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Investigation of Ground-Water Seepage from the Hanford Shoreline of the Columbia River

W. D. McCormack
J. M. V. Carlile

November 1984

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
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INVESTIGATION OF GROUND-WATER SEEPAGE FROM THE HANFORD SHORELINE OF THE COLUMBIA RIVER

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Pacific Northwest Laboratory
Richland, Washington 99352

PREFACE

This report presents the results of a study performed by the Hanford Environmental Surveillance Program to investigate the general characteristics of ground water entering the Columbia River from the Hanford Site.

The Hanford Environmental Surveillance Program is conducted at the Hanford Site by the Pacific Northwest Laboratory, which is operated by Battelle Memorial Institute for the United States Department of Energy. Radiologic conditions in the Hanford environment are monitored and a record is provided of radionuclides and radiation levels attributable to natural causes, worldwide fallout, and Hanford operations.

In addition to routine monitoring activities, special studies are conducted that periodically intensify investigations of specific aspects of the Hanford environment. These special studies serve to update or expand the program's data base, as necessary, with regard to those aspects of the Hanford environment which have the potential to change notably with time.

The study described herein was conducted between the fall of 1982 and the fall of 1983 to supplement the efforts of the Environmental Surveillance Program, which evaluates ground-water discharges to the river indirectly through routine sampling and analysis of Columbia River water. Ground-water discharges are also evaluated by the Ground-Water Surveillance Program, which monitors the unconfined aquifer beneath the Hanford Site.

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Assistance in the design and execution of this study was provided by M. J. Sula, P. A. Eddy, T. L. Liikala, L. S. Prater and J. T. Rieger, members of the Hanford Environmental Surveillance Program.

Water samples were collected by K. Byrne, S. R. Bivins, J. D. Harrison and W. W. King, who were supervised by M. R. Quarders.

Secretarial support was provided by K. E. Shoop and the 300 Area word processing team. M. A. McKinney edited this report and arranged for its publication.

In addition, the authors acknowledge the staff at the Grant County PUD and Priest Rapids Dam whose cooperation permitted the coordination of this investigation with periods of reduced Columbia River flow rates.

SUMMARY

Ground-water discharges to the Columbia River are evaluated by the Hanford Environmental Surveillance and Ground-Water Surveillance Programs via monitoring of the Columbia River and Hanford ground water, respectively. Both programs have concluded that Hanford ground water has not adversely affected Columbia River water quality downstream from the Hanford Site, nor has it affected the public through use of the river as a source of municipal drinking water, for irrigation of foodstuffs, or for fishing and other forms of recreation.

This report presents the results of a study undertaken to supplement the efforts of the above mentioned programs by investigating the general characteristics of ground water entering the Columbia River from the Hanford Site. Specific objectives of the exploratory investigation were to identify general shoreline areas where Hanford-related materials were entering the river via ground-water seepage, and to evaluate qualitatively the physical characteristics and relative magnitudes of those discharges.

The study was conducted in two sequential phases between October 1982 and September 1983. Phase 1 involved visual inspection of approximately 41 miles of Columbia River shoreline, within the Hanford Site, for indications of ground-water seepage. As a result of that inspection, 115 "springs" suspected of discharging ground water were observed and recorded. These springs were accessible only during the periods of low water level caused by reductions in Columbia River discharge rates from Priest Rapids Dam.

During Phase 2, water samples were collected from a distribution of these springs and analyzed for Hanford-related materials known to be present in the ground water. The specific materials used as ground-water indicators for the majority of samples were tritium and nitrate (as NO_3^-) due to their predominance in much of the Hanford ground water. Uranium analyses were used in place of tritium for samples collected in the vicinity of the 300 Area where uranium is a primary ground-water constituent. The magnitude

and distribution of concentrations measured in the spring samples were consistent with concentrations of these materials measured in ground water near the sampled spring locations.

Water samples were also collected from the Columbia River to investigate the localized effects of ground-water discharges occurring above and below river level. These samples were collected within 2 to 4 m of the Hanford shoreline and analyzed for tritium, nitrate, and uranium. Elevated concentrations were measured in river samples collected near areas where ground-water and spring concentrations were elevated. All concentrations were well below applicable DOE Concentration Guides.

CONTENTS

FIGURES

TABLES

INTRODUCTION

In the fall of 1982, the Hanford Environmental Surveillance Program initiated a study of the Hanford shoreline of the Columbia River to expand its data on ground water entering the Columbia River. Specific objectives of the exploratory investigation were to identify general shoreline areas where Hanford-related materials were entering the Columbia River via ground-water seepage, and to evaluate qualitatively the physical characteristics and relative magnitudes of those discharges.

The study was conducted in two sequential phases. Phase 1 involved visual inspection of the Hanford shoreline to locate shoreline springs and record their physical characteristics. In Phase 2, based on the information obtained during Phase 1, selected springs and locations in the Columbia River were sampled and analyzed for tritium and nitrate. These materials were chosen as ground-water indicators for the bulk of samples because of their predominance in much of the Hanford ground water. Uranium analyses were used in place of tritium for samples collected in the vicinity of the 300 Area where uranium is a primary ground-water constituent.

The study area encompassed 41 miles of Columbia River shoreline extending from approximately 1 mile upstream from the 100-B Area to approximately 1 mile downstream from the 300 Area (Figure 1). This area was selected, after review of ground-water surveillance data, to encompass all shoreline areas potentially affected by Hanford ground water.

Specifically excluded from the scope of this study were investigations of ground-water discharges as a function of time or Columbia River flow rate. Field investigations, to the extent possible, were scheduled to coincide with the occurrence of low river level in order to observe ground-water discharges under their probable maximum flow conditions. Also outside the scope of this study were direct investigations of ground-water discharges that did not occur on or very near to the Hanford shoreline. Those potential discharges were investigated indirectly through analysis of water samples collected from the Columbia River near the Hanford shoreline.

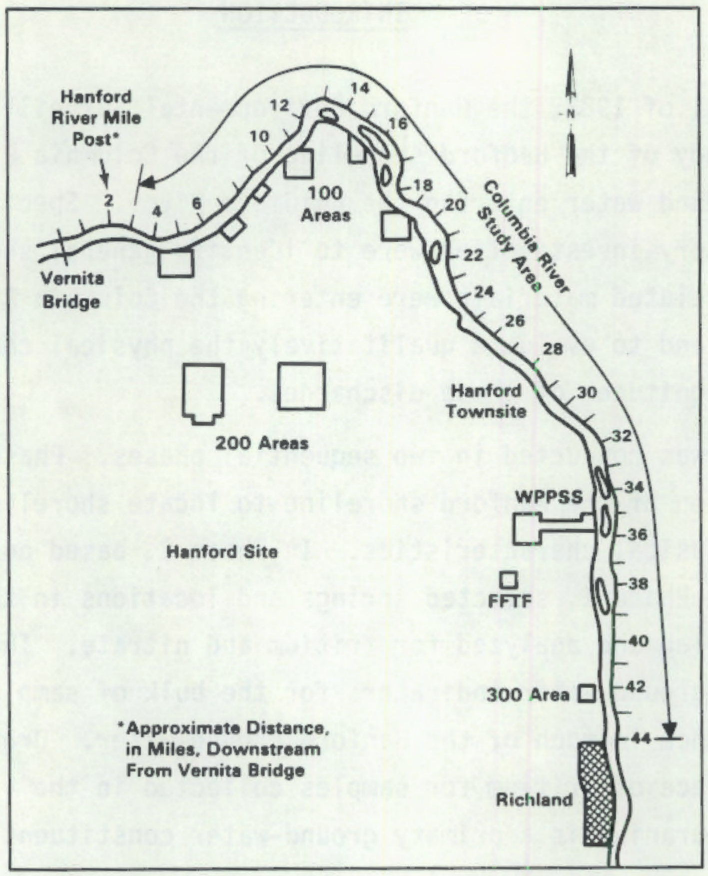

FIGURE 1. Ground-Water Seepage Study Area

BACKGROUND INFORMATION

Operations at the Hanford Site have resulted in the disposal of large volumes of clean and moderately contaminated cooling water and other process wastes to the ground. The bulk of radioactive materials in these streams was retained in the soil beneath the discharge points. Filtration and sorption by the soil column accounted for that retention, with only the more mobile materials traveling downward to the unconfined aquifer beneath the site. These operations and processes are discussed in detail in USERDA (1975) and Prater et al. (1984).

The Hanford Ground-Water Surveillance Program is responsible for monitoring the unconfined aquifer via a network of ground-water sampling wells. Monitoring data have indicated that mobile materials, including tritium, ^{129}I, ^{99}Tc, and nitrate, have migrated with the ground water as it flows beneath the site. A contour map of tritium concentration in the unconfined aquifer during 1983 illustrates this migration (Figure 2). Because the unconfined aquifer beneath the Hanford Site discharges into the Columbia River, the ground-water program personnel have concluded that Hanford related materials present in ground water near the shoreline are entering the river along with the aquifer's flow.

The Columbia River is monitored through the Hanford Environmental Surveillance Program. Samples of river water are collected at locations upstream and downstream from the site and analyzed for a variety of radioactive and nonradioactive materials. Hanford contributions to the river are evaluated through comparison of these analyses. Increases in downstream concentrations relative to those upstream are interpreted to be the result of Hanford discharges.

The last once-through cooling reactor was shut down in the early 1970's (USERDA 1975), leaving N reactor as the only production reactor in operation. Since that time, the only radionuclide routinely identified at extremely low concentrations in downstream samples, but higher relative to upstream, has been ^{129}I (Price et al. 1984). During 1982, the upstream

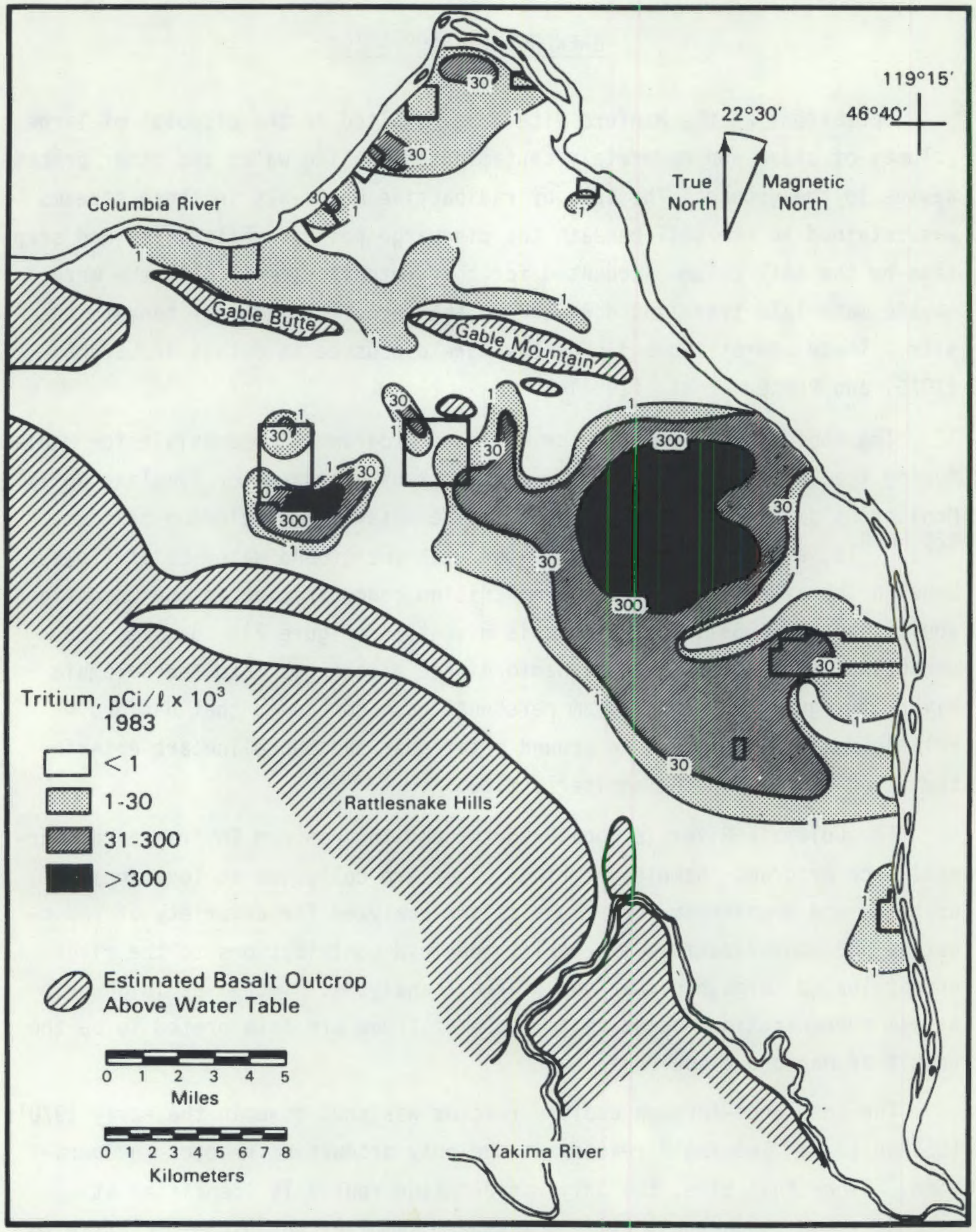

FIGURE 2. Distribution of Average Tritium Concentrations Measured in the Unconfined Aquifer During 1983 (Prater et al. 1984)

concentration of ^{129}I in the Columbia River averaged 6.2 X 10^{-6} ± 7.8 X 10^{-6} pCi/ℓ while downstream averaged 6.5 X 10^{-5} ± 3.3 X 10^{-5} pCi/ℓ. Potential onsite sources of this radionuclide have been the N reactor, which discharges small quantities of ^{129}I as a result of it's operations, and the 200 Area ground-water plume, shown in Figure 2, which contains low levels of ^{129}I.

In order to differentiate the contributions of these two sources to the measured downstream concentrations, the surveillance program personnel conducted a special study during 1981 and 1982. During this period of time, a third river sampler was installed and operated at a location downstream from the N reactor and upstream from the area where the 200 Area ground-water plume contacts the river. The results of that study indicated that N reactor discharges did not produce a detectable effect on concentrations of ^{129}I in the river and that ^{129}I in ground water entering the river downstream from the third sample location was the source of the elevated downstream concentrations.

Ground-water discharges via springs along what is now the Hanford shoreline have been documented as early as 1922 in a report describing the underground water supply in this region (Jenkins 1922). The routine evaluation of ground-water springs associated with known Hanford sources dates back to the mid 1960's. Springs in the vicinity of the 300 Area retention basin and domestic sewage leaching pits were routinely sampled and analyzed for selected biological, chemical, and radiological constituents. Springs on the shoreline near N reactor, resulting from the establishment of a liquid waste crib, have been, and continue to be, monitored routinely (Eliason 1967; Rokkan 1984; Greager 1982). In addition to these routine evaluations, smaller scale investigations were periodically conducted.

PHASE 1: SHORELINE INSPECTION

The shoreline was visually inspected to locate accessible ground-water discharges and to record their physical characteristics prior to sampling and analysis. Although the discharges from shoreline springs may have consisted primarily of river water which had entered the bank during previous high water, all locations were recorded and assumed to be ground water (refer to Prater et al. 1984 for a discussion of "bank-storage"). Inspections were scheduled to coincide with anticipated low water level and were terminated if the water level increased to the point that springs were inundated.

METHODS

Inspection of the shoreline was accomplished by walking near the water's edge at low river stage and noting indications of seepage. As springs were observed, they were assigned a unique identification number and their location was recorded. Because a consistent method was needed for relating spring locations to physical landmarks, all spring identification numbers and location descriptions were referenced to the Hanford river mile (RM) post system, i.e., numbered markers located on the Hanford shoreline of the Columbia River at one-mile intervals indicating shoreline distance downstream from the Vernita Bridge (see Figure 1). The upstream and downstream boundaries of the study area were RM 3 and RM 44, respectively. (RM 3 and RM 44 correspond approximately to USGS river miles 385 and 344 respectively, which are river miles measured upstream from the mouth of the Columbia River.) Recorded spring locations were numbered sequentially from the nearest upstream river mile. For example, the first spring downstream from RM 27 was numbered 27-1; the second was 27-2, etc.

In addition to numbering and recording the location of each spring, the following observations were recorded:

- physical description of the spring and its location
- relative magnitude of the spring flow rate
- temperature of the spring water

- proximity to other landmarks
- river condition, i.e., high/low, rising/falling
- time and date.

The shoreline inspection was conducted on nine days between November 4, 1982 and January 3, 1983. The inspection took advantage of a Grant County Public Utility District (PUD) flow reduction program that coincided with the inspection schedule. The PUD reduced the Columbia River flow rate from Priest Rapids Dam, located 12 miles upstream from the Hanford Site, to 36,000 cfs between 12:00 am and 6:00 am during the period October 15 through November 30, 1982. (The average monthly flow rate below Priest Rapids Dam in 1982 ranged from 80,000 to 210,000 cfs.) During, and for a short time following, these periods of reduced flow rate, abnormally low river levels were experienced along the Hanford reach of the Columbia River.

Inspection of the shoreline was complicated by the fact that most visible seepage occurred very near the river/shoreline interface which varied in elevation very rapidly due to changes in water flow rates past Priest Rapids Dam. Several springs were inundated by the rising river as their locations were being recorded, while others were observed to begin flowing as the river level fell. It was apparent that few, if any, of the observed springs were located far enough up the bank to escape being covered by the river for some portion of each day. Both the frequency of occurrence and magnitude of spring flows varied with fluctuating river level; these variable river conditions during the course of this investigation precluded uniform conditions for observing the springs.

RESULTS

Within the 41 miles of Hanford shoreline covered by the inspection, 115 river-bank springs were observed and documented (Appendix A). Three general types of river-bank springs were observed during the inspection:

- trickles or streams, above the current river level, emanating from rock covered banks -- This ranged from small trickles to relatively large flows over broad areas. These flows appeared to emanate directly from voids within unconsolidated gravels or from the interface between large rocks and surrounding saturated sand and silt. These types of springs were observed as high as two feet above the existing river level. Drainage patterns caused by these springs were observed on the river bottom indicating more extensive seepage at lower river levels.

- vertical "percolation" of water, both above and below the level of the river, from areas covered with fine sand and silt -- The percolations were upward flowing vertical columns of water that originated from a layer of unconsolidated coarse sand or gravel sandwiched horizontally between layers of fine sand or silt. This type of spring was not observed higher than 2 to 4 inches above the existing river level and was more often found at or below river level (as deep as 18 inches below the river surface).
- saturated sand and silt containing free water above the level of the river -- This type of seepage was observed in the narrow beach areas found at the base of bluffs and sand dunes. Free water commonly broke through the surface of the sand to form small rivulets flowing into the river. Holes dug into the beaches collapsed quickly and filled with water. In addition, layers of coarser sand were often observed to underlie these beaches and to contain additional free water.

No evidence of seepage from the bank was observed above the mean annual high-water elevation (vegetation line), and there was seldom evidence of seepage, either current or past, above the elevation of recent high water. Although active seepage was observed on the bank as high as 2 vertical feet above the river, most visible seepage was within approximately 1 foot of the existing river level.

PHASE 2: SAMPLING AND ANALYSIS

The objectives of sampling and analysis were to identify the general areas of Hanford shoreline where Hanford-related materials were entering the Columbia River via ground-water seepage and to evaluate qualitatively the relative magnitudes of those discharges. This was accomplished by analyzing water samples collected from a distribution of shoreline springs as well as locations in the river for materials chosen to be indicators of Hanford ground water. As with the shoreline inspection, sample collection was scheduled to coincide with periods of low water level in the river.

SAMPLING METHODS

The sampling schedule and methods were developed based on information obtained during the shoreline inspection. With the exception of those areas where springs were not observed, spring sampling locations were selected from the shoreline inspection record (Appendix A) to provide a sample at approximate half-mile intervals along the 41-mile study area. Columbia River water samples were also collected at half-mile intervals, but only along those sections of shoreline where ground water monitoring data had identified the presence of Hanford-related materials in the ground water (see Figure 2). Shoreline sections for RM 3 through RM 12, RM 14 through RM 22, RM 27 through RM 33 and RM 41 through RM 44 were identified for collection of river samples.

At each spring and river sample location, a 1-liter grab sample was collected in a 1-liter poly bottle. In most cases, spring sample containers were filled directly from the spring discharge. Where it was necessary to sample springs with low flow rates, a depression was dug in the bank from which water was scooped and transferred to the sample container. The potential for cross contamination in these cases was reduced by rinsing the trowel used for digging before and after each use and by lining the scoop used to transfer water from the depression to the sample container with a clean plastic bag prior to each use.

River samples were collected from the river's surface (upper 30 cm) within 2 to 4 m of the Hanford shoreline. At each river sample location, an aliquot of water was collected for a composite sample in addition to the 1-liter sample. Composite samples were collected along specific sections of shoreline to provide the large volume of water necessary to perform some of the additional analyses discussed in Appendix B. Composite sample intervals were selected to encompass the sections of shoreline adjacent to each onsite operating area. In addition, three composite sample intervals were identified between RM 27 and RM 33 to divide the ground-water plume that originates at the 200 Areas (see Figure 2) into three approximately equal shoreline sections. Composite sample intervals were as follows:

RM 3 to 5 (100-B Area)	RM 17.5 to 22 (100-F Area)
RM 5 to 7.5 (100-K Area)	RM 27 to 29 (200 Area plume)
RM 7.5 to 9.5 (100-N Area)	RM 29 to 31 (200 Area plume)
RM 9.5 to 12 (100-D Area)	RM 31 to 33 (200 Area plume)
RM 14 to 17.5 (100-H Area)	RM 41.5 to 44 (300 Area)

All composite samples contained 10 liters of river water, while aliquot volumes ranged from 1.25 to 2.5 liters depending upon the length of the composite interval. To ensure the comparability of each 1-liter sample and composite aliquot from a sampling location, water was collected in a single grab sample and split between the 1-liter sample and composite aliquot.

At the upstream end of each composite interval, an additional 1-liter grab sample was collected at the approximate middle of the river channel. These samples were intended to provide indications of concentrations in the river away from localized influences near the Hanford shoreline.

Sample collection was conducted by shoreline section as follows:

RM 3 through RM 12 was sampled December 18, 1982.
RM 14 through RM 33 was sampled January 22 and September 11, 1983.
RM 33 through RM 44 was sampled December 20, 1982.

The shoreline between RM 14 and RM 33 had to be resampled as a result of equipment failures on January 22 which prevented collection of samples downstream from RM 29. Although samples were collected between RM 14 and

RM 29 on the original sample date, they were duplicated on September 11, 1983 to provide a consistent set of data for that section of shoreline. Both sets of data are provided in this report.

ANALYTICAL METHODS

Samples collected between RM 3 and RM 40 were analyzed for tritium (^3H) and nitrate (NO_3^-) while samples collected between RM 40 and RM 44 were analyzed for nitrate and uranium. These are the primary constituents monitored by the Hanford Ground-Water Surveillance Program in those specific areas. Additional analyses performed on selected samples are described in Appendix B.

Following collection, samples were prepared, as necessary, prior to delivery to the lab for analysis. A 200-ml aliquot was drawn from each sample for nitrate analysis. Each aliquot was poured into an acid-rinsed plastic container, preserved with acid, and refrigerated. The first set of samples, collected December 18, 1982, was spiked with boric acid, as prescribed in the procedures for the nitrate electrode analytical method. Difficulties with the nitrate electrode led to selection of the brucine method which prescribes a sulfuric acid spike. All samples collected after December 12, 1982 were spiked with sulfuric acid. No sample preparation was required for samples requiring radiologic analyses. All samples were delivered to the analytical laboratory within 24 hours of collection.

All analyses were performed by United States Testing Co. according to their standard methods. Samples analyzed for tritium were distilled and the distillate counted directly using a liquid scintillation spectrometer with a minimum detectable concentration (MDC) of 300 pCi/ℓ. Uranium was extracted from nitric acid into ether, the ether phase evaporated, and the residue was plated on a stainless steel planchet for counting with a low-background gas flow proportional counter. The MDC for uranium analysis was 0.5 pCi/ℓ. Colorimetric techniques were used to measure nitrate after it had reacted with brucine. The MDC for nitrate analysis was 0.02 ppm.

RESULTS

Forty-one spring and 57 river samples were collected and analyzed for nitrate and tritium. Samples were collected from six springs and six locations in the river and analyzed for uranium and nitrate. Ten composite samples were constructed from aliquots of river water collected along subsections of the shoreline and analyzed for the same materials. The results of these analyses, as well as details of sample collection, are contained in Appendix C. Additional analyses performed on selected samples are described in Appendix B.

Table 1 provides a comparison of tritium concentrations measured in springs, in ground-water monitoring wells adjacent to the spring locations, and in the Columbia River. The concentrations in spring discharges ranged from levels comparable to those found in nearby wells to levels less than the analytical detection limit. Concentrations in composite river samples, also shown in Table 1, reflect the localized effects of ground-water discharges within those sections of shoreline where ground water and spring concentrations were elevated. Along shoreline areas where concentrations of materials in the ground water were relatively low or the number and magnitude of spring discharges were small, concentrations in the composite samples were comparable to those measured upstream from the site. Concentrations measured in samples collected near the middle of the river channel did not indicate any substantial increases relative to concentrations measured upstream from the Hanford Site. In no case did measured concentrations exceed applicable DOE Concentration Guides (USDOE 1981).

Although an attempt was made to sample under conditions that would maximize concentrations in springs on the river shoreline, the data presented in Appendix C are not estimates of maximum potential concentrations in the springs or river. Nor should they be interpreted as necessarily being representative of average conditions. The factors influencing the composition of spring discharges are complex and interdependent. The data contained in this report are specific to the conditions which prevailed during sampling and represent a single point on what is likely to be a broad distribution of potential concentrations.

TABLE 1. Comparison of Tritium Concentrations in Hanford Shoreline and Columbia River Samples

Shoreline Subsection	Shoreline Concentration[a], pCi/ℓ		River Concentration[a], pCi/ℓ		
	Well[b]	Spring	Composite Sample	Midriver Sample	Upstream Sample[c]
RM 3-5	4,770	5,900	600	100	100
RM 5.5-7.5	49,000	5,500	1,100	300	
RM 8-9.5	48,700	38,000	2,700	150	
RM 10-12	14,000	80	830	200	
RM 14-17.5	64,900	4,000	153	65	
RM 18-22	1,900	270	143	130	
RM 22-27	115	530	(e)	(e)	
RM 27-29	230,000	110,000	12,300	107	
RM 29.5-31	(d)	2,700	2,100	(f)	
RM 31.5-33	(d)	570	430	(f)	
RM 33-40	23,000	1,200	(e)	(e)	

(a) Maximum analytical result measured. To be compared to DOE Concentration Guide (USDOE 1981) of 3,000,000 pCi/ℓ.
(b) Maximum single measurement from any nearby monitoring well during 1983. (Data and analytical methods reported in Prater et al. 1984.)
(c) Average of concentration in samples collected from the Columbia River at Priest Rapids Dam during 1983 (Price et al. 1984).
(d) No ground-water monitoring well located adjacent to this section of shoreline.
(e) River sampling not performed along this section of shoreline (see discussion of sampling methods).
(f) Sample not collected.

Concentrations measured in samples of river water can be compared to average concentrations measured in the Columbia River upstream and downstream of the Hanford Site during 1983. These annual average upstream and downstream river concentrations are (Price et al. 1984):

	Upstream	Downstream
Tritium	100 ± 26 pCi/ℓ	130 ± 28 pCi/ℓ
Uranium	0.27 ± 0.08 pCi/ℓ	0.50 ± 0.15 pCi/ℓ
Nitrate	0.23 ± 0.04 ppm	0.27 ± 0.08 ppm

Measured concentrations of tritium, nitrate, and uranium in spring and river samples collected between RM 3 and 12, RM 14 and 22, RM 27 and 33, and RM 41 and 44, and their locations in relation to operating areas and facilities on the Hanford Site, are depicted in Figures 3 through 6 respectively. Additional results for ^{90}Sr, ^{99}Tc, ^{129}I and gross beta are discussed in Appendix B.

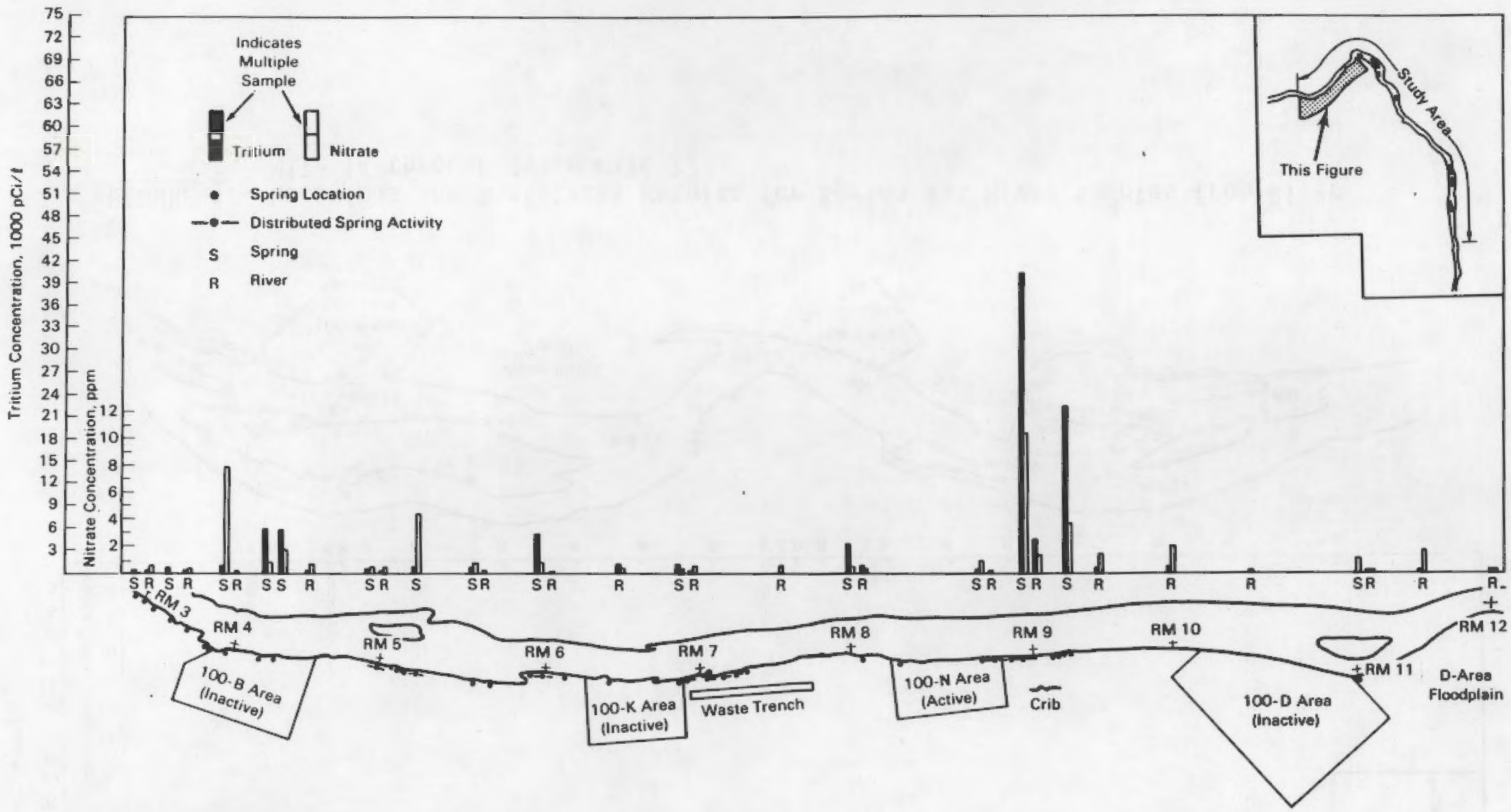

FIGURE 3. Locations and Analytical Results for Spring and River Samples from River Mile 3 through River Mile 12

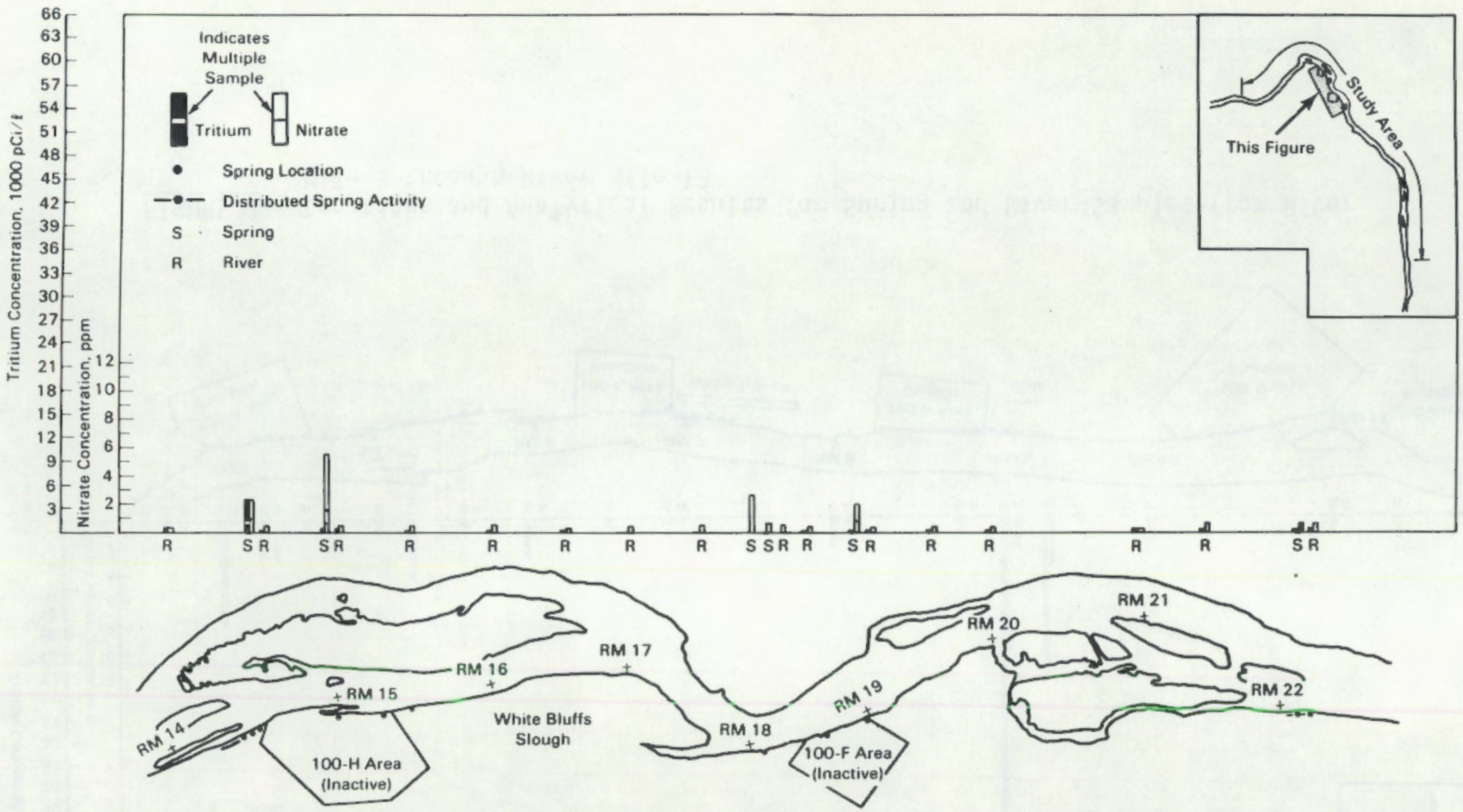

FIGURE 4. Locations and Analytical Results for Spring and River Samples from River Mile 14 through River Mile 22

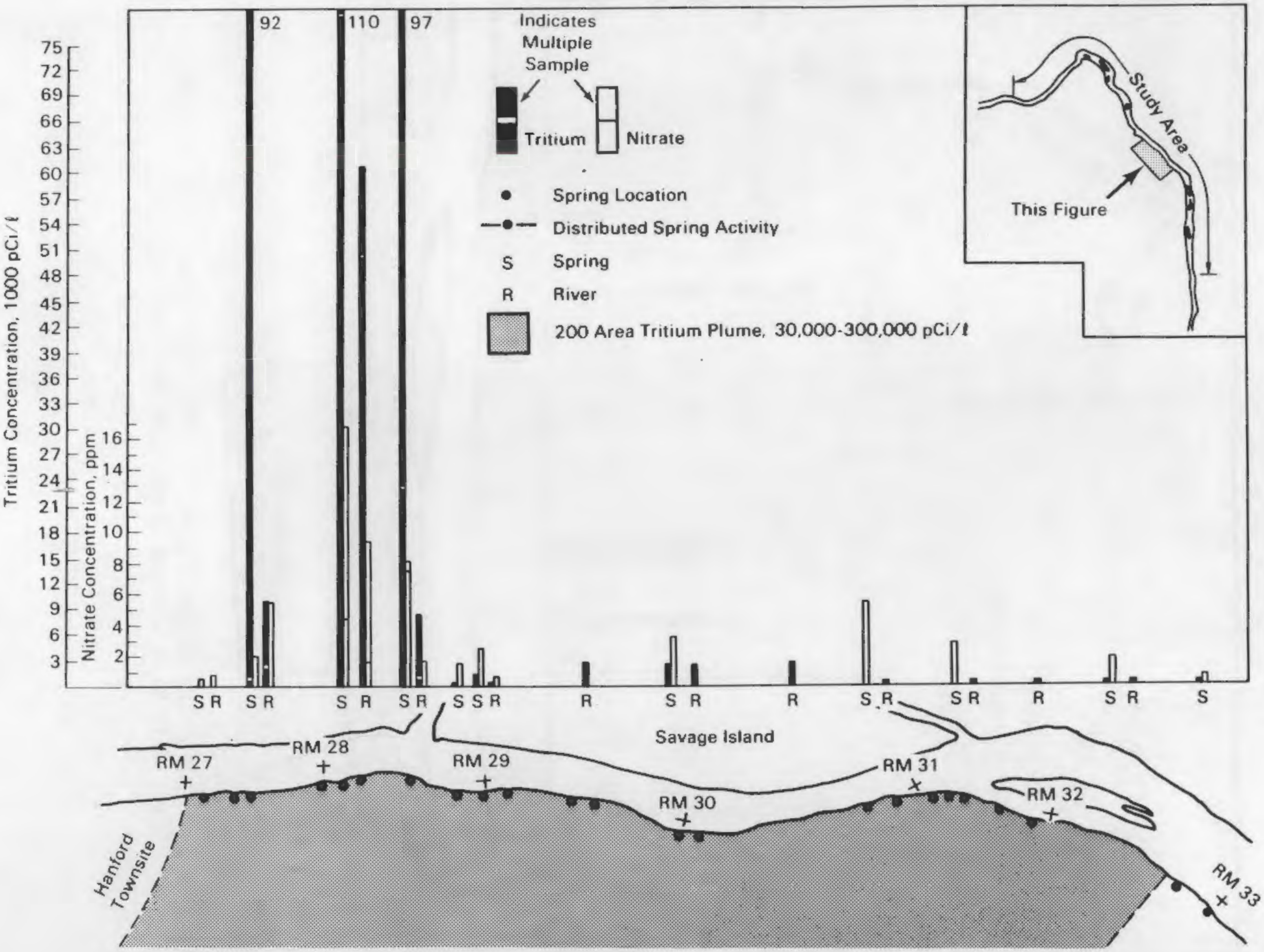

FIGURE 5. Locations and Analytical Results for Spring and River Samples - River Mile 27 through River Mile 33

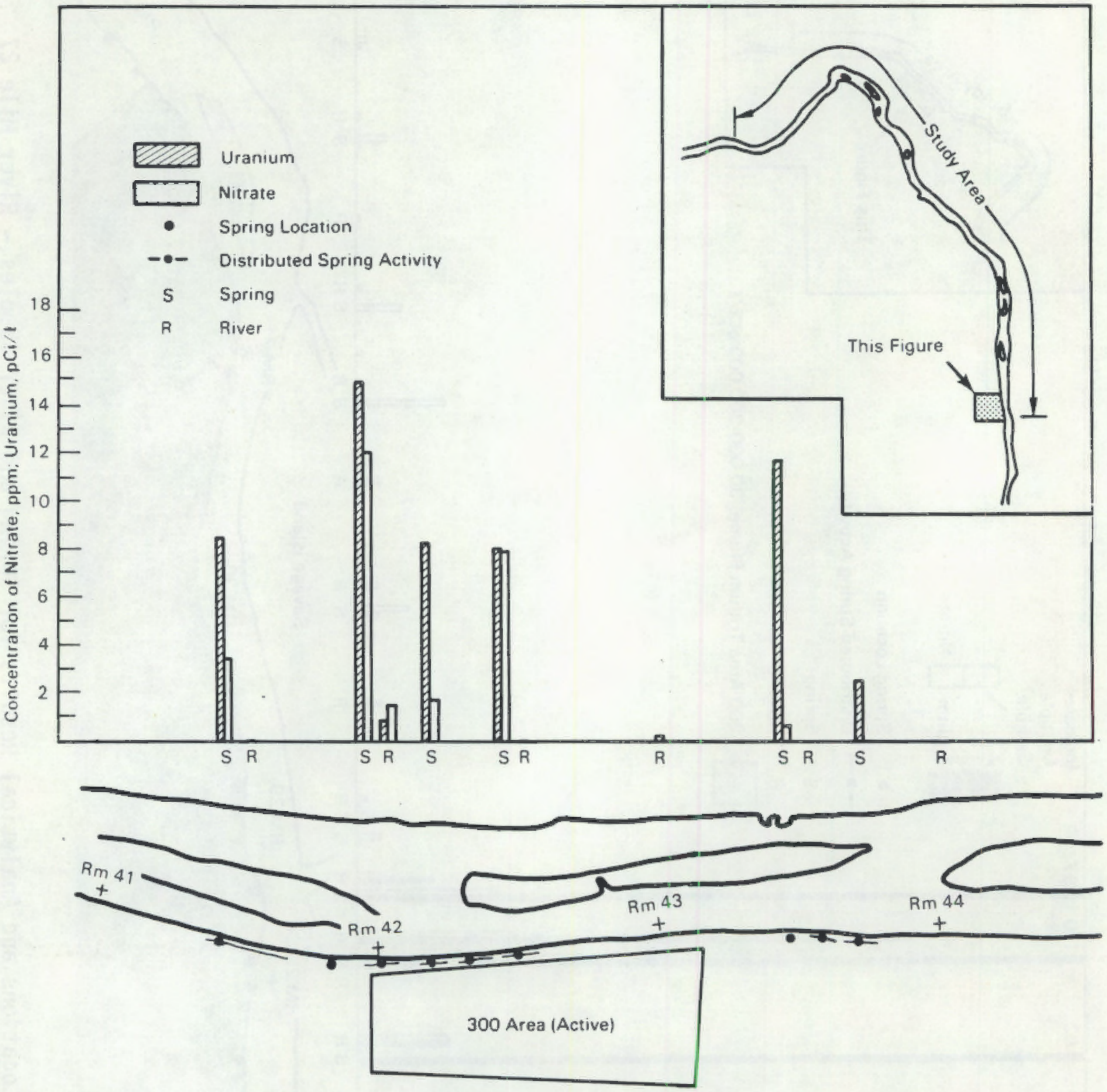

FIGURE 6. Locations and Analytical Results for Spring and River Samples - River Mile 41.5 through River Mile 44

CONCLUSIONS

Data collected during the course of this study complement the information obtained through routine monitoring of the ground water and Columbia River at the Hanford Site. The Hanford Ground-Water and Surface Environmental Surveillance Programs have documented:

- the movement of Hanford-related materials in the unconfined aquifer and their presence at the Hanford shoreline of the Columbia River (Prater et al. 1984), and
- the negligible downstream impact of ground-water discharges into the Columbia River (Price et al. 1984).

The results of this study have provided additional information regarding the location and characteristics of ground-water discharges from the Hanford shoreline. As illustrated in Figures 3 through 6, the predominant areas of ground-water discharge were in the vicinity of the 100-N Area, the old Hanford Townsite, and the 300 Area. However, the volume of ground water entering the river at these locations was very small relative to the flow of the Columbia River.

The results of this study also indicate that monitoring the unconfined aquifer is the most effective method of monitoring ground-water discharges to the Columbia River. Because the majority of shoreline springs are accessible only during periods of low river level, routine access is not possible. In addition, river water can mix with ground water and produce diluted concentrations in spring discharges.

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APPENDIX A

SHORELINE INSPECTION AND SPRING LOG

APPENDIX A

SHORELINE INSECTION AND SPRING LOG

Inspection of the Hanford shoreline between RM 3 and RM 44 was accomplished in nine days. A log of the river-bank springs observed and recorded during these inspections is provided in Table A.1. Daily averaged Columbia River flow rates measured in cubic feet per second (cfs) that were recorded at Priest Rapids Dam for each of the nine days were as follows:

Date	Flow Rate, cfs
11-04-82	102,000
11-11-82	102,000
11-12-82	94,000
11-15-82	100,000
11-17-82	80,000
11-19-82	73,000
11-24-82	112,000
12-27-82	106,000
01-03-83	119,000

Actual flow rates during the inspections, which began at approximately 8:00 a.m., or earlier, each day and were terminated by rising water by midday, were substantially lower than these daily averages. The mean annual flow rate of the Columbia River during 1982 was 140,000 cfs.

TABLE A.1. Shoreline Inspection Record

River Mile Location	Spring Designation	Inspection Date/Time	Description
3	3-1A	11-17-82/7:20 a.m.	10.9°C, moderate to heavy flow, US[a] end of small inlet, 25 ft US from rails extending into river, 10 ft from river's edge, cobbles and boulders
	3-1B	7:35	11.3°C, low flow, 100 ft DS[b] 3-1A, 5 ft from river's edge cobbles and boulders
3.3	3-2	8:00	6.1°C, moderate to heavy flow in middle of narrow muddy inlet extending inland, 1/3 miles DS RM[c] 3, 10 ft from river's edge cobbles and boulders either side inlet
	3-3	8:15	8.0°C, very low flow, in elongated depression-rocks piled on either side, flat bank
3.5	3-4	8:45	6.0°C, very low flow, drainage area behind peninsula
3.75	3-5	9:00	16.4°C, heavy flow, in secondary small inlet inside peninsula, emanates from row of cobble, below no trespass sign
	3-6	9:05	21.9°C, heavy flow, 150 ft DS 3-5, sandy area small gravel, percolates from sandy soil underlain by gravel, 6 ft from river's edge, below sign "1"
3.9	4-0	11-11-82/7:00 a.m.	21.0°C, heavy flow, broad cobble shore, 100 y DS B intake 300 y US RM 4, pools and lighter flow in area 16-19°C, flow within intake rip rap
4.2	4-1	7:20	18.2°C, heavy flow, inside concrete lined outfall, emanating from crack 6 y below rock backfill
4.25	4-2	7:35	23°C, heavy flow, 50 y US from 2nd 100 Area B outfall and PNL TLD, Emanates from cobble right at river level.
5.0	5-1	7:16	11.2°C, moderate flow, area 100 y wide near river's edge, cobble small to medium, 50 ft DS RM 5.
	5-2	7:39	14.2°C, moderate flow, 20 ft area of rocky shore, several percolating springs, 250 y DS RM 5
5.25	5-3	7:56	10.9°C, low flow, small trickle in rocky shore near river's edge, 100 y DS 5-2 between 5-2 and pump house
	5-4	8:09	17.3°C, moderate flow, several small springs at river's edge, 60 y DS 5-3.
5.6	5-4A	11-12-82/6:51 a.m.	12.3°C, low flow, 100 y DS pump station
	5-5	6:58	10.2°C, moderate flow, 50 y DS 5-4A, percolating
5.9	5-6	7:20	12.8°C, moderate flow, continuous to RM 6 (50 y)
6.0	6-1	7:39	12.9°C, moderate flow, percolating continuous for 50 ft, 150 y DS RM 6
6.2	6-2	7:49	10.1°C, low flow, percolating stream, 75 y US boat launch area.
	6-3	8:28	8.8°C, low flow, 75 y DS 100-K West intake
6.8	7-0	7:00	13.2°C, heavy flow, inside narrow inlet extending inland 10 y from river's edge, 200 y DS 100-K East intake, inlets surrounded large boulders and cobble - 20 ft DS is another inlet, low flow 12.0°C
6.9	7-1	7:30	11.9°C, moderate to low flow, emanating from small boulders at DS inlet from small point, 4 ft from river's edge, 100 y DS is another area low flow 12.5°C (at RM 7)

(a) US - Upstream
(b) DS - Downstream
(c) RM - River Mile

TABLE A.1. Shoreline Inspection Record (Cont'd.)

River Mile Location	Spring Designation	Inspection Date/Time	Description
7.0	7-1	7:40	13.8°C, heavy flow, 5 y from river's edge, cobble and boulders, 150 ft DS[b] RM[c] 7, on small point - 10 y DS is 2nd area heavy flow 13.0°C - 30 y DS is 3rd area heavy flow 14.6°C, 6 ft from river's edge - 36 y total DS 7-1 4th area 15.1°C, broad area of springs (directly below K-19 well)-unnumbered well with water in it here, - at K trench overflow, broad area, low flow 12.2°C (BM site sign) - 8:10 a.m.
7.25	7-2	8:12	15.4°C, moderate flow, area 15 ft wide, small inlet at DS end of depressed K-Trench overflow area, 6 ft from river's edge
	7-3	8:20	11.2°C, moderate flow, 100 ft US[a] no trespass sign, 10 y from river's edge - 10.9°C below no trespass sign 100 ft DS from 7-3 intermitten flow DS from 7-3
7.3	7-4	8:45	11.8°C, very heavy flow, forms small pool, boulder area 15 ft from river's edge, bank broad and flat
8.25	8-1	9:25	12.0°C, low flow, in grooves perpendicular to river, 15 y from river's edge, flat cobble shore, 500 y DS RM 8 - 60 ft DS 8-1 12.2°C, percolating vertically from hole between rocks 2 ft from river's edge - 9:30 a.m. 11.9°C below no trespass sign 5 ft from river's edge
8.3	8.25-1	11-17-82/9:45 a.m.	9.6°C, moderate flow, emanates beneath boulders 10 ft from river's edge, mud around spring, small pool
8.6	8-10	7:45	15.5°C, moderate flow, continuous for 75 y, 30 y DS 100 N intake
8.75	8-11	7:53	17.6°C, heavy flow, 25 ft DS UNI TLD, below smokestack, 100 y DS intake
	8-12	8:03	20.2°C, heavy flow, below no trespass sign and trench
8.9	8-13	8:08	20.1°C, heavy flow continuous 25 y and 75 y DS , 100 ft US from sample shack, 100 y DS from 8-12 other temperatures 24.4, 24.7, and 25.6°C at orange rock 25 y US shack and 64 ft from river's edge 8-13 continues past RM 9 - highest discharge at shack
9.25	9-1	8:38	20.9°C, heavy flow, 9-1 marks end of continuous area from 8-13, 1/4 mile DS RM 9
	9-2	8:46	18.1°C, moderate flow, 150 ft DS 9-1
	9-3	8:51	19.7°C, heavy flow, 150 y DS 9-2, huge pool, continuous 30 y
	9-4	9:01	16.7°C, heavy flow, continuous 25 y
11	11-1	1-3-83/8:50 a.m.	11.5°C, heavy flow near river level, 200 ft DS RM 11 at DS edge of concrete outfall, river rising
14.5	14-4	12-27-82/9:13 a.m.	Distributed heavy flow continuous from RM 14.25 to rocky point at RM 14.5, broad flat rocky beach - sand beach below river level, located behind island and below row of trees on bluff, 14-4 marked in red on rocks
14.5	14-5	9:07	Moderate to low flow immediately around rocky point DS of 14-4, emanating from rocks above broad flat sand beach, 14-5 marked in red on rocks
15	15-0	8:48	9.3°C, moderate flow from narrow sandy beach below vegetation behind and few feet DS RM 15, percolation from sand
15.25	15-4	9:00	6°C, very low flow, 40 ft down from concrete slab 70 ft US from bend in H Area fence

(a) US - Upstream
(b) DS - Downstream
(c) RM - River Mile

TABLE A.1. Shoreline Inspection Record (Cont'd.)

River Mile Location	Spring Designation	Inspection Date/Time	Description
15.5	15-5	8:48	6.6°C, moderate flow percolating out of cobble shore, 30 ft on flat bank from river
18.0	18-0	9-11-83/3:25 p.m.	13.3°C, heavy flow from pipe in trench under power line
18.0	18-1	11-11-82/9:30 a.m.	12.3°C, very low flow, 200 y DS[b] RM[c] 18, steep cobble bank, at river level 100 ft DS cut in bank (old irrigation return)
18.6	18-2	10:09	13.1°C, heavy flow, on DS point of old F intake, emanating beneath large concrete slab imbedded in bank 2/3 mile DS RM 18
19.0	18-3/19-1	10:45	12.8°C, low flow, narrow steep bank, small cobble, 5 y below vegetation at river level
22.2	22-1	11:03	11.6°C, very low flow, broad flat shore, slight depression and pool, 100 ft wide along shore
	22-1A	11-24-82/8:15 a.m.	3.7°C, moderate flow, 100 ft DS from 22-1
22.25	22-2		7.1°C, moderate flow, 100 y DS 22-1, emanates 19 y below vegetation, runs out to river 20 ft
22.5	22-3		8.1°C, low flow, 10 ft from river's edge - 15 ft DS, moderate flow 9.7°C - 75 ft DS 8 7°C small pool - continuing DS
22.75	22-4		10.6°C, moderate flow, 30 y below vegetation
23.0	23-1	8:30	8.1°C, low flow, shallow depression, moderately steep cobble shore 4 y from river's edge, pothole 10 ft DS and 10 ft up bank - 25 y DS 8.5°C moderate flow, 1 ft from river - 50 y DS 23-1, 9.8°C, heavy flow, at no trespass sign - intermittent DS
23.25	23-2	9:16	9.3°C, heavy flow, depression at lower level, emanating from rocks and mud at vegetation line, 3 ft from river's edge
23.5	23-3	9:46	6°C, very low flow, large pothole 8 ft from river's edge low flow into pothole - 50 y DS 23-3, 8°C, heavy flow
23.75	23-4	10:00	9.9°C, very heavy flow, cluster of potholes within broad depression, draining rapidly into each other and subsequently into river, no level drop in potholes but no apparent surface flow filling them from bank - 20 ft DS , 9.9°C heavy flow, directly into river - 40 - 50 y DS, 8.4°C, moderate flow, around corner DS from depression
Hanford Slough	25-1S	11:45	12.2°C, heavy flow, muddy vegetated bank, head end of slough, flowing over mud flats to rocky shore
	25-2S		13.3°C, heavy flow, 200 ft DS 25-1S, mud bank, running over flats then cobble, continuous DS
	25-2S		12.7°C, heavy flow, 300 ft DS 25-2S, emanating beneath boulder in mud below vegetation - 50 ft DS 13.8°C, heavy flow from boulder - continuous DS
	25-4S	12:47	12.5°C, moderate flow, halfway in slough, 200 ft of sandy silty beach, oozing and percolating from beach composed of top fine sand, clay layer, sand layer, then cobble layer below
	25-5S	12:21	saturated beach 100 y long at base of collapsing bluff, at entrance to slough
25.3	25-1	11-12-82/11:03 a.m.	11.4°C, heavy flow, percolation and oozing continuous 25 y US and 100 y DS
25.5	25-2	11:18	8.8°C, moderate flow, 200 y DS 25-1, continuous 25 y US and DS
25.5	25-3	11:23	12.4°C, heavy flow, bubbling spring 31 ft from river's edge, 250 y DS pump house

(a) US - Upstream
(b) DS - Downstream
(c) RM - River Mile

TABLE A.1. Shoreline Inspection Record (Cont'd.)

River Mile Location	Spring Designation	Inspection Date/Time	Description
25.75	25-4	11:47	11.3°C, heavy flow, just DS[b] boat ramp (ferry landing), deep cove in bank, entire cove spring activity, 11.9°C
	25-5	12:00	11.8°C, heavy flow, 50 y DS ferry landing
25.8	25-6	12:05	10.6°C, heavy flow, 6 ft wide stream, 150 y DS ferry landing
26.2	26-1	11:20	10.9°C, heavy flow, springs across inlet at TLD location, 10 ft from river's edge, small cobbles with mud and silt
26.25	26-2	11:40	heavy overall flow/moderate individually, 200 ft wide indentation in bank, flat mud and sand beach topped by boulders, 200 ft DS 26-1
26.6	26-3	12:20	moderate flow, streams trickling down from area of pothole located up the bank, pool 20 ft from river's edge, at foot of trees US[a] from well 48-7
26.8	26-4	12:30	heavy flow, silty beach with cobble lenses, inside wide bay in bank below bluff, emanating from middle cobble lens, 20 ft from river's edge, rivulets extend 20 ft into river
27.0	27-1	11-5-82/8:30 a.m.	12.6°C, heavy flow, broad depressed area forming indentation in bank, flow from 100 y wide area, 100 y DS RM[c] 27
27.25	27-2	9:04	12.7°C, heavy flow, broad dished area, surrounded by numerous potholes, cobble with mud in depressions
27.5	27-3	9:15	12.5°C, heavy flow, broad 100 y wide dished area, broad cobble shoreline, fine silt in areas of springs - 50 y DS 27-3, dished area - 100 DS 27-3 broad shallow depression 100 y US RM 28, several flowing potholes
28	28-1	9:10	12.5°C, moderate flow, continuous 200 y DS
	28-2	9:30	12.3°C, heavy flow, bluff recedes, rocky point in river, DS side of point major flow
28.25	28-3	9:40	12.2°C, large pool 50 ft diameter
28.5	28-4	10:00	12.1°C, large pool DS from point and bend in river, US from narrow beach and bluffs to RM 29 - saturated sand area US from RM 29
29.25	29-1	10:00	13°C, moderate flow, small depressed area and potholes, 150 y wide
29.5	29-2		12.8°C, saturated mud and silt, signs of recent surface flow, buried pipe and timber across hole in bank.
29.75	29-3		12.3°C, saturated mud and silt, no flow on surface
30.0	30-0	10:30	11.7°C, intermittent saturated areas 100 y DS RM 30
	30-1		12.9°C, low flow, narrow shore, 250 y DS RM 30
30.9	30-2		12.0°C, very low flow, 100 y US RM 31, numerous potholes
31.0	31-1		extensive fine mud and silt, signs of recent runoff
31.3	31-2		saturated area, located behind point in back eddy, no trespass sign
31.5	31-3		12.8°C, more sand present, moderate flow
	31-4		12.8°C, low flow, saturated area, in back eddy
31.6	31-5		13.4°C, heavy flow, cobble area separating narrow sandy beaches, opposite US end of Ringold island numerous sandy beaches 200 y US and 1 mile DS, saturated and oozing water, rivulets flowing, 1st layer of silt, 2nd layer coarse sand, 3rd layer silt, hole in sand 13:1, fills rapidly
33.0	33-1	12:30	11.7°, low flow, dry rivulets and saturated beaches, dryer for rest of RM 33, sand more compact

(a) US - Upstream
(b) DS - Downstream
(c) RM - River Mile

TABLE A.1. Shoreline Inspection Record (Cont'd.)

River Mile Location	Spring Designation	Inspection Date/Time	Description
34.0	34-1	12:50	50 y DS[b] Cable crossing, saturated sand between cobble, appearance of recent flow
34.9	34-2	1:10	saturated above high water mark
	34-3	1:15	surface flow observed, saturated above high water, 50 y DS 34-2, 100 y US[a] RM[c] 35
	34-4		substantial standing water on bank
35.6	35-1	11-15-82/ 9:15 a.m.	moderate flow located in back eddy on sandy shore, 150 ft DS 1st WPPSS intake - small ponds 100 y DS 2nd intake
36	35-2		low flow, broad seepage on sandy bank, pond in weeds US, located in back eddy
36.75	36-1	10:45	9.3°C, low flow, continuous several hundred feet DS, 200 y DS powerlines, sandy and rocky
37.1	37-1	10:46	moderate flow, rocky shoreline located in slough, continuous 25 y DS, rocky shore
37.5	37-2	11:00	high discharge, 5 springs 10 y US and DS from stake, sandy shore with cobbles and boulders
38.25	38-1	11:42	heavy flow, 75 y continuous, muddy, source below boulders
38.8	38-10	11:43	7.9°C, low flow, sandy beach, muskrat and beaver ditches, flow from ditches, 250 y US RM 39
39.25	39-1	12:50	several springs in small ditches flowing onto sandy beach and pools 6.9°C
40.0	40-1	1:30	8.6°C, low flow, sandy rocky beach, 25 y DS RM 40
	40-2	1:35	11.1°C, low flow, rocky shore, 100 ft DS 40-1
40.75	40-3	2.09	10.0°C, low flow, emanates under boulder at river's edge
	40-4	2:10	10.3°C, low flow, trickles from rocky shore at river's edge, 300 y US RM[c] 41
41.5	41-1	2:44	14.3°C, low to moderate flow, continuous trickles on sandy beaches for several hundred ft DS[b] 41.75
41.8	41-2	2:57	13.6°C, moderate flow sandy beaches below bank side cut, swallows nests
42.0	42-1	11-19-82/ 8:18 a.m.	13.9°C, moderate flow, continuous 20 y US and 30 y DS, sandy muddy shore
	42-2	8:25	15.2°C, heavy flow, sandy muddy shore, continuous 30 y US and 50 y DS to point in river, no trespass sign, 100 y DS RM 42-at point huge flow at 19°C 12-12-82/10:00 a.m.
42.25	42-3	8:48	13.6°C, moderate flow, emanates from sandy mud, small spring, boulders and cobbles surrounded by patches of mud
	42-4	9:03	15.1°C, heavy flow continuous 25 y US and 50 y DS, 100 ft US from tree - final half mile of RM 42, intermittent springs 10.8°C - note to 42-4 at locations of historic 300 Area Springs #1
43.6	43-1	10:23	11.6°C, moderate flow, rocky shoreline, 50 y DS from boat ramp, 250 y US POB
43.75	43-2	10:32	11.6°C, moderate flow, continuous 10 y US to POB 100 y DS, rocky shoreline
43.8	43-3	10:45	12.1°C, moderate discharge, sandy muddy beach, intermittent cobble, continuous along beach DS, trickles and percolation

(a) US - Upstream
(b) DS - Downstream
(c) RM - River Mile

APPENDIX B

ADDITIONAL ANALYSES

APPENDIX B

ADDITIONAL ANALYSES

In addition to the analyses described in the Phase 2, Sampling and Analysis section of this report, selected samples were analyzed for ^{90}Sr, ^{129}I, ^{99}Tc, and gross beta. These analyses are discussed in the sections that follow.

STRONTIUM-90 ANALYSES

Analyses for ^{90}Sr were performed on composite samples of river water collected between RM 3 and RM 22. Because this analysis requires a 9.5-liter sample, individual spring and river samples were not analyzed for ^{90}Sr. Results of these analyses, listed in Table B.1, are consistent with the results of other analyses performed on samples collected in these areas, in that the highest concentrations were observed in shoreline areas known to be in contact with Hanford ground water.

IODINE-129 ANALYSES

Analyses for ^{129}I were performed on four spring samples and two large-volume river samples collected between RM 27 and RM 33. Iodine-129 is a constituent of the ground-water plume that originates in the 200 Areas and is thought to be discharging ^{129}I to the Columbia River along this section of shoreline. For the purpose of these analyses, additional 10-liter samples were collected from springs 27-1, 28-2, 31-5, and 32-0. Two large-volume river samples were collected at RM 27 and RM 29 by pumping 100 liters of water through mixed resin ion exchange columns. The results of these analyses are listed in Table B.2. As with ^{90}Sr, the results are consistent with other analytical results obtained from samples in this area.

GROSS BETA ANALYSES

Gross beta analyses were performed on spring samples collected September 11, 1983, between RM 14 and RM 33, in response to public inquiries about ground-water discharges via river-bank springs. The analyses were performed on January 6, 1984 using water remaining in each sample after analyses for tritium and nitrate had been performed. Results of the gross beta analyses are listed in Table B.3.

TECHNETIUM-99 ANALYSES

In addition to the ^{129}I analyses described above, ^{99}Tc analyses were performed on the 10-liter samples collected from springs 27-1, 28-2, 31-5, and 32-0. These analyses produced results that were consistent with the ^{129}I and other analyses performed on samples collected from these springs. Results of ^{99}Tc analyses are listed in Table B.4.

TABLE B.1. Strontium-90 Analyses from Columbia River Samples

River Mile Location	Sample ID	Date Collected	Concentration, pCi/ℓ ±2σ
3.0-5.0	B Comp RW[a]	01/22/83	0.55 ± 0.23
5.5-7.5	K Comp RW	12/18/82	0.18 ± 0.02
8.0-9.5	N Comp RW	12/18/82	28 ± 0.47
10.0-12.0	D Comp RW	12/18/82	1.1 ± 0.05
14.0-17.5	H Comp RW	01/22/83	0.50 ± 0.14
18.0-22.0	F Comp RW	01/22/83	0.93 ± 0.15
Upstream Columbia River Concentration (Average 1983)			0.18 ± 0.22
DOE Concentration Guide (USDOE 1981)			300

(a) Comp-RW denotes composite river water sample comprised of aliquots from immediately preceding river sample locations.

TABLE B.2. Iodine-129 Analyses from Spring and Columbia River Samples

River Mile Location	Sample ID	Date Collected	Concentration, pCi/ℓ ±2σ
27.0	27.0 RW[a]	01/22/83	$3.3 \times 10^{-6} \pm 1.4 \times 10^{-6}$
27.0	27-1 Sp[b]	09/11/83	$1.6 \times 10^{-4} \pm 2.1 \times 10^{-5}$
28.0	28-2 Sp	09/11/83	$6.2 \times 10^{-2} \pm 6.8 \times 10^{-3}$
29.0	29.0 RW	01/22/83	$6.3 \times 10^{-5} \pm 5.0 \times 10^{-6}$
31.75	31-5 Sp	09/11/83	$3.0 \times 10^{-5} \pm 4.0 \times 10^{-6}$
32.5	32-0 Sp	09/11/83	$4.4 \times 10^{-5} \pm 2.7 \times 10^{-5}$
Upstream Columbia River Concentration (1983 Average)			$2.4 \times 10^{-5} \pm 2.6 \times 10^{-5}$
DOE Concentration Guide (USDOE 1981)			60

(a) RW denotes composite river water sample.
(b) Sp denotes river bank spring sample.

TABLE B.3. Gross Beta Analyses from Spring Samples

River Mile Location	Sample ID	Date Collected	Concentration, pCi/ℓ ±2σ
14.5	14-4 Sp[a]	09/11/83	2.5 ± 1.8
15.0	15-0 Sp	09/11/83	3.2 ± 2.0
19.0	18-3 Sp	09/11/83	12 ± 2.8
22.75	22-4 Sp	09/11/83	4.6 ± 2.0
23.6	23-4 Sp	09/11/83	0.46 ± 1.6
Hanford Slough	25-2s Sp	09/11/83	3.9 ± 1.9
25.5	25-3 Sp	09/11/83	0.21 ± 1.3
26.2	26-1 Sp	09/11/83	2.2 ± 1.7
27.0	27-1 Sp	09/11/83	0.26 ± 1.6
27.5	27-3 Sp	09/11/83	35 ± 4.4
28.0	28-2 Sp	09/11/83	3.0 ± 1.7
28.5	28-4 Sp	09/11/83	9.8 ± 2.6
30.0	30-1 Sp	09/11/83	5.0 ± 2.1
31.0	31-1 Sp	09/11/83	1.0 ± 1.8
31.75	31-5 Sp	09/11/83	2.6 ± 1.8
32.5	32-0 Sp	09/11/83	0.46 ± 1.4
33.0	33-1 Sp	09/11/83	26 ± 3.9
Upstream Columbia River Concentration (1983 Average)			6.1 ± 22
DOE Concentration Guide (USDOE 1981)			3,000

(a) Sp denotes river bank spring sample.

TABLE B.4. Technetium-99 Analyses from Spring Samples

River Mile Location	Sample ID	Date Collected	Concentration, pCi/ℓ ±2σ
27.0	27-1 Sp[a]	09/11/83	0.049 ± 0.005
28.0	28-2 Sp	09/11/83	43 ± 2
31.75	31-5 Sp	09/11/83	0.012 ± 0.D03
32.5	32-0 Sp	09/11/83	0.065 ± 0.007
Upstream Columbia River Concentration (1983 Average)			NA[b]
DOE Concentration Guide (USDOE 1981)			200,00

(a) Sp denotes river bank spring sample.
(b) Not analyzed.

APPENDIX C

SUMMARY OF SAMPLE COLLECTION
AND ANALYTICAL RESULTS

TABLE C.1. Summary of Sample Collection and Analytical Results

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^3H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
3.0	3.0 BKG[b]	1ℓ	12-18-82/0745	$(1.05\times10^2 \pm 1.83\times10^2)$[f]	0.26		6.2°C mid river
	3.0 RW[c]	1ℓ	12-18-82/0745	$(2.73\times10^2 \pm 3.0\times10^2)$	0.53		2ℓ for B comp.
		1ℓ	01-22-83/0800	$2.97\times10^2 \pm 2.15\times10^2$	0.71		
	3-1A Sp[d]	1ℓ	12-18-82/0756	$(2.60\times10^2 \pm 2.83\times10^2)$	1.28		9.0°C
3.5	3.5 RW	1ℓ	12-18-82/0800	$(2.51\times10^2 \pm 2.64\times10^2)$	0.31		2ℓ for B comp.
		1ℓ	01-22-83/0900	$(2.09\times10^2 \pm 2.14\times10^2)$	0.66		
	3-3 Sp	1ℓ	12-18-82/0804	$5.50\times10^2 \pm 2.60\times10^2$	0.18		7.6°C
4.0	4.0 RW	1ℓ	12-18-82/0815	$(1.61\times10^2 \pm 2.40\times10^2)$	0.22		2ℓ for B comp.
		1ℓ	01-22-83/0930	$2.70\times10^2 \pm 2.14\times10^2$	1.24		
	4-0 Sp	1ℓ	12-18-82/0818	$(1.10\times10^3 \pm 2.27\times10^2)$	7.84		18.2°C
4.2	4-1 Sp	1ℓ	12-18-82/0820	$5.92\times10^3 \pm 3.82\times10^2$	0.75		17.2°C
4.25	4-2 Sp	1ℓ	12-18-82/0821	$5.81\times10^3 \pm 2.89\times10^2$	1.68		20.1°C
4.5	4.5 RW	1ℓ	12-18-82/0841	$3.85\times10^2 \pm 3.27\times10^2$	0.58		2 ℓ for B comp.
		1ℓ	01-22-83/1000	$(9.10\times10^1 \pm 2.11\times10^2)$	0.97		
5.0	5.0 RW	1ℓ	12-18-82/0845	$(2.80\times10^2 \pm 3.96\times10^2)$	0.53		2 ℓ for B comp.
		1ℓ	01-22-83/1030	$(6.30\times10^1 \pm 2.11\times10^2)$	0.80		
	B comp. RW[e]	1ℓ	12-18-82/0900	$5.97\times10^2 \pm 4.05\times10^2$	0.44		
		10ℓ	01-22-83/1030	$(8.20\times10^1 \pm 2.11\times10^2)$	0.93		
	5-1 Sp	1ℓ	12-18-82/0848	$6.39\times10^2 \pm 3.13\times10^2$	0.44		10.2°C
5.25	5-4 Sp	1ℓ	12-18-82/0900	$8.71\times10^2 \pm 3.03\times10^2$	4.43		16.9°C
5.5	5.5 BKG	1ℓ	12-18-82/0911	$3.09\times10^2 \pm 2.78\times10^2$	0.44		6.2°C mid river
	5.5 RW	1ℓ	12-18-82/0908	$(3.26\times10^2 \pm 4.04\times10^2)$	0.18		2 ℓ for K comp.
	5-4A Sp	1ℓ	12-18-82/0909	$8.73\times10^2 \pm 3.32\times10^2$	0.80		10.2°C
6.0	6.0 RW	1ℓ	12-18-82/0915	$(2.77\times10^2 \pm 4.88\times10^2)$	0.09		2 ℓ for K comp.
	6-1 Sp	1ℓ	12-18-82/0915	$5.49\times10^3 \pm 2.87\times10^2$	0.80		8.1°C
6.5	6.5 RW	1ℓ	12-18-82/0925	$1.28\times10^3 \pm 2.30\times10^2$	0.40		2 ℓ for K comp.
7.0	7.0 RW	1ℓ	12-18-82/0933	$3.50\times10^2 \pm 2.71\times10^2$	0.58		2 ℓ for K comp.
	7-1 Sp	1ℓ	12-18-82/0933	$1.40\times10^3 \pm 2.32\times10^2$	0.40		11.2°C

(a-f) Key found at end of table.

TABLE C.1. (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^3H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
7.5	7.5 RW[c]	1ℓ	12-18-82/0938	$(1.85\times10^{2} \pm 1.94\times10^{2})$[f]	0.62		2 ℓ for K comp.
	K comp. RW[e]	10ℓ	12-18-82/0938	$1.13\times10^{3} \pm 2.96\times10^{2}$	0.13		
8.0	8.0 BKG[b]	1ℓ	12-18-82/0948	$1.49\times10^{2} \pm 1.38\times10^{2}$	0.09		6.1°C mid river
	8.0 RW	1ℓ	12-18-82/0945	$1.33\times10^{3} \pm 2.31\times10^{2}$	0.35		2.5 ℓ for N comp.
	8-1 Sp[d]	1ℓ	12-18-82/0945	$3.97\times10^{3} \pm 2.66\times10^{2}$	0.44		10.1°C
8.5	8.5 RW	1ℓ	12-18-82/0952	$3.10\times10^{2} \pm 2.81\times10^{2}$	0.18		2.5 ℓ for N comp.
	8-10 Sp	1ℓ	12-18-82/0952	$4.86\times10^{2} \pm 2.81\times10^{2}$	1.02		15.2°C
9.0	9.0 RW	1ℓ	12-18-82/1001	$4.43\times10^{3} \pm 3.50\times10^{2}$	1.34		2.5 ℓ for N comp.
	9-0 Sp	1ℓ	12-18-82/1001	$3.85\times10^{4} \pm 5.54\times10^{2}$	10.4		20.1°C
9.25	9-4 Sp	1ℓ	12-18-82/1007	$2.24\times10^{4} \pm 3.39\times10^{2}$	3.54		16.1°C
9.5	9.5 RW	1ℓ	12-18-82/1016	$7.61\times10^{2} \pm 2.01\times10^{2}$	1.37		2.5 ℓ for N comp.
	N comp. RW	10ℓ	12-18-82/1016	$2.71\times10^{3} \pm 2.53\times10^{2}$	1.24		2.5 ℓ for N comp.
10.0	10.0 BKG	1ℓ	12-18-82/1025	$2.04\times10^{2} \pm 1.83\times10^{2}$	0.44		
	10.0 RW	1ℓ	12-18-82/1021	$8.30\times10^{2} \pm 1.49\times10^{2}$	1.99		2 ℓ for D comp.
10.5	10.5 RW	1ℓ	12-18-82/1133	$3.14\times10^{2} \pm 3.01\times10^{2}$	0.22		2 ℓ for D comp.
11.0	11.0 RW	1ℓ	12-18-82/1137	$3.10\times10^{2} \pm 2.52\times10^{2}$	0.24		2 ℓ for D comp.
	11-1 Sp	1ℓ	01-22-83/1230	$(8.00\times10^{1} \pm 2.11\times10^{2})$	1.11		6.1°C
11.5	11.5 RW	1ℓ	12-18-82/1142	$(2.49\times10^{2} \pm 2.59\times10^{2})$	1.75		2 ℓ for D comp.
12.0	12.0 RW	1ℓ	12-18-82/1148	$2.96\times10^{2} \pm 2.19\times10^{2}$	0.18		2 ℓ for D comp.
	D comp. RW	10ℓ	12-18-82/1148	$8.29\times10^{2} \pm 3.26\times10^{2}$	0.22		
14.0	14.0 BKG	1ℓ	12-18-82/1200	$4.74\times10^{2} \pm 2.39\times10^{2}$			6.4°C
		1ℓ	01-22-83/0739	$(4.90\times10^{1} \pm 2.11\times10^{2})$	0.66		4.3°C
		1ℓ	09-11-83/1640	$(6.46\times10^{1} \pm 2.03\times10^{2})$	0.03		18.4°C mid river
	14.0 RW	1ℓ	12-18-82/1200	$(1.56\times10^{2} \pm 1.89\times10^{2})$	0.31		
		1ℓ	01-22-83/0743	$(6.30\times10^{1} \pm 2.11\times10^{2})$	0.26		1.5 ℓ for H comp.
		1ℓ	09-11-83/1637	$6.03\times10^{2} \pm 2.11\times10^{2}$	0.10		1.5 ℓ for H comp.

(a-f) Key found at end of table.

TABLE C.1. (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^3H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
14.5	14.5 RW[c]	1ℓ	01-22-83/0820	$(-1.70\times10^{1} \pm 2.10\times10^{2})$[f]	0.44		1.5 ℓ for H comp.
		1ℓ	09-11-83/1634	$(1.30\times10^{2} \pm 2.04\times10^{2})$	0.15		1.5 ℓ for H comp.
	14-4 Sp[d]	1ℓ	12-27-82/0920	$1.21\times10^{3} \pm 2.20\times10^{2}$	1.06		
		1ℓ	09-11-83/1630	$4.05\times10^{3} \pm 2.74\times10^{2}$	2.36		13.9°C
15.0	15.0 RW	1ℓ	01-22-83/0835	$3.89\times10^{2} \pm 2.16\times10^{2}$	0.44		
		1ℓ	09-11-83/1620	$(3.19\times10^{1} \pm 2.02\times10^{2})$	0.25		1.5 ℓ for H comp.
	15-0 Sp	1ℓ	12-27-82/0848	$5.80\times10^{2} \pm 2.18\times10^{2}$	5.75		1.5 ℓ for H comp.
		1ℓ	01-22-83/0843	$4.51\times10^{2} \pm 2.17\times10^{2}$	1.55		7.2°C
		1ℓ	09-11-83/1622	$2.12\times10^{2} \pm 2.03\times10^{2}$	0.48		19.3°C
15.5	15.5 RW	1ℓ	01-22-83/0850	$(1.62\times10^{2} \pm 2.11\times10^{2})$	0.44		1.5 ℓ for H comp.
		1ℓ	09-11-83/1614	$2.34\times10^{2} \pm 2.04\times10^{2}$	<0.02		1.5 ℓ for H comp.
16.0	16.0 RW	1ℓ	01-22-83/0855	$(-8.00\times10^{0} \pm 2.10\times10^{2})$	0.58		1.5 ℓ for H comp.
		1ℓ	09-11-83/1609	$3.49\times10^{2} \pm 2.06\times10^{2}$	0.43		1.5 ℓ for H comp.
16.5	16.5 RW	1ℓ	01-22-83/0901	$(9.80\times10^{1} \pm 2.11\times10^{2})$	0.31		1.5 ℓ for H comp.
		1ℓ	09-11-83/1606	$2.45\times10^{2} \pm 2.06\times10^{2}$	0.15		1.5 ℓ for H comp.
17.0	17.0 RW	1ℓ	01-22-83/0939	$(1.72\times10^{2} \pm 2.12\times10^{2})$	0.44		1.5 ℓ for H comp.
		1ℓ	09-11-83/1648	$(1.35\times10^{2} \pm 2.01\times10^{2})$	0.20		1.5 ℓ for H comp.
17.5	17.5 RW	1ℓ	01-22-83/0949	$(5.30\times10^{1} \pm 2.10\times10^{2})$	0.44		
		1ℓ	09-11-83/1600	$(3.36\times10^{1} \pm 1.99\times10^{2})$	<0.02		1.5 ℓ for H comp.
	H comp. RW[e]	10ℓ	01-22-83/0939	$(1.53\times10^{2} \pm 2.12\times10^{2})$	0.66		
		10ℓ	09-11-83/1637	$(-3.68\times10^{1} \pm 1.97\times10^{2})$	0.15		
H Slough	H Slough-RW	1ℓ	01-22-83/0947	$(3.30\times10^{1} \pm 2.10\times10^{2})$	0.22		middle of slough
		1ℓ	09-11-83/1538	$3.95\times10^{2} \pm 2.87\times10^{2}$	<0.02		
18.0	18.0 BKG[b]	1ℓ	01-22-83/0953	$(1.30\times10^{1} \pm 2.10\times10^{2})$	0.80		4.4°C mid river
		1ℓ	09-11-83/1535	$(1.31\times10^{2} \pm 2.04\times10^{2})$	0.05		18.4°C mid river
	18.0 RW	1ℓ	01-22-83/1100	$(6.70\times10^{1} \pm 2.11\times10^{2})$	0.44		1.5 ℓ for F comp.
		1ℓ	09-11-83/1522	$(1.73\times10^{2} \pm 2.04\times10^{2})$	0.23		1.25 ℓ for F comp.

(a-f) Key found at end of table.

TABLE C.1 (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^{3}H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
14.5	14.5 RW[c]	1ℓ	01-22-83/0820	$(-1.70\times10^{1} \pm 2.10\times10^{2})$[f]	0.44		1.5 ℓ for H comp.
		1ℓ	09-11-83/1634	$(1.30\times10^{2} \pm 2.04\times10^{2})$	0.15		1.5 ℓ for H comp.
	14-4 Sp[d]	1ℓ	12-27-82/0920	$1.21\times10^{3} \pm 2.20\times10^{2}$	1.06		
		1ℓ	09-11-83/1630	$4.05\times10^{3} \pm 2.74\times10^{2}$	2.36		13.9°C
15.0	15.0 RW	1ℓ	01-22-83/0835	$3.89\times10^{2} \pm 2.16\times10^{2}$	0.44		
		1ℓ	09-11-83/1620	$(3.19\times10^{1} \pm 2.02\times10^{2})$	0.25		1.5 ℓ for H comp.
	15-0 Sp	1ℓ	12-27-82/0848	$5.80\times10^{2} \pm 2.18\times10^{2}$	5.75		1.5 ℓ for H comp.
		1ℓ	01-22-83/0843	$4.51\times10^{2} \pm 2.17\times10^{2}$	1.55		7.2°C
		1ℓ	09-11-83/1622	$2.12\times10^{2} \pm 2.03\times10^{2}$	0.48		19.3°C
15.5	15.5 RW	1ℓ	01-22-83/0850	$(1.62\times10^{2} \pm 2.11\times10^{2})$	0.44		1.5 ℓ for H comp.
		1ℓ	09-11-83/1614	$2.34\times10^{2} \pm 2.04\times10^{2}$	<0.02		1.5 ℓ for H comp.
16.0	16.0 RW	1ℓ	01-22-83/0855	$(-8.00\times10^{0} \pm 2.10\times10^{2})$	0.58		1.5 ℓ for H comp.
		1ℓ	09-11-83/1609	$3.49\times10^{2} \pm 2.06\times10^{2}$	0.43		1.5 ℓ for H comp.
16.5	16.5 RW	1ℓ	01-22-83/0901	$(9.80\times10^{1} \pm 2.11\times10^{2})$	0.31		1.5 ℓ for H comp.
		1ℓ	09-11-83/1606	$2.45\times10^{2} \pm 2.06\times10^{2}$	0.15		1.5 ℓ for H comp.
17.0	17.0 RW	1ℓ	01-22-83/0939	$(1.72\times10^{2} \pm 2.12\times10^{2})$	0.44		1.5 ℓ for H comp.
		1ℓ	09-11-83/1648	$(1.35\times10^{2} \pm 2.01\times10^{2})$	0.20		1.5 ℓ for H comp.
17.5	17.5 RW	1ℓ	01-22-83/0949	$(5.30\times10^{1} \pm 2.10\times10^{2})$	0.44		
		1ℓ	09-11-83/1600	$(3.36\times10^{1} \pm 1.99\times10^{2})$	<0.02		1.5 ℓ for H comp.
	H comp. RW[e]	10ℓ	01-22-83/0939	$(1.53\times10^{2} \pm 2.12\times10^{2})$	0.66		
		10ℓ	09-11-83/1637	$(-3.68\times10^{1} \pm 1.97\times10^{2})$	0.15		
H Slough	H Slough-RW	1ℓ	01-22-83/0947	$(3.30\times10^{1} \pm 2.10\times10^{2})$	0.22		middle of slough
		1ℓ	09-11-83/1538	$3.95\times10^{2} \pm 2.87\times10^{2}$	<0.02		
18.0	18.0 BKG[b]	1ℓ	01-22-83/0953	$(1.30\times10^{1} \pm 2.10\times10^{2})$	0.80		4.4°C mid river
		1ℓ	09-11-83/1535	$(1.31\times10^{2} \pm 2.04\times10^{2})$	0.05		18.4°C mid river
	18.0 RW	1ℓ	01-22-83/1100	$(6.70\times10^{1} \pm 2.11\times10^{2})$	0.44		1.5 ℓ for F comp.
		1ℓ	09-11-83/1522	$(1.73\times10^{2} \pm 2.04\times10^{2})$	0.23		1.25 ℓ for F comp.

(a-f) Key found at end of table.

TABLE C.1. (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^{3}H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
18.25	18-1 Sp[d]	1ℓ	01-22-83/1100	$(1.58\times10^{2} \pm 2.13\times10^{2})$[f]	0.66		5.0°C
18.5	18.5 RW[c]	1ℓ	01-22-83/1113	$2.42\times10^{2} \pm 2.13\times10^{2}$	0.44		1.5 ℓ for F comp.
		1ℓ	09-11-83/1515	$(1.31\times10^{2} \pm 2.04\times10^{2})$	0.24		1.25 ℓ for F comp.
19.0	19.0 RW	1ℓ	01-22-83/1127	$(1.99\times10^{2} \pm 2.13\times10^{2})$	0.26		1.5 ℓ for F comp.
		1ℓ	09-11-83/1450	$2.10\times10^{2} \pm 2.03\times10^{2}$	0.10		1.25 ℓ for F comp.
	18-3 Sp	1ℓ	01-22-83/1127	$2.69\times10^{2} \pm 2.14\times10^{2}$	0.88		4.9°C
		1ℓ	09-11-83/1445	$2.56\times10^{2} \pm 2.04\times10^{2}$	1.77		17.7°C
19.5	19.5 RW	1ℓ	01-22-83/1134	$2.33\times10^{2} \pm 2.14\times10^{2}$	0.44		1.5 ℓ for F comp.
		1ℓ	09-11-83/1435	$(2.01\times10^{2} \pm 2.03\times10^{2})$	0.05		1.25 ℓ for F comp.
20.0	20.0 RW	1ℓ	01-22-83/1142	$(1.66\times10^{2} \pm 2.12\times10^{2})$	0.44		1.5 ℓ for F comp.
		1ℓ	09-11-83/1431	$(1.92\times10^{2} \pm 2.03\times10^{2})$	0.16		1.25 ℓ for F comp.
20.5	20.5 RW	1ℓ	09-11-83/1427	$(-6.87\times10^{1} \pm 1.97\times10^{2})$	<0.02		1.25 ℓ for F comp.
21.0	21.0 RW	1ℓ	09-11-83/1410	$2.54\times10^{2} \pm 2.06\times10^{2}$	0.10		1.25 ℓ for F comp.
21.5	21.5 RW	1ℓ	01-22-83/1640	$3.37\times10^{2} \pm 2.15\times10^{2}$	0.66		1.5 ℓ for F comp.
		1ℓ	09-11-83/1416	$(1.23\times10^{2} \pm 2.04\times10^{2})$	0.25		1.25 ℓ for F comp.
22.0	22.0 RW	1ℓ	01-22-83/1625	$2.85\times10^{2} \pm 2.14\times10^{2}$	0.66		1.5 ℓ for F comp.
	22-1 Sp	1ℓ	01-22-83/1620	$(2.11\times10^{2} \pm 2.13\times10^{2})$	0.66		6.1°C
	F comp. RW[e]	10ℓ	01-22-83/1640	$(1.43\times10^{2} \pm 2.14\times10^{2})$	0.66		
		10ℓ	09-11-83/1522	$(4.38\times10^{1} \pm 2.00\times10^{2})$	<0.02		
22.75	22-4 Sp	1ℓ	01-22-83/1610	$3.13\times10^{2} \pm 2.05\times10^{2}$	0.88		6.3°C
		1ℓ	09-11-83/1345	$2.35\times10^{2} \pm 2.06\times10^{2}$	6.87		17.4°C
23.6	23-4 Sp	1ℓ	09-11-83/1335	$2.22\times10^{2} \pm 2.03\times10^{2}$	0.38		17.3°C
Hanford Slough	25-2S Sp	1ℓ	01-22-83/0810	$2.66\times10^{2} \pm 2.05\times10^{2}$	5.53		12.3°C
		1ℓ	09-11-83/1315	$(6.63\times10^{1} \pm 2.00\times10^{2})$	0.35		23.3°C
Hanford Slough	Hanford Slough-RW	1ℓ	01-22-83/1540	$2.62\times10^{2} \pm 2.14\times10^{2}$	1.51		Collected from shore
		1ℓ	09-11-83/1317	$3.53\times10^{2} \pm 2.06\times10^{2}$	<0.02		

(a-f) Key found at end of table.

TABLE C.1. (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^3H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
25.3	25-1 Sp[d]	1ℓ	01-22-83/1550	$3.80x10^2 \pm 2.06x10^2$	0.22		7.0°C
25.5	25-3 Sp	1ℓ	01-22-83/0945	$3.10x10^2 \pm 2.06x10^2$	0.66		4.9°C
		1ℓ	09-11-83/1300	$5.34x10^2 \pm 2.10x10^2$	0.47		17.7°C
25.8	25-4 Sp	1ℓ	01-22-83/1710	$(1.36x10^2 \pm 2.11x10^2)$[f]	1.11		7.1°C
26.2	26-1 Sp	1ℓ	01-22-83/1015	$3.21x10^2 \pm 2.06x10^2$	1.33		4.9°C
		1ℓ	09-11-83/1245	$(8.15x10^1 \pm 2.08x10^2)$	0.55		21.4°C
27.0	27.0 BKG[b]	1ℓ	09-11-83/1225	$(1.07x10^2 \pm 2.01x10^2)$	0.09		17.4°C mid river
	27.0 RW[c]	1ℓ	01-22-83/1127	$(-4x10^0 \pm 2.10x10^2)$	0.75		2 ℓ for27/29 comp.
		1ℓ	09-11-83/1221	$(1.55x10^2 \pm 2.02x10^2)$	0.21		2 ℓ for 27/29 comp.
	27-1 Sp	1ℓ	01-22-83/1125	$2.92x10^2 \pm 2.05x10^2$	0.58		4.5°C
		1ℓ	09-11-83/1215	$3.69x10^2 \pm 2.06x10^2$	0.73		15.1°C
27.5	27.5 RW	1ℓ	01-22-83/1338	$1.05x10^4 \pm 3.42x10^2$	5.53		2 ℓ for 27/29 comp.
		1ℓ	09-11-83/1200	$2.76x10^3 \pm 2.54x10^2$	0.05		2 ℓ for 27/29 comp.
	27-3 Sp	1ℓ	01-22-83/1336	$8.03x10^2 \pm 3.16x10^2$	1.99		8.2°C
		1ℓ	09-11-83/1206	$9.17x10^4 \pm 9.18x10^2$	3.05		16.7°C
28.0	28.0 RW	1ℓ	01-22-83/1400	$4.88x10^4 \pm 6.10x10^2$	9.52		2 ℓ for 27/28 comp.
		1ℓ	09-11-83/1157	$6.06x10^4 \pm 7.61x10^2$	1.18		2 ℓ for 27/29 comp.
	28-2 Sp	1ℓ	01-22-83/1400	$7.98x10^4 \pm 7.79x10^2$	16.6		11.1°C
		1ℓ	09-11-83/1150	$1.10x10^5 \pm 9.95x10^2$	4.65		17.4°C
28.5	28.5 RW	1ℓ	01-22-83/1225	$1.11x10^3 \pm 2.22x10^2$			2 ℓ for 27/29 comp.
		1ℓ	09-11-83/1140	$7.92x10^3 \pm 3.28x10^2$	2.35		2 ℓ for 27/29 comp.
	28-4 Sp	1ℓ	01-22-83/1425	$2.32x10^4 \pm 4.54x10^2$	7.52		5.9°C
		1ℓ	09-11-83/1136	$9.69x10^4 \pm 9.40x10^2$	8.2		19.8°C
28.8	28-5 Sp	1ℓ	01-22-83/1517	$4.31x10^2 \pm 2.15x10^2$	1.55		new location-middle of beach between Sp 28-4 and RM 29

(a-f) Key found at end of table.

TABLE C.1. (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^3H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
29.0	29.0 RW[c]	1ℓ	01-22-83/1240	$(1.01 \times 10^2 \pm 2.11 \times 10^2)$[f]	0.71		
		1ℓ	09-11-83/1119	$4.11 \times 10^3 \pm 2.75 \times 10^2$	0.24		2 ℓ for 27/29 comp.
	29-0 Sp[d]	1ℓ	01-22-83/1255	$1.63 \times 10^3 \pm 2.34 \times 10^2$	2.65		new location-beach below RM 29
	27/29 comp. RW[e]	10ℓ	01-22-83/1430	$(1.23 \times 10^4 \pm 3.60 \times 10^4)$	2.65		2 ℓ for 27/29 comp.
		10ℓ	09-11-83/1221	$1.17 \times 10^4 \pm 3.74 \times 10^2$	0.35		
29.5	29.5 RW	1ℓ	09-11-83/1100	$2.56 \times 10^3 \pm 2.48 \times 10^2$	<0.02		2.5 ℓ for 29/31 comp.
30.0	30.0 RW	1ℓ	09-11-83/1033	$2.32 \times 10^3 \pm 2.44 \times 10^2$	0.15		2.5 ℓ for 29/31 comp.
	30-1 Sp	1ℓ	09-11-83/1025	$2.73 \times 10^3 \pm 2.52 \times 10^2$	3.14		20.4°C
30.5	30.5 RW	1ℓ	09-11-83/1012	$2.73 \times 10^3 \pm 2.51 \times 10^2$	0.05		2.5 ℓ for 29/31 comp.
31.0	31.0 RW	1ℓ	09-11-83/1009	$9.38 \times 10^2 \pm 2.20 \times 10^2$	0.05		2.5 ℓ for 29/31 comp.
	31-1 Sp	1ℓ	09-11-83/1005	$(1.57 \times 10^2 \pm 2.02 \times 10^2)$	5.25		15.8°C
	29/31 comp. RW	10ℓ	09-11-83/1100	$2.07 \times 10^3 \pm 2.39 \times 10^2$	0.26		
31.5	31.5 RW	1ℓ	09-11-83/0946	$6.86 \times 10^2 \pm 2.13 \times 10^2$	0.15		2.5 ℓ for 31/33 comp.
31.75	31-5 Sp	1ℓ	09-11-83/0950	$(1.90 \times 10^2 \pm 2.02 \times 10^2)$	2.64		17.4°C
32.0	32.0 RW	1ℓ	09-11-83/0923	$4.69 \times 10^2 \pm 2.09 \times 10^2$	0.09		2.5 ℓ for 31/33 comp.
32.5	32.5 RW	1ℓ	09-11-83/0912	$8.06 \times 10^2 \pm 2.16 \times 10^2$	0.11		2.5 ℓ for 31/33 comp.
	32-0 Sp	1ℓ	09-11-83/0927	$3.17 \times 10^2 \pm 2.06 \times 10^2$	1.78		17.8°C
33.0	33.0 RW	1ℓ	09-11-83/0900	$(1.30 \times 10^2 \pm 2.04 \times 10^2)$	0.05		2.5 ℓ for 31/33 comp.
	33-1 Sp	1ℓ	09-11-83/0900	$5.73 \times 10^2 \pm 2.11 \times 10^2$	0.75		17.9°C
	31/33 comp. RW	10ℓ	09-11-83/0950	$4.31 \times 10^2 \pm 2.08 \times 10^2$	0.15		
37.2	37-1 Sp	1ℓ	12-20-82/1047	$1.19 \times 10^3 \pm 2.30 \times 10^2$	5.31		6.7°C
38.25	38-1 Sp	1ℓ	12-20-82/1120	$4.72 \times 10^2 \pm 2.50 \times 10^2$	4.65		6.4°C
41.5	41.5 RW	1ℓ	12-20-82/1235		0.62	0.408 ± 0.143	2 ℓ for 41.5/44 comp.; 6.2°C
41.8	41-1 Sp	1ℓ	12-20-82/1235		3.98	9.03 ± 3.16	11.1°C

(a-f) Key found at end of table.

TABLE C.1. (contd)

Sample Collection				Analyses			
River Mile Location[a]	Sample ID	Sample Size	Date/Time Collected	^3H, pCi/ℓ ±2σ	NO_3, ppm	U, pCi/ℓ ± 2σ	Comments
42.0	42.0 RW	1ℓ	12-20-82/1235		2.12	1.57 ± 0.549	2 ℓ for 41.5/44 comp.
	42-1 Sp	1ℓ	12-20-82/1235		12.6	15.4 ± 5.40	11.8°C
		1ℓ	01-22-83/1530			19.0 ± 6.64	13.7°C
42.25	42-2 Sp[d]	1ℓ	12-20-82/1305		2.21	16.2 ± 5.67	11.2°C
		1ℓ	01-22-83/1500		--	8.72 ± 3.05	17.1°C
42.5	42.5 RW[c]	1ℓ	12-20-82/1314		0.26	0.612 ± 0.214	2 ℓ for 41.5/44 comp.
	42-4 Sp	1ℓ	12-20-82/1314		8.41	8.35 ± 2.92	6.6°C
		1ℓ	01-22-83/1515			8.38 ± 2.93	17.3°C
43.0	43.0 RW	1ℓ	12-20-82/1327		0.75	0.401 ± 0.140	2 ℓ for 41.5/44 comp.
43.5	43.5 RW	1ℓ	12-20-82/1340		0.26	0.325 ± 0.114	2 ℓ for 41.5/44 comp.
	43-1 Sp	1ℓ	12-20-82/1340		1.15	12.2 ± 4.26	7.8°C
43.8	43-3 Sp	1ℓ	12-20-82/1359		0.44	2.99 ± 1.05	10.1°C
44.0	44.0 RW	1ℓ	12-20-82/1350		0.18	0.391 ± 1.37	2 ℓ for 41.5/44 comp.
	41.5/44 comp. RW[e]	10ℓ	12-20-82/1350		0.66	0.746 ± 0.261	

(a) River mile locations based on markers indicating shoreline distance downstream from Vernita Bridge.
(b) BKG denotes "background" river sample collected from river surface at the middle of the river channel away from Hanford Shoreline.
(c) RW denotes river water sample collected from surface within 2 to 4 meters of Hanford shoreline.
(d) Sp denotes river-bank spring sample.
(e) Comp. RW denotes composite river water sample comprised of aliquots from immediately preceeding sample locations.
(f) Parenthesis enclosing a value indicates that the radionuclide was not detectable; i.e., the value was less than its two-standard deviation (counting error) or the value was negative. (It is not uncommon for individual measurements of environmental radioactivity to result in values of zero or negative numbers due to subtracting out instrumental background.)

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