

DEFINITION OF FLOWS THROUGH
KESWICK ISLANDS CHANNELS,
SAINT JOHN RIVER
NEW BRUNSWICK

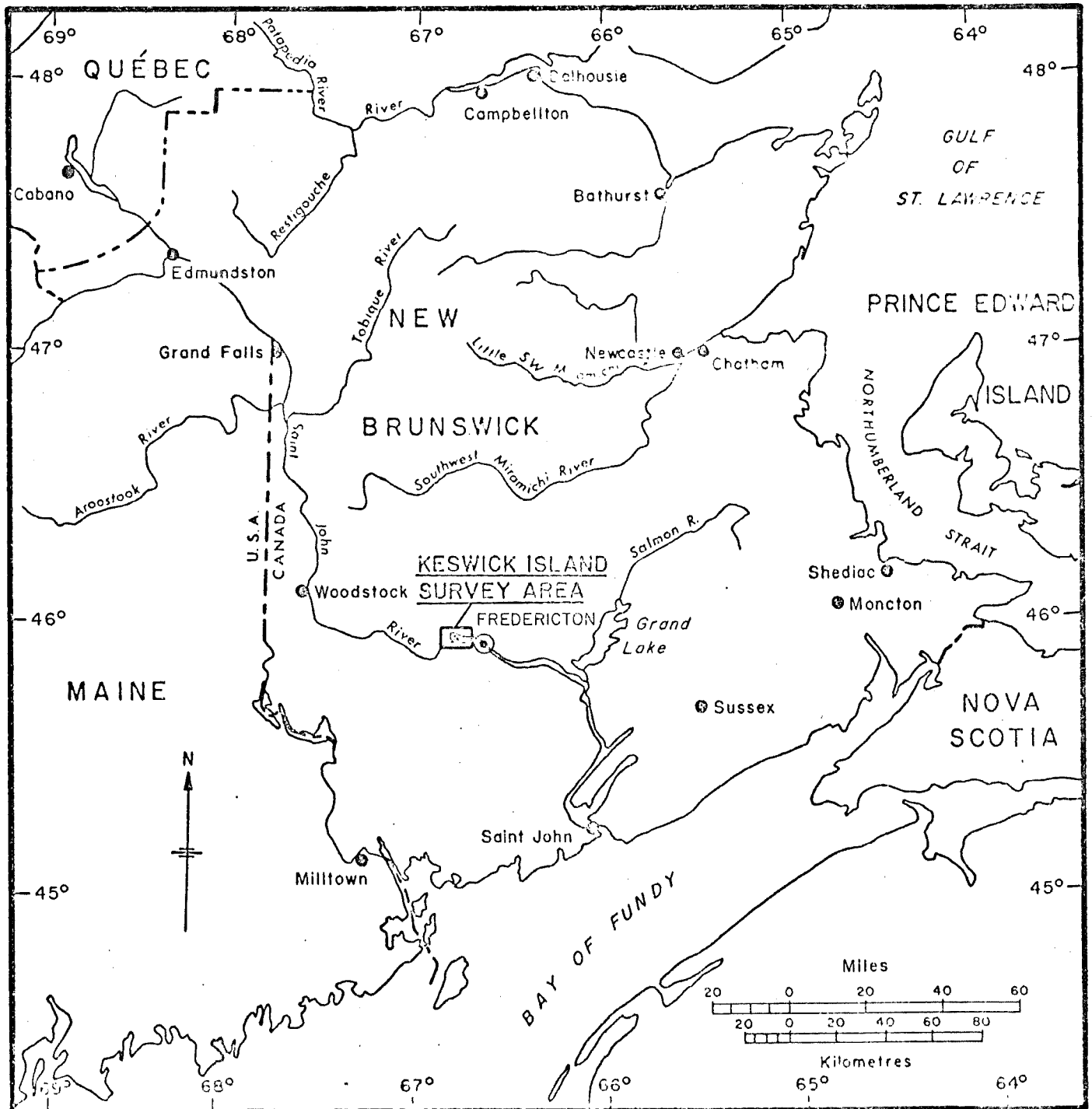
D.K. Randall

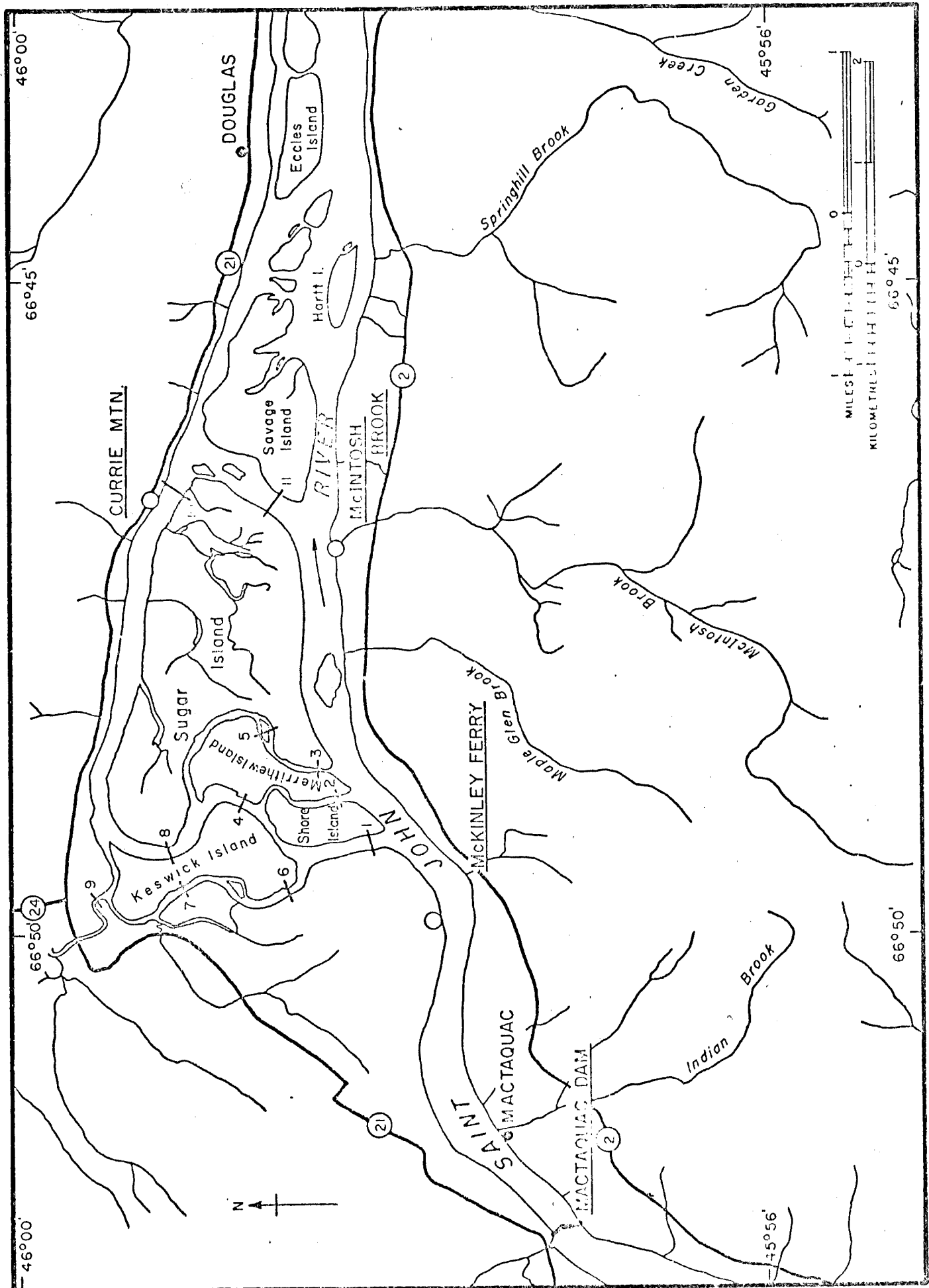
Water Resources Branch
Atlantic Region
In Cooperation with
the New Brunswick
Electric Power Commission

Halifax, Canada, 1975

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INTRODUCTION

The Keswick Islands are located in a reach of the Saint John River which starts about two miles downstream of the Mactaquac Hydroelectric Generating Station and extends down river to the City of Fredericton boundary. Much of the land area of the islands is low in elevation and flooding during high river discharges is quite common. At extremely high river stages, as was experienced in 1973 and 1974, some inundation of the islands occurs. The geographic location of the Study Area is illustrated by page iii.

In response to a concern by local farmers in the Keswick Islands region for access to the islands to attend crops and for pasturing cattle during periods of low flow, a feasibility study was initiated by the Province of New Brunswick to study the possibility of constructing causeways to connect some of the islands.

By a request from the New Brunswick Electric Power Commission through their engaged consultant, The Shawinigan Engineering Company Limited, Water Survey of Canada, Atlantic Region, was asked to investigate the discharges, velocities and water levels in the Keswick Islands region of the Saint John River, immediately downstream of the Mactaquac Hydroelectric Generating Station. This investigation would provide a preliminary data base for a feasibility and environmental study of the proposed construction of causeways to permit access to the Islands.

METHODOLOGY

The request cited two flow ranges, 2000 cfs and 40,000 cfs, and identified eleven cross-sections amongst the Islands for which

data were required. These cross-sections are noted on page iv.

After discussing the survey with Commission officials, it was concluded that measurements at the 2000 cfs flow range had to take place on a Saturday or Sunday when power requirements were minimal. Clearance was obtained to conduct the survey at the 2000 cfs flow range on Sunday, December 1 and at the 40,000 cfs flow range on Monday, December 2. They agreed to supply support staff and some equipment such as boats and outboard motors to assist Water Survey staff of the Fredericton Office.

In the planning, Water Survey assumed the responsibility for determining streambed elevations and water levels at each section, channel velocities and discharges, as well as acting as coordinator for the survey. The Commission assumed the responsibility of transferring Geodetic Survey of Canada datum to the cross-sections from their previously established bench marks on the islands and from the mainland.

On November 28 visits were made to each of the cross-sections to familiarize staff with the channels and to prepare the 11 sections by establishing section markers and temporary bench marks. Because time restraints would be placed upon the survey, temporary bench marks had to be established at each cross-section. It was proposed that the water level at each section during the time of metering the flow would be referred to the temporary bench mark and later referred to Geodetic Survey of Canada datum.

For the December 1 discharge survey at the 2000 cfs flow range, it was noted that the channel was dry and still water existed at many of cross-sections. On December 2 at the 40,000 cfs range, all cross-sections contained flowing water. Flow measurements were obtained by conventional means from boats, except section no. 6 which was waded on December 2. Coincident with the lowering of the Saint John River levels on December 1, at section no. 9 which was across the mouth of the Keswick River, a greater flow of water was observed than on December 2. It should be noted that both measurements at section no. 9 were obtained through ice cover. At section no. 7 a causeway complete with culverts already existed, therefore, no attempt was made to measure the flow on December 2. The section was observed dry on December 1.

A continuous check during the survey on water levels through the Keswick Island reach of the Saint John River was maintained by four recording gauging stations. Two of the stations are operated by Water Survey of Canada - at McKinley Ferry and Fredericton and two by the New Brunswick Electric Power Commission - at Currie Mountain and McIntosh Brook.

RESULTS

Considering the time of year, the results obtained were excellent.

The hourly water levels recorded at the four gauging stations, the hourly releases from Mactaquac Dam, and the streambed elevations, velocities and discharges for each cross-section are tabulated and plotted and presented in the Appendix. For each cross-section the mean

velocity at each station (vertical) across the width is listed. The maximum velocity noted is the maximum observed velocity in any vertical. The orientation to the shoreline at each cross-section is noted as if facing downstream by left bank (LB) and right bank (RB).

ACKNOWLEDGEMENTS

We would like to express our appreciation to the staff of the New Brunswick Electric Power Commission who assisted our staff in the metering of the cross-sections and transmitted the vertical control information to each section. Also, special thanks should go to the Drafting Section of Inland Waters Directorate, Ottawa, who provided the maps and drafted the results of the survey.

APPENDIX

Table of hourly discharge releases from Mactaquac Dam

December 1, 1974		December 2, 1974	
Time (AST)	Approx. Discharge (cfs)	Time (AST)	Approx. Discharge (cfs)
0100	5560	0100	6740
0200	2780	0200	6740
0300	2820	0300	3120
0400	3040	0400	3030
0500	2820	0500	3030
0600	2820	0600	3030
0700	2890	0700	6060
0800	2930	0800	16100
0900	2880	0900	25050
1000	2880	1000	39000
1100	2930	1100	39750
1200	2930	1200	39750
1300	2930	1300	39750
1400	2880	1400	39750
1500	2850	1500	39750
1600	2850	1600	39000
1700	10700	1700	39000
1800	22450	1800	35250
1900	20700	1900	29250
2000	18000	2000	23400
2100	20000	2100	8720
2200	19500	2200	3200
2300	19650	2300	2670
2400	7240	2400	2810

DATA SUPPLIED BY THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

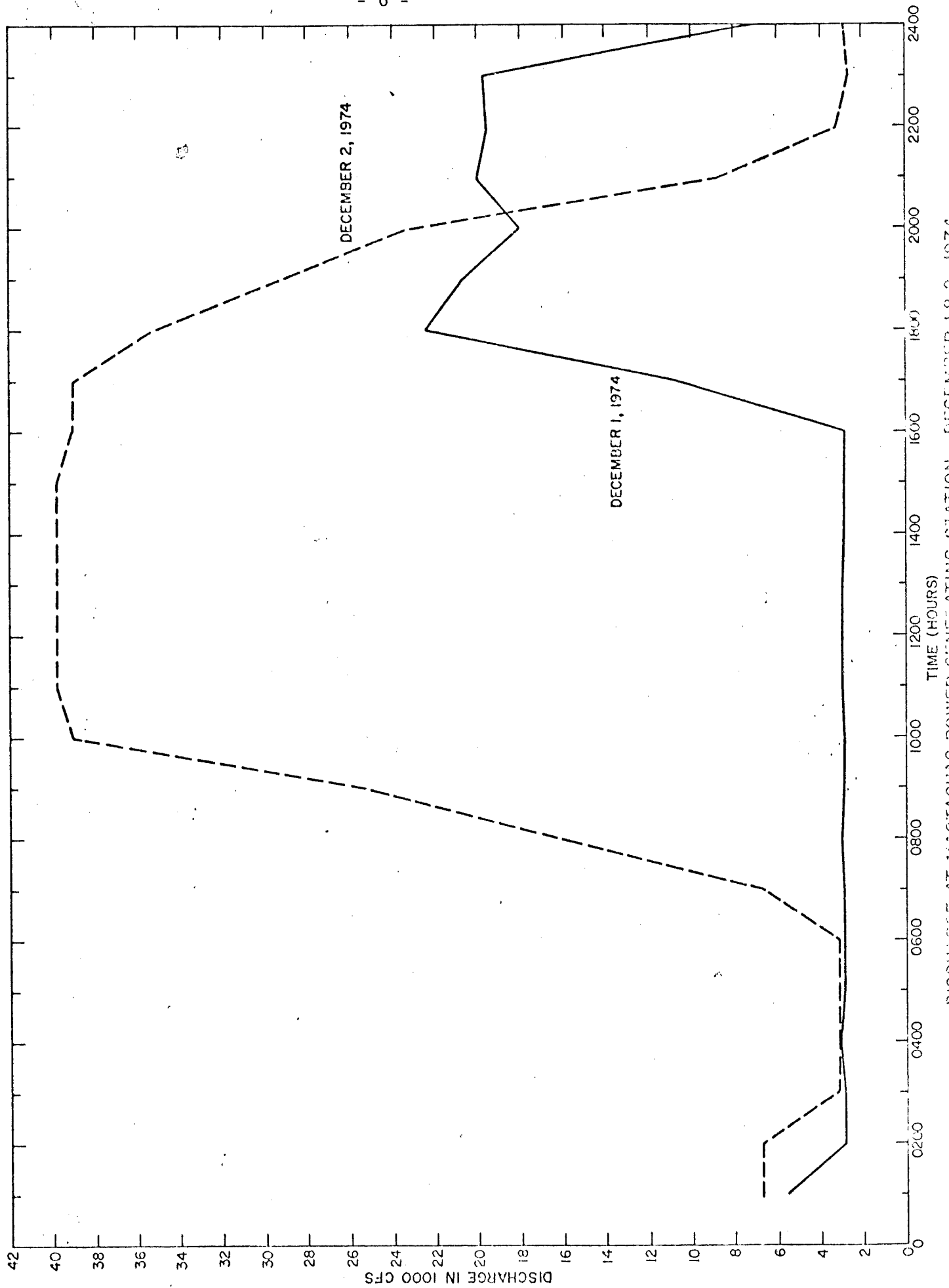


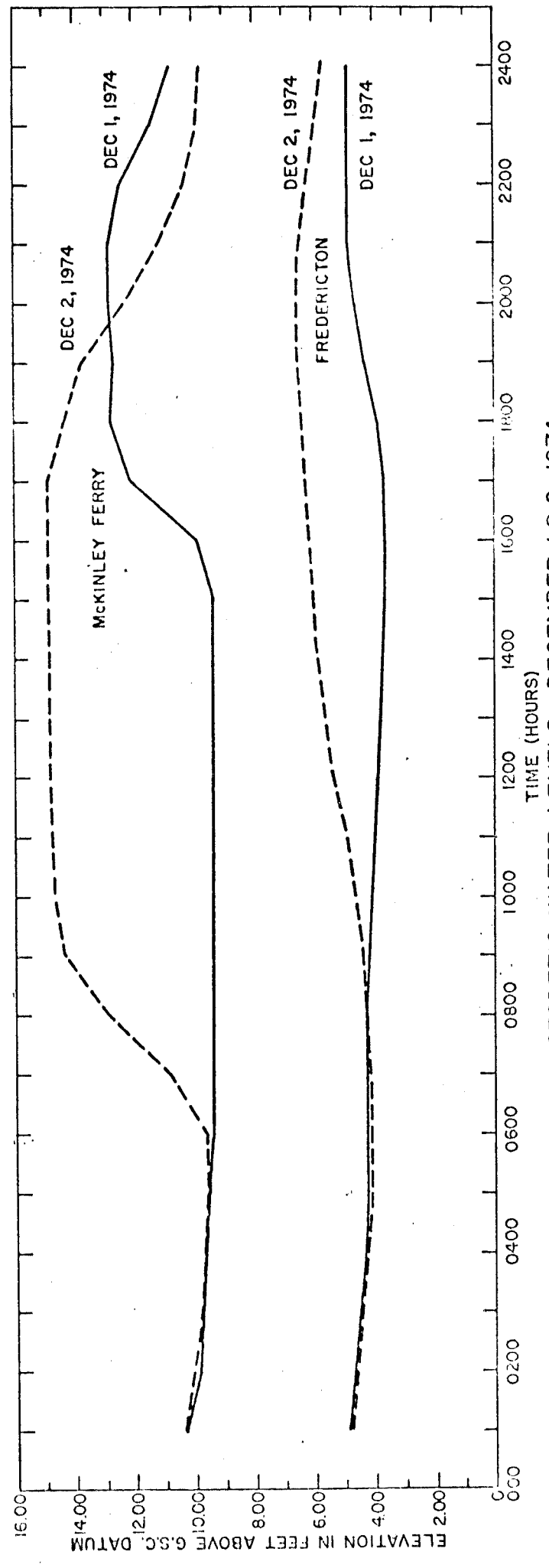
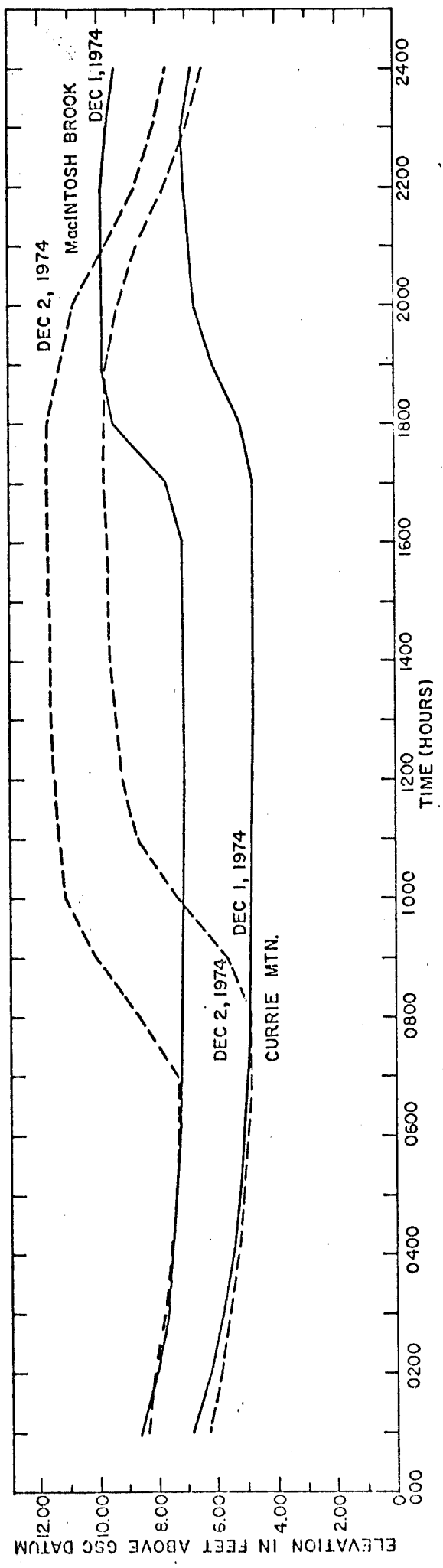
Table of hourly water levels at McIntosh Brook and Currie Mountain
Gauging Stations

December 1, 1974			December 2, 1974		
Time (AST)	McIntosh Brook (ft.)	Currie Mtn. (ft.)	Time (AST)	McIntosh Brook (ft.)	Currie Mtn. (ft.)
0100	8.58	6.83	0100	8.39	6.33
0200	8.03	6.28	0200	8.13	5.92
0300	7.63	5.82	0300	7.77	5.62
0400	7.53	5.49	0400	7.53	5.35
0500	7.35	5.24	0500	7.38	5.15
0600	7.26	5.11	0600	7.32	4.99
0700	7.21	4.99	0700	7.37	4.91
0800	7.20	4.92	0800	8.60	4.89
0900	7.18	4.91	0900	10.11	5.66
1000	7.18	4.84	1000	11.12	7.29
1100	7.18	4.83	1100	11.39	8.60
1200	7.18	4.81	1200	11.48	9.14
1300	7.18	4.79	1300	11.56	9.42
1400	7.18	4.79	1400	11.56	9.56
1500	7.18	4.77	1500	11.60	9.63
1600	7.18	4.77	1600	11.66	9.69
1700	7.65	4.76	1700	11.67	9.79
1800	9.50	5.16	1800	11.68	9.82
1900	9.91	6.10	1900	11.23	9.72
2000	9.87	6.69	2000	10.79	9.32
2100	9.93	6.91	2100	9.73	8.66
2200	9.95	7.10	2200	8.73	7.69
2300	9.70	7.14	2300	8.12	7.00
2400	8.90	6.86	2400	7.70	6.47

DATA SUPPLIED BY THE NEW BRUNSWICK ELECTRIC POWER
COMMISSION

Table of hourly water levels at McKinley Ferry and Fredericton
Gauging Station

December 1, 1974			December 2, 1974		
Time (AST)	McKinley Ferry (ft.)	Fredericton (ft.)	Time (AST)	McKinley Ferry (ft.)	Fredericton (ft.)
0100	10.35	4.93	0100	10.41	4.79
0200	9.91	4.76	0200	10.06	4.63
0300	9.78	4.55	0300	9.79	4.46
0400	9.62	4.36	0400	9.64	4.31
0500	9.52	4.25	0500	9.58	4.18
0600	9.47	4.21	0600	9.64	4.13
0700	9.46	4.24	0700	10.87	4.18
0800	9.45	4.26	0800	12.93	4.27
0900	9.45	4.20	0900	14.30	4.43
1000	9.44	4.12	1000	14.69	4.62
1100	9.44	4.00	1100	14.76	4.95
1200	9.44	3.90	1200	14.81	5.30
1300	9.43	3.82	1300	14.81	5.60
1400	9.43	3.74	1400	14.81	5.82
1500	9.42	3.66	1500	14.89	5.99
1600	9.92	3.62	1600	14.89	6.13
1700	12.16	3.67	1700	14.92	6.26
1800	12.77	3.90	1800	14.36	6.39
1900	12.66	4.34	1900	13.72	6.51
2000	12.78	4.66	2000	12.37	6.53
2100	12.79	4.82	2100	11.10	6.47
2200	12.44	4.88	2200	10.35	6.23
2300	11.42	4.92	2300	9.93	5.93
2400	10.75	4.90	2400	9.77	5.65



GEODETIC WATER LEVELS - DECEMBER 1 & 2, 1974

CROSS-SECTION NO. 1

Dec. 1, 1974 Summary

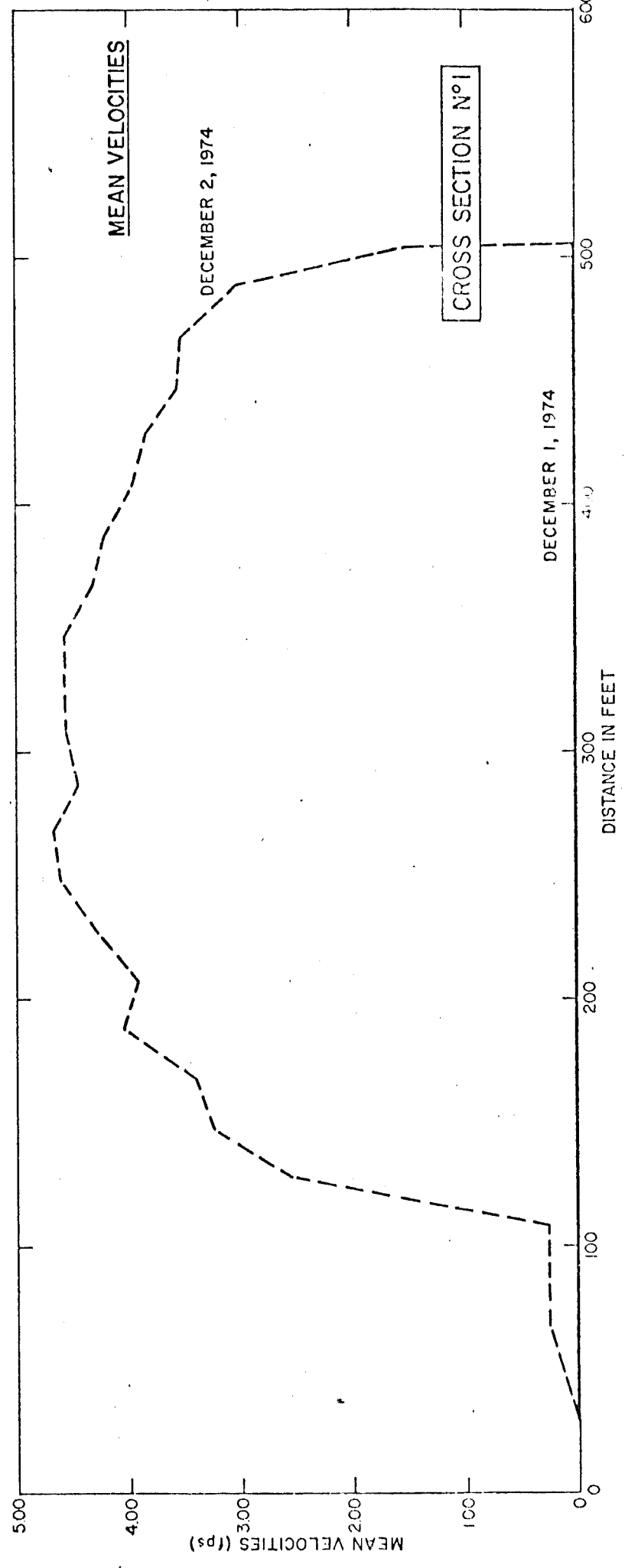
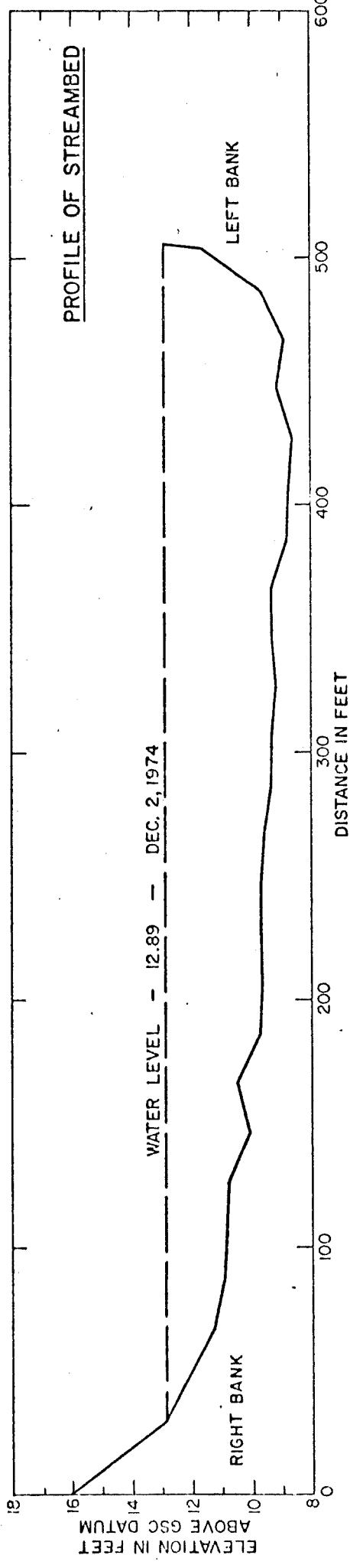
Discharge: 0 cfs
Mean Velocity:
Maximum Velocity:
Time(AST): Begin End
Water Level(Ft.GSC): Begin End

Dec. 2, 1974 Summary

Discharge: 5790 cfs
Mean Velocity: 3.69 fps
Maximum Velocity: 5.02 fps
Time(AST): Begin 1200 End 1310
Water Level(Ft.GSC): Begin 12.89 End

STATION (Ft.)		ELEVATION STREAMBED(Ft.GSC)	MEAN VELOCITY (fps)	
			Dec. 1 Survey	Dec. 2 Survey
0+00	RB	16.12		
0+67		11.13		0.28
0+87		10.92		0.28
1+07		10.87		0.28
1+27		10.78		2.59
1+47		10.01		3.24
1+67		10.48		3.41
1+87		9.61		4.05
2+07		9.57		3.93
2+27		9.58		4.29
2+47		9.56		4.59
2+67		9.52		4.67
2+87		9.35		4.46
3+07		9.30		4.56
3+27		9.07		4.58
3+47		9.30		4.56
3+67		9.33		4.30
3+87		8.68		4.20
4+07		8.62		3.96
4+27		8.53		3.82
4+47		9.08		3.56
4+67		8.87		3.54
4+87		9.63		3.02
5+03		11.66		1.51
5+05	LB	13.0		0
0+29		12.89		0

Streambed Dry



CROSS-SECTION NO. 2

Dec. 1, 1974 Summary

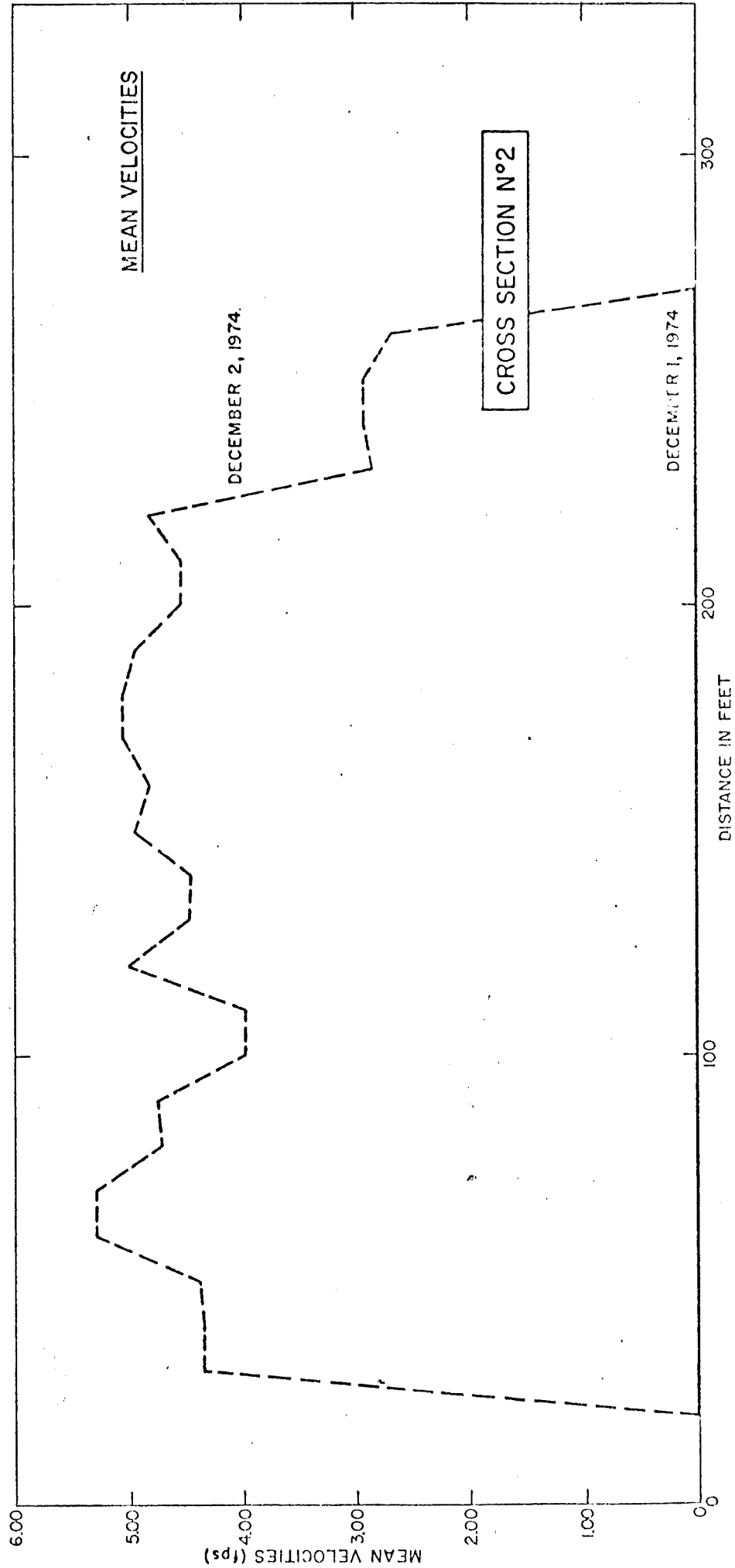
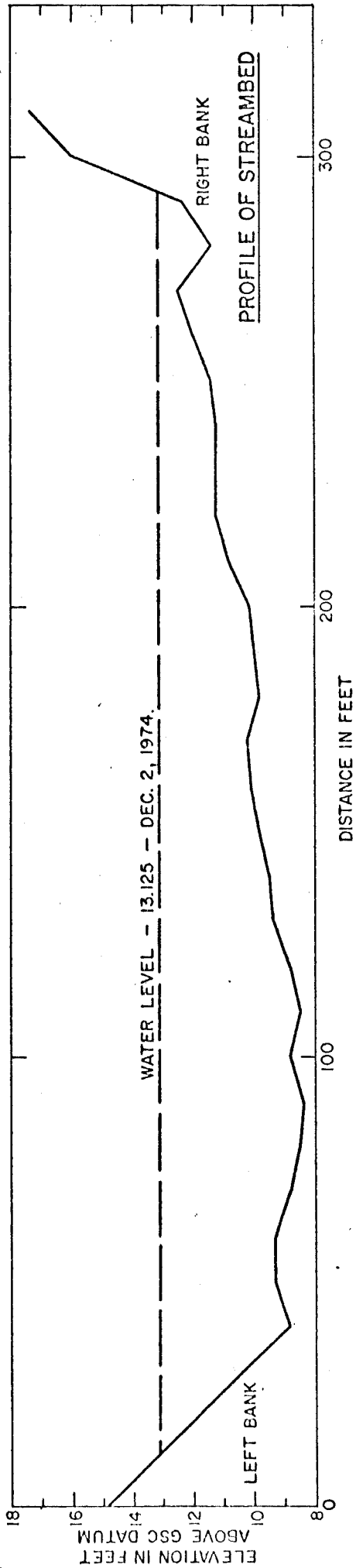
Discharge: 0 cfs
 Mean Velocity:
 Maximum Velocity:
 Time(AST): Begin End
 Water Level(Ft.GSC): Begin End

Dec. 2, 1974 Summary

Discharge: 3730 cfs
 Mean Velocity: 4.49 fps
 Maximum Velocity: 7.92 fps
 Time(AST): Begin 1045 End 1145
 Water Level(Ft.GSC): Begin 13.125
 End 13.125

STATION (Ft.)	ELEVATION STREAMBED(Ft.GSC)	MEAN VELOCITY (fps)	
		Dec. 1 Survey	Dec. 2 Survey
0+00 LB	14.89		
0+20	11.89		0
0+30	10.29		4.34
0+40	8.79		4.34
0+50	9.29		4.39
0+60	9.29		5.30
0+70	8.79		5.30
0+80	8.49		4.72
0+90	8.39		4.76
1+00	8.69		3.98
1+10	8.49		3.98
1+20	8.79		5.00
1+30	9.39		4.45
1+40	9.49		4.45
1+50	9.79		4.94
1+60	10.09		4.83
1+70	10.19		5.05
1+80	9.79		5.05
1+90	9.99		4.94
2+00	10.09		4.54
2+10	10.79		4.54
2+20	11.19		4.83
2+30	11.19		2.85
2+40	11.19		2.91
2+50	11.39		2.91
2+60	11.99		2.68
2+70	12.49		0
2+80	11.39		
2+90	12.39		
3+00	15.99		
3+10 RB	17.39		

Streambed Dry



CROSS-SECTION NO. 3

Dec. 1, 1974 Summary

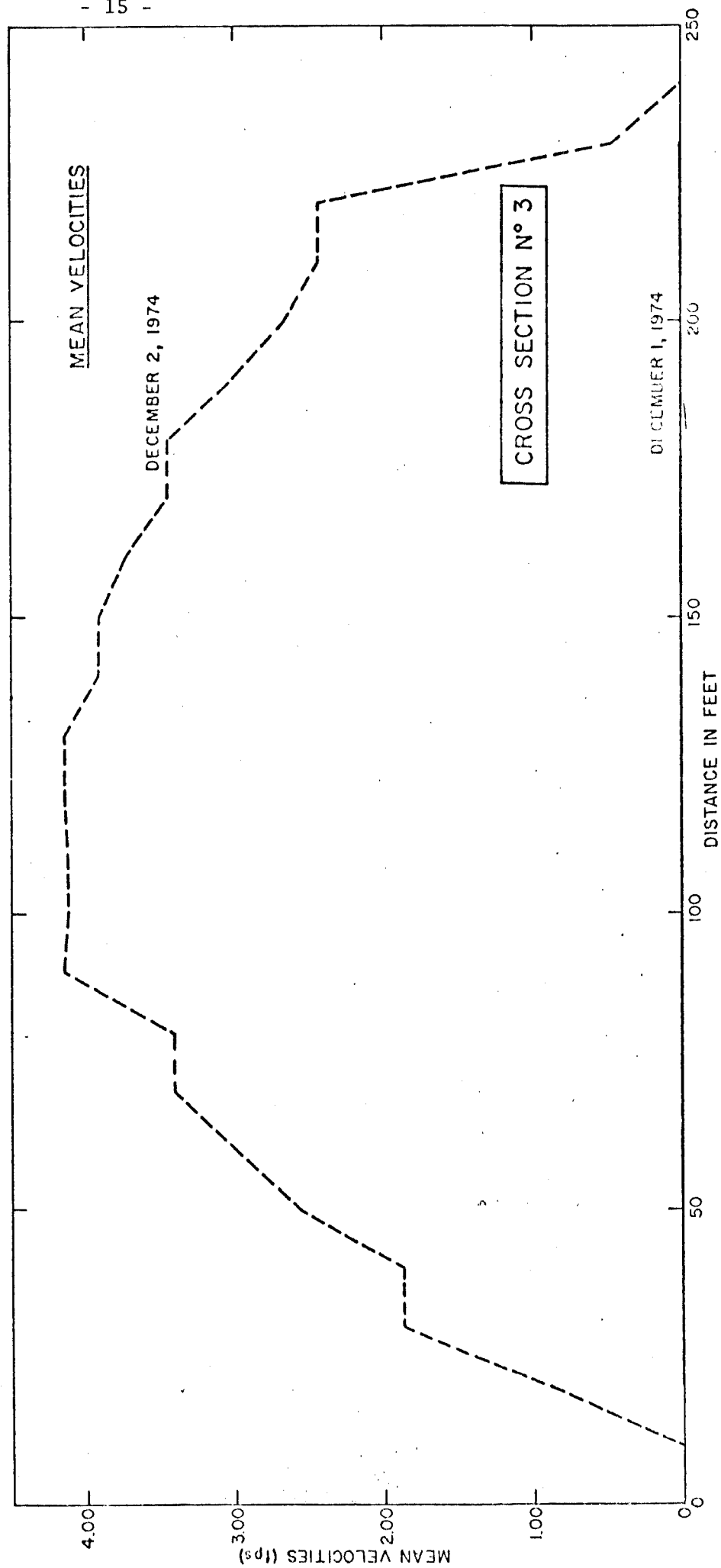
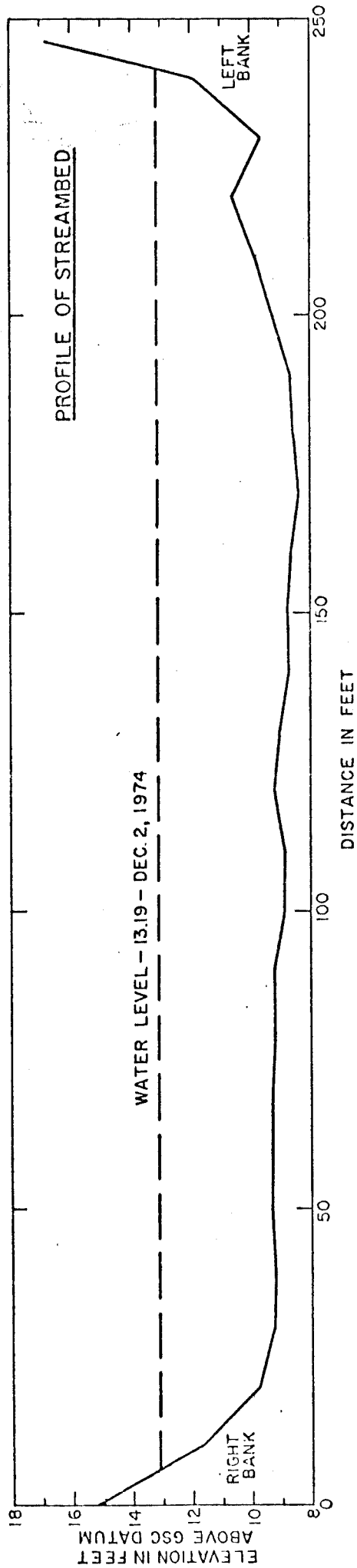
Discharge: 0 cfs
 Mean Velocity:
 Maximum Velocity:
 Time(AST): Begin End
 Water Level(Ft.GSC): Begin End

Dec. 2, 1974 Summary

Discharge: 2430 cfs
 Mean Velocity: 3.13 fps
 Maximum Velocity: 4.34 fps
 Time(AST): Begin 1200 End 1300
 Water Level(Ft.GSC): Begin 13.19 End 13.19

STATION (Ft.)	ELEVATION STREAMBED(Ft.GSC)	MEAN VELOCITY (fps)	
		Dec. 1 Survey	Dec. 2 Survey
0+00 RB	15.23		
0+10	11.63		0
0+20	9.73		0.88
0+30	9.23		1.86
0+40	9.23		1.86
0+50	9.33		2.56
0+60	9.33		2.99
0+70	9.33		3.42
0+80	9.23		3.42
0+90	9.23		4.14
1+00	8.93		4.12
1+10	8.93		4.12
1+20	9.23		4.14
1+30	9.03		4.14
1+40	8.63		3.92
1+50	8.73		3.92
1+60	8.63		3.73
1+70	8.43		3.46
1+80	8.53		3.46
1+90	8.63		3.00
2+00	9.23		2.66
2+10	9.83		2.43
2+20	10.53		2.43
2+30	9.63		0.47
2+40	11.93		0
2+46 LB	16.83		

Streambed Dry



CROSS-SECTION NO. 4

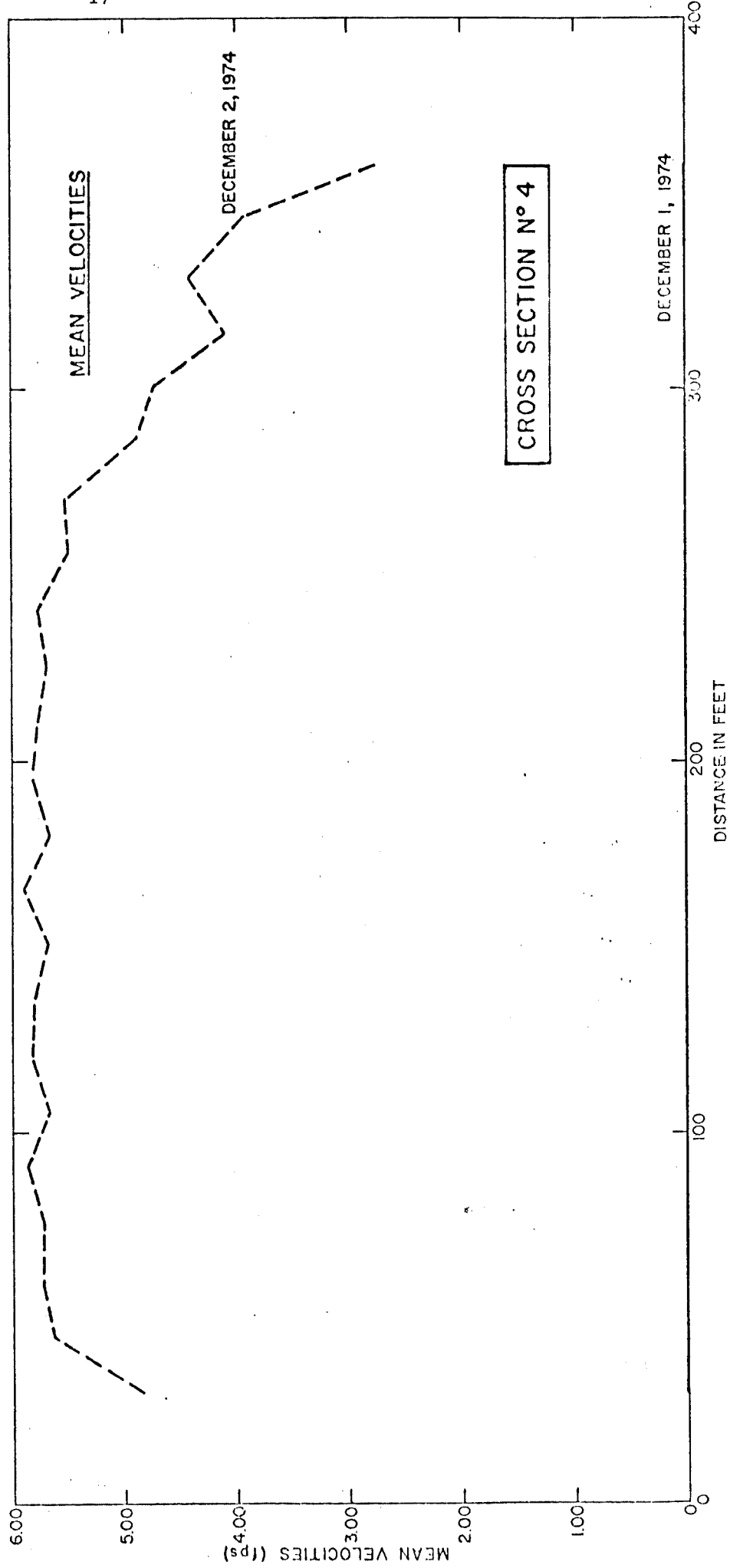
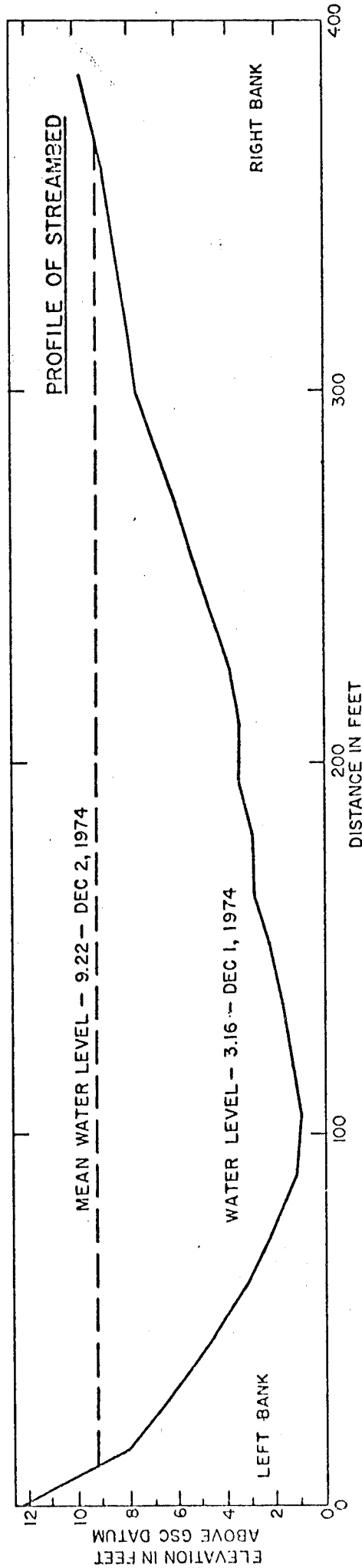
Dec. 1, 1974 Summary

Discharge: 0 cfs
 Mean Velocity:
 Maximum Velocity:
 Time(AST): Begin End
 Water Level(Ft.GSC): Begin 3.16 End 3.16

Dec. 2, 1974 Summary

Discharge: 9065 cfs
 Mean Velocity: 5.56 fps
 Maximum Velocity: 6.72 fps
 Time(AST): Begin 1045 End 1220
 Water Level(Ft.GSC): Begin 8.66 End 9.77

STATION (Ft.)	ELEVATION STREAMBED (Ft.GSC)	MEAN VELOCITY (fps)	
		Dec. 1 Survey	Dec. 2 Survey
0+00 LB	12.27		
0+15	8.00		0
0+30	6.31		4.84
0+45	4.56		5.62
0+60	3.16	0	5.72
0+75	2.07	0	5.72
0+90	1.17	0	5.86
1+05	1.03	0	5.67
1+20	1.34	0	5.82
1+35	1.74	0	5.80
1+50	2.26	0	5.68
1+65	2.88	0	5.89
1+80	2.95	0	5.66
1+95	3.48	0	5.80
2+10	3.39		5.76
2+25	3.83		5.68
2+40	4.51		5.76
2+55	5.29		5.47
2+70	5.97		5.52
2+85	6.80		4.89
3+00	7.59		4.73
3+15	7.94		4.09
3+30	8.24		4.40
3+45	8.67		3.91
3+60	8.87		2.76
3+85 RB	9.77		0



CROSS-SECTION NO. 5

Dec. 1, 1974 Summary

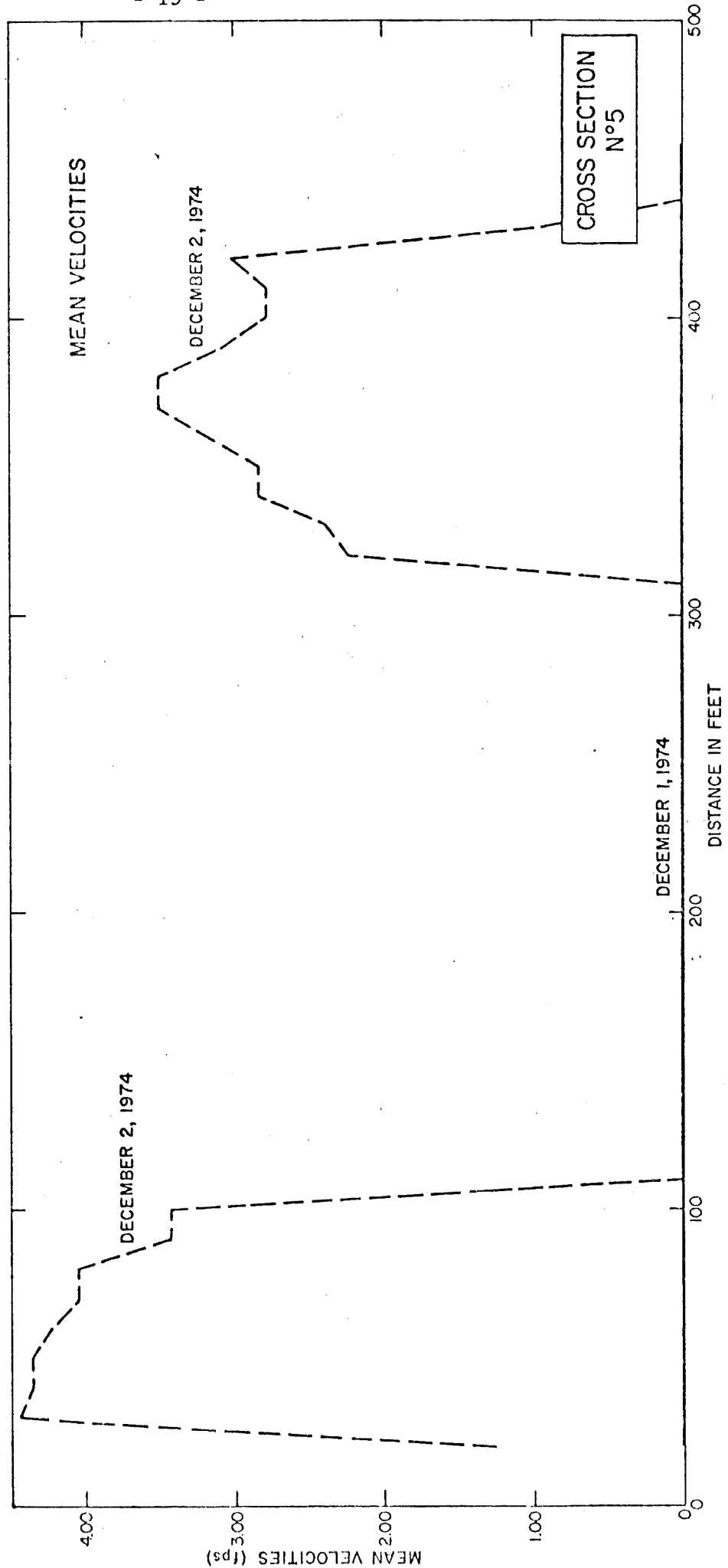
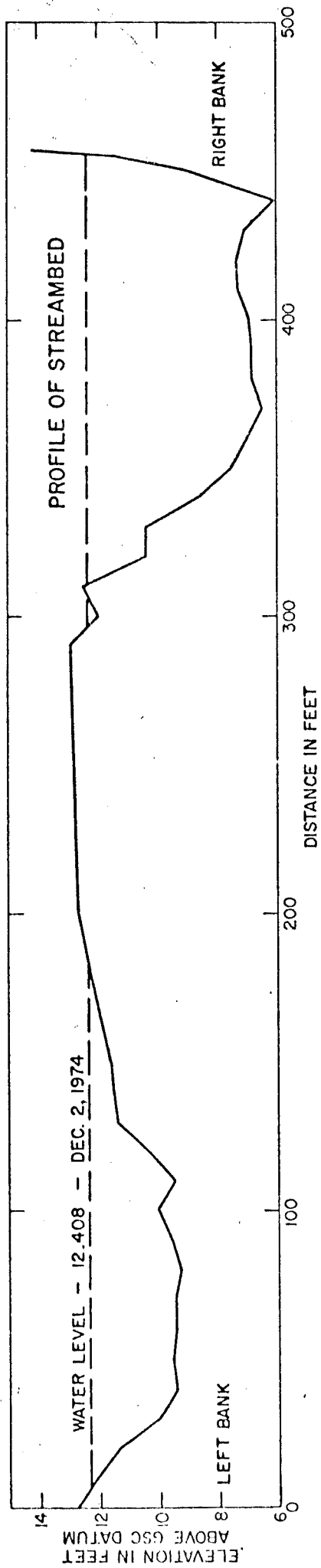
Discharge: 0 cfs
 Mean Velocity:
 Maximum Velocity:
 Time(AST): Begin End
 Water Level(Ft.GSC): Begin End

Dec. 2, 1974 Summary

Discharge: 2540 cfs
 Mean Velocity: 3.04 fps
 Maximum Velocity: 4.45 fps
 Time(AST): Begin 1315 End 1430
 Water Level(Ft.GSC): Begin 12.408 End 12.40

STATION (Ft.)	ELEVATION STREAMBED (Ft.GSC)	MEAN VELOCITY (fps)	
		Dec. 1 Survey	Dec. 2 Survey
0+00	12.70		
0+10	12.2		0
0+20	11.4		1.26
0+30	10.0		4.45
0+40	9.5		4.36
0+50	9.6		4.36
0+60	9.5		4.24
0+70	9.5		4.05
0+80	9.3		4.05
0+90	9.6		3.43
1+00	10.1		3.43
1+10	9.5		0
1+20	10.3		0
1+30	11.4		0
1+40	11.5		0
1+50	11.6		0
2+00	12.7		0
2+90	12.9		0
3+00	12.0		0
3+10	12.5		0
3+20	10.4		2.24
3+30	10.4		2.38
3+40	8.6		2.84
3+50	7.5		2.84
3+60	7.0		3.20
3+70	6.5		3.50
3+80	6.8		3.50
3+90	6.8		3.08
4+00	6.9		2.78
4+10	7.3		2.78
4+20	7.3		3.02
4+30	7.1		1.00
4+40	6.1		0
4+50	9.0		0
4+55	11.4		0
4+57 RB	14.2		0

Streambed Dry



CROSS-SECTION NO. 6

Dec. 1, 1974 Summary

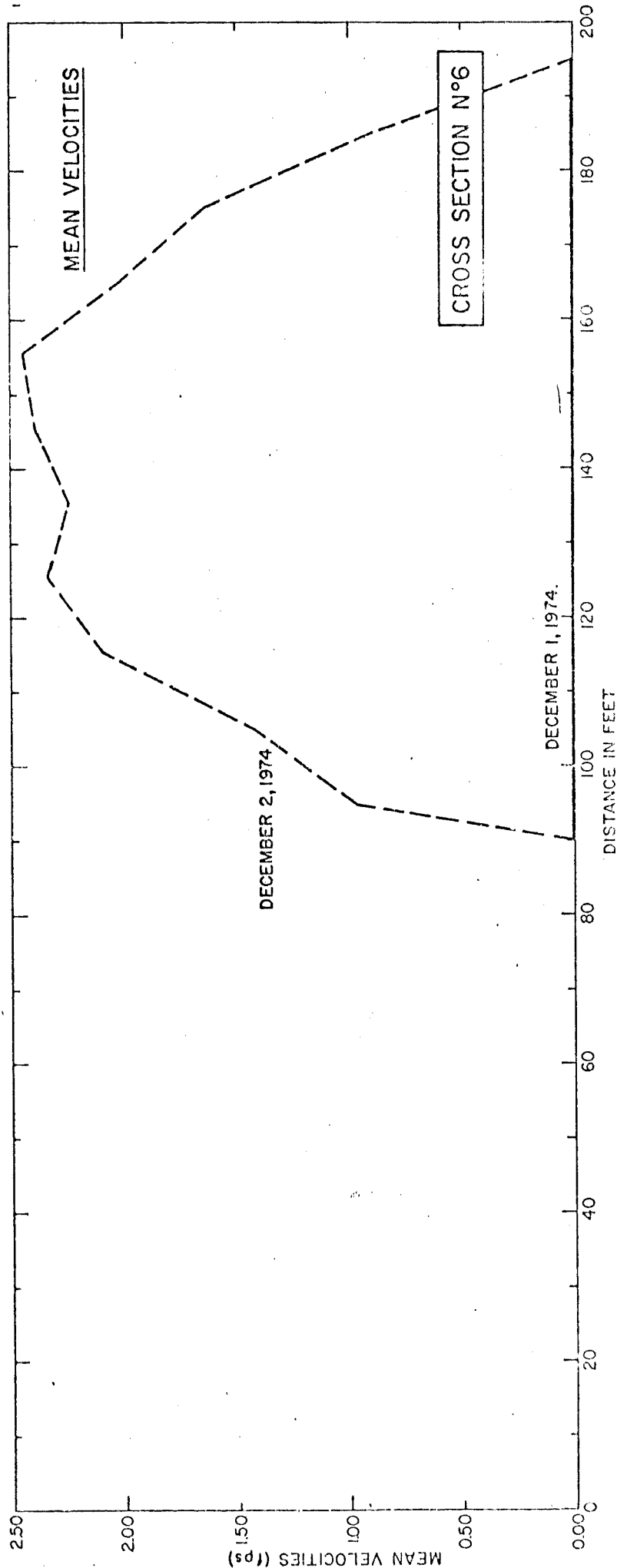
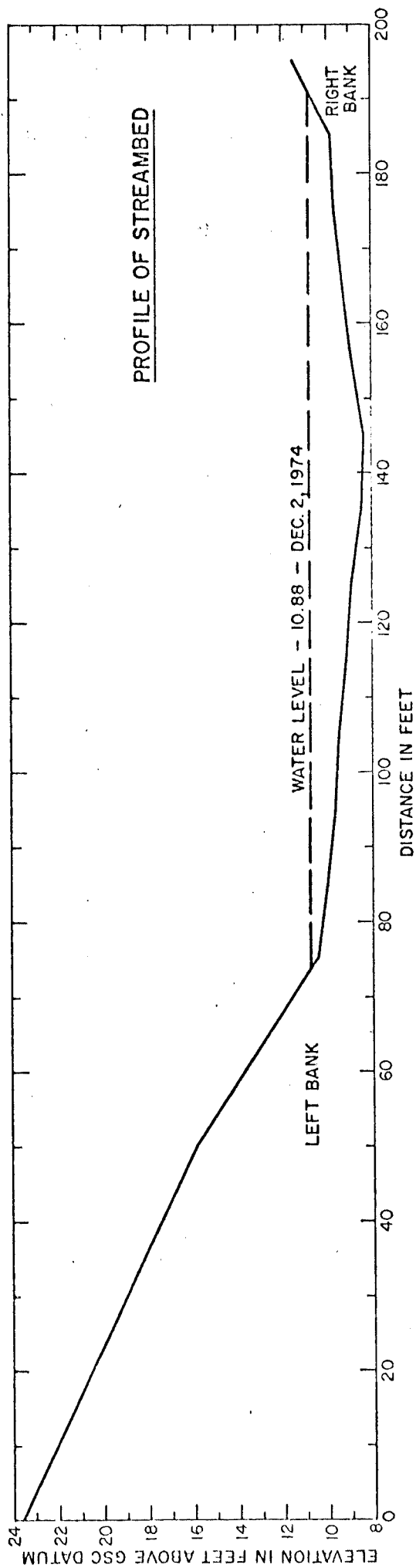
Discharge: 0 cfs
Mean Velocity:
Maximum Velocity:
Time(AST): Begin End
Water Level(Ft.GSC): Begin End

Dec. 2, 1974 Summary

Discharge: 423 cfs
Mean Velocity:
Maximum Velocity: 2.45 fps
Time(AST): Begin 1030 End 1100
Water Level(Ft.GSC): Begin 10.88 End

STATION(Ft.)	ELEVATION STREAMBED(Ft.GSC)	MEAN VELOCITY	
		Dec. 1 Survey	Dec. 2 Survey
0+00 LB	23.52		
0+50	15.94		
0+75	10.45		
0+85	10.06		0
0+95	9.63		0.97
1+05	9.44		1.42
1+15	9.19		2.10
1+25	8.98		2.34
1+35	8.63		2.25
1+45	8.45		2.39
1+55	8.92		2.45
1+65	9.36		2.01
1+75	9.68		1.64
1+85	9.89		0.90
1+95 RB	11.40		0

Streambed Dry



CROSS-SECTION NO. 8

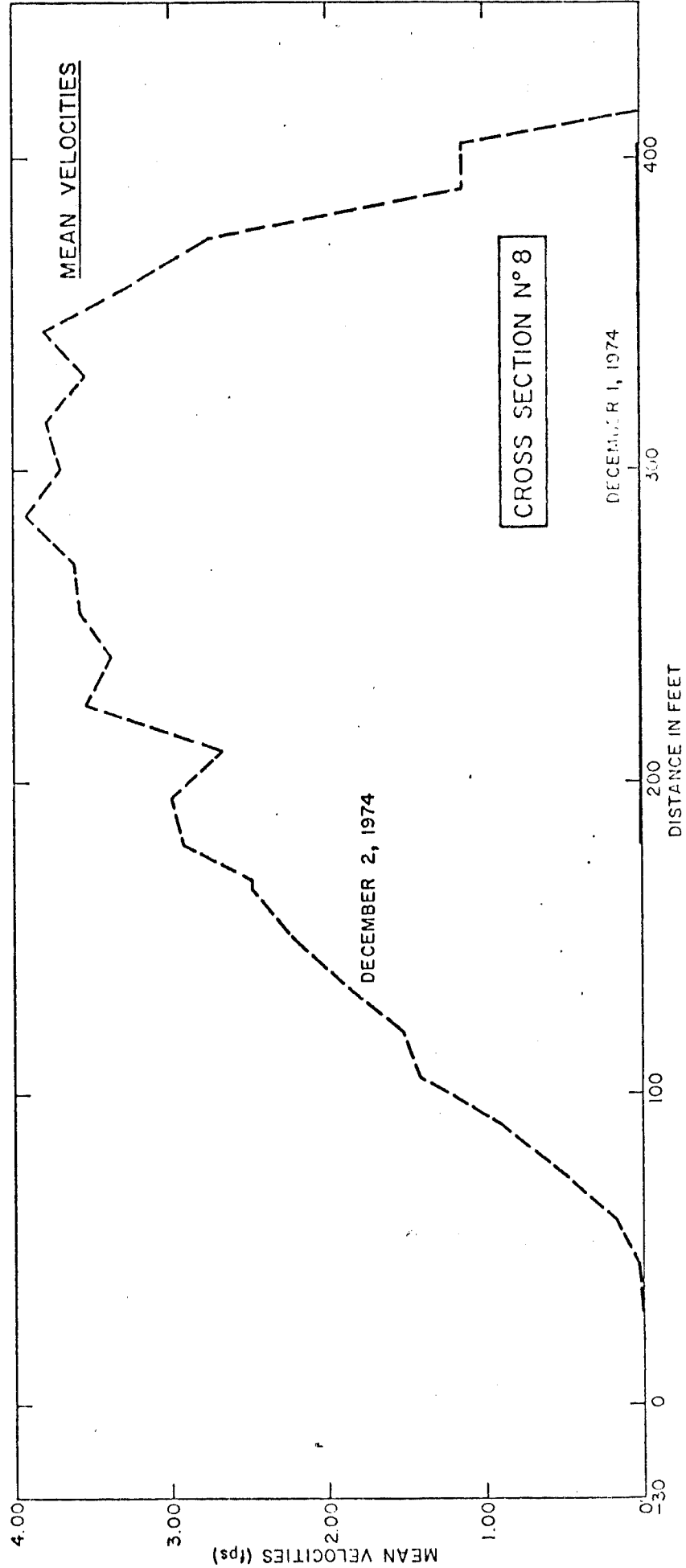
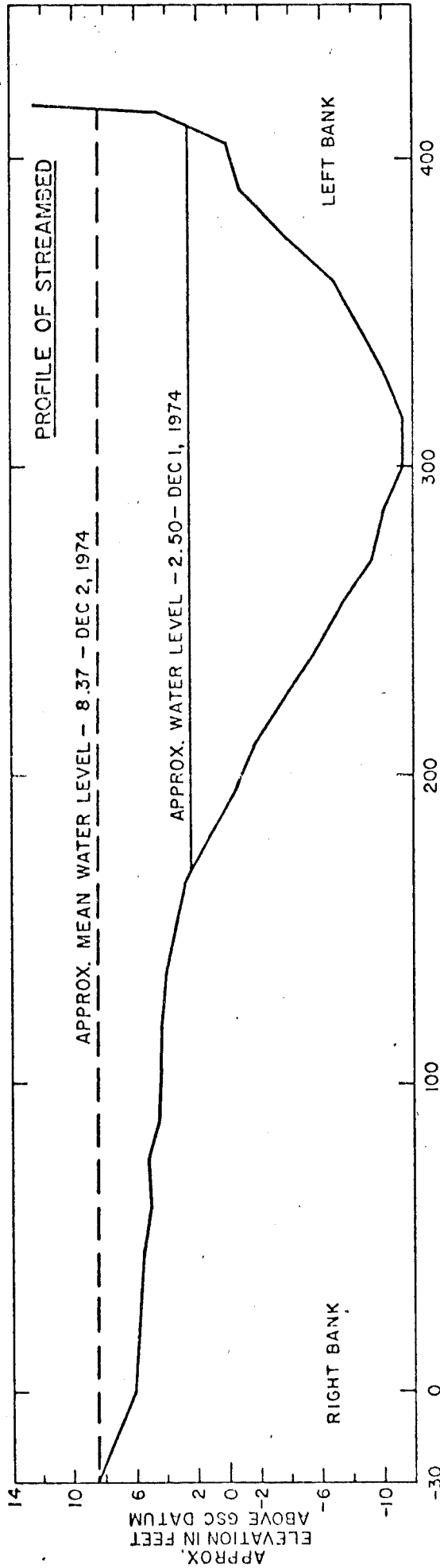
Dec. 1, 1974 Summary

Discharge: 0 cfs
Mean Velocity:
Maximum Velocity:
Time(AST): Begin End
Water Level (Ft.GSC): Begin 2.50 End 2.50
(approximate)

Dec. 2, 1974 Summary

Discharge: 11700 cfs
Mean Velocity: 3.06 fps
Maximum Velocity: 4.34 fps
Time(AST): Begin 1540 End 1655
Water Level(Ft.GSC): Begin 8.46 End 8.25
(approximate)

		APPROX. ELEVATION		
STATION (Ft.)		STREAMBED (Ft.GSC)	Dec. 1 Survey	Dec. 2 Survey
0-30	RB	8.50		
0+00		6.09		0
0+15		5.97		0
0+30		5.83		0
0+45		5.60		0.03
0+60		5.19		0.18
0+75		5.25		0.53
0+90		4.63		0.90
1+05		4.39		1.40
1+20		4.24		1.52
1+35		4.01		1.90
1+50		3.45		2.22
1+65		2.89		2.48
1+68		2.50		2.48
1+80		1.07	0	2.92
1+95		-0.50	0	3.00
2+10		-1.80	0	2.68
2+25		-3.76	0	3.54
2+40		-5.64	0	3.38
2+55		-7.33	0	3.58
2+70		-9.23	0	3.62
2+85		-10.00	0	3.92
3+00		-11.30	0	3.70
3+15		-11.30	0	3.79
3+30		-10.10	0	3.54
3+45		-8.60	0	3.80
3+60		-6.90	0	3.23
3+75		-3.70	0	2.75
3+90		-0.75	0	1.14
4+05		0.00	0	1.14
4+10		2.50		.57
4+15		4.68		0
4+17	LB	12.50		0



CROSS-SECTION NO. 9

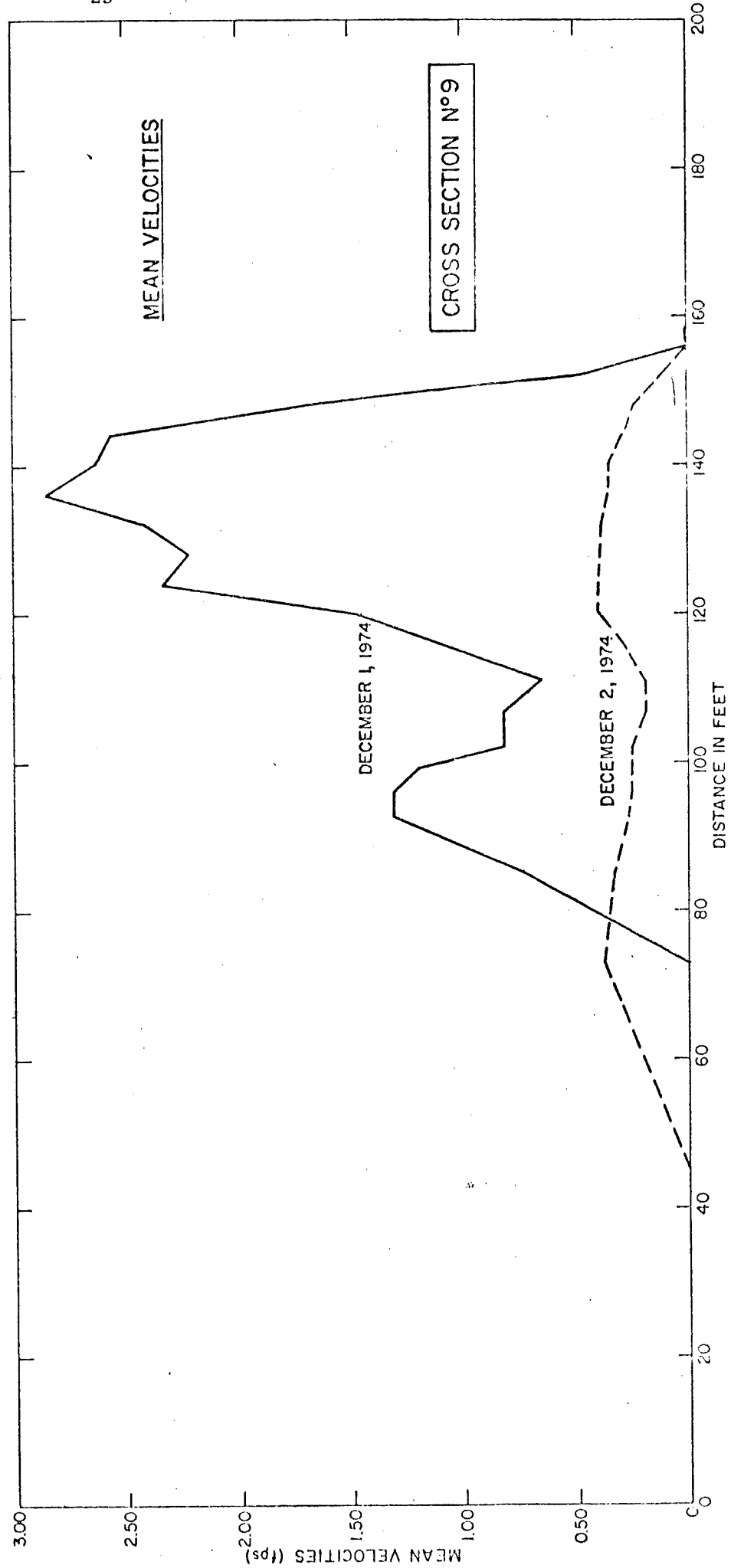
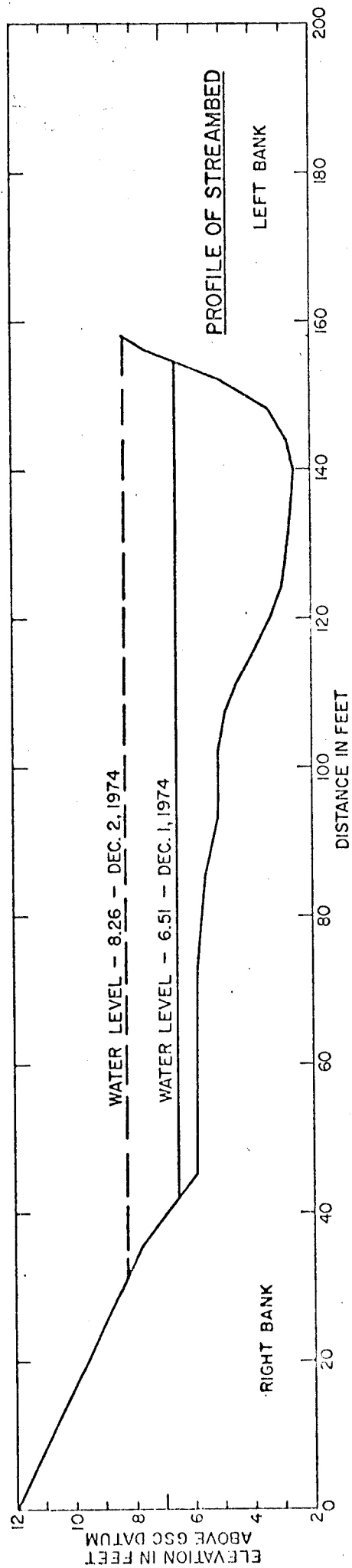
Dec. 1, 1974 Summary

Discharge: 195 cfs
 Mean Velocity: 2.00 fps
 Maximum Velocity: 2.85 fps
 Time(AST): Begin 1140 End 1220
 Water Level(Ft. GSC): Begin 6.51 End 6.51

Dec. 2, 1974 Summary

Discharge: 94.0 cfs
 Mean Velocity: 0.30 fps
 Maximum Velocity: 0.48 fps
 Time(AST): Begin 1030 End 1130
 Water Level(Ft.GSC): Begin 8.26 End 8.26

STATION (Ft.)		ELEVATION STREAMBED (Ft.GSC)	MEAN VELOCITY(fps)	
			Dec. 1 Survey	Dec. 2 Survey
0	RB	12.0		
35		7.85		
45		5.96		0
73		5.91		.37
85		5.59	.73	.33
93		5.13	1.31	.27
96		5.11	1.31	.25
99		5.11	1.20	.25
102		5.12	.82	.25
107		4.96	.82	.19
111		4.52	.66	.19
116		3.78	1.09	.29
120		3.42	1.48	.40
124		3.01	2.34	.40
128		2.86	2.22	.39
132		2.73	2.41	.38
136		2.71	2.85	.35
140		2.58	2.63	.35
144		2.80	2.57	.28
148		3.47	1.63	.23
152		5.01	0.47	.11
156		7.54	0	0
158	LB	8.3		



CROSS-SECTION NO. 10

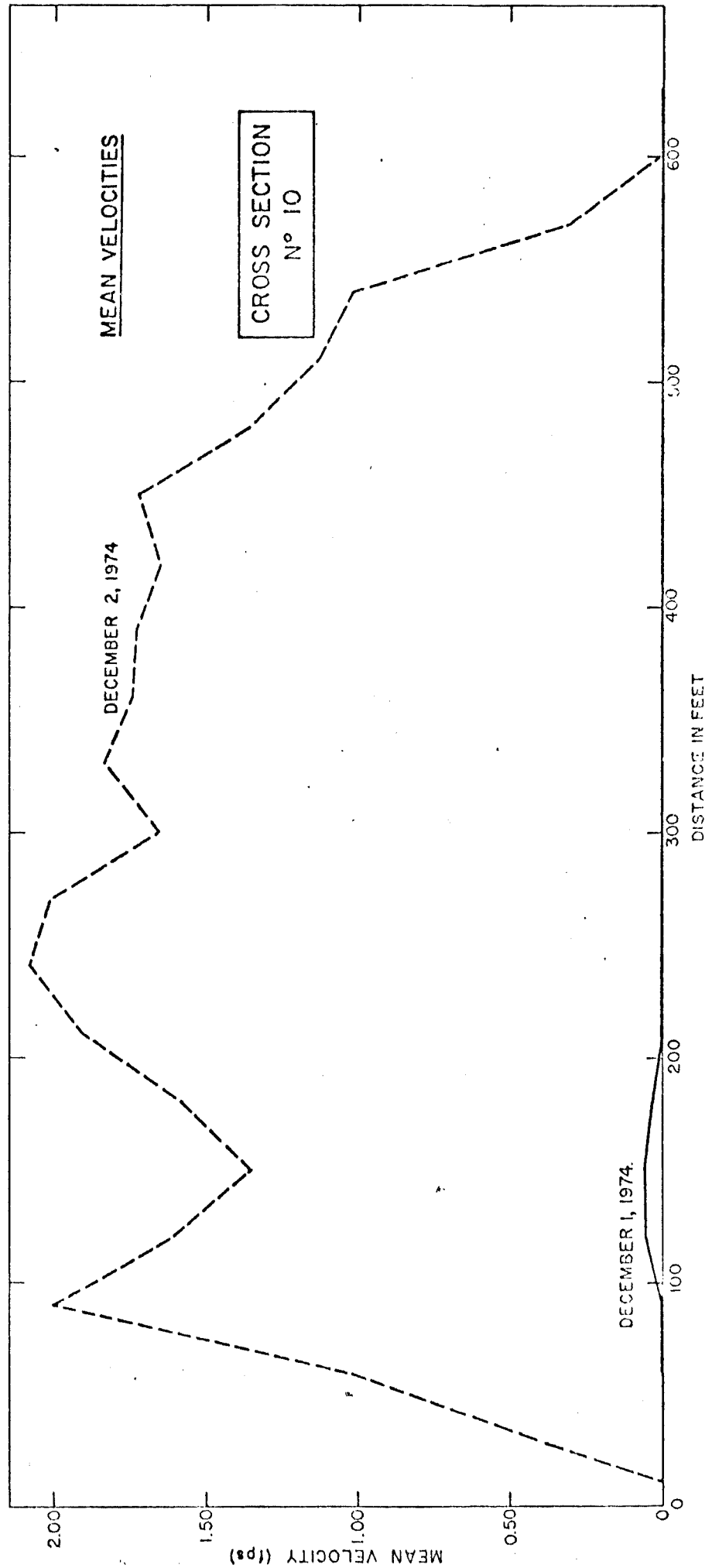
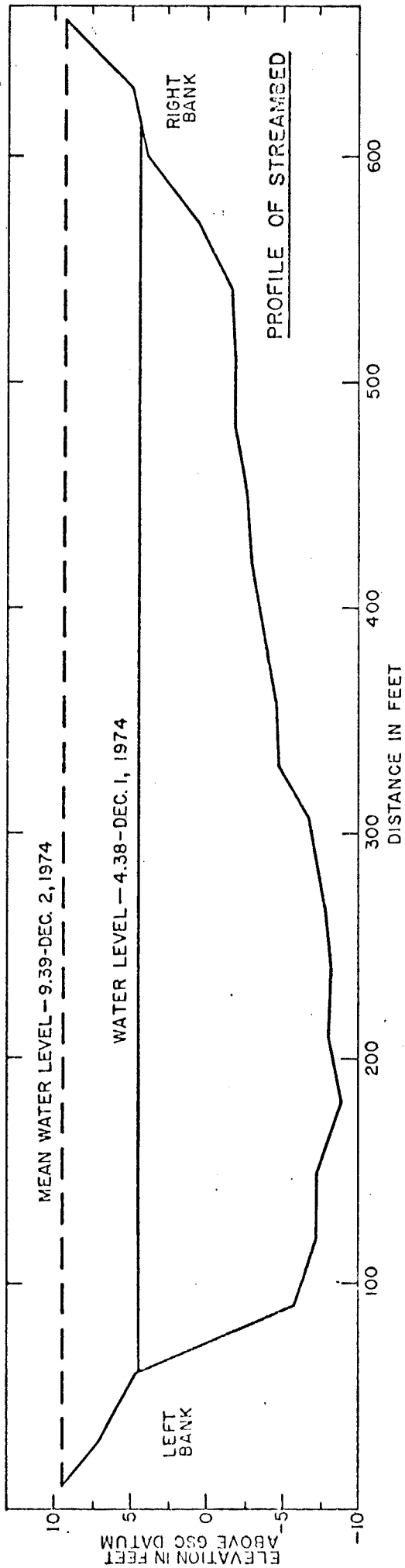
Dec. 1, 1974 Summary

Discharge: 79.0 cfs
 Mean Velocity:
 Maximum Velocity: 11 fps
 Time(AST): Begin 1130 End 1230
 Water Level(Ft.GSC): Begin 4.38 End 4.38

Dec. 2, 1974 Summary

Discharge: 11500 cfs
 Mean Velocity: 1.50 fps
 Maximum Velocity: 2.13 fps
 Time(AST): Begin 1315 End 1430
 Water Level(Ft.GSC): Begin 9.41 End 9.36

STATION (Ft.)	ELEVATION STREAMBED (Ft.GSC)	MEAN VELOCITY (fps)	
		Dec. 1 Survey	Dec. 2 Survey
0 LB			
12	9.3		0
30	7.0		.41
60	4.7	0	1.04
90	-5.7	0	2.00
120	-7.2	.06	1.62
150	-7.2	.06	1.36
180	-8.8	.03	1.58
210	-8.0	0	1.91
240	-8.2	0	2.08
270	-7.7	0	2.02
300	-6.7	0	1.66
330	-4.7	0	1.84
360	-4.6	0	1.75
390	-3.7	0	1.74
420	-2.9	0	1.66
450	-2.7	0	0.72
480	-1.8	0	1.36
510	-1.9	0	1.13
540	-1.7	0	1.02
570	0.6	0	1.31
600	4.0	0	0
630	5.0	0	0
660 RB	9.3		



CROSS-SECTION NO. 11

Dec.1, 1974 Summary

Discharge: 2100 cfs
 Mean Velocity: 1.88 fps
 Maximum Velocity: 3.56 fps
 Time(AST): Begin 1100 End 1215
 Water Level(Ft.GSC): Begin 5.26 End 5.26

Dec. 2, 1974 Summary

Discharge: 13200 cfs
 Mean Velocity: 4.36 fps
 Maximum Velocity: 6.21 fps
 Time(AST): Begin 1040 End 1140
 Water Level(Ft.GSC): Begin 8.34 End 8.70

STATION (Ft.)	ELEVATION STREAMBED (Ft.GSC)	MEAN VELOCITY (fps)	
		Dec. 1 Survey	Dec. 2 Survey
0 RB			
0+10	13.58		
0+20	9.98		
0+30	9.01		
0+40	8.50		0
0+48	7.96		.86
0+49	7.70		.86
0+55	5.32		3.42
0+90	5.26	0	3.84
1+00	4.60		3.84
1+30	3.60	1.42	4.70
1+60	3.50	1.44	4.77
1+90	3.6	1.22	4.70
2+20	3.6	1.87	5.32
2+50	3.1	2.08	4.84
2+80	3.1	2.97	4.79
3+00	3.1	2.97	5.52
3+40	2.5	3.04	5.26
3+70	2.6	2.38	4.70
4+00	2.5	2.86	4.94
4+30	3.2	2.49	4.82
4+60	4.2	2.49	4.77
4+90	4.5	1.35	4.66
5+20	4.1	0.75	3.72
5+50	3.7	0.30	3.40
5+80	3.3	0.68	3.61
6+10	2.7	0.96	3.31
6+40	5.1	0.13	2.68
6+60	6.5	0	0.39
6+80	6.6		0
7+00	7.45		
7+50 LB	8.80		

