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Results of The Tritium Survey of Fourmile Branch and its Seeplines in the F- and H-Areas of SRS: March 1996

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Abstract

The Environmental Sciences Section (ESS) of the Savannah River Technology Center (SRTC) conducted a quarterly monitoring program of the Fourmile Branch (FMB) stream and its associated seepline located down gradient from the F- and H-Area Seepage Basins beginning May 1992 and ending in May 1995. The quarterly tritium survey has been changed to a semi-annual schedule, and this report details the results of the first event in FY96. The primary focus of this program is to measure and track changes in tritium levels. However, specific conductivity and pH were also measured and tracked. The measurements from this survey (March 1996) exhibited similar tritium levels, conductivity measurements, and pH values to data from the previous quarterly tritium surveys. The overall results of the tritium survey and stream monitoring data (Looney et al., 1993) indicate that the tritium plume resulting from the past operation of the seepage basins continues to flush from the seeplines and wetlands to Fourmile Branch.

Executive Summary

In March 1996 the Environmental Sciences Section (ESS) surveyed the Fourmile Branch seepline down gradient from the F- and H-Area Seepage Basins for tritium, specific conductivity, and pH. This survey was the first of two surveys scheduled during FY96 to monitor the movement of contaminants from the basins since closure in 1990. Surface-water samples were collected from 60 locations along the seepline and from three stream locations along Fourmile Branch. The seepline locations included 22 from F Area, 22 from H Area, and 16 from the seepline south of 643-E, which is a decommissioned area in the Solid Waste Disposal Facility. Forty-four of the locations were sampled in 1989 by the Savannah River Laboratory (now Savannah River Technology Center) as part of an extensive characterization study (Haselow et al. 1990). ESS found that tritium activities in both F- and H-Area seeplines in March 1996 were significantly lower than the activities measured by Haselow et al. (1990). However, there were five locations from the March 1996 survey that showed a significant increase in tritium activity above the March 1989 results.

Previous tritium surveys have consistently shown a declining trend in tritium activity at both the F-and H-Area seepline. Total tritium fluxes to the wetlands and FMB have steadily declined since basin closure (Looney et al., 1993) and overall results from this tritium survey and the previous quarterly surveys continue to support this finding. Differences in tritium activities measured at individual seepline sampling locations from one sampling event to the next represent seasonal variability in the depth to the water table, amounts of rainfall, and changes due to the flushing of the plume from the wetland system. Conclusions about tritium fluxes to the wetlands and FMB should consider the long-term surface water, seepline, and groundwater monitoring data and not rely on quarterly or semi-annual changes in concentrations at seepline monitoring stations alone. These considerations were applied within this report before making conclusions about the tritium fluxes. The long term tritium trends are shown in Figures 19 and 20.

March 1996 conductivity measurements exhibited similar trends as tritium activities in both F and H Areas and the average seepline pH was approximately the same as the last survey which was conducted in May 1995. This indicates that conditions have somewhat stabilized from extremely acid (pH < 4.5) to slightly acid (combined average pH of 5.3) which is closer to normal for this type of wetland. Aluminum concentrations measured along the seepline in 1989 (Haselow et al., 1990) were elevated enough to be potentially toxic to plants. An increase in pH reduces the solubility of aluminum and thereby decreases the potential for aluminum toxicity to plants. Concentrations of aluminum, as well as other metals, measured along the seepline in 1992, 1993, and 1994 were substantially lower than 1989 concentrations, consistent with the increased pH (Dixon and Rogers, 1993e; Dixon et al. 1995). Field observations have revealed that vegetation in most areas is showing noticeable recovery, (Nelson and Irwin, 1994; Nelson and Rogers, 1995). Studies have also shown that the toxicity of these areas is decreasing, (Nelson and Westbury, 1994; Westbury and Nelson, 1994)

The seepline south of 643-E, along a tributary of Fourmile Branch, is influenced by tritium migrating from the Burial Ground Complex. The tributary (old F-Area effluent ditch) is a natural drainage that received effluent discharge from F-Area Separations prior to the construction of the engineered effluent canal. The March 1996 tritium activities on the east side of the natural drainage ranged from 15 to 406 pCi/mL and on the west side from 240 to 20,200 pCi/mL. The tritium activity measured in the stream of the natural drainage was 15,000 pCi/mL. These results continue to suggest that the tritium outcrop area has been delineated by the sampling locations established on the west side of the drainage channel. Conductivity and pH measurements taken on both sides of the drainage were similar to those recorded in May 1995, and were within the range of normal values for this wetland. The low conductivity values measured along the drainage way suggest that the tritium plume outcropping in the area emanates from 643-E because wastes introduced into 643-E contained low levels of salt ions compared to the waste in the F-and H-Area Seepage Basins.

Introduction

Seepage basins in the F and H Areas of SRS received low-level radioactive waste effluent from the chemical separation processes in the General Separation Area, (GSA). The basins retained the effluent and allowed it to be slowly release into the soil. The waste effluent consisted principally of sodium hydroxide, nitric acid, low levels of various radionuclides, and some metals (Killian et al., 1985a and 1985b). Discharges of tritiated water to the seepage basins accounted for a majority of the radioactivity (Fenimore and Horton, 1972).

The Savannah River Laboratory (now the Savannah River Technology Center) conducted an extensive study designed to characterize the shallow groundwater outcropping into Fourmile Branch (FMB) and its associated seepline in 1988 and 1989 (Haselow et al., 1990). As a part of this study, Haselow et al. (1990) surveyed for tritium, pH, and conductivity. Researchers found low pH and elevated conductivity and tritium values along the seeplines and concluded that contaminants leaching from the F- and H-Area Seepage Basins were impacting the wetlands below the basins. SRS stopped discharges to the seepage basins in 1988 and capped and sealed the basins in 1990 to isolate the contaminants from direct rainfall. Scientists hypothesized that after the elimination of the contaminant source, natural groundwater flow from annual rainfall would flush the remaining contaminant plume out of the shallow groundwater over time. After the contaminant plume in the shallow groundwater is flushed out, the impacted wetland systems immediately down gradient from the basins should recover.

To investigate this hypothesis, a quarterly sampling program was established in May 1992 and concluded in May 1995. ESS sampled 44 of the seepline locations sampled by Haselow et al. (1990) for tritium, pH, and specific conductivity. The 1996 sampling program is intended to complement semi-annual sampling of the seepline for selected Appendix IX constituents, which began in July 1992 and is now, 1996, conducted annually. A report summarizing results from the semi-annual sampling program has been completed (Dixon and Rogers, 1993e, Dixon, Koch, and Rogers, 1995). The Haselow et al. (1990) results established the baseline to which the results from the quarterly tritium sampling program are compared. These collection points were chosen as the baseline because they are the only data available that were collected before the basin discharges were discontinued. The Haselow et al. (1990) data should be representative of conditions immediately prior to closing the basins.

There was expressed concern about the source of tritium and other contaminants that possibly emanate from an area in the southwest corner of 643-E rather than from the closed basins. To investigate this possibility, numerous sampling locations on the H-Area seepline south of 643-E were established and were incorporated into the quarterly sampling plans and subsequently the FY96 .

Methods

ESS conducted the first in a series of two FY96 sampling events for tritium in March 1996. Sampling locations were the same as those selected in the quarterly tritium surveys. These locations, according to 1989 data, exhibited high and low values for the three variables of concern. Attempts were made to establish an even ground coverage along both seeplines. ESS collected 60 samples from the seeplines in F and H Area: 22 from the F-Area seepline, 22 from the H-Area seepline, and 16 from the FHB seepline south of 643-E Area. One sample was taken from the old effluent stream. ESS also collected three stream samples from locations on Fourmile Branch. Figures 1 and 2 approximate these sampling locations.

Prior to sampling for the first quarterly survey in May 1992, the Health Protection Department (HPD) collected soil samples from several locations along both seeplines and monitored them for gamma radioactivity. HPD did not detect gamma radiation; therefore, ESS selected rubber boots and disposable rubber gloves as protective clothing to prevent skin contact with seepline water during sampling operations.

Seepline sampling locations had been previously marked and labeled with PVC stakes. Samples were collected within a three foot radius of the PVC stake by boring a hole into the soil with a small soil auger, generally six inches and not more than eighteen inches deep to obtain sample. To collect water for tritium analysis, polyethylene sample containers (25 mL) were dipped into the water until full and then capped. The outside of each container was then rinsed with deionized water and sealed in a small polyethylene bag to minimize the possibility of contamination. The small bags were then sealed in a large polyethylene bag. General Engineering Laboratories (GEL) performed the tritium analysis for the standard and duplicate samples and the Environmental Monitoring Section (EMS) performed the analysis on split samples.

ESS measured specific conductivity and pH *in situ* with conductivity and pH electrodes (WSRC-L14.1, 1992a and 1992b). The electrodes were rinsed with deionized water after each sampling. All sampling equipment was thoroughly rinsed with deionized water at the end of each day.

Results and Observations

Parameters measured at seepline sampling locations fluctuate throughout the year. Seepline measurements are made on water collected from fixed locations at the distal end, or toe outcrop, of the contaminant plume. Because the plume is dynamic (i.e., influenced by weather and other activities in the area) seepline monitoring is sensitive to both long term changes and seasonal/transient influences. Climatic and seasonal conditions, especially rainfall amounts influence measured concentrations Groundwater flow paths in F and H Area are complex, as illustrated in Figures 3 and 4. Recharge to the groundwater is primarily due to infiltration of rainwater (rainfall minus runoff and evapotranspiration). Groundwater then moves laterally, down and to Fourmile Branch and its tributaries.

As the water travels toward the stream, additional infiltration forces up-gradient water deeper. Near the stream, the flow lines rise to the surface, emerging between the seepline and the stream (which acts as the groundwater "drain"). This typical vertical trajectory, a path curving downward near the groundwater divide and then upward into draining surface water, is shown as flow lines on Figures 3 and 4.

Figure 3 shows the flow lines without contaminated water from the seepage basins and Figure 4 shows the addition of contaminated flow lines resulting from F and H Area operation of the basins. The theoretical plume geometry is clearly confirmed by the real vertical profile of the F-Area Seepage Basin plume based on the detailed grid wells available in the 1970s (Looney et al., 1993). Changes in the water balance in the area influence the flow velocity and tend to move the plume either deeper or shallower and cause the location of the contaminated water to move. This is especially important to data interpretation if the "toe" of the plume is shifting relative to the fixed sample locations. Figure 5 summarizes the projected changes in the plume based on a range of transient activities. Increased rainfall (or other activities that increase infiltration such as harvesting trees) result in increased plume velocity and movement downward and away from the seepline. This decreases contaminant concentrations at the seepline sampling locations. Less infiltration decreases plume velocity and causes the plume to move upward and outcrop closer to the basins. This results in increased contaminant concentrations as measured at the seepline sampling locations.

Low rainfall for a few months prior to sampling increases constituent concentrations, and high rainfall decreases constituent concentrations in the shallow groundwater at the seepline intercept. Rainfall measured at SRS at the weather station in F Area for December 1995 through March 1996 was 45.4cm. From 1960 to 1991, the average rainfall measured in F Area for this same period was 38.2 cm. This indicates that rainfall amounts in the area were above average for the few months prior to this sample period. Figure 6 shows a comparison of April 1995-March 1996 rainfall to the long term average (1960-1991). It is hypothesized that above average rainfall observed in the area for this period would cause contaminant concentrations to decrease at sample locations closer to the basins and to increase at the more distant locations. This increase in infiltration causes the toe of the plume to migrate downward through the soil profile and the arrival point of the toe to move towards the FMB and away from the basins. Note that the direction of the plume flow always remains the same, only the flow velocity and outcrop location changes relative to the changes in infiltration.

Tritium concentrations at five sample locations were above the March 1989 readings, with these sample locations showing an average tritium activity increase of 960 pCi/mL. Generally, these are the most distant sample location points from the closed basins along Fourmile Branch. Figures 7 through 12 show comparisons of March 1989 with May 1995 and March 1996 tritium, conductivity, and pH measurements for locations in F- and H-Area seepline. Data for the first twelve surveys can be found in Dixon, Rogers, and Looney (1992, 1993a, 1993b, 1993c, 1993d and 1993e and 1994), Rogers et al. (1994a, 1994b, and 1994c) and Koch and Dixon (1994 and 1995). Figures 13 through 15 show the data for the Fourmile Branch stream locations. Figures 16 through 18 show the data for the sampling locations along the old effluent seepline and include one stream sample from the branch channel south of 643-E. These sampling locations were identified with the prefix FHB.

F- and H-Area Seepline Tritium Measurements

F Area

March 1996 tritium values in the F-Area seepline ranged from 7 to 7740 pCi/mL (Figure 6 and Table 2). None of the 22 sampling locations were dry, and three sampling locations had tritium activities that exceeded the 1989 measurements by more than ten percent. No sample's activity exceeded the maximum value of 14,000 pCi/mL measured in March 1989 at this seepline.

Figure 19 was developed to graphically show the downward trend of tritium concentrations in this area. It is a plot of the mean of the tritium concentrations from each sampling event beginning with the March 1989 baseline event through the March 1996 sampling event (Table 6).

As with data from previous sampling events, a Wilcoxon signed-rank test was conducted to compare March 1996 tritium activities to March 1989 activities. The Wilcoxon signed-rank test uses the sign and the magnitude of the rank of the differences between pairs of measurements to compare nonparametric data (Daniel, 1978). This test was chosen because it allows comparisons of paired data without assumptions of normality. If the P value is less than or equal to 0.05, then the March 1996 tritium levels are significantly less than the March 1989 tritium levels. The results from this test gave a P value of 0.02. This shows that the March 1996 concentrations were significantly lower than the 1989 concentrations for this seepline.

H Area

Tritium values in the H-Area seepline ranged from 20 to 7,660 pCi/mL (Figure 8 and Table 3). One of the 22 sampling locations was dry, and two sampling locations had tritium activities that exceeded the 1989 measurements by more than ten percent. These locations, HSP071 and HSP097 are among the furthest locations from the closed basins. No sample's activity exceeded the maximum value of 24,000 pCi/mL measured in March 1989 at this seepline.

Figure 20 was developed to graphically show the downward trend of tritium levels in this area. It is a plot of the mean of the tritium concentrations from each sampling event beginning with the March 1989 event (Table 6).

As with data from F Area, a Wilcoxon signed-rank test was conducted to compare March 1996 tritium activities to March 1989 activities. The results showed that the March 1996 concentrations were significantly less ($P=0.002$) than the 1989 concentrations for H Area.

F and H Areas

Figures 7 and 8 show tritium activity at F and H Area for the March 1996 sampling event. Tritium concentrations increased at 5 sample locations, while 37 locations either decreased or were relatively unchanged compared to the May 1995 sampling event. There were no dry sites. Overall, sampling has shown a declining trend in tritium concentrations at the F-and H-Area seeplines (Figures 19 and 20).

It is important to note that total tritium fluxes to the wetlands and FMB have steadily declined since basin closure (Looney et al., 1993) and that overall results of the tritium survey support this finding. Differences in tritium concentrations measured at seepline sampling locations from one sampling event to the next represent seasonal variability and variable rainfall as well as changes due to the flushing of the plume from the wetland system.

F- and H-Area Seepline Conductivity Measurements

F Area

Conductivity measurements in the F-Area seepline ranged from 25 to 1,799 µS/cm (Figure 9 and Table 2). Due to the variability of conductivity measurements, only differences of 100 µS/cm or more are considered significant. Of the 22 locations sampled at the F-Area seepline, two locations measured more than 100 µS/cm above the 1989 measurements. A comparison of the graphs in Figures 7 and 9 suggests that conductivity follows the same general trends as the tritium activities. Using a Spearman rank correlation test for nonparametric data, it was found that the probability that tritium and conductivity exhibited independent trends was $P<0.05$. The Spearman rank correlation coefficient was found to be $r_s = 0.93$, suggesting that the two parameters are exhibiting the same trends. This similarity is to be expected because tritium serves to track the movement of the contaminant plume from the basins (Haselow et al., 1990).

H Area

Conductivity measurements in the H-Area seepline ranged from 30 to 332 µS/cm (Figure 10 and Table 3). None of the sampling locations, had a measurement of more than 100 µS/cm above the 1989 measurements. The Spearman rank correlation test for nonparametric data was used to investigate the correlation of H Area tritium activities and conductivity values. The probability that the two parameters exhibited independent trends was

P<0.07 The rank correlation coefficient (r_s = 0.40) for H Area was much less than that for F Area and suggested a weak or absent correlation. In past tritium surveys, 1992 to 1995, this correlation has been good.

F- and H-Area Seepline pH Measurements

F- Area pH values ranged from 3.0 to 6.3 with an average value of 4.7 (Figure 11 and Table 2). H- Area pH values ranged from 5.1 to 6.6 with an average of 5.9 (Figure 12 and Table 3). The pH for the entire seepline (F and H Areas combined) averaged 5.3. This represents an increase of 0.4 units over the 4.9 average in 1989 and is the same overall average for the May 1995 sampling event (Haselow et al., 1990). An increase in pH will affect the solubility of metals in the soil which should improve the soil water chemistry and enhance the recovery of wetland vegetation stressed indirectly by low pH. Aluminum concentrations measured along the seepline in 1989 (Haselow et al., 1990) were high enough to be toxic to plants. Increases in pH from an average of 4.9 in 1989 have reduced the amount of aluminum in solution and thereby reduced it as a possible source of plant toxicity. Concentrations of aluminum and other metals measured along the seepline in July 1992 were substantially lower than 1989 concentrations, consistent with the observed pH (Dixon and Rogers, 1993e). Field observations have revealed that vegetation in most of the stressed areas is making noticeable recovery (Nelson and Irwin, 1994; Nelson and Rogers, 1995). Studies have also shown that the toxicity of these areas is decreasing, (Nelson and Westbury, 1994; Westbury and Nelson, 1994).

Fourmile Branch Measurements

Figures 13 through 15 show the tritium, conductivity, and pH values for the Fourmile Branch stream sampling locations. Table 4 provides the data used in the figures. Tritium activities at these locations ranged from 29 to 456 pCi/mL. These values were consistent with previous data and show increases in tritium downstream as the seepline water enters the channel of Fourmile Branch. Conductivity measurements ranged from 30 to 42 µS/cm and pH ranged from 5.4 to 6.2. Both conductivity and pH values were at near normal levels.

Solid Waste Disposal Facility (643-E) Seepline Measurements

The graphs in Figures 16 through 18 show tritium, conductivity, and pH values for the seepline and stream sampling locations south of 643-E, which is part of the Solid Waste Disposal Facility. Table 5 provides the data used in the figures. This seepline is along the natural drainage (old F-Area effluent ditch) that was used to discharge effluent from F-Area separations prior to the construction of the engineered effluent canal.

Tritium activities for the locations on the east side of the drainage ranged from 15 to 406 pCi/mL. Activities on the west side of the drainage ranged from 240 to 20,200 pCi/mL. The tritium activity at the stream location in the drainage (FHB012) was 15,000 pCi/mL.

Conductivity measurements on both sides of the drainage were near background at most locations and ranged from 25 to 106 µS/cm. Conductivity values are typical of the conductivity values being reported in the water table wells in the vicinity of the old F-Area effluent ditch (EMS, 1993). Using the Spearman rank correlation test, no correlation (r_s = .19) was found between conductivity and tritium for these locations. The pH values ranged from 4.2 to 5.8 with an average of 5.0.

These results are consistent with the Haselow et al. (1990) results for the western portion of the

H-Area seepline, particularly near location HSP103. Haselow et al. (1990) found that down gradient from 643-E, conductivity values were near background while tritium concentrations were elevated. This was attributed to tritiated wastes deposited in 643-E. Tritium activities measured along the seepline down gradient of 643-E (particularly sample points on the west side) suggest that tritium migrating from 643-E and outcropping in this area is substantial. The appearance of tritium on the west side as opposed to the east side of the drainage suggests that soil material placed in the northern reaches of the natural drainage forced the tritium plume to outcrop down gradient. It appears that the groundwater containing tritium is moving below the fill material and outcropping on the west side of the drainage channel. The results suggest that the sampling locations on the west side of the drainage have delineated the tritium plume with the center located at or near FHB018.

Conclusions

F- and H-Area Seeplines and Fourmile Branch

- Tritium concentrations measured at most locations during March 1996 remained relatively unchanged compared to the previous sampling event yet are significantly lower that the 1989 baseline tritium levels.
- Total tritium fluxes to the wetlands and FMB have steadily declined since basin closure (Looney et al., 1993) and overall results from the tritium survey support this finding These findings support the hypothesis that the tritium plume in F and H Area is being flushed from the shallow groundwater.
- The trends indicate that sample locations near the Fourmile Branch channel and the most distant from the capped basins show elevated tritium concentration.
- Differences in tritium concentrations measured at seepline sampling locations from one sampling event to the next represent seasonal and rainfall variability as well as changes due to flushing of the contaminant plume from the wetland system. No correction has been made for tritium decay because of the short time between sample events. Conclusions about tritium fluxes to the wetlands and FMB should consider the complexity of the groundwater system and should be based on long-term surface water, seepline, and groundwater monitoring data and not on quarterly changes in concentrations at seepline monitoring locations.

Solid Waste Disposal Facility (643-E) Seepline

Evaluation of data from 16 seepline locations south of the 643-E Area indicates that tritium migrating from 643-E is outcropping at the F-Area effluent ditch, particularly on the west side of the stream channel. It appears that sampling locations on the west side of the ditch have delineated the tritium outcrop area with the present climatic and hydrologic conditions. Data does not indicate that the tritium plume has decreased over the past eight sampling events. The lack of decrease in tritium concentration supports the assumption that the source of tritium is coming from 643-E rather than the capped basins.

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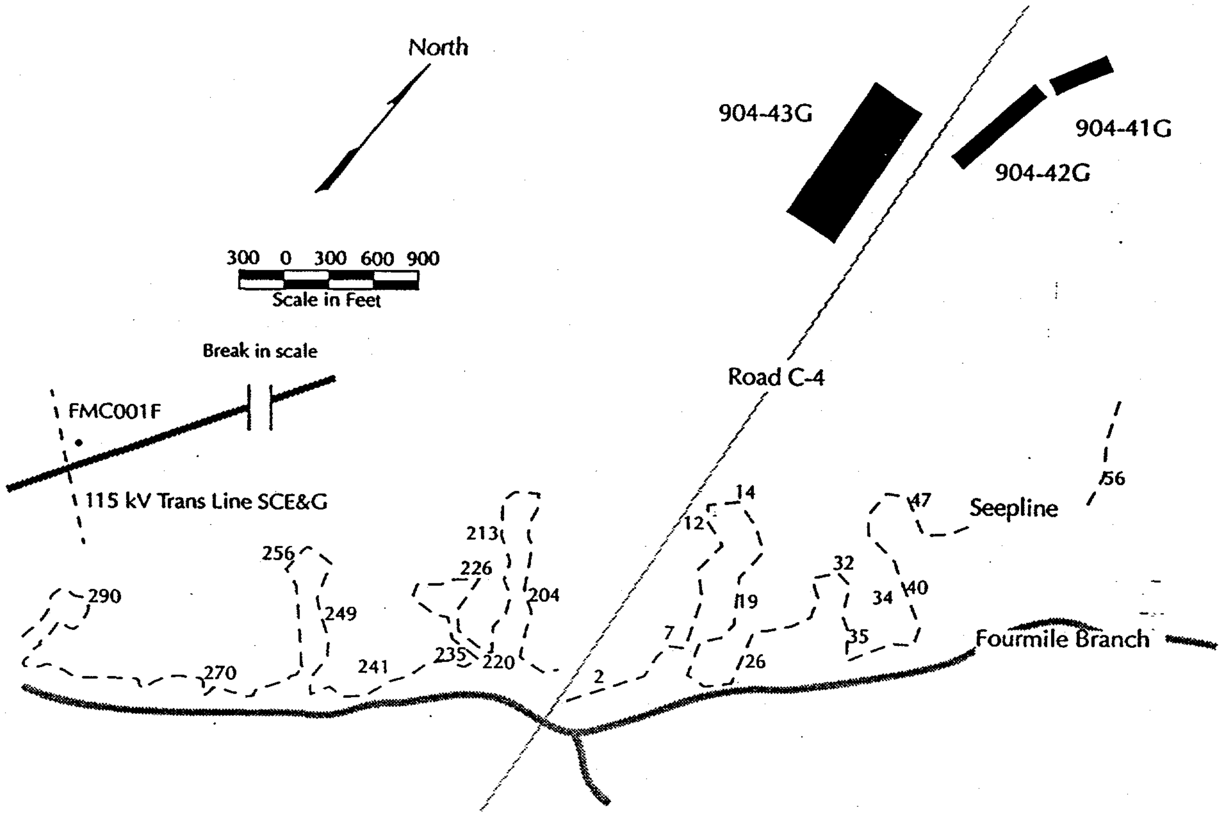

Figure 1. Location of F-Area Seepage Basins and Seepline Sampling Points.

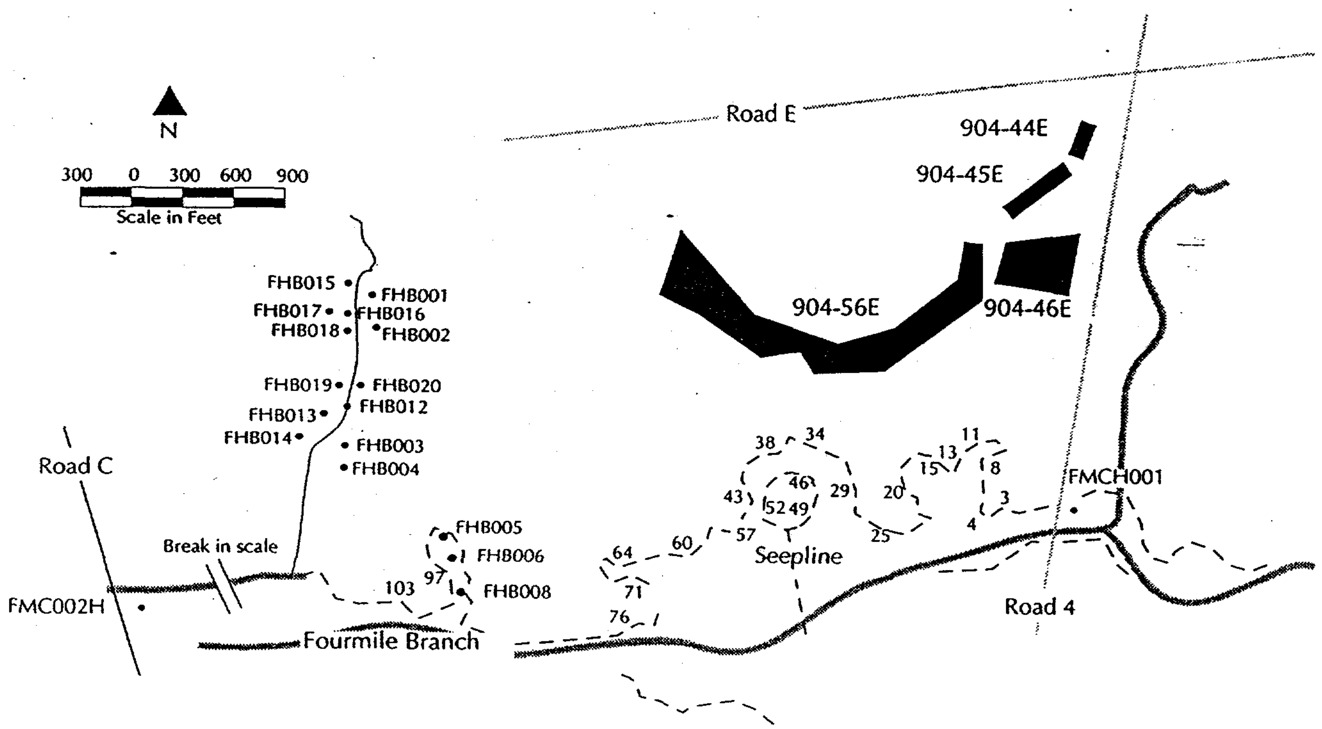

Figure 2. Location of H-Area Seepage Basins and Seepline Sampling Points and FHB Sampling Points.

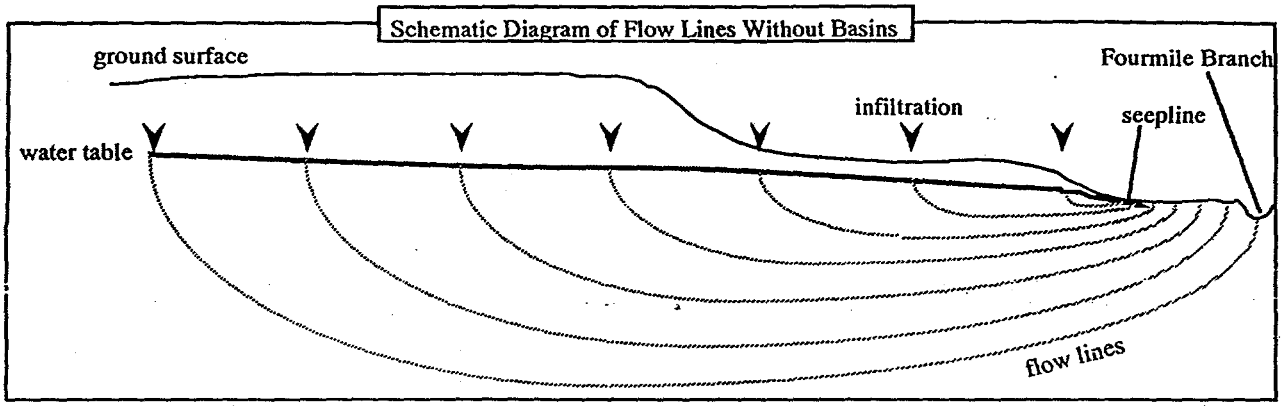

Figure 3. Schematic Diagram of Flow Lines in the Shallow Groundwater at the F- and H-Area without Seepage Basins

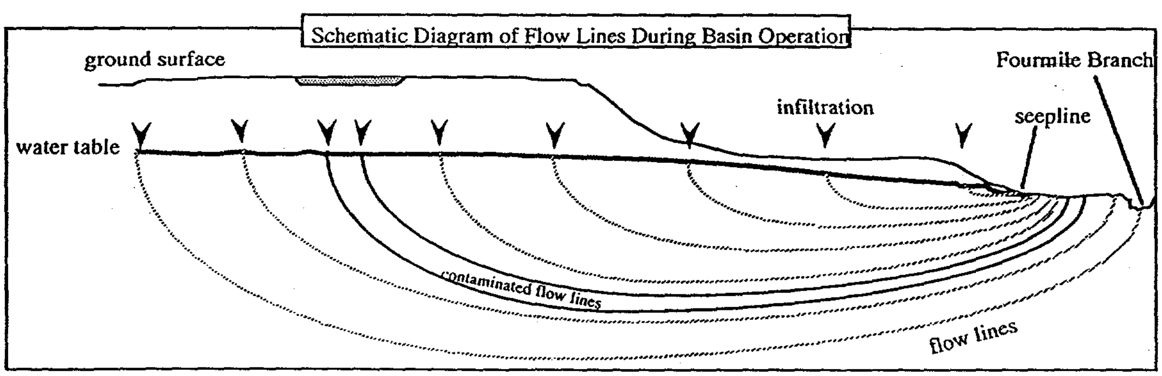

Figure 4. Schematic Diagram of Flow Lines in the Shallow Groundwater at the F- and H-Area Seepline during Basin Operation

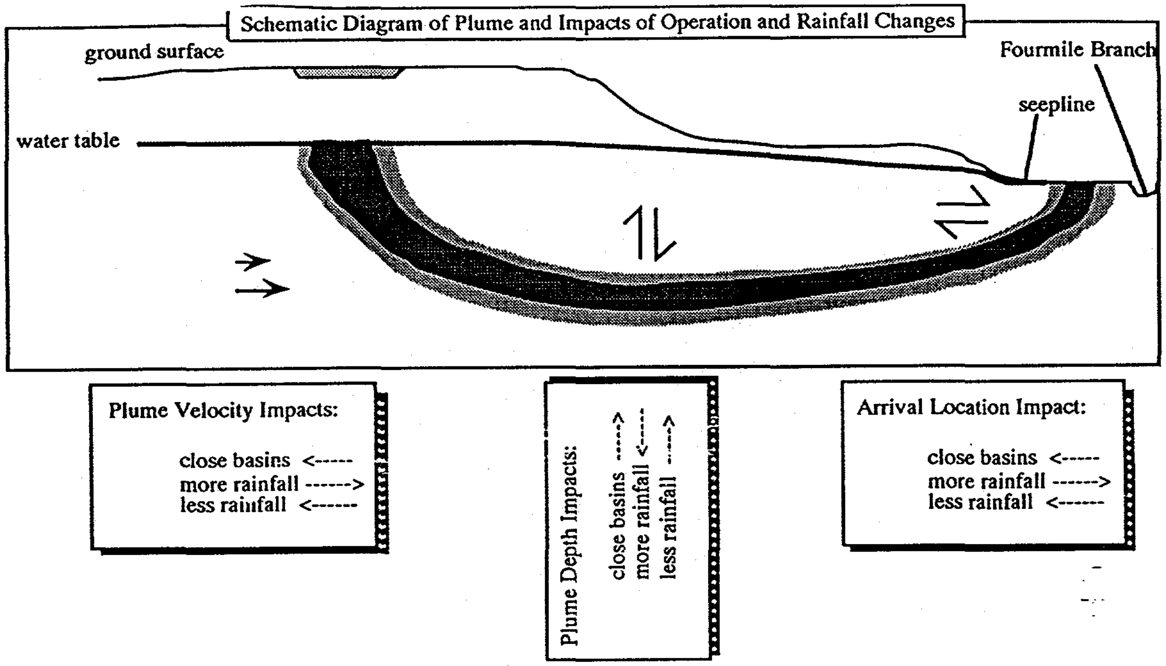

Figure 5. Schematic Diagram of the Tritium Plume Migrating from F- and H-Area Seepage Basins

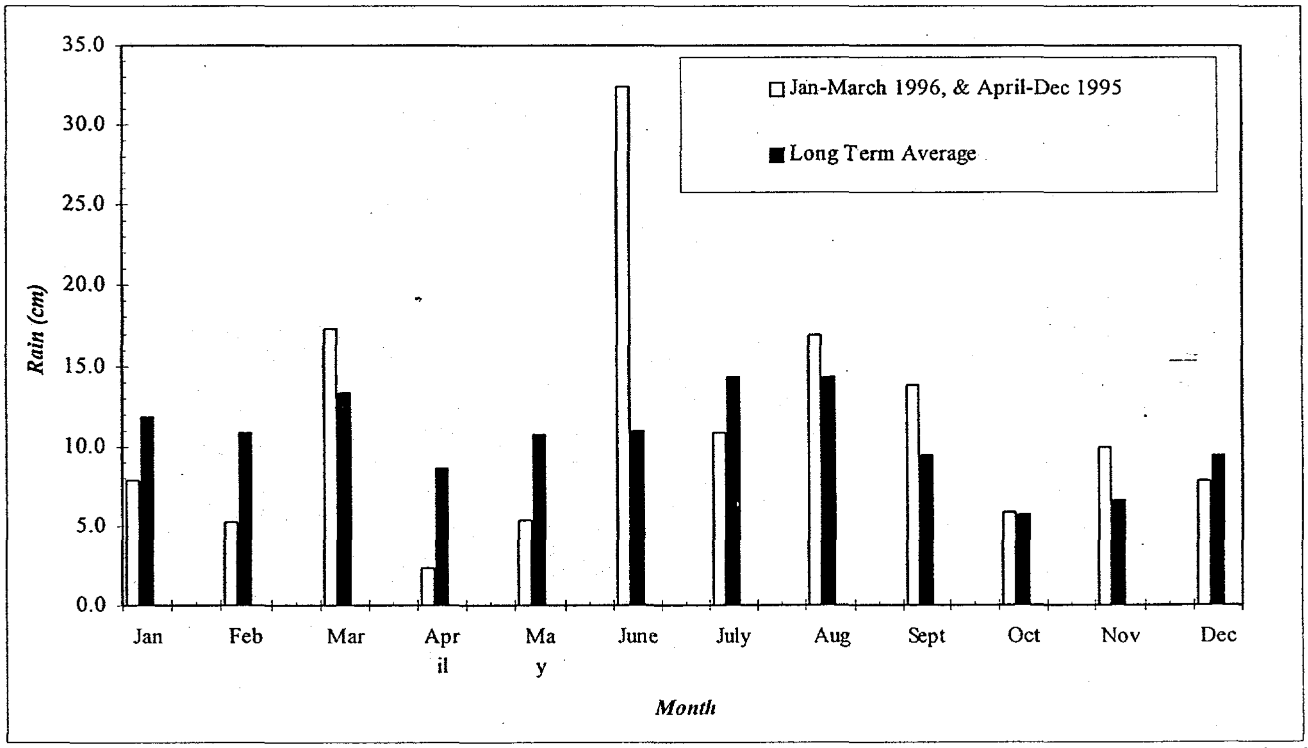

Figure 6. Comparison of April 1995-March 1996 Monthly Rainfall to the Long-Term Average (1960-1991) for the F-Area Weather Station

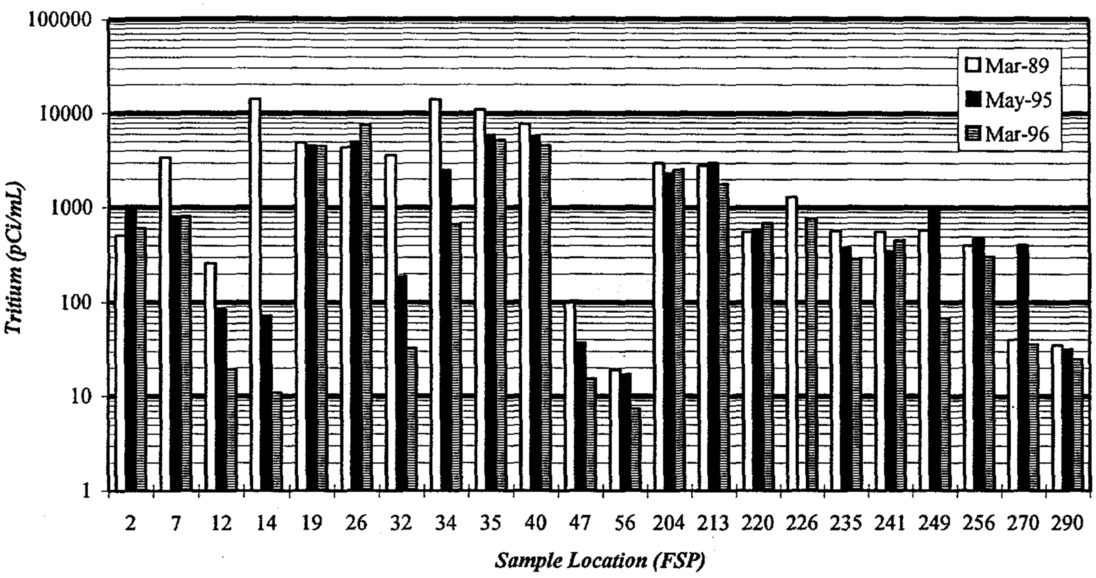

Figure 7. Comparison of Tritium Concentrations for Selected F-Area Seepline Locations

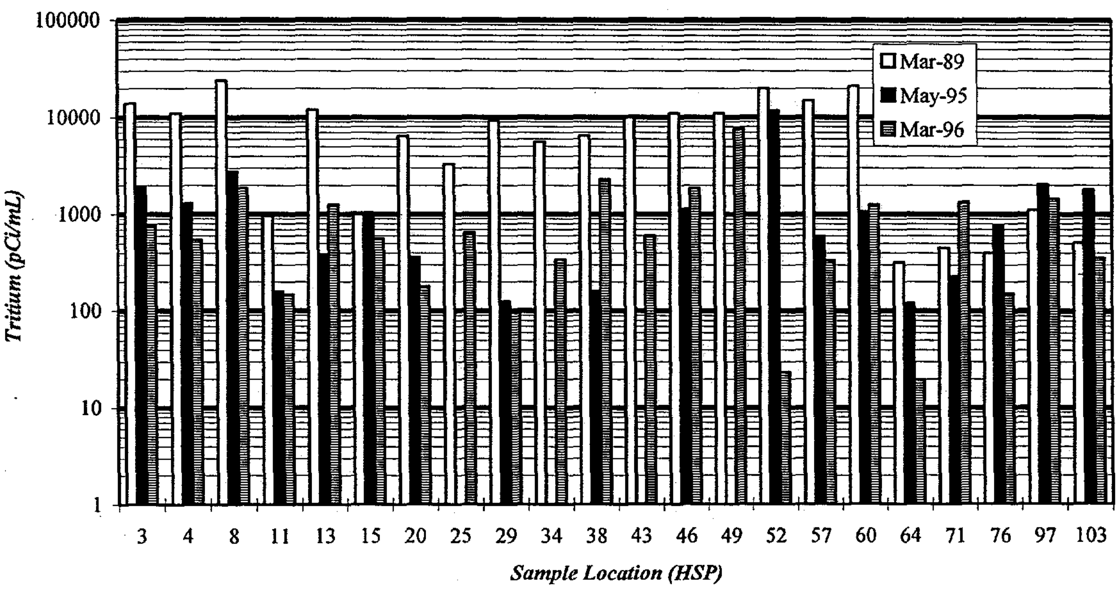

Figure 8. Comparison of Tritium Measurements for Selected H-Area Seepline Locations

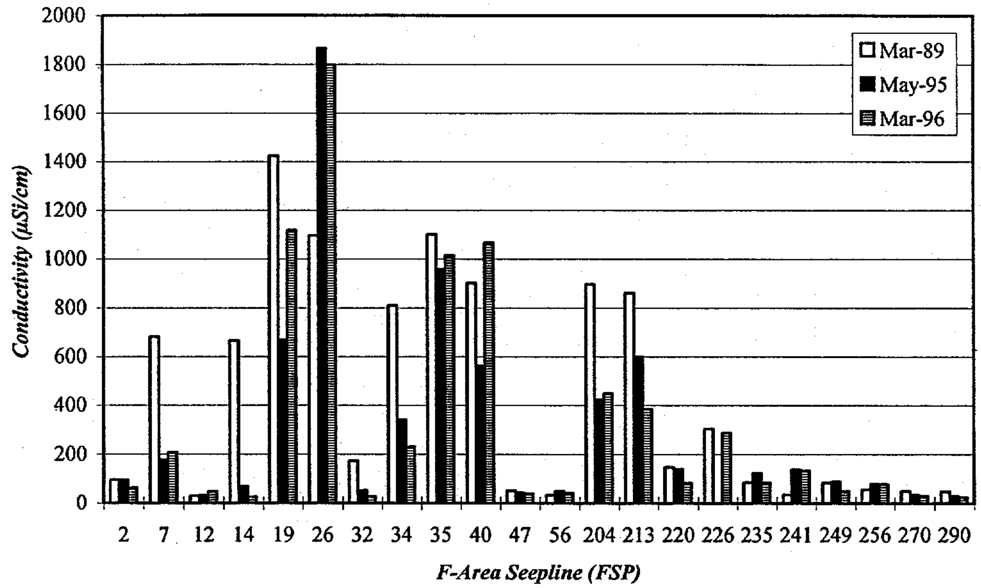

Figure 9. Comparison of Conductivity Measurements for Selected F-Area Seepline Locations

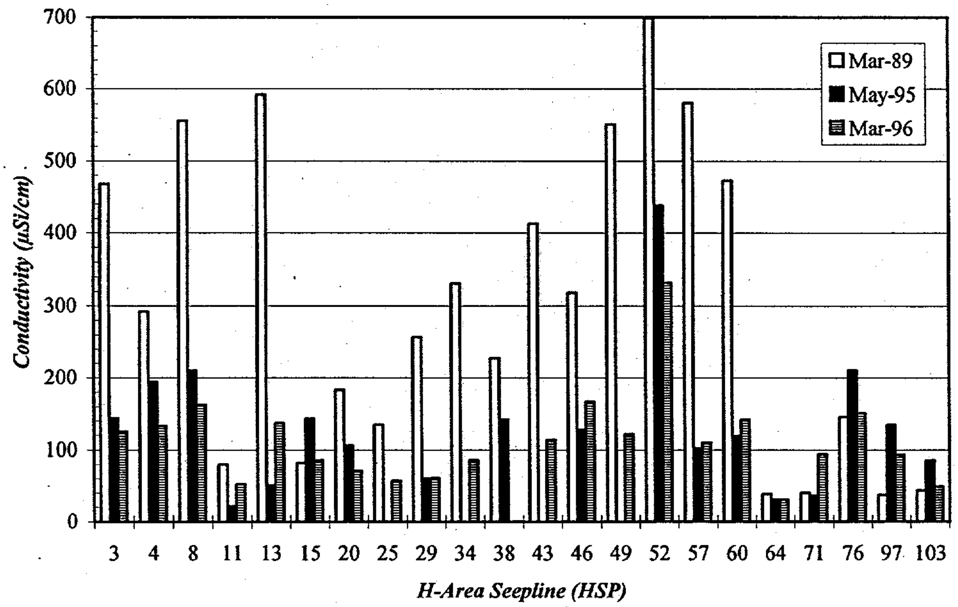

Figure 10. Comparison of Conductivity Measurements for Selected H-Area Seepline Locations.

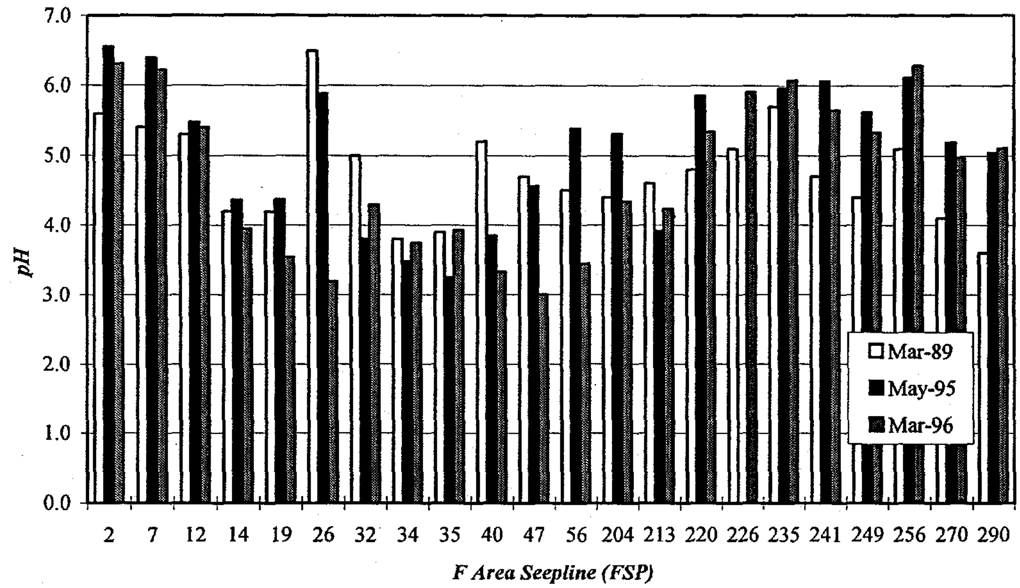

Figure 11. Comparison of pH Measurements for Selected F-Area Seepline Locations

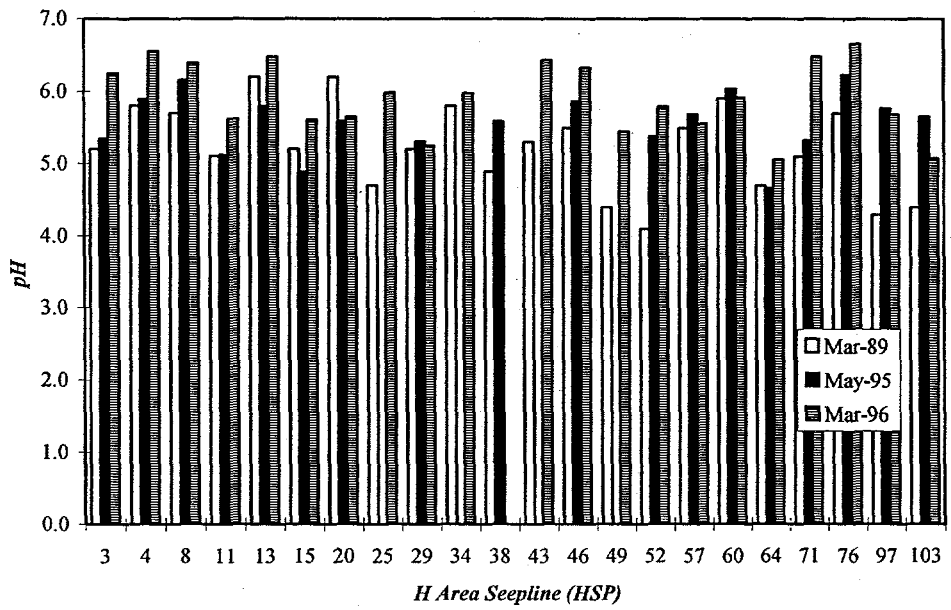

Figure 12. Comparison of pH Measurements for Selected H-Area Locations

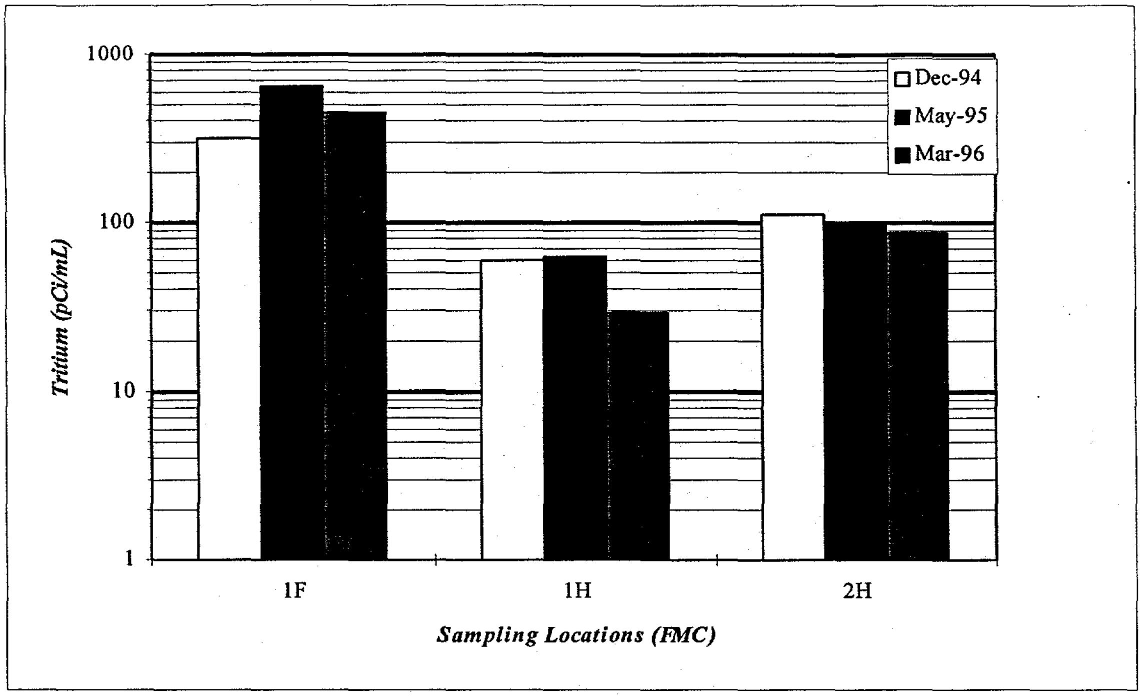

Figure 13. Comparison of Tritium Concentrations for Selected Fourmile Branch Locations

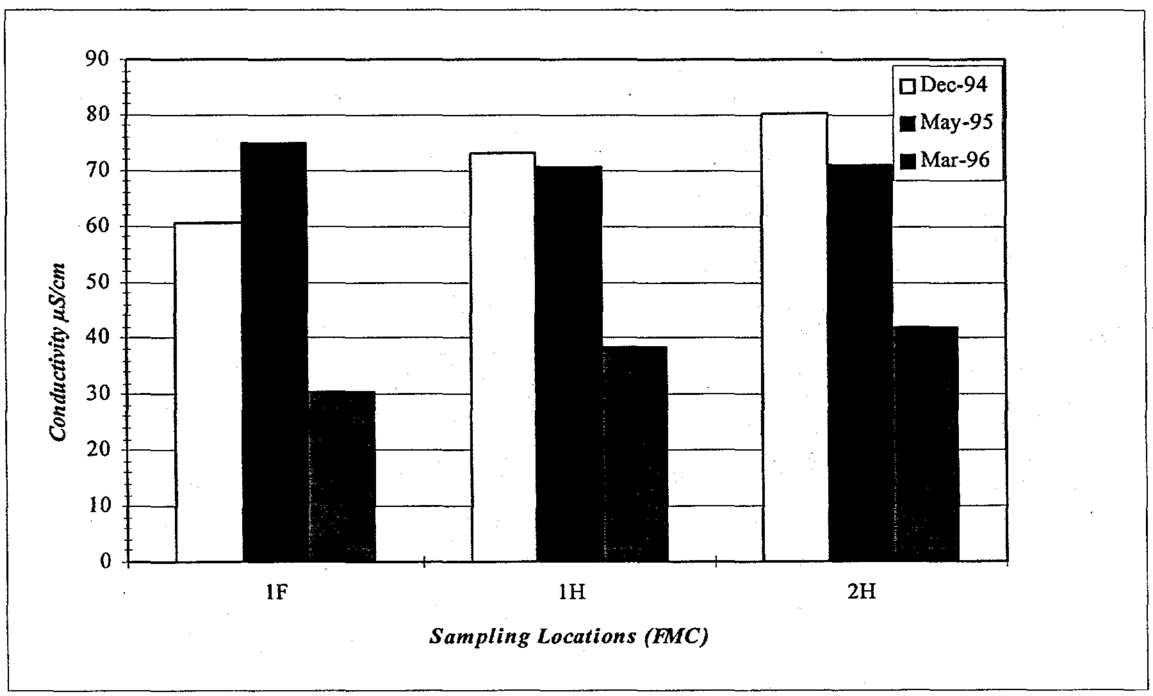

Figure 14. Comparison of Conductivity Measurements for Selected Fourmile Branch Locations

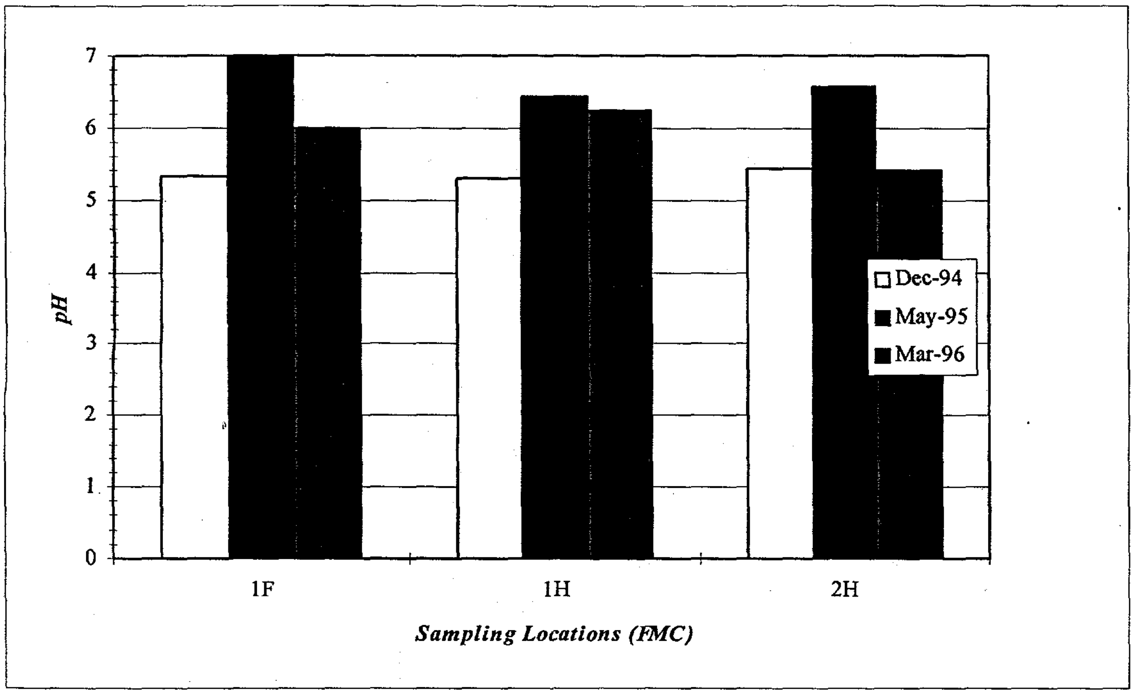

Figure 15. Comparison of pH Measurements for Selected Fourmile Branch Locations

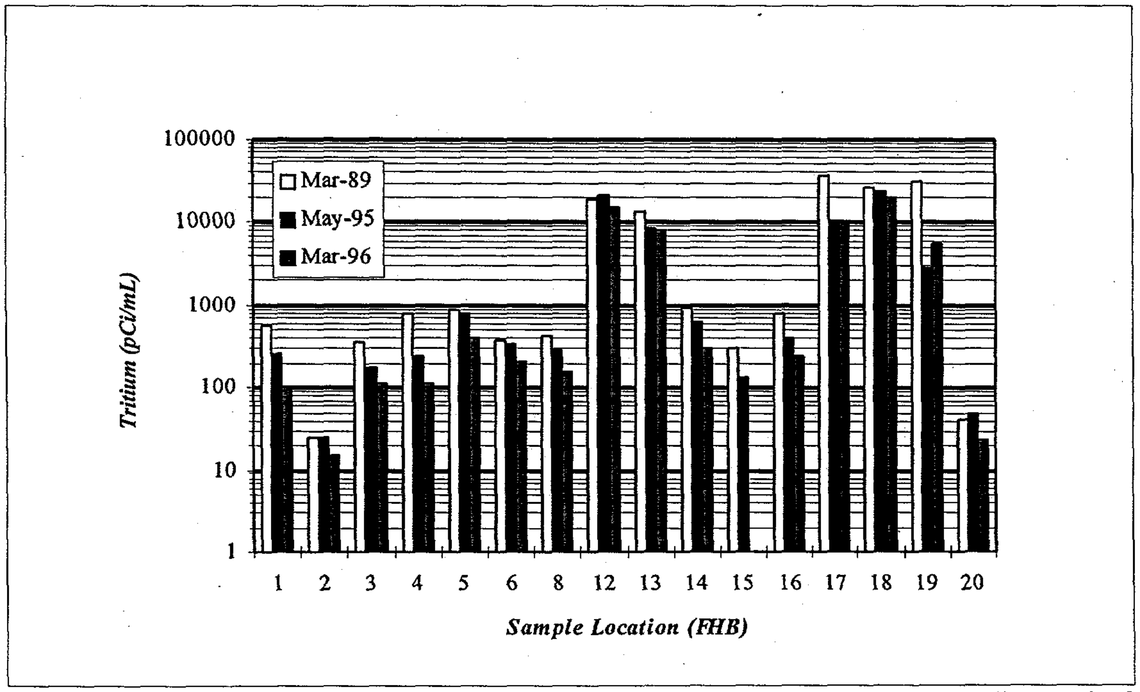

Figure 16. Comparison of Tritium Concentrations for Selected Locations on the Seepline South of 643-E

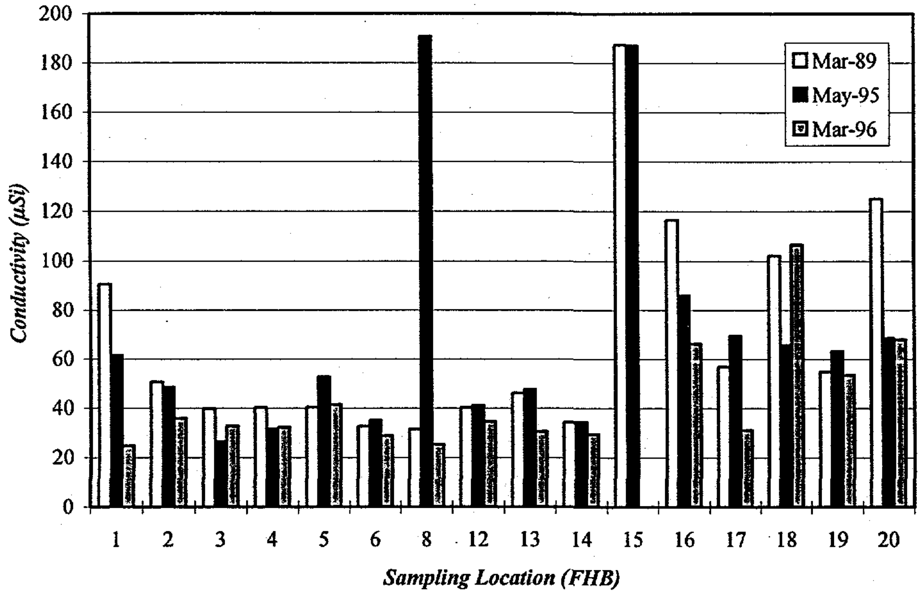

Figure 17. Comparison of Conductivity Concentrations for Selected Locations on the Seepline South of 643-E

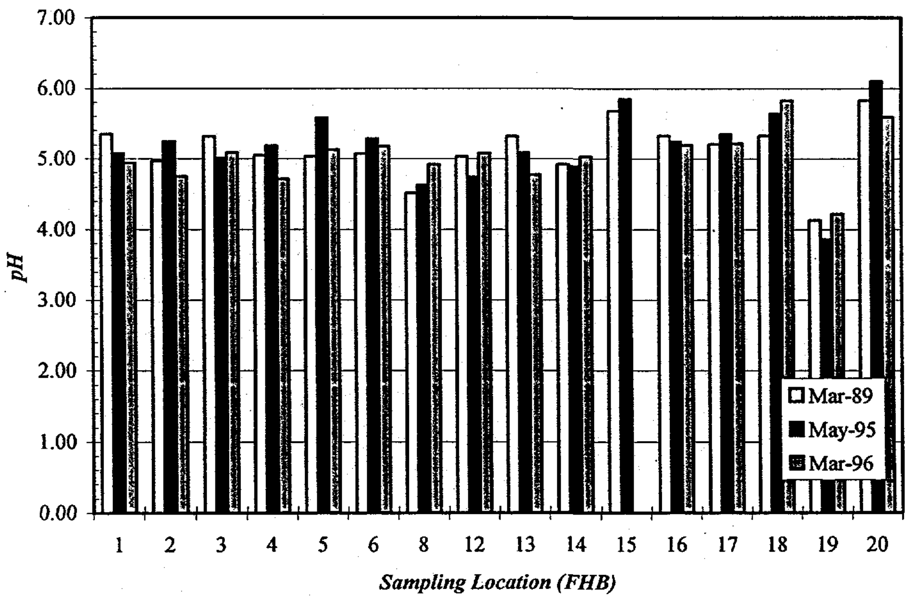

Figure 18. Comparison of pH Concentrations for Selected Locations on the Seepline South of 643-E

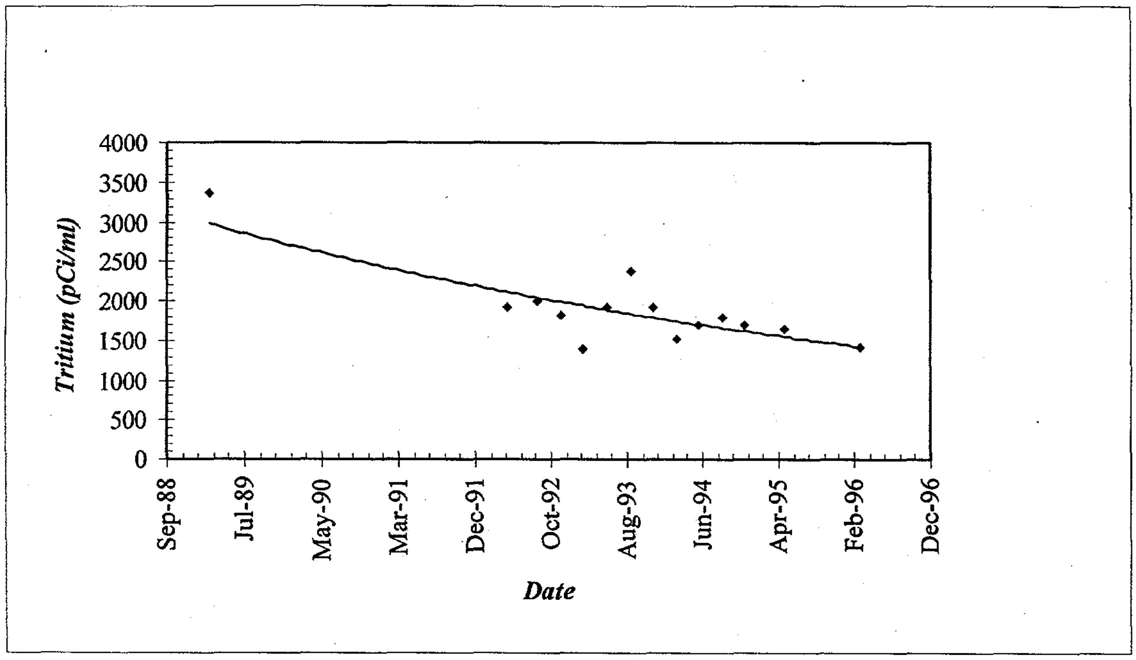

Figure 19. Tritium Trends for F-Area Seepline. Each point represents the mean of a sampling event.

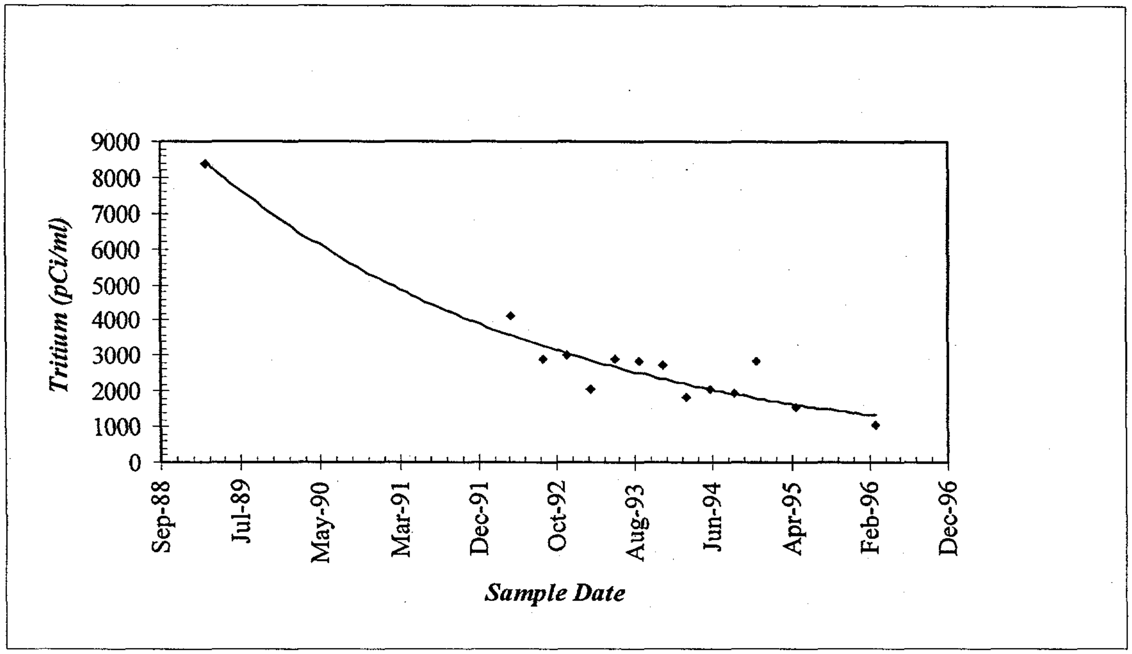

Figure 20. Tritium Trends for H-Area Seepline. Each point represents the mean of a sampling event.

Table 1. Comparison of 1996 Monthly Rainfall to the Long Term Average Rainfall (1960-1991) from the F-Area Weather Station

Month	***Year***	***Rainfall (cm)***	***Long-Term Rainfall (cm)***
April	95	2.4	8.6
May	95	5.3	10.7
June	95	32.3	10.9
July	95	10.8	14.3
Aug	95	17.0	14.3
Sept	95	13.8	9.5
Oct	95	5.9	5.7
Nov	95	9.9	6.6
Dec	95	7.8	9.5
Jan	96	7.8	11.8
Feb	96	5.3	10.8
Mar	96	17.3	13.3

Table 2. Comparison of F-Area Seepline Measurements for Tritium, Conductivity, and pH for the March 1989, May 1995, and March 1996 Sampling Events.

	Tritium (pCi/ml)			*Conductivity (µS/cm)*			*pH(-log H)*		
Location	***Mar-89***	***May-95***	***Mar-96***	***Mar-89***	***May-95***	***Mar-96***	***Mar-89***	***May-95***	***Mar-96***
2	520	917	613	95	93	63	5.6	6.56	6.31
7	3400	819	809	681	179	208	5.4	6.40	6.22
12	260	86	19	30	32	49	5.3	5.48	5.40
14	14000	72	11	666	69	26	4.2	4.36	3.95
19	4900	4580	4530	1424	669	1117	4.2	4.37	3.54
26	4400	5000	7740	1095	1865	1799	6.5	5.89	3.19
32	3600	188	33	174	52	27	5.0	3.81	4.30
34	14000	2530	677	810	343	232	3.8	3.48	3.75
35	11000	5930	5260	1100	959	1014	3.9	3.25	3.93
40	7800	5720	4600	900	562	1066	5.2	3.85	3.33
47	100	37	15	52	44	40	4.7	4.56	3.00
56	19	17	7	34	50	42	4.5	5.39	3.45
204	3000	2340	2560	895	425	449	4.4	5.31	4.34
213	2800	3020	1790	860	599	384	4.6	3.92	4.24
220	560	597	698	147	140	84	4.8	5.86	5.34
226	1300	1	776	306	dry	288	5.1	dry	5.91
235	580	378	290	84	122	84	5.7	5.96	6.07
241	560	349	456	36	138	133	4.7	6.06	5.65
249	580	940	68	84	88	50	4.4	5.62	5.33
256	400	471	307	56	78	78	5.1	6.11	6.28
270	40	408	36	50	35	31	4.1	5.19	4.97
290	35	32	25	49	30	25	3.6	5.05	5.11

Table 3. Comparison of H-Area Seepline Measurements for Tritium, Conductivity, and pH for the March 1989, May 1995, and March 1996 Sampling Events.

	Tritium (pCi/ml)			Conductivity (µS/cm)@25deg C			pH (-log H)		
Location	**Mar-89**	**May-95**	**Mar-96**	**Mar-89**	**May-95**	**Mar-96**	**Mar-89**	**May-95**	**Mar-96**
3	14000	1950	780	468	144	125	5.2	5.35	6.25
4	11000	1300	545	292	194	133	5.8	5.90	6.55
8	24000	2770	1865	556	210	163	5.7	6.16	6.39
11	960	160	148	80	22	52	5.1	5.12	5.62
13	12000	388	1260	592	50	137	6.2	5.80	6.48
15	1000	1040	561	82	144	86	5.2	4.89	5.61
20	6500	362	180	183	106	71	6.2	5.59	5.65
25	3300	1	655	135	dry	57	4.7	dry	5.99
29	9200	126	98	257	60	61	5.2	5.31	5.25
34	5600	1	341	331	dry	86	5.8	dry	5.98
38	6500	161	2310	227	142	dry	4.9	5.59	dry
43	10000	1	603	413	dry	114	5.3	dry	6.43
46	11000	1150	1870	318	127	167	5.5	5.86	6.33
49	11000	1	7660	551	dry	121	4.4	dry	5.45
52	20000	11800	24	699	438	332	4.1	5.38	5.79
57	15000	595	334	581	102	110	5.5	5.69	5.56
60	21000	1070	1260	473	119	142	5.9	6.04	5.92
64	320	120	20	38	30	30	4.7	4.67	5.06
71	450	229	1340	40	36	94	5.1	5.32	6.48
76	400	770	152	146	211	151	5.7	6.23	6.65
97	1100	2040	1440	37	134	94	4.3	5.77	5.69
103	510	1810	357	43	86	48	4.4	5.66	5.08

Table 4. Comparison of Fourmile Branch Stream Measurements for Tritium, Conductivity, and pH for the December 1994, May 1995, and March 1996 Sampling Events.

	Tritium (pCi/ml			Conductivity (µS/cm)			pH (-log H)		
Location	**Dec-94**	**May-95**	**Mar-96**	**Dec-94**	**May-95**	**Mar-96**	**Dec-94**	**May-95**	**Mar-96**
1F	312	643	456	61	75	30	5.34	6.99	6.00
1H	59	63	29	73	71	38	5.29	6.44	6.25
2H	113	97	88	80	71	42	5.44	6.59	5.41

Table 5. Comparison of 643-E Seepline Measurements for Tritium, Conductivity, and pH for the September 1994, May 1995, and March 1996 Sampling Events.

	Tritium (pCi/ml)			*Conductivity (µS/cm)*			*pH (-log H)*		
Location	***Dec-94***	***May-95***	***Mar-96***	***Dec-94***	***May-95***	***Mar-96***	***Dec-94***	***May-95***	***Mar-96***
1	553	258	102	91	61	25	5.35	5.08	4.94
2	25	25	15	51	49	36	4.97	5.25	4.75
3	370	176	115	40	27	33	5.32	5.01	5.09
4	785	249	115	40	32	32	5.05	5.19	4.71
5	907	774	406	40	53	41	5.03	5.58	5.13
6	378	344	207	33	35	29	5.07	5.29	5.18
8	419	287	157	32	191	25	4.52	4.63	4.92
12	18738	20600	15000	40	41	35	5.03	4.74	4.77
13	13762	8800	8120	46	48	31	5.32	5.09	5.03
14	939	639	307	34	34	29	4.92	4.89	dry
15	315	134	dry	187	187	dry	5.68	5.85	5.20
16	785	407	240	117	86	66	5.33	5.25	5.22
17	36383	9660	10400	57	70	31	5.21	5.35	5.83
18	25966	23900	20200	102	66	106	5.33	5.64	4.22
19	30537	2870	5630	55	63	54	4.13	3.86	5.59
20	42	49	24	125	69	68	5.83	6.10	5.08

Note: Location #12 is a stream sample location.

Table 6. Average of F- and H-Area Seepline tritium values (March 1989-March 1996)

Sample Event Date	***Average Tritium Value (pCi/ml)***	***Average Tritium Value (pCi/ml)***
	H Area	***F Area***
Mar-89	8402	3357
May-92	4131	1934
Sep-92	2904	1990
Dec-92	3001	1823
Apr-93	2063	1398
Jun-93	2885	1936
Sep-93	2876	2384
Dec-93	2749	1920
Mar-94	1818	1525
Jun-94	2053	1688
Sep-94	1953	1806
Dec-94	2836	1698
May-95	1547	1634
Mar-96	1082	1424