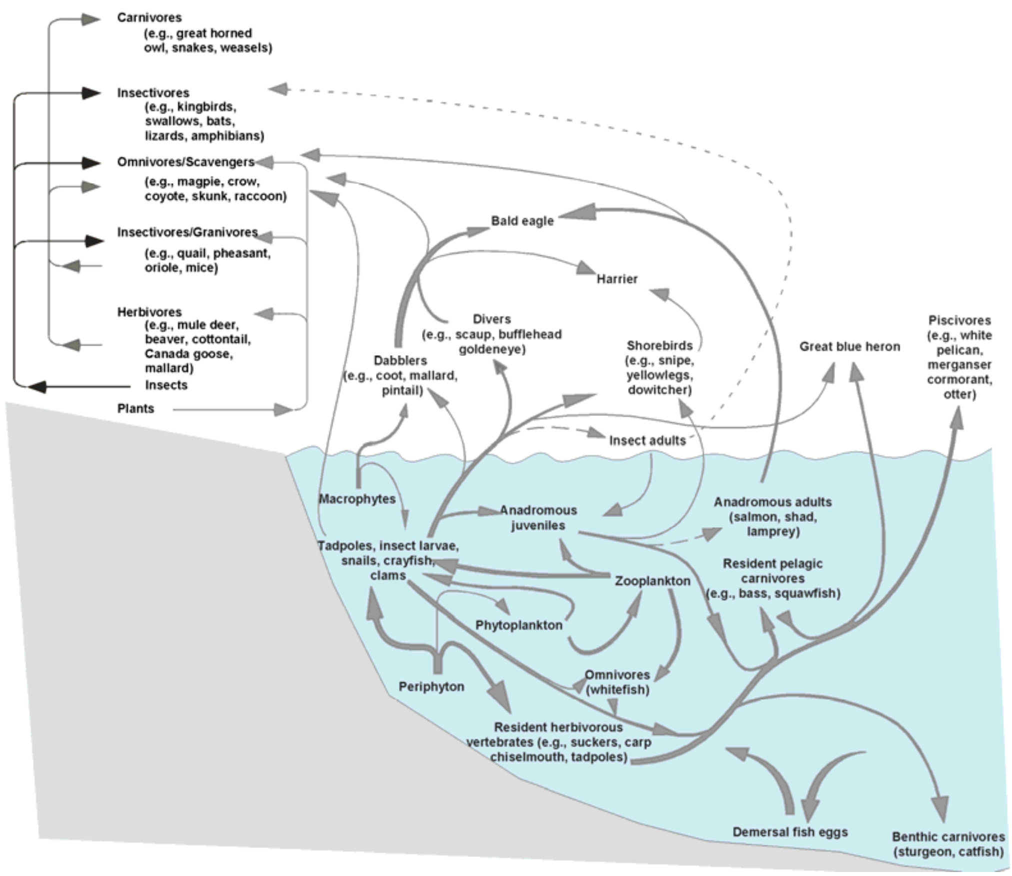


**Figure 4.1**. Aquatic and Riparian Food Web for the 300-FF-5 Groundwater Operable Unit Ecological Risk Assessment

Table 4.2 lists all the species considered for the 300-FF-5 Groundwater Operable Unit ecological risk assessment. The table includes the common and the scientific names of the organisms. The species are organized by taxonomic group, with the aquatic species listed first, followed by riparian species.

**Table 4.2**. Species Included in the 300-FF-5 Groundwater Operable Unit Ecological Risk Assessment

| Common Name | Scientific Name | Taxonomic Group |
|---|---|---|
| carp | *Cyprinus carpio* | Aquatic, benthic, fish |
| channel catfish | *Ictalurus punctatus* | Aquatic, benthic, fish |
| clams | *Corbicula sp.* | Aquatic, benthic, invertebrate |
| Columbia pebblesnail | *Fluminicola columbianus* | Aquatic, benthic, invertebrate |
| crayfish | *Astacus sp.* | Aquatic, benthic, invertebrate |
| *Daphnia magna* | *Daphnia magna* | Aquatic, pelagic, invertebrate |
| *Hyalella* | *Hyalella* | Aquatic, benthic, invertebrate |
| largescale/mountain sucker | *Catostomus species* | Aquatic, benthic, fish |
| mayfly | *Ephemeroptera ap.* | Aquatic, benthic, invertebrate |
| mountain whitefish | *Prosopium williamsoni* | Aquatic, benthic, fish |
| mussels | multiple species | Aquatic, benthic, invertebrate |
| Pacific lamprey (juvenile) | *Entosphenus tridentatus* | Aquatic, benthic, fish |
| periphyton | multiple species | Aquatic, benthic, plant |
| phytoplankton | multiple species | Aquatic, pelagic, plant |
| rainbow trout (adults) | *Oncorhynchus mykiss* | Aquatic, pelagic, fish |
| rainbow trout (eggs) | *Oncorhynchus mykiss* | Aquatic, benthic, fish |
| rainbow trout (juvenile) | *Oncorhynchus mykiss* | Aquatic, pelagic, fish |
| salmon (adults) | *Oncorhynchus sp.* | Aquatic, pelagic, fish |
| salmon (eggs) | *Oncorhynchus sp.* | Aquatic, benthic, fish |
| salmon (juvenile) | *Oncorhynchus sp.* | Aquatic, pelagic, fish |
| smallmouth bass | *Micropterus dolomieui* | Aquatic, benthic, fish |
| water milfoil | *Myriophyllum spicatum* | Aquatic, benthic, plant |
| white sturgeon | *Acipenser transmontanus* | Aquatic, benthic, fish |
| Woodhouse's toad (tadpole) | *Bufo woodhousei* | Aquatic, pelagic, amphibian |
| American coot | *Fulica americana* | Riparian, animal |
| American kestrel | *Falco sparverius* | Riparian, animal |
| American robin | *Turdus migratorius* | Riparian, animal |
| American white pelican | *Pelecanus erythrorhynchos* | Riparian, animal |
| bald eagle | *Haliaeetus leucocephalus* | Riparian, animal |
| bats | multiple species | Riparian, animal |
| beaver | *Castor canadensis* | Riparian, animal |
| black cottonwood | *Populus trichocarpa* | Riparian, plant |
| bufflehead | *Bucephala albeola* | Riparian, animal |
| California quail | *Callipepla californica* | Riparian, animal |
| Canada goose | *Branta canadensis* | Riparian, animal |
| cattle (meat) | multiple species | Riparian, animal |
| cattle (milk) | multiple species | Riparian, animal |
| chickens (adults) | *Gallus gallus* | Riparian, animal |
| chickens (eggs) | *Gallus gallus* | Riparian, animal |
| cliff swallow | *Hirundo pyrrhonota* | Riparian, animal |
| Columbia yellowcress | *Rorippa columbiae* | Riparian, plant |
| common snipe | *Gallinago gallinago* | Riparian, animal |

**Table 4.2.** (contd)

| Common Name | Scientific Name | Taxonomic Group |
|---|---|---|
| coyote | *Canis latrans* | Riparian, animal |
| dense sedge | *Carex densa* | Riparian, plant |
| earthworms | *Lumbricus spp.* | Riparian, animal |
| European starling | *Sturnus vulgaris* | Riparian, animal |
| Forster’s tern | *Sterna forsteri* | Riparian, animal |
| fungi | multiple species | Riparian, plant |
| grains | multiple species | Riparian, plant |
| grapes | multiple species | Riparian, plant |
| grasses | multiple species | Riparian, plant |
| great blue heron | *Ardea herodias* | Riparian, animal |
| hawks | multiple species | Riparian, animal |
| killdeer | *Charadrius vociferus* | Riparian, animal |
| leafy vegetables | multiple species | Riparian, plant |
| lizards | multiple species | Riparian, animal |
| mallard | *Anas platyrhynchos* | Riparian, animal |
| mulberry | *Morus alba* | Riparian, plant |
| mule deer | *Odocoileus hemionus* | Riparian, animal |
| muskrat | *Ondatra zibethica* | Riparian, animal |
| Northern harrier | *Circus cyaneus* | Riparian, animal |
| onions | *Allium* sp. | Riparian, plant |
| oriole | *Icterus bullockii* | Riparian, animal |
| pied-billed grebe | *Podilymbus podiceps* | Riparian, animal |
| porcupine | *Erethizon dorsatum* | Riparian, animal |
| rabbits | multiple species | Riparian, animal |
| raccoon | *Procyon lotor* | Riparian, animal |
| reed canarygrass | *Phalaris arundinacea* | Riparian, plant |
| ring-necked pheasant | *Phasianus colchicus* | Riparian, animal |
| root vegetables | multiple species | Riparian, plant |
| rushes | *Juncus sp.* | Riparian, plant |
| shrubs | multiple species | Riparian, plant |
| song sparrow | *Melospiza melodia* | Riparian, animal |
| terrestrial arthropods | multiple species | Riparian, animal |
| tree fruit | multiple species | Riparian, plant |
| tule | *Scirpus sp.* | Riparian, plant |
| vagrant shrew | *Sorex vagrans* | Riparian, animal |
| voles | *Microtus sp.* | Riparian, animal |
| weasel | *Mustela sp.* | Riparian, animal |
| Western harvest mouse | *Reithrodontomys megalotis* | Riparian, animal |
| Western kingbird | *Tyrannus verticalus* | Riparian, animal |
| Western terrestrial garter snake | *Thamnophis elegans* | Riparian, animal |
| willows | *Salix sp.* | Riparian, plant |
| Woodhouse’s toad (adult) | *Bufo woodhousei* | Riparian, animal |

A subset of the species in the ecological risk assessment is designated as food for use in the human health scenarios. These human food species are listed in Table 4.3. Species body burden results calculated in the ecological risk assessment are used to create a database of food concentrations that is the input into the human health calculations.

**Table 4.3**. Food Species Calculated for Use in the Human Health Model

| Species Common Name | Species Type |
|---|---|
| **Birds** | |
| Canada goose | Terrestrial animal |
| chickens (adults) | Terrestrial animal |
| **Eggs** | |
| chickens (eggs) | Terrestrial animal |
| **Fish** | |
| salmon (adults) | Aquatic animal |
| smallmouth bass | Aquatic animal |
| **Fruit** | |
| grains | Terrestrial plant |
| grapes | Terrestrial plant |
| mulberry | Terrestrial plant |
| tree fruit | Terrestrial plant |
| **Leafy Vegetables** | |
| leafy vegetables | Terrestrial plant |
| root vegetables | Terrestrial plant |
| **Meat** | |
| mule deer | Terrestrial animal |
| cattle (meat) | Terrestrial animal |
| cattle (milk) | Terrestrial animal |

## 4.2 Analysis

There are two components to the analysis phase: exposure assessment and effects assessment. The exposure assessment includes a description of the tools used to estimate exposure of a species to a contaminant. The effects assessment includes a description of the toxicity or other effects information used to relate the exposure estimates to a level of adverse effect.

### 4.2.1 Ecological Exposure Assessment

The exposure assessment was performed using the Ecological Contaminant Exposure Model (ECEM). ECEM is a multimedia, food web-based chronic exposure model. It is intended for use in situations where chemicals of concern are temporally invariant or are sufficiently static such that exposed organisms reach equilibrium with the environment. Chemicals of concern may vary spatially, however, on any scale. These conditions are met with the 300-FF-5 Groundwater Operable Unit contaminant sources, which are slowly released to the accessible environment, primarily via groundwater transport.

The ECEM code addresses exposure from chemicals of concern in air, surface water, groundwater, soils and sediment, along with associated media of pore water, seeps, and springs. With these as starting points, the code calculates contaminant concentrations in aquatic and terrestrial species including human foods such as fish and shellfish, terrestrial crops, meat, eggs, and other animal products. Exposure pathways explicitly modeled include external irradiation, dermal contact, inhalation, and ingestion of water, soil, sediment, and biota. ECEM can incorporate all components of an ecosystem or any fraction, including primary producers, herbivores, omnivores, and carnivores, as well as detritivores and other components of the decomposer community. Communities may include both aquatic and terrestrial (both riparian and upland) environments.

The ECEM code accommodates radioactive, inorganic, and organic contaminants. Multimedia exposure results are provided as tissue concentrations or dose for chemicals and radionuclides; health risks are quantified by converting these exposure metrics into hazard quotients, which are the dimensionless ratio of the estimated exposure to a toxicological reference benchmark.

The ECEM code is stochastic, accommodating uncertainty in environmental conditions and biological transport. The code accepts definition of parameters according to best-estimate, maximum, and minimum values, and type of distribution (uniform, triangular, normal, or lognormal). In this assessment, only the input contaminant concentrations were modeled stochastically. All of the uncertainty in the ecological results is due to variability in the input concentrations and not to variability in the ECEM parameters.

ECEM implements a series of ecological risk models that have been developed for applications in only terrestrial or aquatic systems, or only for plants or animals, to assess the entire range of organisms present at the Hanford Site. The models calculates body burden concentration in terrestrial plants from uptake through root uptake, foliar uptake and adsorption, and rainsplash of contaminants in soil, air, and water (Baes et al. 1984; Cowherd et al. 1985; Bacci et al. 1990; Riederer 1990; EPA 1991a; Nicholls 1991; McKone 1993; Hope 1995). Body burdens in terrestrial animals are based on contaminant uptake and adsorption from any combination of dermal contact, ingestion, and inhalation (EPA 1991a and 1993a; Hope 1995). The body burdens of aquatic animals and plants (or water-respiring organisms) are based on mass-balance equilibrium models that estimate exposures of aquatic organisms to metal or organic contaminants in sediments, pore water, surface water, and the subsequent transfer through the food chain (Thomann 1989; Thomann et al. 1992, 1995; Baker and Soldat 1992; EPA 1993b). The equations for the ECEM code are documented in Volume 2 of the updated *User Instructions for the System Assessment Capability, Rev. 1, Computer Codes* (Eslinger et al. 2006). The ECEM code has been used in previous risk assessments for the *Columbia River Comprehensive Impact Assessment: Screening Assessment and Requirements for a Complete Assessment* (DOE 1998a) and Hanford site-wide assessments (Bryce et al. 2002), 100-NR-2 Groundwater Operable Unit (DOE 2006a), and 200-ZP-1 Groundwater Operable Unit (DOE 2006b).

The parameters needed to model ecological risk by ECEM include species-specific attributes (e.g., body weights), species and analyte-specific attributes (e.g., bioconcentration factors, depuration rates), and analyte-specific parameters (octanol-water partition coefficient). For the 300-FF-5 Groundwater Operable Unit ecological risk assessment, the model was only used with deterministic (single point) parameters.

Data for ECEM were primarily derived from literature values. Parameters that are species-specific and parameters that are analyte-specific were obtained from standard references with little ambiguity in the values. Parameters that are both species-specific and analyte-specific were not as readily available and were selected based on the degree of relevance to the species and/or analytes being evaluated.

The first level of relevance for selection of species and analyte-specific parameters was defined primarily on the bases of major lifestyle and taxonomic similarities (Table 4.4). Under this scheme, when data were unavailable for a species of interest, values for closely related species at the immediately more general level of similarity were used instead. For example, if bioconcentration factor data for suckers were unavailable, data from the taxonomic family of fish, e.g., the *Cyprinoideae* family, were used. If no data were available for that family, then the average value for bony fishes was used instead. Data were generally rounded to one or two significant digits, depending on average data quality among taxonomic groups.

**Table 4.4**. Hierarchy of Substitution for Species-By-Chemical Parameterization

| | | | | | |
|---|---|---|---|---|---|
| **Mammals** | | | | | |
| Family | | | | | |
| Genus | | | | | |
| | **Birds** | | | | |
| | Family | | | | |
| | Genus | | | | |
| | | **Reptiles and Amphibians** | | | |
| | | Family | | | |
| | | Genus | | | |
| | | | **Fish** | | |
| | | | Family | | |
| | | | Genus | | |
| | | | | **Aquatic and Terrestrial Invertebrates** | |
| | | | | Family | |
| | | | | Genus | |
| | | | | | **Aquatic and Terrestrial Plants** |
| | | | | | Family |
| | | | | | Genus |

### 4.2.2 Ecological Effects Assessment

The potential for an individual organism developing adverse effects as a result of exposure to the toxic chemicals of interest is expressed as the EHQ. The EHQ is a ratio of the tissue concentration or applied dose of the chemical or radionuclide through all exposure pathways to that chemical's reference dose, or the reference dose for radiological exposure. The reference dose is an assessment endpoint. An EHQ of 1.0 is the value at which some impact might begin to be expected based on exposure to toxic materials.

Assessment endpoints indicate the biological resources and attributes that are to be protected and maintained within the ecosystem potentially at risk (EPA 1992). The resource attributes to be protected center on the long-term survival and health of the populations of receptors within the study area. Measurable thresholds that represent these attributes are termed "measurement endpoints." Measurement endpoints were selected that reflect significant mortality as well as sublethal effects such as adverse effects on behavior, growth, and reproduction, etc.

Radiological dose action levels are set by DOE's Biota Dose Assessment Committee (BDAC) and are set at a no observable adverse effects level (NOAEL). The BDAC is a topical committee established through the DOE Technical Standards Program. The purpose of the BDAC is to assist DOE in conceiving, developing, and promoting technical standards and guidance in assessing radiation doses to aquatic and terrestrial biota. The radiological dose thresholds for protection of biological populations, as set forth in DOE Technical Standard 1153 (DOE 2002), are as follows:

- For aquatic animals, 1 rad/d (10 Gy/d)
- For terrestrial plants, 1 rad/d (10 mGy/d)
- For terrestrial animals, 0.1 rad/d (1 mGy/d).

Available data indicate that dose rates below these limits cause no detectable adverse effects to populations of plants and animals (DOE 2002).

Thresholds for chemicals of interest (nonradionuclides) are established through extensive literature reviews and are chemical- and species- specific lowest observable adverse effects levels (LOAEL). Because exposure of receptor species to contaminants in the study area is assumed to be chronic, measurement endpoints (benchmarks) were selected that reflect sublethal effects on subtle aspects of the receptor species' biology, such as adverse effects on behavior, growth, and reproduction. Therefore, the measurement endpoints selected for this assessment include the lowest concentrations of the contaminants that are known to produce a clinically toxic response in any individual of a group of test organisms (lowest observable adverse effects concentration [LOEC] or level [LOAEL]). A complete listing of the non-radionuclide threshold values is given in Appendix B.

The process used to select the chemical chronic (LOEC and LOAEL) benchmarks in this assessment was as follows. Most of the benchmarks are the result of laboratory toxicological testing and so apply to the animal species that were used in the tests. Consequently, benchmarks for the receptor classes were derived by extrapolating across taxonomic groups. First, the receptors in Table 4.2 were grouped taxonomically and, to a lesser extent, by physical position in the environment (e.g., benthic organisms). Then, benchmark toxicological values were selected for a given class of receptor via a hierarchical decision-making process.

In benchmark selection, the first level of relevance was defined primarily on the bases of taxonomic and major life style similarities between the test (benchmark) organism and the class of receptor. Under this scheme, when data were unavailable for a given class of receptor, values for closely related species at the immediately more general level of taxonomic similarity were used instead. An example of a taxonomically based extrapolation would be for the determination of a toxicological benchmark for the smallmouth bass (*Micropterus dolomieu*) for a particular contaminant. If there were no specific data available for this species, then other members of the genus *Micropterus* or the family Centrarchidae were investigated. In the absence of data for the family, we used data for fish in general. In each case where extrapolation was used and three or more data points were available, we averaged the specific endpoint for the taxonomic group to retain a conservative estimate of the relevant benchmark.

An example of a lifestyle-based extrapolation would be for the determination of toxicological benchmarks for Columbia pebblesnail (*Fluminicola columbianus*) and a particular contaminant. If no specific data were available for this species, then other mollusks were investigated. In the absence of data on mollusks, data for other benthic invertebrates were used rather than data for mollusks in general because of similarity of life style with the receptor (i.e., bottom dwelling, etc.).

Although biological exposures are likely chronic in the study area, toxicological data from tests with longer exposure times were not selected preferentially to the exclusion of data based on shorter exposure times. Generally, the magnitude of the data from tests with longer exposure times did not differ noticeably from the magnitude of those based on shorter exposure times, and the former data were much fewer by comparison. Consequently, it was not worthwhile to preferentially select toxicological data from tests with longer exposure times.

In addition to differences in exposure time, toxicity tests often use organisms of differing sizes and life stages. However, little of this detail was retained in the databases reviewed. Further, the receptor classes identified in Table 4.2 are generally not life-stage specific. Thus, matching of life stages and sizes between benchmark organisms and receptor classes was not done.

Where two benchmarks were available that were both potentially suitable for a class of receptors, the lower (more conservative) reported value was selected. Where more than two benchmarks were available for the same species, the mean of the reported values was used. In cases where LOEC/LOAEL values were unavailable, they were estimated using 1/15th of the median lethal concentration/median lethal dose (LC50/LD50) (Suter 1993; Urban and Cook 1986; Tucker and Lietzke 1979).

## 4.3 Ecological Risk Assessment Results

Potential ecological risk from exposure to 300-FF-5 Groundwater Operable Unit nonradiological and radiological contaminants was evaluated for all the organisms shown in Table 4.2 at the City of Richland and 300 Area shorelines. These areas are influenced by the 300-FF-5 Groundwater Operable Unit contaminants through the groundwater pathway, and the aquatic and riparian plants and animals assimilate the contaminants through interaction with the surface water, pore water, seep, sediment, and soil. Figures 4.2 and Figure 4.3 illustrate the EHQs for nonradiological and radiological contaminants, respectively, for all the organisms by location. In these figures, EHQs for each analyte are shown as the range that occurs over all species that are listed in Table 4.2 at each location.

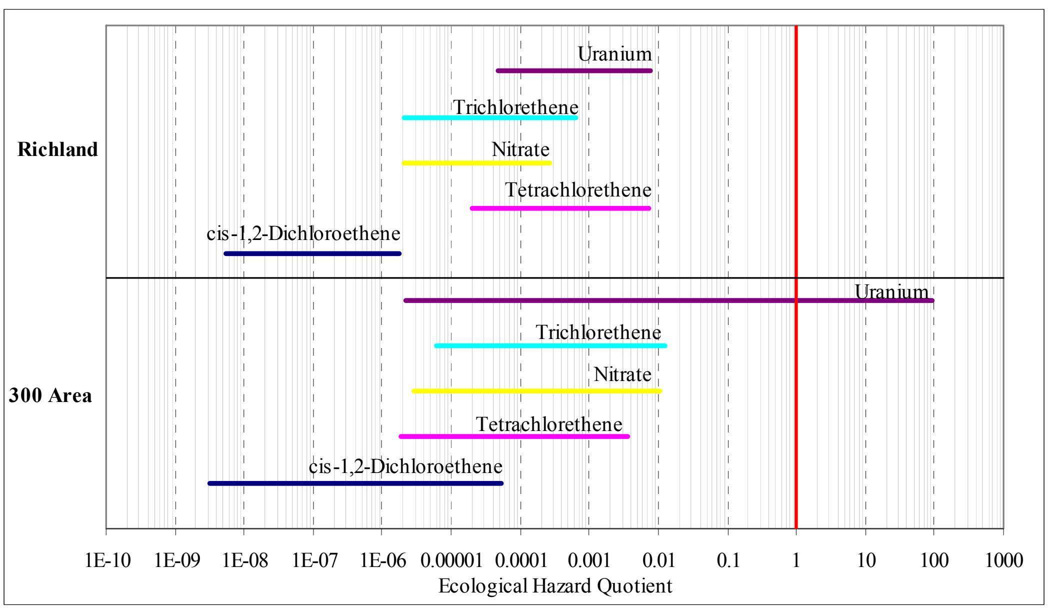


**Figure 4.2**. Estimated Ecological Hazard Quotients for Non-Radiological Analytes Based on Maximum Environmental Media Concentrations. Red line indicates threshold of hazard.

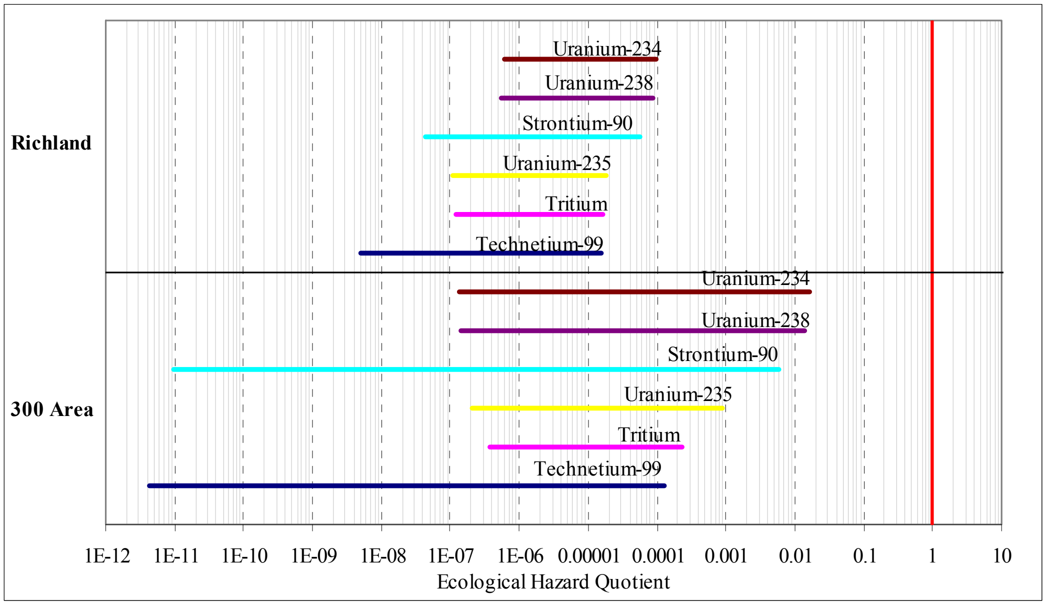


**Figure 4.3**. Estimated Ecological Hazard Quotients for Radionuclides Based on Maximum Environmental Media Concentrations. Red line indicates threshold of hazard.

### 4.3.1 Nonradionuclides

Table 4.5 summarizes the results for species where the EHQ exceeds 0.1. Figure 4.2 shows the results for all the species and contaminants by location. There is no single reference for nonradionuclide benchmark dose or concentration. Various individual studies have been used to provide benchmark dose limits that show no adverse effects. The ecological benchmark body burdens used are given in Appendix B.

The only nonradiological analyte for which any EHQ exceeded a benchmark is uranium. The three top species with an EHQ greater than 1 are all aquatic plants: periphyton, water milfoil, and phytoplankton. Uranium is known to accumulate in aquatic plants at concentrations that exceed the concentration in the water; however, there is evidence that, at least for the periphyton, uranium accumulates outside the cells of the organism and therefore may not interfere with cellular function (Bunn et al. 2006). The next highest EHQ was for uranium in the American coot. This is due primarily to uptake of the uranium through the coot's food, which is 80% periphyton and water milfoil.

### 4.3.2 Radionuclides

The radiological dose threshold for protection of plant and animal populations is set in the DOE Technical Standard *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002) as described earlier. This standard applies to the total radiological dose across all radionuclides, so Table 4.6 summarizes the results for the highest EHQs based on total radionuclide dose. In order to assess individual radionuclide contribution to total EHQ, Figure 4.3 shows the radionuclide-specific EHQ results across all species by location.

**Table 4.5**. Ecological Body Burdens and Non-Radionuclide EHQs

| Location | Species | Analyte | Body Burden | | Benchmark | | Chronic EHQ |
|---|---|---|---|---|---|---|---|
| 300 Area | periphyton | Uranium | 110860 | µg/kg dry | 1196 | µg kg dry | 93 |
| 300 Area | water milfoil | Uranium | 137 | µg/kg dry | 3 | µg /kg dry | 48 |
| 300 Area | phytoplankton | Uranium | 3297 | µg/kg dry | 962 | µg /kg dry | 3.4 |
| 300 Area | American coot | Uranium | 17668 | µg/kg wet | 15325 | µg kg wet | 1.2 |
| 300 Area | cliff swallow | Uranium | 13029 | µg/kg wet | 15325 | µg /kg wet | 0.85 |
| 300 Area | common snipe | Uranium | 12436 | µg/kg wet | 15325 | µg /kg wet | 0.81 |
| 300 Area | vagrant shrew | Uranium | 8206 | µg/kg wet | 17913 | µg /kg wet | 0.46 |
| 300 Area | bufflehead | Uranium | 6377 | µg/kg wet | 15325 | µg /kg wet | 0.42 |
| 300 Area | bats | Uranium | 8754 | µg/kg wet | 21303 | µg /kg wet | 0.41 |
| 300 Area | European starling | Uranium | 6248 | µg/kg wet | 15325 | µg /kg wet | 0.41 |
| 300 Area | song sparrow | Uranium | 5925 | µg/kg wet | 15325 | µg /kg wet | 0.39 |
| 300 Area | pied-billed grebe | Uranium | 4372 | µg/kg wet | 15325 | µg /kg wet | 0.29 |
| 300 Area | mallard | Uranium | 4293 | µg/kg wet | 15325 | µg /kg wet | 0.28 |
| 300 Area | *Hyalella* | Uranium | 148385 | µg/kg dry | 620000 | µg /kg dry | 0.24 |
| 300 Area | American kestrel | Uranium | 2583 | µg/kg wet | 15325 | µg kg wet | 0.17 |
| 300 Area | killdeer | Uranium | 2528 | µg/kg wet | 15325 | µg /kg wet | 0.16 |
| 300 Area | American robin | Uranium | 2446 | µg/kg wet | 15325 | µg /kg wet | 0.16 |
| 300 Area | Forster's tern | Uranium | 2132 | µg/kg wet | 15325 | µg /kg wet | 0.14 |
| 300 Area | Western kingbird | Uranium | 1914 | µg/kg wet | 15325 | µg /kg wet | 0.12 |
| 300 Area | Canada goose | Uranium | 1833 | µg/kg wet | 15325 | µg /kg wet | 0.12 |
| 300 Area | weasel | Uranium | 629 | µg/kg wet | 6270 | µg /kg wet | 0.10 |
| | The risk or hazard exceeds threshold levels. | | | | | | |

The maximum EHQ is 3.2E-02 for the American coot at the 300 Area. The maximum total radiological dose for any species is 4.3E-03 rad/d to *Hyalella* in the aquatic environment at the 300 Area subregion.

## 4.4 Comparison to Measured Tissue Concentrations

The body burden estimates from ECEM were compared to concentrations measured in organisms collected from the 300 Area vicinity by other Hanford programs to investigate the relationship between observed concentrations and concentrations estimated from environmental media values obtained from constrained spatial and temporal horizons. Very little coincident data are available in the HEIS database. Because ECEM does not model concentrations in body parts (e.g., organs, fillets, or bones), only field data on the whole body concentration could be used for this comparison.

One study gathered clams (*Corbicula* sp.) from the Columbia River along the 300 Area between 2002 and 2005. Clams are benthic, located on top of the cobble river bottom, and are exposed to a mixture of river and pore water. In the model, the clams' exposure to the water is 80% pore water and 20% surface water. In addition, there are drive point and aquifer tube results for uranium at these locations during a similar time frame, and these results were the basis of the pore water media concentration used in the assessment (Table 3.4). This makes the clam a good species to consider in the comparison of modeled versus measured body burdens.

**Table 4.6**. Radiological Doses and Ecological Hazard Quotients

| Location | Species Type | Species of Interest | Dose | Units | Dose Limit | Units | EHQ |
|---|---|---|---|---|---|---|---|
| 300 Area | Terrestrial Animal | American coot | 3.2E-03 | rad/d | 0.1 | rad/d | 3.2E-02 |
| 300 Area | Terrestrial Animal | cliff swallow | 2.7E-03 | rad/d | 0.1 | rad/d | 2.7E-02 |
| 300 Area | Terrestrial Animal | common snipe | 2.6E-03 | rad/d | 0.1 | rad/d | 2.6E-02 |
| 300 Area | Terrestrial Animal | bats | 1.8E-03 | rad/d | 0.1 | rad/d | 1.8E-02 |
| 300 Area | Terrestrial Animal | vagrant shrew | 1.7E-03 | rad/d | 0.1 | rad/d | 1.7E-02 |
| 300 Area | Terrestrial Animal | European starling | 1.3E-03 | rad/d | 0.1 | rad/d | 1.3E-02 |
| 300 Area | Terrestrial Animal | bufflehead | 1.3E-03 | rad/d | 0.1 | rad/d | 1.3E-02 |
| 300 Area | Terrestrial Animal | song sparrow | 1.3E-03 | rad/d | 0.1 | rad/d | 1.3E-02 |
| 300 Area | Terrestrial Animal | American kestrel | 9.0E-04 | rad/d | 0.1 | rad/d | 9.0E-03 |
| 300 Area | Terrestrial Animal | pied-billed grebe | 8.8E-04 | rad/d | 0.1 | rad/d | 8.8E-03 |
| 300 Area | Terrestrial Animal | mallard | 8.3E-04 | rad/d | 0.1 | rad/d | 8.3E-03 |
| 300 Area | Terrestrial Animal | weasel | 7.2E-04 | rad/d | 0.1 | rad/d | 7.2E-03 |
| 300 Area | Terrestrial Animal | Northern harrier | 5.8E-04 | rad/d | 0.1 | rad/d | 5.8E-03 |
| 300 Area | Terrestrial Animal | killdeer | 5.3E-04 | rad/d | 0.1 | rad/d | 5.3E-03 |
| 300 Area | Terrestrial Animal | American robin | 5.2E-04 | rad/d | 0.1 | rad/d | 5.2E-03 |
| 300 Area | Terrestrial Animal | Forster's tern | 4.5E-04 | rad/d | 0.1 | rad/d | 4.5E-03 |
| 300 Area | Aquatic Animal | *Hyallela* | 4.3E-03 | rad/d | 1 | rad/d | 4.3E-03 |
| 300 Area | Terrestrial Animal | Western kingbird | 4.0E-04 | rad/d | 0.1 | rad/d | 4.0E-03 |
| 300 Area | Terrestrial Animal | Canada goose | 3.9E-04 | rad/d | 0.1 | rad/d | 3.9E-03 |
| 300 Area | Terrestrial Animal | coyote | 3.5E-04 | rad/d | 0.1 | rad/d | 3.5E-03 |
| 300 Area | Terrestrial Animal | hawks | 3.3E-04 | rad/d | 0.1 | rad/d | 3.3E-03 |
| 300 Area | Terrestrial Animal | muskrat | 2.6E-04 | rad/d | 0.1 | rad/d | 2.6E-03 |
| 300 Area | Aquatic Animal | mayfly | 2.5E-03 | rad/d | 1 | rad/d | 2.5E-03 |
| 300 Area | Terrestrial Animal | raccoon | 2.5E-04 | rad/d | 0.1 | rad/d | 2.5E-03 |
| 300 Area | Terrestrial Animal | beaver | 2.0E-04 | rad/d | 0.1 | rad/d | 2.0E-03 |
| 300 Area | Aquatic Animal | *Daphnia magna* | 2.0E-03 | rad/d | 1 | rad/d | 2.0E-03 |
| 300 Area | Aquatic Plant | periphyton | 1.9E-03 | rad/d | 1 | rad/d | 1.9E-03 |
| 300 Area | Terrestrial Animal | California quail | 1.8E-04 | rad/d | 0.1 | rad/d | 1.8E-03 |
| 300 Area | Terrestrial Animal | oriole | 1.8E-04 | rad/d | 0.1 | rad/d | 1.8E-03 |
| 300 Area | Terrestrial Animal | mule deer | 1.8E-04 | rad/d | 0.1 | rad/d | 1.8E-03 |
| 300 Area | Terrestrial Animal | porcupine | 1.7E-04 | rad/d | 0.1 | rad/d | 1.7E-03 |
| 300 Area | Terrestrial Animal | ring-necked pheasant | 1.7E-04 | rad/d | 0.1 | rad/d | 1.7E-03 |
| 300 Area | Terrestrial Animal | Western harvest mouse | 1.6E-04 | rad/d | 0.1 | rad/d | 1.6E-03 |
| 300 Area | Terrestrial Animal | great blue heron | 1.4E-04 | rad/d | 0.1 | rad/d | 1.4E-03 |
| 300 Area | Aquatic Animal | columbia pebblesnail | 1.4E-03 | rad/d | 1 | rad/d | 1.4E-03 |
| 300 Area | Terrestrial Animal | rabbits | 1.3E-04 | rad/d | 0.1 | rad/d | 1.3E-03 |
| 300 Area | Terrestrial Animal | chickens (eggs) | 1.2E-04 | rad/d | 0.1 | rad/d | 1.2E-03 |
| 300 Area | Terrestrial Animal | cattle (meat) | 1.2E-04 | rad/d | 0.1 | rad/d | 1.2E-03 |
| 300 Area | Terrestrial Animal | voles | 1.2E-04 | rad/d | 0.1 | rad/d | 1.2E-03 |

The comparison for uranium in clams found at 300 Area spring locations versus the estimates from ECEM is shown in Figure 4.4. The clam whole-body tissue concentration predicted by ECEM (pink line on Figure 4.4) is within the maximum values for the 70 clam tissues that were measured and included in HEIS. These results are considered a good comparison for a risk assessment using maximum environmental media concentrations.

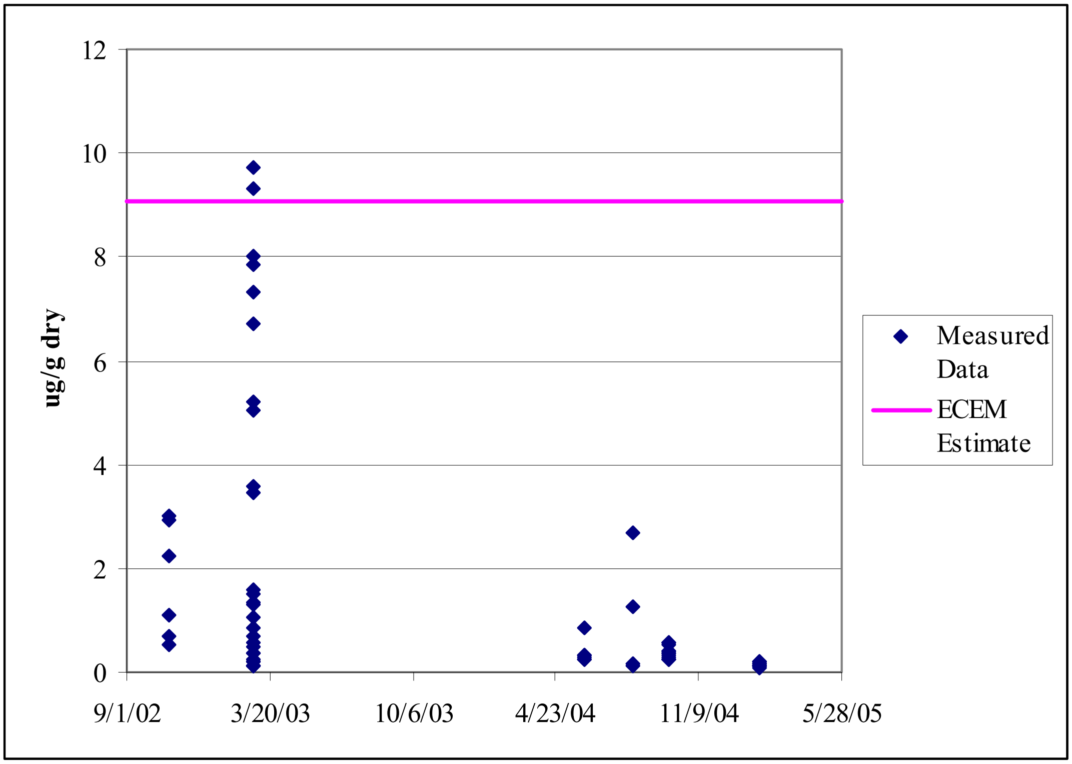


**Figure 4.4**. Measured and Modeled Uranium Body Burden in Clams at the 300 Area

Another contaminant of the 300-FF-5 Groundwater Operable Unit for which sufficient tissue data were available in HEIS was for strontium-90 in carp carcasses, as shown in Figure 4.5. Carp are found in the Columbia River all year long and do not travel significantly (they have a relatively small home range). The tissue concentrations in HEIS are for the entire carcass, including tissues, organs and bones, which are comparable to the body burden predicted by ECEM. Carp are considered benthic fish, but in ECEM the water exposure is 5% pore water and 95% surface water. There are no pore water data for strontium-90, and the values used in the assessment were the same as the surface water. This makes the carp interesting to consider in the comparison of modeled versus measured body burdens.

The comparison for strontium-90 in carp found in the Columbia River near the 300 Area versus the estimates from ECEM is shown in Figure 4.5. The carp whole-body tissue concentration estimated by ECEM (pink line on Figure 4.5) is within the range of values for the 20 carp carcasses that were measured and included in HEIS. One complication with this comparison is the low detection limit for strontium-90 in fish tissues, and 7 of the 20 samples are considered nondetects. Overall, the ECEM results are considered to be reasonable estimates for a risk assessment using maximum environmental media concentrations.

## 4.5 Uncertainties

There are several sources of uncertainty in the results of the risk assessment presented here. The sources of uncertainty are associated with the environmental media concentrations, exposure assumptions, toxicity values, and risk characterization.

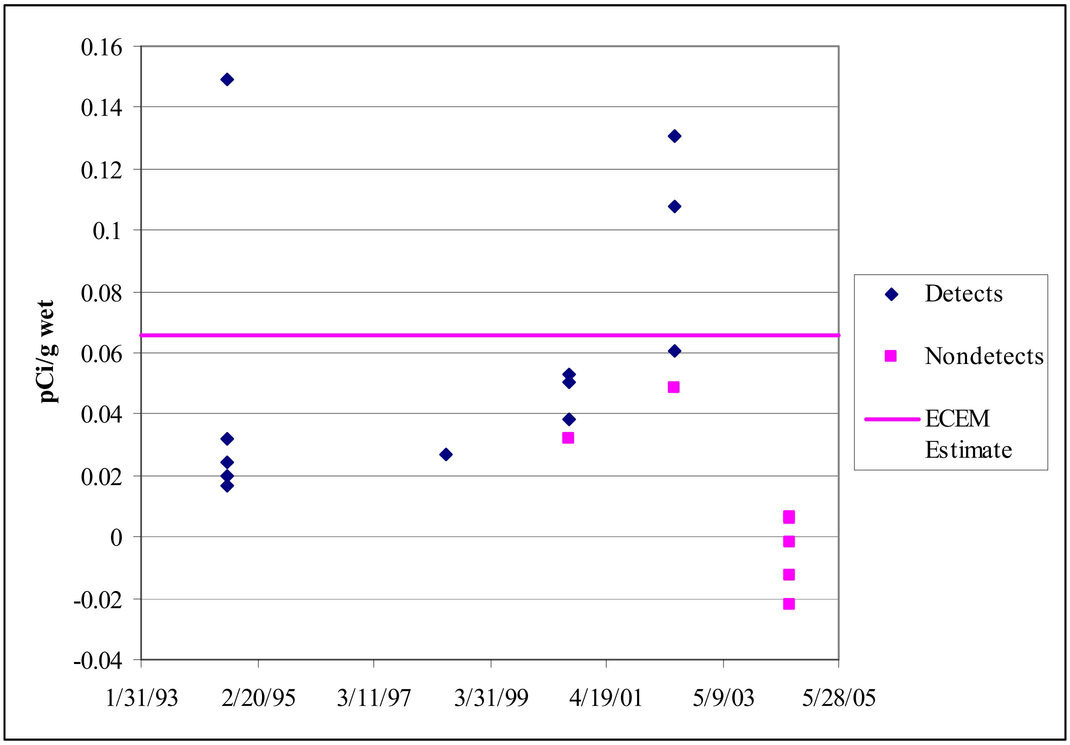


**Figure 4.5**. Strontium-90 Body Burden in Carp at the 300 Area

### 4.5.1 Uncertainty in the Environmental Media Concentrations

The ecological risk assessment was based on using the maximum environmental media concentration at a location. The actual measurements, however, were made at different points within a location. For example, some near-shore river values collected as part of the report, *Survey of Radiological and Chemical Contaminants in the Near-Shore Environment at the Hanford Site 300 Area* (Patton et al. 2003), collected as part of the surface water dataset. The use of maximum contaminant concentrations from across a large spatial extent is likely to overestimate the risks to ecological resources.

The selection of the maximum environmental media concentrations was also across periods of time that differed among the various media. The groundwater concentrations were based on values from 2002 through 2005. The maximum concentrations for surface water, seep, pore water, sediment, and soil were selected from values collected from 1994 through 2005. The longer period of time was necessary for these other media because they were not sampled as frequently as the groundwater. In some cases, the values had to be surrogated from one media type to another or estimated based on chemical or radioisotopic analysis. The effect of these extrapolations and use of different time periods is likely to overestimate the risk to ecological resources.

This assessment does not account for decay of radionuclides over time. Radionuclide concentrations were used as measured in the period from 1994 to present. The risk from exposure to radionuclides may be overestimated if radionuclide concentrations decrease over time. The contaminant most likely to be affected by this uncertainty is tritium because it has the shortest half-life (12.32 years) of the radionuclides that are considered.

### 4.5.2 Uncertainty Associated with the Exposure Assessment

Several types of uncertainties are associated with the exposure assessment. These include uncertainty in the estimation of risk from assumptions about the presence of the species selected for the assessment, the life styles of the species, and how the species interact with the environmental media.

In the modeling structure, an organism is assumed to live its entire life (or life-stage, as in the case of the three salmon life-stages considered) at a single location, constantly exposed to maximum contaminant concentrations. The uncertainty associated with this assumption will depend on the species being assessed. For example, this assumption is appropriate for aquatic and terrestrial plants, animals with a small home range, and organism that are short-lived. This assumption will overestimate the risks to species that have a large home range or spend part of their time at another location (e.g., migrate). In the case of the Canada goose, some of the population does migrate each year. However, since a portion of the population remains throughout the year, the more conservative assumption of a year-long exposure is appropriate for the assessment (Fitzner and Gray 1991, DOE 1994a). Similarly, a large species, like the mule deer, will have a large home range, and use of maximum contaminant concentrations can overestimate the uptake of contaminants. Past studies have shown that there are mule deer that use the areal extent of the 300-FF-5 Groundwater Operable Unit as their home range (Tiller and Poston 2000).

The food web for the species is an important risk driver in the assessment. There is some site-specific information about what a species is consuming and the proportion of their diet, and for some species, there is a lot of information about their consumption preferences in peer-reviewed literature. It is assumed that all the food is contaminated, and there is no provision for dilution of contaminated foodstuff by non-contaminated foodstuff. The variability in information about the food web is a source of uncertainty for this assessment.

Most of the ecological transport parameters are the result of laboratory testing and so apply to the animal species that were used in the tests. As discussed in Section 4.2.1, there was not information available for all species and contaminants for the transport and toxicological parameters required by this assessment. The surrogation activities necessary for populating the database required to run the ecological risk model may over- or underestimate the risk to the species.

An example of uncertainty in the assessment from the transport of environmental media to a species body burden is the case of strontium-90 in the Canada goose. The major contributor of strontium-90 to the Canada goose body burden in the exposure model is from root uptake from the soil. The source of the maximum soil value is 0.171 pCi/g dry in the west portion of the 300 Area (Table 3.5). This value is consistent with the soil concentration north of the 300 Area, which was 0.155 pCi/g dry. Both of these values were measured in 1997 as part of the Hanford Site monitoring program to provide information on long-term contamination trends and baseline environmental radionuclide concentrations in undisturbed locations (Dirkes and Hanf 1998) and are not indicative of groundwater contamination. Plants growing in this region of the Hanford Site are likely to take up strontium-90 and pass it on to a variety of plant-eating animals. The transport parameter for strontium-90 root uptake is the same value considered for human health assessments (Beyeler et al. 1999). While the ecological hazard quotient for the Canada goose and strontium-90 was well below levels of concern, the modeled tissue concentration in the Canada goose is high enough to drive the risk in the human health assessment (see Section 5.4.1 and Table 5.14).

### 4.5.3 Uncertainty Associated with the Toxicity Assessment

The toxicological database is also a source of uncertainty. The values for the benchmarks used in the ecological hazard quotient came from numerous sources with varying uncertainties. These uncertainties typically belong in the following categories:

- Use of information on dose-response effects from high-dose exposure scenarios to predict effects at low-dose exposure scenarios.
- Use of dose-response data from one species as a surrogate for another species.
- Use of short-term exposure data to extrapolate to long-term exposure or vice versa.
- Use of dose-response information from a homogeneous animal to predict the effects that may occur in the general population in which there are varying sensitivities to different contaminants.

An example of uncertainty in the assessment from the toxicology benchmarks is in the assessment of uranium in aquatic plants. The benchmark used for uranium and aquatic plants was 2.6 µg /L based on Suter and Tsao (1996). More recent studies would indicate that uranium effects are related to water hardness (presence of calcium ions). Sheppard et al. (2005) recommended a predicted no effects level of 0.005 mg/L with a hardness of 20 mg/L as $CaCO_3$, which corresponds to a LOEL-based benchmark of 75 µg /L. Ongoing studies on Columbia River periphyton response to uranium indicate that no effects levels are at 2 orders of magnitude higher at 60 mg/L as $CaCO_3$ than Sheppard et al. (2005) for the periphyton community (Bunn et al. 2006). Based on the uncertainty in the laboratory studies used to estimate the benchmark for calculating the EHQ for uranium and aquatic plants, these laboratory studies indicate that the impact to aquatic plants from uranium can vary; however, the body burden to the periphyton and phytoplankton is significant enough to indicate there would be impacts to that community at the measured uranium pore water concentration.

### 4.5.4 Uncertainty of Risk Characterization

The discussion of the EHQs for all the species for a contaminant involves iterating through the food web and numerous transport parameters, which may result in over- or underestimating the magnitude of the health impact. Uncertainties arise in the assumption that impact to an organism in the lowest levels of the food web are transferred to higher levels of the food web and result in higher body burdens. In addition, toxicity benchmarks that are prepared to be protective of all species are equally protective to populations of a species.

# 5.0 Human Health Risk Assessment

This section contains the human health risk assessment for the 300-FF-5 Groundwater Operable Unit. The exposure assessment identifies the pathways for the contaminants of interest to humans. The toxicity assessment discusses the sources of information (e.g., reference doses and slope factors) used to assess the toxicity of the contaminants to which humans will potentially be exposed. The fourth subsection includes the results of the exposure and toxicity assessment. The fifth subsection discusses the uncertainty associated with the risk assessment.

## 5.1 Human Health Risk Assessment Approach

The potential for an individual developing noncancer health effects as a result of exposure to the toxic chemicals of interest is expressed as the hazard quotient. The hazard quotient is a ratio of intake of the chemical through all pathways to the chemical's reference dose. A hazard quotient of 1.0 is the value at which some health impact might begin to be expected based on exposure to toxic materials. A hazard quotient of 0.1 indicates that the intake of potentially toxic material is at 10 percent of the levels at which toxic impacts might occur. Carcinogenic risks are characterized as an excess probability of developing cancer over a lifetime (i.e., an increased risk of developing cancer attributable to exposures to site-related contaminants). The likelihood or probability that an individual will develop cancer as a result of exposure to the carcinogenic chemicals and radionuclides of interest from the 300-FF-5 Groundwater Operable Unit is expressed as the incremental risk – an excess individual lifetime cancer risk distinct from risks that are not associated from a particular exposure scenario on the site. A risk of $1 \times 10^{-4}$ indicates a 1 in 10,000 chance that the individual would develop cancer. Similarly, a risk of $1 \times 10^{-6}$ indicates a 1 in a 1,000,000 chance that the individual would develop cancer (EPA 1989; DOE 1995; DOE 1998a).

### 5.1.1 Hazard and Risk Levels of Concern

A Baseline Risk Assessment determines the extent of cleanup needed to reduce potential incremental risk levels to within EPA's acceptable range (e.g., carcinogenic risks of $10^{-4}$ to $10^{-6}$- 40 CFR 300.430(e)(2)(i)(A)(2)):

> "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between $10^{-4}$ and $10^{-6}$ using information on the relationship between dose and response. The $10^{-6}$ risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure."
>
> "For systemic toxicants, acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety."

### 5.1.2 Summary of Human Health Exposure Scenarios

This section describes potential exposure scenarios applicable to the Hanford Site. To bring consistency to the assessment approach, DOE and the regulators developed a framework for how risk assessments will be performed and used on and around the Central Plateau. This approach was documented in the Tri-Parties response to Hanford Advisory Board Advice #132 (DOE 2005b). The scenarios presented in this section were developed for use at Hanford (Miley et al. 2006) and are used for this assessment with minor modifications.

Because humans potentially affected by groundwater contamination could be involved in a wide range of activities, various scenarios have been developed. Each scenario illustrates particular activity patterns by a specific group. This report defines the scenarios and the exposure factors used as the basis for estimating the potential range of risk to human health from Hanford-derived contaminants. Scenarios (based on conditions in the vicinity) have been developed to reflect the possible uses of the Hanford Site in the near future, and the scenarios are based on other assessments that have been used to evaluate risk in the region. Although the scenarios are based on current conditions, this does not imply that people are actually currently exposed to these risks. The risk estimated is only potential risk; it would only be actual risk if people were to start performing the activities postulated. The scenarios used for the 300-FF-5 Groundwater Operable Unit risk assessment are summarized in Table 5.1. For this report, only those scenarios listed as potentially occurring under current conditions are assessed.

**Table 5.1**. Summary of Human Health Scenarios for the 300-FF-5 Groundwater Operable Unit Assessment

| | Current Conditions | | |
|---|---|---|---|
| | | Offsite | |
| | Onsite | 300 Area Shoreline | Richland |
| Industrial | X | | X |
| Casual Recreation | | X | |
| Avid Recreation | | X | |
| Child Recreation | | | X |
| Offsite Residential Farmer | | | X |
| Drinking Water Only (GW) | X[a] | | |
| Drinking Water Only (SW) | X[a] | | X[a] |

[a]Drinking 2 L/d of unfiltered water is not a currently occurring scenario, but is evaluated for demonstration purposes.

### 5.1.3 Description of the HUMAN Computer Code

The human risk model is a screening-level chronic exposure model. It is intended for use in situations where the environmental contamination conditions are static or only slowly varying. The models are not appropriate for estimating risks from short-term accidental releases.

The HUMAN code addresses pathways related to long-term contamination from sources in air, surface water, and groundwater, with the associated contaminated media of seeps, springs, soils, and sediments. With these as starting points, the code estimates the exposures from contaminant concentrations in surface soil, air from resuspension and volatilization, aquatic foods, terrestrial crops, and animal products. Both domestic animals and wild animals have been included. Exposure pathways explicitly modeled include external irradiation, dermal contact, inhalation, and ingestion.

The HUMAN code provides flexibility in combining the various pathways into exposure scenarios. Scenarios are defined through the use of representative sets of input parameters to simulate annual average or lifetime average exposure conditions. The scenarios are focused on individual exposures.

Individuals are assumed to spend the amounts of time specified in the scenario at the location of analysis; individual mobility throughout the analysis domain is not supported.

The HUMAN code provides results for radioactive contaminants; non-radioactive but carcinogenic contaminants; and non-radioactive, non-carcinogenic, but still hazardous contaminants. Radiation impacts to people may be calculated as either radiation dose or risk. Carcinogenic chemical impacts are provided in terms of incremental risk, and impacts from hazardous chemicals are provided as hazard quotients – the dimensionless ratio of the estimated intake to a standard reference dose.

The HUMAN code is designed to accept multiple realizations of concentration of contaminants in the environment. It allows the definition of stochastic exposure parameters, which combine with the uncertainty in the input media concentrations to provide a full range of uncertainty on the final dose or risk to the hypothetical exposed individual. For this assessment, parameters within the HUMAN model were held at best-estimate values so that the impact of the variability in the input media concentrations is the only uncertainty represented in the results.

The HUMAN code implements standard human intake and impacts following established methodology as presented in *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors* (EPA 1991a) and *Hanford Site Risk Assessment Methodology* (DOE 1995). The equations for the HUMAN code are documented in Volume 2 of the Updated *User Instructions for the System Assessment Capability, Rev. 1, Computer Codes* (Eslinger et al. 2006). The HUMAN code has been used in previous risk assessments for the *Columbia River Comprehensive Impact Assessment: Screening Assessment and Requirements for a Complete Assessment* (DOE 1998a) and Hanford site-wide assessments (Bryce et al. 2002), the 100-NR-2 Groundwater Operable Unit (DOE 2006a), and the 200-ZP-1 Groundwater Operable Unit (DOE 2006b).

## 5.2 Exposure Assessment

The human health exposure assessment uses standard health assessment methodologies to estimate the magnitude, frequency, duration, and route of exposure of contaminants by humans through exposure scenarios and selected pathways. The exposures are described in scenarios and indicate complete pathways between the contaminants of interest and humans. Available contaminants in the media of interest at the study locations are described in Section 3.0, and the completed pathway exposure for the scenarios are described in the results presentations in Section 5.4. The exposure model and scenarios are described in this section.

The scenarios used in this assessment are Hanford Site-specific, and only a few basic types of human exposures scenarios are in use. Each scenario is routinely "customized" or adjusted to be appropriate for the location and type of chemical or radioactive contamination expected to be encountered. All are derived from earlier sets of scenarios developed at Hanford and first collected into DOE's *Hanford Site Risk Assessment Methodology* (HSRAM) (DOE 1995). HSRAM provides a set of uniform methods and inputs for use at Hanford so that assessments performed at various times by different organizations have a consistent basis. HSRAM, in turn, consolidates recommendations from other agencies such as EPA (1991a) and the Washington Administrative Code (WAC 1996). The scenarios were revised and expanded with stakeholder and tribal input for the Columbia River Comprehensive Impact Assessment (CRCIA) (DOE 1998a). Through the early stages of risk assessment at Hanford, there was an intercontractor group (Hanford Environmental Dose Overview Panel) dedicated to ensuring that all Hanford contractors used consistent assumptions and parameters in environmental calculations. That group is no longer functioning, but the general principle of "internal consistency" is still important so the results of various analyses can be directly compared. Site-specific assessments have resulted in further adaptation of the basic scenarios (Bryce et al. 2002; Napier and Snyder 2002; Thatcher 2003; Rittmann 2004). The most recent scenario compilation for the Hanford Tank Waste Performance Assessment (i.e., Rittmann 2004) was used as the starting point for the 300-FF-5 Groundwater Operable Unit scenarios. This compilation is based on the long history of stakeholder involvement starting with HSRAM and CRCIA and continuing through the Hanford Site System Assessment Capability.

A suite of human health scenarios is needed to capture at least the main potential human activities upon which factors (based on current conditions) can be screened to assess potential risk. The scenarios are designed to provide insights into various exposure pathways and the range of potential risks associated with different kinds of activity. The intent is to indicate the potential range of risk associated with activities ranging from occasional, casual exposure through intensive, continual contact.

The two main factors to be defined for each scenario are the contaminant pathways (media and exposure route of that media) and the exposure factors (intake/contact rate, exposure frequency, exposure duration, and special factors that apply to only certain media and exposure routes). An exposure pathway describes a unique mechanism by which an individual is exposed to radionuclides at or originating from a particular location. The media providing potential contamination to humans vary according to the particular scenario. The media considered are surface water, groundwater, soil, air, plants, and animal products. These media come in contact with humans via the exposure routes of ingestion, external radiation exposure, and inhalation.

Exposure factors are based on the scenario to be modeled. The exposure factors defined in the scenarios are the intake/contact rate, exposure frequency, exposure duration, and other factors that apply to only certain media and exposure routes. For instance, the amount of dust in the air is a parameter needed to estimate the inhalation exposure.

### 5.2.1 Industrial Worker Scenario

This scenario represents exposures that may occur to a person whose job is primarily indoors but would also include some outdoor activities, for example, building and grounds maintenance. The principal route of contamination of the environment is via groundwater or surface water, depending upon time. The worker is assumed to spend 8 hours/day in activities, to consume drinking water from the Columbia River, to ingest incidental quantities of soil, and to breathe materials suspended from the soils. The scenario assumes that the workers do not wear protective clothing. The HSRAM industrial scenario (DOE 1995) has been adopted with minimal modification because it is an accepted method that has been previously reviewed.

The primary pathways included in the Industrial Worker Scenario include direct water, soil, and air, as:

- Ingestion of contaminated water
- Ingestion of contaminated soil
- External exposure from radionuclides in the soil
- Inhalation of fugitive dust.

The Model Toxics Control Act Cleanup Regulation (MTCACR) (WAC 1996, section 745) provides standard exposure parameters for exposure to soil at industrial sites. These parameters are used in evaluating soil ingestion: exposure frequency, exposure duration, body weight (70 kg), and averaging time (20 years). The MTCACR also provides parameters for evaluating industrial/commercial exposures to airborne contaminants under WAC 1996, section 750. The exposure frequency of 250 days/year is used to represent the number of working days/year (EPA 1991b). The MTCACR assumes a frequency of contact of 0.4 to represent a reasonable maximum soil exposure, resulting in an exposure frequency of 146 days/year to soil. A shielding factor (a reduction in the dose rate by building walls and other deviations from a uniformly contaminated, flat surface) of 0.8 is used (DOE 1995).

For use in this assessment, the HSRAM rates for air inhalation were revised. The HSRAM inhalation rate is 20 $m^3$/d, or 2.5 $m^3$/hr for the 8-hour work day. This is the standard default exposure factor the commercial/industrial worker (EPA 1991b). The International Commission on Radiation Protection provides average adult inhalation rates (ICRP 1975). The ICRP value for inhalation rate for light activity is 1.2 $m^3$/hr, with a note that this value can increase to nearly 2.6 $m^3$/hr during periods of heavy work. The HSRAM value, which is near the ICRP maximum, seems unreasonable for the entire working year. Therefore, a value of 1.25 $m^3$/hr is used.

The worker is assumed to ingest small quantities of soil from hands, food, or other slightly soiled items. An intake of 50 mg per working day is assumed (EPA 1991b) for 146 days/year. The worker is assumed to consume 1 L/day of water from a surface water source while working. After a full workday, the worker takes a 10-minute shower at work using surface water.

The factors used for the Industrial Worker Scenario are presented in Table 5.2. The best-estimate value parameters in this scenario are equivalent to those reported by Rittmann (2004), as derived from the HSRAM (DOE 1995).

**Table 5.2.** Key Exposure Parameters for the Industrial Worker Scenario

| Pathway Parameters | Industrial Worker Best-Estimate Value |
|---|---|
| **Soil Exposure** | |
| External exposure, hr/d | 8 |
| Shielding[(a)] | 0.8 |
| Soil ingestion, g/d | 0.05 |
| Soil exposure, d/yr | 146 |
| **Inhalation** | |
| Breathing rate, $m^3$/d | 30 |
| Soil mass loading, g/$m^3$ | 0.00005 |
| Volatiles from surface water, hr/d | 0.17 |
| Breathing exposure, d/yr | 250 |
| Air exposure, hr/d | 8 |
| **Water Ingestion** | |
| Surface water ingestion, L/d | 1 |
| Drinking exposure, d/yr | 250 |
| **Food Ingestion** | |
| Food exposure, d/yr | NA |
| (a) The external gamma shielding factor is applied for the time spent indoors.<br>NA = Not analyzed. | |

### 5.2.2 Casual Recreation Scenario

This individual is included because many people currently use the Hanford Reach and adjacent wildlife refuge areas. Although there are a variety of year-round recreational activities, one of the most popular is sport fishing. The average angler catches salmon, steelhead, sturgeon, and smallmouth bass. This individual may fish along the shoreline or from a motorized or non-motorized boat (USDA 1993). Fishing seasons in Washington are regulated by the Washington Department of Fish and Wildlife (WDFW), and special rules and seasons are provided for trout, salmon, and sturgeon (WDFW 1995c). Other activities might include hunting, water-skiing, and swimming.

Jet and propeller-driven boats are used along the entire Hanford Reach, while non-motorized boats generally stay in the vicinity of the three primitive river access areas: Vernita Bridge, White Bluffs Ferry Landing (east side only), and Ringold Hatchery. Public access to shorelines and islands is restricted, and no overnight camping is allowed within the Hanford Site. Recreational boating is only a day-use activity. Data as to daily fishing and boating stay times per individual have not been determined. However, current factors as reported in HSRAM indicate that this individual may be potentially exposed 7 days/year averaged over a 70-year lifetime. For this report, the value is 4 days/year.

For the purposes of this study, the standard HSRAM recreational scenario is used as a baseline. For this report, the HSRAM recreational scenario is included with minimal modification. The MTCACR (WAC 1996), although acknowledging that recreational activities may occur at a site, does not provide parameters for evaluating recreational exposures. Therefore, exposure parameters are derived from information in EPA (1989, 1991a, 1991b, and 1991c), and the exposure parameters of the MTCACR. Inhalation of resuspended soil has been added for consistency with other scenarios. Factors for this scenario are provided in Table 5.3. The casual recreational scenario in this report includes ingestion of seep water, which is consistent with the scenario used in the 1994 report but is a deviation from the HSRAM scenario.

Minor ingestions of locally caught fish and game are assumed. Meat is assumed to be game (deer). The hunter is assumed to consume 25% of all meat acquired, sharing the remainder with others (DOE 1998a; Napier and Snyder 2002). One deer per season is assumed to be shot and eaten by the hunter and his family. (Elk are not included in this analysis because Hanford elk remain on the Fitzner-Eberhardt Arid Land Ecology Reserve almost exclusively and rarely travel across Highway 240.) The deer is assumed to have a total weight of 45 kg (99 lb), of which a 50-percent yield of deer meat is assumed for a total edible meat weight of 22.5 kg (49.6 lb)/deer (Paustenbach 1989). The average intake rate for the hunter from one 45-kg (99-lb) deer is 15 g (0.5 oz)/day. The HSRAM value is modified by a hunter success rate of 0.19 per year, which assumes a hunter harvests a deer about once every 5 years. However, this is not appropriate when calculating an annual impact because the meat would normally be consumed the year it is captured.

**Table 5.3**. Key Exposure Parameters for the Casual Recreation Scenario

| Pathway Parameters | Riparian Casual Recreation Best-Estimate Value |
|---|---|
| **Soil Exposure** | |
| External exposure, hr/d | 4 |
| Shielding | 1.0 |
| Soil ingestion, g/d | 0.04 |
| Soil exposure, d/yr | 4 |
| **Shore External Exposure** | |
| Swimming, hr/d | 2.6 |
| Boating, hr/d | 2.6 |
| Sediment exposure, hr/d | 4 |
| Sediment exposure, d/yr | 4 |
| Sediment ingestion, g/d | 0.04 |
| Sediment shielding | 0.2 |
| **Inhalation** | |
| Breathing rate, $m^3$/d | 20 |
| Soil mass loading, g/$m^3$ | 0.000025 |
| Volatiles from water, hr/d | NA |
| Sweat bathing, hr/yr | NA |
| Breathing exposure, d/yr | 4 |
| Air exposure, hr/d | 4 |
| **Water Ingestion** | |
| Seep water ingestion, L/d | 2 |
| Drinking exposure, d/yr | 4 |
| **Food Ingestion** | |
| Food exposure, d/yr | 365 |
| Leafy vegetables, kg/yr | NA |
| Other vegetables, kg/yr | NA |
| Fruit, kg/yr | NA |
| Grain, kg/yr | NA |
| Milk, L/yr | NA |
| Meat (mule deer), kg/yr[a] | 5.6 |
| Fowl, kg/yr | NA |
| Eggs, kg/yr | NA |
| Fish (adult salmon), kg/yr | 9.9 |

(a) Local game.
NA = Not analyzed.

### 5.2.3 Avid Recreation Scenario

The avid recreation scenario is defined in Miley et al. (2006). For the 300-FF-5 Groundwater Operable Unit current conditions baseline risk assessment, the avid recreation scenario is run only offsite at the 300 Area shoreline. The hunting and fishing occur in the river adjacent to the 300 Area, and drinking water is assumed to be brought from the Richland location. Key parameters for the Avid Recreational scenario are summarized in Table 5.4.

A variety of scenarios have been postulated to represent recreational use of the current Hanford Site; an early documented version is presented in HSRAM. The HSRAM scenario represents an interpretation of the current uses of the Hanford stretch of the Columbia River and adjacent wildlife refuge areas. Activities might include hunting, water skiing, and swimming.

The current HSRAM scenario indicates that individuals may be potentially exposed 7 days/year–this assumption has been criticized as an insufficient current usage rate and will definitely underestimate future uses when the Hanford Reach is actively used within the Hanford Reach National Monument. The CRCIA (DOE 1998a) provided an Avid Recreational Visitor Scenario to attempt provide information about risks from recreating in the area for a longer period of time each year compared to the HSRAM scenario. The CRCIA Avid Recreational Visitor Scenario involves an individual who fishes and hunts for game birds and animals onsite. The individual is exposed to soil and air while hunting in upland regions, to shoreline sediment while fishing or hunting, and to surface water while fishing and from ingestion of fish, birds, amphibians, and deer.

Exposure to contaminated soil may occur during trips to the site for hunting and other recreation. The hunter success rate is assumed to be typical, but the total catch of this reasonable maximum individual is 10 times the regional average: for upland game birds 25 pheasants/season (0.5 pheasants/day) (WDFW 1992, 1993, 1994, 1995a). That implies the hunter makes 50 trips hunting to upland areas. Each hunting trip involves 4 hours of onsite exposure with soil contact at the daily average value. The maximum number of days that could be spent hunting deer in a season is the length of the various deer hunting seasons (bow, muzzle loader, and firearm). In the state game management regions around Hanford (272, 278, 281, 284, 371, and 372) this is 48 days (WDFW 1995b). However, an individual hunter is not likely to spend the entire 48 days hunting. A maximum number of 44 days is assumed here. The maximum time spent (deer hunting, upland game bird hunting) is 80 days/year. This season could conceivably be longer if hunting seasons for other species such as doves and quail are included.

The hunter is assumed to ingest soil inadvertently during time spent onsite and in the field. The daily intake of 100 mg/day for adults is assumed to be related to the site (EPA 1991b). This results in an intake of 3.5 g/yr for this scenario. The hunter is assumed to be onsite 4 hours/day in riparian areas with exposure to soil occurring during that period. Because this is an outdoor scenario, no shielding of the radiation fields is assumed.

Resuspension of soil with subsequent inhalation is assumed to occur at all times while the hunter is onsite. External exposure over the period onsite is treated as the product of a dose rate from an infinite slab of contaminated soil, with an allowance for shielding by building walls. As noted above, no time is assumed to be spent indoors; therefore, this entire amount is assumed to be unreduced by the indoor shielding factor. The hunter is assumed to inhale a total of 20 $m^3/d$ of air. No indoor filtration is applicable.

During development of the Avid Recreation scenario with input from regulators, stakeholders and tribal representatives in preparation of the CRCIA (DOE 1998a), the type of water for ingestion was discussed. It was decided that the recreational visitor would drink surface water. This scenario was used for the current conditions assessment. This scenario was not assessed in the 1994 report.

Meat is assumed to be game (deer). The hunter is assumed to consume 25% of all meat acquired, sharing the remainder with others (DOE 1998a; Napier and Snyder 2002). One deer per season is assumed to be shot and eaten by the hunter family. (Elk are not included in this analysis because Hanford elk remain on the Fitzner-Eberhardt Arid Land Ecology Reserve almost exclusively and rarely travel across Highway 240.) The deer is assumed to have a total weight of 45 kg (99 lb), of which a 50% yield of deer meat is assumed for a total edible meat weight of 22.5 kg (49.6 lb)/deer (Paustenbach 1989). The average intake rate for the hunter from one 45-kg (99-lb) deer is 15 g (0.5 oz)/d. The HSRAM value is modified by a hunter success rate of 0.19/year, which assumes a hunter harvests a deer about once every 5 years. However, this is not appropriate when calculating an annual impact because the meat would normally be consumed the year it is captured. The weight of meat from each upland game bird caught by a hunter is taken to be 0.5 kg (50% of a 1-kg [2.2 lb] bird). The same is true for a water fowl. The total consumption of game birds and waterfowl is 16.1 kg (35.5 lb)/year (adopted from DOE 1998a).

**Table 5.4**. Key Exposure Parameters for the Avid Recreation Scenario

| Pathway Parameters | Riparian Avid Recreation Best-Estimate Value |
|---|---|
| **Soil Exposure** | |
| External exposure, hr/d | 4 |
| Shielding | 1.0 |
| Soil ingestion, g/d | 0.04 |
| Soil exposure, d/yr | 44 |
| **Shore External Exposure** | |
| Swimming, hr/d | NA |
| Boating, hr/d | 4 |
| Boating exposure, d/yr | 44 |
| Sediment exposure, hr/d | 4 |
| Sediment exposure, d/yr | 44 |
| Sediment ingestion, g/d | 0.04 |
| Sediment shielding | 0.2 |
| **Inhalation** | |
| Breathing rate, $m^3$/d | 20 |
| Soil mass loading, $g/m^3$ | 0.000025 |
| Volatiles from water, hr/d | NA |
| Sweat bathing, hr/yr | NA |
| Breathing exposure, d/yr | 44 |
| Air exposure, hr/d | 4 |
| **Water Ingestion** | |
| Surface water ingestion, L/d | 2 |
| Drinking exposure, d/yr | 44 |
| **Food Ingestion** | |
| Food exposure, d/yr | 365 |
| Leafy vegetables, kg/yr | NA |
| Other vegetables, kg/yr | NA |
| Fruit, kg/yr | NA |
| Grain, kg/yr | NA |
| Milk, L/yr | NA |
| Meat (mule deer), kg/yr[a] | 5.6 |
| Fowl (Canada goose), kg/yr[b] | 16.1 |
| Eggs, kg/yr | NA |
| Fish (smallmouth bass), kg/yr | 9.9 |

(a) Maximum annual deer consumption rate; 25% of one deer.
(b) Waterfowl and birds.
NA = Not analyzed.

### 5.2.4 Child Recreation Scenario

This individual is included because many people currently use the Hanford Reach and adjacent wildlife refuge areas. There are a variety of year-round recreational activities including boating, water-skiing, and swimming. Jet and propeller-driven boats and personal watercraft are used along the entire Hanford Reach, while non-motorized boats generally stay in the vicinity of the three primitive river access areas: Vernita Bridge, White Bluffs Ferry Landing (east side only), and Ringold Hatchery. Public access to shorelines and islands is restricted, and no overnight camping is allowed within the Hanford Site. Recreational boating is only a day-use activity. In this scenario, it is assumed a young person spends a good deal of time in the warmer months swimming, boating, floating ("tubing"), and sunbathing on the Columbia River shoreline. This scenario has no conceptual antecedents in HSRAM or other analyses. Key parameters for the Child Recreational scenario are summarized in Table 5.5.

The current HSRAM recreational scenario indicates that individuals may be potentially exposed 7 days/year – this assumption has been criticized as an insufficient current usage rate and will definitely underestimate future uses when the Hanford Reach is actively used within the Hanford Reach National Monument. This Recreational Visitor Scenario is an attempt to overcome the limitations of the HSRAM scenario for non-hunting visitors. This visitor is assumed to spend 5 days/week during the non-school period in June, July, and August near the river, for a total of 60 days/year. The individual is exposed to soil and air while loitering in upland regions, to shoreline sediment while picnicking or sunbathing, and to surface water while boating or swimming.

Exposure to contaminated soil may occur during trips to the site for recreation. The visitor is assumed to ingest soil inadvertently during time spent onsite and in the field. The CERCLA default soil ingestion rate for children is 200 mg/day (EPA 1991b). The visitor is assumed to be onsite 1.5 hours/day in upland areas and 4 hours/day in riparian areas, with exposure to soil or sediment occurring during these periods, and nominally 2.6 hours/day in or on the water (per HSRAM); because the times are only fractional days, a total soil intake of 100 millgrams/day (half of the child's total daily intake) is assigned to the site. The daily intake of 100 milligrams/day is apportioned to upland soil (25%) and riparian sediments (75%). This results in an intake of 6 grams (0.2 oz)/year of combined soil and sediment for this scenario. Because this is an outdoor scenario, no shielding of the radiation fields is assumed. A shore-width factor of 0.2 is applied to convert the nominal infinite-plane external dose rate factors into shoreline dose factors.

Resuspension of soil or sediment with subsequent inhalation is assumed to occur at all times while the visitor is onsite. The amount of resuspension is determined by using the mass loading approach as described for the avid recreational scenario, averaging 25 $\mu g/m^3$ ($1.6 \times 10^{-9}$ $lb/ft^3$). The visitor is assumed to inhale a total of 16 $m^3$ (565 $ft^3$) of air during the 8 hours while onsite (EPA 1989), a base breathing rate of 2 $m^3$/(70 $ft^3$) hour. No indoor filtration is applicable.

The visitor is assumed to ingest incidental amounts of river water while swimming and during water sports. Because this is assumed to be incidental to the various activities, a rate 1/10 that of normal is assumed, or about 0.2 L (0.5 gal)/d.

### 5.2.5 Offsite Residential Farmer Scenario

The Columbia Basin area is extensively farmed. The HSRAM (DOE 1995) established an Agricultural Resident Scenario to account for potentially increased exposures as a result of living on a

**Table 5.5**. Key Exposure Parameters for the Child Recreation Scenario

| Pathway Parameters | Child Recreation Best-Estimate Value |
|---|---|
| **Soil Exposure** | |
| External exposure, hr/d | 4 |
| Shielding | 1.0 |
| Soil ingestion, g/d | 0.025 |
| Soil exposure, d/yr | 60 |
| **Shore External Exposure** | |
| Swimming, hr/d | 2.6 |
| Swimming exposure, d/yr | 60 |
| Boating, hr/d | 2.6 |
| Boating exposure, d/yr | 60 |
| Sediment exposure, hr/d | 4 |
| Sediment exposure, d/yr | 60 |
| Sediment ingestion, g/d | 0.075 |
| Sediment shielding | 0.2 |
| **Inhalation** | |
| Breathing rate, $m^3$/d | 16 |
| Soil mass loading, g/$m^3$ | 0.000025 |
| Volatiles from water, hr/d | NA |
| Sweat bathing, hr/yr | NA |
| Breathing exposure, d/yr | 60 |
| Air exposure, hr/d | 4 |
| **Water Ingestion** | |
| Surface water ingestion, L/d | 0.2 |
| Drinking exposure, d/yr | 60 |
| NA = Not analyzed. | |

farm affected by Hanford contaminants. The Agricultural Resident Scenario involves consumption of locally produced food and animal products in addition to the external exposure, inhalation, and soil ingestion pathways of the other scenarios. It is assumed that the food products are grown in the same soil to which the Offsite Residential Farmer is exposed for external and inhalation exposures. The soil concentrations used in this assessment are based on monitoring results (see Section 3), and do not include modeling of soil concentrations based on irrigating the soil with contaminated water. The Washington State Department of Health (WDOH 1997) has defined a set of input parameters for this scenario. The advantage of the WDOH set of parameters is that the environmental parameters are all related to the Hanford Site.

The parameters in the CRCIA version of the scenario (DOE 1998a) were adapted from the HSRAM (DOE 1995) tables but made internally consistent. The breathing rates were standardized at 20 $m^3$ (26.2 yd3)/d. The CRCIA and HSRAM intake rates of soil are twice those of the WDOH recommendations because they "double count" surface soil and riparian sediments. Because the riparian sediments are many miles from most of the Hanford upland areas, the WDOH values are more reasonable. The parameters of significance are presented in Table 5.6 for the WDOH scenario; these were also the recommendations for the Hanford Reach National Monument Agricultural Resident Scenario (Napier and Snyder 2002).

**Table 5.6**. Key Exposure Parameters for the Offsite Residential Farmer Scenario

| Pathway Parameters | Offsite Residential Farmer Best-Estimate Value |
|---|---|
| **Soil Exposure** | |
| External exposure, hr/d | 16 |
| Shielding | 0.8 |
| Soil ingestion, g/d | 0.12 |
| Soil exposure, d/yr | 317 |
| **Shore External Exposure** | |
| Swimming, hr/d | NA |
| Boating, hr/d | NA |
| Sediment exposure, hr/d | NA |
| **Inhalation** | |
| Breathing rate, $m^3/d$ | 20 |
| Soil mass loading, $g/m^3$ | 0.00005 |
| Volatiles from water, hr/d | 0.17 |
| Breathing exposure, d/yr | 317 |
| Air exposure, hr/d | 18 |
| **Water Ingestion** | |
| Surface water ingestion, L/d | 1.5 |
| Drinking exposure, d/yr | 317 |
| **Food Ingestion** | |
| Food exposure, d/yr | 365 |
| Leafy vegetable, kg/yr[a] | 2.7 |
| Root vegetables, kg/yr[b] | 73 |
| Tree fruit, kg/yr[b] | 37 |
| Grain, kg/yr[b] | 0 |
| Milk, L/yr | 100 |
| Meat (cattle), kg/yr | 30 |
| Fowl (adult chicken), kg/yr | 6 |
| Eggs (chicken eggs), kg/yr | 6.8 |
| Fish, kg/yr | NA |

NA = Not analyzed.
[a] As suggested by WDOH (1997)
[b] Value of 110 kg/yr from WDOH (1997) apportioned 2/3 to other vegetables, 1/3 to fruits, and 0 to grains, as suggested by Rittmann (2004).

The ingestion rates of locally grown farm products are the WDOH values. They have been apportioned into specific categories as suggested by Rittmann (2004).

Overall, the WDOH values inputs are reasonable, and because they have been derived for local conditions, are recommended. A different value is recommended for the atmospheric mass loading, for which an annual average value of 50 µg $m^3$ is recommended. A key parameter for the inhalation pathway is the amount of material in the air from local sources on the ground. A value for this that has been commonly used is 100 µg/$m^3$. This value has been used at Hanford for many years (e.g., Schreckhise et al. 1993) based on historical measurements that indicated the total dust loading in the Hanford vicinity averaged about 85 µg/$m^3$. However, more recent measurements of $PM_{10}$, the particles less than 10 µm in aerodynamic median activity diameter – respirable size – account for only a fraction of the total dust loading. The RESRAD manual (Yu et al. 2000) presents a distribution taken from the EPA Aerometric Information Retrieval System (AIRS). The RESRAD distribution, verified by download from the AIRS site (http://www.epa.gov/airs/airs.html), indicates that the United States average concentration of $PM_{10}$ is only about 23 μg/$m^3$. Recent data from a particulate sampler located in the Hanford 200 Area for the period February 2001 through June 2002 is available (Napier and Snyder 2002, Appendix C). The mean air concentration of $PM_{10}$ particulate in the 200 Areas, in an outdoor area influenced by the Hanford 24 Command wildfire in 2000, is only 21 μg/$m^3$. The $95^{th}$ percentile daily value is only 36.5 μg/$m^3$. Thus, a default of 100 μg/$m^3$ is probably excessive. The RESRAD manual states that "…use of a high, short-term loading will result in an overestimate of the annual dose. A time average mass loading factor should be used in RESRAD for a more realistic dose estimate" (Yu et al. 2000, p. 4-15). Because the dust in frequented areas such as dirt roads might be enhanced because of mechanical disturbances, an annual average value of 50 μg/$m^3$ is appropriate.

The selected parameters differ slightly from, but are consistent with, both those of Rittmann (2004) and Thatcher (2003). They are also of the same magnitude as those recommended for an agricultural screening scenario developed by the National Council on Radiation Protection and Measurements (NCRP 1999).

### 5.2.6 Drinking Water Scenario

A drinking water only scenario is run, not as a realistic scenario for current conditions, but as a bounding scenario for evaluating the risk to humans. The only exposure allowed under the drinking water scenario is 2 L (0.5 gal)/d (730 L [193 gal] of water per year) consumption of water. For the onsite drinking water scenario, both groundwater consumption and surface water consumption are evaluated. For the offsite drinking water scenario, surface water is consumed.

## 5.3 Toxicity Assessment

The toxicity assessment evaluates the magnitude of exposure to a contaminant in the groundwater at the 300 Area and subregions, as well as the transport of that contaminant through the groundwater pathway and to the City of Richland. The assessment also evaluates the likelihood and/or severity of adverse health effects to potentially exposed populations. There are two steps to the toxicity assessment: hazard characterization and dose-response. Hazard characterization involves determining if the exposure to a contaminant in the groundwater can cause an increase in the incidence of a particular adverse health effect (e.g., kidney damage, cancer) and whether the adverse health effect is likely to occur in people that interact with the groundwater. Dose-response assessment involves describing the quantitative relationship between the amount of exposure to a contaminant and the incidence of an adverse health effects in the people that interact with the groundwater (EPA 1989).

### 5.3.1 Hazard Characterization and Dose-Response Evaluation

The types of toxic effects are identified in the hazard characterization step. There are two broad categories of contaminants and their toxic effects: noncarcinogens and carcinogens. Noncarcinogenic contaminants are known to cause a wide variety of systemic effects, and carcinogenic contaminants are known or suspected of causing cancer. Some contaminants can be categorized as both noncarcinogenic and carcinogenic, e.g., uranium. Risks from noncarcinogens and carcinogens are calculated differently, and their results are reported separately. The contaminants considered in the 300-FF-5 Groundwater Operable Unit include noncarcinogenic (toxic) chemicals, carcinogenic chemicals, and radionuclides (which can have both a toxic and carcinogenic health risk) (EPA 1989).

Noncarcinogenic chemicals and radionuclides (which are known to have a toxic effect) are assessed using toxicity values from studies of chronic effects. The toxicity values are referred to as chronic reference dose factors (RfD). They are an estimate of a daily exposure level for people that are unlikely to result in an appreciable risk of adverse effect during a lifetime. Chronic RfD have been derived to be protective of sensitive populations for long periods of time – from 7 years to a lifetime (EPA 1989). The list of contaminants that are noncarcinogens is given in Table 5.7.

Carcinogenic chemicals and radionuclides have been classified as cancer-causing using a weight-of-evidence approach. EPA has developed an approach for classifying chemicals as carcinogens that uses a weight-of-evidence approach to determine the likelihood of that chemical as a human carcinogen. The two chemical carcinogens considered in the 300-FF-5 Groundwater Operable Unit Risk Assessment are TCE and tetrachloroethene. They have been classified as possible (C) or probable human carcinogen (B2) based on data from animal studies. A slope factor for a carcinogenic contaminant is used to estimate the upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a concentration of a potential carcinogen (EPA 1989). Further information on the carcinogenic chemicals is provided in Table 5.8.

Exposure to ionizing radiation from radionuclides at levels typical of environmental contamination can lead to adverse effects due to energy deposited in sensitive tissues, known as the radiation dose. Adverse effects typical of the levels of radionuclides found from environmental contamination include carcinogenicity, mutagenicity, and teratogenicity. Based on the theory that there is no safe level of radiation, any dose of radiation has the potential to produce an adverse effect. Risk coefficients have been developed as a means of quantifying the probability of an adverse effect from internal and external exposure to ionizing radiation from radionuclides (EPA 1989, 1999).

Dose-response assessment involves describing the quantitative relationship between the amount of exposure to a substance and the extent of toxic injury or disease. Data are derived from animal studies or, less frequently, from studies in exposed human populations. There may be many different dose-response relationships for a substance if it produces different toxic effects under different conditions of exposure. The risks of a substance cannot be ascertained with any degree of confidence unless dose-response relations are quantified, even if the substance is known to be toxic (EPA 1989).

### 5.3.2 Sources of Data for the Toxicity Assessment

Toxicity values for noncarcinogenic and carcinogenic chemicals in the 300-FF-5 Groundwater Operable Unit risk assessment were obtained from two sources. The Integrated Risk Information System (IRIS) database was used as the primary source of toxicity values. This database is maintained by EPA to provide information that is intended for use in protecting public health through risk assessment and risk management. The Risk Assessment Information System (RAIS) was consulted as a secondary source of information when data on a contaminant were not available in IRIS. RAIS is sponsored by DOE.

Toxicity values for radionuclides were collected from sources that provide information according to the *Cancer Risk Coefficients for Environmental Exposure to Radionuclides* (EPA 1999). These values include parameters for inhalation, ingestion, and submersion (EPA 1988) as well as external radiation (EPA 1993b). The latest values were checked in the most recent supplemental material on cancer risk coefficients (EPA 2002).

### 5.3.3 Reference Doses for Noncancer Effects

Reference dose values are the toxicity estimates describing the dose-response relationship for noncancer effects. For noncarcinogens, there is evidence that the body can be exposed to a concentration at which there is no adverse effect. However, when the exposure exceeds some threshold concentration, then adverse effects are possible. An RfD is derived from dose-response experiments that determine an exposure level at which there are no statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control. This concentration is called the no-observed-adverse-effect-level (NOAEL). Some effects may be produced at this level, but they are not considered to be adverse, nor precursors to specific adverse effects. In an experiment with more than one NOAEL, the regulatory focus is primarily on the highest one, leading to the common usage of the term NOAEL to mean the highest exposure level without adverse effect (EPA 1989).

The process of developing RfD from NOAEL (or LOAEL) for the critical toxic effect involves the consistent application of uncertainty factors (UFs) and a modifying factor (MF). Uncertainty factors generally consist of multiples of 10, although sometimes values less than 10 are used. Each factor represents a specific area of uncertainty inherent in the extrapolation from the available data. The bases for applying uncertainty factors are listed below (EPA 1989):

- A UF of 10 is used to account for variation in the general population and is intended to protect sensitive subpopulations (e.g., elderly, children)
- A UF of 10 is used when extrapolating from animals to humans. This factor is intended to account for the interspecies variability between humans and other mammals
- A UF of 10 is used when a NOAEL derived from a subchronic instead of a chronic study is used as the basis for a chronic RfD
- A UF of 10 is used when a LOAEL is used instead of a NOAEL. This factor is intended to account for the uncertainty associated with extrapolating from LOAELs to NOAELs.

A MF for an RfD is a value ranging from >0 to 10 that is included to reflect a qualitative professional assessment of additional uncertainties in the studies to determine the toxicity value and for information that is not explicitly addressed by the uncertainty factors (EPA 1989). The MF is 1 for all the contaminants in this assessment (EPA 1989).

To calculate a RfD, the effects threshold (NOAEL or LOAEL) is divided by the product of all of the applicable uncertainty factors and the modifying factor:

$$\text{RfD} = \text{NOAEL or LOAEL}/(\text{UF}_1 \times \text{UF}_2 \times \ldots \times \text{UF}_n \times \text{MF})$$

The ratio of the human dose calculated in the exposure for a contaminant to the contaminant's RfD value is the hazard quotient (EPA 1989). The reference doses used for this assessment are given in Table 5.7.

**Table 5.7**. Human Health Reference Doses for Ingestion and Inhalation

| Analyte | Ingestion RfD (mg/kg/d) | Uncertainty Factor | Source | Inhalation RfD (mg/kg/d) | Uncertainty Factor | Source |
|---|---|---|---|---|---|---|
| cis-1,2-Dichloroethene | 1.00E-02 | 3000 | RAIS | | | |
| Nitrate | 1.60E+00 | 1 | IRIS | | | |
| Tetrachloroethene | 1.00E-02 | 1000 | IRIS | 1.71E-01[a] | 30 | RAIS |
| Trichloroethylene | 3.00E-04[b] | 3000[b] | RAIS | 1.14E-02[b] | 1000[b] | RAIS |
| Uranium | 6.00E-04[c] | | RAIS | | | |

[a] The Risk Assessment Program has contacted Superfund and been given provisional values that should be used for DOE projects. This value should be clearly documented as provisional.
[b] These toxicity values present EPA's most current evaluation of the potential health risks from exposure to trichloroethylene (TCE) (EPA 2001b). EPA Region IX and Region III have also adopted these toxicity values.
[c] Source: *Federal Register*, Thursday December 7, 2000. Part II, Environmental Protection Agency. 40 CFR Parts 9, 141, and 142 - National Primary Drinking Water Regulations; Radionuclides; Final Rule. p 76713.

### 5.3.4 Slope Factors for Cancer Effects from Carcinogenic Chemicals

The slope factor is used in this risk assessment to estimate an upper-bound lifetime probability above background of an individual developing cancer as a result of exposure to a carcinogenic chemical. Slope factors are expressed in units of incremental risk per level of exposure (or intake). The dose-response relationship used to calculate slope factors comes from studies with animals or human studies based on occupational exposures or epidemiological studies. Typically, these studies are conducted with high doses of the carcinogen, and the values for lower doses are extrapolated from mathematical models. The values recommended by EPA assume linearity at low doses when there is uncertainty in the carcinogen's mechanism of action. Often, the slope factor is the upper 95 percent confidence limit of the slope of the dose-response curve and is expressed as mg/kg/day. These assumptions result in the uncertainty of the estimate to be included in the recommended slope factor. Estimates of risk from the slope factors are therefore plausible upper-bound estimates of the probability of a response per unit intake of a contaminant over a lifetime (EPA 1989). The slope factors for cancer effects from chemicals are given in Table 5.8.

**Table 5.8**. Human Health Slope Factors for Ingestion and Inhalation

| Analyte | Weight-of-Evidence Classification | Ingestion Slope Factor $(mg/kg/d)^{-1}$ | Source | Inhalation Slope Factor $(mg/kg/d)^{-1}$ | Source |
|---|---|---|---|---|---|
| Tetrachloroethene | C-B2 | 5.2E-02[a] | RAIS | 2.03E-03[a,b] | RAIS |
| Trichloroethylene | C-B2 | 4.00E-01[c] | RAIS | 4.00E-01[b] | RAIS |

a RAIS has adopted an oral slope factor of 5.40E-01 $(mg/kg/d)^{-1}$ and an inhalation slope factor of 2.07E-02 $(mg/kg/d)^{-1}$ from California EPA and EPA Region 9. EPA Regions VI and III have also adopted these toxicity values. The slope factor values used in this table were current at the time the calculations were done for this assessment. The change in the slope factors does not impact total risk at the 300 Area since tetrachloroethene risk is not a significant contributor to total risk (see Figure 5.2), and total risk at the City of Richland location would still be well below 1E-06 using the newer slope factors.
b The Inhalation Slope Factor was calculated from inhalation unit risk as described in Supplemental Guidance from RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance) (November 1995) (EPA 2000b).
c These toxicity values present EPA's most current evaluation of the potential health risks from exposure to TCE (EPA 2001b). EPA Region IX and Region III have adopted these toxicity values as well.

### 5.3.5 Risk Coefficients for Effects from Radionuclides

The estimation of risk to human health from exposure to radionuclides was done using risk coefficients. This process considers state-of-the-art methods and models to take into account risks to health from internal or external exposure to radionuclides considering age and gender dependence of intake, metabolism, dosimetry, radiogenic risk, and competing cause of death in estimating. Morbidity risk coefficients were used in this assessment rather than the mortality risk coefficients. A morbidity risk coefficient is a comparable estimate of the average total incremental risk above background of experiencing a radiogenic cancer, whether or not the cancer is fatal (EPA 2002). This coefficient is similar to the estimate made using a slope factor for carcinogenic chemicals, and because the morbidity risk coefficient is similar to the estimate of risk using a slope factor for carcinogenic chemicals, the results of each of these risks can be summed to estimate the cumulative incremental risk from both carcinogenic chemicals and radionuclides. Cancer risk coefficients for radionuclides are estimates of the probability of radiogenic cancer morbidity above background per unit activity inhaled or ingested for internal exposure, or per unit time-integrated activity concentration in air or soil for external exposure (EPA 2002). The risk factors used for ingestion when more than water was ingested are given in Table 5.9. The risk factors for the drinking water only scenarios are given in Table 5.10.

**Table 5.9**. Human Health Risk Factors for Dietary Ingestion

| Description | Risk Factor (EPA 2002) | Units | Value Used | Units |
|---|---|---|---|---|
| H3 risk factor for soil | 0 | risk/sec per Bq/kg | 0 | risk/hr per pCi/kg |
| H3 risk factor for swimming | 0 | Sv/sec per Bq/m3 | 0 | risk/hr per pCi/L |
| H3 risk factor for boating | 0 | risk/sec per Bq/m3 | 0 | risk/hr per pCi/L |
| H3 risk factor for ingestion | 1.76E-12 | risk/Bq | 6.51E-14 | risk/pCi |
| H3 risk factor for inhalation | 1.52E-12 | risk/Bq | 5.62E-14 | risk/pCi |
| Sr-90 risk factor for soil | 1.68E-17 | risk/sec per Bq/kg | 2.24E-15 | risk/hr per pCi/kg |
| Sr-90 risk factor for swimming | 3.78E-19 | Sv/sec per Bq/m3 | 4.02E-15 | risk/hr per pCi/L |
| Sr90 risk factor for boating | 1.89E-19 | risk/sec per Bq/m3 | 2.01E-15 | risk/hr per pCi/L |
| Sr-90 risk factor for ingestion | 2.58E-09 | risk/Bq | 9.53E-11 | risk/pCi |
| Sr-90 risk factor for inhalation | 1.27E-09 | risk/Bq | 4.69E-11 | risk/pCi |
| Tc-99 risk factor for soil | 6.97E-20 | risk/sec per Bq/kg | 9.28E-18 | risk/hr per pCi/kg |
| Tc-99 risk factor for swimming | 3.14E-21 | Sv/sec per Bq/m3 | 3.35E-17 | risk/hr per pCi/L |
| Tc-99 risk factor for boating | 1.57E-21 | risk/sec per Bq/m3 | 1.67E-17 | risk/hr per pCi/L |
| Tc-99 risk factor for ingestion | 1.08E-10 | risk/Bq | 4.00E-12 | risk/pCi |
| Tc-99 risk factor for inhalation | 3.14E-11 | risk/Bq | 1.16E-12 | risk/pCi |
| U-233 risk factor for soil | 8.41E-19 | risk/sec per Bq/kg | 1.12E-16 | risk/hr per pCi/kg |
| U-233 risk factor for swimming | 3.64E-20 | Sv/sec per Bq/m3 | 3.88E-16 | risk/hr per pCi/L |
| U-233 risk factor for boating | 1.82E-20 | risk/sec per Bq/m3 | 1.94E-16 | risk/hr per pCi/L |
| U-233 risk factor for ingestion | 2.62E-09 | risk/Bq | 9.69E-11 | risk/pCi |
| U-233 risk factor for inhalation | 1.74E-08 | risk/Bq | 6.44E-10 | risk/pCi |
| U-234 risk factor for soil | 2.16E-19 | risk/sec per Bq/kg | 2.88E-17 | risk/hr per pCi/kg |
| U-234 risk factor for swimming | 1.75E-20 | Sv/sec per Bq/m3 | 1.86E-16 | risk/hr per pCi/L |
| U-234 risk factor for boating | 8.75E-21 | risk/sec per Bq/m3 | 9.32E-17 | risk/hr per pCi/L |
| U-234 risk factor for ingestion | 2.58E-09 | risk/Bq | 9.55E-11 | risk/pCi |
| U-234 risk factor for inhalation | 1.70E-08 | risk/Bq | 6.29E-10 | risk/pCi |

**Table 5.9**. (contd)

| Description | Risk Factor (EPA 2002) | Units | Value Used | Units |
|---|---|---|---|---|
| U-235 risk factor for soil | 4.44E-16 | risk/sec per Bq/kg | 5.91E-14 | risk/hr per pCi/kg |
| U-235 risk factor for swimming | 1.59E-17 | Sv/sec per Bq/m3 | 1.69E-13 | risk/hr per pCi/L |
| U-235 risk factor for boating | 7.95E-18 | risk/sec per Bq/m3 | 8.47E-14 | risk/hr per pCi/L |
| U-235 risk factor for ingestion | 2.55E-09 | risk/Bq | 9.44E-11 | risk/pCi |
| U-235 risk factor for inhalation | 1.59E-08 | risk/Bq | 5.88E-10 | risk/pCi |
| U-238 risk factor for soil | 4.27E-20 | risk/sec per Bq/kg | 5.69E-18 | risk/hr per pCi/kg |
| U-238 risk factor for swimming | 7.95E-21 | Sv/sec per Bq/m3 | 8.47E-17 | risk/hr per pCi/L |
| U-238 risk factor for boating | 3.98E-21 | risk/sec per Bq/m3 | 4.24E-17 | risk/hr per pCi/L |
| U-238 risk factor for ingestion | 2.34E-09 | risk/Bq | 8.66E-11 | risk/pCi |
| U-238 risk factor for inhalation | 1.54E-08 | risk/Bq | 5.70E-10 | risk/pCi |

**NOTES:**
U-235+D includes Th-231
Sr-90 value used is Sr/Y-90, Sr-90 plus Y-90
Soil exposure is for contaminated soil depth of 15 cm and is from EPA (2002), soil volume, morbidity
Swimming factor is from EPA (1993b, Table III.2), effective
Boating exposure is ½ swimming exposure
Ingestion factor is from EPA (2002), dietary, morbidity.
Tritium ingestion factor is from EPA (2002), tritiated water, morbidity
Inhalation factor is from EPA (2002), particulate, type F, morbidity
Tritium inhalation factor is from EPA (2002), water vapor, morbidity

**Table 5.10**. Human Health Risk Factors for Water Ingestion Only

| Analyte | Risk Factor (Water Only – EPA [2002]) | Units | Value Used | Units |
|---|---|---|---|---|
| H3 | 1.37E-12 | risk/Bq | 5.07E-14 | risk/pCi |
| Sr-90/Y-90 | 2.00E-09 | risk/Bq | 7.39E-11 | risk/pCi |
| Tc-99 | 7.44E-11 | risk/Bq | 2.75E-12 | risk/pCi |
| U-234 | 1.91E-09 | risk/Bq | 7.07E-11 | risk/pCi |
| U-235 (+D) | 1.94E-09 | risk/Bq | 7.18E-11 | risk/pCi |
| U-238 | 1.73E-09 | risk/Bq | 6.40E-11 | risk/pCi |

**NOTES:**
U-235+D (+Daughters) includes Th-231
Sr-90/Y-90 is Sr-90 plus Y-90
Tritium ingestion factor is from EPA (2002), tritiated water, morbidity
Ingestion factor is from EPA (2002), D water, total, morbidity.

## 5.4 Human Health Risk Assessment Results

Potential human health risk from exposure to current conditions of the groundwater from the 300-FF-5 Groundwater Operable Unit was evaluated for the 300 Area, the subregions of the 300 Area (618-10/316-4 and 618-11) and the City of Richland. The assessment included an evaluation of the hazards and risks associated with exposure to the groundwater or from other pathways that were affected by the groundwater, as discussed Section 5.1.2. The contaminants of interest included carcinogenic chemicals, toxic chemicals and radionuclides (which can have both a toxic and carcinogenic health risk). Results of the human health risk assessment were based on exposure to the maximum environmental concentrations (a deterministic assessment) and on the range of environmental concentrations (a stochastic assessment). The parameters within the HUMAN model were held constant for the stochastic assessment so that only the uncertainty in environmental concentrations is reflected. The median of the stochastic results is presented in this section.

Figure 5.1 and Figure 5.2 present the ranges of calculated impacts by contaminant across the range of scenarios evaluated at the City of Richland location and at the 300 Area. Only the currently occurring scenarios are represented in these figures, not the hypothetical drinking water scenarios. The drinking water scenarios use unfiltered water, which is not how city residents consume publicly supplied water. The range of results for the City of Richland includes casual recreation, child recreation, farmer, and industrial. The range of results for the 300 Area includes avid recreation, casual recreation, and industrial. The results for the 618-10/316-4 and 618-11 subregions have not been included because the industrial scenario effects would be represented by a single point.

At the City of Richland location, the maximum impacts from carcinogenic chemicals, toxic chemicals, and radionuclides are more than an order of magnitude below the hazard quotient of 1.0 and $1x10^{-6}$ probability of incremental cancer incidence for any of the scenarios evaluated. The impact from groundwater entering the Columbia River and being used by people in the City of Richland does not pose a potential health risk considering the current conditions in the 300 Area today.

The 300 Area does have maximum impacts of carcinogenic chemicals, toxic chemicals, and radionuclides that exceed health concerns for the scenarios evaluated. The maximum hazard quotient for uranium in the 300 Area exceeds 0.1 for all the scenarios evaluated and exceeds 1.0 for some of the scenarios. This assessment considered the chemically toxic aspects of uranium. The maximum risks from uranium-238 and -234, and strontium-90 exceeded the incremental probability of $1x10^{-6}$ for carcinogenic risk in some of the scenarios evaluated in the 300 Area.

Table 5.11 presents results for each area by scenario for the median and maximum contaminant concentration cases. The table presents the sum of hazard quotients for all the toxic chemicals by each scenario evaluated and the sum of incremental risks for all carcinogenic chemicals and radionuclides for each scenario. The highest hazard quotients for the median case are the hypothetical groundwater drinking water scenarios in the 300 Area, 618-10/316-4, and 618-11 subregions. The highest hazard quotients for the maximum case are the Avid Recreation and groundwater drinking water scenarios in the 300 Area, and groundwater drinking water scenario at 618-10/316-4 and 618-11 subregions. Uranium is the toxic chemical driving the hazard quotient to be greater than 1 in these scenarios as illustrated in Figure 5.1.

The incremental risks are greater than $1 \times 10^{-6}$ for the maximum case for all of the scenarios evaluated in the 300 Area subregions (Table 5.11). For the median contaminant concentration case, the incremental risk is greater than $1x10^{-6}$ for some of the scenarios in the 300 Area (Table 5.11). As shown in Figure 5.2, the contaminants that are driving the incremental risk above $1 \times 10^{-6}$ are associated with exposure to uranium-238, uranium-234, and strontium-90. The exposure pathways and the contributing contaminants in each exposure scenario are discussed below.

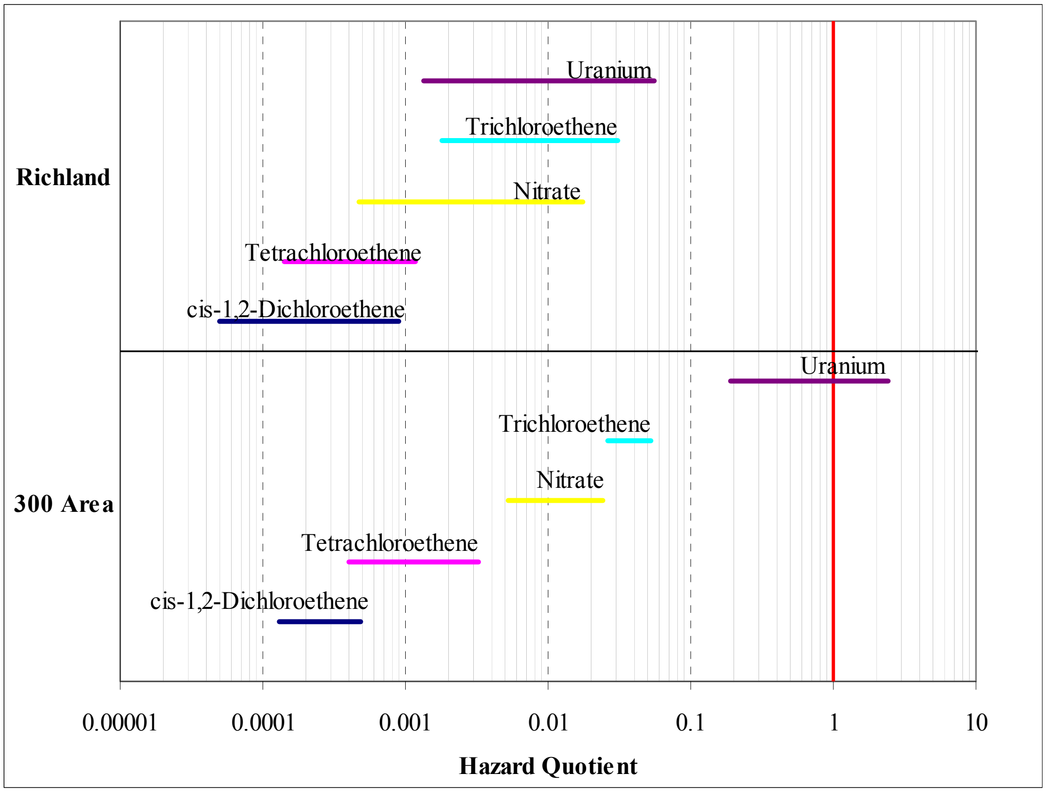


**Figure 5.1**. Human Health Non-Carcinogenic Hazard Results by Analyte

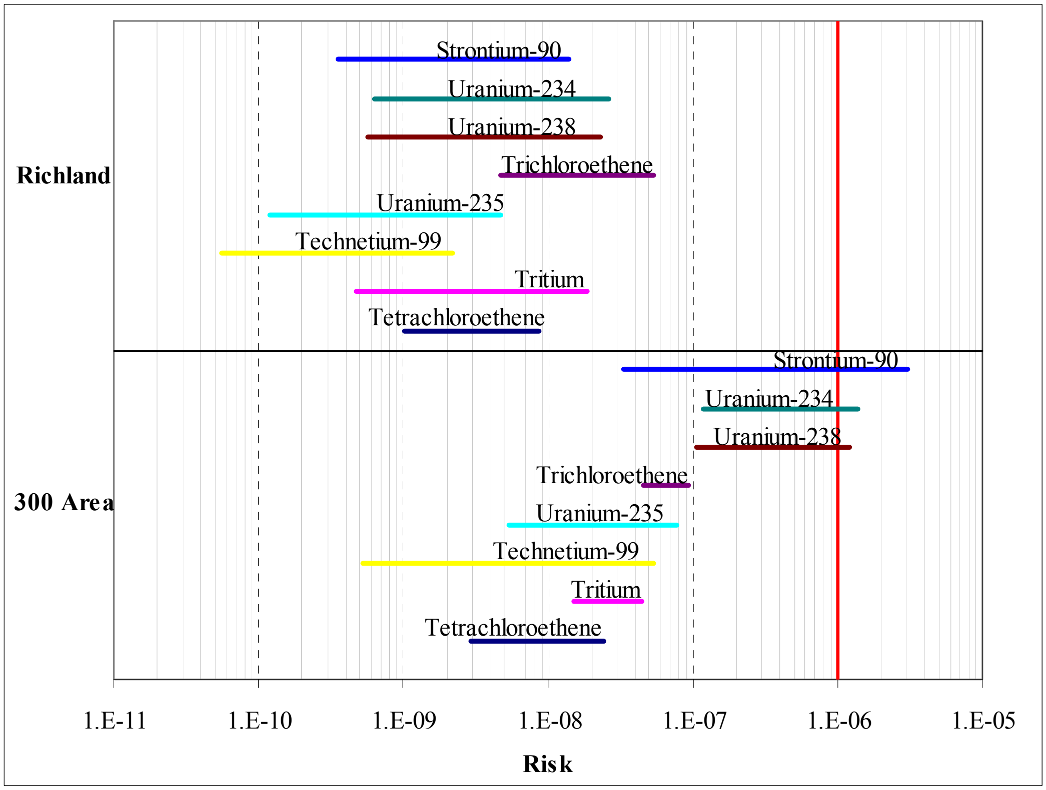


**Figure 5.2**. Human Health Carcinogenic Incremental risk Results by Analyte

**Table 5.11.** Summary of Human Health Impacts by Scenario for the 300-FF-5 Groundwater Operable Unit.

| | | Stochastic Median Case | | Maximum Case | |
|---|---|---|---|---|---|
| Location | Scenario | Total HQ | Total Risk | Total HQ | Total Risk |
| 300 Area[a] | Avid Recreation | 0.93 | 3.E-06 | 2.5 | 6.E-06 |
| 300 Area | Casual Recreation | 0.080 | 9.E-07 | 0.23 | 2.E-06 |
| 300 Area | Industrial | 0.10 | 8.E-07 | 0.24 | 2.E-06 |
| 300 Area | GW Drinking Water | 5.5 | 4.E-06 | 15 | 1.E-05 |
| 300 Area | SW Drinking Water | 0.25 | 1.E-06 | 0.57 | 4.E-06 |
| 618-10/316-4 | Industrial | 0.10 | 8.E-07 | 0.24 | 2.E-06 |
| 618-10/316-4 | GW Drinking Water | 1.6 | 1.E-06 | 2.9 | 2.E-05 |
| 618-11 | Industrial | 0.10 | 8.E-07 | 0.24 | 2.E-06 |
| 618-11 | GW Drinking Water | 1.5 | 5.E-05 | 2.9 | 1.E-04 |
| Richland | Child Recreation | 0.0018 | 3.E-09 | 0.0038 | 8.E-09 |
| Richland | Farmer | 0.049 | 5.E-08 | 0.11 | 2.E-07 |
| Richland | Industrial | 0.028 | 4.E-08 | 0.06 | 8.E-08 |
| Richland | SW Drinking Water | 0.071 | 7.E-08 | 0.15 | 2.E-07 |

[a] Drinking water for this scenario is from the City of Richland location

These scenarios are hypothetical. They do not occur under current conditions

The incremental risk or hazard benchmark is exceeded for this scenario

### 5.4.1 Risk Assessment Results for the Avid Recreation Scenario

The current conditions scenario with the highest risk is the avid recreation scenario. This scenario was evaluated only at the 300 Area. The activity assumes that the individual is spending 44 days per year hunting and fishing as well as boating and swimming in the publicly accessible areas of the Columbia River along the shores of the 300 Area (Table 5.4). The pathways for interacting with groundwater from the 300-FF-5 Groundwater Operable Unit are soil, external exposure to Columbia River water and sediment while swimming and boating, inhalation, ingestion of drinking water (surface water from the Richland location) and food (hunting for mule deer and Canada geese, and fishing for bass). Table 5.12 summarizes the risk assessment results for the avid recreation scenario.

**Table 5.12.** Risk Assessment Results for the Avid Recreation Scenario for the Maximum Contaminant Concentration Case

| Location | Analyte ID | Solution Type | Value | % of Total | Solution Type | Value | % of Total |
|---|---|---|---|---|---|---|---|
| 300 Area[a] | cis-1,2-Dichloroethene | HQ | 0.00027 | 0.0% | | | |
| 300 Area[a] | Nitrate | HQ | 0.005 | 0.2% | | | |
| 300 Area[a] | Tetrachloroethene | HQ | 0.0033 | 0.1% | Risk | 2.E-08 | 0.4% |
| 300 Area[a] | Trichloroethylene | HQ | 0.053 | 2.1% | Risk | 9.E-08 | 1.6% |
| 300 Area[a] | Uranium | HQ | 2.4 | 97.5% | | | |
| 300 Area[a] | Strontium-90 | | | | Risk | 3.E-06 | 52.5% |
| 300 Area[a] | Technetium-99 | | | | Risk | 5.E-08 | 0.9% |
| 300 Area[a] | Tritium | | | | Risk | 3.E-08 | 0.4% |
| 300 Area[a] | Uranium-234 | | | | Risk | 1.E-06 | 24.0% |
| 300 Area[a] | Uranium-235 | | | | Risk | 8.E-08 | 1.3% |
| 300 Area[a] | Uranium-238 | | | | Risk | 1.E-06 | 20.7% |
| **300 Area[a]** | **TOTAL** | **HQ** | 2.5 | | **Risk** | 6.E-06 | |

[a] Drinking water for this scenario is from the City of Richland location.

The risk or hazard benchmark is exceeded for this analyte

Exposure to the non-carcinogenic chemicals in the groundwater at the 300 Area through this scenario does exceed the hazard quotient of 1.0 (HQ = 2.5), indicating a potential for adverse health effects. The chemical driving the assessment of adverse health effects from noncarcinogenic chemicals is uranium (97.5% of the total). Exposure to uranium is from all the pathways, including concentrations in food, water, and soil, but the ingestion pathway accounts for 99.9% of the total hazard. The results for uranium exposure for the avid recreation scenario are given in Table 5.13.

Exposure to all the carcinogenic chemicals and radionuclides in the groundwater at the 300 Area through this scenario also exceeds the incremental risk level of 1 x $10^{-6}$ indicating a potential for cancer to be developed over a lifetime (Table 5.12). The drivers for this risk are strontium-90 (52.5%), uranium-234 (24.0%), and uranium-238 (20.7%). Table 5.14 shows that the source of the strontium-90 is through ingestion of Canada goose and mule deer, while the exposure through other pathways (e.g., water and soil) contribute less to the risk by several orders of magnitude. Exposure to the uranium isotopes is through similar pathways as with the strontium-90 (Table 5.15).

Strontium-90 concentrations in the environmental media were not found to be at levels of ecological concern; however, the concentration of strontium-90 is high enough in the estimation of the body burden within the Canada goose and mule deer to have the potential for adverse health effects in a person (Table 5.14). For the goose and deer, the primary source of the strontium-90 is coming from the consumption of plants, and the plants are getting the strontium-90 through root uptake and exposure to soil (Miley et al. 2006). The soil value for this assessment is based on environmental monitoring of soil for air deposition around the 300 Area (Poston et al. 2006), and is not associated with soil from a disturbed area within the 300-FF-1 Operable Unit (Table 3.6). This value is likely to best represent the soil for that native vegetation that will be consumed within the home range of the goose and the deer.

**Table 5.13**. Ingestion Exposure Pathway Results for Uranium for the Maximum Contaminant Concentration Case for Avid Recreation at the 300 Area

| Pathway | Ingestion | | Concentration | | Exposure Frequency | | Dose | | Hazard Quotient |
|---|---|---|---|---|---|---|---|---|---|
| Canada goose | 0.044 | kg/d | 1,830 | µg/kg | 365 | d/yr | 1.15E-03 | mg/kg/d | 1.92 |
| smallmouth bass | 0.027 | kg/d | 734 | µg/kg | 365 | d/yr | 2.84E-04 | mg/kg/d | 0.47 |
| surface water | 2 | L/d | 1.58 | µg/L | 44 | d/yr | 3.07E-05 | mg/kg/d | 0.051 |
| mule deer | 0.015 | kg/d | 97.3 | µg/kg | 365 | d/yr | 2.13E-05 | mg/kg/d | 0.036 |
| sediment (adult) | 3.98E-05 | kg/d | 29,900 | µg/kg | 44 | d/yr | 2.04E-06 | mg/kg/d | 3.4E-03 |
| soil (adult) | 3.98E-05 | kg/d | 1,830 | µg/kg | 44 | d/yr | 1.25E-07 | mg/kg/d | 2.1E-04 |
| (highlighted) | The incremental risk or hazard benchmark is exceeded for this pathway | | | | | | | | |

**Table 5.14**. Ingestion Exposure Pathway Results for Strontium-90 for the Maximum Contaminant Concentration Case for Avid Recreation at the 300 Area Location

| Pathway | Ingestion Rate | | Concentration | | Exposure Frequency | | Dose | | Risk |
|---|---|---|---|---|---|---|---|---|---|
| Canada goose | 0.044 | kg/d | 1.03E+03 | pCi/kg | 365 | d/yr | 0.69 | mrem | 2.E-06 |
| mule deer | 0.015 | kg/d | 2.72E+03 | pCi/kg | 365 | d/yr | 0.63 | mrem | 1.E-06 |
| smallmouth bass | 0.027 | kg/d | 2.67E+00 | pCi/kg | 365 | d/yr | 0.0011 | mrem | 3.E-09 |
| surface water[a] | 2 | L/d | 3.05E-01 | pCi/L | 44 | d/yr | 0.0011 | mrem | 3.E-09 |
| soil | 3.98E-05 | kg/d | 1.71E+02 | pCi/L | 44 | d/yr | 1.2E-05 | mrem | 3.E-11 |
| sediment | 3.98E-05 | kg/d | 2.67E+01 | pCi/L | 44 | d/yr | 1.9E-06 | mrem | 4.E-12 |
| [a] Drinking water is from the City of Richland location | | | | | | | **Total Risk** | | 3.E-06 |
| (highlighted) | The incremental risk or hazard benchmark is exceeded for this pathway | | | | | | | | |

Potential adverse health effects from uranium and its isotopes for avid recreation are from pathways similar to strontium-90. In this case, ingestion of uranium-238 in the Canada goose has the greatest risk followed by surface water, bass, deer, sediment and soil (Table 5.15). Uranium isotopes in the body burden of the goose and bass are from additional exposures through their ingestion of aquatic plants and animals.

**Table 5.15**. Ingestion Exposure Pathway Results for Uranium-238 for the Maximum Contaminant Concentration Case for Avid Recreation at the 300 Area Location

| Pathway | Ingestion Rate | | Concentration | | Exposure Frequency | | Dose | | Risk |
|---|---|---|---|---|---|---|---|---|---|
| Canada goose | 0.044 | kg/d | 6.71E+02 | pCi/kg | 365 | d/yr | 7.84E-04 | Rem | 9.E-07 |
| surface water | 2 | L/d | 5.28E-01 | pCi/L | 44 | d/yr | 3.08E-04 | Rem | 4.E-07 |
| smallmouth bass | 0.027 | kg/d | 2.84E+02 | pCi/kg | 365 | d/yr | 2.04E-04 | Rem | 2.E-07 |
| mule deer | 0.015 | kg/d | 3.25E+01 | pCi/kg | 365 | d/yr | 1.32E-05 | Rem | 2.E-08 |
| sediment (adult) | 3.98E-05 | kg/d | 9.97E+03 | pCi/kg | 44 | d/yr | 1.26E-06 | Rem | 2.E-09 |
| soil (adult) | 3.98E-05 | kg/d | 6.11E+02 | pCi/kg | 44 | d/yr | 7.75E-08 | Rem | 9.E-11 |

### 5.4.2 Risk Assessment Results for the Casual Recreation Scenario

The second highest risk evaluated considering current conditions is the casual recreation scenario. This scenario was evaluated only at the 300 Area. The activity assumes that the individual is spending less time recreating in the same area as that considered for the avid recreation scenario. Four days a year are considered in the casual recreation scenario for hunting and fishing as well as water-skiing and swimming in the publicly accessible areas of the Columbia River along the shores of the 300 Area (Table 5.3). The pathways for interacting with groundwater from the 300-FF-5 Groundwater Operable Unit are soil, external exposure to Columbia River water and sediment while swimming and boating, inhalation, ingestion of drinking water (seep water from the 300 Area location), and food (hunting for mule deer, and fishing for salmon).

Table 5.16 summarizes the risk assessment results for the casual recreation scenario. No adverse health effects from noncarcinogenic chemicals was found for this scenario (total HQ = 0.23). However, the assessment does indicate that there is sufficient exposure at the 300 Area and subregions for the total incremental risk ($2 \times 10^{-6}$) to exceed the EPA threshold for consideration. The drivers for this risk are strontium-90 (82%), uranium-234 (6.7.0%), and uranium-238 (6.1%). The source of the strontium-90 is through ingestion of Canada goose, while the exposures through other pathways (e.g., water and soil) contribute less to the risk.

### 5.4.3 Risk Assessment Results for the Industrial Scenario

The industrial scenario was evaluated at the 300 Area and the City of Richland. This scenario does not directly interact with the groundwater at the 300 Area, 618-10/316-4, and 618-11 under current conditions. The environmental media considered for this scenario includes soil and water. For the evaluation of the groundwater in the 300 Area and subregions, the soil is considered clean because the groundwater is deep under the soil surface. External exposure, ingestion, and inhalation of soil are not contributing to the health impacts assessed in this scenario. Drinking water for the 300 Area and subregions comes from the same surface water location in the 300 Area. The health impacts to the

**Table 5.16.** Risk Assessment Results for the Casual Recreation Scenario for the Maximum Contaminant Concentration Case

| Location | Analyte ID | Solution Type | Value | % of Total | Solution Type | Value | % of Total |
|---|---|---|---|---|---|---|---|
| 300 Area | cis-1,2-Dichloroethene | HQ | 1.3E-04 | 0.06% | | | |
| 300 Area | Nitrate | HQ | 0.0053 | 2.3% | | | |
| 300 Area | Tetrachloroethene | HQ | 0.0028 | 1.2% | Risk | 2.E-08 | 1.2% |
| 300 Area | Trichloroethylene | HQ | 0.026 | 11% | Risk | 5.E-08 | 2.6% |
| 300 Area | Uranium | HQ | 0.20 | 85% | | | |
| 300 Area | Tritium | | | | Risk | 1.E-08 | 0.85% |
| 300 Area | Strontium-90 | | | | Risk | 1.E-06 | 82% |
| 300 Area | Technetium-99 | | | | Risk | 5.E-10 | 0.030% |
| 300 Area | Uranium-234 | | | | Risk | 1.E-07 | 6.7% |
| 300 Area | Uranium-235 | | | | Risk | 5.E-09 | 0.30% |
| 300 Area | Uranium-238 | | | | Risk | 1.E-07 | 6.1% |
| **300 Area** | **Total** | **HQ** | **0.23** | | **Risk** | 2.E-06 | |
| | The incremental risk or hazard benchmark is exceeded for this analyte | | | | | | |

industrial worker at the 300 Area and subregions from inhalation of volatiles from surface water during showering and ingestion of surface water are the same for all of those locations. At the City of Richland, the soil exposures are considered to be with clean soil, and the water exposures are from surface water at the Richland location.

The risk assessment results for the industrial scenario are displayed in Table 5.17. No adverse health effects from noncarcinogenic chemicals were found for the industrial scenario in the 300 Area and subregions (total HQ = 0.24) or at the City of Richland (total HQ = 0.06). However, the assessment does indicate that there is sufficient exposure at the 300 Area and subregions for an individual to potentially develop cancer over a lifetime based on the industrial scenario (total incremental risk = $2 \times 10^{-6}$). The incremental risk from uranium-238 is $1 \times 10^{-6}$, but it only contributes 54% to the total incremental risk. Incremental risk from uranium-234 is below $1 \times 10^{-6}$, but represents 38% of the remaining total incremental risk in the 300 Area. The incremental risk from carcinogenic chemicals and radionuclides at the City of Richland are below levels of concern for the Industrial scenario (risk = $8 \times 10^{-8}$).

### 5.4.4 Risk Assessment Results for the Child Recreation Scenario

The child recreation scenario was only evaluated at the City of Richland location. The scenario assumes that a child goes to Leslie Groves Park in Richland 60 days a year. The child is exposed to the soils that are up away from the shore line 25% of the time and exposed to the sediments at the edge of the Columbia River 75% of the time. The soil and sediment ingestion rate (0.1 g/day) is higher for the child scenario than the adult recreation scenarios (0.08 g/day). Other exposures to the sediment are from swimming and boating. Inhalation and ingestion are the other pathways of exposure. Drinking water is from the Richland surface water location (Table 5.5).

Table 5.18 summarizes the risk assessment results for the child recreation scenario. No adverse health effects from noncarcinogenic chemicals were found for this scenario (total HQ = 0.0038). The incremental risk from carcinogenic chemicals and radionuclides was also less than the level of concern ($8 \times 10^{-9}$). The contaminant with the greatest impact to the child's health was from TCE (HQ = 47%; incremental risk = 59%).

**Table 5.17**. Risk Assessment Results for the Industrial Scenario for the Maximum Contaminant Concentration Case

| Location | Analyte | Solution | Value | % of Total | Solution | Value | % of Total |
|---|---|---|---|---|---|---|---|
| 300 Area | cis-1,2-Dichloroethene | HQ | 4.8E-04 | 0.20% | | | |
| 300 Area | Nitrate | HQ | 0.024 | 9.9% | | | |
| 300 Area | Tetrachloroethene | HQ | 4.0E-04 | 0.17% | Risk | 3.E-09 | 0.14% |
| 300 Area | Trichloroethylene | HQ | 0.027 | 11% | Risk | 5.E-08 | 2.2% |
| 300 Area | Uranium | HQ | 0.19 | 78% | | | |
| 300 Area | Strontium-90 | | | | Risk | 3.E-08 | 1.5% |
| 300 Area | Technetium-99 | | | | Risk | 7.E-10 | 0.03% |
| 300 Area | Tritium | | | | Risk | 4.E-08 | 2.0% |
| 300 Area | Uranium-234 | | | | Risk | 8.E-07 | 38% |
| 300 Area | Uranium-235 | | | | Risk | 4.E-08 | 1.8% |
| 300 Area | Uranium-238 | | | | Risk | 1.E-06 | 54% |
| **300 Area** | **Total** | **HQ** | **0.24** | | **Risk** | 2.E-06 | |
| Richland | cis-1,2-Dichloroethene | HQ | 4.8E-04 | 0.80% | | | |
| Richland | Nitrate | HQ | 0.0092 | 15% | | | |
| Richland | Tetrachloroethene | HQ | 6.5E-04 | 1.1% | Risk | 5.E-09 | 5.8% |
| Richland | Trichloroethylene | HQ | 0.016 | 27% | Risk | 3.E-08 | 35% |
| Richland | Uranium | HQ | 0.033 | 55% | | | |
| Richland | Strontium-90 | | | | Risk | 7.E-09 | 8.9% |
| Richland | Technetium-99 | | | | Risk | 1.E-09 | 1.4% |
| Richland | Tritium | | | | Risk | 1.E-08 | 12% |
| Richland | Uranium-234 | | | | Risk | 1.E-08 | 18% |
| Richland | Uranium-235 | | | | Risk | 3.E-09 | 3.2% |
| Richland | Uranium-238 | | | | Risk | 1.E-08 | 16% |
| **Richland** | **Total** | **HQ** | **0.060** | | **Risk** | 8.E-08 | |
| | The incremental risk or hazard benchmark is exceeded for this analyte | | | | | | |

**Table 5.18**. Risk Assessment Results for the Child Recreation Scenario for the Maximum Contaminant Concentration Case

| Location | Analyte ID | Solution Type | Value | % of Total | Solution Type | Value | % of Total |
|---|---|---|---|---|---|---|---|
| Richland | cis-1,2-Dichloroethene | HQ | 5.0E-05 | 1.3% | | | |
| Richland | Nitrate | HQ | 4.8E-04 | 13% | | | |
| Richland | Tetrachloroethene | HQ | 1.4E-04 | 3.8% | Risk | 1.E-09 | 13% |
| Richland | Trichloroethylene | HQ | 0.0018 | 47% | Risk | 5.E-09 | 59% |
| Richland | Uranium | HQ | 0.0013 | 35% | | | |
| Richland | Strontium-90 | | | | Risk | 3.E-10 | 4.4% |
| Richland | Technetium-99 | | | | Risk | 6.E-11 | 0.69% |
| Richland | Tritium | | | | Risk | 5.E-10 | 6.0% |
| Richland | Uranium-234 | | | | Risk | 6.E-10 | 8.0% |
| Richland | Uranium-235 | | | | Risk | 1.E-10 | 1.5% |
| Richland | Uranium-238 | | | | Risk | 6.E-10 | 7.1% |
| **Richland** | **Total** | **HQ** | **0.0038** | | **Risk** | **8.E-09** | |

### 5.4.5 Risk Assessment Results for the Offsite Residential Farmer Scenario

The offsite residential farmer scenario was only evaluated at the City of Richland location because farming is not a current scenario for the 300 Area. The offsite residential farmer is in contact with the environmental media more than individuals in the other scenarios. Soil exposure is considered for

317 days/year, but there is no sediment exposure. The inhalation pathway includes volatiles from water during showering. Drinking water is from the Richland surface water location. More types of food are considered in this scenario than in the others. The farmer is assumed to consume vegetables, fruit, milk, beef, chicken, and eggs, which have only been exposed to surface water at the Richland location (Table 5.6).

Table 5.19 summarizes the risk assessment results for the offsite residential farmer scenario. No adverse health effects from noncarcinogenic chemicals were found for this scenario (total HQ = 0.11). The incremental risk from carcinogenic chemicals and radionuclides was also less than the level of concern ($2 \times 10^{-7}$). The toxic contaminant with the greatest impact to the farmer's health was from uranium, the carcinogenic chemical TCE (incremental risk = 35%), and the uranium isotopes (total incremental risk = 35.2%).

### 5.4.6 Risk Assessment Results for the Drinking Water Only Scenario

The hypothetical groundwater drinking water scenario was evaluated at the 300 Area, 618-10/316-4, and 618-11 (Table 5.11). This scenario involved drinking 2 L/d of unfiltered groundwater, where the groundwater consumed contains the maximum concentration of each contaminant observed at any 300 Area well. In addition to the fact that there is no groundwater well at which all of the maximum contaminant concentrations occur, there is currently no access to a source of unfiltered groundwater for drinking. Under this hypothetical scenario, both the noncarcinogenic hazard and the carcinogenic risk exceed health-based standards for human health in all subregions of the 300 Area.

Figure 5.3 shows the analyte contributions to the hazard quotient for the three 300 Area subregions. The greatest contributor to hazard at the 300 Area subregion is uranium, which contributes 76% of the total hazard quotient. The other major contributor to hazard at the 300 Area subregion is nitrate, which contributes 16% of the hazard. The greatest contributor to hazard at the 618-10 burial ground/316-4 trench subregion is uranium, which contributes 69% of the total hazard quotient. Nitrate is also a contributor to hazard in the 618-10 burial ground/316-4 trench subregion, contributing 30% of the total hazard quotient. At the 618-11 burial ground subregion, the major contributor to hazard is nitrate, which contributes 83% of the total hazard quotient. Uranium contributes 18% of the total hazard quotient at the 618-11 burial ground subregion.

**Table 5.19**. Risk Assessment Results for the Offsite Residential Farmer Scenario for the Maximum Contaminant Concentration Case

| Location | Analyte ID | Solution Type | Value | % of Total | Solution Type | Value | % of Total |
|---|---|---|---|---|---|---|---|
| Richland | cis-1,2-Dichloroethene | HQ | 9.0E-04 | 0.85% | | | |
| Richland | Nitrate | HQ | 0.017 | 17% | | | |
| Richland | Tetrachloroethene | HQ | 0.0012 | 1.1% | Risk | 9.E-09 | 5.8% |
| Richland | Trichloroethylene | HQ | 0.031 | 29% | Risk | 5.E-08 | 35% |
| Richland | Uranium | HQ | 0.055 | 52% | | | |
| Richland | Strontium-90 | | | | Risk | 1.E-08 | 9.2% |
| Richland | Technetium-99 | | | | Risk | 2.E-09 | 1.5% |
| Richland | Tritium | | | | Risk | 2.E-08 | 12% |
| Richland | Uranium-234 | | | | Risk | 3.E-08 | 17% |
| Richland | Uranium-235 | | | | Risk | 5.E-09 | 3.2% |
| Richland | Uranium-238 | | | | Risk | 2.E-08 | 15% |
| **Richland** | **Total** | **HQ** | **0.11** | | **Risk** | **2.E-07** | |

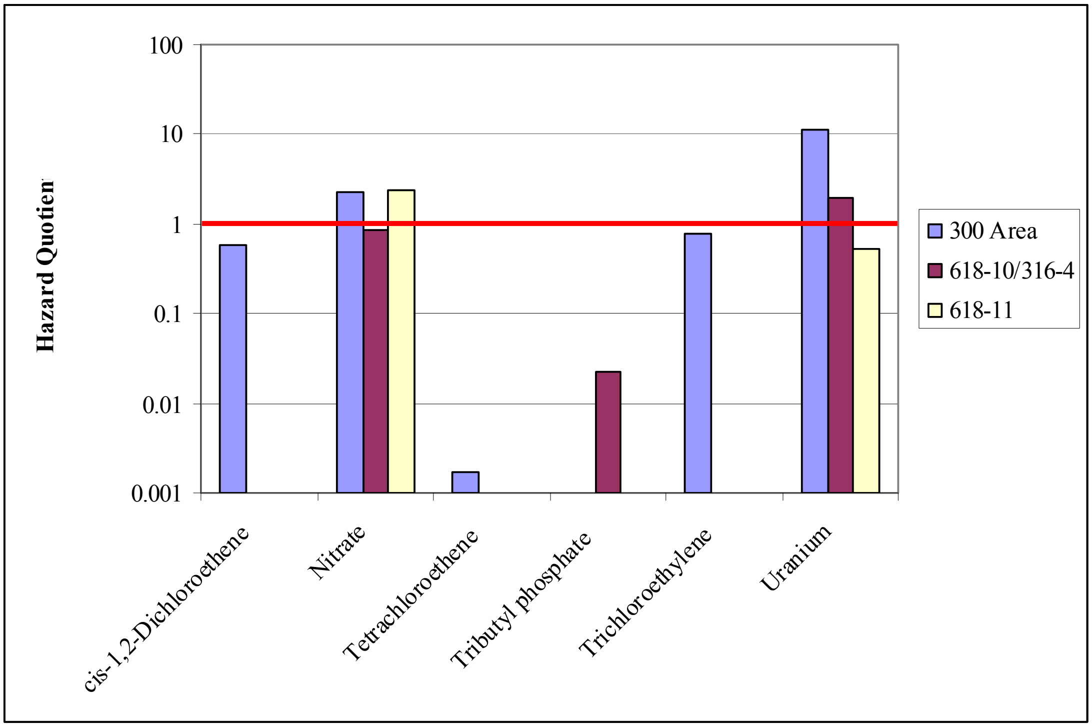


**Figure 5.3**. Hazard by Analyte for the Hypothetical Groundwater Drinking Water Scenario for the Maximum Contaminant Concentration Case

Figure 5.4 shows the analyte contribution to risk from carcinogens at all three of the 300 Area subregions. The greatest contributors to incremental risk at the 300 Area subregion are uranium-234 (41% of incremental risk) and uranium-238 (36% of incremental risk). TCE is also a significant contributor to risk, with a contribution of 13% of the total incremental risk from drinking water in the 300 Area subregion. The greatest contributor to incremental risk at the 618-10 burial ground/316-4 trench subregion is tributyl phosphate, which contributes 92% of the incremental risk. The maximum incremental risk from the hypothetical drinking water scenario occurs in the 618-11 subregion, and it exceeds 1.E-04. The greatest contributor to incremental risk in the 618-11 burial ground subregion is tritium, which contributes 99% of the risk.

The hypothetical surface water drinking water scenario was evaluated at the 300 Area and City of Richland (Table 5.11). This scenario involved drinking 2 L/d of unfiltered surface water from a location at the 300 Area or Richland. There is currently no access to a source of unfiltered surface water for drinking at the 300 Area, and it is unlikely that an individual is drinking unfiltered surface water in Richland when municipally treated water is readily available.

Figure 5.5 shows the hazard by analyte for the hypothetical surface water drinking water scenario. No individual analyte exceeds the hazard quotient limit of 1.0, and the total hazard quotient is also below 1.0. The highest contributors to hazard at both the 300 Area location and the Richland location are uranium, TCE, and nitrate. At the 300 Area location, 74% of the hazard is from uranium. At the Richland location, 50% of the hazard is from uranium.

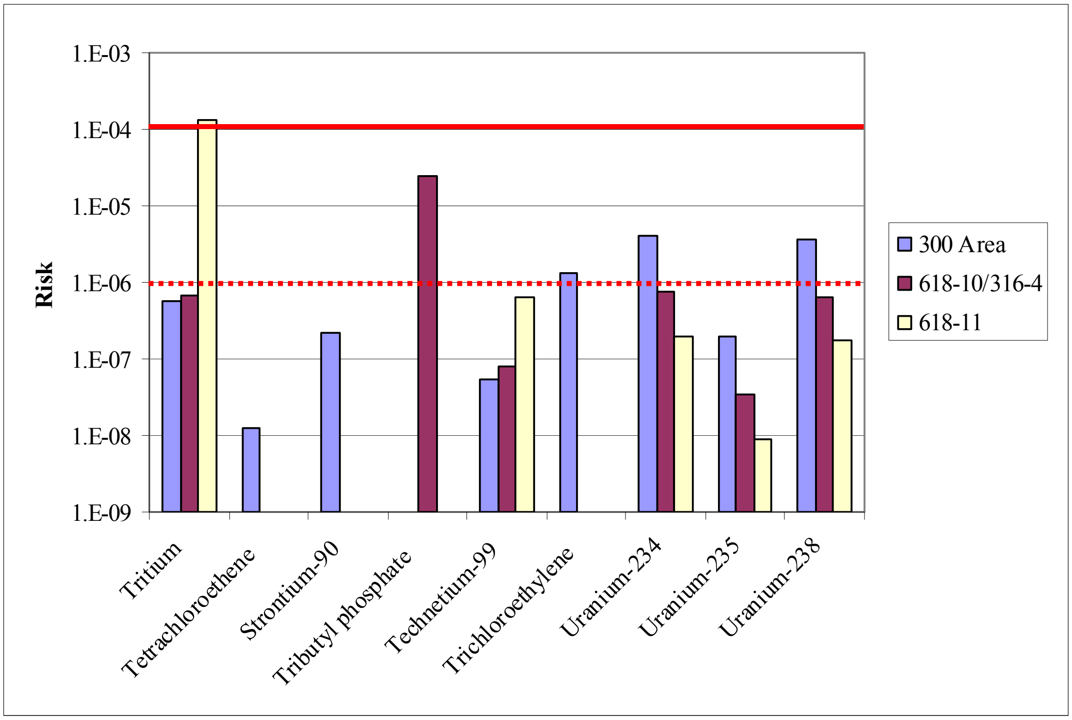


**Figure 5.4**. Risk by Analyte for the Hypothetical Groundwater Drinking Water Scenario for the Maximum Contaminant Concentration Case

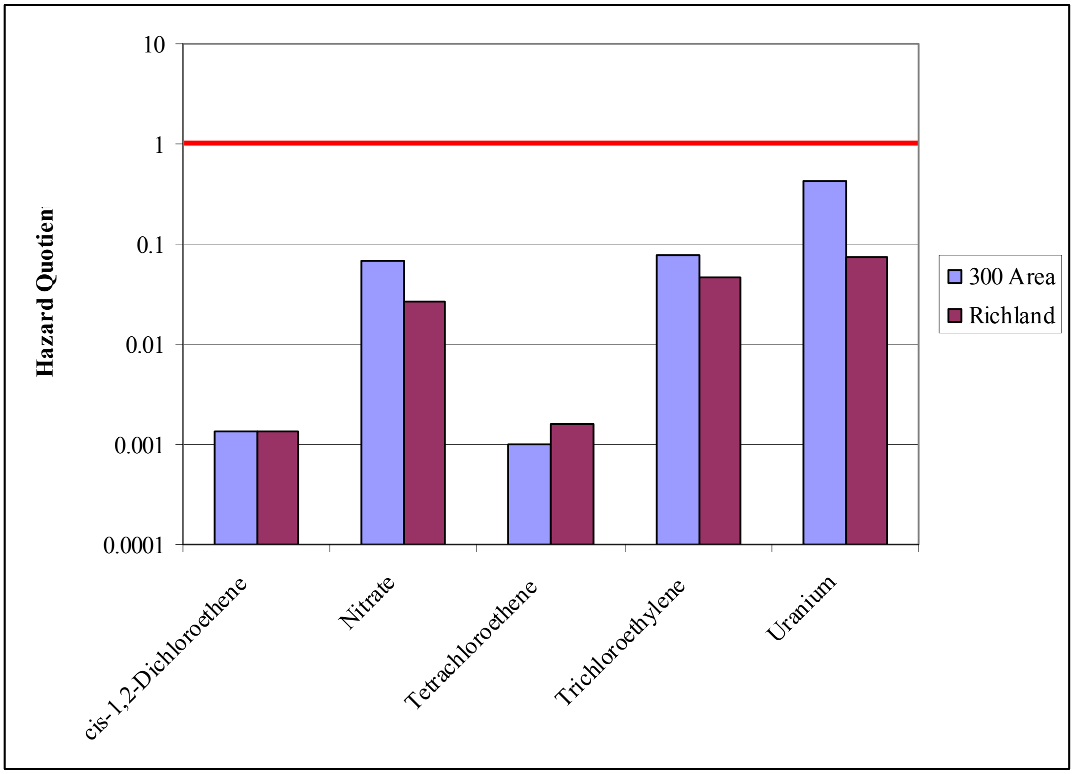


**Figure 5.5**. Hazard by Analyte for the Hypothetical Surface Water Drinking Water Scenario for the Maximum Contaminant Concentration Case

Figure 5.6 shows the contribution to risk by analyte for the hypothetical surface water drinking water scenario under maximum contaminant concentrations. The incremental risk at the 300 Area location exceeds the incremental risk threshold limit of 1.E-06. The major contributors to risk at the 300 Area are uranium-238, which contributes 54% of the incremental risk, and uranium-234, which contributes 37% of the incremental risk. At the Richland location, TCE contributes 41% of the total incremental carcinogenic risk. The other contributors are uranium-234 (15%), uranium-238 (13%), and tritium (12%).

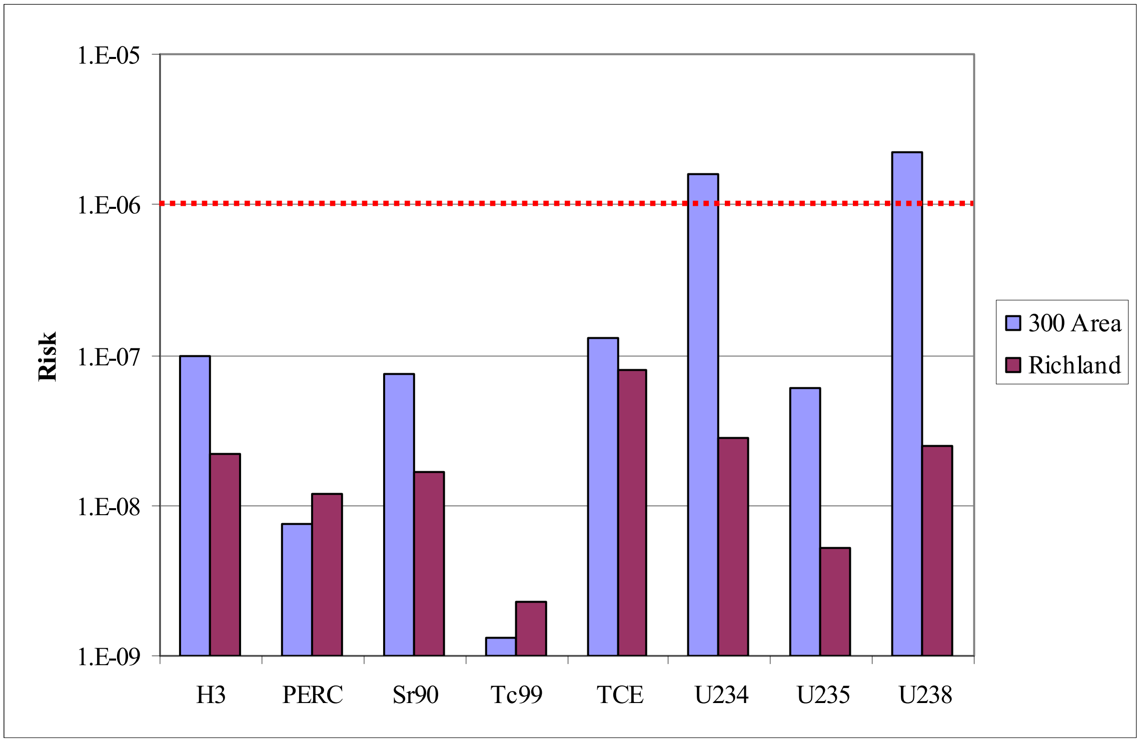


**Figure 5.6**. Incremental risk by Analyte for the Hypothetical Surface Water Drinking Water Scenario for the Maximum Contaminant Concentration Case

## 5.5 Uncertainty Analysis

There are several sources of uncertainty in the results of the hazard and carcinogenic assessment presented in this human health risk assessment. The sources of uncertainty are associated with the environmental media concentrations, exposure assumptions, toxicity values, and risk characterization.

### 5.5.1 Uncertainty in the Environmental Media Concentrations

The human health risk assessment was based on using the maximum environmental media concentration at a location. The maximum concentration for a contaminant occurred at different regions within a location. It would be unlikely that an individual would have an occupational or lifetime exposure to the maximum concentrations of all the contaminants. The use of maximum contaminant concentrations from across a large spatial extent is likely to overestimate the risks to human health.

The selection of the maximum environmental media concentrations was based on different periods of time. The groundwater concentrations were based on values from 2002 through 2005. The maximum concentrations for surface water, seep, pore water, sediment, and soil were selected from values collected from 1994 through 2005. The longer period of time was necessary for these other media because the other media are not sampled as frequently as the groundwater, and the programs that collect the other environmental media have purposes that go beyond risk assessment. In some cases, the values had to be surrogated from one media type to another or estimated based on chemical or radioisotopic analysis. The uncertainty associated with environmental media concentrations is likely to overestimate the risk to human health.

This assessment does not account for decay of radionuclides over time. Radionuclide concentrations were used as measured in the period from 1994 to present. The risk from exposure to radionuclides may be overestimated if radionuclide concentrations are decreasing over time. The contaminant most likely to be affected by this uncertainty is tritium because it has the shortest half-life of the radionuclides that are considered.

### 5.5.2 Uncertainty Associated with the Exposure Assessment

The scenarios used in the human health risk assessment represent potential use of the 300 Area and exposure to the groundwater pathway as well as hypothetical uses of the groundwater. The scenarios may over- or underestimate the ingestion of contaminated water, ingestion of contaminated soil and/or sediment, ingestion of food, external exposure to radionuclides in the soil, and inhalation of soil and/or volatile contaminants. The exposures described in the scenarios may over- or underestimate the actual exposures that an individual would receive in an occupational or lifetime use of the groundwater.

The avid and casual recreation as well as the farmer scenarios included the ingestion of food. The quantity and type of food ingested may over- or underestimate the hazard and carcinogenic risk to humans. The concentration in the food is based on the linkage to the ecological risk assessment and includes the uncertainties in the parameterization of that assessment. In addition, the use of the total body burden from ECEM may overestimate the risk if the typical consumer would only eat a portion of the organism (i.e., only the meat rather than the meat, organs and bones). Some of the parameters are from sources where the uncertainty is well-characterized (e.g., the bioconcentration factors for the transfer of contaminants from soil to plants from references published by the International Atomic Energy Agency), while other parameters are based on the average of numerous values in peer-reviewed literature.

### 5.5.3 Uncertainty Associated with the Toxicity Assessment

The toxicological database is also a source of uncertainty. There is a discussion of uncertainty for each value for reference dose factor and slope factor from EPA’s IRIS database. Several types of uncertainty are discussed for each reference dose factor and slope factor from EPA’s IRIS database. The general types of uncertainty include:

- Use of information on dose-response effects from high-dose exposure scenarios to predict effects at low-dose exposure scenarios
- Use of animal dose-response data to predict effects in humans
- Use of short-term exposure data to extrapolate to long-term exposure or vice versa
- Use of dose-response information from a homogeneous animal or healthy human population to predict the effects that may occur in the general population where there are varying sensitivities to different contaminants.

For some of the contaminants, most notably for TCE, the risk values have been rescinded by EPA due to uncertainty in human health related effects. Reference concentrations for inhalation effects from hazardous chemicals were converted to reference dose factors by RAIS and used in this assessment. Including these values that have not received the most rigorous EPA quality reviews may result in overestimating the risk.

### 5.5.4 Uncertainty of Risk Characterization

The discussion of the hazards and risks includes the summing of hazard quotients and risks from multiple contaminants and pathways (e.g., ingestion and inhalation), which may over- or underestimate the magnitude of the health impact. Uncertainties arise in the assumption that the chemicals have the same mode of action leading to similar health effects. Summing the hazard quotients and risks assumes that the impacts are additive and does not consider synergistic or antagonistic effects from exposure to multiple contaminants.

# 6.0 Conclusions

This section presents a brief summary of the results presented in the preceding chapters for the 300-FF-5 Groundwater Operable Unit current conditions baseline risk assessment and a comparison to the 1994 baseline risk assessment. In addition, this section includes an estimate of the hazard and risk from drinking groundwater with a uranium concentration set to the drinking water standard.

## 6.1 Summary of Results

Three major conclusions result from this risk assessment:

1. The results of this risk assessment are consistent with the 1994 baseline risk assessment for those constituents of concern included in the 1996 ROD and for current exposure scenarios.
2. Uranium was the primary contributor to ecological and human health impacts under current conditions in the 300 Area. This was due to the migration of uranium-contaminated groundwater to surface water exposure points where direct ingestion was assumed to have occurred and also where uranium was incorporated into the food chain.
3. Currently, direct exposure to groundwater is prevented by access restrictions in the 300-FF-5 Groundwater Operable Unit. If restrictions were not imposed, direct ingestion of groundwater could yield hazards and risks that exceed threshold levels.

These conclusions are discussed further in the following sections.

### 6.1.1 Risk-Driving Contaminants

The maximum concentrations of contaminants of interest considered in this report did result in hazards and risks that exceeded health thresholds for the current conditions. There are uncertainties in the assessment and conditions evaluated included assumptions that may over or under-estimate the hazards and risks (see Sections 4.5 and 5.5 for further information). Based on these assumptions, the drivers for the hazards and risks are:

- Ecological hazard to aquatic plants at the 300 Area
- Ecological hazard to the American coot through food chain accumulation
- Human health avid recreation scenario at the 300 Area
  - Uranium hazard from consumption of waterfowl
  - Uranium-234 and uranium-238 risk from consumption of waterfowl
- Human health industrial scenario at the 300 Area, 618-10/316-4, and 618-11 subregions
  - Uranium-238 risk from ingestion of surface water.

Strontium-90 is a contributor to risk for the avid and casual recreation scenarios at the 300 Area. There is no impact to ecological organisms from strontium-90. The following is a summary of the strontium-90 human health impacts based on the exposure assumptions described in Section 5.1.2:

- Human health avid recreation scenario at the 300 Area
  - Stronium-90 risk from consumption of game and waterfowl

- Human health casual recreation scenario at the 300 Area
  - Strontium-90 risk from consumption of game.

The strontium-90 risk from consumption of game and waterfowl is associated with surface soil contamination. These soil samples are background measurements coincident with air sampling stations. The strontium-90 risk is not attributable to the 300-FF-5 Groundwater Operable Unit.

### 6.1.2 Hypothetical Groundwater Drinking Water Hazard and Risk

Institutional controls prevent the ingestion of groundwater at the 300 Area subregions. In the absence of a groundwater consumption pathway, the hazards and risks associated with current scenarios is through accumulation in the food chain. A hypothetical scenario was assessed to estimate the human health impacts associated with drinking unfiltered groundwater at the maximum concentrations occurring in the three 300 Area subregions. The hazards and risks associated with the groundwater drinking water scenario are:

- Hypothetical human health drinking water risk at the 300 area subregion
  - Hazard benchmarks are exceeded for uranium and nitrate
  - Risk levels are exceeded for uranium-234, uranium-238, and Trichloroethylene
- Hypothetical human health drinking water risk at the 618-10/316-4 subregion
  - Hazard benchmark is exceeded for uranium
  - Risk level is exceeded for tributyl phosphate
- Hypothetical human health drinking water risk at the 618-11 subregion
  - Hazard benchmark is exceeded for uranium
  - Risk level is exceeded for tritium

## 6.2 Comparison to the 1994 Baseline Risk Assessment Results

This assessment is an update to the 1994 baseline risk assessment report (DOE 1994a) that presented results for current conditions using 1992 data. A comparison to the 1994 report is given in this section. The analytes considered in the 1994 report are presented in Table 6.1.

**Table 6.1**. Exposure Point Concentrations in Groundwater and Surface Water for Current Exposure Scenarios for the 1994 Risk Assessment

| | | Groundwater Well 399-4-12 | 300 Area Average Surface Water | 300 Area Maximum Surface Water | Richland Average Surface Water |
|---|---|---|---|---|---|
| Trichloroethylene | µg /L | 7 | not measured | 2 | not measured |
| Strontium-90 | pCi/L | not measured | not detected | not measured | 0.094 |
| Technetium-99 | pCi/L | not measured | not detected | 5.4 | not detected |
| Tritium | pCi/L | 1,890 | 130 | 3100 | 110 |
| Uranium-234 | pCi/L | 8.1 | 0.28 | 18 | 0.23 |
| Uranium-235 | pCi/L | 0.51 | not detected | 1.1 | not detected |
| Uranium-238 | pCi/L | 8.4 | 0.24 | 19 | 0.2 |

### 6.2.1 Ecological Impacts Results Comparison

The 1994 baseline risk assessment report found the most significant ecological risk from nonradionuclides to be manganese in the loggerhead shrike, Swainson's hawk, and Canada goose, and copper and nickel in aquatic organisms. Chemical uranium effects were not reported in DOE (1994a). This assessment found nonradionuclide impacts to aquatic plants and the American coot from uranium. No other nonradionuclides showed aquatic or terrestrial effects in this assessment. Manganese, copper, and nickel were not contaminants of interest in this assessment (see Section 1.1.3). The contaminants of interest for the 300-FF-5 Groundwater Operable Unit have changed over time based on the original ROD and subsequent 5-year reviews.

DOE (1994a) reports that all radiological doses to ecological organisms is well below the 1 rad/d benchmark of DOE Order 5400.5, the prevailing guidance at the time of the 1994 report. In this assessment, there was an updated benchmark of 0.1 rad/d for terrestrial animals with the benchmark remaining at 1 rad/d for aquatic organisms and terrestrial plants (DOE 2002). As in DOE (1994a), all radionuclide impacts were well below the radionuclide benchmarks in this assessment.

### 6.2.2 Human Health Results Comparison

The 1994 current conditions risk assessment is summarized in Table 6.2. These results are presented as Table 6.34 in the RI/FS (DOE 1994a). Values in the table that are red exceed the acceptable level of risk for carcinogens (levels of risk are described in Section 5.1). Non-cancer impacts were evaluated in the 1994 report only for chloroform, which is not a contaminant of interest for the present assessment.

**Table 6.2**. Summary of Lifetime Incremental Cancer Risk Under Current Conditions for the 1994 Risk Assessment

| 1994 Results | | | Off Hanford Site | | | |
|---|---|---|---|---|---|---|
| Medium | Exposure Point | Industrial On 300 Area | Industrial | Residential | Recreational | Agricultural |
| Groundwater | Well 399-4-12 | 2.E-05 | Not Evaluated | Not Evaluated | Not Evaluated | Not Evaluated |
| Surface Water | Columbia River at 300 Area | 5.E-06 | Not Evaluated | Not Evaluated | 4.E-07 | Not Evaluated |
| Surface Water | Columbia River at Richland | Not Evaluated | 1.E-07 | 4.E-07 | 8.E-09 | 4.E-07 |
| Total ICR | | 2.E-05 | 1.E-07 | 4.E-07 | 5.E-07 | 4.E-07 |
| | | | | | | |
| 2006 Results | | | Off Hanford Site | | | |
| Medium | Exposure Point | Industrial On 300 Area | Industrial | Offsite residential farmer | Casual Recreational | Avid Recreational |
| Groundwater | 300 Area | Not Evaluated | Not Evaluated | Not Evaluated | Not Evaluated | Not Evaluated |
| Surface Water | Columbia River at 300 Area | 2.E-06 | Not Evaluated | Not Evaluated | 2.E-06 | 6.E-06 |
| Surface Water | Columbia River at Richland | Not Evaluated | 8.E-08 | 2.E-07 | Not Evaluated | Not Evaluated |

## 6.3 Human Health Results for Uranium at the Drinking Water Standard

An assessment of the incremental risk and hazard associated with the cleanup goal of 30 μg/L for uranium was done to give a point of reference for the magnitude of the current risks associated with 300 Area contaminants. The interim ROD for 300-FF-5 Groundwater Operable Unit is based on the federal drinking water standard for uranium, which has changed over the years. In 1976, National Interim Primary Drinking Water Regulations (EPA 1976) were promulgated for radium-226 and -228, gross alpha particle radioactivity and beta particle and photon radioactivity. The 1986 reauthorization of the Safe Drinking Water Act (SDWA) (42 USC 300f et seq.) required EPA to promulgate MCLGs and National Primary Drinking Water Regulations (NPDWRs) for those same analytes plus radon and uranium. In 1991, EPA proposed changes to the current radionuclides standards and new standards for radon and uranium (EPA 1991d). The interim standard for uranium set in 1991 was 20 μg/L (or 30 pCi/L). A final rule for radionuclides (EPA 2000c) was issued on December 7, 2000 that set the uranium drinking water standard at 30 μg/L.

In setting the current standard, EPA identified the best-estimate of the Lowest Observed Adverse Effects Level (LOAEL) for uranium as 60 mg/kg/d, based on estimations of risk from experiments with rats (EPA 2000d). In estimating the reference dose (RfD), EPA used an uncertainty factor of 100 (rounded from the product of 3 for intra-species variability, 10 for inter-species variability, and 3 for the use of a LOAEL). EPA followed the recommended methodology of the National Academy of Sciences in estimating the uncertainty factor. Using this uncertainty factor, the RfD is calculated to be 0.6 mg/kg/d. The drinking water equivalent level (DWEL) (μg/L) is the best estimate of the drinking water concentration that results in the RfD (mg/kg/d), assuming a water ingestion rate of 2 L/d and a body mass of 70 kg. The DWEL for uranium based on the 0.6 mg/kg/d RfD is 20 μg/L.

While 20 μg/L is the Agency's best estimate of the DWEL, there are several reasons, in the Agency's judgment, that demonstrate that there is not a predictable difference in health effects due to exposure between the DWEL of 20 μg/L and a level of 30 μg/L (EPA 2000c). For instance, variability in the normal range for proteinuria in humans is very large and there is additional variability in proteinuria levels observed at uranium exposures large enough to induce the effect. In the existing few epidemiology studies, each of which are based on small study populations, there were some persons exposed to over five times the DWEL of 20 μg/L without the observation of effects more serious than mild proteinuria (within the high end of the normal range). An MCL of 30 μg/L represents a relatively small increase over the DWEL compared to the over-all uncertainty in the RfD and the uncertainty in the importance of the mild proteinuria observed for uranium exposures from high drinking water levels. While it is assumed that risk of an effect (here a mild effect) increases as exposure increases over the RfD, it is not known at what exposure an effect is likely. Given that the uncertainty factor of 100 provides a relatively wide margin of safety, the likelihood of any significant effect in the population at 30 μg/L is very small. EPA, thus, believes that the difference in kidney toxicity risk for exposures at 20 μg/L versus 30 μg/L is insignificant.

To prepare the assessment of the drinking water standard, data were generated for uranium isotopes using the natural abundance relationships established in Section 3.2.3. A groundwater drinking water only scenario was run with uranium set to 30 μg/L and no other contaminants present. The resulting risks are presented in Table 6.3.

**Table 6.3**. Incremental Risk and Hazard from Uranium at the Drinking Water Standard (30 µg/L)

| Analyte | Groundwater Concentration | | Dose | | Risk or Hazard | |
|---|---|---|---|---|---|---|
| Uranium | 30 | µg/L | 8.6E-04 | mg/kg/d | 1.4 | HQ |
| **Total** | | | **8.6E-04** | **mg/kg/d** | **1.4** | **HQ** |
| Uranium-234 | 10.3 | pCi/L | 0.58 | mrem | 5.E-07 | Risk |
| Uranium-235 | 0.467 | pCi/L | 0.025 | mrem | 2.E-08 | Risk |
| Uranium-238 | 10.0 | pCi/L | 0.53 | mrem | 5.E-07 | Risk |
| **Total** | | | **1.13** | **mrem** | **1.E-06** | **Risk** |

The assessment of the drinking water scenario for uranium groundwater concentration set at the EPA drinking water standard of 30 µg/L illustrates that the assumptions in setting the drinking water standard are different from those used by EPA in assessing chemical hazards and radiological dose. For example, the hazard quotient for drinking 2 L/d of water with a total uranium concentration of 30 µg/L is 1.4, which exceeds the level of concern considered in the assessment and established in the EPA risk assessment methodology for consideration by the risk managers (EPA 1989). The evaluation of the radiological dose is based on the conversion of total uranium to its isotopes based on the ratio of uranium isotopes that are naturally present in the earth's crust. The total incremental risk from all the uranium isotopes is 1.E-06, the lower limit for the level of concern established in EPA's risk assessment methodology for consideration by risk managers (DOE 2005b). The sum of the activity of the uranium isotopes listed in Table 6.3 is 20.7 pCi/L, which is less than the 30 pCi/L isotopic activity listed by EPA as the radionuclide uranium MCL (EPA 2001c). If the incremental risk was calculated for an activity of 30 pCi/L, the total risk would be greater than 1.E-06. This analysis is an example of some of the difficulties when comparing values calculated through a risk assessment to values calculated for the protection of health considering a different purpose.

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# Appendix A

# Data for the Risk Assessment

# Appendix A – Data for the Risk Assessment

The data for the 300-FF-5 risk assessment were provided by the Groundwater Performance Assessment Project and the Surface Environmental Surveillance Project (SESP). All data used in this assessment are available in the Hanford Environmental Information System (HEIS). Data were gathered for the time period since the previous assessment, from 1994 to the present. Because extensive groundwater data are available, these data were limited to a more recent time period. Figure 3.1 in Section 3.1 of this document shows the various media from which data were collected. The maximum value for each contaminant/medium combination is identified in the corresponding data plot. The line in the data table corresponding to the maximum value is shown in bold text.

## A.1 Groundwater Data

The groundwater data used for the 300-FF-5 risk assessment are from the HEIS database for the period 11/1/2002 through 10/5/2005 (Table A.1). Summary statistics were prepared using Pacific Northwest National Laboratory's Data Visualization and Evaluator (DaVE) interface with HEIS. Groundwater Performance Assessment Project staff processed the HEIS data, and the raw data are not available for presentation here.

## A.2 Surface Water Data

The surface water data were provided by staff from the SESP. Data were provided for the 300 Area vicinity and for the Richland Pumphouse location at the end of Snyder Street in Richland.

### A.2.1 cis-1,2-Dichloroethene Surface Water Data

There were 13 surface water samples of cis-1,2-dichloroethene at the Richland Pumphouse location and 10 at the 300 Area location. There were no detections at either location. Because cis-1,2-dichloroethene is a contaminant of concern at the 300 Area, the summary statistics for cis-1,2-dichloroethene were calculated with the nondetects set at one-half the detection limit as directed in the Risk Assessment Guidance for Superfund (RAGS) Section 5.3 (EPA 1989). The samples for the Richland Pumphouse were collected between 12/7/1995 and 9/14/2005. The samples at the 300 Area were all collected on 9/20/1996. The values are plotted in Figure A.1, and the data are presented in Table A.2.

**Table A.1**. Groundwater Data for the 300 Area

| Well/Tube Name | Contaminant | Filt? | No. of Results | No. of Detects | No. of Excludes[(1)] | Min Value | Max Value | Ave Value | MCL[(2)] | No. of Samples Exceeding MCL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ***300 Area Wells: Upper Unconfined Aquifer (TU)*** | | | | | |
| 399-5-1 | Nitrate (ug/L) | N | 3 | 3 | 0 | 79,700 | 99,200 | 91,800 | 45,000 | 3 |
| 699-S27-E12A | Nitrate (ug/L) | N | 2 | 2 | 0 | 117,000 | 129,000 | 123,000 | 45,000 | 2 |
| 699-S27-E14 | Nitrate (ug/L) | N | 8 | 8 | 0 | 50,900 | 77,500 | 64,900 | 45,000 | 8 |
| 699-S28-E13A | Nitrate (ug/L) | N | 2 | 2 | 0 | 74,800 | 85,400 | 80,100 | 45,000 | 2 |
| 699-S29-E12 | Nitrate (ug/L) | N | 2 | 2 | 0 | 76,100 | 90,700 | 83,400 | 45,000 | 2 |
| 699-S29-E13A | Nitrate (ug/L) | N | 2 | 2 | 0 | 74,800 | 76,100 | 75,450 | 45,000 | 2 |
| 699-S29-E16A | Nitrate (ug/L) | N | 3 | 3 | 0 | 66,000 | 70,800 | 68,033 | 45,000 | 3 |
| 699-S30-E15A | Nitrate (ug/L) | N | 3 | 3 | 0 | 64,600 | 76,100 | 71,100 | 45,000 | 3 |
| 399-1-7 | Trichloroethene (ug/L) | N | 10 | 10 | 0 | 0.5 | 7.2 | 2.1 | 5 | 2 |
| 399-3-2 | Trichloroethene (ug/L) | N | 5 | 5 | 0 | 0.7 | 8.3 | 3.2 | 5 | 1 |
| 399-1-1 | Uranium (ug/L) | N | 6 | 6 | 0 | 35 | 66 | 50 | 20 | 6 |
| 399-1-7 | Uranium (ug/L) | N | 10 | 10 | 0 | 55 | 80 | 63 | 20 | 10 |
| 399-1-10A | Uranium (ug/L) | N | 23 | 23 | 0 | 37 | 235 | 76 | 20 | 23 |
| 399-1-11 | Uranium (ug/L) | N | 11 | 11 | 0 | 8 | 28 | 14 | 20 | 1 |
| 399-1-12 | Uranium (ug/L) | N | 6 | 6 | 0 | 14 | 22 | 18 | 20 | 3 |
| 399-1-16A | Uranium (ug/L) | N | 21 | 21 | 0 | 40 | 94 | 69 | 20 | 21 |
| 399-1-17A | Uranium (ug/L) | N | 22 | 22 | 0 | 40 | 70 | 52 | 20 | 22 |
| 399-1-21A | Uranium (ug/L) | N | 6 | 5 | 1 | 18 | 97 | 39 | 20 | 4 |
| 399-2-1 | Uranium (ug/L) | N | 5 | 5 | 0 | 47 | 149 | 94 | 20 | 5 |
| 399-2-2 | Uranium (ug/L) | N | 6 | 6 | 0 | 60 | 137 | 91 | 20 | 6 |
| 399-3-1 | Uranium (ug/L) | N | 1 | 1 | 0 | 122 | 122 | 122 | 20 | 1 |
| 399-3-10 | Uranium (ug/L) | N | 6 | 6 | 0 | 63 | 127 | 90 | 20 | 6 |
| 399-3-11 | Uranium (ug/L) | N | 8 | 8 | 0 | 24 | 107 | 48 | 20 | 8 |
| 399-3-12 | Uranium (ug/L) | N | 6 | 6 | 0 | 18 | 33 | 24 | 20 | 5 |
| 399-4-1 | Uranium (ug/L) | N | 6 | 6 | 0 | 15 | 24 | 19 | 20 | 2 |
| 399-4-9 | Uranium (ug/L) | N | 6 | 6 | 0 | 66 | 104 | 87 | 20 | 6 |
| 399-4-10 | Uranium (ug/L) | N | 4 | 4 | 0 | 89 | 94 | 91 | 20 | 4 |
| 399-4-12 | Uranium (ug/L) | N | 10 | 10 | 0 | 12 | 24 | 20 | 20 | 7 |
| | | | | | ***300 Area Wells: Lower Unconfined Aquifer (LU)*** | | | | | |
| 399-1-16B | Dichloroethylene[(3)] (ug/L) | N | 21 | 19 | 2 | 95 | 200 | 145 | 70 | 19 |
| 399-1-8 | Uranium (ug/L) | N | 6 | 6 | 0 | 0 | 41 | 14 | 20 | 1 |

**Table A.1**. (contd)

| Well/Tube Name | Contaminant | Filt? | No. of Results | No. of Detects | No. of Excludes[(1)] | Min Value | Max Value | Ave Value | MCL[(2)] | No. of Samples Exceeding MCL |
|---|---|---|---|---|---|---|---|---|---|---|
| ***618-11 Sub-Region Wells: Upper Unconfined Aquifer (TU)*** | | | | | | | | | | |
| 699-12-2C | Nitrate (ug/L) | N | 6 | 6 | 0 | 51,400 | 134,000 | 91,233 | 45,000 | 6 |
| 699-13-1E | Nitrate (ug/L) | N | 8 | 8 | 0 | 40,700 | 59,800 | 48,700 | 45,000 | 5 |
| 699-13-2D | Nitrate (ug/L) | N | 6 | 6 | 0 | 52,200 | 65,500 | 57,883 | 45,000 | 6 |
| 699-13-3A | Nitrate (ug/L) | N | 7 | 7 | 0 | 66,400 | 101,000 | 82,729 | 45,000 | 7 |
| 699-12-2C | Tritium (pCi/L) | N | 11 | 11 | 0 | 294,000 | 375,000 | 338,364 | 20,000 | 11 |
| 699-13-0A | Tritium (pCi/L) | N | 11 | 11 | 0 | 26,700 | 41,400 | 32,264 | 20,000 | 11 |
| 699-13-1A | Tritium (pCi/L) | N | 1 | 1 | 0 | 139,000 | 139,000 | 139,000 | 20,000 | 1 |
| 699-13-1E | Tritium (pCi/L) | N | 13 | 13 | 0 | 137,000 | 239,000 | 172,000 | 20,000 | 13 |
| 699-13-2D | Tritium (pCi/L) | N | 11 | 11 | 0 | 428,000 | 591,000 | 507,273 | 20,000 | 11 |
| 699-13-3A | Tritium (pCi/L) | N | 13 | 13 | 0 | 1,470,000 | 3,620,000 | 2,392,308 | 20,000 | 13 |
| ***618-10/316-4 Sub-Region Wells: Upper Unconfined Aquifer (TU)*** | | | | | | | | | | |
| 699-S6-E4L | Nitrate (ug/L) | N | 14 | 14 | 0 | 29,200 | 49,100 | 43,443 | 45,000 | 6 |
| 699-S6-E4A | Uranium (ug/L) | N | 12 | 12 | 0 | 11 | 42 | 18 | 20 | 2 |
| 699-S6-E4L | Uranium (ug/L) | N | 14 | 14 | 0 | 16 | 36 | 30 | 20 | 12 |

**Footnotes:** (1) "Excludes" refers to outlier results, i.e., not considered representative of aquifer conditions; (2) "MCL" refers to maximum contaminant level, normally the value associated with drinking water supplies; and (3) Form of dichloroethene is cis-1,2-dichloroethene.

**Source:** Hanford Environmental Information System (HEIS) database for the period 11/1/2002 through 10/5/2005. Summary statistics prepared using PNNL's Data Visualization and Evaluator (DaVE) interface with HEIS.

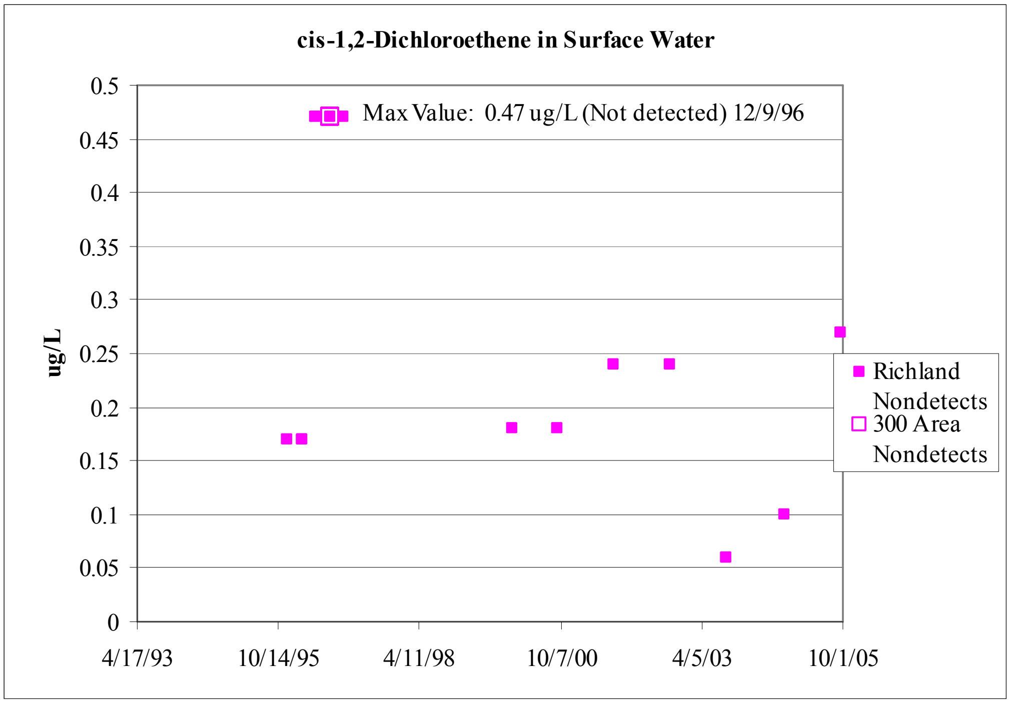


**Figure A.1**. cis-1,2-Dichloroethene in Surface Water

**Table A.2**. cis-1,2-Dichloroethene Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filtered Flag | Sample Date | Value (µg/L) | Qualifier |
|---|---|---|---|---|---|---|---|
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 0.17 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.17 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.17 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 0.47 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 0.47 | U |
| **cis-1,2-Dichloroethene** | **Rich.Pmphs-1 HRM46.4** | | **River** | **N** | **12/9/96** | **0.47** | **U** |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.18 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/19/00 | 0.18 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/13/01 | 0.24 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/10/02 | 0.24 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/9/03 | 0.06 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/04 | 0.1 | U |
| cis-1,2-Dichloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/14/05 | 0.27 | UN |
| cis-1,2-Dichloroethene | 300 Area-10 HRM 43.1 | B0G1F9 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -9 HRM 43.1 | B0G1F8 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -8 HRM 43.1 | B0G1F7 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -7 HRM 43.1 | B0G1F6 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -6 HRM 43.1 | B0G1F5 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -5 HRM 43.1 | B0G1F4 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -4 HRM 43.1 | B0G1F3 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -3 HRM 43.1 | B0G1F2 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -2 HRM 43.1 | B0G1F1 | River | N | 9/20/96 | 0.47 | U |
| cis-1,2-Dichloroethene | 300 Area -1 HRM 43.1 | B0G1F0 | River | N | 9/20/96 | 0.47 | U |

### A.2.2 Tritium Surface Water Data

There were 214 (2 nondetect) surface water samples of tritium at the Richland Pumphouse location and 148 (5 nondetect) at the 300 Area location. The samples were collected between 1/25/1994 and 9/15/2005. The values are plotted in Figure A.2, and the data are presented in Table A.3.

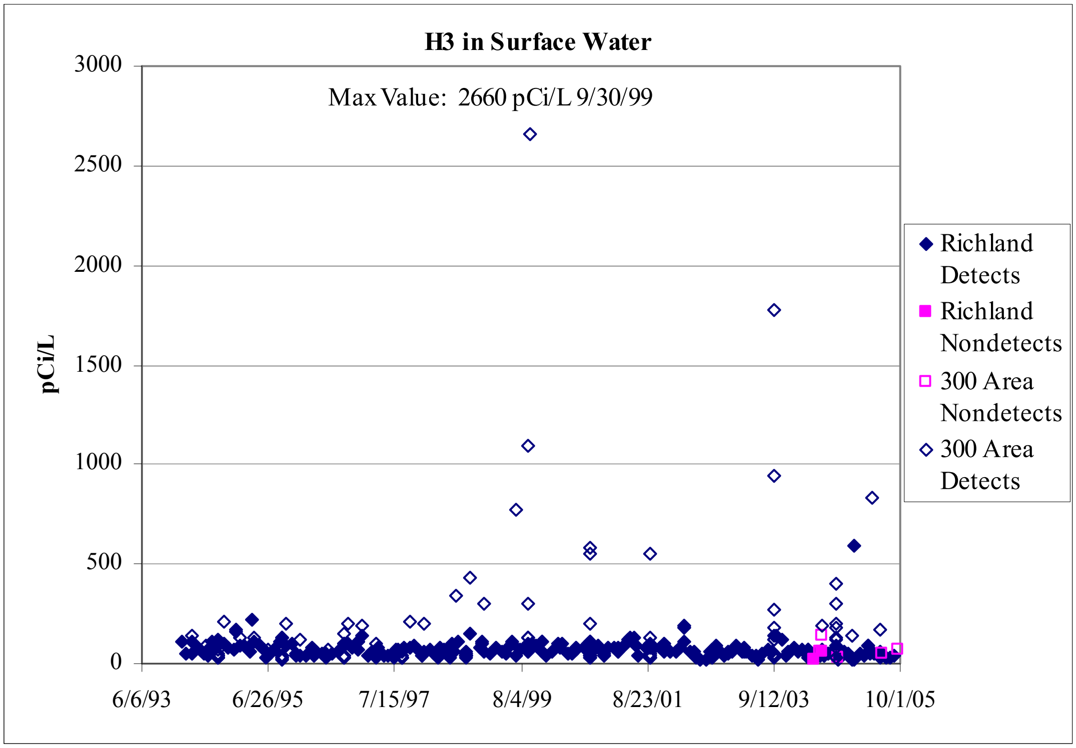


**Figure A.2**. Tritium in Surface Water

**Table A.3**. Tritium Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/24/04 | 60.4 | 61 | 143 | U |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 5/6/04 | 19.7 | 13 | 23.1 | U |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/31/94 | 51 | 2.5 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 7/1/94 | 39.1 | 2.4 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 8/26/94 | 91.2 | 2.94 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/21/94 | 166 | 3.66 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/17/95 | 224 | 4.23 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/16/95 | 33.3 | 2.35 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/18/95 | 134 | 3.53 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/7/95 | 36.1 | 2.43 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/18/96 | 43 | 2.55 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/18/96 | 45.9 | 2.59 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/7/96 | 53.8 | 2.99 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/20/96 | 96.7 | 3.19 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/9/96 | 115 | 3.38 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/9/96 | 109 | 3.33 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 4/1/97 | 31 | 2.46 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 8/25/97 | 71 | 3.39 | | |

**Table A.3**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/19/97 | 44.4 | 2.53 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/19/97 | 39.3 | 2.45 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/24/98 | 37.5 | 2.44 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/24/98 | 39.4 | 2.44 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/23/98 | 98.7 | 3.09 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/15/98 | 52.1 | 2.79 | | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/15/98 | 107 | 3.5 | 4.88 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/15/98 | 99.3 | 3.4 | 4.88 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/14/99 | 102 | 2.1 | 4.48 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/14/99 | 114 | 2.3 | 4.47 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/16/99 | 95.6 | 2 | 4.42 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/6/99 | 107 | 2.1 | 5.08 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/6/99 | 109 | 2.1 | 5.13 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/28/00 | 86.8 | 1.9 | 4.51 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/28/00 | 84.8 | 1.9 | 4.43 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/20/00 | 68.9 | 1.6 | 4.33 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/19/00 | 39.9 | 3.5 | 6.27 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/19/00 | 40.9 | 3.5 | 6.22 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/5/00 | 48.1 | 3.7 | 6.3 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/5/00 | 40.8 | 3.5 | 6.31 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 2/26/01 | 62.8 | 3.2 | 5.13 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 2/26/01 | 64.5 | 2.8 | 4.51 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 5/17/01 | 126 | 5.1 | 6.79 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/12/01 | 88.5 | 4.5 | 6.57 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/13/01 | 87.8 | 4.4 | 6.43 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/4/01 | 98.8 | 4.5 | 6.27 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/4/01 | 90.1 | 4.3 | 6.26 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/26/02 | 184 | 5.6 | 6.37 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/26/02 | 187 | 5.6 | 6.26 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/11/02 | 27.3 | 2.7 | 5.06 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/10/02 | 43.4 | 3 | 5.16 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/10/02 | 63.3 | 3.2 | 5 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/10/02 | 54.2 | 3.1 | 4.94 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/25/03 | 64.3 | 4 | 3.39 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/25/03 | 75.6 | 4.4 | 3.53 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/10/03 | 19.6 | 2.7 | 5.6 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/9/03 | 136 | 7.9 | 5.08 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/8/03 | 60.9 | 3.8 | 3.48 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/8/03 | 51.8 | 3.7 | 3.51 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/30/04 | 72.4 | 3.5 | 5.53 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/30/04 | 66.4 | 3.4 | 5.5 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/24/04 | 65.6 | 6.7 | 6.11 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 9/15/04 | 92.5 | 7.6 | 6.11 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/19/04 | 23.9 | 4.5 | 5.86 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 12/19/04 | 28.1 | 4.7 | 5.88 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/29/05 | 87.6 | 3.7 | 5.4 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 3/29/05 | 95.3 | 3.9 | 5.44 | |
| Tritium | Rich.Pmphs -1 HRM46.4 | | River | N | 6/7/05 | 63.7 | 6 | 6.01 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/25/94 | 113 | 3.29 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/22/94 | 50.6 | 2.68 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/29/94 | 107 | 3.11 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/3/94 | 77 | 2.81 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/7/94 | 45.9 | 2.39 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/6/94 | 66.5 | 2.69 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/1/94 | 115 | 3.19 | | |

**Table A.3.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/6/94 | 123 | 3.26 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/4/94 | 105 | 3.06 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/1/94 | 84.6 | 2.87 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/6/94 | 73.9 | 2.77 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/21/94 | 165 | 3.69 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/3/95 | 87.7 | 2.86 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/7/95 | 92.7 | 3 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/7/95 | 59.2 | 2.72 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/4/95 | 114 | 3.34 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/2/95 | 88.8 | 3.06 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/6/95 | 69.3 | 2.83 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/5/95 | 46.2 | 2.5 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/1/95 | 74.2 | 2.86 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/6/95 | 113 | 3.34 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/3/95 | 92.7 | 3.12 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/8/95 | 105 | 3.24 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/5/95 | 52 | 2.63 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/3/96 | 40.4 | 2.49 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/7/96 | 41.5 | 2.53 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/6/96 | 82 | 3.01 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/3/96 | 57.4 | 2.68 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/8/96 | 48.2 | 2.74 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/5/96 | 29.6 | 2.43 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/2/96 | 51.2 | 2.68 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/7/96 | 61.3 | 2.75 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/4/96 | 77.2 | 3.04 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/9/96 | 105 | 3.3 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/6/96 | 76 | 3.13 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/4/96 | 75 | 3.14 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/30/96 | 136 | 3.63 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/3/97 | 37.8 | 3.54 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/5/97 | 62.6 | 2.87 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/9/97 | 84.8 | 3.15 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/7/97 | 36.1 | 2.72 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/4/97 | 43 | 2.61 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/9/97 | 26.4 | 2.41 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/6/97 | 69.3 | 2.95 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/3/97 | 76.4 | 2.99 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/8/97 | 76.4 | 2.94 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/5/97 | 87.8 | 3.06 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/3/97 | 75.1 | 2.89 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/30/97 | 61.7 | 2.71 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/4/98 | 71.2 | 2.84 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/4/98 | 52.8 | 2.59 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/8/98 | 84.3 | 3.01 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/7/98 | 67.5 | 2.88 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/4/98 | 29 | 2.29 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/30/98 | 59.4 | 2.83 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/29/98 | 107 | 3.68 | | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/8/98 | 149 | 3.9 | 4.78 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/3/98 | 84.5 | 3.2 | 4.78 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/30/98 | 57.8 | 2.8 | 4.78 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/3/99 | 51.4 | 2.8 | 4.82 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/3/99 | 78.8 | 1.7 | 5.39 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/7/99 | 62 | 1.4 | 5.08 | |

**Table A.3.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/5/99 | 46 | 1.1 | 5.04 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/2/99 | 87.5 | 1.8 | 5.02 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/30/99 | 38.2 | 1 | 4.42 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/28/99 | 70.3 | 1.6 | 4.89 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/1/99 | 76.1 | 1.7 | 4.42 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/6/99 | 96.9 | 2 | 4.85 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/3/99 | 89.1 | 1.9 | 4.52 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/1/99 | 59.1 | 1.4 | 4.93 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/29/99 | 43.1 | 1.1 | 5.03 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/2/00 | 61.5 | 1.5 | 4.44 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/8/00 | 98.1 | 2 | 4.93 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/5/00 | 96.7 | 2.1 | 4.58 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/3/00 | 52.6 | 1.3 | 4.23 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/31/00 | 49.9 | 1.3 | 4.44 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/29/00 | 80.6 | 1.8 | 4.39 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/10/00 | 80.2 | 1.8 | 4.62 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/7/00 | 97 | 4.4 | 6.07 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/5/00 | 75.6 | 4.1 | 6.26 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/2/00 | 88.9 | 4.4 | 6.3 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/29/00 | 62.7 | 3.9 | 6.24 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/4/01 | 81.6 | 4.2 | 6.31 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/31/01 | 76.3 | 4.1 | 6.34 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/1/01 | 75.7 | 4.1 | 6.25 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/4/01 | 90.7 | 4.4 | 6.36 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/2/01 | 119 | 4.8 | 6.25 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/30/01 | 130 | 4.9 | 6.2 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/28/01 | 36.4 | 3.4 | 6.28 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/9/01 | 81 | 4.1 | 6.09 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/5/01 | 84.3 | 4.3 | 6.32 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/2/01 | 79 | 4.2 | 6.4 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/1/01 | 80.1 | 4.3 | 6.36 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/27/01 | 62.7 | 3.9 | 6.25 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/3/02 | 61.6 | 3.9 | 6.42 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/6/02 | 63.1 | 4.3 | 7.22 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/7/02 | 75.3 | 4.3 | 6.62 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/3/02 | 113 | 4.9 | 6.61 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/1/02 | 63.6 | 4 | 6.5 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/29/02 | 62.6 | 3.9 | 6.47 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/27/02 | 23.6 | 2.6 | 5.1 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/7/02 | 25 | 2.7 | 5.17 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/4/02 | 59.2 | 3.2 | 5.22 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/2/02 | 86.9 | 3.6 | 5.03 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/30/02 | 62.5 | 3.8 | 6.27 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/26/02 | 43.6 | 2.9 | 4.97 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/8/03 | 55.9 | 3.1 | 4.94 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/5/03 | 94.6 | 5.2 | 4.15 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/5/03 | 60.1 | 4.6 | 4.59 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/2/03 | 56.3 | 3.2 | 5.28 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/30/03 | 39.3 | 3 | 5.28 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/28/03 | 36.1 | 3.1 | 5.71 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/10/03 | 50.3 | 3.1 | 5.32 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/8/03 | 73.3 | 3.5 | 5.36 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/3/03 | 62.4 | 5.6 | 4.98 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 9/30/03 | 139 | 4.3 | 5.33 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/29/03 | 118 | 4.3 | 5.77 | |

**Table A.3.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 11/25/03 | 41.5 | 3.1 | 5.54 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/8/04 | 77.5 | 10 | 10 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/4/04 | 56.7 | 8 | 8.05 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/2/04 | 71 | 7.6 | 6.76 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/1/04 | 49.9 | 13 | 21.2 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 4/1/04 | 28.3 | 6.6 | 6.67 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/6/04 | 47.7 | 6.8 | 6.31 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/8/04 | 41.5 | 5.4 | 5.04 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/8/04 | 36.2 | 11 | 22.3 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/8/04 | 36.9 | 11 | 21.6 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/8/04 | 37.7 | 3 | 5.57 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/4/04 | 54.5 | 3.3 | 5.6 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/4/04 | 55 | 11 | 21.2 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/31/04 | 50.8 | 3.2 | 5.41 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/31/04 | 61 | 11 | 22.5 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/1/04 | 15.4 | 2.7 | 5.67 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/1/04 | 49.6 | 12 | 23.4 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/28/04 | 50.3 | 6 | 6.22 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 10/28/04 | 60.4 | 11 | 22.1 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/1/04 | 47 | 12 | 22.3 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 12/1/04 | 36.2 | 5.3 | 6.18 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/5/05 | 21.4 | 3.4 | 7.18 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 1/5/05 | 594 | 21 | 26.2 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 2/3/05 | 45.3 | 6.1 | 7.31 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/2/05 | 42.3 | 5.7 | 6.99 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 3/31/05 | 53.5 | 3.3 | 5.57 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 5/3/05 | 54.3 | 6.2 | 6.9 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 6/9/05 | 34.2 | 4.8 | 5.83 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 7/7/05 | 29.3 | 4.5 | 6 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/4/05 | 32.7 | 5.7 | 8.49 | |
| Tritium | Rich.Pmphs HRM 46.4 | | River | N | 8/31/05 | 36.6 | 5.2 | 7.03 | |
| Tritium | 300 Area Outfl13 | B19JC4 | River | N | 6/24/04 | 140 | 63 | 140 | U |
| Tritium | 300 Area | B19HD4 | River | N | 6/10/04 | 57.2 | 59 | 121 | U |
| Tritium | 300 Area | B1BCB0 | River | N | 9/24/04 | 29.9 | 62 | 137 | U |
| Tritium | 300 Area | | River | N | 6/15/05 | 49.4 | 64 | 130 | U |
| Tritium | 300 Area | | River | N | 9/15/05 | 71.9 | 91 | 193 | U |
| Tritium | 300 Area-10 HRM 43.1 | B0C5C6 | River | N | 8/26/94 | 36.2 | 2.34 | | |
| Tritium | 300 Area-10 HRM 43.1 | B0G8B2 | River | N | 9/18/95 | 36.3 | 2.47 | | |
| Tritium | 300 Area-10 HRM 43.1 | B0J8Y6 | River | N | 9/20/96 | 36.5 | 2.48 | | |
| Tritium | 300 Area-10 HRM 43.1 | B0LVW6 | River | N | 8/25/97 | 33.3 | 2.45 | | |
| Tritium | 300 Area-10 HRM 43.1 | B0PVR3 | River | N | 9/15/98 | 36.3 | 2.42 | | |
| Tritium | 300 Area-10 HRM 43.1 | B0WB28 | River | N | 9/16/99 | 57.1 | 1.4 | 4.48 | |
| Tritium | 300 Area-10 HRM 43.1 | B106Y3 | River | N | 9/19/00 | 30.6 | 3.3 | 6.13 | |
| Tritium | 300 Area-10 HRM 43.1 | B12TC6 | River | N | 9/13/01 | 32.5 | 3.6 | 6.88 | |
| Tritium | 300 Area-10 HRM 43.1 | B158M0 | River | N | 9/10/02 | 41.7 | 2.9 | 5.01 | |
| Tritium | 300 Area-10 HRM 43.1 | B17CK0 | River | N | 9/9/03 | 32.9 | 4.3 | 4.84 | |
| Tritium | 300 Area-10 HRM 43.1 | B1B725 | River | N | 9/15/04 | 26.7 | 5.2 | 7 | |
| Tritium | 300 Area Shr HRM42.9 | B0WB56 | River | N | 9/16/99 | 132 | 2.6 | 4.92 | |
| Tritium | 300 Area Shr HRM42.9 | B109D2 | River | N | 9/19/00 | 37.4 | 3.4 | 6.26 | |
| Tritium | 300 Area Shr HRM42.9 | B10782 | River | N | 9/19/00 | 43.6 | 3.5 | 6.09 | |
| Tritium | 300 Area Shr HRM42.9 | B12TR6 | River | N | 9/13/01 | 48.7 | 3.8 | 6.54 | |
| Tritium | 300 Area Shr HRM42.9 | B158Y9 | River | N | 9/10/02 | 34.2 | 2.8 | 4.98 | |
| Tritium | 300 Area Shr HRM42.9 | B17CX7 | River | N | 9/9/03 | 183 | 4.7 | 5.27 | |
| Tritium | 300 Area Shr HRM42.9 | B1B7C7 | River | N | 9/15/04 | 126 | 4.7 | 6.42 | |
| Tritium | 300 Area Shr HRM42.5 | B0WB55 | River | N | 9/16/99 | 1090 | 8.3 | 4.44 | |

**Table A.3**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | 300 Area Shr HRM42.5 | B10779 | River | N | 9/19/00 | 105 | 4.6 | 6.24 | |
| Tritium | 300 Area Shr HRM42.5 | B109D1 | River | N | 9/19/00 | 106 | 4.6 | 6.28 | |
| Tritium | 300 Area Shr HRM42.5 | B12TR2 | River | N | 9/13/01 | 103 | 4.8 | 6.76 | |
| Tritium | 300 Area Shr HRM42.5 | B158Y6 | River | N | 9/10/02 | 44.5 | 2.9 | 4.99 | |
| Tritium | 300 Area Shr HRM42.5 | B17CX3 | River | N | 9/9/03 | 1780 | 160 | 122 | |
| Tritium | 300 Area Shr HRM42.4 | B1B7H3 | River | N | 9/15/04 | 304 | 6 | 5.66 | |
| Tritium | 300 Area Shr HRM42.1 | B0WB54 | River | N | 9/16/99 | 306 | 4.4 | 5.1 | |
| Tritium | 300 Area Shr HRM42.1 | B109D0 | River | N | 9/19/00 | 551 | 9.1 | 6.35 | |
| Tritium | 300 Area Shr HRM42.1 | B10776 | River | N | 9/19/00 | 581 | 9.2 | 6.13 | |
| Tritium | 300 Area Shr HRM42.1 | B12TP8 | River | N | 9/13/01 | 547 | 9.1 | 6.45 | |
| Tritium | 300 Area Shr HRM42.1 | B158Y3 | River | N | 9/10/02 | 70.1 | 3.3 | 4.99 | |
| Tritium | 300 Area Shr HRM42.1 | B17CW9 | River | N | 9/9/03 | 947 | 9.8 | 5.29 | |
| Tritium | 300 Area Shr HRM42.1 | B1B7C3 | River | N | 9/15/04 | 400 | 7.3 | 6.38 | |
| Tritium | 300 Area Shr HRM41.5 | B0WB53 | River | N | 9/16/99 | 128 | 2.4 | 4.44 | |
| Tritium | 300 Area Shr HRM41.5 | B109C9 | River | N | 9/19/00 | 202 | 5.8 | 6.24 | |
| Tritium | 300 Area Shr HRM41.5 | B10773 | River | N | 9/19/00 | 115 | 4.7 | 6.2 | |
| Tritium | 300 Area Shr HRM41.5 | B12TP4 | River | N | 9/13/01 | 135 | 5 | 6.4 | |
| Tritium | 300 Area Shr HRM41.5 | B158Y0 | River | N | 9/10/02 | 65 | 3.3 | 4.98 | |
| Tritium | 300 Area Shr HRM41.5 | B17CW5 | River | N | 9/9/03 | 268 | 5.6 | 5.43 | |
| Tritium | 300 Area Shr HRM41.5 | B1B7B9 | River | N | 9/15/04 | 197 | 5.2 | 6 | |
| Tritium | 300 Area Outfl 13 | B19JC4 | River | N | 6/24/04 | 186 | 10 | 6.17 | |
| Tritium | 300 Area Outfl 13 | B1B7H7 | River | N | 9/15/04 | 182 | 10 | 5.82 | |
| Tritium | 300 Area Outfl 13 | B1BW54 | River | N | 12/19/04 | 136 | 13 | 5.84 | |
| Tritium | 300 Area Outfl 13 | | River | N | 6/7/05 | 174 | 9.3 | 5.97 | |
| Tritium | 300 Area -9 HRM 43.1 | B0C5C5 | River | N | 8/26/94 | 31.3 | 2.28 | | |
| Tritium | 300 Area -9 HRM 43.1 | B0G8B1 | River | N | 9/18/95 | 25 | 2.27 | | |
| Tritium | 300 Area -9 HRM 43.1 | B0J8Y5 | River | N | 9/20/96 | 33.3 | 2.42 | | |
| Tritium | 300 Area -9 HRM 43.1 | B0LVW5 | River | N | 8/25/97 | 29.9 | 2.41 | | |
| Tritium | 300 Area -9 HRM 43.1 | B0PVR2 | River | N | 9/15/98 | 40.8 | 2.47 | | |
| Tritium | 300 Area -8 HRM 43.1 | B0C5C4 | River | N | 8/26/94 | 32 | 2.27 | | |
| Tritium | 300 Area -8 HRM 43.1 | B0G8B0 | River | N | 9/18/95 | 35.3 | 2.43 | | |
| Tritium | 300 Area -8 HRM 43.1 | B0J8Y4 | River | N | 9/20/96 | 28.5 | 2.33 | | |
| Tritium | 300 Area -8 HRM 43.1 | B0LVW4 | River | N | 8/25/97 | 29.4 | 2.4 | | |
| Tritium | 300 Area -8 HRM 43.1 | B0PVR1 | River | N | 9/15/98 | 38.1 | 2.39 | | |
| Tritium | 300 Area -7 HRM 43.1 | B0C5C3 | River | N | 8/26/94 | 33.6 | 2.3 | | |
| Tritium | 300 Area -7 HRM 43.1 | B0G899 | River | N | 9/18/95 | 33.2 | 2.42 | | |
| Tritium | 300 Area -7 HRM 43.1 | B0J8Y3 | River | N | 9/20/96 | 35.8 | 2.48 | | |
| Tritium | 300 Area -7 HRM 43.1 | B0LVW3 | River | N | 8/25/97 | 27.4 | 2.33 | | |
| Tritium | 300 Area -7 HRM 43.1 | B0PVR0 | River | N | 9/15/98 | 38.1 | 2.42 | | |
| Tritium | 300 Area -7 HRM 43.1 | B0WB27 | River | N | 9/16/99 | 68.2 | 1.6 | 4.6 | |
| Tritium | 300 Area -7 HRM 43.1 | B106Y1 | River | N | 9/19/00 | 31.2 | 3.3 | 6.07 | |
| Tritium | 300 Area -7 HRM 43.1 | B12TC4 | River | N | 9/13/01 | 30.4 | 3.3 | 6.39 | |
| Tritium | 300 Area -7 HRM 43.1 | B158L9 | River | N | 9/10/02 | 39.1 | 2.9 | 4.99 | |
| Tritium | 300 Area -7 HRM 43.1 | B17CJ8 | River | N | 9/9/03 | 35.7 | 4.4 | 4.85 | |
| Tritium | 300 Area -7 HRM 43.1 | B1B724 | River | N | 9/15/04 | 27.6 | 4.8 | 6.21 | |
| Tritium | 300 Area -6 HRM 43.1 | B0C5C2 | River | N | 8/26/94 | 34 | 2.31 | | |
| Tritium | 300 Area -6 HRM 43.1 | B0G898 | River | N | 9/18/95 | 34.2 | 2.39 | | |
| Tritium | 300 Area -6 HRM 43.1 | B0J8Y2 | River | N | 9/20/96 | 31.2 | 2.39 | | |
| Tritium | 300 Area -6 HRM 43.1 | B0LVW2 | River | N | 8/25/97 | 27.6 | 2.38 | | |
| Tritium | 300 Area -6 HRM 43.1 | B0PVP9 | River | N | 9/15/98 | 40.4 | 2.48 | | |
| Tritium | 300 Area -5 HRM 43.1 | B0C5C1 | River | N | 8/26/94 | 36 | 2.36 | | |
| Tritium | 300 Area -5 HRM 43.1 | B0G897 | River | N | 9/18/95 | 37.1 | 2.44 | | |
| Tritium | 300 Area -5 HRM 43.1 | B0J8Y0 | River | N | 9/20/96 | 36.4 | 2.48 | | |
| Tritium | 300 Area -5 HRM 43.1 | B0LVW1 | River | N | 8/25/97 | 27.6 | 2.36 | | |
| Tritium | 300 Area -5 HRM 43.1 | B0PVP8 | River | N | 9/15/98 | 33.6 | 2.36 | | |

**Table A.3**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | 300 Area -5 HRM 43.1 | B0WB26 | River | N | 9/16/99 | 69.3 | 1.6 | 4.75 | |
| Tritium | 300 Area -5 HRM 43.1 | B106X9 | River | N | 9/19/00 | 57.9 | 3.8 | 6.12 | |
| Tritium | 300 Area -5 HRM 43.1 | B12TC2 | River | N | 9/13/01 | 33.9 | 3.4 | 6.23 | |
| Tritium | 300 Area -5 HRM 43.1 | B158L8 | River | N | 9/10/02 | 37.5 | 2.9 | 5.12 | |
| Tritium | 300 Area -5 HRM 43.1 | B17CJ6 | River | N | 9/9/03 | 41.2 | 4.6 | 4.83 | |
| Tritium | 300 Area -5 HRM 43.1 | B1B723 | River | N | 9/15/04 | 26.5 | 4.6 | 5.84 | |
| Tritium | 300 Area -4 HRM 43.1 | B0C5C0 | River | N | 8/26/94 | 31.3 | 2.28 | | |
| Tritium | 300 Area -4 HRM 43.1 | B0G896 | River | N | 9/18/95 | 38 | 2.45 | | |
| Tritium | 300 Area -4 HRM 43.1 | B0J8X8 | River | N | 9/20/96 | 37.2 | 2.46 | | |
| Tritium | 300 Area -4 HRM 43.1 | B0LVW0 | River | N | 8/25/97 | 29.3 | 2.39 | | |
| Tritium | 300 Area -4 HRM 43.1 | B0PVP7 | River | N | 9/15/98 | 38.6 | 2.42 | | |
| Tritium | 300 Area -3 HRM 43.1 | B0C5B9 | River | N | 8/26/94 | 41.6 | 2.48 | | |
| Tritium | 300 Area -3 HRM 43.1 | B0G895 | River | N | 9/18/95 | 40 | 2.46 | | |
| Tritium | 300 Area -3 HRM 43.1 | B0J8X6 | River | N | 9/20/96 | 42.6 | 2.54 | | |
| Tritium | 300 Area -3 HRM 43.1 | B0LVV9 | River | N | 8/25/97 | 33.8 | 2.48 | | |
| Tritium | 300 Area -3 HRM 43.1 | B0PVP6 | River | N | 9/15/98 | 38.3 | 2.41 | | |
| Tritium | 300 Area -3 HRM 43.1 | B0WB25 | River | N | 9/16/99 | 63 | 1.5 | 4.47 | |
| Tritium | 300 Area -3 HRM 43.1 | B106X7 | River | N | 9/19/00 | 28.8 | 3.2 | 6.04 | |
| Tritium | 300 Area -3 HRM 43.1 | B12TC0 | River | N | 9/13/01 | 29.7 | 3.3 | 6.33 | |
| Tritium | 300 Area -3 HRM 43.1 | B158L7 | River | N | 9/10/02 | 32 | 2.8 | 5.1 | |
| Tritium | 300 Area -3 HRM 43.1 | B17CJ4 | River | N | 9/9/03 | 49 | 4.9 | 4.83 | |
| Tritium | 300 Area -3 HRM 43.1 | B1B722 | River | N | 9/15/04 | 30.2 | 4.7 | 5.84 | |
| Tritium | 300 Area -2 HRM 43.1 | B0C5B8 | River | N | 8/26/94 | 52.7 | 2.54 | | |
| Tritium | 300 Area -2 HRM 43.1 | B0G894 | River | N | 9/18/95 | 79.2 | 2.95 | | |
| Tritium | 300 Area -2 HRM 43.1 | B0J8X4 | River | N | 9/20/96 | 97.9 | 3.19 | | |
| Tritium | 300 Area -2 HRM 43.1 | B0LVV8 | River | N | 8/25/97 | 41.6 | 2.54 | | |
| Tritium | 300 Area -2 HRM 43.1 | B0PVP5 | River | N | 9/15/98 | 51.1 | 2.64 | | |
| Tritium | 300 Area -2 HRM 43.1 | B0WB24 | River | N | 9/16/99 | 94 | 2 | 4.5 | |
| Tritium | 300 Area -2 HRM 43.1 | B106X5 | River | N | 9/19/00 | 35.5 | 3.4 | 6.08 | |
| Tritium | 300 Area -2 HRM 43.1 | B109C8 | River | N | 9/19/00 | 53.4 | 3.8 | 6.32 | |
| Tritium | 300 Area -2 HRM 43.1 | B12TB8 | River | N | 9/13/01 | 48.7 | 4.1 | 7.33 | |
| Tritium | 300 Area -2 HRM 43.1 | B158L6 | River | N | 9/10/02 | 47.5 | 3 | 5.02 | |
| Tritium | 300 Area -2 HRM 43.1 | B17CJ2 | River | N | 9/9/03 | 124 | 7.4 | 4.88 | |
| Tritium | 300 Area -2 HRM 43.1 | B1B721 | River | N | 9/15/04 | 79.3 | 6.9 | 5.79 | |
| Tritium | 300 Area -1 HRM 43.1 | B0C5B7 | River | N | 8/26/94 | 66.6 | 2.69 | | |
| Tritium | 300 Area -1 HRM 43.1 | B0G893 | River | N | 9/18/95 | 128 | 3.42 | | |
| Tritium | 300 Area -1 HRM 43.1 | B0J8X2 | River | N | 9/20/96 | 148 | 3.67 | | |
| Tritium | 300 Area -1 HRM 43.1 | B0LVV7 | River | N | 8/25/97 | 63 | 2.86 | | |
| Tritium | 300 Area -1 HRM 43.1 | B0PVP4 | River | N | 9/15/98 | 63.3 | 2.82 | | |
| Tritium | 300 Area -1 HRM 43.1 | B0WB23 | River | N | 9/16/99 | 82.3 | 1.8 | 4.37 | |
| Tritium | 300 Area -1 HRM 43.1 | B106X3 | River | N | 9/19/00 | 40.9 | 3.5 | 6.1 | |
| Tritium | 300 Area -1 HRM 43.1 | B109C7 | River | N | 9/19/00 | 46.9 | 3.7 | 6.41 | |
| Tritium | 300 Area -1 HRM 43.1 | B12TB6 | River | N | 9/13/01 | 43.3 | 3.6 | 6.43 | |
| Tritium | 300 Area -1 HRM 43.1 | B158L5 | River | N | 9/10/02 | 43.2 | 3 | 5.09 | |
| Tritium | 300 Area -1 HRM 43.1 | B17CJ0 | River | N | 9/9/03 | 119 | 4 | 5.25 | |
| Tritium | 300 Area -1 HRM 43.1 | B1B720 | River | N | 9/15/04 | 118 | 4.2 | 5.72 | |
| Tritium | 300 Area | B09QT2 | Drinking | N | 3/29/94 | 143 | 3.41 | | |
| Tritium | 300 Area | B0BP89 | Drinking | N | 6/21/94 | 90.3 | 3 | | |
| Tritium | 300 Area | B0C477 | Drinking | N | 10/11/94 | 214 | 4.01 | | |
| Tritium | 300 Area | B0D0Y8 | Drinking | N | 1/3/95 | 135 | 3.31 | | |
| Tritium | 300 Area | B0DKB6 | Drinking | N | 3/27/95 | 130 | 3.45 | | |
| Tritium | 300 Area | B0F909 | Drinking | N | 6/20/95 | 72.1 | 2.85 | | |
| Tritium | 300 Area | B0G537 | Drinking | N | 10/10/95 | 197 | 4.09 | | |
| Tritium | 300 Area | B0GML6 | Drinking | N | 1/4/96 | 118 | 3.43 | | |
| Tritium | 300 Area | B0H524 | Drinking | N | 3/27/96 | 66.9 | 2.87 | | |

**Table A.3.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Tritium | 300 Area | B0HPT1 | Drinking | N | 6/19/96 | 68.2 | 2.94 | | |
| Tritium | 300 Area | B0J464 | Drinking | N | 10/9/96 | 205 | 4.26 | | |
| Tritium | 300 Area | B0JFJ4 | Drinking | N | 1/6/97 | 195 | 4.14 | | |
| Tritium | 300 Area | B0JV31 | Drinking | N | 3/25/97 | 100 | 2.1 | 5.66 | |
| Tritium | 300 Area | B0K6X1 | Drinking | N | 7/17/97 | 71.1 | 2.91 | | |
| Tritium | 300 Area | B0LHF7 | Drinking | N | 10/8/97 | 211 | 4.16 | | |
| Tritium | 300 Area | S0LWT9 | Drinking | N | 12/30/97 | 204 | 4.07 | | |
| Tritium | 300 Area | B0MTB2 | Drinking | N | 3/27/98 | 29.6 | 2.32 | | |
| Tritium | 300 Area | B0NHR3 | Drinking | N | 7/15/98 | 343 | 5.24 | | |
| Tritium | 300 Area | B0P8V0 | Drinking | N | 10/8/98 | 432 | 5.9 | 4.78 | |
| Tritium | 300 Area | B0R233 | Drinking | N | 12/30/98 | 304 | 5 | 4.78 | |
| Tritium | 300 Area | B0VWV9 | Surface | N | 7/1/99 | 768 | 47 | 163 | |
| **Tritium** | **300 Area** | **B0WKP1** | **Surface** | **N** | **9/30/99** | **2660** | **110** | **168** | |
| Tritium | 300 Area | | River | N | 4/19/05 | 828 | 120 | 141 | |

## A.2.3 Nitrate Surface Water Data

There were 11 (1 nondetect) surface water samples of nitrate at the Richland Pumphouse location and 25 at the 300 Area location. The samples were collected between 8/26/1994 and 12/9/1996 at the Richland Pumphouse location, and between 8/26/1994 and 9/24/2004 at the 300 Area location. The values are plotted in Figure A.3, and the data are presented in Table A.4.

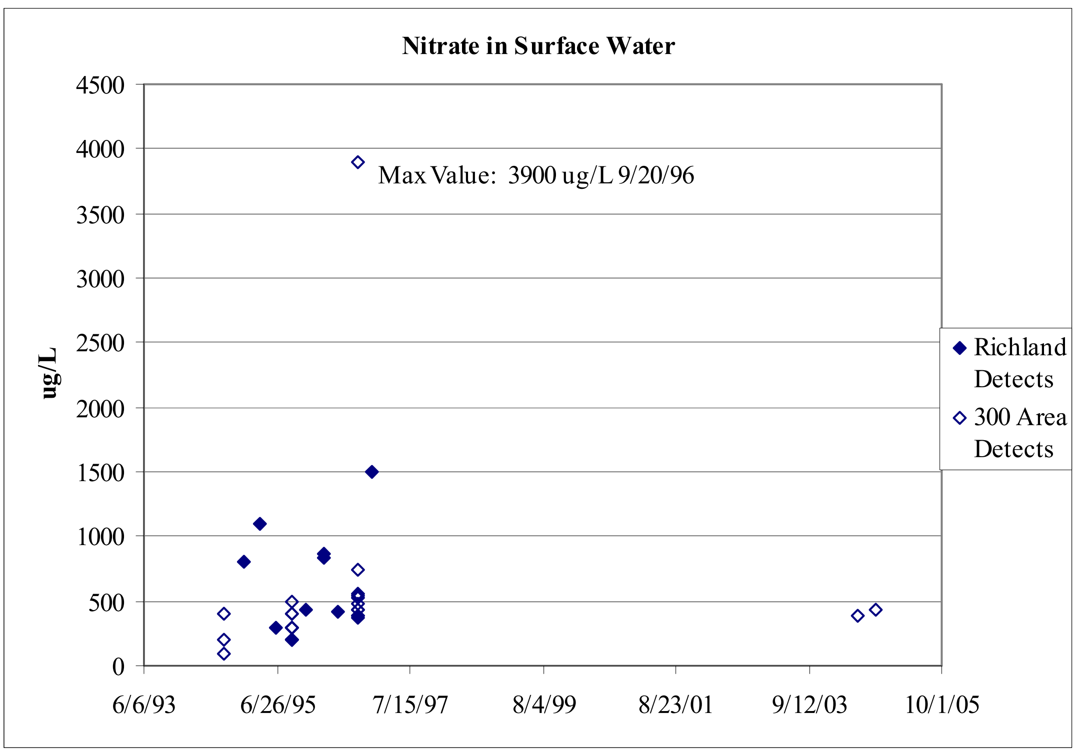


**Figure A.3.** Nitrate in Surface Water

**Table A.4**. Nitrate Data in Surface Water

| Analyte | Location | Sample Number | Sample Number | Sampled From | Filtered Flag | Sample Date | Value (μg/L) | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 8/26/94 | | U |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 12/21/94 | 800 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 3/17/95 | 1100 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 6/16/95 | 300 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 9/18/95 | 200 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 440 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 870 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 830 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 410 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 390 | |
| Nitrate | Richland | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 1500 | |
| Nitrate | 300 Area | 300 Area -9 HRM 43.1 | B0CSC7 | River | N | 8/26/94 | 200 | L |
| Nitrate | 300 Area | 300 Area -8 HRM 43.1 | B0CSC6 | River | N | 8/26/94 | 100 | L |
| Nitrate | 300 Area | 300 Area -10 HRM 43.1 | B0CSC8 | River | N | 8/26/94 | 400 | |
| Nitrate | 300 Area | 300 Area -10 HRM 43.1 | B0G0X2 | River | N | 9/18/95 | 500 | |
| Nitrate | 300 Area | 300 Area -10 HRM 43.1 | B0G1F9 | River | N | 9/20/96 | 750 | |
| Nitrate | 300 Area | 300 Area -9 HRM 43.1 | B0G0X1 | River | N | 9/18/95 | 400 | |
| Nitrate | 300 Area | 300 Area -9 HRM 43.1 | B0G1F8 | River | N | 9/20/96 | 550 | |
| Nitrate | 300 Area | 300 Area -8 HRM 43.1 | B0G0X0 | River | N | 9/18/95 | 400 | |
| Nitrate | 300 Area | 300 Area -8 HRM 43.1 | B0G1F7 | River | N | 9/20/96 | 540 | |
| Nitrate | 300 Area | 300 Area -7 HRM 43.1 | B0G0W9 | River | N | 9/18/95 | 300 | |
| Nitrate | 300 Area | 300 Area -7 HRM 43.1 | B0G1F6 | River | N | 9/20/96 | 480 | |
| Nitrate | 300 Area | 300 Area -6 HRM 43.1 | B0G0W8 | River | N | 9/18/95 | 300 | |
| Nitrate | 300 Area | 300 Area -6 HRM 43.1 | B0G1F5 | River | N | 9/20/96 | 440 | |
| Nitrate | 300 Area | 300 Area -5 HRM 43.1 | B0G0W7 | River | N | 9/18/95 | 200 | |
| Nitrate | 300 Area | 300 Area -5 HRM 43.1 | B0G1F4 | River | N | 9/20/96 | 370 | |
| Nitrate | 300 Area | 300 Area -4 HRM 43.1 | B0G0W6 | River | N | 9/18/95 | 300 | |
| Nitrate | 300 Area | 300 Area -4 HRM 43.1 | B0G1F3 | River | N | 9/20/96 | 440 | |
| Nitrate | 300 Area | 300 Area -3 HRM 43.1 | B0G0W5 | River | N | 9/18/95 | 300 | |
| Nitrate | 300 Area | 300 Area -3 HRM 43.1 | B0G1F2 | River | N | 9/20/96 | 380 | |
| Nitrate | 300 Area | 300 Area -2 HRM 43.1 | B0G0W4 | River | N | 9/18/95 | 200 | |
| Nitrate | 300 Area | 300 Area -2 HRM 43.1 | B0G1F1 | River | N | 9/20/96 | 530 | |
| Nitrate | 300 Area | 300 Area -1 HRM 43.1 | B0G0W3 | River | N | 9/18/95 | 200 | |
| **Nitrate** | **300 Area** | **300 Area -1 HRM 43.1** | **B0G1F0** | **River** | **N** | **9/20/96** | **3900** | |
| Nitrate | 300 Area | 300 Area | B19HD6 | River | N | 6/10/04 | 380 | |
| Nitrate | 300 Area | 300 Area | B1BCB2 | River | N | 9/24/04 | 430 | |

### A.2.4 Tetrachloroethene Surface Water Data

There were 18 surface water samples of tetrachloroethene at the Richland Pumphouse location and 10 at the 300 Area location. There were no detections at either location. Because tetrachloroethene is a contaminant of potential concern at the 300 Area, the summary statistics for tetrachloroethene were calculated with the nondetects set at one-half the detection limit as directed in the RAGS Section 5.3 (EPA 1989). The samples for the Richland Pumphouse were collected between 8/26/1994 and 9/14/2005. The samples at the 300 Area were all collected on 9/20/1996. The values are plotted in Figure A.4, and the data are presented in Table A.5.

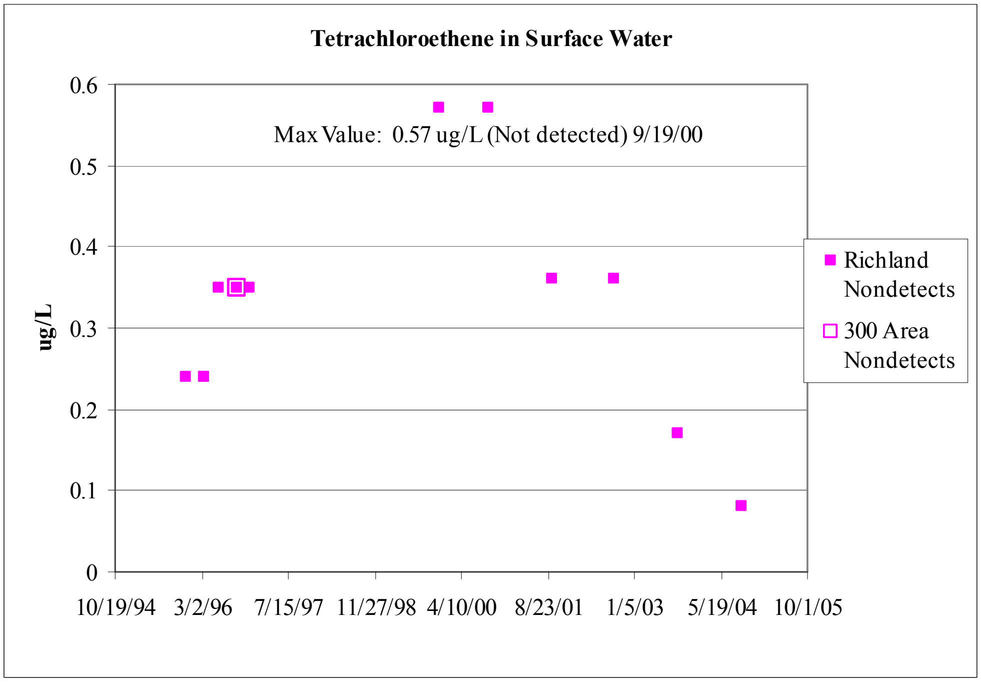


**Figure A.4**. Tetrachloroethene in Surface Water

**Table A.5**. Tetrachloroethene Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filtered Flag | Sample Date | Value (µg/L) | Quali-fier |
|---|---|---|---|---|---|---|---|
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 8/26/94 | | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/21/94 | | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/17/95 | | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 6/16/95 | | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/18/95 | | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 0.24 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.24 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.24 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 0.35 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.35 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.57 | U |
| **Tetrachloroethene** | **Rich.Pmphs-1 HRM46.4** | | **River** | **N** | **9/19/00** | **0.57** | **U** |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/13/01 | 0.36 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/10/02 | 0.36 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/9/03 | 0.17 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/04 | 0.08 | U |
| Tetrachloroethene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/14/05 | 0.1 | UN |
| Tetrachloroethene | 300 Area-10 HRM 43.1 | B0G1F9 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -9 HRM 43.1 | B0G1F8 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -8 HRM 43.1 | B0G1F7 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -7 HRM 43.1 | B0G1F6 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -6 HRM 43.1 | B0G1F5 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -5 HRM 43.1 | B0G1F4 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -4 HRM 43.1 | B0G1F3 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -3 HRM 43.1 | B0G1F2 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -2 HRM 43.1 | B0G1F1 | River | N | 9/20/96 | 0.35 | U |
| Tetrachloroethene | 300 Area -1 HRM 43.1 | B0G1F0 | River | N | 9/20/96 | 0.35 | U |

### A.2.5 Strontium-90 Surface Water Data

There were 205 (11 nondetect) surface water samples of strontium-90 at the Richland Pumphouse location and 145 (21 nondetect) at the 300 Area location. The samples were collected between 1/25/1994 and 9/29/2005. The values are plotted in Figure A.5, and the data are presented in Table A.6.

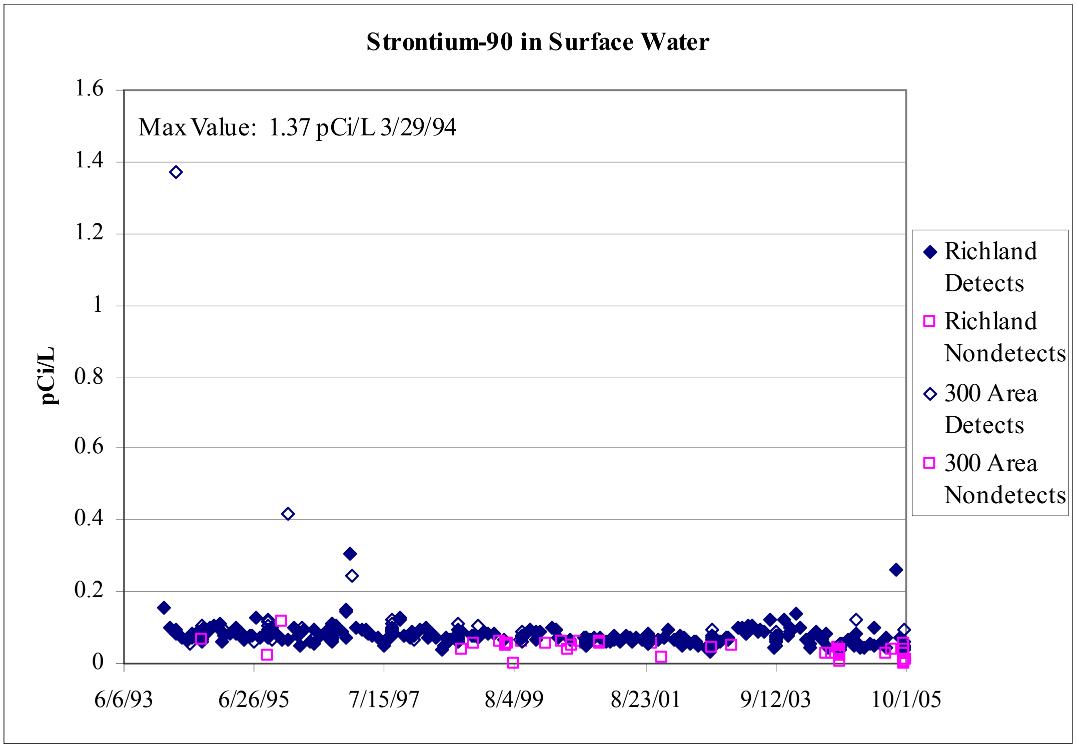


**Figure A.5**. Strontium-90 in Surface Water

**Table A.6**. Strontium-90 Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 0.115 | 0.144 | | U |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/04 | 0.0332 | 0.022 | 0.0372 | U |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/29/05 | -0.00381 | 0.012 | 0.0202 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/28/99 | 0.0000267 | 0.000045 | 0.0406 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/01 | 0.0573 | 0.058 | 0.108 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/27/01 | 0.0156 | 0.051 | 0.126 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/03 | 0.0496 | 0.028 | 0.0501 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/04 | 0.0303 | 0.022 | 0.0361 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/04 | 0.0456 | 0.029 | 0.0478 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/7/05 | 0.0393 | 0.022 | 0.0387 | U |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/29/05 | 0.00927 | 0.017 | 0.0299 | U |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/15/98 | 0.0582 | 0.031 | 0.0524 | J |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/14/99 | 0.0521 | 0.019 | 0.0348 | J |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/14/99 | 0.0533 | 0.017 | 0.0311 | J |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/16/99 | 0.0594 | 0.02 | 0.034 | J |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/19/00 | 0.0539 | 0.026 | 0.0401 | J |

**Table A.6.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/5/00 | 0.0557 | 0.028 | 0.0428 | J |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/5/00 | 0.0589 | 0.024 | 0.0362 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/5/99 | 0.0591 | 0.021 | 0.0435 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/99 | 0.0556 | 0.02 | 0.0368 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/2/00 | 0.0532 | 0.02 | 0.039 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/00 | 0.0599 | 0.018 | 0.0282 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/31/00 | 0.0403 | 0.016 | 0.0336 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/29/00 | 0.0518 | 0.018 | 0.0314 | J |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/10/00 | 0.0598 | 0.017 | 0.0269 | J |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/31/94 | 0.0958 | 0.0389 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 7/1/94 | 0.0812 | 0.0447 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 8/26/94 | 0.0726 | 0.0373 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/21/94 | 0.059 | 0.0426 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/17/95 | 0.0818 | 0.0309 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/16/95 | 0.0756 | 0.0407 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/18/95 | 0.0928 | 0.046 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.0486 | 0.042 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.0861 | 0.0471 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 0.0941 | 0.0527 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 0.109 | 0.0365 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.146 | 0.0414 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.153 | 0.0451 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 4/1/97 | 0.0916 | 0.0363 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 8/25/97 | 0.0949 | 0.0306 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/97 | 0.0889 | 0.0309 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/97 | 0.0772 | 0.031 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/24/98 | 0.0745 | 0.0256 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/24/98 | 0.0912 | 0.0311 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/23/98 | 0.052 | 0.0268 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/98 | 0.0964 | 0.0355 | | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/15/98 | 0.0762 | 0.026 | 0.0346 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.0696 | 0.019 | 0.0288 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.0821 | 0.024 | 0.0379 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/28/00 | 0.0942 | 0.029 | 0.0468 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/28/00 | 0.0943 | 0.033 | 0.0515 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/20/00 | 0.0644 | 0.018 | 0.0299 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 2/26/01 | 0.0758 | 0.032 | 0.045 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 2/26/01 | 0.067 | 0.028 | 0.0417 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/12/01 | 0.0594 | 0.027 | 0.0385 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/13/01 | 0.0533 | 0.029 | 0.0448 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/4/01 | 0.0704 | 0.035 | 0.0545 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/4/01 | 0.0751 | 0.029 | 0.0435 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/26/02 | 0.0573 | 0.029 | 0.0461 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/26/02 | 0.0525 | 0.026 | 0.0412 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/11/02 | 0.0636 | 0.037 | 0.063 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/10/02 | 0.0796 | 0.03 | 0.0438 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/10/02 | 0.0652 | 0.028 | 0.0443 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/10/02 | 0.0727 | 0.028 | 0.0414 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/25/03 | 0.0815 | 0.032 | 0.0506 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/25/03 | 0.0857 | 0.029 | 0.0436 | |

**Table A.6**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/10/03 | 0.0955 | 0.036 | 0.0521 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/9/03 | 0.0707 | 0.018 | 0.0246 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/8/03 | 0.0869 | 0.022 | 0.0366 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/8/03 | 0.0997 | 0.023 | 0.0367 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/30/04 | 0.056 | 0.021 | 0.0356 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/30/04 | 0.0442 | 0.025 | 0.0409 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/24/04 | 0.0835 | 0.022 | 0.0359 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/04 | 0.0829 | 0.027 | 0.0418 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/04 | 0.0621 | 0.022 | 0.0395 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/29/05 | 0.102 | 0.024 | 0.0324 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/05 | 0.0709 | 0.025 | 0.0406 | |
| Strontium-90 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/14/05 | 0.0429 | 0.019 | 0.0322 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/25/94 | 0.156 | 0.0537 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/22/94 | 0.102 | 0.0285 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/29/94 | 0.0837 | 0.0348 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/94 | 0.0749 | 0.0367 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/7/94 | 0.0687 | 0.0294 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/6/94 | 0.0745 | 0.034 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/94 | 0.0893 | 0.0349 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/94 | 0.0992 | 0.04 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/4/94 | 0.0918 | 0.0329 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/94 | 0.106 | 0.0336 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/6/94 | 0.113 | 0.0334 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/21/94 | 0.0868 | 0.0369 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/95 | 0.0781 | 0.037 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/95 | 0.0841 | 0.0326 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/95 | 0.102 | 0.0329 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/95 | 0.0885 | 0.023 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/95 | 0.0666 | 0.0619 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/6/95 | 0.0785 | 0.033 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/5/95 | 0.126 | 0.0679 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/95 | 0.0734 | 0.0369 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/95 | 0.0833 | 0.035 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/3/95 | 0.103 | 0.0421 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/8/95 | 0.0772 | 0.025 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/5/95 | 0.0672 | 0.0354 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/96 | 0.0669 | 0.0332 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/96 | 0.101 | 0.0421 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/6/96 | 0.0771 | 0.042 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/96 | 0.0964 | 0.0506 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/8/96 | 0.0614 | 0.0484 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/5/96 | 0.053 | 0.0355 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/2/96 | 0.0782 | 0.0284 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/96 | 0.0909 | 0.03 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/96 | 0.0689 | 0.0346 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/9/96 | 0.103 | 0.0305 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/6/96 | 0.0912 | 0.0295 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/4/96 | 0.0712 | 0.0345 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/96 | 0.305 | 0.0573 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/97 | 0.0995 | 0.0489 | | |

**Table A.6**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali- fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/97 | 0.0957 | 0.0315 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/9/97 | 0.0856 | 0.0423 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/97 | 0.0779 | 0.0397 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/97 | 0.0709 | 0.0297 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/9/97 | 0.0509 | 0.028 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/6/97 | 0.0663 | 0.0307 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/97 | 0.0814 | 0.0222 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/97 | 0.13 | 0.0398 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/5/97 | 0.078 | 0.0362 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/97 | 0.0721 | 0.0341 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/97 | 0.076 | 0.0394 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/98 | 0.0949 | 0.0297 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/4/98 | 0.0983 | 0.0294 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/8/98 | 0.0847 | 0.0224 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/98 | 0.0711 | 0.0267 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/98 | 0.0393 | 0.0246 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/98 | 0.0748 | 0.0291 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/29/98 | 0.0693 | 0.0296 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/2/98 | 0.07 | 0.0359 | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/98 | 0.0918 | 0.03 | 0.0402 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/98 | | | | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/98 | 0.0757 | 0.033 | 0.0499 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/98 | 0.0733 | 0.025 | 0.0322 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/99 | 0.0872 | 0.025 | 0.032 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/3/99 | 0.0834 | 0.026 | 0.0334 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/7/99 | 0.082 | 0.027 | 0.0361 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/2/99 | 0.069 | 0.025 | 0.0431 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/1/99 | 0.0693 | 0.023 | 0.0405 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/6/99 | 0.085 | 0.023 | 0.0333 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/3/99 | 0.0922 | 0.022 | 0.0294 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/99 | 0.0867 | 0.022 | 0.0333 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/29/99 | 0.0873 | 0.023 | 0.0343 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/8/00 | 0.1 | 0.025 | 0.0342 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/5/00 | 0.0733 | 0.021 | 0.0326 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/7/00 | 0.0724 | 0.021 | 0.0332 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/5/00 | 0.0672 | 0.025 | 0.0369 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/2/00 | 0.0712 | 0.026 | 0.0406 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/29/00 | 0.0717 | 0.022 | 0.0342 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/4/01 | 0.0634 | 0.027 | 0.0406 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/31/01 | 0.0628 | 0.024 | 0.0391 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/1/01 | 0.0734 | 0.026 | 0.0415 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/01 | 0.0598 | 0.026 | 0.0426 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/01 | 0.0795 | 0.027 | 0.0384 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/30/01 | 0.0717 | 0.03 | 0.048 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/28/01 | 0.0715 | 0.028 | 0.0429 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/9/01 | 0.0692 | 0.025 | 0.0339 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/5/01 | 0.0625 | 0.027 | 0.0456 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/01 | 0.0659 | 0.032 | 0.0494 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/02 | 0.0938 | 0.032 | 0.0505 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/6/02 | 0.0642 | 0.027 | 0.0407 | |

**Table A.6**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/02 | 0.0802 | 0.025 | 0.0346 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/02 | 0.0747 | 0.027 | 0.0366 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/1/02 | 0.0569 | 0.026 | 0.0391 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/29/02 | 0.061 | 0.021 | 0.0299 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/27/02 | 0.0496 | 0.025 | 0.0393 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/02 | 0.0428 | 0.021 | 0.0323 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/02 | 0.0361 | 0.017 | 0.0266 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/02 | 0.0532 | 0.031 | 0.0522 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/30/02 | 0.0609 | 0.025 | 0.037 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/26/02 | 0.0702 | 0.033 | 0.0523 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/5/03 | 0.098 | 0.034 | 0.0552 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/03 | 0.0983 | 0.029 | 0.0392 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/2/03 | 0.106 | 0.029 | 0.0401 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/30/03 | 0.107 | 0.039 | 0.0623 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/28/03 | 0.0878 | 0.029 | 0.041 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/10/03 | 0.0903 | 0.033 | 0.0483 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/8/03 | 0.122 | 0.032 | 0.0405 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/03 | 0.0472 | 0.025 | 0.0385 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 9/30/03 | 0.0778 | 0.023 | 0.0336 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/29/03 | 0.121 | 0.021 | 0.0265 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 11/25/03 | 0.0792 | 0.021 | 0.0322 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/04 | 0.141 | 0.027 | 0.0417 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/04 | 0.1 | 0.021 | 0.0338 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/04 | 0.0661 | 0.019 | 0.0287 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 4/1/04 | 0.073 | 0.022 | 0.0337 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/6/04 | 0.0876 | 0.027 | 0.0467 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/8/04 | 0.0678 | 0.026 | 0.0431 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 7/8/04 | 0.0458 | 0.02 | 0.0323 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/1/04 | 0.0577 | 0.021 | 0.0309 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/04 | 0.0644 | 0.025 | 0.0431 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/04 | 0.0511 | 0.021 | 0.0353 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 1/5/05 | 0.0424 | 0.02 | 0.0321 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/05 | 0.0426 | 0.023 | 0.0415 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/05 | 0.0568 | 0.025 | 0.0357 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 3/31/05 | 0.0491 | 0.022 | 0.0392 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/05 | 0.0562 | 0.018 | 0.0282 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 6/9/05 | 0.0435 | 0.022 | 0.0395 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/05 | 0.26 | 0.045 | 0.0646 | |
| Strontium-90 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/05 | 0.0729 | 0.021 | 0.0337 | |
| Strontium-90 | 300 Area-10 HRM 43.1 | B1B725 | River | N | 9/15/04 | 0.0289 | 0.022 | 0.0391 | U |
| Strontium-90 | 300 Area -10 HRM 43.1 | | River | N | 9/15/05 | 0.0262 | 0.02 | 0.0352 | U |
| Strontium-90 | 300 Area Spring 42-2 | | River | N | 9/15/05 | 0.0279 | 0.019 | 0.0346 | U |
| Strontium-90 | 300 Area Shr HRM42.1 | B1B7C3 | River | N | 9/15/04 | 0.0223 | 0.019 | 0.0334 | U |
| Strontium-90 | 300 Area Shr HRM41.5 | B1B7B9 | River | N | 9/15/04 | 0.0357 | 0.019 | 0.0337 | U |
| Strontium-90 | 300 Area Shr HRM41.5 | | River | N | 9/15/05 | 0.00401 | 0.021 | 0.0435 | U |
| Strontium-90 | 300 Area Outfl13 | B19JC4 | River | N | 6/24/04 | 0.0273 | 0.024 | 0.0498 | U |
| Strontium-90 | 300 Area Outfl13 | B1B7H7 | River | N | 9/15/04 | 0.0368 | 0.022 | 0.0365 | U |
| Strontium-90 | 300 Area Outfl13 | | River | N | 6/7/05 | 0.0253 | 0.019 | 0.0326 | U |
| Strontium-90 | 300 Area Outfl13 | | River | N | 9/15/05 | 0.00126 | 0.026 | 0.0479 | U |
| Strontium-90 | 300 Area -9 HRM 43.1 | B0G8B1 | River | N | 9/18/95 | 0.0198 | 0.0393 | | U |

**Table A.6**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | 300 Area -9 HRM 43.1 | B0PVR2 | River | N | 9/15/98 | -0.22 | 0.329 | | U |
| Strontium-90 | 300 Area -7 HRM 43.1 | B1B724 | River | N | 9/15/04 | 0.0326 | 0.021 | 0.0358 | U |
| Strontium-90 | 300 Area -7 HRM 43.1 | | River | N | 9/15/05 | 0.0539 | 0.034 | 0.0544 | U |
| Strontium-90 | 300 Area -6 HRM 43.1 | B0C5C2 | River | N | 8/26/94 | 0.0678 | 0.114 | | U |
| Strontium-90 | 300 Area -5 HRM 43.1 | B158L8 | River | N | 9/10/02 | 0.0422 | 0.03 | 0.045 | U |
| Strontium-90 | 300 Area -5 HRM 43.1 | B1B723 | River | N | 9/15/04 | 0.0328 | 0.022 | 0.0385 | U |
| Strontium-90 | 300 Area -2 HRM 43.1 | B1B721 | River | N | 9/15/04 | 0.0234 | 0.02 | 0.0382 | U |
| Strontium-90 | 300 Area -1 HRM 43.1 | B1B720 | River | N | 9/15/04 | 0.00715 | 0.01 | 0.0204 | U |
| Strontium-90 | 300 Area -1 HRM 43.1 | | River | N | 9/15/05 | 0.0366 | 0.022 | 0.0344 | U |
| Strontium-90 | 300 Area | B0P8V0 | Drinking | N | 10/8/98 | 0.0394 | 0.029 | 0.0487 | U |
| Strontium-90 | 300 Area Shr HRM42.5 | B10779 | River | N | 9/19/00 | 0.055 | 0.024 | 0.038 | J |
| Strontium-90 | 300 Area Shr HRM42.1 | B10776 | River | N | 9/19/00 | 0.0477 | 0.022 | 0.0337 | J |
| Strontium-90 | 300 Area -7 HRM 43.1 | B106Y1 | River | N | 9/19/00 | 0.05 | 0.028 | 0.0454 | J |
| Strontium-90 | 300 Area -3 HRM 43.1 | B106X7 | River | N | 9/19/00 | 0.0592 | 0.024 | 0.0336 | J |
| Strontium-90 | 300 Area -1 HRM 43.1 | B106X3 | River | N | 9/19/00 | 0.0552 | 0.028 | 0.0429 | J |
| Strontium-90 | 300 Area -10 HRM 43.1 | B0C5C6 | River | N | 8/26/94 | 0.0616 | 0.0372 | | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B0G8B2 | River | N | 9/18/95 | 0.12 | 0.0945 | | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B0J8Y6 | River | N | 9/20/96 | 0.101 | 0.0301 | | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B0LVW6 | River | N | 8/25/97 | 0.122 | 0.0352 | | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B0PVR3 | River | N | 9/15/98 | 0.073 | 0.0399 | | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B0WB28 | River | N | 9/16/99 | 0.0775 | 0.021 | 0.0323 | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B106Y3 | River | N | 9/19/00 | 0.0661 | 0.024 | 0.0342 | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B12TC6 | River | N | 9/13/01 | 0.0628 | 0.03 | 0.0455 | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B158M0 | River | N | 9/10/02 | 0.0759 | 0.031 | 0.0446 | |
| Strontium-90 | 300 Area -10 HRM 43.1 | B17CK0 | River | N | 9/9/03 | 0.0645 | 0.021 | 0.0315 | |
| Strontium-90 | 300 Area Spr DR 42-2 | | River | N | 9/15/05 | 0.0934 | 0.036 | 0.0598 | |
| Strontium-90 | 300 Area Shr HRM42.9 | B0WB56 | River | N | 9/16/99 | 0.0731 | 0.024 | 0.0393 | |
| Strontium-90 | 300 Area Shr HRM42.9 | B10782 | River | N | 9/19/00 | 0.0716 | 0.027 | 0.0372 | |
| Strontium-90 | 300 Area Shr HRM42.9 | B12TR6 | River | N | 9/13/01 | 0.0683 | 0.027 | 0.0398 | |
| Strontium-90 | 300 Area Shr HRM42.9 | B158Y9 | River | N | 9/10/02 | 0.0937 | 0.033 | 0.0525 | |
| Strontium-90 | 300 Area Shr HRM42.9 | B17CX7 | River | N | 9/9/03 | 0.072 | 0.02 | 0.0287 | |
| Strontium-90 | 300 Area Shr HRM42.9 | B1B7C7 | River | N | 9/15/04 | 0.0415 | 0.022 | 0.0351 | |
| Strontium-90 | 300 Area Shr HRM42.9 | | River | N | 9/15/05 | 0.0587 | 0.023 | 0.036 | |
| Strontium-90 | 300 Area Shr HRM42.5 | B0WB55 | River | N | 9/16/99 | 0.0779 | 0.023 | 0.0353 | |
| Strontium-90 | 300 Area Shr HRM42.5 | B12TR2 | River | N | 9/13/01 | 0.0594 | 0.027 | 0.0411 | |
| Strontium-90 | 300 Area Shr HRM42.5 | B158Y6 | River | N | 9/10/02 | 0.074 | 0.031 | 0.0501 | |
| Strontium-90 | 300 Area Shr HRM42.5 | B17CX3 | River | N | 9/9/03 | 0.089 | 0.022 | 0.0309 | |
| Strontium-90 | 300 Area Shr HRM42.4 | B1B7H3 | River | N | 9/15/04 | 0.0537 | 0.021 | 0.0328 | |
| Strontium-90 | 300 Area Shr HRM42.1 | B0WB54 | River | N | 9/16/99 | 0.0717 | 0.021 | 0.0331 | |
| Strontium-90 | 300 Area Shr HRM42.1 | B12TP8 | River | N | 9/13/01 | 0.0759 | 0.029 | 0.0423 | |
| Strontium-90 | 300 Area Shr HRM42.1 | B158Y3 | River | N | 9/10/02 | 0.0753 | 0.032 | 0.0538 | |
| Strontium-90 | 300 Area Shr HRM42.1 | B17CW9 | River | N | 9/9/03 | 0.077 | 0.02 | 0.0279 | |
| Strontium-90 | 300 Area Shr HRM41.5 | B0WB53 | River | N | 9/16/99 | 0.0733 | 0.02 | 0.0303 | |
| Strontium-90 | 300 Area Shr HRM41.5 | B10773 | River | N | 9/19/00 | 0.0652 | 0.024 | 0.0337 | |
| Strontium-90 | 300 Area Shr HRM41.5 | B12TP4 | River | N | 9/13/01 | 0.0818 | 0.03 | 0.0423 | |
| Strontium-90 | 300 Area Shr HRM41.5 | B158Y0 | River | N | 9/10/02 | 0.0787 | 0.031 | 0.051 | |
| Strontium-90 | 300 Area Shr HRM41.5 | B17CW5 | River | N | 9/9/03 | 0.061 | 0.019 | 0.0283 | |
| Strontium-90 | 300 Area Outfl13 | B1BW54 | River | N | 12/19/04 | 0.125 | 0.023 | 0.0305 | |
| Strontium-90 | 300 Area -9 HRM 43.1 | B0C5C5 | River | N | 8/26/94 | 0.077 | 0.0412 | | |
| Strontium-90 | 300 Area -9 HRM 43.1 | B0J8Y5 | River | N | 9/20/96 | 0.1 | 0.0348 | | |

**Table A.6**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | 300 Area -9 HRM 43.1 | B0LVW5 | River | N | 8/25/97 | 0.0917 | 0.0301 | | |
| Strontium-90 | 300 Area -8 HRM 43.1 | B0C5C4 | River | N | 8/26/94 | 0.0679 | 0.0361 | | |
| Strontium-90 | 300 Area -8 HRM 43.1 | B0G8B0 | River | N | 9/18/95 | 0.0724 | 0.0424 | | |
| Strontium-90 | 300 Area -8 HRM 43.1 | B0J8Y4 | River | N | 9/20/96 | 0.0698 | 0.0286 | | |
| Strontium-90 | 300 Area -8 HRM 43.1 | B0LVW4 | River | N | 8/25/97 | 0.111 | 0.0308 | | |
| Strontium-90 | 300 Area -8 HRM 43.1 | B0PVR1 | River | N | 9/15/98 | 0.0677 | 0.0452 | | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B0C5C3 | River | N | 8/26/94 | 0.106 | 0.0406 | | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B0G899 | River | N | 9/18/95 | 0.083 | 0.0478 | | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B0J8Y3 | River | N | 9/20/96 | 0.0808 | 0.0333 | | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B0LVW3 | River | N | 8/25/97 | 0.09 | 0.0287 | | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B0PVR0 | River | N | 9/15/98 | 0.0667 | 0.0347 | | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B0WB27 | River | N | 9/16/99 | 0.0907 | 0.024 | 0.0358 | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B12TC4 | River | N | 9/13/01 | 0.0536 | 0.027 | 0.0403 | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B158L9 | River | N | 9/10/02 | 0.063 | 0.03 | 0.0463 | |
| Strontium-90 | 300 Area -7 HRM 43.1 | B17CJ8 | River | N | 9/9/03 | 0.0663 | 0.024 | 0.0367 | |
| Strontium-90 | 300 Area -6 HRM 43.1 | B0G898 | River | N | 9/18/95 | 0.0771 | 0.049 | | |
| Strontium-90 | 300 Area -6 HRM 43.1 | B0J8Y2 | River | N | 9/20/96 | 0.0647 | 0.0322 | | |
| Strontium-90 | 300 Area -6 HRM 43.1 | B0LVW2 | River | N | 8/25/97 | 0.103 | 0.0314 | | |
| Strontium-90 | 300 Area -6 HRM 43.1 | B0PVP9 | River | N | 9/15/98 | 0.114 | 0.0476 | | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B0C5C1 | River | N | 8/26/94 | 0.0699 | 0.0424 | | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B0G897 | River | N | 9/18/95 | 0.0763 | 0.0503 | | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B0J8Y0 | River | N | 9/20/96 | 0.0987 | 0.0386 | | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B0LVW1 | River | N | 8/25/97 | 0.0897 | 0.0279 | | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B0PVP8 | River | N | 9/15/98 | 0.0634 | 0.0365 | | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B0WB26 | River | N | 9/16/99 | 0.0725 | 0.022 | 0.0354 | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B106X9 | River | N | 9/19/00 | 0.0681 | 0.026 | 0.0376 | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B12TC2 | River | N | 9/13/01 | 0.0634 | 0.027 | 0.0386 | |
| Strontium-90 | 300 Area -5 HRM 43.1 | B17CJ6 | River | N | 9/9/03 | 0.0768 | 0.03 | 0.0475 | |
| Strontium-90 | 300 Area -5 HRM 43.1 | | River | N | 9/15/05 | 0.0405 | 0.02 | 0.0296 | |
| Strontium-90 | 300 Area -4 HRM 43.1 | B0C5C0 | River | N | 8/26/94 | 0.0747 | 0.0384 | | |
| Strontium-90 | 300 Area -4 HRM 43.1 | B0G896 | River | N | 9/18/95 | 0.0875 | 0.0459 | | |
| Strontium-90 | 300 Area -4 HRM 43.1 | B0J8X8 | River | N | 9/20/96 | 0.063 | 0.0361 | | |
| Strontium-90 | 300 Area -4 HRM 43.1 | B0LVW0 | River | N | 8/25/97 | 0.0896 | 0.0299 | | |
| Strontium-90 | 300 Area -4 HRM 43.1 | B0PVP7 | River | N | 9/15/98 | 0.0851 | 0.0415 | | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B0C5B9 | River | N | 8/26/94 | 0.087 | 0.0376 | | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B0G895 | River | N | 9/18/95 | 0.106 | 0.0562 | | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B0J8X6 | River | N | 9/20/96 | 0.0729 | 0.0395 | | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B0LVV9 | River | N | 8/25/97 | 0.0839 | 0.0305 | | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B0PVP6 | River | N | 9/15/98 | 0.0655 | 0.0349 | | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B0WB25 | River | N | 9/16/99 | 0.0762 | 0.023 | 0.0385 | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B12TC0 | River | N | 9/13/01 | 0.0566 | 0.028 | 0.0427 | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B158L7 | River | N | 9/10/02 | 0.0662 | 0.031 | 0.0513 | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B17CJ4 | River | N | 9/9/03 | 0.0778 | 0.022 | 0.0305 | |
| Strontium-90 | 300 Area -3 HRM 43.1 | B1B722 | River | N | 9/15/04 | 0.0454 | 0.022 | 0.0388 | |
| Strontium-90 | 300 Area -3 HRM 43.1 | | River | N | 9/15/05 | 0.051 | 0.024 | 0.036 | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B0C5B8 | River | N | 8/26/94 | 0.0863 | 0.0453 | | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B0G894 | River | N | 9/18/95 | 0.118 | 0.066 | | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B0J8X4 | River | N | 9/20/96 | 0.11 | 0.0376 | | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B0LVV8 | River | N | 8/25/97 | 0.0996 | 0.0303 | | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B0PVP5 | River | N | 9/15/98 | 0.0842 | 0.066 | | |

**Table A.6**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Strontium-90 | 300 Area -2 HRM 43.1 | B0WB24 | River | N | 9/16/99 | 0.0634 | 0.021 | 0.0339 | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B106X5 | River | N | 9/19/00 | 0.0735 | 0.026 | 0.0361 | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B12TB8 | River | N | 9/13/01 | 0.0709 | 0.028 | 0.0407 | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B158L6 | River | N | 9/10/02 | 0.0637 | 0.032 | 0.0508 | |
| Strontium-90 | 300 Area -2 HRM 43.1 | B17CJ2 | River | N | 9/9/03 | 0.0622 | 0.021 | 0.0306 | |
| Strontium-90 | 300 Area -2 HRM 43.1 | | River | N | 9/15/05 | 0.06 | 0.021 | 0.0315 | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B0C5B7 | River | N | 8/26/94 | 0.081 | 0.0488 | | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B0G893 | River | N | 9/18/95 | 0.0834 | 0.0465 | | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B0J8X2 | River | N | 9/20/96 | 0.0873 | 0.035 | | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B0LVV7 | River | N | 8/25/97 | 0.0965 | 0.0289 | | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B0PVP4 | River | N | 9/15/98 | 0.0617 | 0.0359 | | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B0WB23 | River | N | 9/16/99 | 0.0745 | 0.022 | 0.0348 | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B12TB6 | River | N | 9/13/01 | 0.0744 | 0.033 | 0.0485 | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B158L5 | River | N | 9/10/02 | 0.066 | 0.034 | 0.0553 | |
| Strontium-90 | 300 Area -1 HRM 43.1 | B17CJ0 | River | N | 9/9/03 | 0.0497 | 0.018 | 0.0284 | |
| **Strontium-90** | **300 Area** | **B09QT2** | **Drinking** | **N** | **3/29/94** | **1.37** | **0.0962** | | |
| Strontium-90 | 300 Area | B0BP89 | Drinking | N | 6/21/94 | 0.0532 | 0.0311 | | |
| Strontium-90 | 300 Area | B0C477 | Drinking | N | 10/11/94 | 0.103 | 0.0375 | | |
| Strontium-90 | 300 Area | B0D0Y8 | Drinking | N | 1/3/95 | 0.0932 | 0.0391 | | |
| Strontium-90 | 300 Area | B0DKB6 | Drinking | N | 3/27/95 | 0.09 | 0.0322 | | |
| Strontium-90 | 300 Area | B0F909 | Drinking | N | 6/20/95 | 0.0601 | 0.027 | | |
| Strontium-90 | 300 Area | B0G537 | Drinking | N | 10/10/95 | 0.0694 | 0.0336 | | |
| Strontium-90 | 300 Area | B0GML6 | Drinking | N | 1/4/96 | 0.417 | 0.0564 | | |
| Strontium-90 | 300 Area | B0H524 | Drinking | N | 3/27/96 | 0.0987 | 0.049 | | |
| Strontium-90 | 300 Area | B0HPT1 | Drinking | N | 6/19/96 | 0.0764 | 0.0389 | | |
| Strontium-90 | 300 Area | B0J464 | Drinking | N | 10/9/96 | 0.107 | 0.0425 | | |
| Strontium-90 | 300 Area | B0JFJ4 | Drinking | N | 1/6/97 | 0.247 | 0.048 | | |
| Strontium-90 | 300 Area | B0JV31 | Drinking | N | 3/25/97 | 0.0963 | 0.0345 | | |
| Strontium-90 | 300 Area | B0K6X1 | Drinking | N | 7/17/97 | 0.0669 | 0.031 | | |
| Strontium-90 | 300 Area | B0LHF7 | Drinking | N | 10/8/97 | 0.121 | 0.0362 | | |
| Strontium-90 | 300 Area | S0LWT9 | Drinking | N | 12/30/97 | 0.0671 | 0.0316 | | |
| Strontium-90 | 300 Area | B0MTB2 | Drinking | N | 3/27/98 | 0.0784 | 0.0281 | | |
| Strontium-90 | 300 Area | B0NHR3 | Drinking | N | 7/15/98 | 0.0611 | 0.0345 | | |
| Strontium-90 | 300 Area | B0R233 | Drinking | N | 12/30/98 | 0.106 | 0.034 | 0.0465 | |

### A.2.6 Technetium-99 Surface Water Data

There were 141 (134 nondetect) surface water samples of technetium-99 at the Richland Pumphouse location and 20 (19 nondetect) at the 300 Area location. The samples were collected between 1/25/1994 and 9/29/2005 at the Richland Pumphouse location and between 3/29/1994 and 12/30/1998 at the 300 Area location. The values are plotted in Figure A.6, and the data are presented in Table A.7.

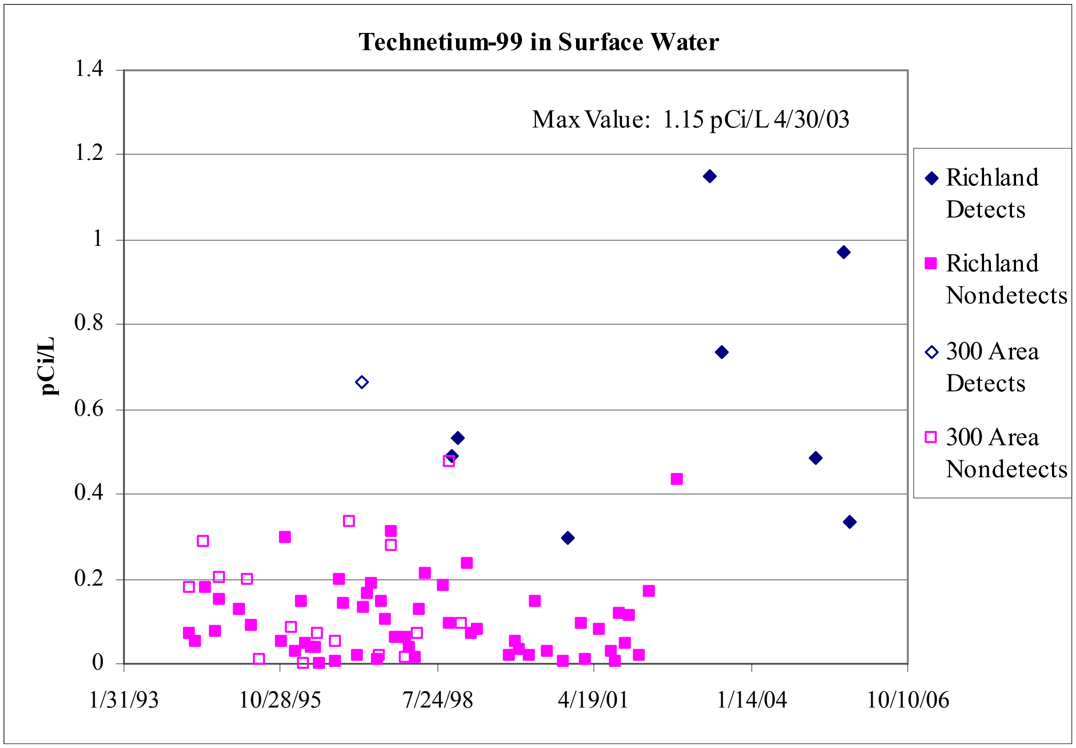


**Figure A.6.** Technetium-99 in Surface Water

**Table A.7.** Technetium-99 Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/25/94 | -0.0355 | 0.102 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/22/94 | -0.0189 | 0.0983 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/29/94 | 0.0699 | 0.0991 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/94 | 0.0509 | 0.097 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/7/94 | -0.413 | 0.1 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/6/94 | 0.18 | 0.102 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/94 | -0.136 | 0.0974 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/94 | 0.076 | 0.102 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/4/94 | 0.153 | 0.101 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/94 | -0.302 | 0.0972 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/6/94 | -0.183 | 0.1 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/95 | -0.0364 | 0.1 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/95 | 0.126 | 0.101 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/95 | -0.0329 | 0.0991 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/95 | -0.0189 | 0.0977 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/95 | 0.0903 | 0.0998 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/6/95 | -0.135 | 0.0976 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/5/95 | -0.108 | 0.0955 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/95 | -0.246 | 0.1 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/95 | -0.00566 | 0.0988 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/3/95 | -0.35 | 0.0961 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/8/95 | 0.0524 | 0.0995 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/5/95 | 0.296 | 0.106 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/96 | -0.0643 | 0.0951 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/96 | 0.0269 | 0.0964 | | U |

**Table A.7**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/6/96 | 0.146 | 0.0986 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/96 | 0.047 | 0.0982 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/8/96 | 0.0363 | 0.0989 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/5/96 | 0.0375 | 0.0954 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/2/96 | 0.00081 | 0.0965 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/96 | -0.03 | 0.146 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/96 | -0.446 | 0.139 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/9/96 | 0.00555 | 0.0984 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/6/96 | 0.2 | 0.0977 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/4/96 | 0.142 | 0.0983 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/96 | -0.0335 | 0.0963 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/97 | -0.0679 | 0.0928 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/97 | 0.0174 | 0.0979 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/9/97 | 0.13 | 0.0973 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/97 | 0.167 | 0.0977 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/97 | 0.19 | 0.203 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/9/97 | 0.0107 | 0.0934 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/6/97 | 0.147 | 0.0929 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/97 | 0.103 | 0.0938 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/97 | 0.311 | 0.102 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/5/97 | 0.0624 | 0.0945 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/97 | -0.00237 | 0.0985 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/97 | 0.0636 | 0.0939 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/98 | 0.0399 | 0.0943 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/4/98 | 0.0127 | 0.0967 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/8/98 | 0.129 | 0.0936 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/98 | 0.212 | 0.0963 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/98 | -0.0643 | 0.0946 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/98 | -0.0312 | 0.093 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/29/98 | -0.0938 | 0.094 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/2/98 | 0.186 | 0.094 | | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/98 | 0.0956 | 0.095 | 0.22 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/98 | -0.0628 | 0.093 | 0.22 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/99 | 0.234 | 0.094 | 0.211 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/3/99 | 0.0687 | 0.097 | 0.222 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/7/99 | 0.0817 | 0.097 | 0.221 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/5/99 | -0.106 | 0.0033 | 0.224 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/2/99 | -0.129 | 0.0043 | 0.212 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/99 | -0.138 | 0.0042 | 0.234 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/28/99 | -0.139 | 0.0042 | 0.229 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/1/99 | -0.124 | 0.0064 | 0.405 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/6/99 | -0.121 | 0.0036 | 0.23 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/3/99 | 0.0208 | 0.00063 | 0.224 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/99 | 0.0523 | 0.0016 | 0.222 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/29/99 | 0.0347 | 0.0011 | 0.231 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/2/00 | -0.0608 | 0.0018 | 0.229 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/8/00 | 0.0206 | 0.0006 | 0.235 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/5/00 | 0.146 | 0.0043 | 0.225 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/00 | -0.0466 | 0.0014 | 0.224 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/31/00 | -0.1 | 0.003 | 0.23 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/29/00 | 0.027 | 0.0008 | 0.225 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/10/00 | -0.0827 | 0.0026 | 0.227 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/7/00 | -0.0637 | 0.0019 | 0.23 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/5/00 | 0.00405 | 0.00012 | 0.227 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/29/00 | -0.0482 | 0.095 | 0.229 | U |

**Table A.7.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/4/01 | -0.0535 | 0.095 | 0.228 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/31/01 | 0.0943 | 0.095 | 0.222 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/1/01 | 0.00808 | 0.096 | 0.229 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/01 | -0.0207 | 0.094 | 0.227 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/01 | -0.058 | 0.096 | 0.231 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/30/01 | 0.08 | 0.096 | 0.227 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/28/01 | -0.0881 | 0.091 | 0.221 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/9/01 | 0.0283 | 0.088 | 0.208 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/5/01 | 0.00644 | 0.088 | 0.208 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/01 | 0.117 | 0.09 | 0.209 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/01 | 0.0481 | 0.086 | 0.202 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/27/01 | 0.111 | 0.097 | 0.226 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/02 | -0.0348 | 0.084 | 0.202 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/6/02 | 0.0179 | 0.23 | 0.543 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/02 | -0.32 | 0.22 | 0.547 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/02 | 0.172 | 0.23 | 0.534 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/1/02 | -0.109 | 0.22 | 0.514 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/29/02 | -0.0906 | 0.22 | 0.535 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/27/02 | -0.0391 | 0.22 | 0.529 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/02 | -0.0266 | 0.23 | 0.545 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/02 | -0.387 | 0.25 | 0.583 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/02 | 0.435 | 0.25 | 0.595 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/30/02 | -0.14 | 0.25 | 0.586 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/26/02 | 0.456 | 0.25 | 0.572 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/03 | 0.0868 | 0.25 | 0.586 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/5/03 | -0.412 | 0.25 | 0.607 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/03 | 0.125 | 0.26 | 0.611 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/2/03 | 0.493 | 0.25 | 0.566 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/28/03 | 0.141 | 0.23 | 0.551 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/8/03 | 0.295 | 0.25 | 0.572 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/03 | 0.396 | 0.25 | 0.588 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/30/03 | -0.00333 | 0.19 | 0.464 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/29/03 | 0.0731 | 0.21 | 0.484 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/25/03 | 0.0867 | 0.21 | 0.493 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/04 | 0.225 | 0.21 | 0.495 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/04 | 0.126 | 0.21 | 0.501 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/04 | 0.102 | 0.21 | 0.48 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 4/1/04 | 0.0198 | 0.2 | 0.488 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/6/04 | 0.0102 | 0.2 | 0.488 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/8/04 | 0.186 | 0.21 | 0.483 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/8/04 | -0.27 | 0.2 | 0.479 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/04 | 0.196 | 0.2 | 0.467 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/04 | -0.222 | 0.21 | 0.484 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/1/04 | 0.423 | 0.21 | 0.482 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/04 | 0.121 | 0.2 | 0.472 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/04 | 0.0224 | 0.2 | 0.487 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 1/5/05 | 0.315 | 0.21 | 0.483 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/05 | -0.0497 | 0.22 | 0.519 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/31/05 | 0.383 | 0.21 | 0.481 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/05 | 0.173 | 0.22 | 0.515 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 6/9/05 | 0.104 | 0.2 | 0.484 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/7/05 | 0.293 | 0.21 | 0.481 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/05 | 0.233 | 0.21 | 0.491 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 9/29/05 | 0.337 | 0.22 | 0.521 | U |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/98 | 0.488 | 0.096 | 0.21 | J |

**Table A.7.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/98 | 0.534 | 0.1 | 0.22 | J |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 11/2/00 | 0.299 | 0.097 | 0.222 | J |
| **Technetium-99** | **Rich.Pmphs HRM 46.4** | | **River** | **N** | **4/30/03** | **1.15** | **0.26** | **0.585** | |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 7/10/03 | 0.737 | 0.25 | 0.588 | |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/05 | 0.484 | 0.21 | 0.483 | |
| Technetium-99 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/05 | 0.969 | 0.23 | 0.532 | |
| Technetium-99 | 300 Area | B09QT2 | Drinking | N | 3/29/94 | 0.179 | 0.101 | | U |
| Technetium-99 | 300 Area | B0BP89 | Drinking | N | 6/21/94 | 0.287 | 0.104 | | U |
| Technetium-99 | 300 Area | B0C477 | Drinking | N | 10/11/94 | 0.202 | 0.102 | | U |
| Technetium-99 | 300 Area | B0D0Y8 | Drinking | N | 1/3/95 | -0.0447 | 0.0997 | | U |
| Technetium-99 | 300 Area | B0DKB6 | Drinking | N | 3/27/95 | 0.196 | 0.107 | | U |
| Technetium-99 | 300 Area | B0F909 | Drinking | N | 6/20/95 | 0.00829 | 0.0959 | | U |
| Technetium-99 | 300 Area | B0G537 | Drinking | N | 10/10/95 | -0.0364 | 0.0998 | | U |
| Technetium-99 | 300 Area | B0GML6 | Drinking | N | 1/4/96 | 0.0861 | 0.0973 | | U |
| Technetium-99 | 300 Area | B0H524 | Drinking | N | 3/27/96 | 0.00081 | 0.0973 | | U |
| Technetium-99 | 300 Area | B0HPT1 | Drinking | N | 6/19/96 | 0.073 | 0.0961 | | U |
| Technetium-99 | 300 Area | B0J464 | Drinking | N | 10/9/96 | 0.0505 | 0.0969 | | U |
| Technetium-99 | 300 Area | B0JFJ4 | Drinking | N | 1/6/97 | 0.336 | 0.108 | | U |
| Technetium-99 | 300 Area | B0K6X1 | Drinking | N | 7/17/97 | 0.0201 | 0.0929 | | U |
| Technetium-99 | 300 Area | B0LHF7 | Drinking | N | 10/8/97 | 0.279 | 0.101 | | U |
| Technetium-99 | 300 Area | S0LWT9 | Drinking | N | 12/30/97 | 0.0127 | 0.0931 | | U |
| Technetium-99 | 300 Area | B0MTB2 | Drinking | N | 3/27/98 | 0.0707 | 0.0926 | | U |
| Technetium-99 | 300 Area | B0NHR3 | Drinking | N | 7/15/98 | -0.03 | 0.0917 | | U |
| Technetium-99 | 300 Area | B0P8V0 | Drinking | N | 10/8/98 | 0.477 | 0.1 | 0.22 | U |
| Technetium-99 | 300 Area | B0R233 | Drinking | N | 12/30/98 | 0.0947 | 0.095 | 0.22 | U |
| Technetium-99 | 300 Area | B0JV31 | Drinking | N | 3/25/97 | 0.663 | 0.106 | | |

### A.2.7 Trichloroethylene Surface Water Data

There were 18 (16 nondetect) surface water samples of trichloroethylene at the Richland Pumphouse location and 12 (9 nondetect) at the 300 Area location. The samples were collected between 8/26/1994 and 9/14/2005 at the Richland Pumphouse location and between 9/18/1995 and 9/20/1996 at the 300 Area location. The values are plotted in Figure A.7, and the data are presented in Table A.8.

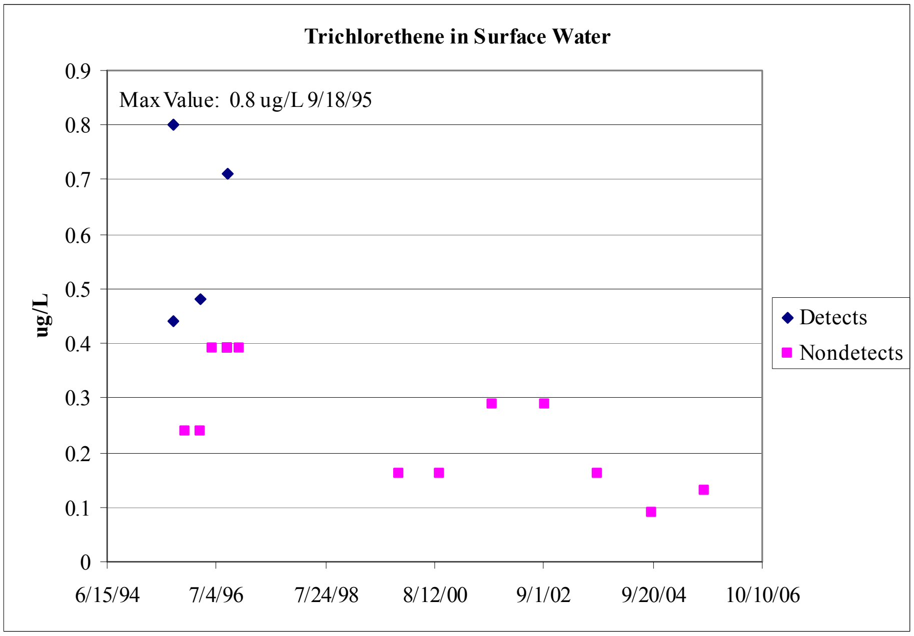


**Figure A.7**. Trichloroethylene in Surface Water

**Table A.8**. Trichloroethylene Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filtered Flag | Sample Date | Value (µg/L) | Quali-fier |
|---|---|---|---|---|---|---|---|
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 8/26/94 | | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/21/94 | | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/17/95 | | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 6/16/95 | | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 0.24 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.24 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 0.39 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.39 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.16 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/19/00 | 0.16 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/13/01 | 0.29 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/10/02 | 0.29 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/9/03 | 0.16 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/04 | 0.09 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/14/05 | 0.13 | U |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 9/18/95 | 0.44 | L |
| Trichloroethylene | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.48 | L |
| Trichloroethylene | 300 Area-10 HRM 43.1 | B0G1F9 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -9 HRM 43.1 | B0G1F8 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -8 HRM 43.1 | B0G1F7 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -7 HRM 43.1 | B0G1F6 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -6 HRM 43.1 | B0G1F5 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -5 HRM 43.1 | B0G1F4 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -3 HRM 43.1 | B0G1F2 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -2 HRM 43.1 | B0G1F1 | River | N | 9/20/96 | 0.39 | U |
| Trichloroethylene | 300 Area -1 HRM 43.1 | B0G1F0 | River | N | 9/20/96 | 0.39 | U |
| **Trichloroethylene** | **300 Area-10 HRM 43.1** | **B0G0X2** | **River** | **N** | **9/18/95** | **0.8** | **L** |
| **Trichloroethylene** | **300 Area -7 HRM 43.1** | **B0G0W9** | **River** | **N** | **9/18/95** | **0.8** | **L** |
| Trichloroethylene | 300 Area -4 HRM 43.1 | B0G1F3 | River | N | 9/20/96 | 0.71 | L |

### A.2.8 Uranium Surface Water Data

There were five surface water samples of uranium at the 300 Area location and none at the Richland Pumphouse location. The samples were collected between 6/10/2004 and 9/15/2005. The values are plotted in Figure A.8, and the data are presented in Table A.9.

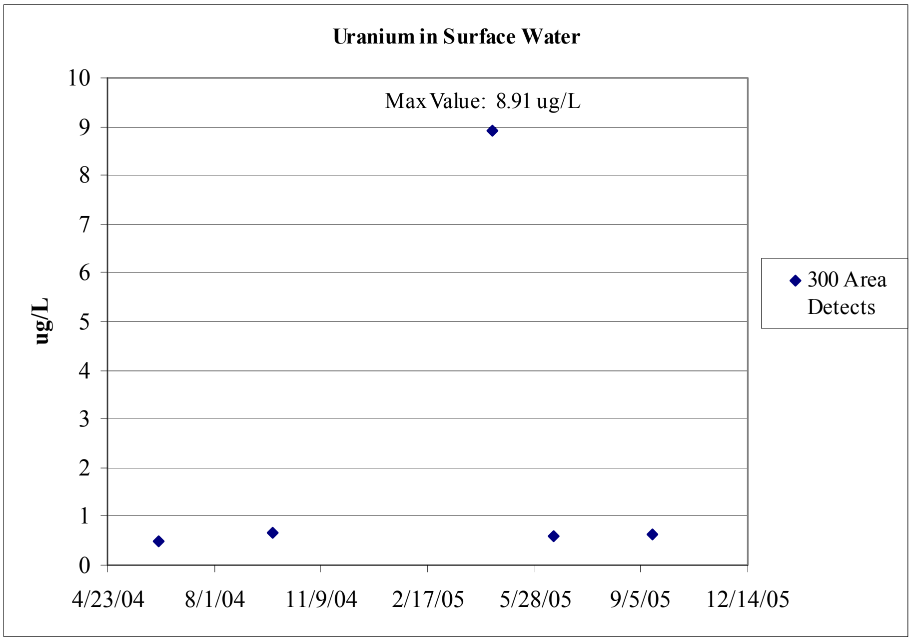


**Figure A.8**. Uranium in Surface Water

**Table A.9**. Uranium Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filtered Flag | Sample Date | Value (µg/L) | Quali-fier |
|---|---|---|---|---|---|---|---|
| Uranium | 300 Area | | River | Y | 6/10/04 | 0.482 | X |
| Uranium | 300 Area | | River | N | 9/24/04 | 0.647 | X |
| **Uranium** | **300 Area** | | **River** | **Y** | **4/19/05** | **8.91** | **X** |
| Uranium | 300 Area | | River | Y | 6/15/05 | 0.609 | X |
| Uranium | 300 Area | | River | Y | 9/15/05 | 0.615 | X |
| Sample comment for X-qualified data reads "Result not blank corrected" | | | | | | | |

### A.2.9 Uranium-234 Surface Water Data

There were 164 surface water samples of uranium-234 at the 300 Area location and none at the Richland Pumphouse location. The samples were collected between 3/29/1994 and 12/19/2004. The values are plotted in Figure A.9 and the data are presented in Table A.10.

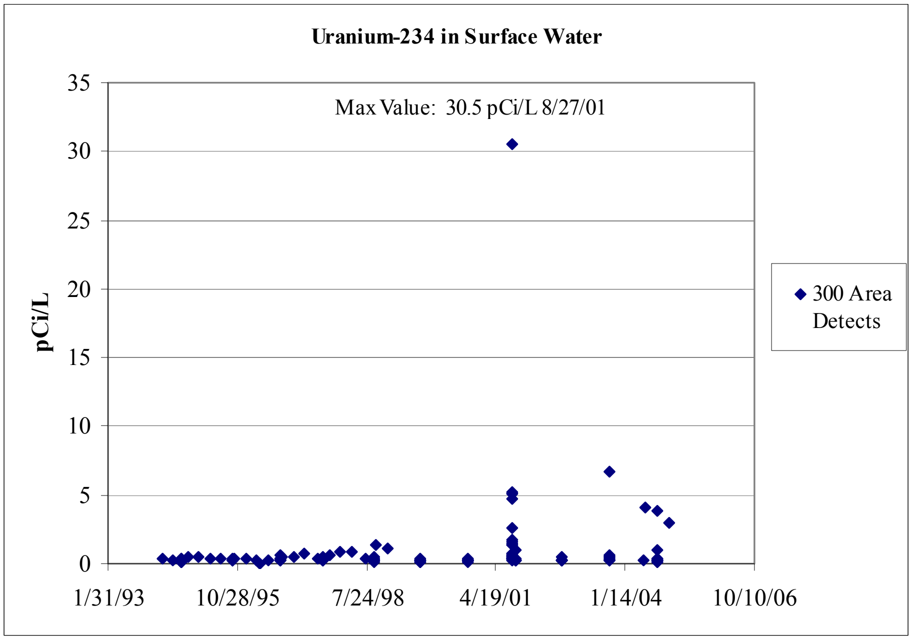


**Figure A.9**. Uranium-234 in Surface Water

**Table A.10**. Uranium-234 Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-234 | 331 Bldg. 300 Area | B0HRH1 | Drinking | N | 4/15/96 | 0.0565 | 0.0257 | | |
| Uranium-234 | 300 Spr DR 9 -4 | B12T19 | River | N | 8/27/01 | 0.315 | 0.042 | 0.00756 | |
| Uranium-234 | 300 Spr DR 9 -3 | B12RV9 | River | N | 8/27/01 | 1.67 | 0.095 | 0.0148 | |
| Uranium-234 | 300 Spr DR 9 -2 | B12RV7 | River | N | 8/27/01 | 5.27 | 0.18 | 0.0102 | |
| Uranium-234 | 300 Spr DR 9 -1 | B12RV5 | River | N | 8/27/01 | 4.7 | 0.16 | 0.0169 | |
| Uranium-234 | 300 Spr DR 7 -4 | B12T15 | River | N | 8/27/01 | 0.267 | 0.041 | 0.00866 | |
| Uranium-234 | 300 Spr DR 7 -3 | B12RT5 | River | N | 8/27/01 | 0.418 | 0.049 | 0.00946 | |
| Uranium-234 | 300 Spr DR 7 -2 | B12RT3 | River | N | 8/27/01 | 0.606 | 0.057 | 0.00907 | |
| Uranium-234 | 300 Spr DR 7 -1 | B12RT1 | River | N | 8/27/01 | 1.43 | 0.089 | 0.00779 | |
| Uranium-234 | 300 Spr DR 11 -4 | B12T23 | River | N | 8/27/01 | 0.384 | 0.054 | 0.0183 | |
| Uranium-234 | 300 Spr DR 11 -3 | B12RX5 | River | N | 8/27/01 | 0.493 | 0.064 | 0.023 | |
| Uranium-234 | 300 Spr DR 11 -2 | B12RX3 | River | N | 8/27/01 | 0.652 | 0.061 | 0.00802 | |
| Uranium-234 | 300 Spr DR 11 -1 | B12RX1 | River | N | 8/27/01 | 2.59 | 0.12 | 0.0102 | |
| Uranium-234 | 300 Spr 9 thru Spr 11 | B12RW1 | River | N | 8/27/01 | 0.538 | 0.055 | 0.00778 | |
| Uranium-234 | 300 Spr 9 -4 | B12T17 | River | N | 8/27/01 | 0.263 | 0.046 | 0.0214 | |
| Uranium-234 | 300 Spr 9 -3 | B12RV3 | River | N | 8/27/01 | 0.356 | 0.052 | 0.0178 | |
| Uranium-234 | 300 Spr 9 -2 | B12RV1 | River | N | 8/27/01 | 1.31 | 0.11 | 0.0212 | |
| **Uranium-234** | **300 Spr 9 -1** | **B12RT9** | **River** | **N** | **8/27/01** | **30.5** | **0.42** | **0.00828** | |
| Uranium-234 | 300 Spr 7 thru Spr 9 | B12RT7 | River | N | 8/27/01 | 0.479 | 0.055 | 0.0107 | |
| Uranium-234 | 300 Spr 7 -4 | B12T13 | River | N | 8/27/01 | 0.418 | 0.05 | 0.00836 | |
| Uranium-234 | 300 Spr 7 -3 | B12RR9 | River | N | 8/27/01 | 0.56 | 0.054 | 0.00348 | |
| Uranium-234 | 300 Spr 7 -2 | B12RR7 | River | N | 8/27/01 | 1.77 | 0.1 | 0.0125 | |

**Table A.10**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-234 | 300 Spr 7 -1 | B12RR5 | River | N | 8/27/01 | 5.14 | 0.17 | 0.00979 | |
| Uranium-234 | 300 Spr 14 -4 | B12T25 | River | N | 8/27/01 | 0.371 | 0.047 | 0.00801 | |
| Uranium-234 | 300 Spr 14 -3 | B12RY3 | River | N | 8/27/01 | 0.542 | 0.057 | 0.00825 | |
| Uranium-234 | 300 Spr 14 -2 | B12RY1 | River | N | 8/27/01 | 0.431 | 0.05 | 0.0148 | |
| Uranium-234 | 300 Spr 14 -1 | B12RX9 | River | N | 8/27/01 | 0.459 | 0.058 | 0.0207 | |
| Uranium-234 | 300 Spr 11 -4 | B12T21 | River | N | 8/27/01 | 0.719 | 0.064 | 0.00803 | |
| Uranium-234 | 300 Spr 11 -3 | B12RW9 | River | N | 8/27/01 | 1.39 | 0.086 | 0.00896 | |
| Uranium-234 | 300 Spr 11 -2 | B12RW7 | River | N | 8/27/01 | 0.703 | 0.061 | 0.00909 | |
| Uranium-234 | 300 Spr 11 -1 | B12RW5 | River | N | 8/27/01 | 5.05 | 0.16 | 0.0101 | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B0C5C6 | River | N | 8/26/94 | 0.279 | 0.139 | | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B0G8B2 | River | N | 9/18/95 | 0.322 | 0.0621 | | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B0J8Y6 | River | N | 9/20/96 | 0.421 | 0.0659 | | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B0LVW6 | River | N | 8/25/97 | 0.464 | 0.0618 | | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B0PVR3 | River | N | 9/15/98 | 0.451 | 0.114 | | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B0WB28 | River | N | 9/16/99 | 0.368 | 0.05 | 0.0182 | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B106Y3 | River | N | 9/19/00 | 0.296 | 0.044 | 0.0117 | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B12TC6 | River | N | 9/13/01 | 0.972 | 0.077 | 0.00844 | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B158M0 | River | N | 9/10/02 | 0.439 | 0.059 | 0.018 | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B17CK0 | River | N | 9/9/03 | 0.467 | 0.059 | 0.0213 | |
| Uranium-234 | 300 Area-10 HRM 43.1 | B1B725 | River | N | 9/15/04 | 0.976 | 0.089 | 0.0146 | |
| Uranium-234 | 300 Area Shr HRM42.9 | B0WB56 | River | N | 9/16/99 | 0.181 | 0.037 | 0.0265 | |
| Uranium-234 | 300 Area Shr HRM42.9 | B10782 | River | N | 9/19/00 | 0.264 | 0.039 | 0.00405 | |
| Uranium-234 | 300 Area Shr HRM42.9 | B12TR6 | River | N | 9/13/01 | 0.249 | 0.038 | 0.00376 | |
| Uranium-234 | 300 Area Shr HRM42.9 | B158Y9 | River | N | 9/10/02 | 0.226 | 0.053 | 0.00808 | |
| Uranium-234 | 300 Area Shr HRM42.9 | B17CX7 | River | N | 9/9/03 | 0.601 | 0.056 | 0.012 | |
| Uranium-234 | 300 Area Shr HRM42.9 | B1B7C7 | River | N | 9/15/04 | 0.243 | 0.04 | 0.0116 | |
| Uranium-234 | 300 Area Shr HRM42.5 | B0WB55 | River | N | 9/16/99 | 0.309 | 0.046 | 0.0119 | |
| Uranium-234 | 300 Area Shr HRM42.5 | B10779 | River | N | 9/19/00 | 0.204 | 0.032 | 0.00749 | |
| Uranium-234 | 300 Area Shr HRM42.5 | B12TR2 | River | N | 9/13/01 | 0.262 | 0.043 | 0.00943 | |
| Uranium-234 | 300 Area Shr HRM42.5 | B158Y6 | River | N | 9/10/02 | 0.237 | 0.036 | 0.00358 | |
| Uranium-234 | 300 Area Shr HRM42.5 | B17CX3 | River | N | 9/9/03 | 6.72 | 0.18 | 0.022 | |
| Uranium-234 | 300 Area Shr HRM42.4 | B1B7H3 | River | N | 9/15/04 | 0.386 | 0.056 | 0.00541 | |
| Uranium-234 | 300 Area Shr HRM42.1 | B0WB54 | River | N | 9/16/99 | 0.303 | 0.045 | 0.0182 | |
| Uranium-234 | 300 Area Shr HRM42.1 | B10776 | River | N | 9/19/00 | 0.335 | 0.039 | 0.00924 | |
| Uranium-234 | 300 Area Shr HRM42.1 | B12TP8 | River | N | 9/13/01 | 0.351 | 0.045 | 0.0146 | |
| Uranium-234 | 300 Area Shr HRM42.1 | B158Y3 | River | N | 9/10/02 | 0.198 | 0.035 | 0.00823 | |
| Uranium-234 | 300 Area Shr HRM42.1 | B17CW9 | River | N | 9/9/03 | 0.373 | 0.045 | 0.00988 | |
| Uranium-234 | 300 Area Shr HRM42.1 | B1B7C3 | River | N | 9/15/04 | 0.322 | 0.049 | 0.00495 | |
| Uranium-234 | 300 Area Shr HRM41.5 | B0WB53 | River | N | 9/16/99 | 0.225 | 0.039 | 0.0161 | |
| Uranium-234 | 300 Area Shr HRM41.5 | B10773 | River | N | 9/19/00 | 0.196 | 0.037 | 0.0138 | |
| Uranium-234 | 300 Area Shr HRM41.5 | B12TP4 | River | N | 9/13/01 | 0.249 | 0.046 | 0.0158 | |
| Uranium-234 | 300 Area Shr HRM41.5 | B158Y0 | River | N | 9/10/02 | 0.214 | 0.04 | 0.0162 | |
| Uranium-234 | 300 Area Shr HRM41.5 | B17CW5 | River | N | 9/9/03 | 0.27 | 0.039 | 0.0036 | |
| Uranium-234 | 300 Area Shr HRM41.5 | B1B7B9 | River | N | 9/15/04 | 0.265 | 0.054 | 0.0071 | |
| Uranium-234 | 300 Area Outfl13 | B19JC4 | River | N | 6/24/04 | 4.07 | 0.19 | 0.0326 | |
| Uranium-234 | 300 Area Outfl13 | B1B7H7 | River | N | 9/15/04 | 3.89 | 0.17 | 0.005 | |
| Uranium-234 | 300 Area Outfl13 | B1BW54 | River | N | 12/19/04 | 2.99 | 0.14 | 0.0267 | |
| Uranium-234 | 300 Area -9 HRM 43.1 | B0C5C5 | River | N | 8/26/94 | 0.167 | 0.126 | | |
| Uranium-234 | 300 Area -9 HRM 43.1 | B0G8B1 | River | N | 9/18/95 | 0.262 | 0.0515 | | |
| Uranium-234 | 300 Area -9 HRM 43.1 | B0J8Y5 | River | N | 9/20/96 | 0.268 | 0.0506 | | |
| Uranium-234 | 300 Area -9 HRM 43.1 | B0LVW5 | River | N | 8/25/97 | 0.277 | 0.047 | | |
| Uranium-234 | 300 Area -8 HRM 43.1 | B0C5C4 | River | N | 8/26/94 | 0.356 | 0.114 | | |
| Uranium-234 | 300 Area -8 HRM 43.1 | B0G8B0 | River | N | 9/18/95 | 0.305 | 0.0536 | | |
| Uranium-234 | 300 Area -8 HRM 43.1 | B0J8Y4 | River | N | 9/20/96 | 0.231 | 0.0454 | | |
| Uranium-234 | 300 Area -8 HRM 43.1 | B0LVW4 | River | N | 8/25/97 | 0.298 | 0.0492 | | |

**Table A.10**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-234 | 300 Area -8 HRM 43.1 | B0PVR1 | River | N | 9/15/98 | 0.224 | 0.0505 | | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B0C5C3 | River | N | 8/26/94 | 0.16 | 0.0798 | | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B0G899 | River | N | 9/18/95 | 0.287 | 0.0543 | | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B0J8Y3 | River | N | 9/20/96 | 0.299 | 0.0609 | | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B0LVW3 | River | N | 8/25/97 | 0.277 | 0.0498 | | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B0PVR0 | River | N | 9/15/98 | 0.347 | 0.119 | | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B0WB27 | River | N | 9/16/99 | 0.203 | 0.036 | 0.0116 | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B106Y1 | River | N | 9/19/00 | 0.21 | 0.039 | 0.0171 | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B12TC4 | River | N | 9/13/01 | 0.234 | 0.038 | 0.00822 | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B158L9 | River | N | 9/10/02 | 0.293 | 0.049 | 0.00542 | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B17CJ8 | River | N | 9/9/03 | 0.252 | 0.038 | 0.00799 | |
| Uranium-234 | 300 Area -7 HRM 43.1 | B1B724 | River | N | 9/15/04 | 0.297 | 0.055 | 0.0257 | |
| Uranium-234 | 300 Area -6 HRM 43.1 | B0C5C2 | River | N | 8/26/94 | 0.168 | 0.0802 | | |
| Uranium-234 | 300 Area -6 HRM 43.1 | B0G898 | River | N | 9/18/95 | 0.264 | 0.0504 | | |
| Uranium-234 | 300 Area -6 HRM 43.1 | B0J8Y2 | River | N | 9/20/96 | 0.308 | 0.0563 | | |
| Uranium-234 | 300 Area -6 HRM 43.1 | B0LVW2 | River | N | 8/25/97 | 0.239 | 0.0421 | | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B0C5C1 | River | N | 8/26/94 | 0.237 | 0.071 | | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B0G897 | River | N | 9/18/95 | 0.221 | 0.0519 | | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B0J8Y0 | River | N | 9/20/96 | 0.198 | 0.0401 | | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B0LVW1 | River | N | 8/25/97 | 0.266 | 0.0476 | | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B0PVP8 | River | N | 9/15/98 | 0.195 | 0.0442 | | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B0WB26 | River | N | 9/16/99 | 0.166 | 0.036 | 0.0265 | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B106X9 | River | N | 9/19/00 | 0.197 | 0.039 | 0.0209 | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B12TC2 | River | N | 9/13/01 | 0.269 | 0.04 | 0.00393 | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B158L8 | River | N | 9/10/02 | 0.217 | 0.038 | 0.0181 | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B17CJ6 | River | N | 9/9/03 | 0.228 | 0.04 | 0.0127 | |
| Uranium-234 | 300 Area -5 HRM 43.1 | B1B723 | River | N | 9/15/04 | 0.223 | 0.048 | 0.0217 | |
| Uranium-234 | 300 Area -4 HRM 43.1 | B0C5C0 | River | N | 8/26/94 | 0.125 | 0.0675 | | |
| Uranium-234 | 300 Area -4 HRM 43.1 | B0G896 | River | N | 9/18/95 | 0.211 | 0.0439 | | |
| Uranium-234 | 300 Area -4 HRM 43.1 | B0J8X8 | River | N | 9/20/96 | 0.317 | 0.0555 | | |
| Uranium-234 | 300 Area -4 HRM 43.1 | B0LVW0 | River | N | 8/25/97 | 0.234 | 0.0449 | | |
| Uranium-234 | 300 Area -4 HRM 43.1 | B0PVP7 | River | N | 9/15/98 | 0.192 | 0.0448 | | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B0C5B9 | River | N | 8/26/94 | 0.265 | 0.201 | | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B0G895 | River | N | 9/18/95 | 0.233 | 0.0456 | | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B0J8X6 | River | N | 9/20/96 | 0.212 | 0.0449 | | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B0LVV9 | River | N | 8/25/97 | 0.248 | 0.047 | | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B0PVP6 | River | N | 9/15/98 | 0.178 | 0.0752 | | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B0WB25 | River | N | 9/16/99 | 0.197 | 0.036 | 0.012 | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B106X7 | River | N | 9/19/00 | 0.196 | 0.031 | 0.00352 | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B12TC0 | River | N | 9/13/01 | 0.24 | 0.037 | 0.0114 | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B158L7 | River | N | 9/10/02 | 0.21 | 0.034 | 0.00917 | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B17CJ4 | River | N | 9/9/03 | 0.254 | 0.041 | 0.0115 | |
| Uranium-234 | 300 Area -3 HRM 43.1 | B1B722 | River | N | 9/15/04 | 0.199 | 0.046 | 0.00683 | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B0C5B8 | River | N | 8/26/94 | 0.112 | 0.0788 | | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B0G894 | River | N | 9/18/95 | 0.215 | 0.0521 | | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B0J8X4 | River | N | 9/20/96 | 0.325 | 0.0554 | | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B0LVV8 | River | N | 8/25/97 | 0.245 | 0.0456 | | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B0PVP5 | River | N | 9/15/98 | 0.201 | 0.0509 | | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B0WB24 | River | N | 9/16/99 | 0.182 | 0.037 | 0.0237 | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B106X5 | River | N | 9/19/00 | 0.212 | 0.033 | 0.00364 | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B12TB8 | River | N | 9/13/01 | 0.227 | 0.036 | 0.00932 | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B158L6 | River | N | 9/10/02 | 0.223 | 0.035 | 0.0109 | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B17CJ2 | River | N | 9/9/03 | 0.264 | 0.042 | 0.0148 | |
| Uranium-234 | 300 Area -2 HRM 43.1 | B1B721 | River | N | 9/15/04 | 0.172 | 0.04 | 0.00595 | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B0C5B7 | River | N | 8/26/94 | 0.317 | 0.141 | | |

**Table A.10**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-234 | 300 Area -1 HRM 43.1 | B0G893 | River | N | 9/18/95 | 0.299 | 0.0513 | | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B0J8X2 | River | N | 9/20/96 | 0.591 | 0.0671 | | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B0LVV7 | River | N | 8/25/97 | 0.244 | 0.0436 | | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B0PVP4 | River | N | 9/15/98 | 0.21 | 0.0466 | | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B0WB23 | River | N | 9/16/99 | 0.23 | 0.042 | 0.0172 | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B106X3 | River | N | 9/19/00 | 0.174 | 0.028 | 0.00823 | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B12TB6 | River | N | 9/13/01 | 0.215 | 0.034 | 0.00351 | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B158L5 | River | N | 9/10/02 | 0.2 | 0.034 | 0.0105 | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B17CJ0 | River | N | 9/9/03 | 0.487 | 0.055 | 0.024 | |
| Uranium-234 | 300 Area -1 HRM 43.1 | B1B720 | River | N | 9/15/04 | 0.256 | 0.055 | 0.00768 | |
| Uranium-234 | 300 Area | B09QT2 | Drinking | N | 3/29/94 | 0.382 | 0.0625 | | |
| Uranium-234 | 300 Area | B0BP89 | Drinking | N | 6/21/94 | 0.291 | 0.048 | | |
| Uranium-234 | 300 Area | B0C477 | Drinking | N | 10/11/94 | 0.544 | 0.0716 | | |
| Uranium-234 | 300 Area | B0D0Y8 | Drinking | N | 1/3/95 | 0.515 | 0.0772 | | |
| Uranium-234 | 300 Area | B0DKB6 | Drinking | N | 3/27/95 | 0.391 | 0.084 | | |
| Uranium-234 | 300 Area | B0F909 | Drinking | N | 6/20/95 | 0.352 | 0.0544 | | |
| Uranium-234 | 300 Area | B0G537 | Drinking | N | 10/10/95 | 0.331 | 0.0573 | | |
| Uranium-234 | 300 Area | B0GML6 | Drinking | N | 1/4/96 | 0.322 | 0.0507 | | |
| Uranium-234 | 300 Area | B0H524 | Drinking | N | 3/27/96 | 0.228 | 0.0448 | | |
| Uranium-234 | 300 Area | B0HPT1 | Drinking | N | 6/19/96 | 0.293 | 0.0537 | | |
| Uranium-234 | 300 Area | B0J464 | Drinking | N | 10/9/96 | 0.531 | 0.0724 | | |
| Uranium-234 | 300 Area | B0JFJ4 | Drinking | N | 1/6/97 | 0.493 | 0.131 | | |
| Uranium-234 | 300 Area | B0JV31 | Drinking | N | 3/25/97 | 0.706 | 0.112 | | |
| Uranium-234 | 300 Area | B0K6X1 | Drinking | N | 7/17/97 | 0.38 | 0.0552 | | |
| Uranium-234 | 300 Area | B0LHF7 | Drinking | N | 10/8/97 | 0.676 | 0.0819 | | |
| Uranium-234 | 300 Area | S0LWT9 | Drinking | N | 12/30/97 | 0.81 | 0.0819 | | |
| Uranium-234 | 300 Area | B0MTB2 | Drinking | N | 3/27/98 | 0.847 | 0.0898 | | |
| Uranium-234 | 300 Area | B0NHR3 | Drinking | N | 7/15/98 | 0.323 | 0.0517 | | |
| Uranium-234 | 300 Area | B0P8V0 | Drinking | N | 10/8/98 | 1.33 | 0.11 | 0.0184 | |
| Uranium-234 | 300 Area | B0R233 | Drinking | N | 12/30/98 | 1.15 | 0.1 | 0.0158 | |
| Uranium-234 | 300 Area | B19HD4 | River | N | 6/10/04 | 0.235 | 0.046 | 0.0159 | |
| Uranium-234 | 300 Area | B1BCB0 | River | N | 9/24/04 | 0.179 | 0.036 | 0.0222 | |

### A.2.10 Uranium-235 Surface Water Data

There were 205 (169 nondetect) surface water samples of uranium-235 at the Richland Pumphouse location and 177 (116 nondetect) at the 300 Area location. The samples were collected between 1/25/1994 and 9/29/2005. The values are plotted in Figure A.10, and the data are presented in Table A.11.

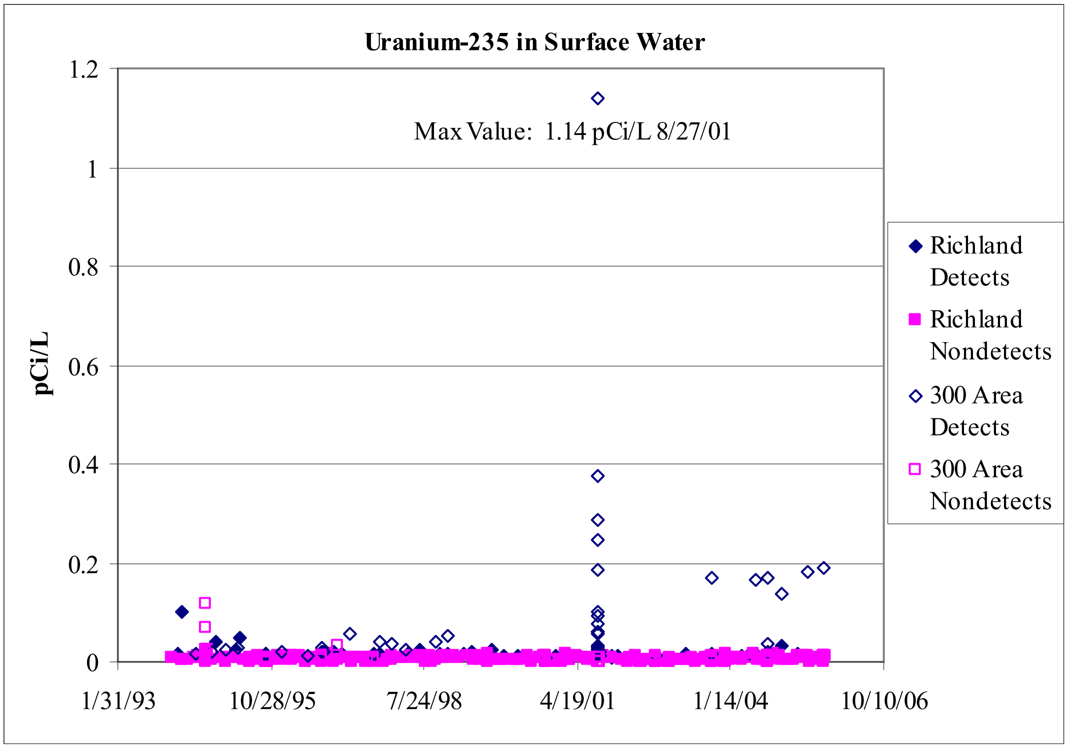


**Figure A.10**. Uranium-235 in Surface Water

**Table A.11**. Uranium-235 Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 7/1/94 | 0.00804 | 0.0107 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 8/26/94 | 0.00514 | 0.0561 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/21/94 | 0.00619 | 0.045 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/17/95 | 0.00627 | 0.00787 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/16/95 | 0.00899 | 0.0109 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/18/95 | 0.00664 | 0.00956 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 0.0084 | 0.0116 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.0118 | 0.0127 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.0112 | 0.0149 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 0.00142 | 0.00644 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 0.000609 | 0.00558 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | -0.000659 | 0.0068 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 4/1/97 | -0.000702 | 0.00516 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 8/25/97 | 0.00394 | 0.008 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/97 | 0.00214 | 0.00603 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/97 | 0.00722 | 0.00927 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/24/98 | 0.00711 | 0.00806 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/23/98 | 0.0105 | 0.016 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/98 | 0.00608 | 0.00833 | | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/15/98 | 0.00814 | 0.011 | 0.0179 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/15/98 | 0.00845 | 0.011 | 0.0159 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/14/99 | 0.00794 | 0.0069 | 0.0125 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/14/99 | 0.00221 | 0.0029 | 0.0119 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/16/99 | -0.00542 | 0.0031 | 0.0135 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.00572 | 0.0057 | 0.0111 | U |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.00543 | 0.0069 | 0.0202 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/28/00 | 0.00421 | 0.0042 | 0.00927 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/20/00 | -0.00113 | 0.0029 | 0.0126 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/19/00 | 0.000331 | 0.00045 | 0.00798 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/5/00 | 0.00199 | 0.006 | 0.00837 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/5/00 | 0.00338 | 0.006 | 0.00364 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 2/26/01 | 0.00542 | 0.0076 | 0.0097 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 2/26/01 | 0.00542 | 0.0066 | 0.00339 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/12/01 | 0.00833 | 0.0073 | 0.00923 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/13/01 | 0.00759 | 0.0077 | 0.0037 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/4/01 | 0.00698 | 0.0078 | 0.00399 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/26/02 | 0.00687 | 0.0077 | 0.00395 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/11/02 | 0.000467 | 0.0044 | 0.00344 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/10/02 | 0.00475 | 0.0066 | 0.00366 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/10/02 | -0.00117 | 0.0074 | 0.0157 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/10/02 | 0.00689 | 0.0083 | 0.00462 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/25/03 | 0.00452 | 0.0064 | 0.00352 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/25/03 | 0.0058 | 0.0068 | 0.00351 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/10/03 | 0.00554 | 0.011 | 0.0163 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/9/03 | 0.00623 | 0.0099 | 0.0147 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/8/03 | 0.0153 | 0.015 | 0.0193 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/8/03 | -0.000594 | 0.015 | 0.0296 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/30/04 | 0.00411 | 0.0089 | 0.0137 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/04 | 0.00374 | 0.0065 | 0.00622 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/04 | 0.00446 | 0.0065 | 0.00977 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/29/05 | 0.00805 | 0.0076 | 0.00936 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/05 | 0.0102 | 0.0074 | 0.00334 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/14/05 | 0.0117 | 0.0084 | 0.00378 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/25/94 | 0.00771 | 0.0111 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/29/94 | 0.00456 | 0.011 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/94 | 0.00349 | 0.00859 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/7/94 | 0.0101 | 0.0117 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/6/94 | 0.0104 | 0.0113 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/94 | 0.00835 | 0.00914 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/94 | 0.0248 | 0.0314 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/4/94 | 0.00432 | 0.00724 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/6/94 | 0.00978 | 0.0135 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/95 | 8.26E-06 | 9.13E-06 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/95 | 0.00676 | 0.0108 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/95 | 0.00292 | 0.00675 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/6/95 | -0.000244 | 0.00679 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/5/95 | 0.00477 | 0.0116 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/95 | 0.0107 | 0.0117 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/95 | 0.00408 | 0.00912 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/3/95 | -0.000739 | 0.0112 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/8/95 | 0.00382 | 0.00763 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/5/95 | 0.0102 | 0.0106 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/96 | 0.00346 | 0.00883 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/96 | 0.0127 | 0.0129 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/6/96 | 0.00385 | 0.01 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/96 | 0.01 | 0.012 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/8/96 | 0.0106 | 0.0119 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/5/96 | 0.00143 | 0.00652 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/2/96 | 0.00279 | 0.00927 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/96 | 0.0068 | 0.00828 | | U |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/96 | 0.00521 | 0.00936 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/9/96 | 0.0084 | 0.0105 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/6/96 | 0.0146 | 0.0233 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/96 | 0.00288 | 0.00987 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/97 | 0.00806 | 0.00928 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/9/97 | 0.00685 | 0.0102 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/97 | 0.00903 | 0.0132 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/97 | 0.00938 | 0.0103 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/9/97 | 0.00152 | 0.00897 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/6/97 | 0.0099 | 0.00987 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/5/97 | -0.000591 | 0.0221 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/97 | 0.00346 | 0.0077 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/97 | 0.0125 | 0.0133 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/98 | 0.00815 | 0.00925 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/4/98 | -0.00679 | 0.0173 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/98 | 0.0115 | 0.0133 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/98 | 0.00994 | 0.0148 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/29/98 | 0.000704 | 0.0113 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/2/98 | 0.0115 | 0.0168 | | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/98 | 0.00222 | 0.0089 | 0.0172 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/98 | 0.0102 | 0.012 | 0.0191 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/99 | 0.0123 | 0.011 | 0.0143 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/3/99 | 0.00858 | 0.0095 | 0.0113 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/5/99 | 0.0133 | 0.01 | 0.0133 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/99 | 0.0115 | 0.0095 | 0.0185 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/28/99 | 0.00357 | 0.0039 | 0.0113 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/1/99 | 0.0081 | 0.0066 | 0.0098 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/3/99 | 0.00436 | 0.0046 | 0.0125 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/99 | 0.00552 | 0.0045 | 0.004 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/2/00 | 0.00296 | 0.0029 | 0.00774 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/8/00 | 0.00254 | 0.0046 | 0.0211 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/5/00 | 0.00317 | 0.0039 | 0.0134 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/31/00 | 0.0129 | 0.01 | 0.0195 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/29/00 | -0.00209 | 0.0049 | 0.0118 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/10/00 | 0.00897 | 0.0087 | 0.0163 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/7/00 | 0.011 | 0.0088 | 0.0136 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/5/00 | 0.00215 | 0.0024 | 0.00899 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/2/00 | 0.00567 | 0.0043 | 0.00348 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/4/01 | -0.000368 | 0.0041 | 0.00646 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/31/01 | 0.0157 | 0.021 | 0.0354 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/1/01 | 0.00513 | 0.0087 | 0.0135 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/01 | 0.0124 | 0.013 | 0.0182 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/30/01 | 0.00638 | 0.0062 | 0.00842 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/28/01 | 0.0039 | 0.0072 | 0.00491 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/9/01 | 0.00501 | 0.0089 | 0.0136 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/5/01 | 0.00776 | 0.009 | 0.00497 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/01 | 0.0113 | 0.011 | 0.00568 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/01 | 0.00873 | 0.0084 | 0.00901 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/6/02 | 0.00442 | 0.0063 | 0.0035 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/02 | 0.00183 | 0.006 | 0.00467 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/1/02 | 0.0121 | 0.014 | 0.0154 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/29/02 | 0.0017 | 0.005 | 0.00341 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/27/02 | 0.00205 | 0.008 | 0.0131 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/02 | 0.00251 | 0.0064 | 0.00957 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/02 | 0.00411 | 0.0047 | 0.00371 | U |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/30/02 | 0.00419 | 0.0067 | 0.00408 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/26/02 | 0.00182 | 0.0051 | 0.00346 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/03 | 0.00597 | 0.007 | 0.0036 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/5/03 | 0.00576 | 0.0067 | 0.00345 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/03 | 0.00208 | 0.0053 | 0.00357 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/30/03 | 0.00844 | 0.0097 | 0.0151 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/28/03 | 0.000688 | 0.008 | 0.0148 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/10/03 | 0.00319 | 0.0064 | 0.00798 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/8/03 | 0.0101 | 0.01 | 0.01 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/03 | 0.00905 | 0.0091 | 0.00613 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/30/03 | 0.0105 | 0.012 | 0.0165 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/29/03 | 0.00628 | 0.0096 | 0.00649 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/25/03 | 0.00125 | 0.0053 | 0.00415 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/04 | 0.00594 | 0.0092 | 0.00623 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/04 | 0.00854 | 0.009 | 0.0046 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/04 | 0.0085 | 0.0075 | 0.00858 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/1/04 | 0.00818 | 0.012 | 0.0201 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/8/04 | 0.0176 | 0.018 | 0.022 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/8/04 | 0.00329 | 0.0086 | 0.0142 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/04 | 0.00499 | 0.0074 | 0.00451 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/04 | 0.00608 | 0.0069 | 0.0047 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/1/04 | 0.00605 | 0.0073 | 0.0112 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/04 | 0.0144 | 0.014 | 0.00827 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/04 | 0.0113 | 0.0097 | 0.0125 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/5/05 | 0.00453 | 0.0054 | 0.00364 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/05 | 0.00423 | 0.0059 | 0.00459 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/05 | 0.00564 | 0.0065 | 0.00439 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/31/05 | 0.0111 | 0.009 | 0.00462 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/05 | 0.0137 | 0.0097 | 0.00438 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/9/05 | 0.000519 | 0.0027 | 0.00368 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 7/7/05 | 0.00797 | 0.0067 | 0.00341 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/05 | 0.00532 | 0.0061 | 0.00753 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/05 | 0.00479 | 0.0069 | 0.0104 | U |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/29/05 | 0.0102 | 0.0083 | 0.00425 | U |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/28/00 | 0.0124 | 0.0087 | 0.0117 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/98 | 0.0168 | 0.012 | 0.0114 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/98 | 0.0143 | 0.012 | 0.0104 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/7/99 | 0.0146 | 0.011 | 0.00958 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/2/99 | 0.0191 | 0.011 | 0.00934 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/6/99 | 0.0227 | 0.013 | 0.018 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/29/99 | 0.0128 | 0.0085 | 0.00951 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/00 | 0.0135 | 0.0089 | 0.00989 | J |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/29/00 | 0.0135 | 0.013 | 0.00652 | J |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/31/94 | 0.1 | 0.0273 | | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.0211 | 0.0147 | | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/24/98 | 0.0139 | 0.0114 | | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/4/01 | 0.00974 | 0.0087 | 0.00768 | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/26/02 | 0.00934 | 0.0085 | 0.00382 | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/30/04 | 0.0105 | 0.0092 | 0.00416 | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/24/04 | 0.0158 | 0.011 | 0.0101 | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/04 | 0.0311 | 0.013 | 0.00361 | |
| Uranium-235 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/29/05 | 0.0174 | 0.012 | 0.014 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/22/94 | 0.0143 | 0.0127 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/94 | 0.0386 | 0.024 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/21/94 | | | | |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/95 | 0.0244 | 0.0193 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/95 | 0.0481 | 0.0213 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 12/4/96 | 0.0151 | 0.0128 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/97 | 0.016 | 0.0137 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/97 | 0.0131 | 0.0107 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/97 | 0.0168 | 0.0139 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/8/98 | 0.0172 | 0.0135 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/98 | 0.0237 | 0.0145 | | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/01 | 0.0111 | 0.0083 | 0.00326 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 11/27/01 | 0.0119 | 0.0089 | 0.01 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/02 | 0.0121 | 0.0097 | 0.00822 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/02 | 0.0106 | 0.0093 | 0.00419 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/02 | 0.00959 | 0.0086 | 0.00389 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 4/2/03 | 0.0149 | 0.011 | 0.0112 | |
| Uranium-235 | Rich.Pmphs HRM 46.4 | | River | N | 5/6/04 | 0.0118 | 0.0083 | 0.00399 | |
| Uranium-235 | 331 Bldg. 300 Area | B0HRH1 | Drinking | N | 4/15/96 | -0.00106 | 0.0089 | | U |
| Uranium-235 | 300 Spr DR 7 -4 | B12T15 | River | N | 8/27/01 | 0.00739 | 0.0081 | 0.00415 | U |
| Uranium-235 | 300 Spr 9 -4 | B12T17 | River | N | 8/27/01 | 0.00187 | 0.0079 | 0.0145 | U |
| Uranium-235 | 300 Spr 7 -4 | B12T13 | River | N | 8/27/01 | 0.0085 | 0.0084 | 0.00401 | U |
| Uranium-235 | 300 Spr 7 -3 | B12RR9 | River | N | 8/27/01 | 0.00849 | 0.0083 | 0.00883 | U |
| Uranium-235 | 300 Spr 14 -4 | B12T25 | River | N | 8/27/01 | 0.0066 | 0.0075 | 0.00384 | U |
| Uranium-235 | 300 Spr 14 -1 | B12RX9 | River | N | 8/27/01 | 0.00885 | 0.01 | 0.014 | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B0C5C6 | River | N | 8/26/94 | 0.00269 | 0.0347 | | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B0J8Y6 | River | N | 9/20/96 | 0.0116 | 0.0122 | | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B0PVR3 | River | N | 9/15/98 | 0.000768 | 0.0146 | | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B0WB28 | River | N | 9/16/99 | 0.00986 | 0.0074 | 0.00981 | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B106Y3 | River | N | 9/19/00 | 0.00209 | 0.0027 | 0.0117 | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B158M0 | River | N | 9/10/02 | 0.0117 | 0.012 | 0.0151 | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | B17CK0 | River | N | 9/9/03 | 0.0112 | 0.011 | 0.0122 | U |
| Uranium-235 | 300 Area-10 HRM 43.1 | | River | N | 9/15/05 | 0.0118 | 0.011 | 0.0133 | U |
| Uranium-235 | 300 Area SPRING 42-2 | | River | N | 9/15/05 | 0.01 | 0.0095 | 0.0121 | U |
| Uranium-235 | 300 Area Spr DR 42-2 | | River | N | 9/15/05 | 0.00763 | 0.014 | 0.0264 | U |
| Uranium-235 | 300 Area Shr HRM42.9 | B0WB56 | River | N | 9/16/99 | 0.00436 | 0.0059 | 0.0192 | U |
| Uranium-235 | 300 Area Shr HRM42.9 | B10782 | River | N | 9/19/00 | 0.00264 | 0.0026 | 0.00405 | U |
| Uranium-235 | 300 Area Shr HRM42.9 | B12TR6 | River | N | 9/13/01 | 0.00777 | 0.0079 | 0.00376 | U |
| Uranium-235 | 300 Area Shr HRM42.9 | B158Y9 | River | N | 9/10/02 | -0.000357 | 0.006 | 0.00808 | U |
| Uranium-235 | 300 Area Shr HRM42.9 | B1B7C7 | River | N | 9/15/04 | 0.0118 | 0.0089 | 0.00427 | U |
| Uranium-235 | 300 Area Shr HRM42.9 | | River | N | 9/15/05 | 0.00648 | 0.0073 | 0.00495 | U |
| Uranium-235 | 300 Area Shr HRM42.5 | B0WB55 | River | N | 9/16/99 | -0.00126 | 0.0032 | 0.0119 | U |
| Uranium-235 | 300 Area Shr HRM42.5 | B10779 | River | N | 9/19/00 | 0.00674 | 0.0051 | 0.00749 | U |
| Uranium-235 | 300 Area Shr HRM42.5 | B12TR2 | River | N | 9/13/01 | 0.000331 | 0.0061 | 0.0115 | U |
| Uranium-235 | 300 Area Shr HRM42.5 | B158Y6 | River | N | 9/10/02 | -0.000699 | 0.0037 | 0.00358 | U |
| Uranium-235 | 300 Area Shr HRM42.1 | B0WB54 | River | N | 9/16/99 | 0.0079 | 0.0068 | 0.0129 | U |
| Uranium-235 | 300 Area Shr HRM42.1 | B10776 | River | N | 9/19/00 | 0.0014 | 0.0014 | 0.00321 | U |
| Uranium-235 | 300 Area Shr HRM42.1 | B158Y3 | River | N | 9/10/02 | 0.00452 | 0.008 | 0.0125 | U |
| Uranium-235 | 300 Area Shr HRM42.1 | B17CW9 | River | N | 9/9/03 | 0.00339 | 0.006 | 0.00364 | U |
| Uranium-235 | 300 Area Shr HRM42.1 | B1B7C3 | River | N | 9/15/04 | 0.0119 | 0.0097 | 0.00495 | U |
| Uranium-235 | 300 Area Shr HRM41.5 | B0WB53 | River | N | 9/16/99 | 0.0074 | 0.0076 | 0.0182 | U |
| Uranium-235 | 300 Area Shr HRM41.5 | B10773 | River | N | 9/19/00 | 0.00198 | 0.0032 | 0.0165 | U |
| Uranium-235 | 300 Area Shr HRM41.5 | B12TP4 | River | N | 9/13/01 | 0.000713 | 0.0057 | 0.00548 | U |
| Uranium-235 | 300 Area Shr HRM41.5 | B17CW5 | River | N | 9/9/03 | 0.00331 | 0.0059 | 0.0036 | U |
| Uranium-235 | 300 Area Shr HRM41.5 | B1B7B9 | River | N | 9/15/04 | 0.00177 | 0.0052 | 0.0071 | U |
| Uranium-235 | 300 Area Shr HRM41.5 | | River | N | 9/15/05 | 0.00785 | 0.0071 | 0.00392 | U |
| Uranium-235 | 300 Area -9 HRM 43.1 | B0C5C5 | River | N | 8/26/94 | 0.0255 | 0.052 | | U |
| Uranium-235 | 300 Area -9 HRM 43.1 | B0G8B1 | River | N | 9/18/95 | 0.00274 | 0.0102 | | U |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | 300 Area -9 HRM 43.1 | B0J8Y5 | River | N | 9/20/96 | 0.0116 | 0.0121 | | U |
| Uranium-235 | 300 Area -8 HRM 43.1 | B0C5C4 | River | N | 8/26/94 | 0.00514 | 0.0177 | | U |
| Uranium-235 | 300 Area -8 HRM 43.1 | B0J8Y4 | River | N | 9/20/96 | 0.0052 | 0.00854 | | U |
| Uranium-235 | 300 Area -8 HRM 43.1 | B0PVR1 | River | N | 9/15/98 | -0.00333 | 0.00867 | | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B0C5C3 | River | N | 8/26/94 | 0.000346 | 0.0189 | | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B0G899 | River | N | 9/18/95 | 0.000862 | 0.0105 | | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B0J8Y3 | River | N | 9/20/96 | 0.0106 | 0.0148 | | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B0LVW3 | River | N | 8/25/97 | 0.0000148 | 0.00933 | | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B0PVR0 | River | N | 9/15/98 | -0.0154 | 0.0244 | | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B0WB27 | River | N | 9/16/99 | 0.00978 | 0.0077 | 0.0131 | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B106Y1 | River | N | 9/19/00 | 0.011 | 0.0087 | 0.0144 | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B12TC4 | River | N | 9/13/01 | -0.00101 | 0.0043 | 0.00822 | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B158L9 | River | N | 9/10/02 | 0.00866 | 0.0098 | 0.00542 | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B17CJ8 | River | N | 9/9/03 | 0.000897 | 0.0049 | 0.00383 | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | B1B724 | River | N | 9/15/04 | 0.00153 | 0.011 | 0.0222 | U |
| Uranium-235 | 300 Area -7 HRM 43.1 | | River | N | 9/15/05 | 0.00624 | 0.011 | 0.0174 | U |
| Uranium-235 | 300 Area -6 HRM 43.1 | B0C5C2 | River | N | 8/26/94 | 0.00907 | 0.0283 | | U |
| Uranium-235 | 300 Area -6 HRM 43.1 | B0G898 | River | N | 9/18/95 | 0.00597 | 0.0116 | | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B0C5C1 | River | N | 8/26/94 | -0.00775 | 0.0129 | | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B0G897 | River | N | 9/18/95 | 0.00783 | 0.014 | | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B0J8Y0 | River | N | 9/20/96 | 0.00951 | 0.011 | | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B0LVW1 | River | N | 8/25/97 | 0.00475 | 0.011 | | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B0PVP8 | River | N | 9/15/98 | 0.00412 | 0.00966 | | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B0WB26 | River | N | 9/16/99 | 0.0158 | 0.012 | 0.0197 | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B106X9 | River | N | 9/19/00 | 0.0114 | 0.0096 | 0.0172 | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B12TC2 | River | N | 9/13/01 | -0.000425 | 0.0041 | 0.00393 | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B158L8 | River | N | 9/10/02 | -0.00062 | 0.0076 | 0.0167 | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B17CJ6 | River | N | 9/9/03 | -0.00172 | 0.0063 | 0.0151 | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | B1B723 | River | N | 9/15/04 | 0.0131 | 0.017 | 0.028 | U |
| Uranium-235 | 300 Area -5 HRM 43.1 | | River | N | 9/15/05 | 0.00209 | 0.011 | 0.0207 | U |
| Uranium-235 | 300 Area -4 HRM 43.1 | B0C5C0 | River | N | 8/26/94 | 0.0103 | 0.0213 | | U |
| Uranium-235 | 300 Area -4 HRM 43.1 | B0G896 | River | N | 9/18/95 | 0.000782 | 0.00767 | | U |
| Uranium-235 | 300 Area -4 HRM 43.1 | B0J8X8 | River | N | 9/20/96 | -0.00288 | 0.00936 | | U |
| Uranium-235 | 300 Area -4 HRM 43.1 | B0LVW0 | River | N | 8/25/97 | 0.00866 | 0.00979 | | U |
| Uranium-235 | 300 Area -4 HRM 43.1 | B0PVP7 | River | N | 9/15/98 | 0.00292 | 0.00849 | | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B0C5B9 | River | N | 8/26/94 | 0.117 | 0.129 | | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B0G895 | River | N | 9/18/95 | 0.00775 | 0.0109 | | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B0J8X6 | River | N | 9/20/96 | -0.00334 | 0.00726 | | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B0LVV9 | River | N | 8/25/97 | 0.00301 | 0.00733 | | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B0PVP6 | River | N | 9/15/98 | -0.00844 | 0.00725 | | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B0WB25 | River | N | 9/16/99 | 0.00749 | 0.0065 | 0.012 | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B106X7 | River | N | 9/19/00 | -0.00178 | 0.0044 | 0.00893 | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B158L7 | River | N | 9/10/02 | 0.00333 | 0.006 | 0.00362 | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B17CJ4 | River | N | 9/9/03 | 0.00294 | 0.0063 | 0.00425 | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | B1B722 | River | N | 9/15/04 | 0.00671 | 0.0087 | 0.00683 | U |
| Uranium-235 | 300 Area -3 HRM 43.1 | | River | N | 9/15/05 | 0.0135 | 0.018 | 0.0286 | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B0C5B8 | River | N | 8/26/94 | 0.00282 | 0.0335 | | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B0G894 | River | N | 9/18/95 | 0.00484 | 0.015 | | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B0LVV8 | River | N | 8/25/97 | 0.00783 | 0.0099 | | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B0PVP5 | River | N | 9/15/98 | 0.00333 | 0.011 | | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B0WB24 | River | N | 9/16/99 | 0.0121 | 0.0094 | 0.0158 | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B12TB8 | River | N | 9/13/01 | 0.00779 | 0.0083 | 0.00932 | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B158L6 | River | N | 9/10/02 | 0.00249 | 0.0058 | 0.00716 | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B17CJ2 | River | N | 9/9/03 | 0.00785 | 0.0085 | 0.00433 | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B1B721 | River | N | 9/15/04 | 0.00354 | 0.0062 | 0.00595 | U |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | 300 Area -2 HRM 43.1 | | River | N | 9/15/05 | 0.00525 | 0.0061 | 0.00414 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B0C5B7 | River | N | 8/26/94 | 0.0695 | 0.0976 | | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B0LVV7 | River | N | 8/25/97 | 0.00225 | 0.00645 | | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B0PVP4 | River | N | 9/15/98 | 0.00421 | 0.00977 | | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B0WB23 | River | N | 9/16/99 | -0.00334 | 0.0069 | 0.0186 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B106X3 | River | N | 9/19/00 | 0.00385 | 0.0031 | 0.00325 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B12TB6 | River | N | 9/13/01 | 0.00652 | 0.0074 | 0.00731 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B158L5 | River | N | 9/10/02 | 0.00339 | 0.006 | 0.00365 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B17CJ0 | River | N | 9/9/03 | 0.00244 | 0.01 | 0.0173 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | B1B720 | River | N | 9/15/04 | 0.00765 | 0.0098 | 0.00768 | U |
| Uranium-235 | 300 Area -1 HRM 43.1 | | River | N | 9/15/05 | -0.000848 | 0.0066 | 0.0173 | U |
| Uranium-235 | 300 Area | B09QT2 | Drinking | N | 3/29/94 | 0.00496 | 0.00855 | | U |
| Uranium-235 | 300 Area | B0F909 | Drinking | N | 6/20/95 | 0.00777 | 0.0109 | | U |
| Uranium-235 | 300 Area | B0G537 | Drinking | N | 10/10/95 | 0.00975 | 0.014 | | U |
| Uranium-235 | 300 Area | B0H524 | Drinking | N | 3/27/96 | 0.00782 | 0.0114 | | U |
| Uranium-235 | 300 Area | B0JFJ4 | Drinking | N | 1/6/97 | 0.0312 | 0.0379 | | U |
| Uranium-235 | 300 Area | B0K6X1 | Drinking | N | 7/17/97 | 0.00979 | 0.0112 | | U |
| Uranium-235 | 300 Area | B0NHR3 | Drinking | N | 7/15/98 | 0.00956 | 0.0123 | | U |
| Uranium-235 | 300 Area | B19HD4 | River | N | 6/10/04 | 0.00965 | 0.012 | 0.0159 | U |
| Uranium-235 | 300 Area | B1BCB0 | River | N | 9/24/04 | 0.00861 | 0.011 | 0.017 | U |
| Uranium-235 | 300 Area | | River | N | 9/15/05 | 0.0119 | 0.011 | 0.0148 | U |
| Uranium-235 | 300 Area -2 HRM 43.1 | B106X5 | River | N | 9/19/00 | 0.00875 | 0.0058 | 0.00364 | J |
| Uranium-235 | 300 Area | B0P8V0 | Drinking | N | 10/8/98 | 0.0422 | 0.02 | 0.0147 | J |
| Uranium-235 | 300 Area | B0R233 | Drinking | N | 12/30/98 | 0.0542 | 0.023 | 0.00623 | J |
| Uranium-235 | 300 Spr DR 9 -4 | B12T19 | River | N | 8/27/01 | 0.0103 | 0.009 | 0.00919 | |
| Uranium-235 | 300 Spr DR 9 -3 | B12RV9 | River | N | 8/27/01 | 0.0782 | 0.021 | 0.0076 | |
| Uranium-235 | 300 Spr DR 9 -2 | B12RV7 | River | N | 8/27/01 | 0.374 | 0.047 | 0.0102 | |
| Uranium-235 | 300 Spr DR 9 -1 | B12RV5 | River | N | 8/27/01 | 0.288 | 0.041 | 0.00797 | |
| Uranium-235 | 300 Spr DR 7 -3 | B12RT5 | River | N | 8/27/01 | 0.0132 | 0.0095 | 0.00373 | |
| Uranium-235 | 300 Spr DR 7 -2 | B12RT3 | River | N | 8/27/01 | 0.0141 | 0.01 | 0.00907 | |
| Uranium-235 | 300 Spr DR 7 -1 | B12RT1 | River | N | 8/27/01 | 0.0617 | 0.019 | 0.00947 | |
| Uranium-235 | 300 Spr DR 11 -4 | B12T23 | River | N | 8/27/01 | 0.017 | 0.012 | 0.00499 | |
| Uranium-235 | 300 Spr DR 11 -3 | B12RX5 | River | N | 8/27/01 | 0.0307 | 0.016 | 0.00541 | |
| Uranium-235 | 300 Spr DR 11 -2 | B12RX3 | River | N | 8/27/01 | 0.0251 | 0.013 | 0.00385 | |
| Uranium-235 | 300 Spr DR 11 -1 | B12RX1 | River | N | 8/27/01 | 0.0937 | 0.024 | 0.00404 | |
| Uranium-235 | 300 Spr 9 THRU Spr 11 | B12RW1 | River | N | 8/27/01 | 0.0187 | 0.011 | 0.00373 | |
| Uranium-235 | 300 Spr 9 -3 | B12RV3 | River | N | 8/27/01 | 0.0139 | 0.011 | 0.0101 | |
| Uranium-235 | 300 Spr 9 -2 | B12RV1 | River | N | 8/27/01 | 0.0607 | 0.023 | 0.00578 | |
| **Uranium-235** | **300 Spr 9 -1** | **B12RT9** | **River** | **N** | **8/27/01** | **1.14** | **0.082** | **0.00828** | |
| Uranium-235 | 300 Spr 7 THRU Spr 9 | B12RT7 | River | N | 8/27/01 | 0.0107 | 0.0094 | 0.00424 | |
| Uranium-235 | 300 Spr 7 -2 | B12RR7 | River | N | 8/27/01 | 0.101 | 0.025 | 0.00822 | |
| Uranium-235 | 300 Spr 7 -1 | B12RR5 | River | N | 8/27/01 | 0.184 | 0.033 | 0.00979 | |
| Uranium-235 | 300 Spr 14 -3 | B12RY3 | River | N | 8/27/01 | 0.0116 | 0.0098 | 0.01 | |
| Uranium-235 | 300 Spr 14 -2 | B12RY1 | River | N | 8/27/01 | 0.0223 | 0.012 | 0.00969 | |
| Uranium-235 | 300 Spr 11 -4 | B12T21 | River | N | 8/27/01 | 0.0322 | 0.014 | 0.00385 | |
| Uranium-235 | 300 Spr 11 -3 | B12RW9 | River | N | 8/27/01 | 0.058 | 0.018 | 0.00353 | |
| Uranium-235 | 300 Spr 11 -2 | B12RW7 | River | N | 8/27/01 | 0.0274 | 0.013 | 0.00909 | |
| Uranium-235 | 300 Spr 11 -1 | B12RW5 | River | N | 8/27/01 | 0.248 | 0.036 | 0.00889 | |
| Uranium-235 | 300 Area-10 HRM 43.1 | B0G8B2 | River | N | 9/18/95 | 0.0171 | 0.016 | | |
| Uranium-235 | 300 Area-10 HRM 43.1 | B0LVW6 | River | N | 8/25/97 | 0.0126 | 0.0113 | | |
| Uranium-235 | 300 Area-10 HRM 43.1 | B12TC6 | River | N | 9/13/01 | 0.0191 | 0.012 | 0.00405 | |
| Uranium-235 | 300 Area-10 HRM 43.1 | B1B725 | River | N | 9/15/04 | 0.0348 | 0.017 | 0.00537 | |
| Uranium-235 | 300 Area Shr HRM42.9 | B17CX7 | River | N | 9/9/03 | 0.0161 | 0.01 | 0.0035 | |
| Uranium-235 | 300 Area Shr HRM42.5 | B17CX3 | River | N | 9/9/03 | 0.169 | 0.029 | 0.014 | |
| Uranium-235 | 300 Area Shr HRM42.4 | B1B7H3 | River | N | 9/15/04 | 0.0211 | 0.013 | 0.00541 | |

**Table A.11**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-235 | 300 Area Shr HRM42.1 | B12TP8 | River | N | 9/13/01 | 0.0117 | 0.0098 | 0.0109 | |
| Uranium-235 | 300 Area Shr HRM41.5 | B158Y0 | River | N | 9/10/02 | 0.0106 | 0.0099 | 0.00472 | |
| Uranium-235 | 300 Area Outfl13 | B19JC4 | River | N | 6/24/04 | 0.166 | 0.038 | 0.00588 | |
| Uranium-235 | 300 Area Outfl13 | B1B7H7 | River | N | 9/15/04 | 0.169 | 0.037 | 0.0199 | |
| Uranium-235 | 300 Area Outfl13 | B1BW54 | River | N | 12/19/04 | 0.139 | 0.03 | 0.0165 | |
| Uranium-235 | 300 Area Outfl13 | | River | N | 6/7/05 | 0.182 | 0.032 | 0.0174 | |
| Uranium-235 | 300 Area Outfl13 | | River | N | 9/15/05 | 0.19 | 0.043 | 0.0199 | |
| Uranium-235 | 300 Area -9 HRM 43.1 | B0LVW5 | River | N | 8/25/97 | 0.0119 | 0.0108 | | |
| Uranium-235 | 300 Area -8 HRM 43.1 | B0G8B0 | River | N | 9/18/95 | 0.0132 | 0.0129 | | |
| Uranium-235 | 300 Area -8 HRM 43.1 | B0LVW4 | River | N | 8/25/97 | 0.0173 | 0.0135 | | |
| Uranium-235 | 300 Area -6 HRM 43.1 | B0J8Y2 | River | N | 9/20/96 | 0.0286 | 0.0188 | | |
| Uranium-235 | 300 Area -6 HRM 43.1 | B0LVW2 | River | N | 8/25/97 | 0.0108 | 0.01 | | |
| Uranium-235 | 300 Area -3 HRM 43.1 | B12TC0 | River | N | 9/13/01 | 0.0126 | 0.0092 | 0.0036 | |
| Uranium-235 | 300 Area -2 HRM 43.1 | B0J8X4 | River | N | 9/20/96 | 0.0191 | 0.0142 | | |
| Uranium-235 | 300 Area -1 HRM 43.1 | B0G893 | River | N | 9/18/95 | 0.0161 | 0.0133 | | |
| Uranium-235 | 300 Area -1 HRM 43.1 | B0J8X2 | River | N | 9/20/96 | 0.0214 | 0.0146 | | |
| Uranium-235 | 300 Area | B0BP89 | Drinking | N | 6/21/94 | 0.0178 | 0.0131 | | |
| Uranium-235 | 300 Area | B0C477 | Drinking | N | 10/11/94 | 0.0209 | 0.0152 | | |
| Uranium-235 | 300 Area | B0D0Y8 | Drinking | N | 1/3/95 | 0.0233 | 0.0177 | | |
| Uranium-235 | 300 Area | B0DKB6 | Drinking | N | 3/27/95 | 0.0287 | 0.0275 | | |
| Uranium-235 | 300 Area | B0GML6 | Drinking | N | 1/4/96 | 0.0208 | 0.0139 | | |
| Uranium-235 | 300 Area | B0HPT1 | Drinking | N | 6/19/96 | 0.0131 | 0.0124 | | |
| Uranium-235 | 300 Area | B0J464 | Drinking | N | 10/9/96 | 0.0184 | 0.0145 | | |
| Uranium-235 | 300 Area | B0JV31 | Drinking | N | 3/25/97 | 0.0561 | 0.0357 | | |
| Uranium-235 | 300 Area | B0LHF7 | Drinking | N | 10/8/97 | 0.0412 | 0.0215 | | |
| Uranium-235 | 300 Area | S0LWT9 | Drinking | N | 12/30/97 | 0.0375 | 0.0183 | | |
| Uranium-235 | 300 Area | B0MTB2 | Drinking | N | 3/27/98 | 0.0259 | 0.0208 | | |

### A.2.11 Uranium-238 Surface Water Data

There were 204 surface water samples of uranium-238 at the Richland Pumphouse location and 181 at the 300 Area location. The samples were collected between 1/25/1994 and 10/6/2005. The values are plotted in Figure A.11, and the data are presented in Table A.12.

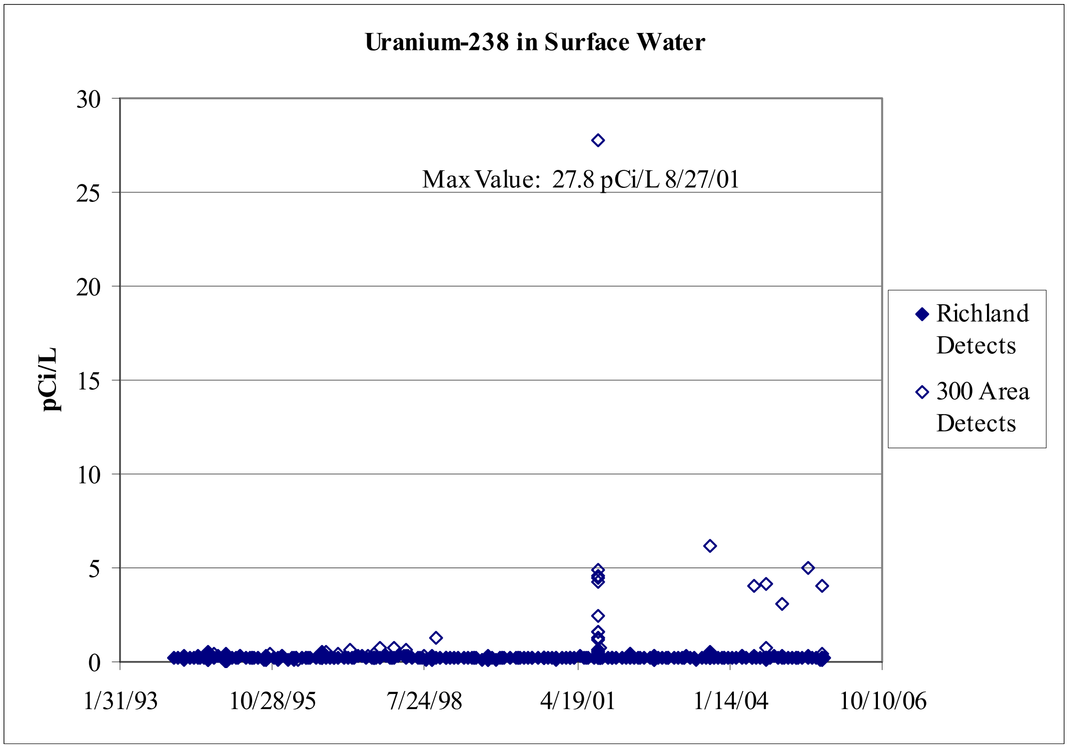


**Figure A.11**. Uranium-238 in Surface Water

**Table A.12**. Uranium-238 Data in Surface Water

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/15/98 | 0.233 | 0.039 | 0.0193 | J |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/15/98 | 0.226 | 0.044 | 0.0159 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/98 | 0.223 | 0.042 | 0.0214 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/98 | 0.209 | 0.038 | 0.0142 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/98 | 0.228 | 0.041 | 0.0172 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/98 | 0.182 | 0.037 | 0.0126 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/99 | 0.232 | 0.04 | 0.0143 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/3/99 | 0.218 | 0.039 | 0.0141 | J |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/7/99 | 0.201 | 0.038 | 0.0132 | J |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/31/94 | 0.141 | 0.0329 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 7/1/94 | 0.176 | 0.0421 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 8/26/94 | 0.337 | 0.202 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/21/94 | 0.329 | 0.12 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/17/95 | 0.164 | 0.0336 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/16/95 | 0.202 | 0.04 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/18/95 | 0.156 | 0.04 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/7/95 | 0.156 | 0.041 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.154 | 0.0362 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/18/96 | 0.207 | 0.0483 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/96 | 0.17 | 0.0357 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/20/96 | 0.2 | 0.0403 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.209 | 0.0428 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/9/96 | 0.196 | 0.0427 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 4/1/97 | 0.218 | 0.0482 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 8/25/97 | 0.161 | 0.034 | | |

**Table A.12.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/97 | 0.208 | 0.0387 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/97 | 0.166 | 0.0359 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/24/98 | 0.246 | 0.0442 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/24/98 | 0.273 | 0.0507 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/23/98 | 0.221 | 0.0494 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/98 | 0.161 | 0.0338 | | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/14/99 | 0.207 | 0.038 | 0.0119 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/14/99 | 0.221 | 0.04 | 0.0125 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/16/99 | 0.151 | 0.032 | 0.0172 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.173 | 0.039 | 0.0381 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/6/99 | 0.192 | 0.039 | 0.0169 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/28/00 | 0.222 | 0.041 | 0.0389 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/28/00 | 0.212 | 0.038 | 0.0159 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/20/00 | 0.17 | 0.035 | 0.0126 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/19/00 | 0.166 | 0.03 | 0.0097 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/5/00 | 0.156 | 0.029 | 0.00364 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/5/00 | 0.201 | 0.035 | 0.00837 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 2/26/01 | 0.226 | 0.034 | 0.00339 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 2/26/01 | 0.232 | 0.037 | 0.00383 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/12/01 | 0.223 | 0.035 | 0.0105 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/13/01 | 0.183 | 0.032 | 0.00772 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/4/01 | 0.227 | 0.036 | 0.00368 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/4/01 | 0.205 | 0.035 | 0.00833 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/26/02 | 0.385 | 0.048 | 0.00395 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/26/02 | 0.373 | 0.046 | 0.011 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/11/02 | 0.161 | 0.029 | 0.00934 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/10/02 | 0.162 | 0.03 | 0.00366 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/10/02 | 0.19 | 0.037 | 0.00462 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/10/02 | 0.187 | 0.041 | 0.00579 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/25/03 | 0.215 | 0.034 | 0.00352 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/25/03 | 0.212 | 0.034 | 0.00351 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/10/03 | 0.143 | 0.041 | 0.0386 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/9/03 | 0.252 | 0.038 | 0.0164 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/8/03 | 0.202 | 0.043 | 0.0249 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/8/03 | 0.231 | 0.052 | 0.0255 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/30/04 | 0.264 | 0.041 | 0.0142 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/30/04 | 0.291 | 0.042 | 0.00401 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/24/04 | 0.303 | 0.042 | 0.0193 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/15/04 | 0.228 | 0.047 | 0.00622 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/04 | 0.231 | 0.036 | 0.0123 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 12/19/04 | 0.354 | 0.045 | 0.0143 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/29/05 | 0.256 | 0.038 | 0.017 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 3/29/05 | 0.208 | 0.034 | 0.0153 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 6/7/05 | 0.333 | 0.041 | 0.00906 | |
| Uranium-238 | Rich.Pmphs-1 HRM46.4 | | River | N | 9/14/05 | 0.214 | 0.036 | 0.0129 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/25/94 | 0.254 | 0.0505 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/22/94 | 0.173 | 0.0422 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/29/94 | 0.229 | 0.0473 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/94 | 0.198 | 0.0412 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/7/94 | 0.185 | 0.041 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/6/94 | 0.165 | 0.0404 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/94 | 0.166 | 0.0379 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/94 | 0.528 | 0.124 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/4/94 | 0.162 | 0.0356 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/94 | 0.358 | 0.0718 | | |

**Table A.12**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/6/94 | 0.177 | 0.045 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/95 | 0.000245 | 0.0000443 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/95 | 0.193 | 0.042 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/95 | 0.234 | 0.0507 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/95 | 0.286 | 0.0514 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/95 | 0.213 | 0.0418 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/6/95 | 0.17 | 0.0402 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/5/95 | 0.164 | 0.0441 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/1/95 | 0.192 | 0.0408 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/6/95 | 0.142 | 0.0329 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/3/95 | 0.233 | 0.0471 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/8/95 | 0.2 | 0.0396 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/5/95 | 0.189 | 0.0402 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/96 | 0.269 | 0.0483 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/7/96 | 0.158 | 0.0388 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/6/96 | 0.209 | 0.0427 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/96 | 0.222 | 0.042 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/8/96 | 0.233 | 0.0444 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/5/96 | 0.184 | 0.0375 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/2/96 | 0.213 | 0.0444 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/96 | 0.187 | 0.0361 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/96 | 0.204 | 0.0417 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/9/96 | 0.219 | 0.046 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/6/96 | 0.182 | 0.0668 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/4/96 | 0.186 | 0.0392 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/96 | 0.241 | 0.0517 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/97 | 0.252 | 0.05 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/97 | 0.25 | 0.044 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/9/97 | 0.227 | 0.049 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/97 | 0.273 | 0.05 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/97 | 0.29 | 0.0478 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/9/97 | 0.161 | 0.0359 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/6/97 | 0.191 | 0.0369 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/97 | 0.248 | 0.0412 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/8/97 | 0.196 | 0.0392 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/5/97 | 0.274 | 0.0902 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/3/97 | 0.255 | 0.0445 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/30/97 | 0.251 | 0.0478 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/98 | 0.291 | 0.0454 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/4/98 | 0.291 | 0.105 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/8/98 | 0.296 | 0.0508 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/7/98 | 0.21 | 0.0508 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/4/98 | 0.227 | 0.0511 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/98 | 0.21 | 0.041 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/29/98 | 0.148 | 0.0413 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/2/98 | 0.243 | 0.0647 | | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/5/99 | 0.249 | 0.042 | 0.0146 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/2/99 | 0.24 | 0.04 | 0.0142 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/30/99 | 0.188 | 0.036 | 0.0193 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/28/99 | 0.151 | 0.031 | 0.0128 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/1/99 | 0.176 | 0.035 | 0.0172 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/6/99 | 0.239 | 0.04 | 0.0147 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/3/99 | 0.155 | 0.032 | 0.0177 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/99 | 0.233 | 0.037 | 0.00835 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/29/99 | 0.213 | 0.038 | 0.0156 | |

**Table A.12.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/2/00 | 0.189 | 0.032 | 0.00941 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/8/00 | 0.23 | 0.047 | 0.0168 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/5/00 | 0.231 | 0.04 | 0.0134 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/00 | 0.187 | 0.036 | 0.0193 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/31/00 | 0.181 | 0.034 | 0.0151 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/29/00 | 0.166 | 0.037 | 0.00565 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/10/00 | 0.163 | 0.039 | 0.022 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/7/00 | 0.229 | 0.042 | 0.0136 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/5/00 | 0.206 | 0.032 | 0.00739 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/2/00 | 0.195 | 0.031 | 0.00726 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/29/00 | 0.175 | 0.042 | 0.00652 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/4/01 | 0.171 | 0.028 | 0.00646 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/31/01 | 0.23 | 0.061 | 0.0297 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/1/01 | 0.25 | 0.04 | 0.0155 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/4/01 | 0.24 | 0.044 | 0.0182 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/2/01 | 0.305 | 0.039 | 0.00679 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/30/01 | 0.239 | 0.034 | 0.00332 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/28/01 | 0.189 | 0.038 | 0.0102 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/9/01 | 0.215 | 0.039 | 0.0136 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/5/01 | 0.172 | 0.036 | 0.0104 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/01 | 0.223 | 0.044 | 0.00568 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/1/01 | 0.185 | 0.032 | 0.0113 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/27/01 | 0.221 | 0.036 | 0.0114 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/3/02 | 0.225 | 0.037 | 0.00822 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/6/02 | 0.195 | 0.032 | 0.0035 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/7/02 | 0.239 | 0.041 | 0.0135 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/3/02 | 0.26 | 0.041 | 0.0121 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/1/02 | 0.232 | 0.051 | 0.0213 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/29/02 | 0.195 | 0.032 | 0.00983 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/27/02 | 0.189 | 0.038 | 0.0165 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/7/02 | 0.195 | 0.033 | 0.00787 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/4/02 | 0.292 | 0.041 | 0.00389 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/2/02 | 0.23 | 0.036 | 0.0127 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/30/02 | 0.196 | 0.035 | 0.014 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/26/02 | 0.166 | 0.03 | 0.00346 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/03 | 0.185 | 0.032 | 0.00978 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/5/03 | 0.199 | 0.032 | 0.00938 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/5/03 | 0.255 | 0.037 | 0.00357 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/2/03 | 0.301 | 0.044 | 0.0182 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/30/03 | 0.238 | 0.037 | 0.0131 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/28/03 | 0.18 | 0.04 | 0.0216 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/10/03 | 0.192 | 0.033 | 0.00383 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/8/03 | 0.214 | 0.039 | 0.0048 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/3/03 | 0.232 | 0.046 | 0.0128 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/30/03 | 0.203 | 0.037 | 0.0216 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/29/03 | 0.217 | 0.046 | 0.00649 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 11/25/03 | 0.19 | 0.035 | 0.00415 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/8/04 | 0.227 | 0.046 | 0.00623 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/4/04 | 0.185 | 0.036 | 0.0046 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/04 | 0.208 | 0.036 | 0.0104 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 4/1/04 | 0.273 | 0.055 | 0.00739 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/6/04 | 0.209 | 0.036 | 0.0137 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/8/04 | 0.249 | 0.058 | 0.0392 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/8/04 | 0.163 | 0.038 | 0.0142 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/04 | 0.161 | 0.034 | 0.0123 | |

**Table A.12.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/04 | 0.164 | 0.035 | 0.0047 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/1/04 | 0.201 | 0.035 | 0.0166 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 10/28/04 | 0.267 | 0.058 | 0.00827 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 12/1/04 | 0.185 | 0.035 | 0.0263 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 1/5/05 | 0.195 | 0.033 | 0.00364 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 2/3/05 | 0.191 | 0.037 | 0.00459 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/2/05 | 0.218 | 0.039 | 0.00439 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 3/31/05 | 0.171 | 0.036 | 0.0183 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 5/3/05 | 0.204 | 0.037 | 0.00914 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 6/9/05 | 0.181 | 0.032 | 0.00368 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 7/7/05 | 0.205 | 0.033 | 0.0117 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/4/05 | 0.193 | 0.033 | 0.00753 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 8/31/05 | 0.157 | 0.031 | 0.0152 | |
| Uranium-238 | Rich.Pmphs HRM 46.4 | | River | N | 9/29/05 | 0.181 | 0.035 | 0.0116 | |
| Uranium-238 | 300 Area | B0R233 | Drinking | N | 12/30/98 | 0.95 | 0.094 | 0.00623 | J |
| Uranium-238 | 331 Bldg. 300 Area | B0HRH1 | Drinking | N | 4/15/96 | 0.0681 | 0.0264 | | |
| Uranium-238 | 300 Spr DR 9 -4 | B12T19 | River | N | 8/27/01 | 0.254 | 0.037 | 0.00919 | |
| Uranium-238 | 300 Spr DR 9 -3 | B12RV9 | River | N | 8/27/01 | 1.57 | 0.092 | 0.0076 | |
| Uranium-238 | 300 Spr DR 9 -2 | B12RV7 | River | N | 8/27/01 | 4.62 | 0.17 | 0.0128 | |
| Uranium-238 | 300 Spr DR 9 -1 | B12RV5 | River | N | 8/27/01 | 4.26 | 0.16 | 0.00797 | |
| Uranium-238 | 300 Spr DR 7 -4 | B12T15 | River | N | 8/27/01 | 0.255 | 0.04 | 0.00415 | |
| Uranium-238 | 300 Spr DR 7 -3 | B12RT5 | River | N | 8/27/01 | 0.354 | 0.045 | 0.00946 | |
| Uranium-238 | 300 Spr DR 7 -2 | B12RT3 | River | N | 8/27/01 | 0.482 | 0.051 | 0.00746 | |
| Uranium-238 | 300 Spr DR 7 -1 | B12RT1 | River | N | 8/27/01 | 1.27 | 0.084 | 0.00947 | |
| Uranium-238 | 300 Spr DR 11 -4 | B12T23 | River | N | 8/27/01 | 0.287 | 0.046 | 0.0104 | |
| Uranium-238 | 300 Spr DR 11 -3 | B12RX5 | River | N | 8/27/01 | 0.437 | 0.06 | 0.0113 | |
| Uranium-238 | 300 Spr DR 11 -2 | B12RX3 | River | N | 8/27/01 | 0.609 | 0.059 | 0.00385 | |
| Uranium-238 | 300 Spr DR 11 -1 | B12RX1 | River | N | 8/27/01 | 2.48 | 0.12 | 0.00404 | |
| Uranium-238 | 300 Spr 9 THRU Spr 11 | B12RW1 | River | N | 8/27/01 | 0.542 | 0.055 | 0.00373 | |
| Uranium-238 | 300 Spr 9 -4 | B12T17 | River | N | 8/27/01 | 0.222 | 0.041 | 0.016 | |
| Uranium-238 | 300 Spr 9 -3 | B12RV3 | River | N | 8/27/01 | 0.348 | 0.05 | 0.00486 | |
| Uranium-238 | 300 Spr 9 -2 | B12RV1 | River | N | 8/27/01 | 1.17 | 0.1 | 0.0121 | |
| **Uranium-238** | **300 Spr 9 -1** | **B12RT9** | **River** | **N** | **8/27/01** | **27.8** | **0.4** | **0.00828** | |
| Uranium-238 | 300 Spr 7 THRU Spr 9 | B12RT7 | River | N | 8/27/01 | 0.374 | 0.049 | 0.00424 | |
| Uranium-238 | 300 Spr 7 -4 | B12T13 | River | N | 8/27/01 | 0.378 | 0.048 | 0.00401 | |
| Uranium-238 | 300 Spr 7 -3 | B12RR9 | River | N | 8/27/01 | 0.442 | 0.048 | 0.00727 | |
| Uranium-238 | 300 Spr 7 -2 | B12RR7 | River | N | 8/27/01 | 1.56 | 0.096 | 0.00394 | |
| Uranium-238 | 300 Spr 7 -1 | B12RR5 | River | N | 8/27/01 | 4.85 | 0.17 | 0.0123 | |
| Uranium-238 | 300 Spr 14 -4 | B12T25 | River | N | 8/27/01 | 0.278 | 0.04 | 0.00384 | |
| Uranium-238 | 300 Spr 14 -3 | B12RY3 | River | N | 8/27/01 | 0.407 | 0.049 | 0.0125 | |
| Uranium-238 | 300 Spr 14 -2 | B12RY1 | River | N | 8/27/01 | 0.433 | 0.05 | 0.00797 | |
| Uranium-238 | 300 Spr 14 -1 | B12RX9 | River | N | 8/27/01 | 0.454 | 0.058 | 0.0178 | |
| Uranium-238 | 300 Spr 11 -4 | B12T21 | River | N | 8/27/01 | 0.639 | 0.061 | 0.00385 | |
| Uranium-238 | 300 Spr 11 -3 | B12RW9 | River | N | 8/27/01 | 1.28 | 0.082 | 0.00896 | |
| Uranium-238 | 300 Spr 11 -2 | B12RW7 | River | N | 8/27/01 | 0.627 | 0.058 | 0.00748 | |
| Uranium-238 | 300 Spr 11 -1 | B12RW5 | River | N | 8/27/01 | 4.48 | 0.15 | 0.0101 | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B0C5C6 | River | N | 8/26/94 | 0.185 | 0.116 | | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B0G8B2 | River | N | 9/18/95 | 0.27 | 0.056 | | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B0J8Y6 | River | N | 9/20/96 | 0.4 | 0.0638 | | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B0LVW6 | River | N | 8/25/97 | 0.417 | 0.0582 | | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B0PVR3 | River | N | 9/15/98 | 0.318 | 0.0942 | | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B0WB28 | River | N | 9/16/99 | 0.305 | 0.046 | 0.0136 | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B106Y3 | River | N | 9/19/00 | 0.246 | 0.04 | 0.0046 | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B12TC6 | River | N | 9/13/01 | 0.787 | 0.069 | 0.00844 | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B158M0 | River | N | 9/10/02 | 0.3 | 0.049 | 0.0151 | |

**Table A.12.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | 300 Area-10 HRM 43.1 | B17CK0 | River | N | 9/9/03 | 0.355 | 0.051 | 0.0138 | |
| Uranium-238 | 300 Area-10 HRM 43.1 | B1B725 | River | N | 9/15/04 | 0.782 | 0.079 | 0.00537 | |
| Uranium-238 | 300 Area-10 HRM 43.1 | | River | N | 9/15/05 | 0.447 | 0.058 | 0.0168 | |
| Uranium-238 | 300 Area SPRING 42-2 | | River | N | 9/15/05 | 0.219 | 0.041 | 0.0194 | |
| Uranium-238 | 300 Area Spr DR 42-2 | | River | N | 9/15/05 | 0.22 | 0.06 | 0.03 | |
| Uranium-238 | 300 Area Shr HRM42.9 | B0WB56 | River | N | 9/16/99 | 0.165 | 0.035 | 0.0236 | |
| Uranium-238 | 300 Area Shr HRM42.9 | B10782 | River | N | 9/19/00 | 0.21 | 0.035 | 0.00405 | |
| Uranium-238 | 300 Area Shr HRM42.9 | B12TR6 | River | N | 9/13/01 | 0.213 | 0.035 | 0.00954 | |
| Uranium-238 | 300 Area Shr HRM42.9 | B158Y9 | River | N | 9/10/02 | 0.177 | 0.048 | 0.0277 | |
| Uranium-238 | 300 Area Shr HRM42.9 | B17CX7 | River | N | 9/9/03 | 0.508 | 0.052 | 0.0035 | |
| Uranium-238 | 300 Area Shr HRM42.9 | B1B7C7 | River | N | 9/15/04 | 0.238 | 0.04 | 0.00427 | |
| Uranium-238 | 300 Area Shr HRM42.9 | | River | N | 9/15/05 | 0.185 | 0.038 | 0.0125 | |
| Uranium-238 | 300 Area Shr HRM42.5 | B0WB55 | River | N | 9/16/99 | 0.226 | 0.04 | 0.0172 | |
| Uranium-238 | 300 Area Shr HRM42.5 | B10779 | River | N | 9/19/00 | 0.187 | 0.031 | 0.00911 | |
| Uranium-238 | 300 Area Shr HRM42.5 | B12TR2 | River | N | 9/13/01 | 0.2 | 0.037 | 0.00452 | |
| Uranium-238 | 300 Area Shr HRM42.5 | B158Y6 | River | N | 9/10/02 | 0.183 | 0.032 | 0.00358 | |
| Uranium-238 | 300 Area Shr HRM42.5 | B17CX3 | River | N | 9/9/03 | 6.19 | 0.17 | 0.0195 | |
| Uranium-238 | 300 Area Shr HRM42.4 | B1B7H3 | River | N | 9/15/04 | 0.26 | 0.047 | 0.00541 | |
| Uranium-238 | 300 Area Shr HRM42.1 | B0WB54 | River | N | 9/16/99 | 0.203 | 0.037 | 0.0233 | |
| Uranium-238 | 300 Area Shr HRM42.1 | B10776 | River | N | 9/19/00 | 0.244 | 0.034 | 0.00669 | |
| Uranium-238 | 300 Area Shr HRM42.1 | B12TP8 | River | N | 9/13/01 | 0.293 | 0.041 | 0.00787 | |
| Uranium-238 | 300 Area Shr HRM42.1 | B158Y3 | River | N | 9/10/02 | 0.162 | 0.032 | 0.0135 | |
| Uranium-238 | 300 Area Shr HRM42.1 | B17CW9 | River | N | 9/9/03 | 0.354 | 0.044 | 0.00364 | |
| Uranium-238 | 300 Area Shr HRM42.1 | B1B7C3 | River | N | 9/15/04 | 0.254 | 0.045 | 0.017 | |
| Uranium-238 | 300 Area Shr HRM41.5 | B0WB53 | River | N | 9/16/99 | 0.203 | 0.04 | 0.033 | |
| Uranium-238 | 300 Area Shr HRM41.5 | B10773 | River | N | 9/19/00 | 0.162 | 0.033 | 0.01 | |
| Uranium-238 | 300 Area Shr HRM41.5 | B12TP4 | River | N | 9/13/01 | 0.197 | 0.041 | 0.0139 | |
| Uranium-238 | 300 Area Shr HRM41.5 | B158Y0 | River | N | 9/10/02 | 0.151 | 0.033 | 0.0128 | |
| Uranium-238 | 300 Area Shr HRM41.5 | B17CW5 | River | N | 9/9/03 | 0.21 | 0.034 | 0.0036 | |
| Uranium-238 | 300 Area Shr HRM41.5 | B1B7B9 | River | N | 9/15/04 | 0.175 | 0.045 | 0.0193 | |
| Uranium-238 | 300 Area Shr HRM41.5 | | River | N | 9/15/05 | 0.202 | 0.035 | 0.00392 | |
| Uranium-238 | 300 Area Outfl13 | B19JC4 | River | N | 6/24/04 | 4.06 | 0.19 | 0.0261 | |
| Uranium-238 | 300 Area Outfl13 | B1B7H7 | River | N | 9/15/04 | 4.14 | 0.18 | 0.0136 | |
| Uranium-238 | 300 Area Outfl13 | B1BW54 | River | N | 12/19/04 | 3.1 | 0.14 | 0.0184 | |
| Uranium-238 | 300 Area Outfl13 | | River | N | 6/7/05 | 5.05 | 0.16 | 0.0187 | |
| Uranium-238 | 300 Area Outfl13 | | River | N | 9/15/05 | 4.06 | 0.19 | 0.00627 | |
| Uranium-238 | 300 Area -9 HRM 43.1 | B0C5C5 | River | N | 8/26/94 | 0.284 | 0.148 | | |
| Uranium-238 | 300 Area -9 HRM 43.1 | B0G8B1 | River | N | 9/18/95 | 0.202 | 0.0447 | | |
| Uranium-238 | 300 Area -9 HRM 43.1 | B0J8Y5 | River | N | 9/20/96 | 0.244 | 0.0477 | | |
| Uranium-238 | 300 Area -9 HRM 43.1 | B0LVW5 | River | N | 8/25/97 | 0.203 | 0.04 | | |
| Uranium-238 | 300 Area -8 HRM 43.1 | B0C5C4 | River | N | 8/26/94 | 0.116 | 0.0666 | | |
| Uranium-238 | 300 Area -8 HRM 43.1 | B0G8B0 | River | N | 9/18/95 | 0.201 | 0.0436 | | |
| Uranium-238 | 300 Area -8 HRM 43.1 | B0J8Y4 | River | N | 9/20/96 | 0.206 | 0.0425 | | |
| Uranium-238 | 300 Area -8 HRM 43.1 | B0LVW4 | River | N | 8/25/97 | 0.258 | 0.0451 | | |
| Uranium-238 | 300 Area -8 HRM 43.1 | B0PVR1 | River | N | 9/15/98 | 0.195 | 0.047 | | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B0C5C3 | River | N | 8/26/94 | 0.186 | 0.0804 | | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B0G899 | River | N | 9/18/95 | 0.236 | 0.0489 | | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B0J8Y3 | River | N | 9/20/96 | 0.274 | 0.0581 | | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B0LVW3 | River | N | 8/25/97 | 0.224 | 0.0443 | | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B0PVR0 | River | N | 9/15/98 | 0.164 | 0.0861 | | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B0WB27 | River | N | 9/16/99 | 0.204 | 0.037 | 0.0131 | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B106Y1 | River | N | 9/19/00 | 0.202 | 0.038 | 0.0158 | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B12TC4 | River | N | 9/13/01 | 0.184 | 0.033 | 0.00394 | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B158L9 | River | N | 9/10/02 | 0.201 | 0.041 | 0.00542 | |
| Uranium-238 | 300 Area -7 HRM 43.1 | B17CJ8 | River | N | 9/9/03 | 0.204 | 0.034 | 0.00383 | |

**Table A.12**. (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | 300 Area -7 HRM 43.1 | B1B724 | River | N | 9/15/04 | 0.249 | 0.051 | 0.0257 | |
| Uranium-238 | 300 Area -7 HRM 43.1 | | River | N | 9/15/05 | 0.174 | 0.048 | 0.046 | |
| Uranium-238 | 300 Area -6 HRM 43.1 | B0C5C2 | River | N | 8/26/94 | 0.181 | 0.0777 | | |
| Uranium-238 | 300 Area -6 HRM 43.1 | B0G898 | River | N | 9/18/95 | 0.224 | 0.0458 | | |
| Uranium-238 | 300 Area -6 HRM 43.1 | B0J8Y2 | River | N | 9/20/96 | 0.231 | 0.0484 | | |
| Uranium-238 | 300 Area -6 HRM 43.1 | B0LVW2 | River | N | 8/25/97 | 0.19 | 0.0373 | | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B0C5C1 | River | N | 8/26/94 | 0.15 | 0.0557 | | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B0G897 | River | N | 9/18/95 | 0.19 | 0.0479 | | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B0J8Y0 | River | N | 9/20/96 | 0.202 | 0.0399 | | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B0LVW1 | River | N | 8/25/97 | 0.191 | 0.0402 | | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B0PVP8 | River | N | 9/15/98 | 0.167 | 0.0407 | | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B0WB26 | River | N | 9/16/99 | 0.178 | 0.037 | 0.025 | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B106X9 | River | N | 9/19/00 | 0.165 | 0.036 | 0.0172 | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B12TC2 | River | N | 9/13/01 | 0.213 | 0.036 | 0.00393 | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B158L8 | River | N | 9/10/02 | 0.167 | 0.033 | 0.0213 | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B17CJ6 | River | N | 9/9/03 | 0.189 | 0.036 | 0.014 | |
| Uranium-238 | 300 Area -5 HRM 43.1 | B1B723 | River | N | 9/15/04 | 0.211 | 0.047 | 0.028 | |
| Uranium-238 | 300 Area -5 HRM 43.1 | | River | N | 9/15/05 | 0.165 | 0.032 | 0.0108 | |
| Uranium-238 | 300 Area -4 HRM 43.1 | B0C5C0 | River | N | 8/26/94 | 0.143 | 0.0685 | | |
| Uranium-238 | 300 Area -4 HRM 43.1 | B0G896 | River | N | 9/18/95 | 0.174 | 0.0394 | | |
| Uranium-238 | 300 Area -4 HRM 43.1 | B0J8X8 | River | N | 9/20/96 | 0.187 | 0.0423 | | |
| Uranium-238 | 300 Area -4 HRM 43.1 | B0LVW0 | River | N | 8/25/97 | 0.187 | 0.0394 | | |
| Uranium-238 | 300 Area -4 HRM 43.1 | B0PVP7 | River | N | 9/15/98 | 0.18 | 0.0426 | | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B0C5B9 | River | N | 8/26/94 | 0.287 | 0.188 | | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B0G895 | River | N | 9/18/95 | 0.139 | 0.0352 | | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B0J8X6 | River | N | 9/20/96 | 0.177 | 0.0404 | | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B0LVV9 | River | N | 8/25/97 | 0.221 | 0.044 | | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B0PVP6 | River | N | 9/15/98 | 0.0958 | 0.0577 | | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B0WB25 | River | N | 9/16/99 | 0.157 | 0.033 | 0.0193 | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B106X7 | River | N | 9/19/00 | 0.161 | 0.028 | 0.00352 | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B12TC0 | River | N | 9/13/01 | 0.161 | 0.03 | 0.0036 | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B158L7 | River | N | 9/10/02 | 0.158 | 0.03 | 0.00917 | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B17CJ4 | River | N | 9/9/03 | 0.22 | 0.038 | 0.0115 | |
| Uranium-238 | 300 Area -3 HRM 43.1 | B1B722 | River | N | 9/15/04 | 0.161 | 0.042 | 0.00683 | |
| Uranium-238 | 300 Area -3 HRM 43.1 | | River | N | 9/15/05 | 0.163 | 0.045 | 0.0397 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B0C5B8 | River | N | 8/26/94 | 0.152 | 0.0861 | | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B0G894 | River | N | 9/18/95 | 0.167 | 0.0449 | | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B0J8X4 | River | N | 9/20/96 | 0.304 | 0.0532 | | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B0LVV8 | River | N | 8/25/97 | 0.166 | 0.0373 | | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B0PVP5 | River | N | 9/15/98 | 0.15 | 0.0435 | | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B0WB24 | River | N | 9/16/99 | 0.175 | 0.039 | 0.0408 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B106X5 | River | N | 9/19/00 | 0.174 | 0.03 | 0.00364 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B12TB8 | River | N | 9/13/01 | 0.191 | 0.033 | 0.00767 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B158L6 | River | N | 9/10/02 | 0.166 | 0.03 | 0.00871 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B17CJ2 | River | N | 9/9/03 | 0.206 | 0.037 | 0.0118 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | B1B721 | River | N | 9/15/04 | 0.154 | 0.039 | 0.0204 | |
| Uranium-238 | 300 Area -2 HRM 43.1 | | River | N | 9/15/05 | 0.158 | 0.033 | 0.0142 | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B0C5B7 | River | N | 8/26/94 | 0.156 | 0.14 | | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B0G893 | River | N | 9/18/95 | 0.246 | 0.0467 | | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B0J8X2 | River | N | 9/20/96 | 0.494 | 0.061 | | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B0LVV7 | River | N | 8/25/97 | 0.209 | 0.0401 | | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B0PVP4 | River | N | 9/15/98 | 0.166 | 0.0406 | | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B0WB23 | River | N | 9/16/99 | 0.144 | 0.034 | 0.0198 | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B106X3 | River | N | 9/19/00 | 0.168 | 0.028 | 0.00325 | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B12TB6 | River | N | 9/13/01 | 0.216 | 0.034 | 0.00351 | |

**Table A.12.** (contd)

| Analyte | Location | Sample Number | Sampled From | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|---|
| Uranium-238 | 300 Area -1 HRM 43.1 | B158L5 | River | N | 9/10/02 | 0.154 | 0.029 | 0.00925 | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B17CJ0 | River | N | 9/9/03 | 0.403 | 0.049 | 0.0189 | |
| Uranium-238 | 300 Area -1 HRM 43.1 | B1B720 | River | N | 9/15/04 | 0.207 | 0.05 | 0.0209 | |
| Uranium-238 | 300 Area -1 HRM 43.1 | | River | N | 9/15/05 | 0.142 | 0.039 | 0.0218 | |
| Uranium-238 | 300 Area | B09QT2 | Drinking | N | 3/29/94 | 0.316 | 0.0564 | | |
| Uranium-238 | 300 Area | B0BP89 | Drinking | N | 6/21/94 | 0.279 | 0.0463 | | |
| Uranium-238 | 300 Area | B0C477 | Drinking | N | 10/11/94 | 0.431 | 0.0635 | | |
| Uranium-238 | 300 Area | B0D0Y8 | Drinking | N | 1/3/95 | 0.449 | 0.0721 | | |
| Uranium-238 | 300 Area | B0DKB6 | Drinking | N | 3/27/95 | 0.327 | 0.0767 | | |
| Uranium-238 | 300 Area | B0F909 | Drinking | N | 6/20/95 | 0.238 | 0.0447 | | |
| Uranium-238 | 300 Area | B0G537 | Drinking | N | 10/10/95 | 0.374 | 0.06 | | |
| Uranium-238 | 300 Area | B0GML6 | Drinking | N | 1/4/96 | 0.31 | 0.0492 | | |
| Uranium-238 | 300 Area | B0H524 | Drinking | N | 3/27/96 | 0.23 | 0.0444 | | |
| Uranium-238 | 300 Area | B0HPT1 | Drinking | N | 6/19/96 | 0.255 | 0.0496 | | |
| Uranium-238 | 300 Area | B0J464 | Drinking | N | 10/9/96 | 0.55 | 0.0734 | | |
| Uranium-238 | 300 Area | B0JFJ4 | Drinking | N | 1/6/97 | 0.448 | 0.123 | | |
| Uranium-238 | 300 Area | B0JV31 | Drinking | N | 3/25/97 | 0.621 | 0.105 | | |
| Uranium-238 | 300 Area | B0K6X1 | Drinking | N | 7/17/97 | 0.289 | 0.0482 | | |
| Uranium-238 | 300 Area | B0LHF7 | Drinking | N | 10/8/97 | 0.72 | 0.0845 | | |
| Uranium-238 | 300 Area | S0LWT9 | Drinking | N | 12/30/97 | 0.776 | 0.08 | | |
| Uranium-238 | 300 Area | B0MTB2 | Drinking | N | 3/27/98 | 0.672 | 0.0802 | | |
| Uranium-238 | 300 Area | B0NHR3 | Drinking | N | 7/15/98 | 0.279 | 0.0475 | | |
| Uranium-238 | 300 Area | B0P8V0 | Drinking | N | 10/8/98 | 1.29 | 0.11 | 0.0199 | |
| Uranium-238 | 300 Area | B19HD4 | River | N | 6/10/04 | 0.17 | 0.04 | 0.0201 | |
| Uranium-238 | 300 Area | B1BCB0 | River | N | 9/24/04 | 0.174 | 0.035 | 0.0146 | |
| Uranium-238 | 300 Area | | River | N | 9/15/05 | 0.168 | 0.035 | 0.0209 | |

## A.3 Seep Water Data

The seep water data were provided by staff from the SESP. Data were provided for two locations along the 300 Area shoreline. The seep data are predominantly from springs 42-2 and 42-2 DR. For the location of these seeps, see Figure 3.1 of this document and Patton et al. (2003).

### A.3.1 cis-1,2-Dichloroethene Seep Water Data

There were 13 (9 nondetect) seep water samples of cis-1,2-dichloroethene at the 300 Area location. The samples were collected between 11/1/1999 and 10/6/2005. The values are plotted in Figure A.12, and the data are presented in Table A.13.

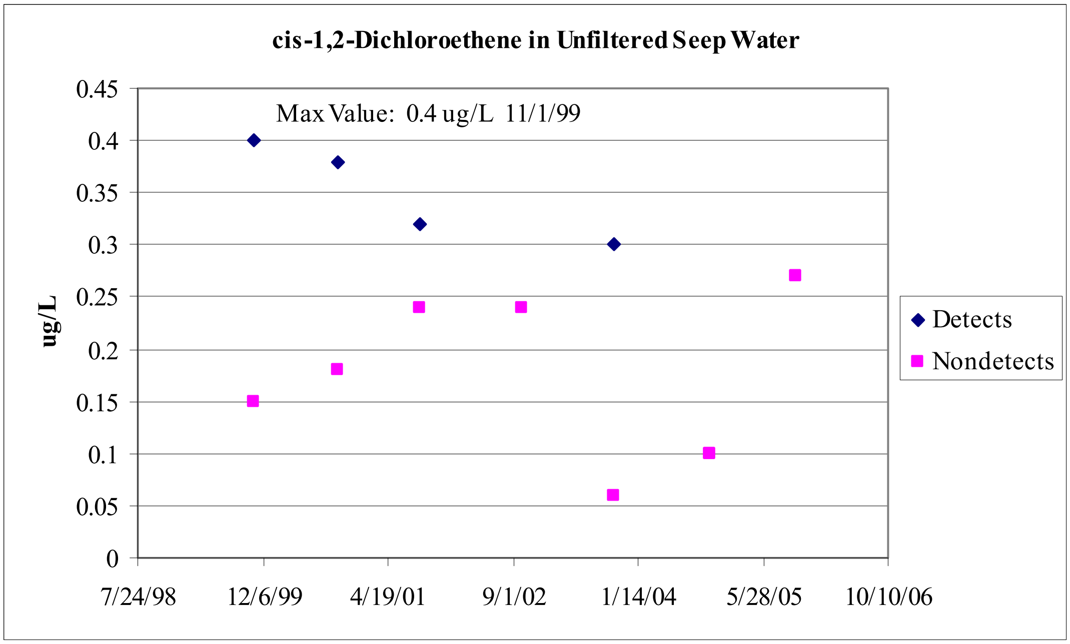


**Figure A.12**. cis-1,2-Dichloroethene in Seep Water Associated with the 300 Area

**Table A.13**. cis-1,2-Dichloroethene Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (µg/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| **cis-1,2-Dichloroethene** | **300 Area Spr DR 42-2** | **B0WMV4** | **N** | **11/1/1999** | **0.4** | | | **J** |
| cis-1,2-Dichloroethene | 300 Area Spr DR 42-2 | B108Y5 | N | 9/27/2000 | 0.38 | | | J |
| cis-1,2-Dichloroethene | 300 Area Spr DR 42-2 | B12RL1 | N | 8/27/2001 | 0.32 | | | J |
| cis-1,2-Dichloroethene | 300 Area Spr DR 42-2 | B17RR5 | N | 10/13/2003 | 0.3 | | | J |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | B0WMV3 | N | 11/1/1999 | 0.15 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | B108Y4 | N | 9/27/2000 | 0.18 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | B12RL2 | N | 8/27/2001 | 0.24 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | B15CD5 | N | 10/7/2002 | 0.24 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | B17RR6 | N | 10/13/2003 | 0.06 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spr DR 42-2 | B1BJ64 | N | 10/25/2004 | 0.1 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | B1BJ63 | N | 10/25/2004 | 0.1 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spring 42-2 | | N | 10/6/2005 | 0.27 | | | U |
| cis-1,2-Dichloroethene | 300 Area Spr DR 42-2 | | N | 10/6/2005 | 0.27 | | | U |

### A.3.2 Tritium Seep Water Data

There were 27 seep water samples of tritium at the 300 Area location. The samples were collected between 8/29/1994 and 10/6/2005. The values are plotted in Figure A.13, and the data are presented in Table A.14.

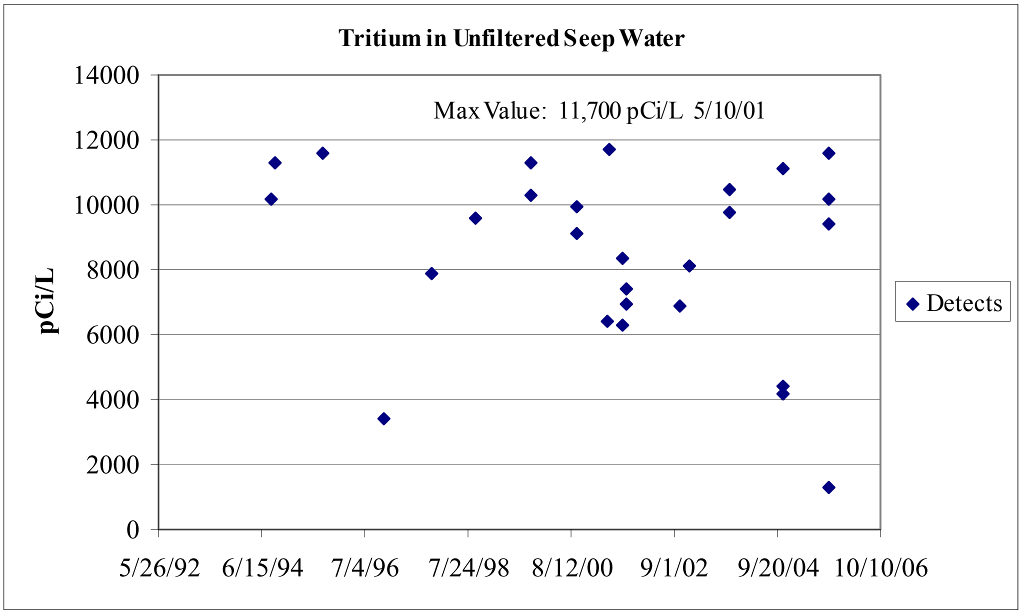


**Figure A.13**. Tritium in Seep Water Associated with the 300 Area

**Table A.14**. Tritium Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Tritium | 300 Area Spring 42-2 | B0C5G4 | N | 8/29/1994 | 10200 | 209 | | |
| Tritium | 300 Area Spring 42-2 | B0C5G6 | N | 9/25/1994 | 11300 | 219 | | |
| Tritium | 300 Area Spring 42-2 | B0G8C1 | N | 9/5/1995 | 11600 | 266 | | |
| Tritium | 300 Area Spring 42-2 | B0J5D0 | N | 11/21/1996 | 3420 | 160 | | |
| Tritium | 300 Area Spring 42-2 | B0M7W3 | N | 10/27/1997 | 7880 | 234 | | |
| Tritium | 300 Area Spring 42-2 | B0PXB3 | N | 9/22/1998 | 9590 | 247 | | |
| Tritium | 300 Area Spring 42-2 | B0WNY3 | N | 11/1/1999 | 10300 | 220 | 169 | |
| Tritium | 300 Area Spr DR 42-2 | B0WP28 | N | 11/1/1999 | 11300 | 230 | 169 | |
| Tritium | 300 Area Spr DR 42-2 | B10949 | N | 9/27/2000 | 9130 | 210 | 175 | |
| Tritium | 300 Area Spring 42-2 | B10913 | N | 9/27/2000 | 9940 | 210 | 173 | |
| Tritium | 300 Area Spr DR 42-2 | B11W57 | N | 5/3/2001 | 6400 | 30 | 6.38 | |
| **Tritium** | **300 Area Spring 42-2** | **B11W38** | **N** | **5/10/2001** | **11700** | **260** | **175** | |
| Tritium | 300 Area Spr DR 42-2 | B12RM6 | N | 8/27/2001 | 8380 | 230 | 169 | |
| Tritium | 300 Area Spring 42-2 | B12RM1 | N | 8/27/2001 | 6300 | 200 | 169 | |
| Tritium | 300 Area Spr DR 42-2 | B12XK2 | N | 9/17/2001 | 6940 | 240 | 213 | |
| Tritium | 300 Area Spring 42-2 | B12XK1 | N | 9/18/2001 | 7410 | 240 | 213 | |
| Tritium | 300 Area Spring 42-2 | B15C11 | N | 10/7/2002 | 6910 | 220 | 185 | |
| Tritium | 300 Area Spr DR 42-2 | B15C75 | N | 12/26/2002 | 8110 | 370 | 134 | |
| Tritium | 300 Area Spr DR 42-2 | B17RK1 | N | 10/13/2003 | 10500 | 370 | 131 | |
| Tritium | 300 Area Spring 42-2 | B17RJ2 | N | 10/13/2003 | 9760 | 360 | 131 | |
| Tritium | 300 Area Spr DR 42-2 | B1BFV8 | N | 10/25/2004 | 4440 | 250 | 151 | |
| Tritium | 300 Area Spring 41-9 | B1BH15 | N | 10/25/2004 | 11100 | 390 | 152 | |
| Tritium | 300 Area Spring 42-2 | B1BFP4 | N | 10/25/2004 | 4150 | 240 | 151 | |
| Tritium | 300 Area Spring 42-2 | | N | 10/6/2005 | 10200 | 390 | 199 | |
| Tritium | 300 Area Spr DR 42-2 | | N | 10/6/2005 | 9400 | 370 | 196 | |
| Tritium | 300 Area Spring 41-9 | | N | 10/6/2005 | 11600 | 410 | 196 | |
| Tritium | 300 Area Spring 42-7 | | N | 10/6/2005 | 1310 | 160 | 196 | |

### A.3.3 Nitrate Seep Water Data

There were three seep water samples of nitrate at the 300 Area location. The samples were collected between 8/29/1994 and 11/21/1996. The values are plotted in Figure A.14, and the data are presented in Table A.15.

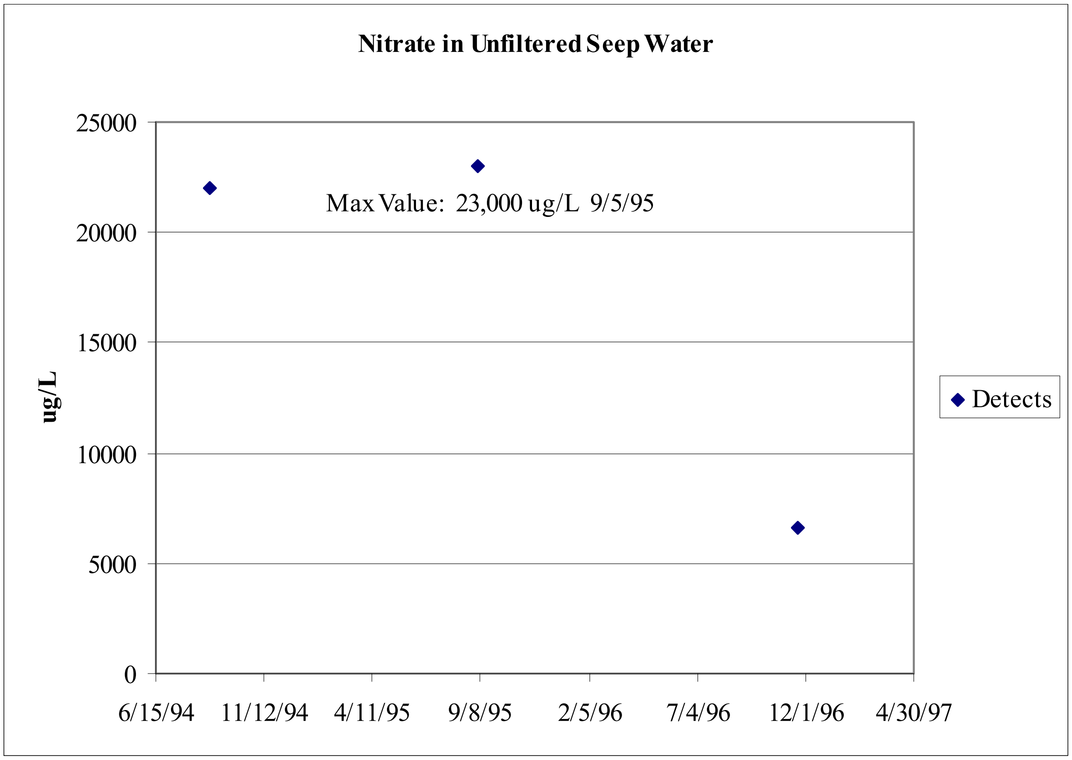


**Figure A.14**. Nitrate in Seep Water Associated with the 300 Area

**Table A.15**. Nitrate Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (μg/L) | Quali-fier |
|---|---|---|---|---|---|---|
| Nitrate | 300 Area Spring 42-2 | B0CSG3 | N | 8/29/1994 | 22000 | D |
| **Nitrate** | **300 Area Spring 42-2** | **B0G0Q8** | **N** | **9/5/1995** | **23000** | **D** |
| Nitrate | 300 Area Spring 42-2 | B0G1G0 | N | 11/21/1996 | 6600 | |

### A.3.4 Tetrachloroethene Seep Water Data

There were 13 (12 nondetect) seep water samples of tetrachloroethene at the 300 Area location. The samples were collected between 11/1/1999 and 10/6/2005. The values are plotted in Figure A.15, and the data are presented in Table A.16.

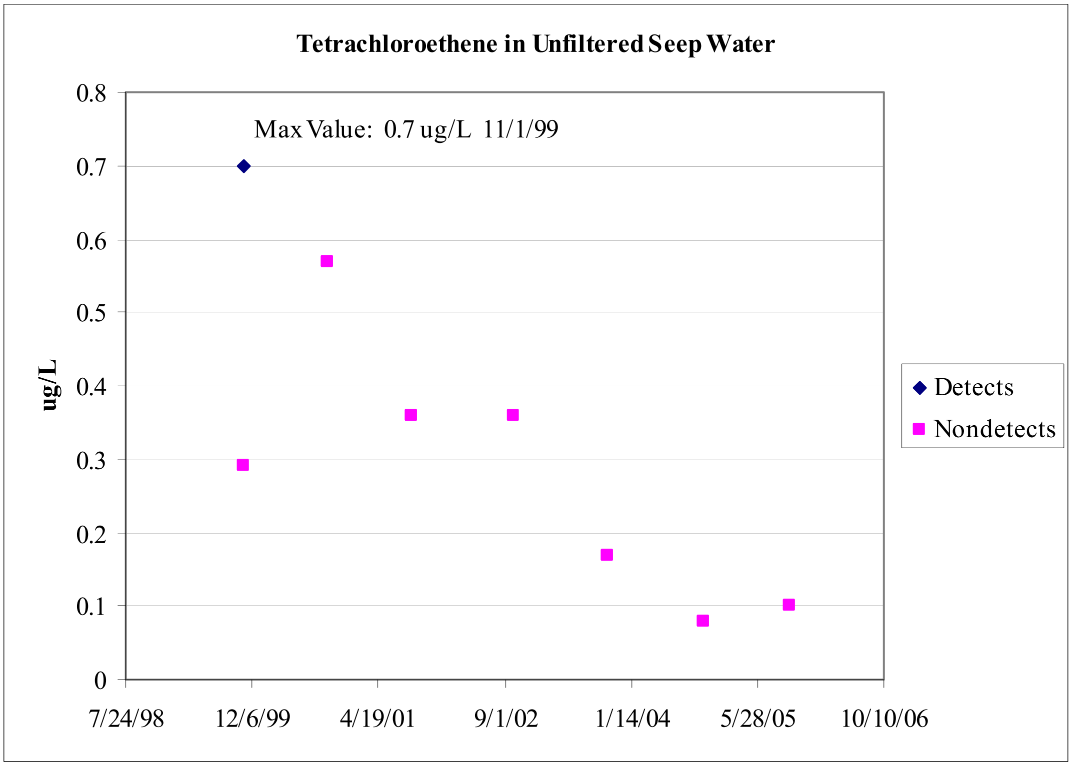


**Figure A.15**. Tetrachloroethene in Seep Water Associated with the 300 Area

**Table A.16**. Tetrachloroethene Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (µg/L) | Quali-fier |
|---|---|---|---|---|---|---|
| **Tetrachloroethene** | **300 Area Spr DR 42-2** | **B0WMV4** | **N** | **11/1/1999** | **0.7** | **J** |
| Tetrachloroethene | 300 Area Spring 42-2 | B0WMV3 | N | 11/1/1999 | 0.29 | U |
| Tetrachloroethene | 300 Area Spr DR 42-2 | B108Y5 | N | 9/27/2000 | 0.57 | U |
| Tetrachloroethene | 300 Area Spring 42-2 | B108Y4 | N | 9/27/2000 | 0.57 | U |
| Tetrachloroethene | 300 Area Spring 42-2 | B12RL2 | N | 8/27/2001 | 0.36 | U |
| Tetrachloroethene | 300 Area Spr DR 42-2 | B12RL1 | N | 8/27/2001 | 0.36 | U |
| Tetrachloroethene | 300 Area Spring 42-2 | B15CD5 | N | 10/7/2002 | 0.36 | U |
| Tetrachloroethene | 300 Area Spr DR 42-2 | B17RR5 | N | 10/13/2003 | 0.17 | U |
| Tetrachloroethene | 300 Area Spring 42-2 | B17RR6 | N | 10/13/2003 | 0.17 | U |
| Tetrachloroethene | 300 Area Spring 42-2 | | N | 10/6/2005 | 0.1 | U |
| Tetrachloroethene | 300 Area Spr DR 42-2 | | N | 10/6/2005 | 0.1 | U |
| Tetrachloroethene | 300 Area Spr DR 42-2 | B1BJ64 | N | 10/25/2004 | 0.08 | UN |
| Tetrachloroethene | 300 Area Spring 42-2 | B1BJ63 | N | 10/25/2004 | 0.08 | UN |

## A.3.5 Strontium-90 Seep Water Data

There were 20 (3 nondetect) seep water samples of strontium-90 at the 300 Area location. The samples were collected between 8/29/1994 and 10/6/2005. The values are plotted in Figure A.16, and the data are presented in Table A.17.

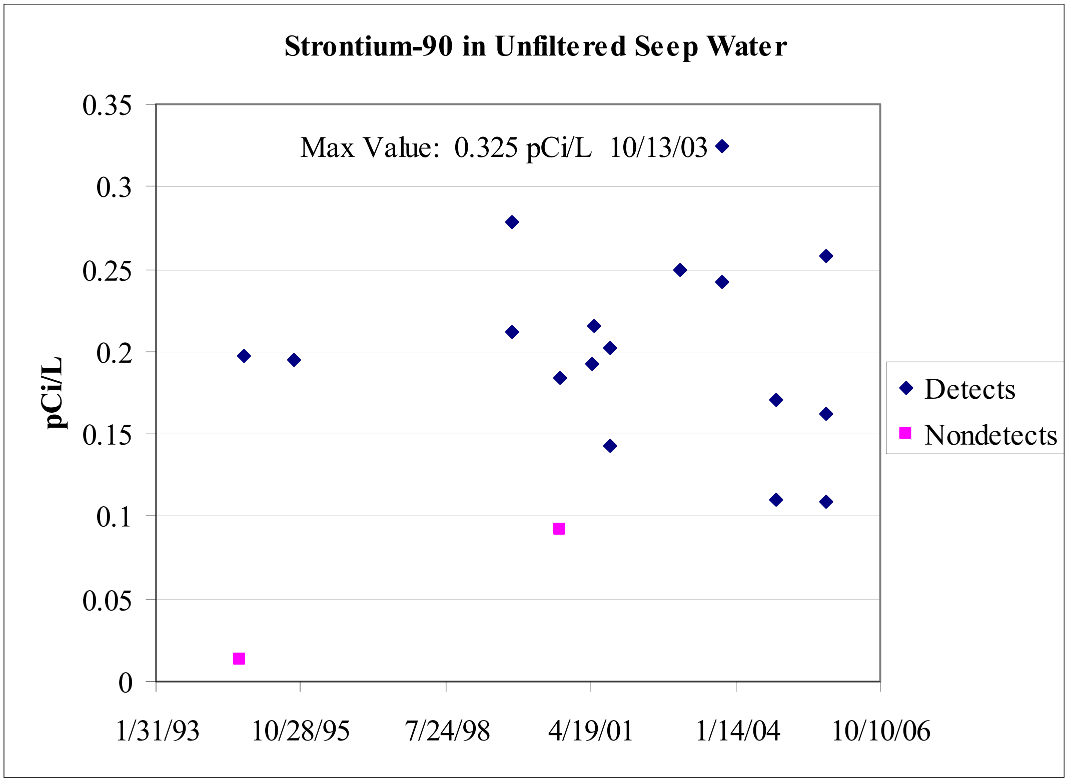


**Figure A.16**. Strontium-90 in Seep Water Associated with the 300 Area

**Table A.17**. Strontium-90 Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Strontium-90 | 300 Area Spring 42-2 | B0C5G4 | N | 8/29/1994 | 0.0136 | 0.486 | | U |
| Strontium-90 | 300 Area Spring 42-2 | B10913 | N | 9/27/2000 | 0.0923 | 0.099 | 0.198 | U |
| Strontium-90 | 300 Area Spring 41-9 | | N | 10/6/2005 | -0.0369 | 0.021 | 0.0476 | U |
| Strontium-90 | 300 Area Spring 42-2 | B0C5G6 | N | 9/25/1994 | 0.198 | 0.0957 | | |
| Strontium-90 | 300 Area Spring 42-2 | B0G8C1 | N | 9/5/1995 | 0.195 | 0.101 | | |
| Strontium-90 | 300 Area Spring 42-2 | B0WNY3 | N | 11/1/1999 | 0.212 | 0.036 | 0.0392 | |
| Strontium-90 | 300 Area Spr DR 42-2 | B0WP28 | N | 11/1/1999 | 0.279 | 0.037 | 0.0325 | |
| Strontium-90 | 300 Area Spr DR 42-2 | B10949 | N | 9/27/2000 | 0.184 | 0.047 | 0.0703 | |
| Strontium-90 | 300 Area Spr DR 42-2 | B11W57 | N | 5/3/2001 | 0.192 | 0.064 | 0.0892 | |
| Strontium-90 | 300 Area Spring 42-2 | B11W38 | N | 5/10/2001 | 0.215 | 0.041 | 0.0478 | |
| Strontium-90 | 300 Area Spring 42-2 | B12RM1 | N | 8/27/2001 | 0.143 | 0.048 | 0.0657 | |
| Strontium-90 | 300 Area Spr DR 42-2 | B12RM6 | N | 8/27/2001 | 0.202 | 0.039 | 0.0427 | |
| Strontium-90 | 300 Area Spr DR 42-2 | B15C75 | N | 12/26/2002 | 0.249 | 0.047 | 0.0553 | |
| **Strontium-90** | **300 Area Spring 42-2** | **B17RJ2** | **N** | **10/13/2003** | **0.325** | **0.033** | **0.0351** | |
| Strontium-90 | 300 Area Spr DR 42-2 | B17RK1 | N | 10/13/2003 | 0.242 | 0.026 | 0.0257 | |
| Strontium-90 | 300 Area Spring 42-2 | B1BFP4 | N | 10/25/2004 | 0.171 | 0.028 | 0.0399 | |
| Strontium-90 | 300 Area Spr DR 42-2 | B1BFV8 | N | 10/25/2004 | 0.11 | 0.04 | 0.0694 | |
| Strontium-90 | 300 Area Spring 42-7 | | N | 10/6/2005 | 0.162 | 0.03 | 0.038 | |
| Strontium-90 | 300 Area Spring 42-2 | | N | 10/6/2005 | 0.109 | 0.044 | 0.0721 | |
| Strontium-90 | 300 Area Spr DR 42-2 | | N | 10/6/2005 | 0.258 | 0.032 | 0.0331 | |

### A.3.6 Technetium-99 Seep Water Data

There were 10 seep water samples of technetium-99 at the 300 Area location. The samples were collected between 8/29/1994 and 9/18/2001. The values are plotted in Figure A.17, and the data are presented in Table A.18.

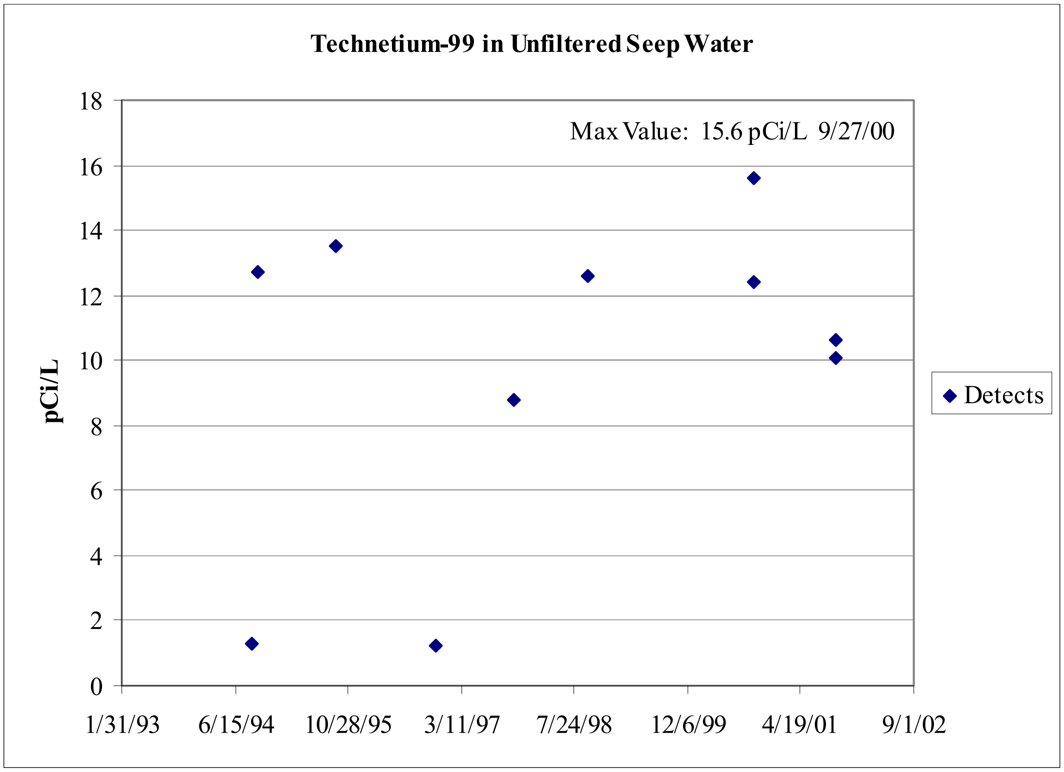


**Figure A.17**. Technetium-99 in Seep Water Associated with the 300 Area

**Table A.18**. Technetium-99 Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Technetium-99 | 300 Area Spr DR 42-2 | B10949 | N | 9/27/2000 | 12.4 | 0.26 | 0.912 | J |
| Technetium-99 | 300 Area Spring 42-2 | B0C5G4 | N | 8/29/1994 | 1.3 | 0.119 | | |
| Technetium-99 | 300 Area Spring 42-2 | B0C5G6 | N | 9/25/1994 | 12.7 | 0.291 | | |
| Technetium-99 | 300 Area Spring 42-2 | B0G8C1 | N | 9/5/1995 | 13.5 | 0.22 | | |
| Technetium-99 | 300 Area Spring 42-2 | B0J5D0 | N | 11/21/1996 | 1.22 | 0.112 | | |
| Technetium-99 | 300 Area Spring 42-2 | B0M7W3 | N | 10/27/1997 | 8.76 | 0.186 | | |
| Technetium-99 | 300 Area Spring 42-2 | B0PXB3 | N | 9/22/1998 | 12.6 | 0.212 | | |
| **Technetium-99** | **300 Area Spring 42-2** | **B10913** | **N** | **9/27/2000** | **15.6** | **0.31** | **0.911** | |
| Technetium-99 | 300 Area Spr DR 42-2 | B12XK2 | N | 9/17/2001 | 10.1 | 0.34 | 0.512 | |
| Technetium-99 | 300 Area Spring 42-2 | B12XK1 | N | 9/18/2001 | 10.6 | 0.33 | 0.496 | |

### A.3.7 Trichloroethylene Seep Water Data

There were 10 seep water samples of trichloroethylene at the 300 Area location. The samples were collected between 8/29/1994 and 9/18/2001. The values are plotted in Figure A.18, and the data are presented in Table A.19.

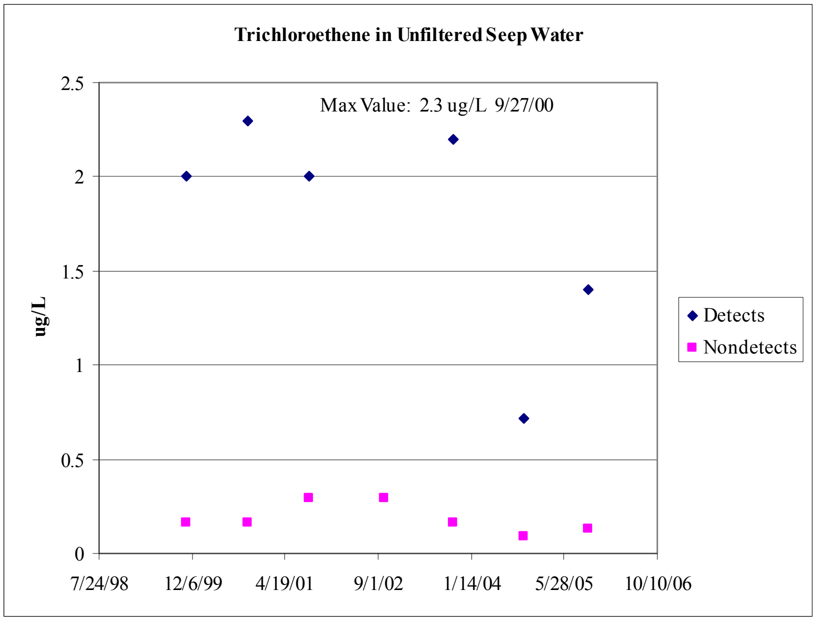


**Figure A.18**. Trichloroethylene in Seep Water Associated with the 300 Area

**Table A.19**. Trichloroethylene Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (µg/L) | Qualifier |
|---|---|---|---|---|---|---|
| Trichloroethylene | 300 Area Spring 42-2 | B0WMV3 | N | 11/1/1999 | 0.16 | U |
| Trichloroethylene | 300 Area Spring 42-2 | B108Y4 | N | 9/27/2000 | 0.16 | U |
| Trichloroethylene | 300 Area Spring 42-2 | B12RL2 | N | 8/27/2001 | 0.29 | U |
| Trichloroethylene | 300 Area Spring 42-2 | B15CD5 | N | 10/7/2002 | 0.29 | U |
| Trichloroethylene | 300 Area Spring 42-2 | B17RR6 | N | 10/13/2003 | 0.16 | U |
| Trichloroethylene | 300 Area Spring 42-2 | B1BJ63 | N | 10/25/2004 | 0.09 | U |
| Trichloroethylene | 300 Area Spring 42-2 | | N | 10/6/2005 | 0.13 | U |
| Trichloroethylene | 300 Area Spr DR 42-2 | B0WMV4 | N | 11/1/1999 | 2 | J |
| Trichloroethylene | 300 Area Spr DR 42-2 | B1BJ64 | N | 10/25/2004 | 0.72 | J |
| **Trichloroethylene** | **300 Area Spr DR 42-2** | **B108Y5** | **N** | **9/27/2000** | **2.3** | |
| Trichloroethylene | 300 Area Spr DR 42-2 | B12RL1 | N | 8/27/2001 | 2 | |
| Trichloroethylene | 300 Area Spr DR 42-2 | B17RR5 | N | 10/13/2003 | 2.2 | |
| Trichloroethylene | 300 Area Spr DR 42-2 | | N | 10/6/2005 | 1.4 | |

### A.3.8 Uranium-234 Seep Water Data

There were 25 seep water samples of uranium-234 at the 300 Area location. The samples were collected between 8/29/1994 and 10/25/2004. The values are plotted in Figure A.19 and the data are presented in Table A.20.

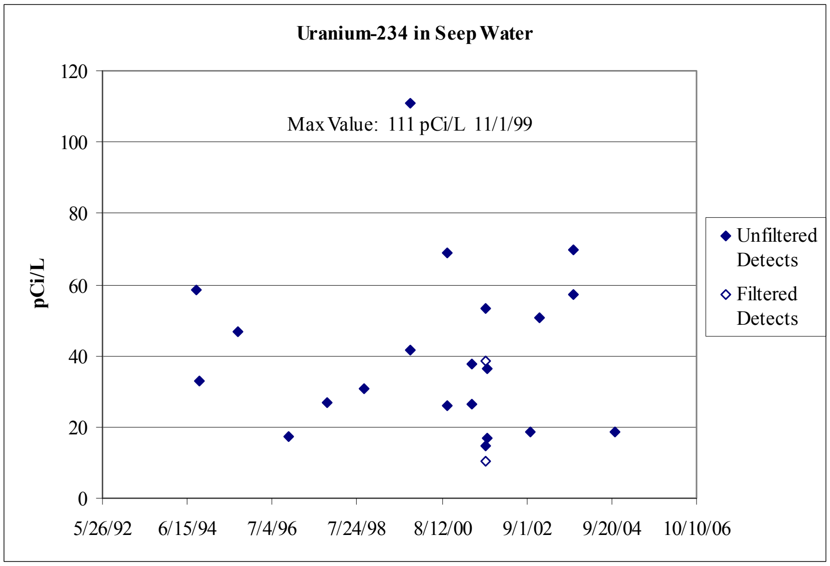


**Figure A.19**. Uranium-234 in Seep Water Associated with the 300 Area

**Table A.20**. Uranium-234 Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-234 | 300 Area Spring 42-2 | B0C5G4 | N | 8/29/1994 | 58.6 | 1.22 | | |
| Uranium-234 | 300 Area Spring 42-2 | B0C5G6 | N | 9/25/1994 | 33.1 | 1.73 | | |
| Uranium-234 | 300 Area Spring 42-2 | B0G8C1 | N | 9/5/1995 | 47 | 0.605 | | |
| Uranium-234 | 300 Area Spring 42-2 | B0J5D0 | N | 11/21/1996 | 17.5 | 0.381 | | |
| Uranium-234 | 300 Area Spring 42-2 | B0M7W3 | N | 10/27/1997 | 26.9 | 0.451 | | |
| Uranium-234 | 300 Area Spring 42-2 | B0PXB3 | N | 9/22/1998 | 30.9 | 0.485 | | |
| **Uranium-234** | **300 Area Spr DR 42-2** | **B0WP28** | **N** | **11/1/1999** | **111** | **8.6** | **1.31** | |
| Uranium-234 | 300 Area Spring 42-2 | B0WNY3 | N | 11/1/1999 | 41.6 | 0.62 | 0.0269 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B10949 | N | 9/27/2000 | 68.9 | 6.6 | 1.09 | |
| Uranium-234 | 300 Area Spring 42-2 | B10913 | N | 9/27/2000 | 25.8 | 0.38 | 0.00384 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B11W57 | N | 5/3/2001 | 37.9 | 0.43 | 0.0083 | |
| Uranium-234 | 300 Area Spring 42-2 | B11W38 | N | 5/10/2001 | 26.5 | 0.79 | 0.0237 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B12RM6 | N | 8/27/2001 | 53.3 | 0.53 | 0.0111 | |
| Uranium-234 | 300 Area Spring 42-2 | B12RM1 | N | 8/27/2001 | 14.6 | 0.3 | 0.00869 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B12XK2 | N | 9/17/2001 | 36.3 | 0.44 | 0.0126 | |
| Uranium-234 | 300 Area Spring 42-2 | B12XK1 | N | 9/18/2001 | 17.1 | 0.31 | 0.00794 | |
| Uranium-234 | 300 Area Spring 42-2 | B15C11 | N | 10/7/2002 | 18.5 | 0.31 | 0.00358 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B15C75 | N | 12/26/2002 | 50.8 | 0.53 | 0.0181 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B17RK1 | N | 10/13/2003 | 57.2 | 0.65 | 0.0171 | |
| Uranium-234 | 300 Area Spring 42-2 | B17RJ2 | N | 10/13/2003 | 69.8 | 0.78 | 0.0059 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B1BFV8 | N | 10/25/2004 | 18.6 | 0.48 | 0.0337 | |
| Uranium-234 | 300 Area Spring 41-9 | B1BH15 | N | 10/25/2004 | 2.58 | 0.17 | 0.0205 | |
| Uranium-234 | 300 Area Spring 42-2 | B1BFP4 | N | 10/25/2004 | 24.3 | 0.55 | 0.0084 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B12RN6 | Y | 8/27/2001 | 38.5 | | | |
| Uranium-234 | 300 Area Spring 42-2 | B12RN5 | Y | 8/27/2001 | 10.3 | | | |

### A.3.9 Uranium-235 Seep Water Data

There were 28 seep water samples of uranium-235 at the 300 Area location. The samples were collected between 8/29/1994 and 10/6/2005. The values are plotted in Figure A.20 and the data are presented in Table A.21.

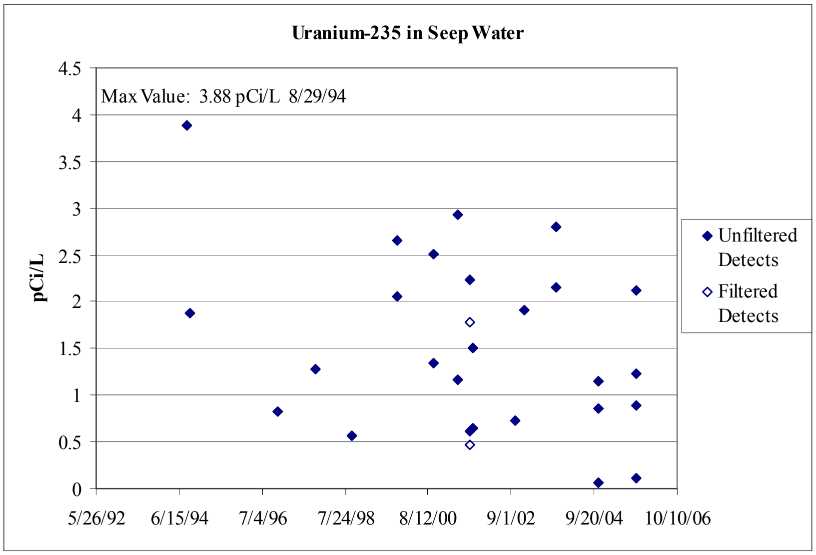


**Figure A.20**. Uranium-235 in Seep Water Associated with the 300 Area

**Table A.21**. Uranium-235 Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| **Uranium-235** | **300 Area Spring 42-2** | **B0C5G4** | **N** | **8/29/1994** | **3.88** | **0.315** | | |
| Uranium-235 | 300 Area Spring 42-2 | B0C5G6 | N | 9/25/1994 | 1.87 | 0.419 | | |
| Uranium-235 | 300 Area Spring 42-2 | B0J5D0 | N | 11/21/1996 | 0.826 | 0.0831 | | |
| Uranium-235 | 300 Area Spring 42-2 | B0M7W3 | N | 10/27/1997 | 1.28 | 0.0985 | | |
| Uranium-235 | 300 Area Spring 42-2 | B0PXB3 | N | 9/22/1998 | 0.567 | 0.0658 | | |
| Uranium-235 | 300 Area Spr DR 42-2 | B0WP28 | N | 11/1/1999 | 2.65 | 1.3 | 1.31 | |
| Uranium-235 | 300 Area Spring 42-2 | B0WNY3 | N | 11/1/1999 | 2.06 | 0.14 | 0.0182 | |
| Uranium-235 | 300 Area Spring 42-2 | B10913 | N | 9/27/2000 | 1.35 | 0.087 | 0.00384 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B10949 | N | 9/27/2000 | 2.51 | 1.2 | 0.429 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B11W57 | N | 5/3/2001 | 2.93 | 0.12 | 0.0083 | |
| Uranium-235 | 300 Area Spring 42-2 | B11W38 | N | 5/10/2001 | 1.17 | 0.17 | 0.0237 | |
| Uranium-235 | 300 Area Spring 42-2 | B12RM1 | N | 8/27/2001 | 0.615 | 0.062 | 0.00417 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B12RM6 | N | 8/27/2001 | 2.24 | 0.11 | 0.0089 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B12XK2 | N | 9/17/2001 | 1.5 | 0.09 | 0.0116 | |
| Uranium-235 | 300 Area Spring 42-2 | B12XK1 | N | 9/18/2001 | 0.655 | 0.061 | 0.011 | |
| Uranium-235 | 300 Area Spring 42-2 | B15C11 | N | 10/7/2002 | 0.726 | 0.062 | 0.00358 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B15C75 | N | 12/26/2002 | 1.91 | 0.1 | 0.00373 | |
| Uranium-235 | 300 Area Spring 42-2 | B17RJ2 | N | 10/13/2003 | 2.8 | 0.16 | 0.016 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B17RK1 | N | 10/13/2003 | 2.16 | 0.13 | 0.0135 | |
| Uranium-235 | 300 Area Spring 41-9 | B1BH15 | N | 10/25/2004 | 0.0576 | 0.026 | 0.00754 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B1BFV8 | N | 10/25/2004 | 0.851 | 0.1 | 0.0291 | |
| Uranium-235 | 300 Area Spring 42-2 | B1BFP4 | N | 10/25/2004 | 1.15 | 0.12 | 0.0084 | |
| Uranium-235 | 300 Area Spr DR 42-2 | | N | 10/6/2005 | 2.12 | 0.12 | 0.0116 | |
| Uranium-235 | 300 Area Spring 41-9 | | N | 10/6/2005 | 0.109 | 0.028 | 0.0101 | |
| Uranium-235 | 300 Area Spring 42-7 | | N | 10/6/2005 | 0.89 | 0.088 | 0.0229 | |
| Uranium-235 | 300 Area Spring 42-2 | | N | 10/6/2005 | 1.23 | 0.093 | 0.0138 | |
| Uranium-235 | 300 Area Spring 42-2 | B12RN5 | Y | 8/27/2001 | 0.4707545 | | | |
| Uranium-235 | 300 Area Spr DR 42-2 | B12RN6 | Y | 8/27/2001 | 1.7772766 | | | |

## A.3.10 Uranium-238 Seep Water Data

There were 25 seep water samples of uranium-238 at the 300 Area location. The samples were collected between 8/29/1994 and 10/26/2004. The values are plotted in Figure A.21 and the data are presented in Table A.22.

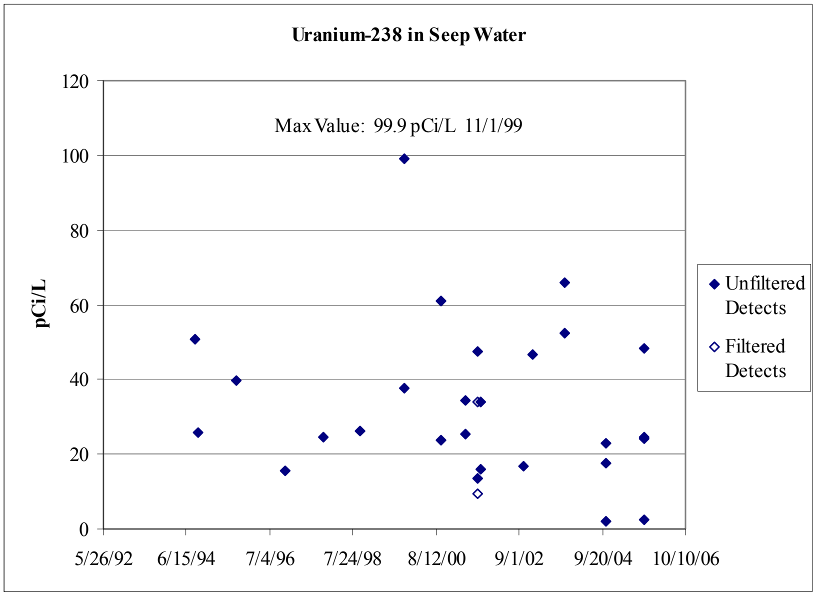


**Figure A.21**. Uranium-238 in Seep Water Associated with the 300 Area

**Table A.22**. Uranium-238 Data in Seep Water in the 300 Area

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-238 | 300 Area Spring 42-2 | B0C5G4 | N | 8/29/1994 | 50.9 | 1.14 | | |
| Uranium-238 | 300 Area Spring 42-2 | B0C5G6 | N | 9/25/1994 | 25.8 | 1.52 | | |
| Uranium-238 | 300 Area Spring 42-2 | B0G8C1 | N | 9/5/1995 | 39.9 | 0.558 | | |
| Uranium-238 | 300 Area Spring 42-2 | B0J5D0 | N | 11/21/1996 | 15.7 | 0.361 | | |
| Uranium-238 | 300 Area Spring 42-2 | B0M7W3 | N | 10/27/1997 | 24.6 | 0.432 | | |
| Uranium-238 | 300 Area Spring 42-2 | B0PXB3 | N | 9/22/1998 | 26.2 | 0.446 | | |
| Uranium-238 | 300 Area Spring 42-2 | B0WNY3 | N | 11/1/1999 | 37.6 | 0.59 | 0.0345 | |
| **Uranium-238** | **300 Area Spr DR 42-2** | **B0WP28** | **N** | **11/1/1999** | **99.3** | **8.1** | **0.947** | |
| Uranium-238 | 300 Area Spr DR 42-2 | B10949 | N | 9/27/2000 | 61 | 6.2 | 0.429 | |
| Uranium-238 | 300 Area Spring 42-2 | B10913 | N | 9/27/2000 | 23.6 | 0.37 | 0.00384 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B11W57 | N | 5/3/2001 | 34.2 | 0.41 | 0.0083 | |
| Uranium-238 | 300 Area Spring 42-2 | B11W38 | N | 5/10/2001 | 25.3 | 0.77 | 0.027 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B12RM6 | N | 8/27/2001 | 47.5 | 0.5 | 0.0101 | |
| Uranium-238 | 300 Area Spring 42-2 | B12RM1 | N | 8/27/2001 | 13.4 | 0.29 | 0.00417 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B12XK2 | N | 9/17/2001 | 33.8 | 0.43 | 0.00929 | |
| Uranium-238 | 300 Area Spring 42-2 | B12XK1 | N | 9/18/2001 | 16.1 | 0.3 | 0.00794 | |
| Uranium-238 | 300 Area Spring 42-2 | B15C11 | N | 10/7/2002 | 16.8 | 0.3 | 0.00358 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B15C75 | N | 12/26/2002 | 46.6 | 0.51 | 0.0101 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B17RK1 | N | 10/13/2003 | 52.3 | 0.62 | 0.0135 | |

**Table A.22.** (contd)

| Analyte | Sample Site | Sample Number | Filter Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-238 | 300 Area Spring 42-2 | B17RJ2 | N | 10/13/2003 | 65.9 | 0.76 | 0.0202 | |
| Uranium-238 | 300 Area Spring 41-9 | B1BH15 | N | 10/25/2004 | 2.21 | 0.16 | 0.00754 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B1BFV8 | N | 10/25/2004 | 17.7 | 0.47 | 0.0411 | |
| Uranium-238 | 300 Area Spring 42-2 | B1BFP4 | N | 10/25/2004 | 22.8 | 0.53 | 0.0084 | |
| Uranium-238 | 300 Area SPRING 42-7 | | N | 10/6/05 | 24.3 | pCi/L | 0.46 | 0.0256 |
| Uranium-238 | 300 Area SPRING 42-2 | | N | 10/6/05 | 24.7 | pCi/L | 0.42 | 0.00997 |
| Uranium-238 | 300 Area SPRING 41-9 | | N | 10/6/05 | 2.4 | pCi/L | 0.13 | 0.0166 |
| Uranium-238 | 300 Area Spr DR 42-2 | | N | 10/6/05 | 48.3 | pCi/L | 0.55 | 0.0262 |
| Uranium-238 | 300 Area Spring 42-2 | B12RN5 | Y | 8/27/2001 | 9.22 | | | |
| Uranium-238 | 300 Area Spr DR 42-2 | B12RN6 | Y | 8/27/2001 | 34.0 | | | |

## A.4 Pore Water Data

Samples were collected from drive points and aquifer tubes for the analytes tritium, nitrate, uranium, uranium-234, uranium-235, and uranium-238. Because the plots of the data show no difference between the aquifer tube and drive point data, all of the data were used to calculate the summary statistics for pore water.

### A.4.1 Tritium Pore Water Data

There were 45 (3 nondetect) aquifer tube samples of tritium at the 300 Area location and 34 drive point samples. The aquifer tube samples were collected between 4/12/2004 and 9/15/2005. The drive point samples were collected between 9/17/2001 and 9/15/2005. The values are plotted in Figure A.22, and the data are presented in Table A.23.

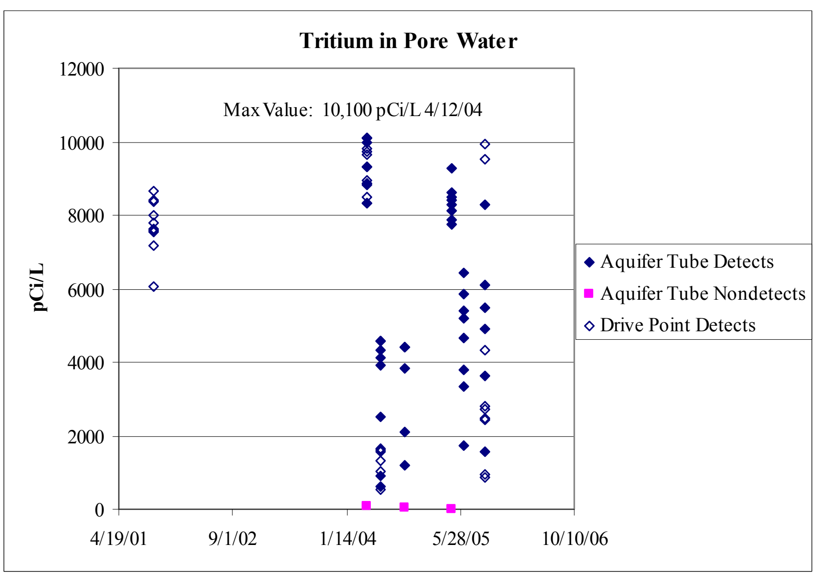


**Figure A.22.** Tritium in Pore Water Associated with the 300 Area

**Table A.23**. Tritium Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Tritium | Aquifer Tube | | N | 4/19/05 | 4.74 | 61 | 143 | U |
| Tritium | Aquifer Tube | B1BC80 | N | 9/24/04 | 44.2 | 66 | 138 | U |
| Tritium | Aquifer Tube | B190Y1 | N | 4/12/04 | 67.4 | 76 | 134 | U |
| Tritium | Aquifer Tube | B19HC2 | N | 6/10/04 | 636 | 110 | 122 | |
| Tritium | Aquifer Tube | B19HC6 | N | 6/10/04 | 911 | 120 | 121 | |
| Tritium | Aquifer Tube | B1BC88 | N | 9/24/04 | 1190 | 140 | 138 | |
| Tritium | Aquifer Tube | | N | 9/15/05 | 1550 | 190 | 327 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 1750 | 160 | 130 | |
| Tritium | Aquifer Tube | B1BCB4 | N | 9/24/04 | 2090 | 180 | 135 | |
| Tritium | Aquifer Tube | B19HD0 | N | 6/10/04 | 2510 | 190 | 120 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 3360 | 220 | 133 | |
| Tritium | Aquifer Tube | | N | 9/15/05 | 3640 | 240 | 325 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 3790 | 230 | 130 | |
| Tritium | Aquifer Tube | B1BC84 | N | 9/24/04 | 3830 | 240 | 147 | |
| Tritium | Aquifer Tube | B19HB4 | N | 6/10/04 | 3920 | 230 | 123 | |
| Tritium | Aquifer Tube | B19HB8 | N | 6/10/04 | 4120 | 240 | 121 | |
| Tritium | Aquifer Tube | B19HD8 | N | 6/10/04 | 4310 | 250 | 122 | |
| Tritium | Aquifer Tube | B1BC92 | N | 9/24/04 | 4410 | 250 | 134 | |
| Tritium | Aquifer Tube | B1BC96 | N | 9/24/04 | 4430 | 250 | 137 | |
| Tritium | Aquifer Tube | B19HB0 | N | 6/10/04 | 4590 | 250 | 121 | |
| Tritium | Aquifer Tube | B19H96 | N | 6/10/04 | 4590 | 250 | 121 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 4640 | 250 | 132 | |
| Tritium | Aquifer Tube | | N | 9/15/05 | 4890 | 270 | 326 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 5180 | 270 | 131 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 5400 | 270 | 130 | |
| Tritium | Aquifer Tube | | N | 9/15/05 | 5470 | 290 | 345 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 5870 | 280 | 133 | |
| Tritium | Aquifer Tube | | N | 9/15/05 | 6100 | 300 | 339 | |
| Tritium | Aquifer Tube | | N | 6/15/05 | 6420 | 290 | 130 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 7760 | 340 | 145 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 7890 | 340 | 144 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 8120 | 340 | 143 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 8290 | 350 | 146 | |
| Tritium | Aquifer Tube | | N | 9/15/05 | 8300 | 340 | 346 | |
| Tritium | Aquifer Tube | B190Y7 | N | 4/12/04 | 8340 | 340 | 138 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 8410 | 350 | 140 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 8500 | 350 | 143 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 8620 | 360 | 145 | |
| Tritium | Aquifer Tube | B190Y9 | N | 4/12/04 | 8840 | 350 | 136 | |
| Tritium | Aquifer Tube | B19101 | N | 4/12/04 | 8860 | 350 | 136 | |
| Tritium | Aquifer Tube | | N | 4/19/05 | 9260 | 370 | 145 | |
| Tritium | Aquifer Tube | B190Y3 | N | 4/12/04 | 9320 | 360 | 138 | |
| Tritium | Aquifer Tube | B190Y5 | N | 4/12/04 | 9340 | 360 | 135 | |
| Tritium | Aquifer Tube | B19103 | N | 4/12/04 | 10000 | 370 | 117 | |
| **Tritium** | **Aquifer Tube** | **B19105** | **N** | **4/12/04** | **10100** | **370** | **121** | |
| Tritium | Drive Point | B19H48 | N | 6/10/04 | 546 | 100 | 122 | |
| Tritium | Drive Point | | N | 9/15/05 | 849 | 160 | 323 | |
| Tritium | Drive Point | | N | 9/15/05 | 951 | 170 | 323 | |
| Tritium | Drive Point | B19H56 | N | 6/10/04 | 1030 | 120 | 118 | |
| Tritium | Drive Point | B19H32 | N | 6/10/04 | 1330 | 150 | 122 | |
| Tritium | Drive Point | B19H40 | N | 6/10/04 | 1580 | 160 | 124 | |
| Tritium | Drive Point | B19H28 | N | 6/10/04 | 1600 | 150 | 122 | |
| Tritium | Drive Point | B19H44 | N | 6/10/04 | 1660 | 160 | 121 | |
| Tritium | Drive Point | | N | 9/15/05 | 2440 | 210 | 325 | |
| Tritium | Drive Point | | N | 9/15/05 | 2490 | 210 | 326 | |

**Table A.23**. (contd)

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Tritium | Drive Point | | N | 9/15/05 | 2720 | 220 | 323 | |
| Tritium | Drive Point | | N | 9/15/05 | 2800 | 220 | 325 | |
| Tritium | Drive Point | | N | 9/15/05 | 4310 | 250 | 324 | |
| Tritium | Drive Point | B12XK8 | N | 9/17/01 | 6060 | 220 | 211 | |
| Tritium | Drive Point | B12XL2 | N | 9/17/01 | 7160 | 240 | 212 | |
| Tritium | Drive Point | B12XK3 | N | 9/18/01 | 7560 | 250 | 212 | |
| Tritium | Drive Point | B12XK9 | N | 9/17/01 | 7590 | 250 | 210 | |
| Tritium | Drive Point | B12XL1 | N | 9/17/01 | 7620 | 250 | 209 | |
| Tritium | Drive Point | B12XL0 | N | 9/17/01 | 7800 | 250 | 210 | |
| Tritium | Drive Point | B12XK4 | N | 9/18/01 | 8020 | 250 | 208 | |
| Tritium | Drive Point | B190X5 | N | 4/12/04 | 8340 | 340 | 118 | |
| Tritium | Drive Point | B12XK5 | N | 9/18/01 | 8390 | 260 | 209 | |
| Tritium | Drive Point | B12XK6 | N | 9/18/01 | 8420 | 260 | 209 | |
| Tritium | Drive Point | B190X9 | N | 4/12/04 | 8510 | 340 | 118 | |
| Tritium | Drive Point | B12XK7 | N | 9/18/01 | 8660 | 260 | 212 | |
| Tritium | Drive Point | B190W1 | N | 4/12/04 | 8880 | 350 | 118 | |
| Tritium | Drive Point | B190W9 | N | 4/12/04 | 8960 | 350 | 120 | |
| Tritium | Drive Point | | N | 9/15/05 | 9530 | 360 | 344 | |
| Tritium | Drive Point | B190W3 | N | 4/12/04 | 9630 | 360 | 117 | |
| Tritium | Drive Point | B190X1 | N | 4/12/04 | 9720 | 360 | 118 | |
| Tritium | Drive Point | B190X3 | N | 4/12/04 | 9820 | 360 | 117 | |
| Tritium | Drive Point | | N | 9/15/05 | 9940 | 360 | 343 | |
| **Tritium** | **Drive Point** | **B190W7** | **N** | **4/12/04** | **10100** | **370** | **118** | |
| **Tritium** | **Drive Point** | **B190W5** | **N** | **4/12/04** | **10100** | **370** | **117** | |

## A.4.2 Nitrate Pore Water Data

There were 23 aquifer tube samples of nitrate at the 300 Area location and 14 drive point samples. The aquifer tube samples were collected between 4/12/2004 and 9/24/2004. The drive point samples were collected between 4/12/2004 and 6/10/2004. The values are plotted in Figure A.23 and the data are presented in Table A.24.

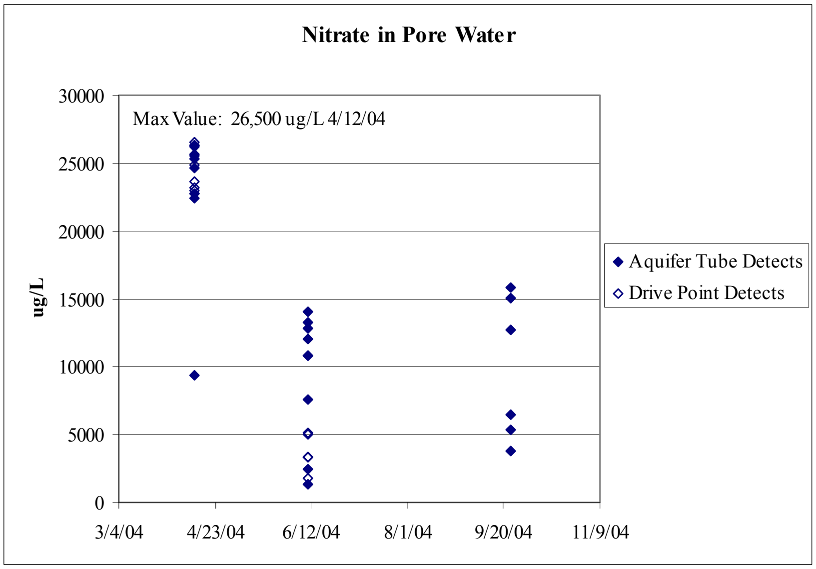


**Figure A.23**. Nitrate in Pore Water Associated with the 300 Area

**Table A.24**. Nitrate Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (µg/L) | Qualifier |
|---|---|---|---|---|---|---|
| Nitrate | Aquifer Tube | B19HC4 | N | 6/10/2004 | 1340 | |
| Nitrate | Aquifer Tube | B19HC8 | N | 6/10/2004 | 2450 | |
| Nitrate | Aquifer Tube | B1BC90 | N | 9/24/2004 | 3780 | |
| Nitrate | Aquifer Tube | B1BC82 | N | 9/24/2004 | 5320 | |
| Nitrate | Aquifer Tube | B1BCB6 | N | 9/24/2004 | 6460 | |
| Nitrate | Aquifer Tube | B19HD2 | N | 6/10/2004 | 7630 | |
| Nitrate | Aquifer Tube | B190Y1 | N | 4/12/2004 | 9350 | |
| Nitrate | Aquifer Tube | B19HB6 | N | 6/10/2004 | 10800 | |
| Nitrate | Aquifer Tube | B19H94 | N | 6/10/2004 | 10800 | |
| Nitrate | Aquifer Tube | B19HC0 | N | 6/10/2004 | 12000 | |
| Nitrate | Aquifer Tube | B1BC86 | N | 9/24/2004 | 12700 | |
| Nitrate | Aquifer Tube | B19HF0 | N | 6/10/2004 | 12800 | |
| Nitrate | Aquifer Tube | B19H98 | N | 6/10/2004 | 13300 | |
| Nitrate | Aquifer Tube | B19HB2 | N | 6/10/2004 | 14000 | |
| Nitrate | Aquifer Tube | B1BC94 | N | 9/24/2004 | 15100 | |
| Nitrate | Aquifer Tube | B1BC98 | N | 9/24/2004 | 15800 | |
| Nitrate | Aquifer Tube | B190Y7 | N | 4/12/2004 | 22400 | |
| Nitrate | Aquifer Tube | B19101 | N | 4/12/2004 | 22800 | |
| Nitrate | Aquifer Tube | B190Y9 | N | 4/12/2004 | 24700 | |
| Nitrate | Aquifer Tube | B190Y3 | N | 4/12/2004 | 25300 | |
| Nitrate | Aquifer Tube | B190Y5 | N | 4/12/2004 | 25500 | |
| Nitrate | Aquifer Tube | B19105 | N | 4/12/2004 | 26200 | |
| Nitrate | Aquifer Tube | B19103 | N | 4/12/2004 | 26300 | |
| Nitrate | Drive Point | B19H50 | N | 6/10/2004 | 1760 | |
| Nitrate | Drive Point | B19H34 | N | 6/10/2004 | 3290 | |
| Nitrate | Drive Point | B19H30 | N | 6/10/2004 | 3320 | |
| Nitrate | Drive Point | B19H58 | N | 6/10/2004 | 3400 | |
| Nitrate | Drive Point | B19H46 | N | 6/10/2004 | 5000 | |
| Nitrate | Drive Point | B19H42 | N | 6/10/2004 | 5080 | |
| Nitrate | Drive Point | B190W1 | N | 4/12/2004 | 22800 | |
| Nitrate | Drive Point | B190X5 | N | 4/12/2004 | 23000 | |
| Nitrate | Drive Point | B190X9 | N | 4/12/2004 | 23200 | |
| Nitrate | Drive Point | B190W9 | N | 4/12/2004 | 23600 | |
| Nitrate | Drive Point | B190W3 | N | 4/12/2004 | 24900 | |
| Nitrate | Drive Point | B190X1 | N | 4/12/2004 | 25600 | |
| Nitrate | Drive Point | B190X3 | N | 4/12/2004 | 26300 | |
| **Nitrate** | **Drive Point** | **B190W5** | **N** | **4/12/2004** | **26500** | |

### A.4.3 Technetium-99 Pore Water Data

There were 8 drive point samples of technetium-99 at the 300 Area location and no aquifer tube samples. The drive point samples were collected between 9/17/2001 and 9/18/2001. The values are plotted in Figure A.24, and the data are presented in Table A.25.

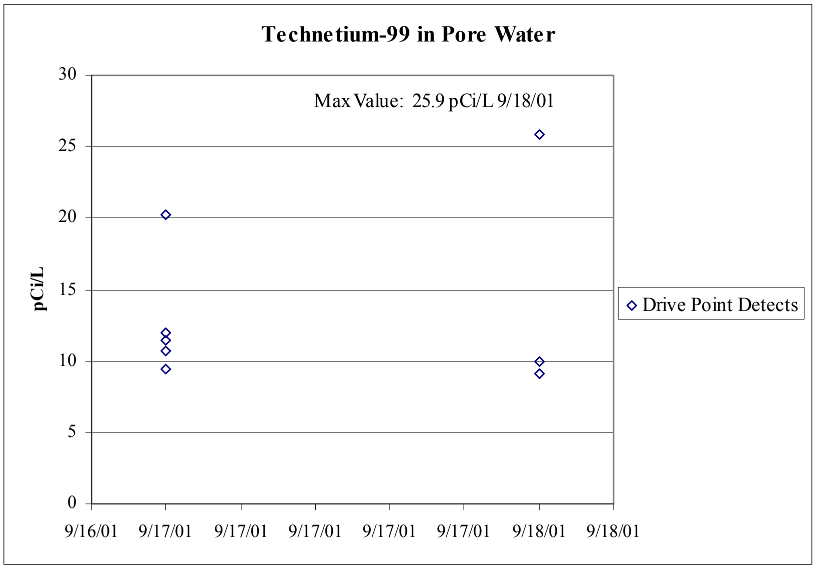


**Figure A.24**. Technetium-99 in Pore Water Associated with the 300 Area

**Table A.25**. Technetium-99 Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Technetium-99 | Drive Point | B12XK6 | N | 9/18/01 | 9.07 | 0.33 | 0.524 | |
| Technetium-99 | Drive Point | B12XK8 | N | 9/17/01 | 9.43 | 0.34 | 0.541 | |
| Technetium-99 | Drive Point | B12XK4 | N | 9/18/01 | 9.93 | 0.38 | 0.606 | |
| Technetium-99 | Drive Point | B12XL2 | N | 9/17/01 | 10.7 | 0.34 | 0.503 | |
| Technetium-99 | Drive Point | B12XL1 | N | 9/17/01 | 11.4 | 0.72 | 1.33 | |
| Technetium-99 | Drive Point | B12XL0 | N | 9/17/01 | 12 | 0.35 | 0.502 | |
| Technetium-99 | Drive Point | B12XK9 | N | 9/17/01 | 20.2 | 0.43 | 0.518 | |
| **Technetium-99** | **Drive Point** | **B12XK5** | **N** | **9/18/01** | **25.9** | **0.75** | **1.08** | |

### A.4.4 Uranium Pore Water Data

Both filtered and unfiltered aquifer tube and drive point data were collected for uranium at the 300 Area. After reviewing the plotted data, the data were combined for calculation of the summary statistics. For the unfiltered samples, there were 103 aquifer tube samples and 229 drive point samples. The unfiltered samples were collected between 9/24/2004 and 2/24/2003. For the filtered samples, there were 205 aquifer tube samples and 190 drive point samples. The filtered samples were collected between 4/12/2004 and 9/15/2005. The values are plotted in Figure A.25, and the data are presented in Table A.26.

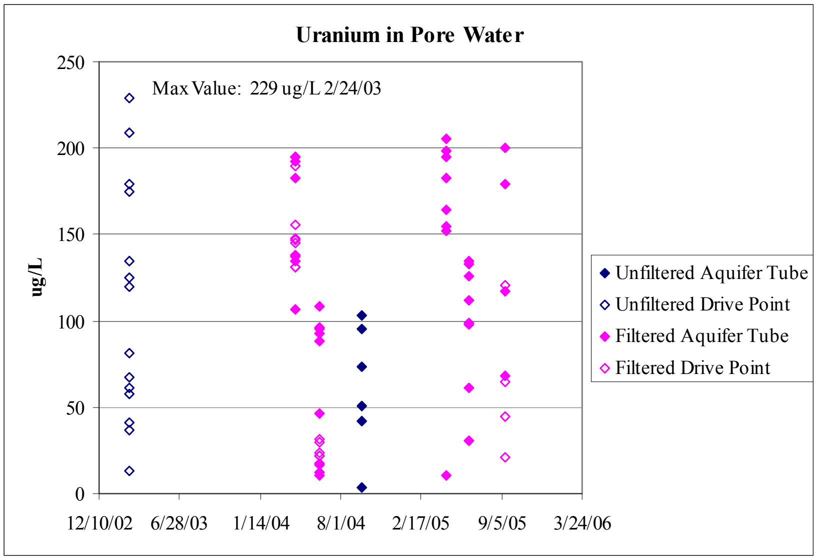


**Figure A.25**. Uranium in Pore Water Associated with the 300 Area

**Table A.26**. Uranium Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (µg/L) | Qualifier |
|---|---|---|---|---|---|---|
| Uranium | Aquifer Tube | | N | 9/24/04 | 3.53 | X |
| Uranium | Aquifer Tube | | N | 9/24/04 | 42 | X |
| Uranium | Aquifer Tube | | N | 9/24/04 | 50.5 | X |
| Uranium | Aquifer Tube | | N | 9/24/04 | 73.7 | X |
| Uranium | Aquifer Tube | | N | 9/24/04 | 94.9 | X |
| Uranium | Aquifer Tube | | N | 9/24/04 | 103 | X |
| Uranium | Drive Point | | N | 2/24/03 | 13 | X |
| Uranium | Drive Point | | N | 2/24/03 | 36.6 | X |
| Uranium | Drive Point | | N | 2/24/03 | 41.4 | X |
| Uranium | Drive Point | | N | 2/24/03 | 58.1 | X |
| Uranium | Drive Point | | N | 2/24/03 | 60.8 | X |
| Uranium | Drive Point | | N | 2/24/03 | 66.9 | X |
| Uranium | Drive Point | | N | 2/24/03 | 81.4 | X |
| Uranium | Drive Point | | N | 2/24/03 | 120 | X |
| Uranium | Drive Point | | N | 2/24/03 | 125 | X |
| Uranium | Drive Point | | N | 2/24/03 | 135 | X |
| Uranium | Drive Point | | N | 2/24/03 | 175 | X |
| Uranium | Drive Point | | N | 2/24/03 | 179 | X |
| Uranium | Drive Point | | N | 2/24/03 | 209 | X |
| **Uranium** | **Drive Point** | | **N** | **2/24/03** | **229** | **X** |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 10.1 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 10.9 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 12 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 17.4 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 30.5 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 46.5 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 61.4 | X |
| Uranium | Aquifer Tube | | Y | 9/15/05 | 68.6 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 88.2 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 92.7 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 95 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 96.3 | X |

**Table A.26.** (contd)

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (µg/L) | Qualifier |
|---|---|---|---|---|---|---|
| Uranium | Aquifer Tube | | Y | 6/15/05 | 97.5 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 99.2 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 107 | X |
| Uranium | Aquifer Tube | | Y | 6/10/04 | 108 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 112 | X |
| Uranium | Aquifer Tube | | Y | 9/15/05 | 117 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 126 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 133 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 135 | X |
| Uranium | Aquifer Tube | | Y | 6/15/05 | 135 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 138 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 152 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 155 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 164 | X |
| Uranium | Aquifer Tube | | Y | 9/15/05 | 179 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 183 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 183 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 192 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 195 | X |
| Uranium | Aquifer Tube | | Y | 4/12/04 | 195 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 195 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 198 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 198 | X |
| Uranium | Aquifer Tube | | Y | 9/15/05 | 200 | X |
| Uranium | Aquifer Tube | | Y | 4/19/05 | 205 | X |
| Uranium | Drive Point | | Y | 6/10/04 | 16.6 | X |
| Uranium | Drive Point | | Y | 9/15/05 | 20.8 | X |
| Uranium | Drive Point | | Y | 6/10/04 | 21.7 | X |
| Uranium | Drive Point | | Y | 6/10/04 | 21.8 | X |
| Uranium | Drive Point | | Y | 6/10/04 | 23.9 | X |
| Uranium | Drive Point | | Y | 6/10/04 | 29.9 | X |
| Uranium | Drive Point | | Y | 6/10/04 | 31.9 | X |
| Uranium | Drive Point | | Y | 9/15/05 | 44.3 | X |
| Uranium | Drive Point | | Y | 9/15/05 | 64.8 | X |
| Uranium | Drive Point | | Y | 9/15/05 | 121 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 131 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 131 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 137 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 145 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 147 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 148 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 156 | X |
| Uranium | Drive Point | | Y | 4/12/04 | 190 | X |

## A.4.5 Uranium-234 Pore Water Data

There were 22 aquifer tube samples of uranium-234 at the 300 Area location and 25 drive point samples. The aquifer tube samples were collected between 4/12/2004 and 9/24/2004. The drive point samples were collected between 9/17/2001 and 6/10/2004. The values are plotted in Figure A.26, and the data are presented in Table A.27.

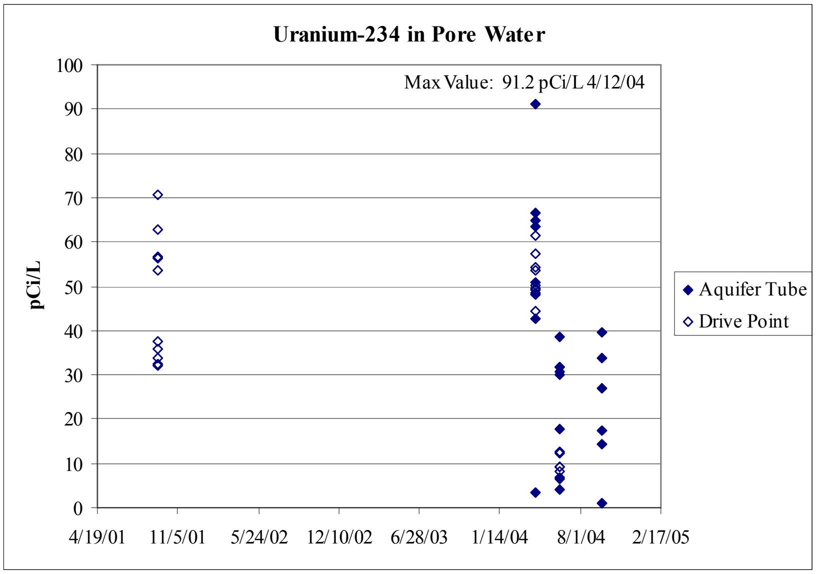


**Figure A.26**. Uranium-234 in Pore Water Associated with the 300 Area

**Table A.27**. Uranium-234 Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-234 | Aquifer Tube | B190Y9 | N | 4/12/04 | 64.8 | 0.57 | 0.00339 | |
| **Uranium-234** | **Aquifer Tube** | **B190Y7** | **N** | **4/12/04** | **91.2** | **0.94** | **0.0636** | |
| Uranium-234 | Aquifer Tube | B19105 | N | 4/12/04 | 48.2 | 0.52 | 0.0325 | |
| Uranium-234 | Aquifer Tube | B19101 | N | 4/12/04 | 42.6 | 0.52 | 0.0118 | |
| Uranium-234 | Aquifer Tube | B19103 | N | 4/12/04 | 50.7 | 0.58 | 0.012 | |
| Uranium-234 | Aquifer Tube | B190Y3 | N | 4/12/04 | 63.6 | 0.62 | 0.0228 | |
| Uranium-234 | Aquifer Tube | B190Y1 | N | 4/12/04 | 3.37 | 0.16 | 0.032 | |
| Uranium-234 | Aquifer Tube | B190Y5 | N | 4/12/04 | 66.6 | 0.61 | 0.04 | |
| Uranium-234 | Aquifer Tube | B19HD8 | N | 6/10/04 | 30.7 | 0.51 | 0.0166 | |
| Uranium-234 | Aquifer Tube | B19HB8 | N | 6/10/04 | 31.8 | 0.7 | 0.033 | |
| Uranium-234 | Aquifer Tube | B19HB4 | N | 6/10/04 | 38.6 | 0.51 | 0.0174 | |
| Uranium-234 | Aquifer Tube | B19HD0 | N | 6/10/04 | 17.6 | 0.35 | 0.0291 | |
| Uranium-234 | Aquifer Tube | B19HC2 | N | 6/10/04 | 4.11 | 0.19 | 0.0159 | |
| Uranium-234 | Aquifer Tube | B19HC6 | N | 6/10/04 | 6.54 | 0.23 | 0.00565 | |
| Uranium-234 | Aquifer Tube | B19H96 | N | 6/10/04 | 31.7 | 0.49 | 0.00523 | |
| Uranium-234 | Aquifer Tube | B19HB0 | N | 6/10/04 | 30 | 0.44 | 0.0116 | |
| Uranium-234 | Aquifer Tube | B1BCB4 | N | 9/24/04 | 17.3 | 0.39 | 0.0304 | |
| Uranium-234 | Aquifer Tube | B1BC96 | N | 9/24/04 | 33.8 | 0.44 | 0.0105 | |
| Uranium-234 | Aquifer Tube | B1BC92 | N | 9/24/04 | 39.6 | 0.59 | 0.0237 | |
| Uranium-234 | Aquifer Tube | B1BC84 | N | 9/24/04 | 27 | 0.4 | 0.0101 | |
| Uranium-234 | Aquifer Tube | B1BC80 | N | 9/24/04 | 1.09 | 0.087 | 0.00969 | |
| Uranium-234 | Aquifer Tube | B1BC88 | N | 9/24/04 | 14.4 | 0.34 | 0.0169 | |
| Uranium-234 | Drive Point | B12XK8 | N | 9/17/01 | 35.7 | 0.52 | 0.0107 | |
| Uranium-234 | Drive Point | B12XK9 | N | 9/17/01 | 53.7 | 0.6 | 0.013 | |
| Uranium-234 | Drive Point | B12XL0 | N | 9/17/01 | 56.6 | 0.6 | 0.0137 | |
| Uranium-234 | Drive Point | B12XL1 | N | 9/17/01 | 56.3 | 0.62 | 0.0116 | |
| Uranium-234 | Drive Point | B12XL2 | N | 9/17/01 | 70.5 | 0.66 | 0.0131 | |
| Uranium-234 | Drive Point | B12XK3 | N | 9/18/01 | 62.8 | 0.62 | 0.0121 | |
| Uranium-234 | Drive Point | B12XK4 | N | 9/18/01 | 32.3 | 0.46 | 0.0125 | |
| Uranium-234 | Drive Point | B12XK5 | N | 9/18/01 | 33.7 | 0.57 | 0.0188 | |
| Uranium-234 | Drive Point | B12XK6 | N | 9/18/01 | 32.2 | 0.52 | 0.0196 | |
| Uranium-234 | Drive Point | B12XK7 | N | 9/18/01 | 37.4 | 0.5 | 0.0219 | |

**Table A.27.** (contd)

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Uranium-234 | Drive Point | B190W3 | N | 4/12/04 | 48.5 | 0.49 | 0.0175 | |
| Uranium-234 | Drive Point | B190W5 | N | 4/12/04 | 53.6 | 0.67 | 0.0155 | |
| Uranium-234 | Drive Point | B190W1 | N | 4/12/04 | 49.6 | 0.52 | 0.00997 | |
| Uranium-234 | Drive Point | B190W7 | N | 4/12/04 | 50.1 | 0.57 | 0.0152 | |
| Uranium-234 | Drive Point | B190X1 | N | 4/12/04 | 54.3 | 0.55 | 0.0212 | |
| Uranium-234 | Drive Point | B190W9 | N | 4/12/04 | 44.5 | 0.48 | 0.0157 | |
| Uranium-234 | Drive Point | B190X3 | N | 4/12/04 | 49.2 | 0.51 | 0.0136 | |
| Uranium-234 | Drive Point | B190X5 | N | 4/12/04 | 61.5 | 0.79 | 0.0197 | |
| Uranium-234 | Drive Point | B190X9 | N | 4/12/04 | 57.4 | 0.61 | 0.0125 | |
| Uranium-234 | Drive Point | B19H28 | N | 6/10/04 | 9.19 | 0.29 | 0.0296 | |
| Uranium-234 | Drive Point | B19H32 | N | 6/10/04 | 8.1 | 0.25 | 0.0174 | |
| Uranium-234 | Drive Point | B19H40 | N | 6/10/04 | 12.3 | 0.28 | 0.0118 | |
| Uranium-234 | Drive Point | B19H44 | N | 6/10/04 | 12.7 | 0.29 | 0.0122 | |
| Uranium-234 | Drive Point | B19H48 | N | 6/10/04 | 9.15 | 0.23 | 0.0256 | |
| Uranium-234 | Drive Point | B19H56 | N | 6/10/04 | 6.83 | 0.2 | 0.0175 | |

### A.4.6 Uranium-235 Pore Water Data

There were 28 aquifer tube samples of uranium-235 at the 300 Area location and 35 drive point samples. The aquifer tube samples were collected between 4/12/2004 and 9/29/2005. The drive point samples were collected between 9/17/2001 and 9/29/2005. The values are plotted in Figure A.27, and the data are presented in Table A.28.

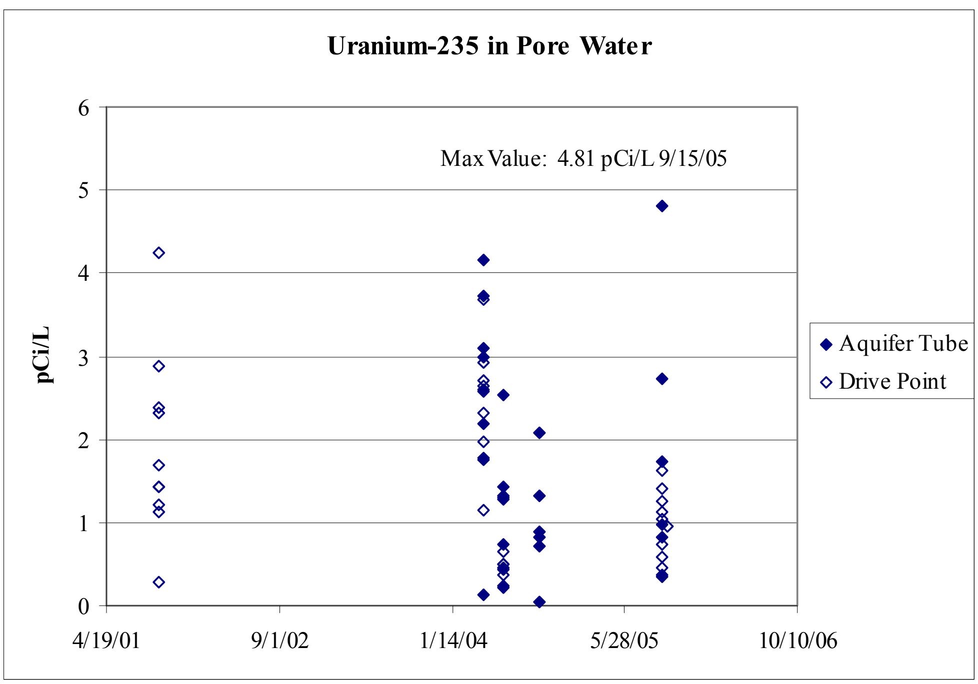


**Figure A.27.** Uranium-235 in Pore Water Associated with the 300 Area

**Table A.28**. Uranium-235 Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Aquifer Tube | B1BC80 | N | 9/24/04 | 0.0451 | 0.018 | 0.0134 | |
| Uranium-235 | Aquifer Tube | B190Y1 | N | 4/12/04 | 0.124 | 0.031 | 0.019 | |
| Uranium-235 | Aquifer Tube | B19HC2 | N | 6/10/04 | 0.211 | 0.043 | 0.00586 | |
| Uranium-235 | Aquifer Tube | | N | 9/15/05 | 0.365 | 0.051 | 0.00991 | |
| Uranium-235 | Aquifer Tube | B19HC6 | N | 6/10/04 | 0.455 | 0.062 | 0.00565 | |
| Uranium-235 | Aquifer Tube | B1BC88 | N | 9/24/04 | 0.713 | 0.075 | 0.0154 | |
| Uranium-235 | Aquifer Tube | B19HD0 | N | 6/10/04 | 0.731 | 0.072 | 0.0162 | |
| Uranium-235 | Aquifer Tube | | N | 9/15/05 | 0.822 | 0.072 | 0.0043 | |
| Uranium-235 | Aquifer Tube | B1BCB4 | N | 9/24/04 | 0.829 | 0.085 | 0.02 | |
| Uranium-235 | Aquifer Tube | B1BC84 | N | 9/24/04 | 0.882 | 0.072 | 0.00397 | |
| Uranium-235 | Aquifer Tube | | N | 9/15/05 | 0.982 | 0.077 | 0.0117 | |
| Uranium-235 | Aquifer Tube | B19HD8 | N | 6/10/04 | 1.28 | 0.1 | 0.00575 | |
| Uranium-235 | Aquifer Tube | B19HB8 | N | 6/10/04 | 1.31 | 0.14 | 0.0217 | |
| Uranium-235 | Aquifer Tube | B19H96 | N | 6/10/04 | 1.33 | 0.1 | 0.0142 | |
| Uranium-235 | Aquifer Tube | B1BC96 | N | 9/24/04 | 1.33 | 0.087 | 0.00388 | |
| Uranium-235 | Aquifer Tube | B19HB0 | N | 6/10/04 | 1.42 | 0.095 | 0.0116 | |
| Uranium-235 | Aquifer Tube | | N | 9/15/05 | 1.74 | 0.095 | 0.0102 | |
| Uranium-235 | Aquifer Tube | B19101 | N | 4/12/04 | 1.78 | 0.11 | 0.0118 | |
| Uranium-235 | Aquifer Tube | B1BC92 | N | 9/24/04 | 2.08 | 0.14 | 0.00597 | |
| Uranium-235 | Aquifer Tube | B190Y3 | N | 4/12/04 | 2.18 | 0.12 | 0.0112 | |
| Uranium-235 | Aquifer Tube | B19HB4 | N | 6/10/04 | 2.53 | 0.13 | 0.0154 | |
| Uranium-235 | Aquifer Tube | B190Y5 | N | 4/12/04 | 2.57 | 0.12 | 0.021 | |
| Uranium-235 | Aquifer Tube | | N | 9/15/05 | 2.73 | 0.14 | 0.00466 | |
| Uranium-235 | Aquifer Tube | B19105 | N | 4/12/04 | 2.98 | 0.13 | 0.0166 | |
| Uranium-235 | Aquifer Tube | B19103 | N | 4/12/04 | 3.1 | 0.14 | 0.00443 | |
| Uranium-235 | Aquifer Tube | B190Y7 | N | 4/12/04 | 3.73 | 0.19 | 0.0436 | |
| Uranium-235 | Aquifer Tube | B190Y9 | N | 4/12/04 | 4.15 | 0.14 | 0.00339 | |
| **Uranium-235** | **Aquifer Tube** | | **N** | **9/15/05** | **4.81** | **0.2** | **0.0147** | |
| Uranium-235 | Drive Point | B19H56 | N | 6/10/04 | 0.228 | 0.037 | 0.0107 | |
| Uranium-235 | Drive Point | B12XK7 | N | 9/18/01 | 0.292 | 0.045 | 0.00461 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 0.351 | 0.045 | 0.00822 | |
| Uranium-235 | Drive Point | B19H28 | N | 6/10/04 | 0.374 | 0.059 | 0.0166 | |
| Uranium-235 | Drive Point | B19H48 | N | 6/10/04 | 0.425 | 0.051 | 0.0158 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 0.463 | 0.049 | 0.0101 | |
| Uranium-235 | Drive Point | B19H32 | N | 6/10/04 | 0.496 | 0.061 | 0.00508 | |
| Uranium-235 | Drive Point | B19H40 | N | 6/10/04 | 0.499 | 0.057 | 0.00435 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 0.577 | 0.056 | 0.00363 | |
| Uranium-235 | Drive Point | B19H44 | N | 6/10/04 | 0.656 | 0.066 | 0.0122 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 0.741 | 0.064 | 0.0107 | |
| Uranium-235 | Drive Point | | N | 9/29/05 | 0.959 | 0.085 | 0.00515 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 1.03 | 0.075 | 0.0101 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 1.12 | 0.076 | 0.00885 | |
| Uranium-235 | Drive Point | B12XK9 | N | 9/17/01 | 1.13 | 0.087 | 0.0045 | |
| Uranium-235 | Drive Point | B190X3 | N | 4/12/04 | 1.15 | 0.077 | 0.00351 | |
| Uranium-235 | Drive Point | B12XK4 | N | 9/18/01 | 1.21 | 0.088 | 0.00435 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 1.26 | 0.12 | 0.0207 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 1.41 | 0.096 | 0.0119 | |
| Uranium-235 | Drive Point | B12XK6 | N | 9/18/01 | 1.43 | 0.11 | 0.00573 | |
| Uranium-235 | Drive Point | B12XK5 | N | 9/18/01 | 1.43 | 0.12 | 0.00653 | |
| Uranium-235 | Drive Point | | N | 9/15/05 | 1.63 | 0.1 | 0.0118 | |
| Uranium-235 | Drive Point | B12XK8 | N | 9/17/01 | 1.7 | 0.11 | 0.00515 | |
| Uranium-235 | Drive Point | B190W5 | N | 4/12/04 | 1.75 | 0.12 | 0.0155 | |
| Uranium-235 | Drive Point | B190W9 | N | 4/12/04 | 1.98 | 0.1 | 0.0169 | |
| Uranium-235 | Drive Point | B190W1 | N | 4/12/04 | 2.31 | 0.11 | 0.00367 | |
| Uranium-235 | Drive Point | B12XL1 | N | 9/17/01 | 2.32 | 0.13 | 0.0116 | |

**Table A.28.** (contd)

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-235 | Drive Point | B12XL0 | N | 9/17/01 | 2.38 | 0.12 | 0.00432 | |
| Uranium-235 | Drive Point | B190W3 | N | 4/12/04 | 2.6 | 0.11 | 0.00915 | |
| Uranium-235 | Drive Point | B190X5 | N | 4/12/04 | 2.65 | 0.16 | 0.0143 | |
| Uranium-235 | Drive Point | B190X1 | N | 4/12/04 | 2.7 | 0.12 | 0.00939 | |
| Uranium-235 | Drive Point | B12XK3 | N | 9/18/01 | 2.88 | 0.13 | 0.00878 | |
| Uranium-235 | Drive Point | B190X9 | N | 4/12/04 | 2.92 | 0.14 | 0.00434 | |
| Uranium-235 | Drive Point | B190W7 | N | 4/12/04 | 3.69 | 0.16 | 0.012 | |
| Uranium-235 | Drive Point | B12XL2 | N | 9/17/01 | 4.25 | 0.16 | 0.00414 | |

### A.4.7 Uranium-238 Pore Water Data

There were 28 aquifer tube samples of uranium-238 at the 300 Area location and 35 drive point samples. The aquifer tube samples were collected between 4/12/2004 and 9/15/2005. The drive point samples were collected between 9/17/2001 and 9/29/2005. The values are plotted in Figure A.28, and the data are presented in Table A.29.

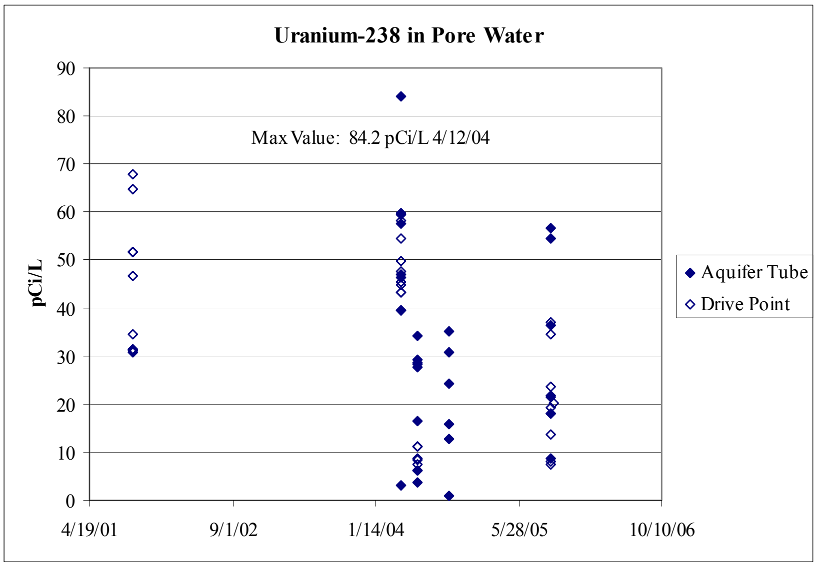


**Figure A.28.** Uranium-238 in Pore Water Associated with the 300 Area

**Table A.29.** Uranium-238 Data in Aquifer Tubes and Drive Points in the 300 Area

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Aquifer Tube | B1BC80 | N | 9/24/04 | 1.06 | 0.086 | 0.0118 | |
| Uranium-238 | Aquifer Tube | B190Y1 | N | 4/12/04 | 3.24 | 0.15 | 0.028 | |
| Uranium-238 | Aquifer Tube | B19HC2 | N | 6/10/04 | 3.75 | 0.18 | 0.00586 | |
| Uranium-238 | Aquifer Tube | B19HC6 | N | 6/10/04 | 6.1 | 0.23 | 0.0153 | |
| Uranium-238 | Aquifer Tube | | N | 9/15/05 | 8.75 | 0.25 | 0.0163 | |
| Uranium-238 | Aquifer Tube | B1BC88 | N | 9/24/04 | 12.8 | 0.32 | 0.00533 | |
| Uranium-238 | Aquifer Tube | B1BCB4 | N | 9/24/04 | 15.9 | 0.37 | 0.02 | |
| Uranium-238 | Aquifer Tube | B19HD0 | N | 6/10/04 | 16.5 | 0.34 | 0.0229 | |
| Uranium-238 | Aquifer Tube | | N | 9/15/05 | 18.2 | 0.34 | 0.0043 | |
| Uranium-238 | Aquifer Tube | | N | 9/15/05 | 21.6 | 0.36 | 0.00848 | |

**Table A.29**. (contd)

| Analyte | Sampled From | Sample Number | Filtered Flag | Sample Date | Value (pCi/L) | Counting Error | MDA | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-238 | Aquifer Tube | B1BC84 | N | 9/24/04 | 24.3 | 0.38 | 0.00827 | |
| Uranium-238 | Aquifer Tube | B19HB0 | N | 6/10/04 | 27.7 | 0.42 | 0.0146 | |
| Uranium-238 | Aquifer Tube | B19HD8 | N | 6/10/04 | 28.3 | 0.49 | 0.012 | |
| Uranium-238 | Aquifer Tube | B19HB8 | N | 6/10/04 | 28.8 | 0.67 | 0.0104 | |
| Uranium-238 | Aquifer Tube | B19H96 | N | 6/10/04 | 29.3 | 0.48 | 0.00523 | |
| Uranium-238 | Aquifer Tube | B1BC96 | N | 9/24/04 | 30.8 | 0.42 | 0.00388 | |
| Uranium-238 | Aquifer Tube | B19HB4 | N | 6/10/04 | 34.4 | 0.48 | 0.0164 | |
| Uranium-238 | Aquifer Tube | B1BC92 | N | 9/24/04 | 35.1 | 0.56 | 0.00597 | |
| Uranium-238 | Aquifer Tube | | N | 9/15/05 | 36.5 | 0.44 | 0.0121 | |
| Uranium-238 | Aquifer Tube | B19101 | N | 4/12/04 | 39.5 | 0.5 | 0.0149 | |
| Uranium-238 | Aquifer Tube | B19103 | N | 4/12/04 | 46.4 | 0.55 | 0.00443 | |
| Uranium-238 | Aquifer Tube | B19105 | N | 4/12/04 | 46.9 | 0.51 | 0.026 | |
| Uranium-238 | Aquifer Tube | | N | 9/15/05 | 54.4 | 0.61 | 0.0134 | |
| Uranium-238 | Aquifer Tube | | N | 9/15/05 | 56.8 | 0.7 | 0.0121 | |
| Uranium-238 | Aquifer Tube | B190Y3 | N | 4/12/04 | 57.5 | 0.59 | 0.024 | |
| Uranium-238 | Aquifer Tube | B190Y5 | N | 4/12/04 | 59.5 | 0.58 | 0.0336 | |
| Uranium-238 | Aquifer Tube | B190Y9 | N | 4/12/04 | 59.9 | 0.55 | 0.00339 | |
| **Uranium-238** | **Aquifer Tube** | **B190Y7** | **N** | **4/12/04** | **84.2** | **0.9** | **0.0436** | |
| Uranium-238 | Drive Point | B19H56 | N | 6/10/04 | 6.11 | 0.19 | 0.0135 | |
| Uranium-238 | Drive Point | B19H32 | N | 6/10/04 | 7.41 | 0.24 | 0.0225 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 7.57 | 0.21 | 0.0153 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 8.15 | 0.21 | 0.0112 | |
| Uranium-238 | Drive Point | B19H28 | N | 6/10/04 | 8.36 | 0.28 | 0.0394 | |
| Uranium-238 | Drive Point | B19H48 | N | 6/10/04 | 8.78 | 0.23 | 0.0256 | |
| Uranium-238 | Drive Point | B19H40 | N | 6/10/04 | 11.1 | 0.27 | 0.0173 | |
| Uranium-238 | Drive Point | B19H44 | N | 6/10/04 | 11.3 | 0.27 | 0.0199 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 13.8 | 0.27 | 0.00363 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 18.1 | 0.31 | 0.0094 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 19.3 | 0.48 | 0.00816 | |
| Uranium-238 | Drive Point | | N | 9/29/05 | 20.2 | 0.39 | 0.00515 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 21.8 | 0.35 | 0.00372 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 23.8 | 0.35 | 0.0172 | |
| Uranium-238 | Drive Point | B12XK6 | N | 9/18/01 | 30.9 | 0.51 | 0.012 | |
| Uranium-238 | Drive Point | B12XK4 | N | 9/18/01 | 31.2 | 0.45 | 0.00435 | |
| Uranium-238 | Drive Point | B12XK5 | N | 9/18/01 | 31.5 | 0.55 | 0.0188 | |
| Uranium-238 | Drive Point | B12XK8 | N | 9/17/01 | 31.6 | 0.49 | 0.0107 | |
| Uranium-238 | Drive Point | B12XK7 | N | 9/18/01 | 34.6 | 0.49 | 0.0188 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 34.6 | 0.47 | 0.00439 | |
| Uranium-238 | Drive Point | | N | 9/15/05 | 37 | 0.49 | 0.0149 | |
| Uranium-238 | Drive Point | B190W9 | N | 4/12/04 | 39.7 | 0.46 | 0.0169 | |
| Uranium-238 | Drive Point | B190W1 | N | 4/12/04 | 43.2 | 0.48 | 0.0126 | |
| Uranium-238 | Drive Point | B190W3 | N | 4/12/04 | 43.3 | 0.46 | 0.0175 | |
| Uranium-238 | Drive Point | B190X3 | N | 4/12/04 | 44.9 | 0.48 | 0.0111 | |
| Uranium-238 | Drive Point | B190W7 | N | 4/12/04 | 45.6 | 0.55 | 0.00443 | |
| Uranium-238 | Drive Point | B12XK9 | N | 9/17/01 | 46.8 | 0.56 | 0.0045 | |
| Uranium-238 | Drive Point | B190X1 | N | 4/12/04 | 47.8 | 0.51 | 0.0136 | |
| Uranium-238 | Drive Point | B190W5 | N | 4/12/04 | 49.9 | 0.65 | 0.0155 | |
| Uranium-238 | Drive Point | B12XL1 | N | 9/17/01 | 51.8 | 0.59 | 0.00459 | |
| Uranium-238 | Drive Point | B12XL0 | N | 9/17/01 | 51.8 | 0.57 | 0.00901 | |
| Uranium-238 | Drive Point | B190X9 | N | 4/12/04 | 54.4 | 0.59 | 0.00904 | |
| Uranium-238 | Drive Point | B190X5 | N | 4/12/04 | 58.2 | 0.77 | 0.0197 | |
| Uranium-238 | Drive Point | B12XK3 | N | 9/18/01 | 64.7 | 0.63 | 0.0121 | |
| Uranium-238 | Drive Point | B12XL2 | N | 9/17/01 | 67.9 | 0.64 | 0.0142 | |

## A.5 Sediment Data

The sediment data were provided by staff from the SESP. Sediment samples are taken as part of the annual Hanford Site monitoring in locations near seeps and other locations along the Columbia River shoreline of the 300 Area.

### A.5.1 Strontium-90 Sediment Data

There were 17 (15 nondetect) sediment samples of strontium-90 at the 300 Area location. The samples were collected between 8/29/2004 and 10/6/2005. The values are plotted in Figure A.29, and the data are presented in Table A.30.

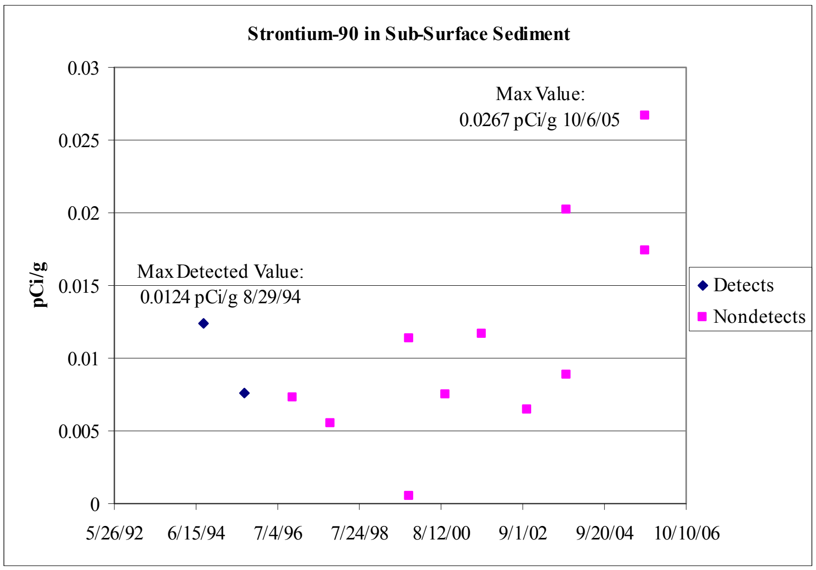


**Figure A.29**. Strontium-90 in Sub-Surface Sediment Associated with the 300 Area

**Table A.30**. Strontium-90 Data in Sub-Surface Sediment in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Strontium-90 | 300 Area Spring 42-2 | B0J5H2 | 11/21/96 | 0.00734 | 0.0105 | | | U |
| Strontium-90 | 300 Area Spring 42-2 | B0M7V3 | 10/27/97 | 0.00547 | 0.00544 | | | U |
| Strontium-90 | 300 Area Spring 42-2 | B0WDL8 | 11/1/99 | 0.0114 | 0.011 | 0.0396 | 74.4 | U |
| Strontium-90 | 300 Area Spr DR 42-2 | B0WDR2 | 11/1/99 | 0.000507 | 0.00076 | 0.0366 | 79.5 | U |
| Strontium-90 | 300 Area Spr DR 42-2 | B10922 | 9/27/00 | 0.00748 | 0.025 | 0.0469 | 71.5 | U |
| Strontium-90 | 300 Area Spring 42-2 | B10908 | 9/27/00 | -0.0122 | 0.026 | 0.0525 | 75.2 | U |
| Strontium-90 | 300 Area Spring 42-2 | B12RL9 | 8/27/01 | 0.0117 | 0.049 | 0.0886 | 75.1 | U |
| Strontium-90 | 300 Area Spr DR 42-2 | B15C47 | 10/7/02 | -0.00709 | 0.025 | 0.0617 | 60.5 | U |
| Strontium-90 | 300 Area Spring 42-2 | B15C07 | 10/7/02 | 0.00649 | 0.028 | 0.0561 | 77 | U |
| Strontium-90 | 300 Area Spring 42-2 | B17J20 | 10/13/03 | 0.0202 | 0.031 | 0.0564 | 68.4 | U |
| Strontium-90 | 300 Area Spr DR 42-2 | B17J59 | 10/13/03 | 0.00886 | 0.023 | 0.0455 | 73.2 | U |
| Strontium-90 | 300 Area Spr DR 42-2 | B1BFR3 | 10/25/04 | -0.0195 | 0.028 | 0.0743 | | U |
| Strontium-90 | 300 Area Spring 42-2 | B1BFN9 | 10/25/04 | -0.0175 | 0.03 | 0.0682 | | U |
| Strontium-90 | 300 Area Spr DR 42-2 | | 10/6/05 | 0.0174 | 0.016 | 0.0339 | 27.5 | U |
| **Strontium-90** | **300 Area Spring 42-2** | | **10/6/05** | **0.0267** | **0.019** | **0.0378** | **29.9** | **U** |
| **Strontium-90** | **300 Area Spring 42-2** | **B0CDM6** | **8/29/94** | **0.0124** | **0.00532** | | | |
| Strontium-90 | 300 Area Spring 42-2 | B0G8W5 | 9/5/95 | 0.0076 | 0.00632 | | | |

## A.5.2 Uranium-234 Sediment Data

There were 18 sediment samples of uranium-234 at the 300 Area location. The samples were collected between 11/1/1999 and 10/25/2004. The values are plotted in Figure A.30, and the data are presented in Table A.31.

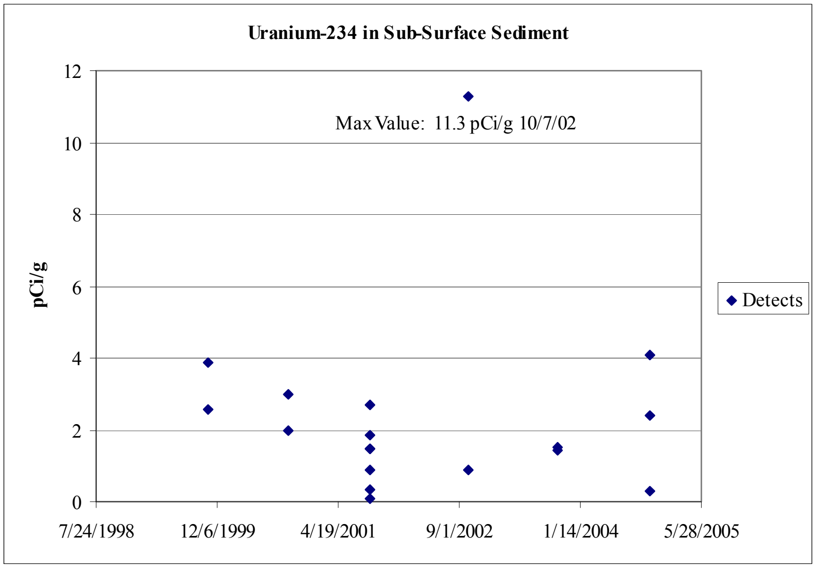


**Figure A.30**. Uranium-234 in Sub-Surface Sediment Associated with the 300 Area

**Table A.31**. Uranium-234 Data in Sub-Surface Sediment in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Uranium-234 | 300 Area Spr DR 42-2 | B0WDR2 | 11/1/99 | 3.89 | 0.12 | 0.0102 | 79.5 | |
| Uranium-234 | 300 Area Spring 42-2 | B0WDL8 | 11/1/99 | 2.56 | 0.099 | 0.01 | 74.4 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B10922 | 9/27/00 | 3.01 | 0.094 | 0.00501 | 71.5 | |
| Uranium-234 | 300 Area Spring 42-2 | B10908 | 9/27/00 | 1.97 | 0.077 | 0.00205 | 75.2 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B12T05 | 8/27/01 | 1.4704455 | | | | |
| Uranium-234 | 300 Area Spring 42-2 | B12T04 | 8/27/01 | 0.896004 | | | | |
| Uranium-234 | 300 Spr 11 | B12T06 | 8/27/01 | 1.4729431 | | | | |
| Uranium-234 | 300 Spr 14 | B12T07 | 8/27/01 | 0.0705564 | | | | |
| Uranium-234 | 300 Area Spring 42-2 | B12RL9 | 8/27/01 | 2.71 | 0.092 | 0.00537 | 75.1 | |
| Uranium-234 | 300 Spr 11 | B12RY9 | 8/27/01 | 1.85 | 0.076 | 0.00433 | 78.3 | |
| Uranium-234 | 300 Spr 14 | B12T01 | 8/27/01 | 0.328 | 0.033 | 0.00564 | 75.6 | |
| **Uranium-234** | **300 Area Spr DR 42-2** | **B15C47** | **10/7/02** | **11.3** | **0.18** | **0.0019** | **60.5** | |
| Uranium-234 | 300 Area Spring 42-2 | B15C07 | 10/7/02 | 0.872 | 0.051 | 0.00198 | 77 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B17J59 | 10/13/03 | 1.52 | 0.075 | 0.0098 | 73.2 | |
| Uranium-234 | 300 Area Spring 42-2 | B17J20 | 10/13/03 | 1.42 | 0.068 | 0.00219 | 68.4 | |
| Uranium-234 | 300 Area Spr DR 42-2 | B1BFR3 | 10/25/04 | 4.07 | 0.1 | 0.00515 | | |
| Uranium-234 | 300 Area Spring 41-9 | B1BH12 | 10/25/04 | 0.279 | 0.028 | 0.00678 | | |
| Uranium-234 | 300 Area Spring 42-2 | B1BFN9 | 10/25/04 | 2.41 | 0.079 | 0.00988 | | |

### A.5.3 Uranium-235 Sediment Data

There were 28 (3 nondetect) sediment samples of uranium-235 at the 300 Area location. The samples were collected between 8/29/1994 and 10/6/2005. The values are plotted in Figure A.31, and the data are presented in Table A.32.

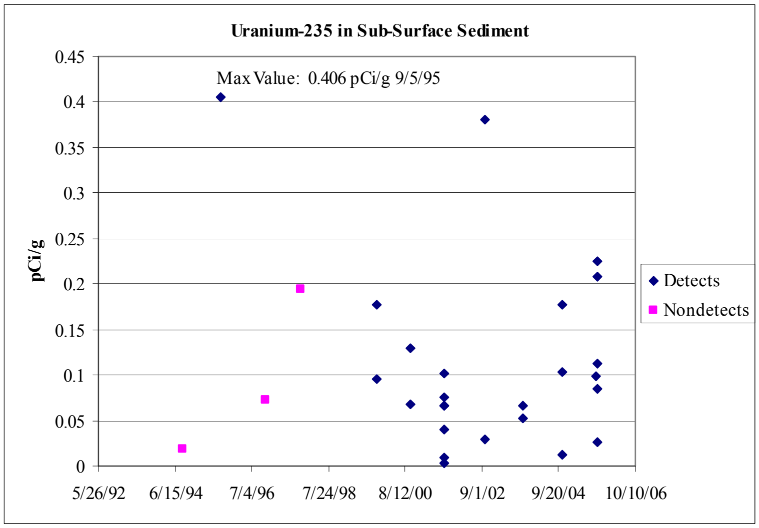


**Figure A.31**. Uranium-235 in Sub-Surface Sediment Associated with the 300 Area

**Table A.32**. Uranium-235 Data in Sub-Surface Sediment in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Uranium-235 | 300 Area Spring 42-2 | B0CDM6 | 8/29/94 | 0.0188 | 0.158 | | | U |
| Uranium-235 | 300 Area Spring 42-2 | B0J5H2 | 11/21/96 | 0.0727 | 0.0705 | | | U |
| Uranium-235 | 300 Area Spring 42-2 | B0M7V3 | 10/27/97 | 0.194 | 0.112 | | | U |
| **Uranium-235** | **300 Area Spring 42-2** | **B0G8W5** | **9/5/95** | **0.406** | **0.16** | | | |
| Uranium-235 | 300 Area Spr DR 42-2 | B0WDR2 | 11/1/99 | 0.177 | 0.025 | 0.0102 | 79.5 | |
| Uranium-235 | 300 Area Spring 42-2 | B0WDL8 | 11/1/99 | 0.0949 | 0.019 | 0.00655 | 74.4 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B10922 | 9/27/00 | 0.129 | 0.019 | 0.00198 | 71.5 | |
| Uranium-235 | 300 Area Spring 42-2 | B10908 | 9/27/00 | 0.0677 | 0.014 | 0.00427 | 75.2 | |
| Uranium-235 | 300 Spr 11 | B12RY9 | 8/27/01 | 0.0757 | 0.015 | 0.00208 | 78.3 | |
| Uranium-235 | 300 Spr 14 | B12T07 | 8/27/01 | 0.0028695 | | | | |
| Uranium-235 | 300 Area Spr DR 42-2 | B12T05 | 8/27/01 | 0.0665435 | | | | |
| Uranium-235 | 300 Spr 11 | B12T06 | 8/27/01 | 0.0657629 | | | | |
| Uranium-235 | 300 Spr 14 | B12T01 | 8/27/01 | 0.00987 | 0.0061 | 0.00222 | 75.6 | |
| Uranium-235 | 300 Area Spring 42-2 | B12T04 | 8/27/01 | 0.0403677 | | | | |
| Uranium-235 | 300 Area Spring 42-2 | B12RL9 | 8/27/01 | 0.102 | 0.018 | 0.00212 | 75.1 | |
| Uranium-235 | 300 Area Spring 42-2 | B15C07 | 10/7/02 | 0.0297 | 0.0096 | 0.00198 | 77 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B15C47 | 10/7/02 | 0.381 | 0.033 | 0.0019 | 60.5 | |
| Uranium-235 | 300 Area Spr DR 42-2 | B17J59 | 10/13/03 | 0.0667 | 0.017 | 0.0128 | 73.2 | |
| Uranium-235 | 300 Area Spring 42-2 | B17J20 | 10/13/03 | 0.052 | 0.013 | 0.00693 | 68.4 | |
| Uranium-235 | 300 Area Spring 41-9 | B1BH12 | 10/25/04 | 0.0119 | 0.0062 | 0.0047 | | |
| Uranium-235 | 300 Area Spr DR 42-2 | B1BFR3 | 10/25/04 | 0.177 | 0.022 | 0.00373 | | |
| Uranium-235 | 300 Area Spring 42-2 | B1BFN9 | 10/25/04 | 0.103 | 0.016 | 0.00547 | | |
| Uranium-235 | 300 Area SHORELINE | | 9/26/05 | 0.0991 | 0.018 | 0.0062 | 27.1 | |
| Uranium-235 | 300 Area SHORELINE | | 9/28/05 | 0.225 | 0.026 | 0.00202 | 17.6 | |
| Uranium-235 | 300 Area Spr DR 42-2 | | 10/6/05 | 0.208 | 0.025 | 0.00198 | 27.5 | |
| Uranium-235 | 300 Area Spring 42-2 | | 10/6/05 | 0.0853 | 0.018 | 0.00249 | 29.9 | |
| Uranium-235 | 300 Area Spring 42-7 | | 10/6/05 | 0.113 | 0.019 | 0.00218 | 28.5 | |
| Uranium-235 | 300 Area Spring 41-9 | | 10/6/05 | 0.0269 | 0.011 | 0.00318 | 33.1 | |

### A.5.4 Uranium-238 Sediment Data

There were 28 sediment samples of uranium-238 at the 300 Area location. The samples were collected between 8/29/1994 and 10/6/2005. The values are plotted in Figure A.32, and the data are presented in Table A.33.

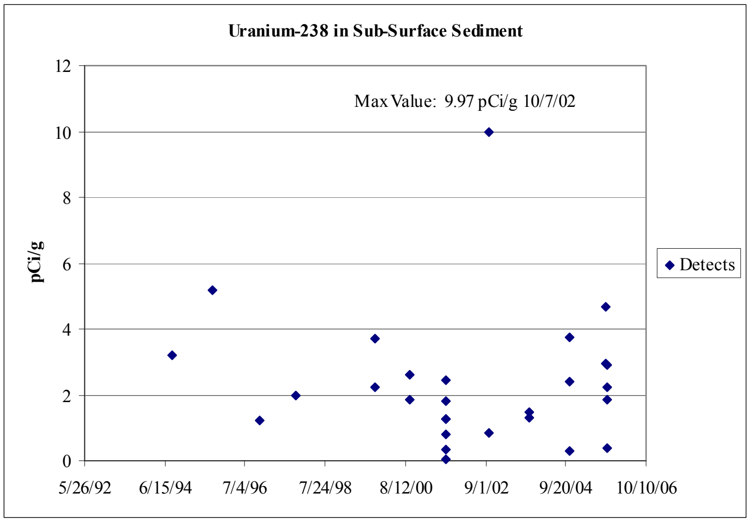


**Figure A.32**. Uranium-238 in Sub-Surface Sediment Associated with the 300 Area

**Table A.33**. Uranium-238 Data in Sub-Surface Sediment in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Uranium-238 | 300 Area Spring 42-2 | B0CDM6 | 8/29/94 | 3.2 | 0.563 | | | |
| Uranium-238 | 300 Area Spring 42-2 | B0G8W5 | 9/5/95 | 5.19 | 0.963 | | | |
| Uranium-238 | 300 Area Spring 42-2 | B0J5H2 | 11/21/96 | 1.22 | 0.46 | | | |
| Uranium-238 | 300 Area Spring 42-2 | B0M7V3 | 10/27/97 | 1.98 | 0.541 | | | |
| Uranium-238 | 300 Area Spring 42-2 | B0WDL8 | 11/1/99 | 2.24 | 0.092 | 0.00946 | 74.4 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B0WDR2 | 11/1/99 | 3.71 | 0.11 | 0.019 | 79.5 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B10922 | 9/27/00 | 2.62 | 0.087 | 0.00198 | 71.5 | |
| Uranium-238 | 300 Area Spring 42-2 | B10908 | 9/27/00 | 1.86 | 0.075 | 0.0052 | 75.2 | |
| Uranium-238 | 300 Area Spring 42-2 | B12T04 | 8/27/01 | 0.785 | | | | |
| Uranium-238 | 300 Spr 14 | B12T07 | 8/27/01 | 0.0506 | | | | |
| Uranium-238 | 300 Area Spr DR 42-2 | B12T05 | 8/27/01 | 1.27 | | | | |
| Uranium-238 | 300 Spr 11 | B12RY9 | 8/27/01 | 1.79 | 0.074 | 0.00208 | 78.3 | |
| Uranium-238 | 300 Spr 11 | B12T06 | 8/27/01 | 1.27 | | | | |
| Uranium-238 | 300 Spr 14 | B12T01 | 8/27/01 | 0.346 | 0.034 | 0.00564 | 75.6 | |
| Uranium-238 | 300 Area Spring 42-2 | B12RL9 | 8/27/01 | 2.45 | 0.088 | 0.00442 | 75.1 | |
| **Uranium-238** | **300 Area Spr DR 42-2** | **B15C47** | **10/7/02** | **9.97** | **0.17** | **0.00515** | **60.5** | |
| Uranium-238 | 300 Area Spring 42-2 | B15C07 | 10/7/02 | 0.832 | 0.049 | 0.00198 | 77 | |
| Uranium-238 | 300 Area Spring 42-2 | B17J20 | 10/13/03 | 1.3 | 0.065 | 0.00749 | 68.4 | |
| Uranium-238 | 300 Area Spr DR 42-2 | B17J59 | 10/13/03 | 1.46 | 0.073 | 0.00845 | 73.2 | |
| Uranium-238 | 300 Area Spring 41-9 | B1BH12 | 10/25/04 | 0.291 | 0.029 | 0.00789 | | |
| Uranium-238 | 300 Area Spr DR 42-2 | B1BFR3 | 10/25/04 | 3.75 | 0.1 | 0.00566 | | |
| Uranium-238 | 300 Area Spring 42-2 | B1BFN9 | 10/25/04 | 2.41 | 0.079 | 0.00668 | | |
| Uranium-238 | 300 Area SHORELINE | | 9/26/05 | 2.96 | 0.097 | 0.00545 | 27.1 | |
| Uranium-238 | 300 Area SHORELINE | | 9/28/05 | 4.66 | 0.12 | 0.00421 | 17.6 | |
| Uranium-238 | 300 Area Spring 41-9 | | 10/6/05 | 0.373 | 0.043 | 0.0165 | 33.1 | |
| Uranium-238 | 300 Area Spring 42-2 | | 10/6/05 | 1.85 | 0.083 | 0.00678 | 29.9 | |
| Uranium-238 | 300 Area Spr DR 42-2 | | 10/6/05 | 2.91 | 0.092 | 0.00787 | 27.5 | |
| Uranium-238 | 300 Area Spring 42-7 | | 10/6/05 | 2.25 | 0.085 | 0.00746 | 28.5 | |

## A.6 Riparian Soil Data

A limited amount of surface soil data were provided by staff from the SESP. Surface soil samples are taken as part of the annual Hanford Site monitoring in locations near air monitoring stations. The locations for the samples are described in *Hanford Site Environmental Report for Calendar Year 2005* (Poston et al. 2006).

### A.6.1 Strontium-90 Surface Soil Data

There were six soil samples of strontium-90 at the 300 Area location. The samples were collected between 8/15/1994 and 8/2/2004. The values are plotted in Figure A.33, and the data are presented in Table A.34.

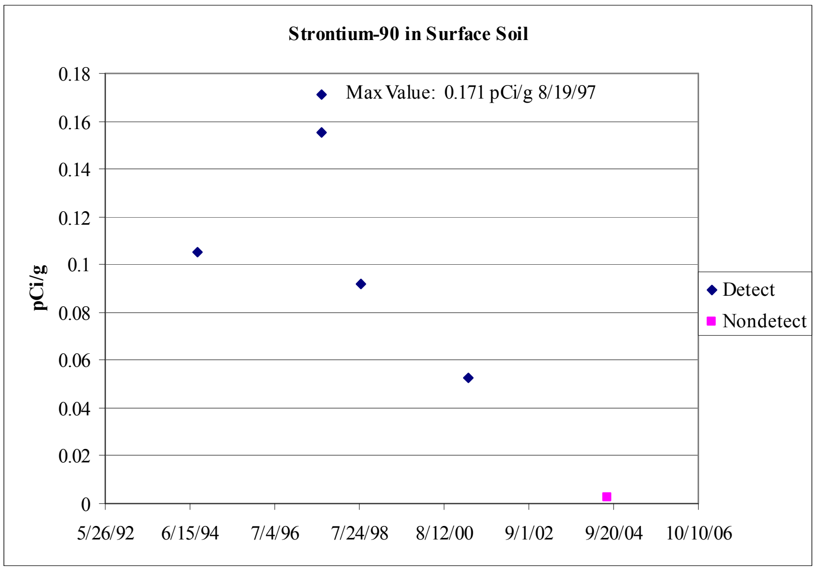


**Figure A.33**. Strontium-90 in Surface Soil Associated with the 300 Area

**Table A.34**. Strontium-90 Data in Surface Soil in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Strontium-90 | North 300 Area | B199H6 | 8/2/2004 | 0.00281 | 0.027 | 0.0428 | 0.3 | U |
| Strontium-90 | North 300 Area | B11JB9 | 3/12/2001 | 0.0525 | 0.025 | 0.0369 | 97.8 | |
| **Strontium-90** | **W. 300 Area Cleanup** | **B0LVQ0** | **8/19/1997** | **0.171** | **0.0133** | | | |
| Strontium-90 | North 300 Area | B0LVQ2 | 8/20/1997 | 0.155 | 0.014 | | | |
| Strontium-90 | North 300 Area | B0P9R1 | 8/4/1998 | 0.0917 | 0.00817 | | | |
| Strontium-90 | North 300 Area | B0BYZ8 | 8/15/1994 | 0.105 | 0.0082 | | | |

### A.6.2 Uranium-234 Surface Soil Data

There were five soil samples of uranium-234 at the 300 Area location. The samples were collected between 8/19/1997 and 8/2/2004. The values are plotted in Figure A.34, and the data are presented in Table A.35.

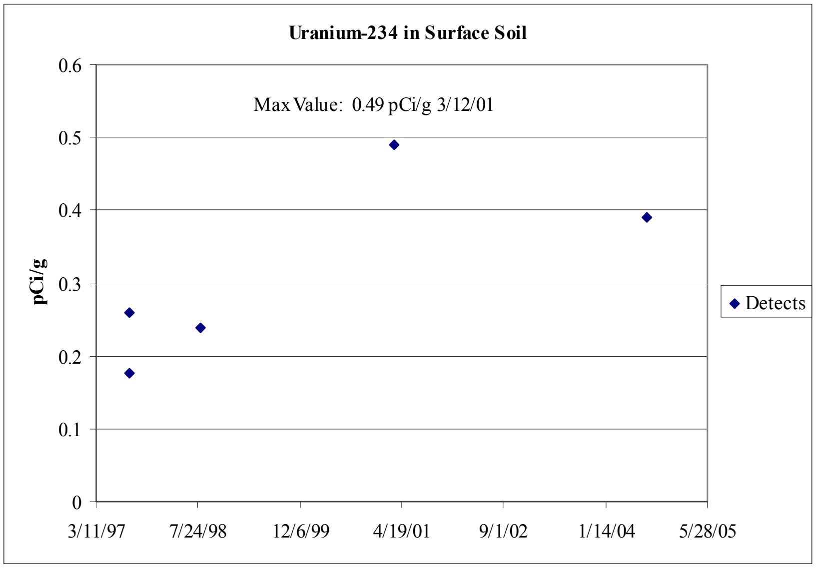


**Figure A.34**. Uranium-234 in Surface Soil Associated with the 300 Area

**Table A.35**. Uranium-234 Data in Surface Soil in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Uranium-234 | W. 300 Area Cleanup | B0LVQ0 | 19-Aug-97 | 0.259 | 0.0129 | | | |
| Uranium-234 | North 300 Area | B0LVQ2 | 20-Aug-97 | 0.177 | 0.0109 | | | |
| Uranium-234 | North 300 Area | B0P9R1 | 04-Aug-98 | 0.238 | 0.0311 | | | |
| **Uranium-234** | **North 300 Area** | **B11JB9** | **12-Mar-01** | **0.49** | **0.046** | **0.0103** | **97.8** | |
| Uranium-234 | North 300 Area | B199H6 | 02-Aug-04 | 0.391 | 0.043 | 0.0031 | 0.3 | |

### A.6.3 Uranium-235 Surface Soil Data

There were six soil samples of uranium-235 at the 300 Area location. The samples were collected between 8/15/1994 and 8/2/2004. The values are plotted in Figure A.35, and the data are presented in Table A.36.

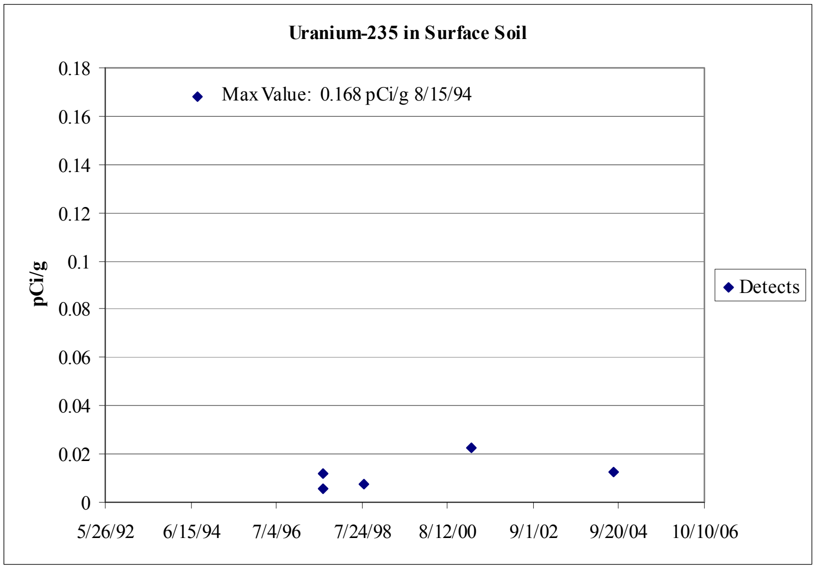


**Figure A.35**. Uranium-235 in Surface Soil Associated with the 300 Area

**Table A.36**. Uranium-235 Data in Surface Soil in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Quali-fier |
|---|---|---|---|---|---|---|---|---|
| Uranium-235 | North 300 Area | B199H6 | 8/2/2004 | 0.0125 | 0.0079 | 0.0031 | 0.3 | |
| Uranium-235 | North 300 Area | B0P9R1 | 8/4/1998 | 0.00744 | 0.00624 | | | |
| Uranium-235 | North 300 Area | B11JB9 | 3/12/2001 | 0.0224 | 0.01 | 0.00711 | 97.8 | |
| Uranium-235 | W. 300 Area Cleanup | B0LVQ0 | 8/19/1997 | 0.0119 | 0.00279 | | | |
| Uranium-235 | North 300 Area | B0LVQ2 | 8/20/1997 | 0.00544 | 0.00198 | | | |
| **Uranium-235** | **North 300 Area** | **B0BYZ8** | **8/15/1994** | **0.168** | **0.0773** | | | |

### A.6.4 Uranium-238 Surface Soil Data

There were six soil samples of uranium-238 at the 300 Area location. The samples were collected between 8/15/1994 and 8/2/2004. The values are plotted in Figure A.36, and the data are presented in Table A.37.

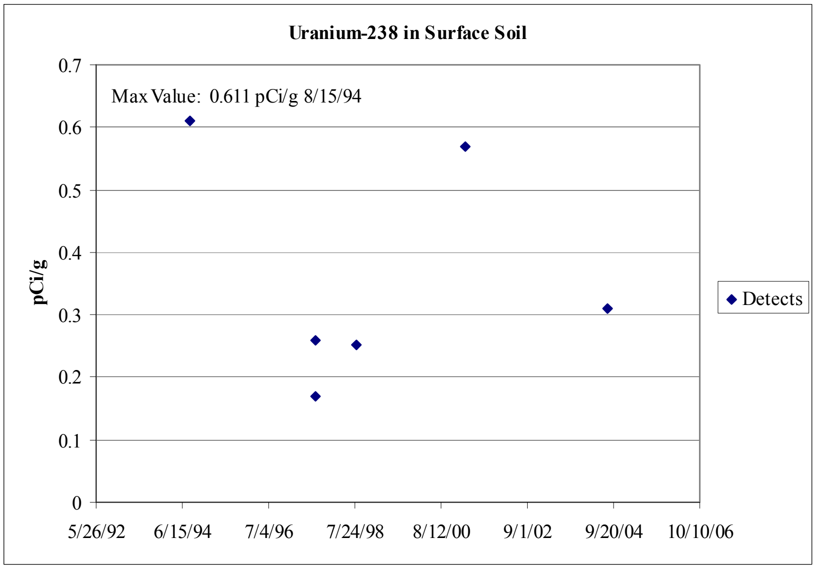


**Figure A.36**. Uranium-238 in Surface Soil Associated with the 300 Area

**Table A.37**. Uranium-238 Data in Surface Soil in the 300 Area

| Analyte | Sample Site | Sample Number | Sample Date | Value (pCi/g) | Counting Error | MDA | % Moisture | Qualifier |
|---|---|---|---|---|---|---|---|---|
| Uranium-238 | North 300 Area | B0LVQ2 | 8/20/1997 | 0.17 | 0.0107 | | | |
| Uranium-238 | W. 300 Area Cleanup | B0LVQ0 | 8/19/1997 | 0.258 | 0.0128 | | | |
| Uranium-238 | North 300 Area | B11JB9 | 3/12/2001 | 0.568 | 0.049 | 0.00889 | 97.8 | |
| Uranium-238 | North 300 Area | B0P9R1 | 8/4/1998 | 0.252 | 0.0319 | | | |
| **Uranium-238** | **North 300 Area** | **B0BYZ8** | **8/15/1994** | **0.611** | **0.255** | | | |
| Uranium-238 | North 300 Area | B199H6 | 8/2/2004 | 0.311 | 0.039 | 0.0031 | 0.3 | |

## A.7 Guide to Data Qualifiers

Many of the tables in the preceding sections contain codes that are qualifiers on the data values. The codes and their meanings are presented in Table A.38.

**Table A.38**. Qualifiers Definitions for the 300-FF-5 Data

| Media | Qualifier | Meaning |
|---|---|---|
| Seep Water | D | Analyte was identified in an analysis at a secondary dilution factor (i.e., dilution factor different than 1.0) |
| Seep Water, Surface Water | J | Value reported is estimated because it was detected at a level less than the Required Detection Limit (RDL) or Practical Quantitation Limit (PQL) and greater than or equal to the MDL. |
| Surface Water | L | Value is between the Method Detection Limit (MDL) and the Contract-Required Quantitation Limit (CRQL) |
| Seep Water, Surface Water | N | Matrix spike duplicate is outside of the control limits |
| Pore Water, Sediment, Seep Water, Soil, Surface Water | U | Indicates constituent was analyzed for but not detected or value reported < 0; value reported < counting error; value reported < total analytical error; value reported <= contract MDL, IDL, Minimum Detectable Activity (MDA), or PQL. For metals, “U” qualifier may be represented by the contract MDL. |
| Seep Water, Surface Water | UN | Characteristics from both “U” and “N” qualifiers exist |
| Pore Water, Surface Water | X | The value-specific reason for this qualifier is provided in the hard copy data report and/or case narrative. Additional values-specific information may also be found in the RESULT COMMENT field for this record. |

## A.8 References


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# Appendix B

# Toxicology Data for the Ecological Assessment

# Appendix B – Toxicology Data for the Ecological Assessment

Toxicological benchmarks were needed for both the radionuclide assessment and the non-radionuclide assessment. Descriptions of the benchmarks selected for both types of assessments are provided below.

## B.1 Radionuclide Benchmark Doses

Benchmark doses for radionuclides are given in the U.S. Department of Energy (DOE) Standard, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002). These doses are compared to the dose in rad/d generated by the ECEM code to calculate an ecological hazard quotient (EHQ) for a radionuclide. The radionuclide benchmark doses are given in Table B.1.

**Table B.1**. Radionuclide Dose Benchmarks

| Species Type | Dose Benchmark (rad/d) |
|---|---|
| Terrestrial Animal | 0.1 |
| Terrestrial Plant | 1.0 |
| Aquatic Animal | 1.0 |

## B.2 Non-Radionuclide Benchmark Doses

Because exposure of receptor species to contaminants in the study area is assumed to be chronic, measurement endpoints (benchmarks) were selected that reflect sublethal effects on subtle aspects of the receptor species' biology, such as adverse effects on behavior, growth, and reproduction, etc. Therefore, the measurement endpoints selected for this assessment include the lowest concentrations of the contaminants of potential concern (COPC) that are known to produce a clinically toxic response in any individual of a group of test organisms (lowest observed adverse effects concentration [LOEC] or level [LOAEL]).

For aquatic receptors and terrestrial plants, LOEC values were sometimes lacking, while $LC_{50}$ (chemical concentration reported to be lethal to 50 percent of the exposed organisms after some period of exposure, usually a few hours to a few days) values were available. In such cases, a LOEC was estimated using 1/15th of the $LC_{50}$ (Suter 1993; Urban and Cook 1986; Tucker and Lietzke 1979). Also, if an $LC_{50}$ value was unavailable, a LOEC was estimated by multiplying the highest concentration tested at which no adverse effects were observed (i.e., no observable effects concentration [NOEC]) by a factor of 15. For terrestrial animal receptors, LOAEL values were generally available and did not need to be estimated from other benchmarks.

These benchmarks were obtained by searching toxicological databases as well as primary and secondary literature sources. Where three or more benchmarks were available, they were averaged. However, where two benchmarks were available, the lower (most conservative) reported value was selected. The benchmarks values for aquatic and terrestrial animals and plants are given in the following sections.

The benchmarks were used for comparison to calculated non-radionuclide body burdens for ecological organisms. For aquatic species, a benchmark water concentration in µg/L was identified. For terrestrial species, the benchmark value was generally a dose in mg/kg/d for animals and a concentration in mg/kg for plants. These aquatic and terrestrial reference values were converted to body burdens in the output units of the ECEM code for calculating the EHQs. The ECEM output units are given in Table B.2.

**Table B.2**. ECEM Output Body Burden Units for Non-Radionuclides

| | Aquatic | | | Terrestrial | |
|---|---|---|---|---|---|
| | Analyte Type | Units | | Analyte Type | Units |
| Animal | Inorganic Chemical | µg/kg dry | Animal | Inorganic Chemical | µg /kg wet |
| | Organic Chemical | µg/g lipid | | Organic Chemical | µg/kg wet |
| Plant | Inorganic Chemical | µg/kg dry | Plant | Inorganic Chemical | µg/kg wet |
| | Organic Chemical | µg/g lipid | | Organic Chemical | µg/kg wet |

## B.2.1 Aquatic Animal Toxicity Benchmarks

For some of the fish receptors and COPCs, benchmarks were from toxicity tests conducted on the same species; however, benchmarks from tests conducted on the same species as the receptor were typically unavailable. In such instances, benchmarks from tests conducted on species in the same family as the receptor (e.g., benchmark for the fathead minnow [*Pimephales promelas*] [test species] applied to largescale/mountain sucker [*Catostomus macrocheilus* and *C. platyrhynchus*] and carp [*Cyprinus carpio*] [receptor species] because all are in the family Cyprinidae) were used, where available. If such benchmarks were unavailable, benchmarks for general fish were used. Fish benchmarks were applied to Woodhouse's toad (*Bufo woodhousii*) tadpole because amphibian benchmarks were largely unavailable.

For some of the aquatic invertebrate receptors and COPCs, benchmarks were from tests conducted on the same type of organism (e.g., benchmark for the pond snail [*Physa heterostropha*] applied to the Columbia River pebblesnail [*Fluminicola columbiana*]). However, benchmarks from tests conducted on the same type of organism as the receptor were typically unavailable. In such instances, benchmarks from test species were applied to receptors based on similarity of physical position in the environment (and hence similar potential for exposure to contaminated media in that environment) (e.g., benchmark for *Corbicula* [a clam species] applied to pebblesnail, mayfly, and mussels because all are bottom dwelling), where such similarities existed. Lacking such similarities and if a benchmark from only one test organism was available, it was applied to all the aquatic invertebrates regardless of physical position in the environment (e.g., benchmark for *Daphnia magna* [water flea] applied to *Hyallela azteca* [scud] [both dwell in the water column], and to crayfish, clams, pebblesnail, mayfly, and mussels [bottom dwellers]).

The reference concentrations for inorganic chemicals (µg/L) are provided in Table B.3. These were converted to reference body burdens (µg/kg) by multiplying by the bioconcentration factor (BCF) in units of L/kg dry weight. The conversion for organic chemicals is to multiply by the ECEM-calculated BCF in units of L/g lipid.

**Table B.3**. Aquatic Animal Benchmark Concentrations

| Species | Units | cis-1,2-Dichloroethene | Nitrate | Tetrachloroethene | Trichloroethene | Uranium |
|---|---|---|---|---|---|---|
| carp | µg/L | 9,000 | 3,176,000 | 8,667 | 9,067 | 203 |
| channel catfish | µg/L | 9,000 | 413,333 | 357 | 8,467 | 203 |
| clams | µg/L | 14,667 | 47,267 | 6,227 | 500 | 124,805 |
| Columbia pebblesnail | µg/L | 14,667 | 47,267 | 6,227 | 3,733 | 124,805 |
| crayfish | µg/L | 14,667 | 47,267 | 680 | 3,733 | 20 |
| *Daphnia magna* | µg/L | 14,667 | 3,176,000 | 1,200 | 3,733 | 20 |
| *Hyalella* | µg/L | 14,667 | 3,176,000 | 1,200 | 3,733 | 20 |
| largescale/mountain sucker | µg/L | 9,000 | 3,176,000 | 8,667 | 9,067 | 203 |
| mayfly | µg/L | 14,667 | 47,267 | 1,913 | 2,800 | 124,805 |
| mountain whitefish | µg/L | 9,000 | 313,333 | 357 | 2,800 | 203 |
| mussels | µg/L | 14,667 | 47,267 | 6,227 | 500 | 124,805 |
| Pacific lamprey (juvenile) | µg/L | 9,000 | 320,278 | 357 | 8,467 | 203 |
| rainbow trout (adults) | µg/L | 9,000 | 313,333 | 357 | 2,800 | 203 |
| rainbow trout (eggs) | µg/L | 9,000 | 313,333 | 357 | 2,800 | 203 |
| rainbow trout (juvenile) | µg/L | 9,000 | 313,333 | 357 | 2,800 | 203 |
| salmon (adults) | µg/L | 9,000 | 320,000 | 357 | 2,800 | 203 |
| salmon (eggs) | µg/L | 9,000 | 320,000 | 357 | 2,800 | 203 |
| salmon (juvenile) | µg/L | 9,000 | 320,000 | 357 | 2,800 | 203 |
| smallmouth bass | µg/L | 9,000 | 372,400 | 867 | 8,467 | 203 |
| white sturgeon | µg/L | 9,000 | 320,278 | 357 | 8,467 | 203 |
| Woodhouse's toad (tadpole) | µg/L | 9,000 | 129,000 | 357 | 8,467 | 203 |

### B.2.2 Aquatic Plant Toxicity Benchmarks

The reference concentrations for inorganic chemicals (µg/L) are provided in Table B.4. These were converted to reference body burdens (µg/kg) by multiplying by the plant BCF in units of L/kg dry weight. The conversion for organic chemicals is to multiply by the ECEM-calculated BCF in units of L/g lipid.

**Table B.4**. Aquatic Plant Benchmark Concentrations

| Species | Units | cis-1,2-Dichloroethene | Nitrate | Tetrachloroethene | Trichloroethene | Uranium |
|---|---|---|---|---|---|---|
| periphyton | µg/L | 11970000 | 3176000 | 54400 | 533 | 2.6 |
| phytoplankton | µg/L | 11970000 | 3176000 | 54400 | 533 | 2.6 |
| water milfoil | µg/L | 11970000 | 3176000 | 54400 | 533 | 2.6 |

### B.2.3 Terrestrial Animal Toxicity Benchmarks

For mammalian receptors, typical toxicity test organisms for the COPCs were mice, rats, guinea pigs, etc. The benchmarks for the test organisms were extrapolated to some of the most common receptor species (bats, shrews, voles, weasels, rabbits, deer) by Sample et al. (1996). Benchmarks for the test organisms were adjusted for the receptor species based on differences in body weight. The rationale and equations used are described in Sample et al. (1996). Benchmarks for test organisms were used without adjustment for the other mammal receptor species not covered in Sample et al. (1996). Benchmarks for (mammalian) test organisms were also largely used (without adjustment) for the avian and herpetofauna receptors because avian toxicity benchmarks for the COPCs were sparse (herpetofauna toxicity benchmarks were non-existent) in Sample et al. (1996) and elsewhere in the toxicological literature. Benchmarks for terrestrial receptors were given in dose units of mg/kg-body weight/day and are given in Table B.5. These were converted to tissue concentrations (mg/kg) by multiplying by contaminant-specific ingestion assimilation efficiencies (unitless) and dividing by contaminant-specific depuration rates (1/d). The doses were also multiplied by unit conversion factor of 1000 µg/mg.

### B.2.4 Terrestrial Plant Toxicity Benchmarks

Benchmarks for terrestrial plant receptors were given in dose units of mg/kg and are provided in Table B.6. The reference concentrations for terrestrial plants were converted to reference body burdens by multiplying by a unit conversion factor of 1000 µg/mg.

**Table B.5**. Terrestrial Animal Benchmark Doses

| Species | Units | cis-1,2-Dichloroethene | Nitrate | Tetrachloroethene | Trichloroethene | Uranium |
|---|---|---|---|---|---|---|
| American coot | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| American kestrel | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| American robin | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| American white pelican | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| bald eagle | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| bats | mg/kg/d | 958.5 | 2,826 | 9.9 | 9.9 | 8.52 |
| beaver | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| bufflehead | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| California quail | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| Canada goose | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| cattle (meat) | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| cattle (milk) | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| chickens (adults) | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| chickens (eggs) | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| cliff swallow | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| common snipe | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| coyote | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| earthworms | mg/kg/d | 3.57 | 1,130 | 3.57 | 3.57 | 100 |
| European starling | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| Forster's tern | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| great blue heron | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| hawks | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| killdeer | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| lizards | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| mallard | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| mule deer | mg/kg/d | 103.5 | 397 | 1.06 | 1.063 | 0.915 |
| muskrat | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| Northern harrier | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| oriole | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| pied-billed grebe | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| porcupine | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| rabbits | mg/kg/d | 270 | 1,040 | 2.78 | 2.783 | 2.4 |
| raccoon | mg/kg/d | 678 | 1,130 | 7 | 7 | 6.13 |
| ring-necked pheasant | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| song sparrow | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| terrestrial arthropods | mg/kg/d | 3.57 | 1,130 | 3.57 | 3.57 | 100 |
| vagrant shrew | mg/kg/d | 53.8 | 3,109 | 8.32 | 8.32 | 7.17 |
| voles | mg/kg/d | 616.5 | 2,376 | 6.36 | 6.36 | 5.48 |
| weasel | mg/kg/d | 282 | 1,088 | 2.91 | 2.91 | 2.51 |
| Western harvest mouse | mg/kg/d | 678 | 2,826 | 7 | 7 | 6.13 |
| Western kingbird | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| Western terrestrial garter snake | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |
| Woodhouse's toad (adult) | mg/kg/d | 678 | 1,130 | 7 | 7 | 240 |

**Table B.6**. Terrestrial Plant Benchmark Concentrations

| Species | Units | cis-1,2-Dichloroethene | Nitrate | Tetrachloroethene | Trichloroethene | Uranium |
|---|---|---|---|---|---|---|
| black cottonwood | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| Columbia yellowcress | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| dense sedge | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| fungi | mg/kg | 3.57 | none | 3.57 | 3.57 | 250 |
| grains | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| grapes | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| grasses | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| leafy vegetables | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| mulberry | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| onions | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| reed canarygrass | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| root vegetables | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| rushes | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| shrubs | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| tree fruit | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| tule | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |
| willows | mg/kg | 35.7 | none | 66. 7 | 66. 7 | 250 |

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