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CS-137 CONCENTRATIONS IN STEEL CREEK IN 1984

SUMMARY

Measurement of Cs-137 concentrations in Steel Creek, 1984, have shown that L Reactor flow tests have not changed the Cs-137 concentrations and the initial phases of L Pond dam construction have only caused a slight increase in Cs-137 concentrations. The Cs-137 concentrations in 1984 were about 1 to 2 percent of the EPA drinking water concentration guide of 200 pCi/L. The concentration in Steel Creek is essentially the same as in 1980, before any major L Reactor refurbishing. The data obtained in 1984 indicate that initial Cs-137 remobilization estimates for Steel Creek are still valid.

INTRODUCTION

In the final Environmental Impact Statement, L-Reactor Operation, several environmental commitments were made. One of these commitments was to monitor for Cs-137 and total suspended solids in Steel Creek prior to and to one year after the restart of L-Reactor (DPST-84-769). The data that have been and will be collected before to L-Reactor startup will be used to show the effects of flow tests and L-Pond dam construction on the movement of Cs-137 and to verify transport models used to estimate the remobilization of Cs-137 during reactor operations. This report summarizes the 1984 data that has been completed to date (October, 1984).

About 284 Ci of Cs-137 have been discharged to Steel Creek since SRP startup, and most of this Cs-137 was discharged in the mid 1960's from P-Area (DPST-82-212). Since Cs-137 has a strong affinity for sediments, much of the released Cs-137 was sorbed and/or deposited on the sediments in the Steel Creek system. This accumulation of Cs-137 in the Steel Creek sediments has been verified by both ground (DPSPU-Year-302 report series) and aerial (EG&G-1183-1816 and EG&G-1183-1665) surveys. The best estimate to date of the amount of Cs-137 remaining in the Steel Creek system from P-Area to the SRP boundary is about 76 Ci, Table 1 (DOE/EIS-0108). About 67 Ci of Cs-137 is in the floodplain sediments below L-Reactor Area. Of the 67 Ci of Cs-137 about 18 Ci will be covered by the waters of L-Pond when it is filled.

The total amount of Cs-137 estimated to be remobilized and transported from Steel Creek during the first year of L-Reactor operation is 4.4 $\pm$ 2.2 Ci (DOE/EIS-0108). The 4.4 Ci remobilization would result in an average Cs-137 concentration of about 11 pCi/L in Steel Creek and about 0.5 pCi/L in the Savannah River. The estimated Cs-137 concentrations in Steel Creek and the Savannah River are about 5% and 1% of the EPA drinking water concentration guide of 200 pCi/L (EPA-570/9-76-003).

Cesium-137 has been the focal point of radionuclide studies in Steel Creek, because of the much higher concentrations of Cs-137 as compared with other radionuclides. Other radionuclides have been discharged to Steel Creek (DPSPU 81-25-1) but have resulted in no buildup of radionuclide concentration in Steel Creek sediments (DPSPU 84-302). This is due either to the small amount discharged and/or to a low affinity for sediments. For instance, only a total of 27 Ci of Co-60 have been discharged to Steel Creek and the sediment concentration (about 2 pCi/gm) is about 5% the Cs-137 concentration (only a small amount was discharged and Co-60 has about the same affinity for sediments as Cs-137). Only about 30 Ci of Sr-90 has been discharged to Steel Creek and the sediment

concentration is about 0.4 pCi/gm because Sr-90 has low affinity for sediments.

SAMPLING AND MEASUREMENT

Two sampling locations were selected to determine the Cs-137 concentrations in Steel Creek. The first location is above the Steel Creek delta area at Hattieville Bridge shown in Figure 1. This location is the closest to the delta where all of Steel Creek flow is contained in one channel and it is an established HP monitoring (SC#5) location. The other location is the mouth of Steel Creek.

The samples were collected by automatic water samplers, set to collect water samples every four hours, and the samples were combined to give a weekly composite. The weekly composites were analyzed for Cs-137 and suspended solids concentrations. The Cs-137 concentrations were determined by Health Protection according to their standardized procedures. A minimum counting sensitivity for the Cs-137 measurement is about $\pm$ 1 pCi/L. Standard deviations are shown when sample concentrations are averaged. The suspended solids were analyzed by the water quality lab in 400 area using a standard water-quality gravimetric procedure.

The water flows are calculated by the US Geological Survey at SC#5 using algorithms calibrated to convert their water height measurements to flow.

RESULTS AND DISCUSSION

To determine the background Cs-137 concentrations and the effect of L-Reactor startup on the remobilization of Cs-137 in the Steel Creek floodplain, background Cs-137 and suspended solids concentrations are being made at two Steel Creek locations (SC#5 and the mouth of Steel Creek). Cs-137 concentrations in Steel Creek are controlled by the discharge of Par Pond water from P-Area operations to Steel Creek and the remobilization of Cs-137 from Steel Creek floodplain sediments. Prior to any major L-refurbishing work (1980), the background Cs-137 concentration resulting from these sources in Steel Creek at SC#5 averaged 5.1 $\pm$ 6.4 pCi/L (DPSPU 81-302). The Cs-137 concentration measured in 1984 averaged 2.6 $\pm$ 1.2 pCi/L (January - October) is not different from the 1980 average, 5.1 $\pm$ 6.4 pCi/L, indicating that no major changes have occurred in the average Cs-137 concentrations in Steel Creek (Table 2).

Two factors that could cause an increase in Cs-137 concentrations in Steel Creek are sediment erosion increases due to larger water flows from the reactor cold flow tests and L-Pond dam

construction. Water flow in Steel Creek has increased about a factor of 2 due to flow tests in L Area. This increase in flow may cause an increase in remobilization of Cs-137 from the Steel Creek floodplain sediments due to the increased erosion of Cs-137 containing sediments. L-Pond dam construction could increase the erosion of Cs-137 bearing sediment through removal of the protective vegetative cover in the vicinity of the dam area.

The flow doubled from about 40 cfs in 1980 to 85 cfs in 1984 (January - October) because of flow testing in L-Area, and this flow increase did not change the average Cs-137 concentration as measured at SC#5. No correlation between the flow and the Cs-137 concentration can be derived from the time plot of flow and Cs-137 concentration at SC#5 (Figure 2). The slight increase in Cs-137 concentration (beginning in July) is a result of L-Pond dam L-Pond dam construction activity which started in late July, 1984.

L-Pond construction began the last week in July, 1984, with road construction in the floodplain and surrounding land. Since that time construction activity has increased. It is evident from late July to October, 1984 that the suspended solids concentration has increased (Figure 3) along with a slight increase in Cs-137 concentration. If the January to late July, 1984 averaged Cs-137 concentrations are compared with the late July to October concentrations, an increase from 2.2 to 3.6 pCi/L was calculated (Table 2). This slight increase is probably due to L Pond construction. The Cs-137 concentration is about 1.5% of the EPA drinking water guideline of 200 pCi/L and is below the average 1980 Cs-137 concentrations of about 5 pCi/L.

The Cs-137 concentrations measured in the mouth of Steel Creek averaged less than 1 pCi/L (Table 2, Figure 4). The much lower Cs-137 concentration in the mouth of Steel Creek as compared to SC#5 is primarily a result of the increased water flow from Pen Branch (K-Area). Pen Branch contributes about 84% of the flow at the mouth of Steel Creek (Pen Branch-450 cfs to Steel Creek-85cfs). Pen Branch contains much less than 1 pCi/L of Cs-137. Also the low Cs-137 concentrations in the mouth of Steel Creek indicate that as Steel Creek water flows over the delta little additional erosion Cs-137 containing sediments is occurring.

The Cs-137 concentrations measured in 1984 in Steel Creek at SC#5 are about the same concentration as measured during flow tests in 1983 (3 to 5 pCi/L). The Cs-137 measurements made in flow tests in 1983 were used as a basis for estimating the amount of Cs-137 that may be remobilized when L Reactor restarts. The concentrations measured during 1984 indicate that no change in the initial remobilization estimates are necessary.

CONCLUSIONS

Cesium-137 concentrations measured at two locations in Steel Creek during 1984 (January - October) show that L Reactor flow tests have not increased Cs-137 concentrations at Hattieville Bridge. L-Pond construction, which started in late July, has had a small effect on Cs-137 concentrations in 1984. Cs-137 concentrations from January to late July, 1984 averaged 2.2 $\pm$ 0.8 pCi/L, whereas concentrations from late July to October, 1984 averaged 3.6 $\pm$ 1.3 pCi/L. These Cs-137 concentrations are about the same as Cs-137 concentrations were in 1980 (5.1 $\pm$ 6.4 pCi/L), before any major L Reactor refurbishing activity. The Cs-137 concentration results to date demonstrate that the Cs-137 remobilization estimates in EIS are valid.

REFERENCES

DPSPU-81-302, Environmental Monitoring at the Savannah River Plant, Annual Report Series (DPSPU-Year-302), Savannah River Plant, Aiken, South Carolina.

DPST-84-769, Status Report on L-Reactor Environmental Commitments, Savannah River Laboratory, Aiken, South Carolina (1984).

DPST-82-212, Anticipated Transport of Cs-137 from Steel Creek Following L-Area Restart, Savannah River Laboratory, Aiken, South Carolina (1982).

DOE/EIS-0108, Final Environmental Impact Statement, L-Reactor Operation Savannah River Plant, Aiken, South Carolina, Volume 2 (1984).

EG&G-1183-1665, Aerial Radiological Survey of the Savannah River Plant (Aiken, South Carolina) Date of Survey: 2 thru 25 June 1984, P. K. Boyns, EG&G Aerial Operations, Las Vegas, Nevada (1975).

EG&G-1183-1816, An Aerial Radiological Survey of the Savannah River Plant and Surrounding Area, Aiken, South Carolina, P. K. Boyns and D. B. Smith, EG&G Aerial Operations, Las Vegas, Nevada (1982).

EPA-570/9-76-003, National Interim Primary Drinking Water Regulations, Environmental Protection Agency, Washington, DC (1976).

TABLE 1. Inventory of Cs-137 in Steel Creek*

Above L Reactor	9 Ci
Between L Reactor and Delta	35 Ci
Delta	23 Ci
Delta to SRP Boundary	9 Ci
TOTAL	76 Ci

* Based on soil core measurements of Cs-137 concentration and Steel Creek floodplain area.

TABLE 2. Concentration of Cesium-137 and Suspended Solids and Flow in Steel Creek (January 4 to July 16, 1984)

DATE	SC#5 Cs-137 pCi/L	SC#5 ERROR Cs-137 pCi/L	SC#5 SUSPENDED SOLIDS mg/L	SC#5 FLOW cfs	MOUTH Cs-137 pCi/L	MOUTH ERROR Cs-137 pCi/L	MOUTH SUSPENDED SOLIDS mg/L
01-04-84	2.6	1.2	11	101.5	0.4	0.9	6
01-09-84	3.2	1.3	11	85.2	0.4	1.0	4
01-17-84	2.6	1.4	5	83.4	0.4	1.0	4
01-23-84	2.4	1.3	5	106.2	1.0	1.1	4
01-30-84	-	-	-	126.6	0.1	1.0	4
02-06-84	1.8	1.2	4	94.5	1.2	1.2	2
02-13-84	4.0	1.4	5	94.5	0.8	1.2	0
02-22-84	2.4	1.2	9	136.0	0.8	1.2	4
02-28-84	1.8	1.3	9	106.8	-0.1	1.1	4
03-05-84	1.2	1.2	5	101.5	-	-	-
03-12-84	2.0	1.3	6	140.1	0.1	1.1	4
03-20-84	2.0	1.3	5	139.5	0.4	1.2	4
02-27-84	1.8	1.3	8	137.7	-0.3	1.1	6
04-02-84	0.8	1.2	6	117.9	0.3	1.2	2
04-09-84	1.9	1.4	5	145.9	0.5	1.2	2
04-16-84	1.4	1.3	6	112.0	0.3	1.2	4
04-23-84	1.2	1.3	8	102.7	0.1	1.1	2
04-30-84	2.1	1.4	10	101.0	0.6	1.2	7
05-07-84	1.9	1.4	16	105.0	0.5	1.2	7
05-14-84	3.0	1.5	9	105.0	0.8	1.3	3
05-21-84	2.2	1.4	10	105.0	0.6	1.2	6
05-29-84	2.6	1.5	8	105.0	0.8	1.2	10
06-04-84	3.6	1.6	15	105.0	0.6	1.2	10
06-11-84	2.0	1.4	13	43.2	0.8	1.2	10
06-18-84	1.8	1.3	22	29.0	0.7	1.2	8
06-25-84	-	-	40	29.7	-	-	7
07-02-84	-	-	-	45.4	-	-	7
07-09-84	-	-	13	33.3	0.0	1.3	6
07-16-84	-	-	-	39.2	0.2	1.3	4

TABLE 2 (cont'd). Concentration of Cesium-137 and Suspended Solids and Flow in Steel Creek (July 23 to October 8, 1984)

DATE	SC#5 SC#5 Cs-137 pCi/L	SC#5 ERROR Cs-137 pCi/L	SUSPENDED SOLIDS mg/L	SC#5 FLOW cfs	MOUTH Cs-137 pCi/L	MOUTH ERROR Cs-137 pCi/L	MOUTH SUSPENDED SOLIDS mg/L
07-23-84	3.9	1.7	15	81.5	0.9	1.4	6
07-30-84	4.0	1.7	23	90.8	0.4	1.4	8
08-06-84	3.8	1.4	19	65.9	0.1	1.3	6
08-13-84	5.6	1.0	16	78.0	1.0	1.4	7
08-20-84	4.7	1.2	13	72.4	1.5	1.5	4
08-27-84	1.3	1.2	47	61.1	1.6	1.5	10
09-04-84	1.9	1.2	17	45.1	0.5	1.1	5
09-11-84	3.6	1.6	22	40.3	0.6	1.3	8
09-17-84	5.1	1.8	19	40.9	1.4	1.4	12
09-24-84	3.1	1.6	22	39.5	1.9	1.8	2
10-01-84	4.0	1.1	6	67.6	0.1	1.6	3
10-08-84	1.8	1.9	8	57.6	0.4	1.7	16
AVERAGE (1/4 - 7/16)	2.2 ±0.8		10.2 ± 7.4	95.8 ±34.7	0.5 ±0.4		5.0 ±2.6
AVERAGE (7/23 - 10/8)	3.6 ±1.3		18.9 ±10.3	61.7 ±17.4	0.9 ±0.6		7.2 ±4.0
OVERALL AVERAGE (1/4 - 10/8)	2.6 ±1.2		12.9 ± 9.3	85.9 ±34.3	0.6 ±0.5		5.7 +3.2

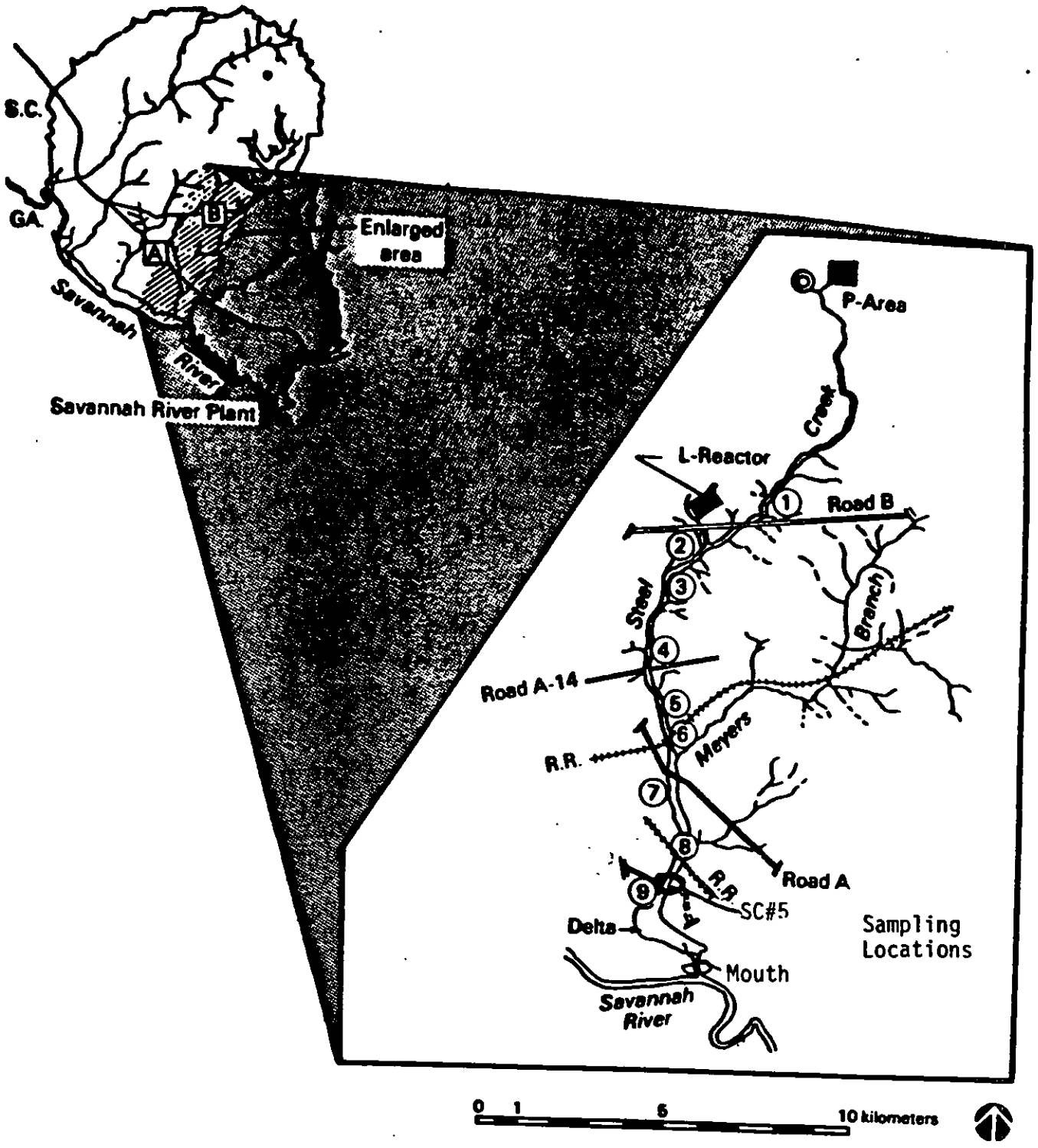


FIGURE 1. Sampling Locations and Other Reference Points on Steel Creek

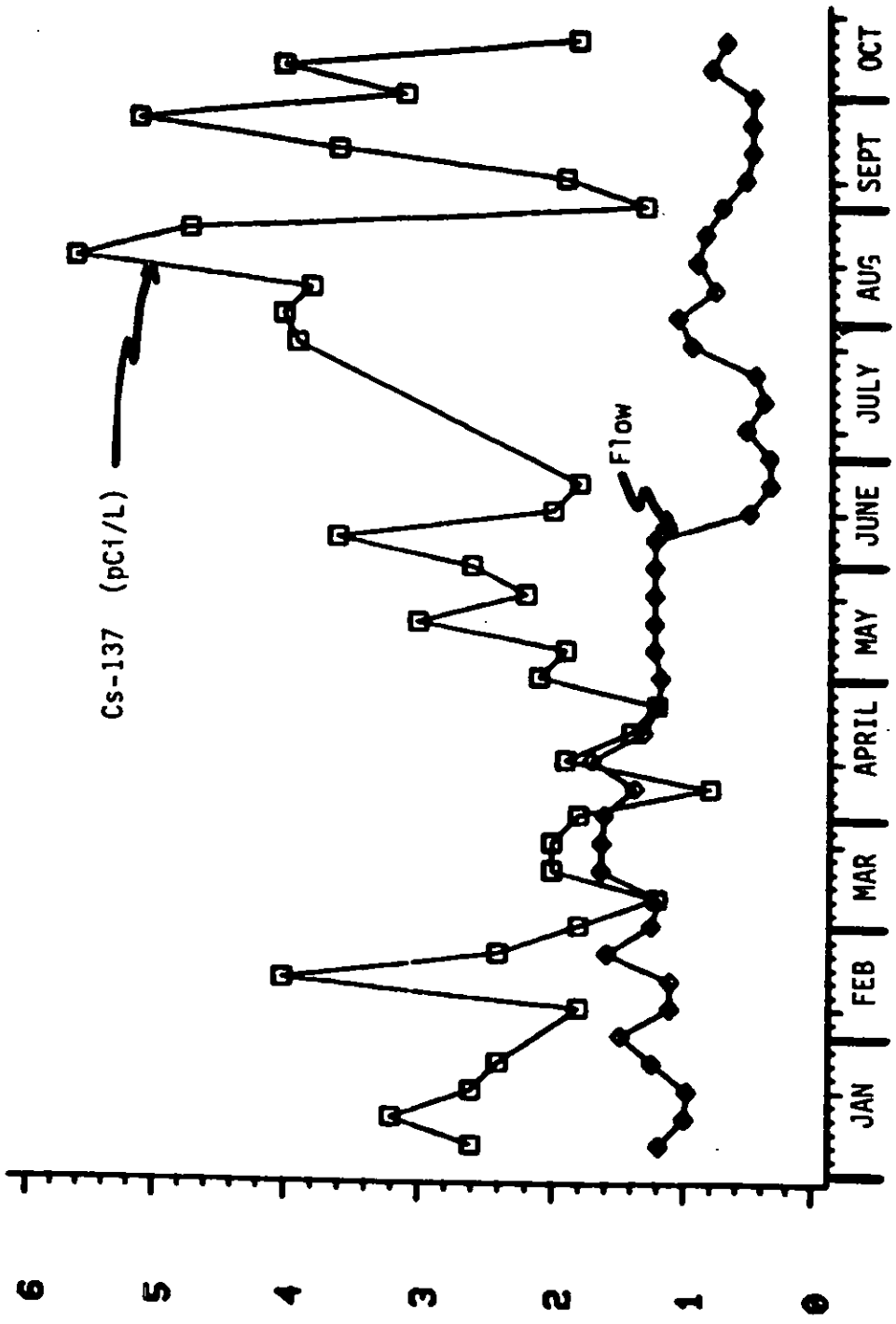

NORMALIZED FLOW AND CS-137 CONCENTRATION AT LOCATION #5
Cs-137 (pCi/L)
Flow
JAN
FEB
MAR
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
1984
0
1
2
3
4
5
6
Normalized - Flow Divided by Average

FIGURE 2

FIGURE 3

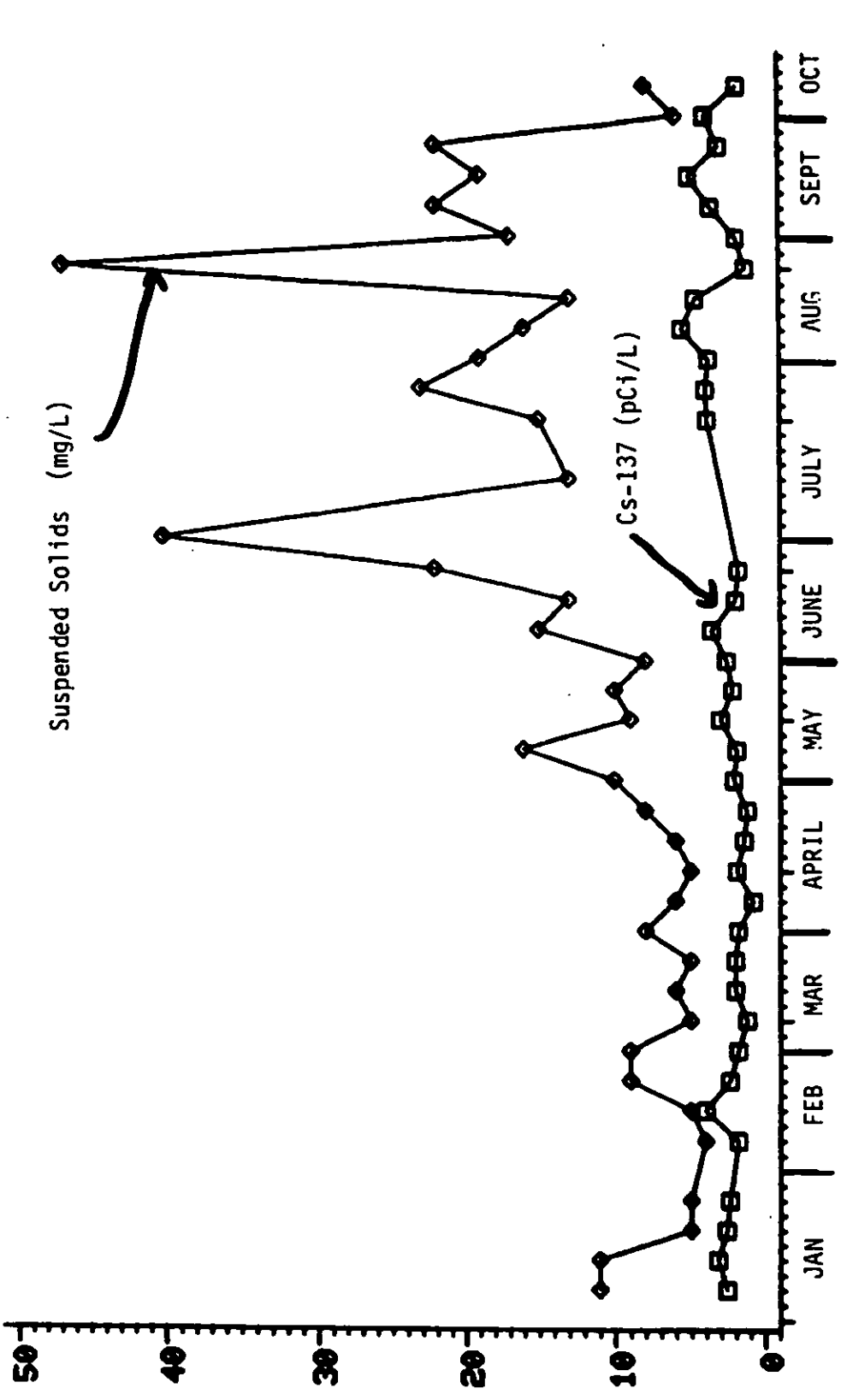
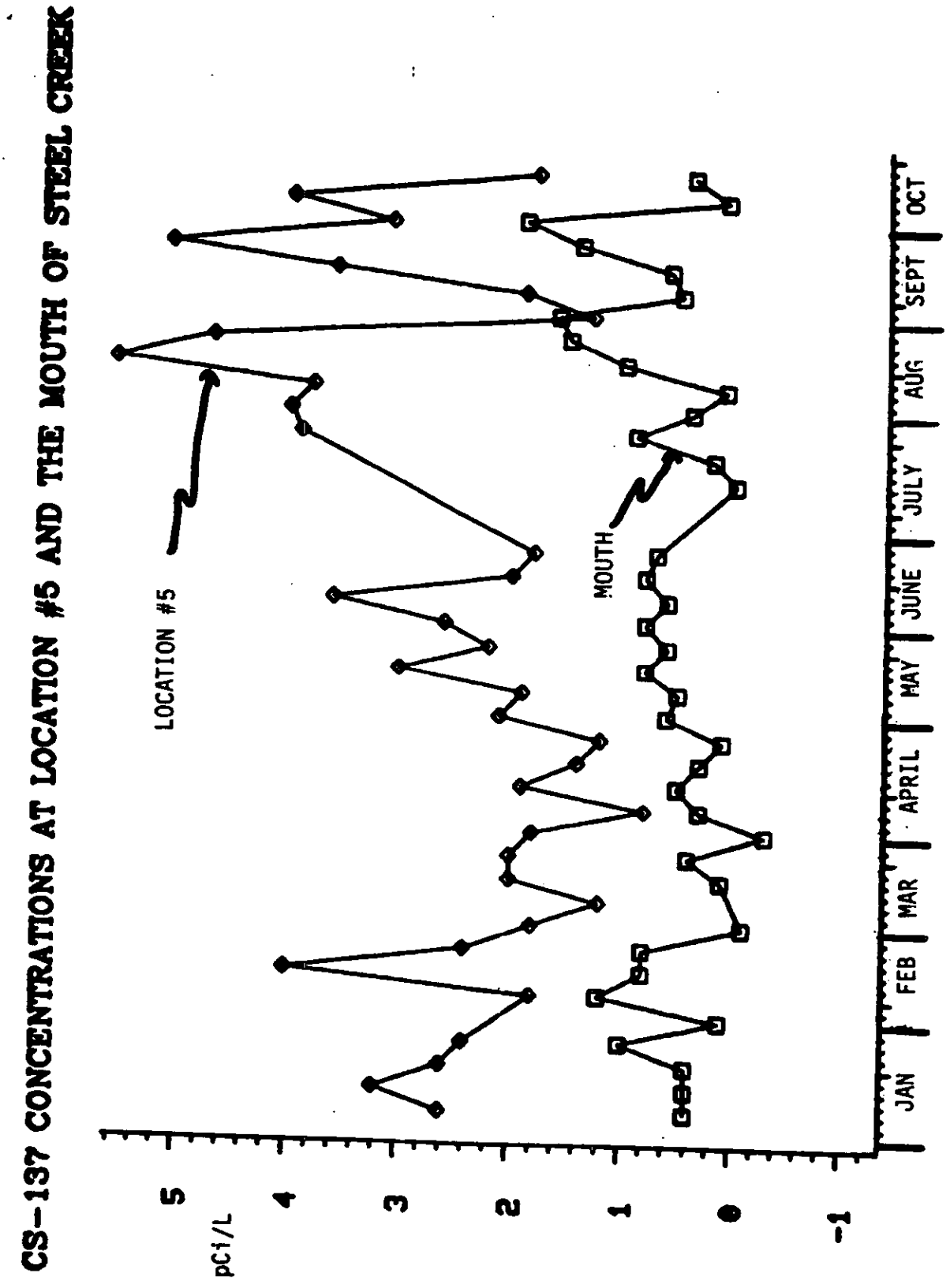

SUSPENDED SOLIDS AND CS-137 CONCENTRATIONS AT LOCATION #5
Suspended Solids (mg/L)
Cs-137 (pCi/L)
50
40
30
20
10
0
JAN
FEB
MAR
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
1984

FIGURE 4


CS-137 CONCENTRATIONS AT LOCATION #5 AND THE MOUTH OF STEEL CREEK
LOCATION #5
MOUTH
pCi/L
5
4
3
2
1
0
-1
JAN
FEB
MAR
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
1984