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Nez Perce

ENVIRONMENTAL RESTORATION & WASTE MANAGEMENT

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October 22, 1993

Kevin Clarke
Richland Field Office
P.O. Box 550
Richland, WA 99352

Dear Kevin:

Enclosed please find a copy of the Nez Perce Department of Environmental Restoration and Waste Management's *Response To: The Columbia River Impact Evaluation Plan,* Rev. 0. The Tribe's response reflects an in-depth scientific review of the Plan, completed in accordance with the government-to-government agreement between the U.S. Department of Energy and the Nez Perce Tribe. The Tribe provides general comments on the Plan objectives, including: sampling and analysis descriptions; approaches to chemical fate and transport; use of statistics; risk assessment approach and calculations; and use of literature in the subject plan.

If you have any questions, or require additional information, please do not hesitate to contact our office, (208) 843-7375. Thank you.

Sincerely,

Donna L. Powaukee

Donna L. Powaukee
Manager

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Response To:
The Columbia River Impact Evaluation Plan
DOE/RL-92-28, Rev. 0

Nez Perce Tribe

Environmental Restoration & Waste Management

Comments Prepared By:

Nez Perce Tribe
Department of Environmental
Restoration & Waste Management

September 3, 1993

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Executive Summary

The DOE/RL-92-28 REV. 0 ***Columbia River Impact Evaluation Plan*** was reviewed by the Nez Perce Tribe Department of Environmental Restoration and Waste Management in accordance with the government-to-government agreement between the U. S. Department of Energy and the Nez Perce Tribe.

The Columbia River Impact Evaluation Plan does not provide a health and environmental impact evaluation plan, as intended, but simply a plan to acquire sufficient data to characterize existing conditions from which to evaluate health and environmental effects at some later stage by an unspecified methodology. Since it does not provide an impact evaluation plan, the document does not fulfill the requirements of Milestone M-30-02 of the Tri-Party Agreement.

Furthermore, even in attempting to fulfill the preliminary function of characterizing existing conditions, the document is flawed. As an example, the mathematical modeling of radiological transport to the river along the 94 kilometer Hanford Reach is unverified. The calculated results are compared against only a single datum point measured outside the area of interest (at about 100 kilometers), and the order of magnitude differences are dismissed by a qualitative and unverified argument. No data were obtained to check values calculated at the points of discharge between 20 and 50 kilometers. Without valid verification of this model, both predictions of consequence and projections for the collection of further data could be spurious.

The Columbia River Impact Evaluation Plan is a useful beginning draft document but is deficient in its presentation. Revisions are recommended. The estimations of human health and environmental risk associated with the 100-Area of the Hanford Reach need to be adequately addressed especially in the areas of potential sources, receptors, and intake mechanisms. There are areas within the Columbia River Impact Evaluation Plan such as the risk assessment process and the conceptual site model that need supplemental information. These include sampling and analysis, chemical fate and transport modeling, receptor exposure assessment, and toxicological assessment and identification of additional complete potential exposure pathways. A detailed line-by-line enumeration of inconsistencies, errors, and inadequacies is beyond the purpose of this review. The attached partial listing is provided to assist in a comprehensive revision of the document in fulfillment of Milestone M-30-02. The Nez Perce Tribe Department of Environmental Restoration and Waste Management, recommends that a major revision of this document be produced correcting the difficulties encountered.

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LIST OF APPENDIXES

Section 1.0 Introduction

The Nez Perce Department of Environmental Restoration and Waste Management is funded by a grant from the U.S. Department of Energy. The Department's expertise is in environmental science, cultural affairs, program management, and communications. It's main focus is to monitor and participate in the cleanup effort at the Hanford Nuclear Facility near Richland, Washington. The Nez Perce Department of Environmental Restoration and Waste Management currently participates in the cleanup effort by providing predecisional input to the U.S. Department of Energy.

The Columbia River Impact Evaluation Plan is a document written by the U.S. Department of Energy to satisfy Milestone M-30-02 of the Tri-Party agreement. The cumulative health and environmental impacts of contaminated springs and seeps along the Columbia River are evaluated. The document is a mechanism to generate sufficient data to characterize the environment for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 purposes. The information gathered will lead to a prioritization of the existing monitoring programs and determine areas where there is a need for better characterization. The Columbia River Impact Evaluation Plan reviews past and present records, the ongoing monitoring, the boundaries of potential impact, and development of a risk assessment. Only the most recent and readily available information was used. The steps involved determine the contaminants, develop an exposure pathway model, identify the components of the contaminant transport system, determine possible contaminant fates, identify the potential health and environmental impacts and determine the data gaps, and development of a plan for the Columbia River Impact Assessment.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management has noted that the Columbia River Impact evaluation Plan has a number of serious deficiencies including the following:

- The objectives of the plan are not clearly stated.
- The scientific design is not adequate to achieve even the stated objectives.
- The statistical approaches are inadequate.
- Estimates of risk are based on qualitative data and are not properly qualified as highly preliminary estimates.

- The conclusions are unsupported.
- The data review omits a significant amount of historic data.
- The approaches to reporting of data within the document are nonstandard or inconsistent.
- The geochemistry is not considered.

These deficiencies indicate a need for a more careful approach to the document preparation and a more adequate review.

Section 2.0, the synopsis of Comments, summarizes specific and general comments in the following areas:

- Objectives
- Sampling and Analysis
- Chemical Fate and Transport
- Statistics
- Risk assessment
- Use of Literature

Section 3.0 contains conclusions.

References are included in Section 4.0.

Appendix A contains specific comments provided by the reviewers. These comments are listed by the corresponding page, paragraph, and sentence number.

2.0 Summary of Contents

At the U.S. Department of Energy's request, the Nez Perce Tribe Department of Environmental Restoration and Waste Management has provided general comments regarding the Columbia River Impact Evaluation Plan objectives; sampling and analysis descriptions; approaches to chemical fate and transport; use of statistics; risk assessment approach and calculations; and use of literature in the subject plan. The comments are summarized in the following subsections.

2.1 Objectives

The Columbia River Impact Evaluation Plan lists the following objectives for the report:

- Submit a plan to EPA and Ecology to determine cumulative health and environmental impacts to the Columbia River under M-30-01

    - Milestone M-30-01 is, "Submit a report (secondary document) to EPA and Ecology evaluating the impact to the Columbia River from contaminated springs and seeps as described in the operable unit work plans listed in M-30-03."

The Columbia River Impact Evaluation Plan has inadequately met the stated objectives and has, instead, focused on using incomplete data and methods to estimate marginally acceptable levels of risk.

2.2 Sampling and Analysis

Virtually no detail is provided concerning sampling design, frequency, locations, methods, or analytical procedures and limits. This calls into question the appropriateness of using any of the data for other than a qualitative discussion. The uncertainties related to sampling and chemical analysis were not evaluated as they effect the quality of data input to the risk calculations.

2.3 Chemical Fate and Transport

The descriptions of chemical fate and transport are inadequate to assess the conservatism of the transport modeling. It also appears that current concentrations, based on very few data, are used to estimate long-term source concentrations. This could certainly result in an underestimation of

concentrations released to the Columbia River, since it is quite possible that the concentrations may increase over time.

2.4 Statistics

The general impression from the Columbia River Impact Evaluation Plan is that statistical methods used to attempt to quantify concentrations of chemicals of concern were not very rigorous, or at least did not justify underlying assumptions. Positive conclusions are presented with little statistical support, and in at least one case, the conclusions are clearly in error.

2.5 Risk Assessment

The Environmental Protection Agency risk assessment guidance documents provide a systematic means for organizing, analyzing, and presenting information on the nature and magnitude of risks to public health and the environment posed by chemical and radionuclide exposures. Despite the advanced state of the current risk assessment methodology, uncertainties and limitations are inherent in the risk assessment process. In general, the uncertainties and limitations in the risk assessment can be classified in the following categories:

- Sampling and analysis
- Chemical fate and transport modeling
- Receptor exposure assessment
- Toxicological assessment

The descriptions of data throughout the document are suitable for only qualitative purposes. In addition, the Columbia River Impact Evaluation Plan contains unclear descriptions of chemical fate and transport modeling, receptor exposure assessment, and the assessment of toxicological properties associated with the chemicals of concern. At a minimum this gives rise to questions as to the methods used to estimate risk and may have resulted in underestimates of risk. Given this, the U.S. Department of Energy, has nevertheless, used these data to calculate estimated human health risks. The calculated estimates, some of which exceed the Environmental Protection Agency's benchmark levels of acceptable risk, have then been presented as cancer risk probabilities, without necessary qualification statements regarding the uncertainty associated with these values. In fact,the Department of Energy implies that the existing data are used to "accurately predict impacts" (p.3).

The Conceptual Site Model presented in Figure 3-1 includes both human and ecological receptors but does not present all potential exposure pathways, uptake mechanisms, or receptors. We believe that two simpler Conceptual Site Model's would improve the presentation of exposure pathways.

We recommend that the conceptual site model be divided into two models: one for potential human exposure and one for ecological exposure. This division would lend itself to a more complete evaluation and identification of all potential exposure pathways, uptake mechanisms, receptors, and use scenarios. For example, the existing Conceptual Site Model does not appear to include a differentiation between existing and potential future uses by humans or ecological receptors. The Conceptual Site Model, as it exists, inadequately defines potential pathways to receptors, and therefore also inadequately identifies data needed to assess the risks to these receptors.

Uranium toxicity, which may contribute significantly to human cancer health risk, has not been evaluated in the risk assessment, due to lack of an oral reference dose. An oral reference dose for uranium (3 x 10-3 mg/kg/day) can be derived from the Maximum Containment Level (0.02 mg/L) assuming 20 percent contribution from drinking water, 70 kg body weight, and consumption of 2 liters of water per day. To be protective and conservative, it seems appropriate to include this approach in the risk estimate calculations.

2.6 Use of Literature

Throughout the document, brief quotations of conclusions from related documents are used to justify approaches. For those many cases in which the approach is subject to debate or interpretation, additional data or text from the references should be included to support use of the approach.

3.0 Conclusions

Since 1855, reserved treaty rights of the Nez Perce in the Mid-Columbia area have been recognized and reaffirmed through a series of federal and state actions. These actions have protected the interests of the Nez Perce to exploit their usual and accustomed resources and resource areas in the Hanford Reach of the Columbia River and elsewhere. Accordingly, the Nez Perce Tribe Department of Environmental Restoration and Waste Management (ERWM) has received support from the U.S. Department of Energy (DOE) to participate in and monitor certain DOE Five-Year Plan activities. In October of 1993, the Nez Perce Tribe reviewed the Columbia River Impact Evaluation Plan (CRIEP)(DOE, 1993).

The purpose of the CRIEP was "to submit a plan to the Environmental Protection Agency (EPA) and the Washington Department of Ecology (Ecology) to determine cumulative health and environmental impacts to the Columbia River under M-30-01". Milestone M-30-01 is to, "Submit a report (secondary document) to EPA and Ecology evaluating the impact to the Columbia River from contaminated springs and seeps as described in the operable unit work plans listed in M-30-03." The CRIEP actually focuses on the Hanford Reach of the Columbia River along the 100 Area.

On the basis of our review, the Nez Perce ERWM has concluded that the CRIEP is useful as a beginning draft document. Revisions are recommended to address deficiencies in adequately addressing potential sources, receptors, and intake mechanisms for estimations of human health and environmental risks associated with the 100-Area of the Hanford Reach of the Columbia River.

EPA's risk assessment guidance documents provide a systematic means for organizing, analyzing, and presenting information on the nature and magnitude of risks to public health and the environment posed by chemical and radionuclide exposures. However, despite the advanced state of the current risk assessment methodology, uncertainties and limitations are inherent in the risk assessment process. In general, the uncertainties and limitations include: (1) sampling and analysis; (2) chemical fate and transport modeling; (3) receptor exposure assessment; and (4) toxicological assessment. The Nez Perce ERWM take exception to the current risk assessment approach because (1) insufficient data are used to quantify risk and (2) the conceptual site model omits potentially complete exposure pathways.

The general impression received from the descriptions of data throughout the CRIEP is that the existing data referenced in the report are suitable only for qualitative purposes. The statistical methods used to quantify concentrations of chemicals of concern were not very rigorous, or at least did not justify underlying assumptions. Positive conclusions are presented with little statistical support, and in at least one case, the conclusions regarding the data are clearly in error. In addition, the CRIEP contains unclear descriptions of chemical fate and transport modeling, receptor exposure assessment, and the assessment of toxicological properties associated with the chemicals of concern. At a minimum this gives rise to questions about the methods used to estimate risk and whether these have resulted in underestimates of risk.

Given this, DOE has, nevertheless, used the existing data to calculate and present estimated human health risks. The calculated estimates, some of which exceed EPA's benchmark levels of acceptable risk, have then been presented in the report as cancer risk probabilities, without necessary qualification statements regarding the uncertainty associated with these values. The lay reader may, in fact, be mislead to believe that the existing data have been properly used to "accurately predict impacts."

The Conceptual Site Model (CSM), as it exists, inadequately defines potential pathways to receptors, and therefore also inadequately identified data needed to assess the risks to these receptors. It also appears that potentially complete exposure pathways have been eliminated from the current CSM for further consideration on the basis of inadequate data. The Nez Perce Department of ERWM has provided comments to DOE expressing these concerns, and desires to work with DOE in revising the CRIEP to identify data quality objectives to ensure that adequate data are gathered to provide the necessary input to a comprehensive assessment of risks, taking into account the specific concerns effecting Nez Perce interests.

Tribal communities have increased exposure to environmental contamination because the use of fish, wildlife, and plants for subsistence and cultural activities occurs at a much higher rate than in the general population. The conceptual site model (CSM) presented in the CRIEP, and exposure factor calculation guidance provided in EPA's Risk Assessment Guidance for Superfund (RAGS) do not fully take into account the pathways and ingestion scenarios that may impact tribal use of resources. In addition to assessing the impact to fish, the studies would include human ingestion of waterfowl, venison, plants, irrigated crops, domestic livestock, and other animal products. Although some of these pathways may, with appropriate data, be ultimately found to be relatively insignificant compared with the surface water ingestion pathway, it would

seem prudent to evaluate all potentially complete pathways with adequate data prior to eliminating them.

Finally the Nez Perce Tribe wishes to assist DOE in ensuring consideration of data needs relative to Nez Perce-specific exposure mechanisms and intake factors.

References

Freeze, R. Allen, and John A. Cherry, 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632

U.S. Environmental Protection Agency. u/d. Guidance for planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process (EPA QA/G-4), Interim Final.

U.S. Environmental Protection Agency. 1988. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual. OSWER Directive 9285.7-01a. September 29.

U.S. Environmental Protection Agency. 1988. Superfund Exposure Assessment Manual. OSWER Directive 9285.5-1, EPA/540/1-88/001.

U.S. Geological Survey. 1982. Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge. Geological Survey Water-Supply Paper 2175.

U.S. Geological Survey. 1982. Measurement and Computation of Streamflow: Volume 2. Computation of Discharge. Geological Survey Water-Supply Paper 2175.

Appendix A

Following is a partial listing of responses to the Columbia River Impact Evaluation Plan. They are listed in the format of **listing** in Geneva type, **excerpt** in Times New Roman type, and **response** in Geneva Type.

Page 1: Paragraph 1:

As a result of past practices, four areas of the Hanford site (the 100, 200, 300 and 1100 Areas) have been included on the US. Environmental Protection Agency' s (EPA's) National Priorities List (NPL) under the *Comprehensive Environmental Response, Compensation, and Liability Act of* 1980 (CERCLA, 42 USC 9601 et seq.). In addition to the four NPL sites, there are over 60 *Resource Conservation and Recovery Act of* 1976 (RCRA, 42 USC 6901 et seq.) treatment, storage, or disposal facilities that will be closed or permitted to operate in accordance with RCRA regulations. To accomplish the timely cleanup of the past-practice units, the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), (Ecology et al. 1989) was signed by the Washington State Department of Ecology, (Ecology), EPA, and the US. Department of Energy (DOE).

The Nez Perce Environmental Restoration and Waste Management Program notes that this paragraph establishes the concept that this document is bound by the CERCLA, RCRA, and Tri-Party Agreements.

Page 1: Paragraph 2:

To support the Tri-Party Agreement , milestones were adopted. These milestones represent the actions needed to ensure acceptable progress toward Hanford Site compliance with CERCLA, RCRA, and the *Washington State Hazardous Waste Management Act of* 1976. This report was prepared to fulfill the requirement of Tri-Party Agreement Milestone M-30-02, which requires a plan to determine cumulative health and environmental impacts to the Columbia River. This plan supplements the CERCLA remedial investigations/feasibility studies (RI/FS) and RCRA facility investigations/corrective measures studies (RFI/CMSs) that will be undertaken in the 100 Area.

The Nez Perce Environmental Restoration and Waste management program interprets this paragraph as establishing the purpose of milestone M-30-02 requiring a plan to determine cumulative health and environmental impacts to the Columbia River, and the requirement for ensuring acceptable progress for Hanford in compliance with CERCLA, RCRA, and Tri-Party requirements.

Page 1: Paragraph 3: Sentences 2 & 3

The purpose of the preliminary impact evaluation was to assess the adequacy of existing data and proposed data collection activities. Based on the result of the evaluation, a plan is proposed to collect additional data or make changes to existing or proposed data collection activities.

The Nez Perce ERWM observes that these sentences establish the Plan to be a preliminary evaluation to assess the adequacy of existing data and proposed data collection activities.

Page 1: Paragraph 5: Sentence 1

In May 1991, the Tri-Party Agreement was amended by the *Hanford Facility Agreement and Consent Order Change Package* (DOE-RL 1991la) and Milestones M-30-01 through M-30-05 were proposed to guide data collection activities in the 100 Aggregate Area.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management notices that Milestone M-30-01 is not listed in the references. This statement also does not agree with Page 1: Paragraph 3: Sentences 2 & 3.

Page 2: Paragraph 1: Sentences 2-4

The results of this evaluation were used to develop a plan that would ensure collection of sufficient data to ensure adequate characterization of the Columbia River along the 100 Area for CERCLA purposes. By using such an approach, both key exposure pathways and potential risk-driving contaminants are identified. In addition, the potential risks to human health and the environment are preliminarily quantified.

Is the evaluation referred to supposed to be M-30-01? This shows the establishment of CERCLA guidelines for scientific data collection. This sentence establishes the guidelines for adequate characterization of exposure pathways, and contaminants. Quantification means: "to determine or express the quantity of". The Nez Perce Tribe Department of Environmental Restoration and Waste Management asks, if the word "quantified" be changed to "qualified", since no supporting documentation is provided?

Page 2: Paragraph 2: Sentence 2

Thus, the objective of the plan included in this document is to evaluate impacts to the Columbia River in the vicinity of 100 Area and its environs and

assess the need for specific characterization efforts that will provide information for the 100 Area risk assessment.

The Nez Perce ERWM notes that this sentence establishes that the plan evaluates the impacts for 100 area risk assessment.

Page 2: Paragraph 3: Sentence 4

In general, the downstream impact evaluation boundary was the Hanford Town site, with the exception that the city of Richland was used to evaluate residential drinking water exposure, and the entire 94 km (58 MI) section of the Hanford Reach was used to evaluate human ingestion of fish.

The Nez Perce Tribe notes this sentence establishes that samples were taken at the city of Richland, and also establishes that 94 km of river was tested for human ingestion of fish.

Page 2: Paragraph 4: Sentence 2

A quantitative baseline Hanford Reach risk assessment should be conducted to support final records of decision at Hanford.

This sentence establishes that there is no quantitative assessment. This statement is in conflict with the previous statement on Page 2: Paragraph 1: Sentence 4.

Page 2: Paragraph 6: Sentence 1

The scope of this document includes the review of relevant existing data and Hanford Site data collection programs.

The Nez Perce Environmental Restoration and Waste Management program notes that this sentence establishes the scope and what is to be included in this document.

Page 3: Paragraph 1: Sentences 4 -7

To complete this plan, only existing, readily-available information was used (see Chapter 6). Other readily available information that was not referenced, but provided background information, is included in Appendix A (Bibliography). For most of the data covered in this evaluation, 1989 was the most complete data set. Data from previous or more recent data collection activities is included for completeness.

The Nez Perce Environmental Restoration and Waste Management program notes that these two sentences are not in agreement with Page 1: Paragraph 3: Sentence 2. This sentence establishes the fact that, except for the 1989 data set, the rest of the data sets are incomplete. This raises the question of the methodology used, scientific repeatability, quality assurance and quality control under the Tri-Party Agreement. This document was published June 1993. If the data sets are incomplete as late as 1992, the methodology of statistical data gathering including the 1989 data set are in question.

Page 3: Paragraph 1: Sentence 6

For most of the data covered in this evaluation, 1989 was the most complete data set.

The Nez Perce ERWM asks, "What were the methods used, can the data undergo scientific repeatability, and does this document have the essential quality control and quality assurance to meet the requirements under the Tri-Party Agreement?"

Page 3: Paragraph 2: Item 1: Sentence 2

Contaminants of potential concern due to Hanford Site operations in the 100 Area that might impact the Hanford Reach ecosystem were identified based on the groundwater concentrations that exceeded ambient water quality or drinking water standards.

What is the primary standard to be used? The CERCLA, RCRA, Tri Party Agreement Regulations or the NCP? Which one is to be used, ambient water quality, drinking water quality, or Class A (Excellent) surface water body standards? The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to know if the identification approach considers the geochemistry of the systems including the decay products, mass balance, pH, Eh, reactivity, exchange capacity of the aquifer, speciation effects, temperature, or time?

Page 3: Paragraph 3: Item 2: Sentences 2 & 3

Conceptual model development required identification of the major components of the Hanford Reach ecosystem together with the likely pathways along which contaminants of potential concern might move. Hanford Reach ecosystem components are included in the conceptual model if river water was identified as the primary transport medium of the contaminant to the component.

The Nez Perce Environmental Restoration and Waste Management program takes note that these sentences establish the need for identification of the major components of the Hanford Reach Ecosystem and the likely pathways. They also establish the inclusion of the Hanford Reach Ecosystem components if the Columbia river is identified as the primary transport medium.

Page 3: Paragraph 4: Item 3: Sentences 2 & 3

The potential exposure pathways to ecosystem components were identified for those contaminants found to pose a potential significant adverse impact to the environment or human health. This pathway assessment included identification of hazardous substance release and transport mechanisms, exposure media and routes, and receptors.

The contaminants of potential significant adverse effects have not been established. These sentences establish the identification of exposure pathways and listing of several paths, but do not list time, geochemistry, transformation products, temperature, pH, Eh, reactivity, speciation, subsurface geology, ion mobilization, or other significant aspects for evaluating contaminant pathways.

Page 3: Paragraph 5: Item 4: Sentences 2 & 3

The threats to human health and the environment by contaminants of potential concern attributable to releases from 100 Area operations were evaluated for selected exposure pathways judged most likely to result in significant adverse health or environmental impacts. Threats were evaluated preliminarily in a manner of consistent with NCP risk assessment requirements.

The preliminary risk assessment approach for selected exposure pathways does not clearly document whether all potentially significant pathways have been evaluated. For example, the Nez Perce ERWM notes intrusion and future use scenarios are not discussed or presented in the Conceptual Site Model (CSM). A complete presentation of all potentially significant pathways in the form of a CSM should be used to qualitatively and preliminarily address the issue of relative significance.

Page 3: Paragraph 6: Item 5: Sentences 2 & 3

If, during the course of the impact evaluation, there were insufficient data to accurately predict impacts for a particular medium or pathway, a data gap was identified. These data gaps were summarized to provide guidance of future data gathering activities proposed in 100 Area operational areas that might potentially impact the Hanford Reach.

These sentences establish the need to identify and summarize the data gaps.

Page 3: Paragraph 7: Item 6: Sentence 2

Based on identified data gaps, a plan is developed to ensure adequate data collection that will support subsequent 100 Area risk assessments.

The Nez Perce ERWM asks that the word "adequate" be further defining in terms of the Tri-Party agreement, CERCLA, RCRA regulations and the Endangered Species Act.

Page 4: Paragraph 1: sentence 2

The primary federal statutes relevant to the impact assessment process are CERCLA and RCRA.

This sentence establishes that the document is bound by CERCLA, RCRA, and Washington State statutes Model Toxic Control Act and the Hazardous Waste Management Act. This section does not include the Tri-Party agreement and the Endangered Species Act.

Page 4: Paragraph 6: Sentence 1

Chapter 5 includes a summary of the preliminary impact evaluation results (Section 5.1), and a plan and schedule of tasks and activities needed to acquire additional information to be used to assess cumulative impacts to the Hanford Reach due to 100 Area operational activities (Section 5.2).

The Nez Perce ERWM asks if a summary of the preliminary impact evaluation results is already supposed to have been done with the completion of Milestone M-30-01.

Page 5: Paragraph 1: Sentence 4

It is expected that any significant adverse impacts associated with activities in the 100 Area would be observed in the Columbia River at the point of impact or immediately downstream of the 100 Area.

It would also be expected that any adverse impacts would occur in the sediments lying in the low energy pools not only downstream but cross stream due to sediment transfer.

Page 5: Paragraph 2: Sentence 1

Given the important ecological functions of the Hanford Reach of the Columbia River, the purpose of this section is to describe the location of the Hanford Reach, the history of Hanford Site operations along the Hanford Reach, and the physical and biological characteristics of the Hanford Reach.

The Nez Perce ERWM notes that this sentence establishes the importance of the Hanford Reach.

Page 5: Paragraph 3: Sentence 5

Namely, it is one of the last mainstream spawning grounds for fall Chinook salmon (Oncorhyncus tshawytsha) (Dauble and Watson 1990). In addition, it is becoming an essential spawning ground for other anadromous salmon (0. spp.) and steelhead trout (0. mykiss) (Fickeisen et al. 1980).

This sentence establishes to the Nez Perce ERWM the importance of the river for spawning salmon and steelhead trout which spawn in the gravel of the river bed.

Page 5: Paragraph 4: Sentence 5

Average monthly temperatures range from a low of 2°C (29°F) in January to a high of 24°C (76°F) in July.

This statement does not make allowances for temperature extremes that dominate the climate. The Nez Perce ERWM insists that annual high and low temperatures can make a large difference in the solubility of the reactability of all of the constituent contaminants and the transporting medium. The local wind direction is extremely variable and also needs to be taken into account.

Page 6: Figure 2-1

The Nez Perce ERWM notes that the legend is not complete. This map of the Hanford Site is inappropriate to use if sites such as the McNary Dam and the Priest Rapids Dam are referenced (Page 5: Paragraph 3: Sentence 1). The arrow above the words "YAKIMA RIVER" is very misleading. What does it indicate secondary wind direction, north, or current flow? The arrow near the words COLUMBIA RIVER has the same effect as the previously mentioned arrow. The arrows are not listed in a legend box, along with typical map items such as bridge symbols, boundary symbols, and feature pointers. This is not standard cartographic nomenclature. Because there are islands depicted in the river channel

there should be some references to the current flow and sediment transport patterns. The earlier reference to Page 5: Paragraph 4: Sentence 5 states that the area is important for spawning salmon and steelhead fish.

Page 7: Paragraph 1: Sentence 6

As a consequence, significant amounts of radioactive, chemicals, and heat were released to the river environment during the operational period of these eight reactors.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management asks that the word "significant" be further defined in terms of operational changing of the ecology, with a comprehensive description of the baseline ecology.

Page 7: Paragraph 4: Sentence 2

The Columbia River is the fifth largest river by volume in North America (Stenner et al. 1988)

This sentence establishes the fact that the Columbia River is the fifth largest river by volume in North America.

Page 7: Paragraph 4: Sentence 5 & 6

These dams provide a storage capacity of greater than 46 km^3 ($11mi^3$) of water (Stenner et al. 1988). Average annual flow of the Columbia River is approximately 3,400 m^3/s (120,000 ft^3/s), but daily averages can vary from 1,000 to 7,000 m^3/s (35,000 to 250,000 ft^3/s).

Converting cubic meters to cubic miles is not a standard conversion and is cumbersome. The most common usage is in acre-feet. Because of the importance of the river mentioned on Page 5: Paragraph 4: Sentence 5, the Nez Perce ERWM believes that there should be a reference to the amounts of water that pass by the Hanford Reach. There should also be a description of the hydrological characteristics, including, quantitative geomorphology, role of river bars, stability of sediments, and bedload characteristics.

Page 7: Paragraph 5: Sentence 3-5

Flows up to 12,700 m 3/s (448,000 ft 3/s) are frequently recorded during periods of peak spring runoff (Energy Research and Development Administration ERDA 1975). Average monthly flow rates generally peak from April through June,

and the lowest monthly mean flows are observed during September and October. Recent annual average flows at Priest Rapids Dam range from 2,830 to 3,400 m 3/s (99,900 to 120,000 ft 3/s).

The sentence does not mention where the rates are recorded. The sentence also establishes the fact that the lowest mean flow rates occur during the months of September and October precisely during the time of the spawning of the fall Chinook Salmon as referenced on Page 5 Paragraph 3: Sentence 5. The most important flow data are for times of spawning (Fall), not average annual flows. The Nez Perce Tribe Department of Environmental Restoration and Waste Management recommend that additional flow data be collected during the Fall.

Page 8: Paragraph 1: Sentence 2 - 4

The channel does not meander strongly but contains large longitudinal bars, of which a few may support tree growth. The river channel remain relatively stable because the river flow rate is regulated by upstream dams. Channel sediments consist primarily of sands and gravels with cobbles that range up to 20 cm (8 in.) in diameter.

Longitudinal bars are a primary indicator of non-stable river channels indicating that the river is actively moving sediments irrespective of the dams or the dam practices. The indication that the river channel is relatively stable does not apply here, especially without the use of a time parameter. References for this determination should be included.

Page 8: Paragraph 1: Sentence 5

Silt- and clay-sized material accumulates in areas of low-energy flow, such as pools and channel margins.

Indicating the existence of low energy areas implies there are references to support this sentence. This also leads to the acknowledgment that the contaminants (many are heavy metals) would migrate to areas such as those mentioned.

Page 8: Paragraph 4: Sentence 1

The riverine zone is composed of those aquatic habitats that are submerged for much of the year.

The Nez Perce ERWM asks if this is an incomplete definition in terms of this document.

Page 9: Paragraph 6: Sentence 3

The riparian zone provides food and cover for many species, including several that are endangered or threatened.

The Nez Perce ERWM notes that the Endangered Species Act has not been mentioned and should be at Page 4: Paragraph 1: Sentence 2.

Page 9: Paragraph 7: Sentences 1 & 2

In general, the riparian plant communities developed in response to the shore substrate and the degree of water level fluctuation (Fickeisen et al. 1980). Typically, the riparian vegetation consist of a narrow zone of grasses and forbs interspersed with a few scattered deciduous shrubs and trees that are able to establish and grow in a cobble and gravel substrate.

The Nez Perce ERWM asks, "Are the terms "shore substrate" and "cobble and gravel substrate" being used appropriately in the sense of ecological terminology?" Riparian vegetation is usually outside the stream channel. Does the term "cobble and gravel substrate" explicitly refer to a mapped subsurface unit?

Page 10: Paragraph 1: Sentence 1

Typical riparian tree species that characteristically border most streams and rivers are scarce along the Hanford Reach.

The Nez Perce ERWM notes that this sentence does not agree with the statement on Page 8: Paragraph 2: Sentence 2.

Page 10: Paragraph 4: Sentence 1

The riparian zone serves as sensitive habitat for several species that are listed as endangered or threatened.

The Nez Perce ERWM notes that the endangered species act has not been mentioned and should be at Page 4: Paragraph 1: Sentence 2.

Page 10: Paragraph 6: Sentences 2 & 3

Well networks used to collect groundwater samples have been designed for facility -specific, operational , and groundwater surveillance activities. Locations of the Hanford Site groundwater monitoring wells near the 100 Area associated, with the Environmental Monitoring Program are shown in Figure 2-2.

To adequately assess the ground water flow, the Nez Perce Tribe Department of Environmental Restoration and Waste Management asks that data be supplied as to the well construction, depth, and inter-well subsurface geology correlation's. The well positions need to reflect a distinct correlation to the subjects being monitored. The well spacing on Figure 2-2 , does not. The legend is incomplete, and the map has not been adequately detailed or labeled. Are the wells bottomed out in the same subsurface unit?

Page 12: Paragraph 1: Sentence 1

For the purposes of this study, infiltration and migration of wastes through the soil to groundwater culminating in the discharge of contaminated groundwater to the Columbia River is considered the current primary pathway for environmental contamination and impact on the Columbia River.

The term "soil" indicates that the subsurface has been determined, and that the contamination products flowed through distinct horizons. The term "current primary pathway" indicates that the subsurface has been adequately mapped and modeled.

Page 12: Paragraph 2: Sentence 1

The major chemical and radiological contaminants found in groundwater at the Hanford Site associated with 100 Area operations include tritium (^{3}H), cobalt-60 (^{60}Co), strontium-90 (^{90}Co), strontium-90 (^{90}Sr), hexavalent chromium (Cr), and sulfate (SO_4) (Evans et. al. 1990).

The Nez Perce ERWM asks "Why only the major chemical and radiological contaminants listed?" This is not an inclusive list. Elements that should have been included are Rubidium (^{86}Rb), Ruthenium (^{106}Ru), and Cesium (^{137}Cs). Is there any data on Iodine ^{127}I?

Page 12: Paragraph 2: Sentence 2

In general, groundwater contaminant plumes that are flowing toward the Columbia River have been identified using nitrate (NO_3) and ^{3}H as conservative indicators of contaminated groundwater movement (Figures 2-3 and 2-4).

The designation of indicator ions needs to be further discussed in terms of how they were determined. There are no supporting materials or references on this matter.

The Plan designates the nitrate ion and Tritium as the indicator species for "conservative" ground water movement. The Nez Perce ERWM asks why the geochemistry involved with the interaction of competing ions and

the sorptive properties of a major subsurface constituent, montmorillonite were not taken into more consideration.

Page 12: Paragraph 2: Sentence 5

Thus, large quantities of contaminants were discharged to the soil column with the potential to reach groundwater in the unconfined aquifer eventually.

The term "soil column" is used in the context that discharges were done to a unique soil stratigraphic unit, when in fact the act of trenching removes some or all of the soil. The term "soil column" also refers to a heterogenous unit, with distinguishable inter-units. The aquifer has not been adequately defined in terms of consistency, pore space, lithology, pH, Eh, geochemistry, or subsurface geomorphology. Nowhere is the mention of the distribution coefficients for each of the elements, along with the cation exchange capacity, the selectivity quotient and the total competing cation concentration. This information is essential to determine the effects of how the distribution coefficients are affected by ion exchange, precipitation, substitution, redox reactions, and acid-base buffering. The movement of the elements through the subsurface needs to be adequately explained.

Page 12: Paragraph 2: Sentence 6

The NO_3 and ^3H plume maps show that contaminants associated with 100 Area operations have to reach the Hanford Reach ecosystem.

The Nez Perce ERWM notes that the supplied plume maps are not complete enough pertaining to controls showing what is indicated in this sentence. For example, the well positioning does not reflect ground water movement as indicated in the water table diagram.

Page 12: Paragraph 3: Sentence 1 & 2

On basis of the 1989 results from Evans et al. (1990), the ground water contaminants were regarded as contaminants of potential concern in this evaluation if their concentrations exceeded the more stringent of the standards promulgated in either the drinking-water standards 40 CFR 141-143, and Ch. 248-54 WAC(ambient water quality criteria (EPA 1986a) or the ground water standards of the Model Toxic Control Act Cleanup Regulation (MTCACR; Ch. 173-340 WAC) (see Appendix B for further details). Based on these standards, the following constituents were identified as contaminants: Cr, NO3, 3H, 90Sr, technetium-99 (99Tc), and total uranium (U).

The Nez Perce ERWM asks which standards are used? Who determined which standard to use? Why are the results of Evans et al. regarded as the standard for determining what is and what is not the contaminant of potential concern? Why weren't the standards used for the endangered species act used? This list is not complete and doesn't reflect the most basic of geochemistry modeling for the contaminants listed in the partial list on Page 12: Paragraph 2: Sentence 1. The more stringent regulations would have listed more, not fewer elements of concern not to mention ^{137}Cs, ^{86}Rb, ^{106}Ru,^{96}Mo, ^{60}Co, and all of the daughter products from the decay of uranium including radium.

Page 12: Paragraph 4: Sentence 4

In addition, the ground water discharge rate for each plume is estimated in Appendix B.

The Nez Perce ERWM notes that the term "ground water discharge" is not standard and does not reflect actual ground water movement in terms of rates and is not actually estimated in Appendix B.

Page 12: Paragraph 5: Sentence 1

Table 2-1 shows the mean, standard deviation, and range for contaminants of potential concern in groundwater plumes identified in Appendix B.

The Nez Perce ERWM asserts that Table 2-1 does not show the mean, standard deviation, and range for contaminants of potential concern. It shows "Draft Clean-up Levels" for drinking water, chronic aquatic and ground water. The title itself is misleading in terms of language. Who set the levels? The best option for the environment from this table is obviously the chronic aquatic.

Page 12: Paragraph 5: Sentence 2

These statistics were computed using data from wells that were that were sampled and analyzed during the indicated period.

The Nez Perce ERWM notes that the data presented is unclear regarding where the wells positioning reflects the groundwater movement, at what depth, bottomed out in which aquifer and with what type of quality controls? We cannot determine which statistics were computed and are referred to as being in Table 2-1, since Table 2-1 in not what the text claims it to be.

Page 12: Paragraph 5: Sentence 3

Because some wells were not necessarily analyzed during each sampling period and the locations of wells within a given plume are not necessarily representative of the entire plume, the statistics are only general indicators of groundwater quality.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management points out that the lack of information regarding the data quality and sampling design casts doubt on the usability of those data for statistical purposes.

Page 13: Figure 2-3

The Nez Perce ERWM observes that the legend is incomplete. A solid line is an indicator of a high degree of certainty to within meters, yet the wells which provide the controls are up to kilometers apart. There is a dilution error by using wells not in the suspected plume.

Page 14: Figure 2-4

The Nez Perce ERWM notes that the legend is incomplete. A solid line is an indicator of a high degree of certainty to within meters, yet the wells which provide the controls are up to kilometers apart. The designation of generalized basalt indicates the basalt may or may not be at the location designated by a solid line depicting a high degree of certainty to within meters and the controls are not within that degree of accuracy. The distribution of the most recent wells indicates that the subsurface has not been explained regarding the subsurface gradient, otherwise why sink so many wells up gradient from the suspected contaminant plumes? Instead of using a map of this scale, it would be easy to produce a larger scale map with 10 times the detail, depicting river currents, well depths, subsurface features, and buried river channels.

Page 15: Figure 2-5

The Nez Perce ERWM asks if this picture is too simplistic for use in a document dealing with endangered species. This is an inadequate characterization that doesn't accomplish the flow directions from the gradient contours (Page B-4 Figure B-3).

Page 20: Paragraph 1: Sentence 2

Table 2-2 identifies the contaminants, their 1989 maximum source concentration, and the estimated flow rate for each plume.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to mention that additional data regarding plume mapping would be useful.

Page 20: Paragraph 2: Sentence 2

These plumes and the contaminant concentrations will serve as the basis for the impact evaluation in Chapter 4.

Is there a valid reason for evaluating a structure such as a subsurface plume when the data presented so far is at the very least incomplete?

Page 20: Paragraph 2: Sentence 3

These plumes and the contaminant concentrations will serve as the basis for the impact evaluation in Chapter 4. Although it is possible that all contaminants are not identified, those that are identified are sufficient given the preliminary and qualitative nature of the impact evaluation in Chapter 4.

The contaminants identified are not sufficient for adequate identification and tracking in terms of a proper evaluation. The Nez Perce ERWM points out that the document has not provided proper information to determine plume characteristics in terms of ground water movement or geochemistry.

Page 20: Paragraph 2: Sentence 4

Future risk assessments will identify contaminants of potential concern using a more thorough screening process set forth in the Hanford Site Baseline Risk Assessment Methodology.

The Nez Perce ERWM asks if the Hanford Site Baseline Risk Assessment was supposed to be completed. The screening process needs to be consistent, comprehensive, and build upon the results of the Hanford Site Baseline Risk Assessment. If the Hanford Site Baseline Risk Assessment has not been completed, it would seem reasonable to identify contaminants of potential concern using the screening process set forth in the Hanford Site Baseline Risk Assessment Methodology for the Columbia River Impact Evaluation Plan, rather than the method used in that plan.

Page 20: Paragraph 4: Sentence 2

Chromium was not detected in any water samples collected by Dirkes (1990) from Hanford Reach springs; however, during 1991 spring sampling (DOE-

RL 1992D), Cr was found to be entering the river from springs in the 100-B/C, 100-D, 100-H, and 100-F Areas.

The Nez Perce ERWM asserts that the time factor makes a large difference in the ground water flow rates. What was the sampling process, at what times, from which springs, and by whom?

Page 20: Paragraph 5

Nitrate. Nitrate was present in many waste streams. The source for contamination of groundwater in the 100 Area may reflect the extensive use of nitric acid in decontamination operations.

The document failed to take into account sulfates, transformations, complexations, especially as the Nez Perce ERWM notes, some complexants are as toxic as their parent compounds. The geochemical environment was not considered leaving out important information such as pH, Eh, and temperature.

The Nez Perce Environmental Restoration and Waste Management Program notes that the document fails to take into account sulfates, transformations, complexations, especially as some complexants are as toxic as their parent compounds. The geochemical environment was not considered leaving out important information such as pH, Eh, and transformations

Page 21: Table 2-2

On Page 20: Paragraph 1: Sentence 2 it is stated that "Table 2-2 identifies the contaminants, their 1989 maximum source concentration, and the estimated flow rate for each plume. On the basis of this information, it is evident that contaminants generated by past operations in the 100 Area affect the Hanford Reach."

The Nez Perce ERWM maintains that no relationship is evident between the calculations presented in appendix B, the groundwater discharge analyses used to develop a groundwater discharge rate for contaminated groundwater discharging to the Hanford Reach in the 100 Area, and the "estimated flow rate" presented in Table 2-2, in liters/minute. Groundwater velocity rates would be more appropriate to estimate the potential for contaminants in the 100 Area groundwater Plumes to impact the Hanford Reach.

Page 22: Paragraph 1: Sentence 1

Strontium-90 has been detected in a number of plumes across the Hanford Site.

The Nez Perce ERWM would like to know where on the plume the samples taken, by whom, at what time of year, with what type of methodology, and the matrix of the plume aquifer?

Page 22: Paragraph 3

Uranium. Uranium-contaminated groundwater was found in monitoring wells associated with liquid-waste-disposal facilities at the 100-F (plume 100F-2) and 100-H Areas (plume 100H-2) (Evans et al. 1990). Detectable concentrations of uranium were found to be entering the river during the 1990 sampling of 100 Area springs (DOE-RL 1992d) in springs adjacent to the 100-B/C, 100-K, 100-N, 100-H, 100-F Areas.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to know if any daughter products were detected, i.e. Radium. Why wasn't the public informed, at the discovery of uranium entering the river? Was speciation and adsorption within the aquifer taken into account? Why is there no description of interaction between the elements?

Page 22: Paragraph 5: Sentence 6

In addition to direct discharges of contaminated cooling water, the Hanford Reach received and continues to receive contaminants indirectly through contaminated effluent to soil column waste disposal units or through leaks from pipelines and groundwater discharge.

How much contamination has leaked through the pipelines, at what locations, were there any monitoring wells? Also, are there any injection wells on the Hanford Reach?

Page 22: Paragraph 6: Sentence 1

A summary of radioactive constituents discharged during 1990 to the Hanford Reach from the 100 Area is shown in Table 2-3.

The Nez Perce ERWM notes that this is not a complete list. Were the material safety data sheets (MSDS) for each operation looked at?

Page 22: Paragraph 6: Sentence 2

In addition, radioactive and non-radioactive constituents discharged during 1990 in liquids to ground-disposal facilities are shown in Table 2-4.

The Nez Perce ERWM points out that this is not a sufficient list. The magnitude of comprehensive evaluations that should be done in order to satisfy Milestone M-30-02 as listed on Page 1: Paragraph 6: Sentence 1, would dictate that all the pertinent information be used.

Page 22: Paragraph 6: Sentence 5

Although additional contaminants are disposed of in the river, the focus of this documents remains on the contaminants of potential concern identified in subsection 2.2.1

The Nez Perce ERWM asks what additional contaminants are being referred to here? Are there direct discharges to the river that have not been discussed in this document?

Page 24: Paragraph 1: Sentence 1

Water-quality samples from the Columbia River have been collected upstream of the Hanford Site (at Vernita Bridge and at Priest Rapids Dam), and downstream of the Site (at Richland Pump house [water intake]) to determine the effect of Hanford operations on river-water quality.

The Columbia River Impact Evaluation Plan provides very little information concerning monitoring periods, sampling design, or data collection methods. The Nez Perce ERWM asserts that without addressing these aspects, additional sample collections may be based on the assumption that none of the existing data are usable. The Columbia River Impact Evaluation Plan should identify previous data collection details, at least by reference, to identify those previously collected data that could be usable and to identify areas of data gaps.

Page 24: Paragraph 2: Sentence 2

The report provides quantitative data for those specific radionuclides detected, such as ^{3}H, ^{60}Co, strontium-89 (^{89}Sr), ^{90}Sr, ^{99}Tc, iodine-129 (^{129}I), iodine- 131 (^{131}I), cesium-137 (^{137}Cs), uranium-234 (^{234}U), uranium-235 (^{235}U), uranium-238 (^{238}U), and $^{239,240}Pu$.

The Nez Perce ERWM asks for more data on these specific radionuclides.

Page 24: Paragraph 3

Hanford Site Environmental Reports from 1970 to 1990 were used to construct Figures 2-6 through 2-8. Data used to develop these figures are annual averages for the various constituents. It was not possible to use the same reporting period for every potential contaminant because the data were not measured every year, were not detected, or were simply not reported in each annual environmental report. In addition, some data were reported as negative numbers (due to correction for laboratory background radiation levels) and could not be used for logarithmic plots.

This paragraph indicates that the methods used in the Hanford Site Environmental Reports may need to be examined more closely.

Were the chemical tests taken at the same time period? Were the tests taken at the same sites? What was the methodology used for the sampling? The Nez Perce ERWM would like to know if the geochemistry of the river has been taken into account. The sampling stations do not seem representative for the amount of area the river covers. The statement on Page 5: Paragraph 3: Sentence 1, states that there are 58 miles of Hanford reach. The statement on Page 8: Paragraph 1: Sentence 5 states that there are low energy areas in the river. How do the sampling station positions take this into account? The sentence on Page 7: Paragraph 4: Sentence 6 states that daily flow rates can vary from 1000 m^3/s to 7000 m^2/s. How have the flow rates been taken into account? The reported results do not seem to allow for adequate evaluations to be used for the purpose of ensuring adequate progress toward Hanford Site compliance with CERCLA (Page 1: Paragraph 2: Sentence 2).

Page 24: Paragraph 4: Sentence 2 (Bullet 1)

- The levels of contaminants in river water have been decreasing.

The Nez Perce ERWM notes that the figures do not illustrate that the levels of contaminants are decreasing, rather they appear to be increasing. The U.S. Department of Energy should either test this statistically or use the proper caveats. The data should be corrected for seasonality.

Page 24: Paragraph 5: Sentence 1

Thus, except for ^3H, these data do not show any significant adverse impact on overall river-water quality that can be attributed to Hanford Site operations at this time.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management observes the data does not support this conclusion. Our sense is that the statistical methods are not very rigorous. For example, do the data meet the assumptions of the t-test? Also no trend test was performed. The tone of the conclusions seems too positive.

Page 29: Figure 2-7

Because there are admitted gaps in the data collection (Page 24: Paragraph 3: Sentences 3 and 4) the sampling methodology is in question. What is important is not the "quantitative" view but the qualitative view, i.e. the overall concentration is important.

Page 30: Figure 2-8

The 1990 concentration amount is not significantly different from the 1976 concentration amount. Why have the decay products not been taken into account? The Nez Perce ERWM notes that Figure 2-8 seems to demonstrate no significant decreasing trend in total uranium, in contrast to the statement on Page 24: Paragraph 2: Sentence 2: Bullet 1.

Page 31: Table 2-6

The Nez Perce ERWM asks how the river flow rates are taken into account with this chart?

Page 32: Paragraph 4: Sentence 4

River-water sampling was conducted once during this study, and samples were analyzed for a comprehensive list of potential contaminates including the dangerous waste constituents as identified by the state of Washington in WAC 173-303-9905.

River sampling was done only once during this study. The Nez Perce Department of Environmental Restoration and Waste Management notes that river sediment sampling data is missing, and that the Columbia River Impact Evaluation Impact Plan has two sampling sites. Providing more information on the sampling would be helpful.

Page 32: Paragraph 5: Sentence 2

Both spring studies found the discharges from springs were small relative to the flow of the Columbia River, and downstream river sampling demonstrated that the impacts to river-water quality of groundwater discharges were minimal, and, in most cases, negligible.

What were the methods involved in terms of evaluating the relative volumes between the springs and the river? Did the sampling include any sediment sampling? The Nez Perce ERWM would like to know how many samples were taken, where they were taken, and were there more than two samples taken?

Page 32: Paragraph 5: Sentence 3

According to the Dirkes study, localized areas of impact were observed within the river near the spring discharge zone, with radionuclide concentrations above drinking water standards.

This sentence establishes that there are radionuclides exiting from springs along the river. If the Dirkes study found results that indicated that radionuclides were in fact entering the river, the Nez Perce ERWM asks why there was no follow up examination on the sediments? Many of the radionuclides do not float, thus, do not add up significantly in samples taken from the top of a water column. The results should have been oriented towards the chronic aquatic levels. The term "negligible" is a qualitative statement based on what parameters? Is this "negligible" discharge applicable to spawning steelhead and salmon?

Page 32: Paragraph 5: Sentences 6 - 8

In 1991, samples were obtained at a spring and the river at Hanford river mile 9.0 (DOE-rl 1992d). The ^{3}H and ^{90}Sr concentration in the spring were 15, 900 and 3,210 p Ci/L, respectively. In the river, ^{3}H and ^{90}Sr concentrations were 300 and 8.1 p Ci/L, respectively.

The Nez Perce ERWM notes that this spring is one tenth of a mile or about 161 meters downstream from the previously mentioned stream. What was the sampling distance from the shore, the depth, and the riverbed composition?

Page 32: Paragraph 5: Sentence 9

Although the river provides considerable dilution capacity, it is evident that groundwater discharges to the river cause localized impacts on a small scale.

Could this sentence be explained with more detail in terms of how the conclusion was determined?

Page 33: Paragraph 1: Sentence 1

Outside the areas near the spring discharge zones, however, average river-water contaminant concentrations were below drinking-water standards (chemical contaminants were generally undetectable)(Dirkes 1990).

The Nez Perce ERWM asks where are the locations for these samples, at what depth, and at what time of year were the samples taken?

Page 33: Paragraph 2: Sentence 2

These relatively small springs flow intermittently and appear to be influenced by the river stage (Dirkes 1990; DOE-RL 1992d).

The Nez Perce ERWM asks that the term "relatively" be defined further. The springs are called intermittent. Where are the references for this? Where is the information depicting the actual aquifer dimensions? Do the springs' discharge extend out into the riverbed?

Page 33: Paragraph 5: Sentence 2

The reports further noted that localized zones of contaminated river-water quality were observed; however, the zones of impact rapidly dissipated downstream.

The Nez Perce ERWM asks where is the data for this observation?

Page 33: Paragraph 5: Sentence 3

Downstream river sampling demonstrated that the effects of groundwater discharges on river-water quality were very small due to the high dilution factor.

The Nez Perce ERWM would like to see the data. Do these tests include lower water column sampling, or bed load sampling?

Page 33: Paragraph 6: Sentence 1

Sediments of the Hanford Reach are known to contain low levels of radionuclides of Hanford origin.

How did this statement become quantified regarding the amount of contamination present? The Nez Perce ERWM would like to know where the samples were taken, at what depth, and at what time of year?

Page 33: Paragraph 6: Sentence 2

The sampling of sediment on the shoreline and river bottom along the Hanford Reach has been performed intermittently between 1957 and 1989.

Intermittent sampling at odd intervals with no controls is at the very least questionable scientific methodology.

Page 35: Paragraph 2: Sentence 1

The 1991 sampling of the 100 Area springs (DOE-RL 1992d) also sampled sediments from springs along the 100 Area of the Columbia River.

The Nez Perce ERWM would like to see where the sample locations are located. Are they representative for the stream morphology and was a map depicting those locations presented?

Page 35: Paragraph 4: Sentence 5

Because of the continued influx of uncontaminated sediments from upstream and export of contaminated sediments downstream, it is anticipated that there will be further dilution of radioactivity in sediments along the Hanford Reach.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to know what the basis was for the conclusion in this statement? There is no evidence presented showing that the sediments will be diluted. The statement is technically incorrect because the sediments will be buried and the ability to detect the radiation will become harder, but the sediments probably will not become diluted.

Page 35: Paragraph 5: Sentence 1

The present Environmental Monitoring Program includes radiation surveillance at selected locations along the Hanford Reach (Woodruff and Hanf 1991).

The Nez Perce ERWM asks who selected the sites for sampling? What was the criteria? Was qualitative geomorphology taken into account?

Page 36: Paragraph 2: (Bullet 3)

Discrete particles of contamination, containing ^{60}Co, believed to be metallic flakes, possibly pump or valve components used in the production reactors. The aerial survey of the Hanford Site performed in 1988 (Reiman and

Dahlstrom 1990) collected information of gamma-ray emitting radioisotopes. This survey noted the presence of a number of areas along the Hanford Reach outside of constructed facilities that have elevated radioisotope concentrations. The most common radionuclides identified by the survey were ^{60}Co and ^{137}Cs.

The Nez Perce ERWM notes that this paragraph is confusing. Were the metallic flakes determined through aerial surveys? The presence of metallic ^{60}Co swirling around in the drinking water is noted.

Page 36: Paragraph 3: Sentence 4

Concerns associated with potential adverse environmental effects from discharging radioactive materials prompted initiation of many radioecological studies at the Site (Becker 1990).

Could more information including the references from Becker 1990 be provided to the Nez Perce ERWM for clarity here?

Page 36: Paragraph 5: Sentence 3

Although the food web accounted for transfer of radionuclides through the river ecosystem, the concentration factors for most radionuclides were lowest at the higher trophic levels (Becker 1990).

This statement is quite sweeping in scope. The Nez Perce Tribe Department of Environmental Restoration and Waste management suggests that some supporting information should be provided from the Becker reference.

Page 36: Paragraph 5: Sentence 4

Thus, food chains appear to result in a biodilution of radionuclide concentrations in larger animals.

The Nez Perce ERWM asks if the use of the term "biodilution" can be substantiated with the data that has been provided. The term "biodilution" is not in common usage.

Page 37: Paragraph 2: Sentence 1

The Hanford Environmental Monitoring Program entails opportunistic sampling of biota at the Site, including aquatic biota from the Hanford Reach.

How many fish were caught, at what locations, and at what depth? This is not a very comprehensive sampling method for such an important

document. Does the information from the fish obtained, provide a method for ensuring adequate progress under the regulations as listed on Page 1: Paragraph 2: Sentence 2?

Page 37: Paragraph 2: Sentence 4

Strontium-90 was more variable; however, mean concentrations were low (less than 0.04 p Ci/g wet weight) in all samples.

Because wet weight is used in applications for assessing uptake by predators, and because wet weight concentrations are lower than those based on dry weight, The Nez Perce Tribe Department of Environmental Restoration and Waste Management questions if concentrations were also based on a dry weight basis? If so, what were the results? Dry weight concentrations usually have reduced variability since the moisture factor has been taken into account.

Page 37: Paragraph 2: Sentence 5

Jaquish and Bryce (1989) could find no meaningful differences between fish samples collected upstream and downstream of the Site and therefore could not find any measurable influence on fish from radionuclides released to the Hanford Reach due to current or past Site operations.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to obtain information about where the fish were caught, at what time of year, and at what depth? The conclusion is based on insufficient supporting information, and it is unknown whether the sample size was large enough to support statistical inferences of "meaningful" differences.

Page 37: Paragraph 2: Sentence 6

However, it should be noted that fish are mobile within the Hanford Reach and the opportunistic sampling methods used by the Environmental Monitoring Program may be insufficient to detect impacts.

The Nez Perce Tribe Department of Environmental Restoration and Waste management notes that without additional sampling design information, it is impossible to determine whether previous sampling was sufficient to detect impacts. It is further recommended that additional data for risk assessment purposes be collected in the framework of carefully defined data quality objectives.

Page 37: Paragraph 3: Sentence 2

Canada goose eggshells collected from islands along the Hanford Reach have detectable levels of ^{90}Sr with the highest average concentration, from 1986 to 1987, measuring 1.6 pCi/g (Rickard and Price 1990).

Because the Canada geese usually eat food out of the muds, and their eggshells were found to have ^{90}Sr, the Nez Perce Tribe Department of Environmental Restoration and Waste management asks if this aspect further inspected? Were the sediments adequately tested for contaminants?

Page 37: Paragraph 3: Sentence 5

Radionuclides (^{60}Co, ^{90}Sr, and ^{137}Cs) were not detected in tissue samples of mallard ducks collected along the Hanford Reach.

The Nez Perce Tribe Department of Environmental Restoration and Waste management would appreciate a listing of the collection methods used for waterfowl.

Page 37 Paragraph 4: Sentences 2 and 3

Metals (lead, cadmium, and mercury) were measured in nest debris (feces and food scraps) at a great blue heron rookery at the Site. The levels of these metals in the heron rookery were less than levels reported at other Pacific Northwest locations (Fitzner et al. 1982).

The Nez Perce Tribe Department of Environmental Restoration and Waste Management observes that the data are insufficient for statistical analysis or conclusions.

Page 37: Paragraph 4: Sentence 4

Organochlorine residues were found in low measurable concentrations in great blue herons collected along the Hanford Reach (Fitzner et al. 1988).

The Nez Perce Tribe Department of Environmental Restoration and Waste management would like a list of the organochlorides found, and whether they were found on any of the Material Safety Data Sheet's onsite?

Page 37: Paragraph 4: Sentence 5

According to the authors, these residues seemed to exert little influence on reproductive success and were believed to originate on heron wintering grounds located off the Hanford Site.

The Nez Perce ERWM would like to know where the authors got the reproductive data? Could more information be produced on this subject?

Page 37: Paragraph 5: Sentence 4

Four elements (bromine, mercury, rubidium, and selenium) remained relatively constant.

The Nez Perce ERWM asks why the concentrations of these four elements remained constant? What were the levels of concentration? The paragraph's subject is on the food web and the meaning is unclear.

Page 38: Paragraph 1: Sentence 3

Environmental studies and monitoring date have not shown, however, that the observed contaminant concentrations have resulted in any significant adverse impact to the Hanford Reach ecosystem.

The Nez Perce ERWM asks if the data that supports the conclusion indicated in this sentence be produced for a more thorough interpretation.

Page 39: Paragraph 2: Sentence 3

This chapter concludes with an analysis of contaminant transport through each significant migration pathway in Section 3.3.

The Nez Perce ERWM asserts that the analysis of contaminant transport is premature in the terms of the material presented so far. There is no supporting data on the methods used, the locations of samples, the time, and geochemistry.

Page 41: Paragraph 2: Sentence 2

There is no quantitative information to partition ground water flow between the surface or subsurface seeps; however, the consensus is that subsurface flow predominates (Dirkes 1990; DOE-RL 1992d).

The Nez Perce ERWM asks if more supporting documentation and data can be produced to show how this statement relates to Page 21: Table 2-2? This statement is also appears to be in conflict with the statement on Page 33: Paragraph 2: Sentence 3.

Page 41: Paragraph 3: Sentence 4

Potential impacts, however, would be limited to environmental receptors since human access to the 100 Area is limited by institutional controls.

This statement does not agree with the statement on Page 32: Paragraph 2: Sentence 3 (Bullet 3). The Nez Perce ERWM notes that CERCLA-based risk assessment guidance requires consideration of potential future-use scenarios. Human access to the 100 Area may not be restricted institutionally in the future; therefore, EPA directs, in Risk Assessment Guidance for Superfund (RAGS), that data be obtained for evaluating the human health impacts due to future exposure by ingestion of water or sediment or by direct contact at the seeps. EPA also typically considers inadvertent intrusion as an exposure scenario; therefore; the assumption that human exposure need not be considered at the seeps is not acceptable for risk assessment purposes.

Page 41: Paragraph 5: Sentence 2

Recent analysis of river-water quality do not show appreciable differences between sampling points upstream and downstream of the Hanford Site.

Based on the information and methodology presented so far, the differences in contaminant concentrations from the two sample points is not enough to make a definitive statement indicating little or no difference. The Nez Perce Tribe Department of Environmental Restoration and Waste Management points out that Tritium is very different. Other chemicals, may or may not exhibit a difference. The statistical analysis needs to be better supported. The amount of physical space separating the two points is enough to consider evaluating the characteristics along that area.

Page 41: Paragraph 5: Sentence 3

In addition, river-water sampling conducted in conjunction with spring sampling shows that impacts to river-water quality dissipate rapidly downstream due to high dilution factors (subsection 2.2.2.2).

This statement on high dilution factors is based on the information presented up to this point. The Nez Perce ERWM asks that this statement be backed up to include data, and references.

Page 41: Paragraph 5: Sentence 4

Consequently, it is not likely that any significant adverse downstream environmental or health-impact associated with the river-water column would be extensive.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management asks, "Do you mean that there is a significant impact, but it would not be 'extensive'? Please Explain."

Page 41: Paragraph 5: Sentence 5

The most significant contaminant exposure pathways are judged to be human ingestion of water and fish, and aquatic organism immersion within the water column.

Please refer to the statement on Page 36: Paragraph 1: Sentence 1 (Bullet 3). The Nez Perce Tribe Department of Environmental Restoration and Waste Management wishes to note that metallic flakes of ^{60}Co could be ingested while water skiing or eating fish caught in the Hanford Reach.

Page 41: Paragraph 6: Sentence 3

In addition, there is no evidence of past or present significant ecological impacts associated with contaminated sediments. This does not necessarily mean that significant impacts have not occurred, only that the tools to evaluate impacts are lacking. However, data collection activities needed to fill this gap are discussed in section 5.2.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management observes that on Page 90: Paragraph 7: 5.2.2.3 Task 3, contaminants entering the Hanford Reach from discharging groundwater are retained or deposited within the river sediments. However, although monitoring is proposed under this task, details concerning sediment data collection activities are not provided. Data needs to provide input for addressing the sediment pathway for risk assessment include analysis for chemicals of concern, particle size analysis, evaluation of suspended sediments, and data for hydraulic modeling of sediment distribution and transport.

Page 42: Paragraph 1: Sentence 2

Biotic pathways of contaminant transport in the Hanford Reach are difficult to evaluate due to ecosystem complexity, but are based to a large degree on the food chain.

This statement establishes that the biotic pathways and the food chain exist.

Page 42: Paragraph 2: Sentence 2

However, human ingestion of fish is judged to be the most significant biotic pathway for evaluating human exposure to contaminants in the river (Woodruff and Hanf 1991).

If this sentence is related to the sentence above (Page 42: Paragraph 1: Sentence 2), would it make sense to verify the amount of exposure occurring through the consumption of waterfowl also as referenced to the statement on Page 37: Paragraph 3: Sentence 2? The Nez Perce ERWM states that the American Indian population and their subsistence gathering provides yey another potential exposure pathway that should be examined. The statement on Page 36: Paragraph 1: Bullet 1 refers to shoreline contamination. The waterfowl including the endangered white pelican eat food from these shores.

Page 42: Paragraph 2: Sentence 4

However, human ingestion of fish is judged to be the most significant biotic pathway for evaluating human exposure to contaminants in the river (Woodruff and Hanf 1991).

The Nez Perce ERWM would like to see the data and the applicable exerpts from Woodruff and Hanf in support of this statement.

Page 42: Paragraph 4: Sentence 1

Exposures in non-aquatic sensitive habitats (as derived from 40 CFR Part 300, Appendix A) or in non-aquatic critical habitats (as defined in 50 CFR §424.02(d)) of endangered or threatened species to contaminants in the Hanford Reach do not, at this time, appear to be significant concerns from the perspective of the environmental evaluation.

The Nez Perce Department of Environmental Restoration and Waste Management asserts that because this is an environmental evaluation, it

would make sense to consider the Endangered Species Act before superficially treating endangered and threatened species.

Page 42: Paragraph 4: Sentence 3

The eagles, however, primarily consume spawned-out Chinook salmon which, during their life cycle, spend little time within the Hanford Reach, and, while within the Reach, do not feed during spawning.

Does this mean that Chinook salmon spawning in the radioactive contaminated sands and gravels along the Hanford reach are not eaten by bald eagles? The Nez Perce Tribe Department of Environmental Restoration and Waste Management notes that spawning salmon in the area may not feed, but they do breathe and pass large amounts of water across their gills, providing yet another pathway for contamination. The relative importance of uptake from food vs. absorption from water across the gills should be discussed in the Columbia River Impact Evaluation Plan, with the data collection methods to support addressing this issue for risk assessment identified. Bioavailability of contaminants should also be considered.

Page 42: Paragraph 5: Sentence 1

In keeping with the qualitative and conservative nature of the model used for this impact evaluation and the absence of Site-specific data, biological (except bioaccumulation), chemical, and physical processes that would affect contaminant fate were generally disregarded.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management is aware that physio-chemical fate and transport processes generally tend to dilute and retard the movement of chemicals from sources to exposure points, however, they should not be ignored.

Page 43: Paragraph 1: Sentence 3

The results represent a biased estimate of the potential exposure to the evaluated contaminants of potential concern.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management believes that ignoring sediment accumulation is not necessarily conservative.

Page 43: Paragraph 2: Sentence 1

In Section 2.2, empirical data from surface springs and seeps, groundwater monitoring wells located near the river's edge, and surface-water monitoring of the Hanford Reach were used to assess the current status of contaminants in the groundwater (at the river's edge) and in the ambient river-water column.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to know if the "empirical data" are the same as the data used to construct Page 16: Table 2.1?

Page 43: Paragraph 2: Sentence 1

In Section 2.2, empirical data from surface springs and seeps, groundwater monitoring wells located near the river's edge, and surface-water monitoring of the Hanford Reach were used to assess the current status of contaminants in the groundwater (at the river's edge) and in the ambient river-water column.

The data presented in Section 2.2 should be reexamined due to the methodology, lack of quality assurance and lack of quality control.

Page 43: Paragraph 4: Sentence 3

The contaminant concentrations together with the estimated flow rates were used to derive a contaminant flux for each groundwater plume.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management would like to point out that the descriptions in Subsection 3.3.1 and Appendix B of the calculations performed to derive contaminant flux through the cross-sectional areas of each plume are difficult to understand or duplicate. Subsection 3.3.1 states that groundwater transport "was estimated based on information presented in Appendix B. This appendix identifies groundwater plumes, groundwater flow direction, and estimated flow rates. The contaminant concentrations together with the estimated flow rates were used to derive a contaminant flux for each ground water plume." Appendix B appears to calculate specific discharge rates for each plume using a macroscopic continuum approach. That is, it is assumed that for any cross section A, the specific discharge, v, is defined as $v = Q / A$, where v is specific discharge, Q is the volumetric flow rate, and A is the cross-sectional area of the aquifer materials through which the plume passes (Freeze and Cherry 1979).

This is confusing because the groundwater discharge analysis summary presented on Table B-1 shows hydraulic gradient, hydraulic conductivity, aquifer thickness, and plume width in terms of feet (ft) and feet per day

(ft/d), with groundwater discharge rate reported in gallons per minute (gpm). Furthermore, paragraph two under the groundwater discharge analyses subsection of page B-8 mentions that pumping rates or scenarios are being evaluated. Does this mean that the pumping rates presented in Table B-1 are equal to the volumetric flow rates for each plume?

The Nez Perce Tribe Department of Environmental Restoration and Waste Management also notes that hydraulic conductivity values reported in Liikala et al. ranged from 49 to 5940 ft/d (p. B-8). Therefore, use of a single hydraulic conductivity value of 700 ft/d for all plumes is likely to introduce error into the estimates of transport rates and volumes of contaminated water reaching receptor points. This range of hydraulic conductivity values being average into a single value also calls into question the validity of assuming that plumes can be segregated into separate streams for purposes of assessing impacts to the Columbia River due to spring discharges, as discussed on page B-15.

Page 43: Paragraph 5: Sentence 2

The groundwater source concentrations under the above assumptions become the current plume-specific riverbank concentrations for each identified contaminant of potential concern.

The Nez Perce Tribe Department of Environmental Restoration and Waste Management requests the collection of more site-specific data to allow more refined calculations of groundwater concentrations.

Page 43: Paragraph 5: Sentence 2

The groundwater source concentrations under the above assumptions become the current plume-specific riverbank concentrations for each identified contaminant of potential concern.

The assumption that the contaminants do not become impeded, adsorbed, or transformed during subsurface transport indicates that further studies have to be based on models that may not be adequate.

Page 44: Paragraph 3: Sentence 4

Downstream turbulent mixing is neglected because the downstream flow rate is assumed to be far greater than the rate of downstream turbulent mixing.

If the river is assumed to be of uniform dimensions, then turbulent mixing would not occur because of laminar flow conditions.

Page 47: Paragraph 2: Sentence 5

In addition, because the equation uses the groundwater contaminant mass discharge rate and not the groundwater concentration, the river water concentration C(x,y) will not equal the groundwater concentration at the point of discharge.

The Nez Perce Department of Environmental Restoration and Waste Management notes that the river water concentration is not supposed to equal the ground water concentration at the point of discharge.

Page 47: Paragraph 2: Sentence 7

This level of resolution is judged to be adequate for 94 km (58 mile) length of river.

The Nez Perce ERWM asks if this level of resolution is adequate for making real life assumptions since some variables were not included, and because there is a high degree of error involved.

Page 47: Paragraph 3: Sentence 2

The depth and width of the channel are estimated, and a conservative low velocity for the river is obtained from the volumetric flow rate and the cross-section area of the channel (velocity = flow rate / cross-section area).

The Nez Perce ERWM asks that the data to support the estimates be provided for clarity. Is the data detailed enough to apply assumptions along the curving 94 km river channel?

Page 47: Paragraph 5: Sentence 1

The transverse dispersion coefficient is a calculated parameter based on a correlation for natural streams (Fischer et al. 1979).

The Nez Perce ERWM points out that the use of this coefficient will skew results towards the ultramixing view, when the model is based on a laminar flow regime.

Page 50: Paragraph 2: Sentence 1

If the data available for the model parameters are reasonably well known and the model is appropriately applied, (i.e., conditions in the river are not widely different from the assumed conditions), the concentration estimates provided by the computational model are order-of-magnitude results.

The Nez Perce Points out that the data is not well known and that the conditions in the river seem to be widely different from the computer model.

Page 50: Paragraph 2: Sentence 2

This level of accuracy is adequate for the preliminary and qualitative nature of this impact evaluation.

Based on the information presented so far it is true that the level of accuracy is adequate. But the Nez Perce ERWM maintains that concluding that a problem does or does not exist based on this information is preliminary and without supporting information.

Page 50: Paragraph 3: Sentence 1

The use of a line source to represent contaminant release resulting from groundwater discharge is likely the largest departure from the natural system incorporated into the model.

The Nez Perce ERWM believes that the use of a line source is only one of many departures from the natural system. The largest departure is the amount of distance that needs to be mapped.

Page 50: Paragraph 3: Sentence 3

In the natural system, we anticipate the groundwater discharge to occur throughout the surface area of the river bottom, resulting in a distributed contaminant source.

The Nez Perce ERWM notices that the use of a line source should be replaced with the integration of an area source.

Page 50: Paragraph 3: Sentence 5

Consequently, the model has a tendency to overestimate the contaminant concentrations in the source areas due to the highly concentrated source term or to underestimate the concentration at the discharge point due to the assumption of instantaneous vertical mixing.

The model does not reflect a concentrated point source, but actually reflects a very narrow band of possible contamination concentrations. Assuming instantaneous vertical mixing may prove to be wrong in light of the very different flow velocities on the bottom of a river near a source.

The model does not tend to overestimate anything based on the data presented.

Page 79: Paragraph 4: Sentence 2

For the purposes of this environmental evaluation, it is likely that the most significant contaminants, in terms of concentration toxicity, and persistence, have been included.

The Nez Perce ERWM asks if assuming that the ground water investigations are complete is a poor assumption based on the information presented up to this point.

The Columbia River Impact Evaluation Plan can be very useful for identifying where the areas of need are.

Following are some examples:

- There is a lack of scientific information on the contaminant plume fluxes.
- The unbounded host aquifer should be mapped and its physical properties need to be determined.
- The mineralogy of the Hanford subsurface should be determined
- The structural configuration of the subsurface should be mapped.
- The water quality should be examined from a geochemical perspective.
- The intersections of the seeps, springs, plumes and the river should be precisely determined.
- There should be a comprehensive well positioning program to adequately account for the plume boundaries.
- Quality control and quality assurance should be given a high priority.
- There should be a complete aquatic sampling program.
- The plumes should be proved in a fashion similar to proving an ore body.
- The Columbia River should be geologically mapped on a 1" to 100' scale and the geomorphology considered.
- The river bottom sediments should be mapped and the sediment transport characteristics determined.
- The water level has known to be variable from season to season. This affects the sediments, the springs, and the environment and should be considered.
- The ecology of the plants, fish and waterfowl should be further identified (separately and together) for contaminant pathway understanding.

- The contaminant mixing modeling needs to be examined from a multi-dimensional perspective.
- The contaminant pathways for fish need to be determined.
- Monitoring stations need to be set up in strategic positions based on the geologic mapping program.

The characterization of the Hanford Reach will be extensive, and must be comprehensive and scientifically sound. The gaps in the data are evident in the Columbia River Impact Evaluation Plan and illustrate the need for a total and comprehensive rewriting of this document. The Columbia River Impact Evaluation Plan does not meet the objectives outlined on the first page.

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APPENDIX B

FIGURES AND TABLES

from

The Columbia River Impact Evaluation Plan
(DOE/RL-92-28, Rev. 0)

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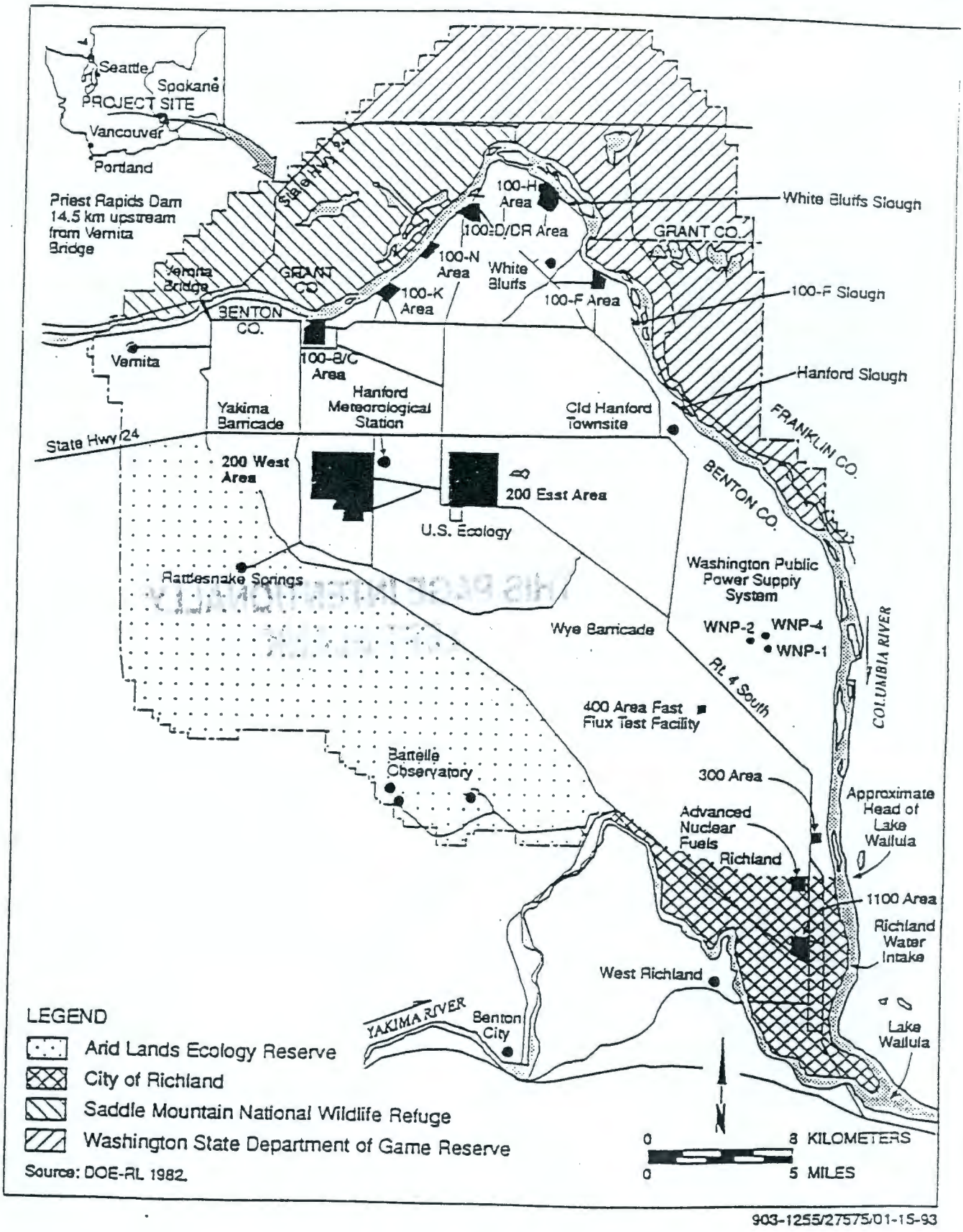

Figure 2-1. Hanford Site

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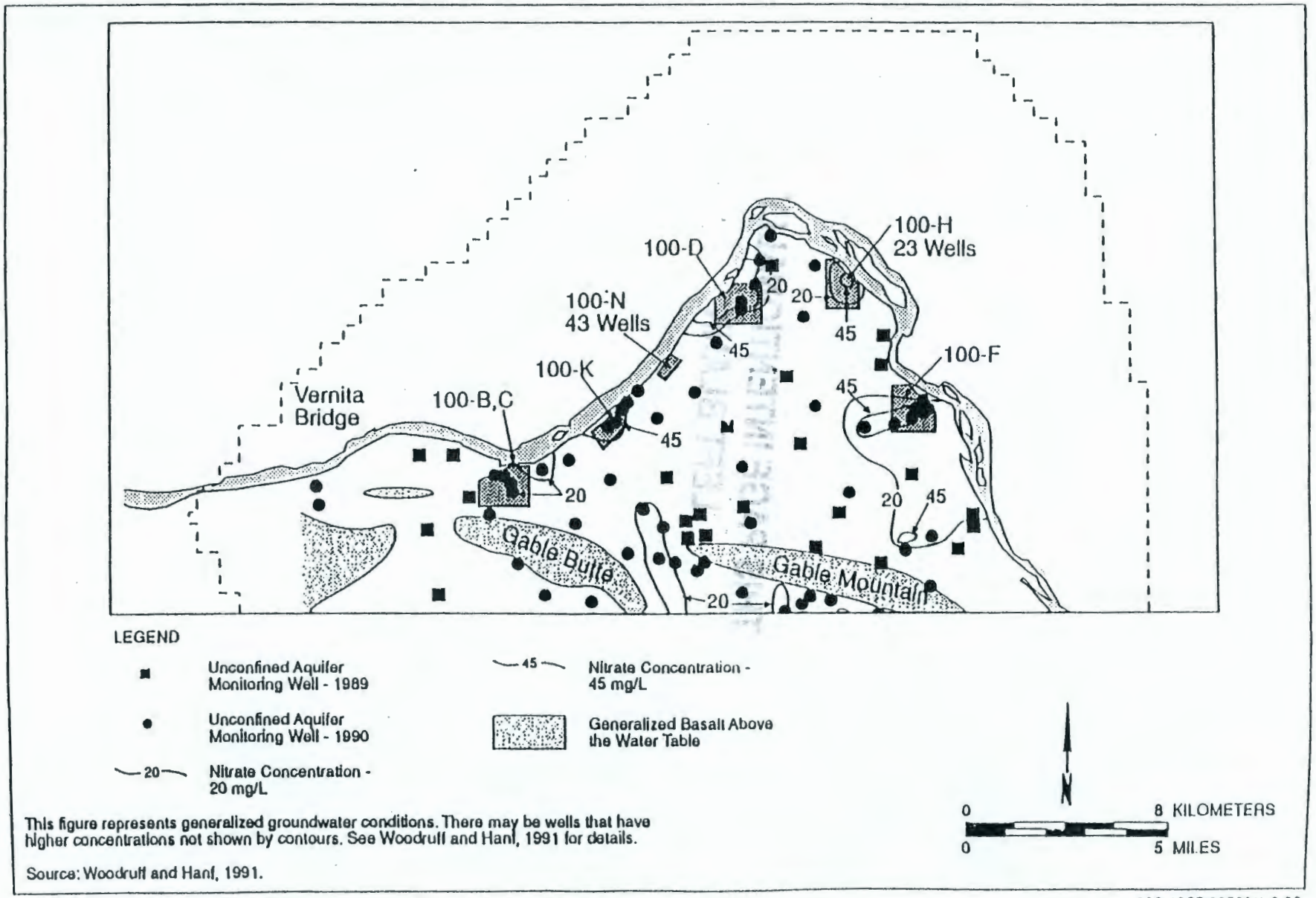

Figure 2-3. Nitrate (NO_3) Concentrations in the 100 Area Unconfined Aquifer, 1990.

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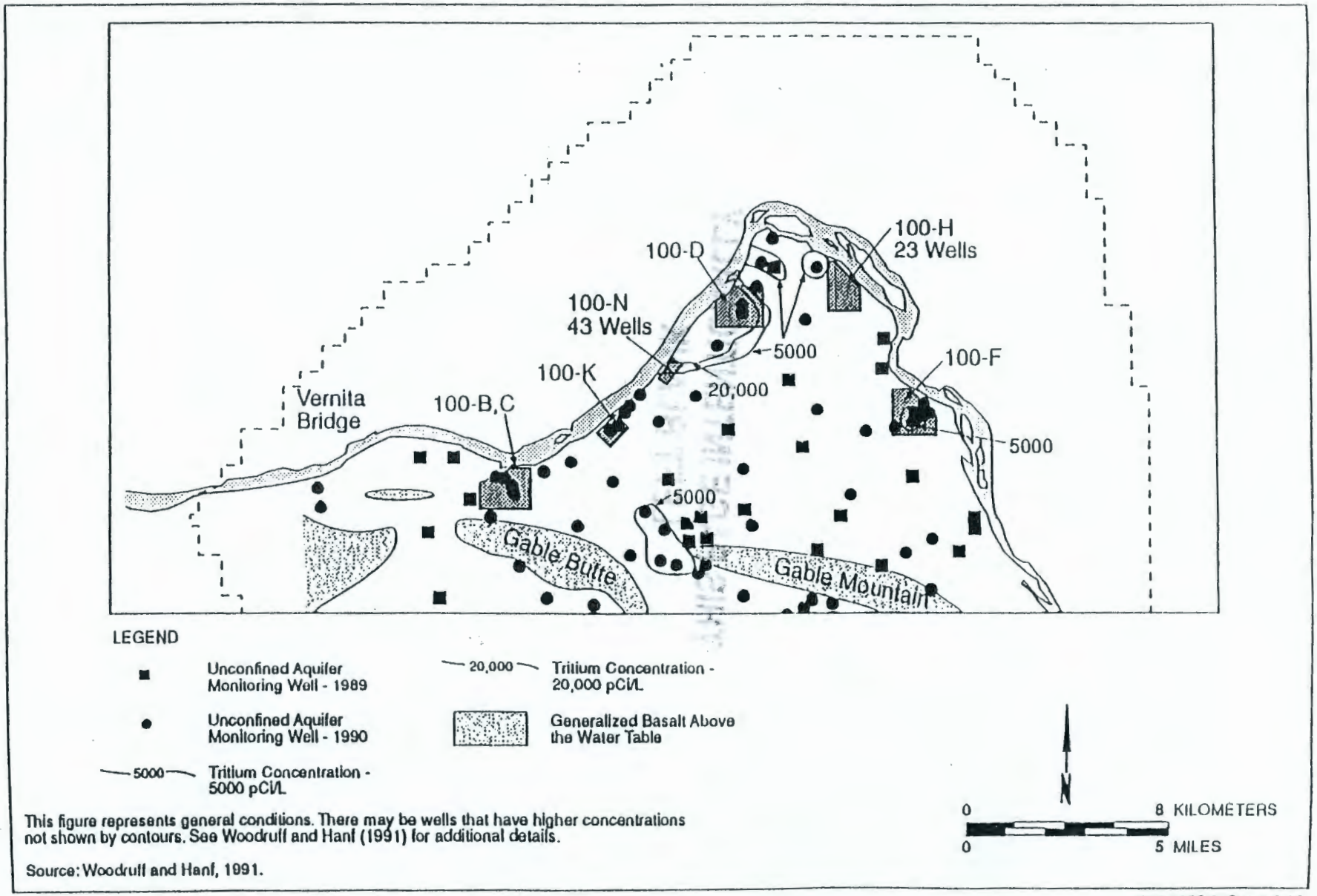

This figure represents general conditions. There may be wells that have higher concentrations not shown by contours. See Woodruff and Hanf (1991) for additional details.

Source: Woodruff and Hanf, 1991.

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Figure 2-4. Tritium (^3H) Concentrations in the 100 Area Unconfined Aquifer, 1990.

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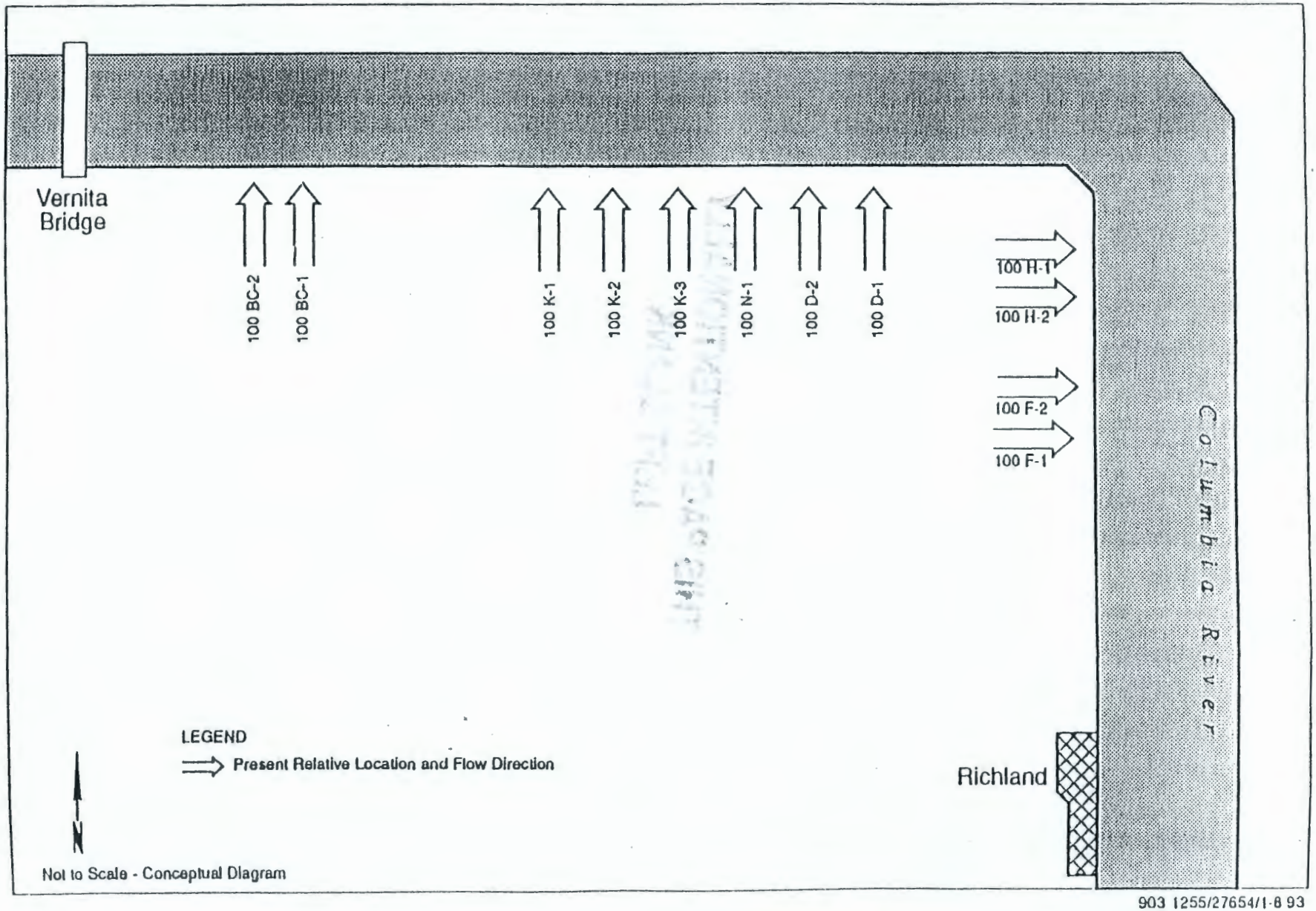

Figure 2-5. Relative Plume Locations and Projected Flow Directions Along the Hanford Reach.

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Table 2-2. Estimated Groundwater Flow Rates and Contaminant Source Concentrations in Hanford 100 Area Groundwater Plumes.

Groundwater Plume	Contaminant of Potential Concern	Maximum Source Concentration (1989 data)	Estimated Flow Rate
100BC-2	^{90}Sr	54 pCi/L	757 L/min
100BC-1	^{90}Sr	53 pCi/L	757 L/min
	Cr	0.02 mg/L	
	NO_3	56 mg/L	
100K-1	NO_3	66 mg/L	1,938 L/min
	^{3}H	880,000 pCi/L	
100K-2	NO_3	51 mg/L	1,938 L/min
	Cr	0.11 mg/L	
100K-3	Cr	0.16 mg/L	3,785 L/min
100N-1	^{90}Sr	23,000 pCi/L	2,850 L/min
	^{3}H	220,000 pCi/L	
100D-2	^{3}H	96,000 pCi/L	3,785 L/min
100D-1	^{90}Sr	45 pCi/L	3,028 L/min
	^{3}H	53,000 pCi/L	
	Cr	0.69 mg/L	
	NO_3	120 mg/L	
100H-1	NO_3	56 mg/L	757 L/min
	Cr	0.42 mg/L	
100H-2	^{99}Tc	3,700 pCi/L	233 L/min
	U	150 pCi/L	
	Cr	0.79 mg/L	
	NO_3	520 mg/L	
100F-2	U	143 pCi/L	1,163 L/min
	NO_3	170 mg/L	
100F-1	^{90}Sr	145 pCi/L	1,163 L/min

Reference: Evans et al. 1990, PNL Groundwater Database accessed September 1992.
*See Appendix B for details.

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Table 2-3. Radionuclides in Liquid Effluents Discharged to the Hanford Reach from the 100 Area in 1990 (Woodruff and Hanf 1991).

Radionuclide	Release, Ci
Tritium	38
Strontium-90	1.9
Cesium-137	0.11
Ruthenium-106	0.07
Cobalt-60	0.04
Cesium-134	0.02
Antimony-125	0.02
Manganese-54	0.015
Plutonium-239,240	0.0000021
Plutonium-238	0.00000036

Table 2-4. Liquids Effluents Discharged to Ground Disposal Facilities in the 100 Area in 1990 (Woodruff and Hanf, 1991).

Nonradioactive constituents

Constituent	Release, kg
Aluminum Sulfate	69,300
Polyacrylamide	205
Sodium Sulfate	110,230

Radioactive constituents

Radionuclide	Release, Ci
Tritium	38
Manganese-54	0.26
Cobalt-60	7.8
Strontium-90	14
Cesium-134	0.12
Cesium-137	7.1
Plutonium-238	0.0025
Plutonium-241	0.047

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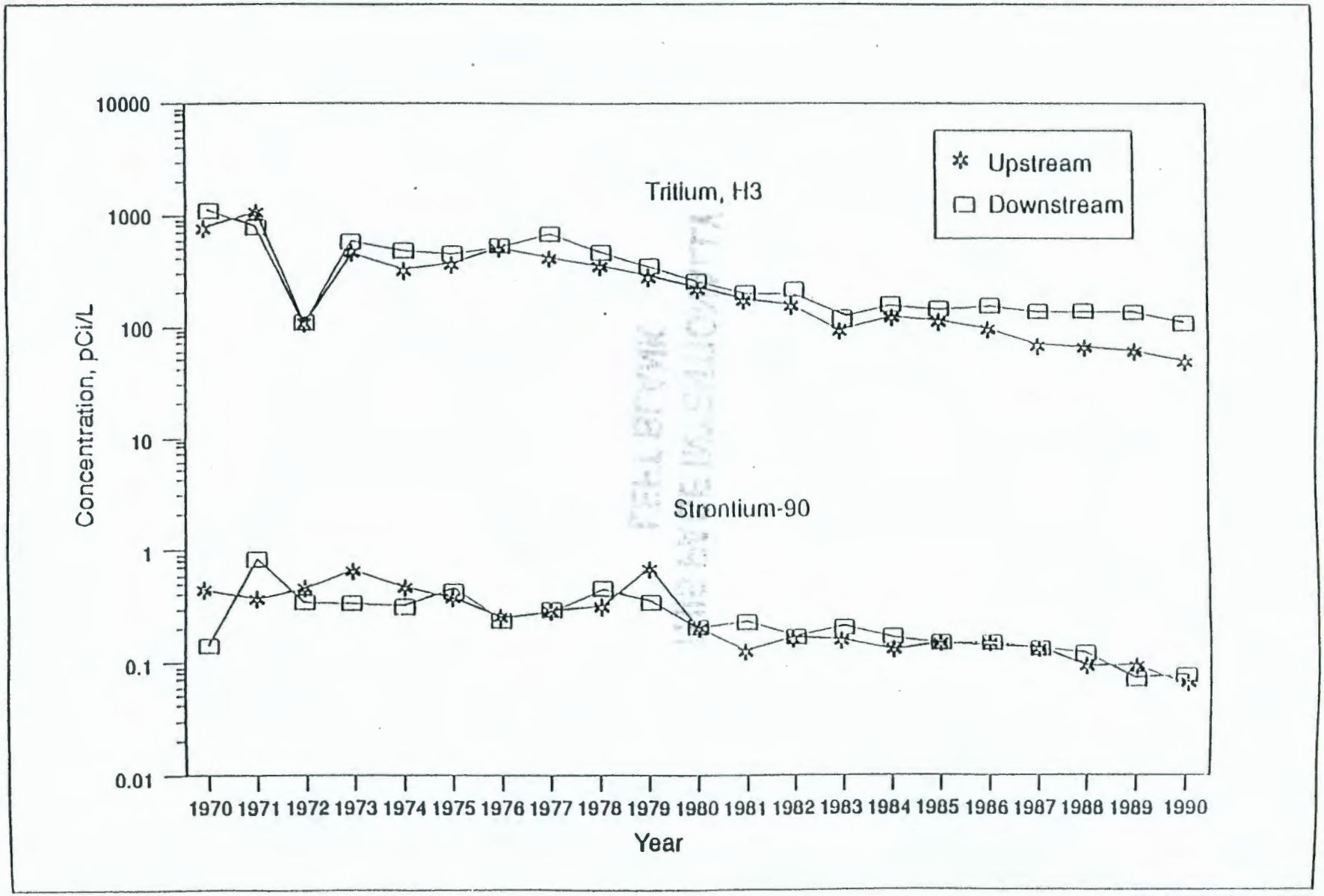

Figure 2-7. ^{3}H and ^{90}Sr Concentrations in the Columbia River Since Reactor Shutdown.

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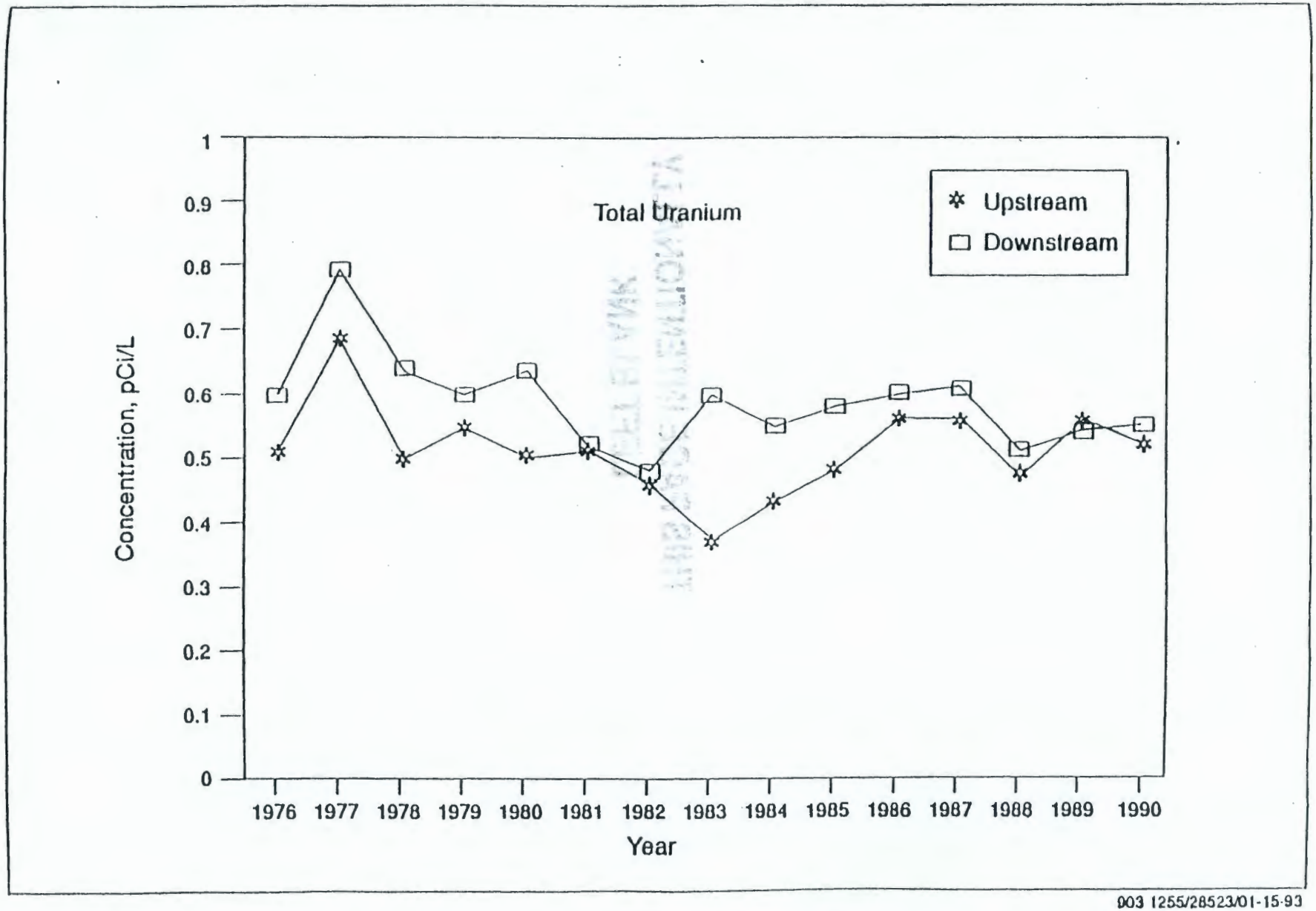

Figure 2-8. Total Uranium in the Columbia River Since Reactor Shutdown.

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Table 2-6. Differences in Contaminant Concentrations in the Columbia River at Sample Locations Upstream and Downstream of the Hanford Site.

	1989		1988		1987		1986		1985	
	upstream	downstream	upstream	downstream	upstream	downstream	upstream	downstream	upstream	downstream
Tritium										
mean (pCi/L)	63	129	70	132	70	130	100	150	110	150
sd	8.66	31.18	10.39	17.32	17.32	17.32	17.32	34.64	31.18	36.37
n	12	12	12	12	12	12	12	12	12	12
t_s	-7.065*		-10.633*		-8.485*		-4.472*		-2.892*	
Strontium-90										
mean (pCi/L)	0.08	0.07	0.1	0.12	0.14	0.13	0.15	0.16	0.15	0.16
sd	0.017	0.035	0.035	0.035	0.035	0.035	0.035	0.052	0.043	0.05
n	12	12	12	12	12	12	12	12	12	12
t_s	0.890		-1.399		0.699		-0.552		-0.525	
Technetium-99										
mean (pCi/L)	0.07	0.5	nm	nm	nm	nm	nm	nm	nm	nm
sd	1.645	1.559	nm	nm	nm	nm	nm	nm	nm	nm
n	12	12	nm	nm	nm	nm	nm	nm	nm	nm
t_s	-0.657		-	-	-	-	-	-	-	-
Uranium-total										
mean (pCi/L)	0.46	0.44	0.37	0.41	0.46	0.51	nr	nr	0.38	0.48
sd	0.052	0.121	0.069	0.121	0.069	0.139	nr	nr	0.173	0.329
n	12	12	12	12	12	12	nr	nr	12	12
t_s	0.526		-0.994		-1.116		-	-	-0.931	
Nitrate										
mean (mg/L)	0.09	0.11	0.14	0.3	0.09	0.2	0.17	0.3	0.13	0.1
sd	0.036	0.541	0.052	0.346	0.052	0.173	0.139	0.52	0.139	0.087
n	13	13	12	12	12	12	12	12	13	13
t_s	-0.132		-1.584		-2.109*		-0.836		0.659	

Notes:

1. Upstream sample location Priest Rapids Dam for ^3H, ^{90}Sr, ^{99}Tc and Vernita Bridge for nitrate. Downstream sample location is Richland Pumphouse for all constituents.
2. nm = not measured; nr = not reported
3. sd = standard deviation, n = number of samples, t_s computed t value between upstream and downstream means for each year
4. $H_0: \mu_{up} = \mu_{down}$; $H_1: \mu_{up} = \mu_{down}$; criteria for rejecting H_0: $t_s < -t_{\alpha, n_{up}+n_{down}-2} \Rightarrow t_{0.01,25} = 1.717$, $t_{0.01,24} = 1.711$; * Upstream concentration significantly less than downstream concentration, $p < 0.05$

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