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REPORT TO
THE INTERNATIONAL LAKE SUPERIOR BOARD OF CONTROL

DISCHARGE MEASUREMENTS at
FRANCIS H. CLERGUE G.S.
ON THE ST. MARYS RIVER at
SAULT STE. MARIE, ONTARIO
August and October, 1983

Environment Canada
Inland Waters Directorate
Ontario Region
Water Resources Branch
Guelph, Ontario
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SUMMARY

In August and October 1983, Water Resources Branch, Ontario Region, conducted discharge measurements in the power canal of the Francis H. Clergue Generating Station on the St. Marys River at Sault Ste. Marie, Ontario, to verify discharge data from the flowmeters permanently installed in the plant.

Five measurements were taken in August 1983 and one in October with all 3 units in the plant operating at full capacity. Also, five measurements were taken in October with all units reduced to about 2/3 capacity.

All of the measurements satisfy applicable I.S.O. standards for streamflow measurements. The average standard error of the measurements was computed as 2.8%.

The differences between the flowmeter discharges and corresponding measured discharges ranged between +20 m³/s (706 cfs) and -4 m³/s (141 cfs). A negative value indicates a flowmeter discharge less than measured discharge. In percentage terms, the differences ranged between +2.8% of the measured flow and -0.4% of the measured flow. The differences are roughly normally distributed about a mean value of +9.6 m³/s (339 cfs) and have a standard deviation of 7.2 m³/s (254 cfs). In percentage terms, the mean difference was +1.2% of measured flow.

These results indicate that the flowmeters are accurate for flow conditions where any or all units are operated near full capacity or near 2/3 capacity.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

In a letter dated October 26, 1982, the Canadian Section of the International Lake Superior Board of Control requested the Water Resources Branch to obtain and provide a hydraulic capacity rating for the new Great Lakes Power Ltd. hydro-electric generating station at Sault Ste. Marie, Ontario. In a letter dated December 8, 1982, to the Canadian Section of the International Lake Superior Board of Control, the Water Resources Branch proposed that the required rating be obtained by discharge measurement checks of several points on the plant's design ratings.

On May 17, 1983, Great Lakes Power Ltd. informed the Water Resources Branch that the turbine wicket gates would be modified in June and that as a result, the plant's ratings would change. The Water Resources Branch took one set of measurements during August 10-12 with the plant operating at about full capacity. Subsequent to this first set of measurements, the Water Resources Branch and the Canadian Section of the International Lake Superior Board of Control agreed that the discharge measurements should be used to verify the plant's flowmeters rather than the plant's hydraulic ratings. One reason was that the revised hydraulic ratings were not yet available. Another reason was that Great Lakes Power Ltd. was using the flowmeters instead of the ratings to determine the turbine flows. Each of the three turbines in the plant has a differential pressure type flowmeter which monitors the instantaneous flow through the turbine. The instantaneous flows are recorded on charts which are later analyzed to determine mean plant flows.

The Water Resources Branch took a second set of measurements during October 18-19 with each of the turbines operating at about full capacity and later operating at about 2/3 capacity. The following sections describe and discuss both sets of survey procedures and computations and compare the measured discharges with the corresponding flowmeter discharges.

2. SURVEY PROCEDURES

2.1 Measuring Section

The measuring section was located in the power canal about 300 m above the Francis H. Clergue Generating Station, as shown in Figure 1. The section was aligned perpendicular to the direction of the flow.

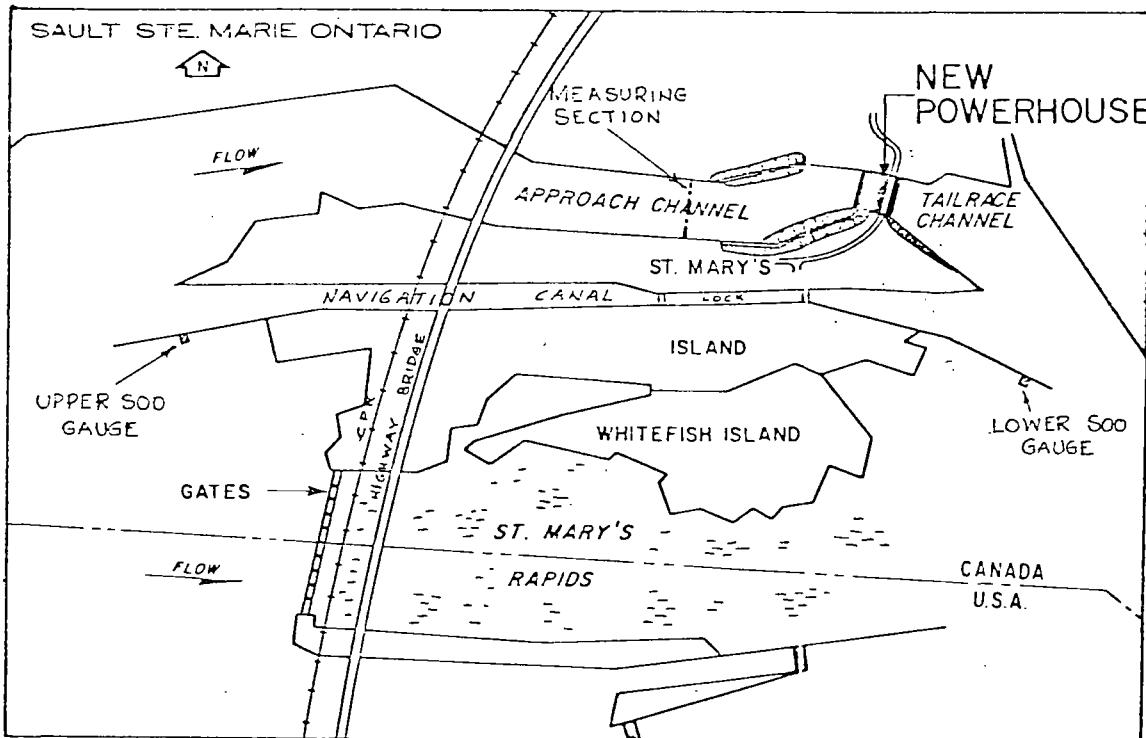


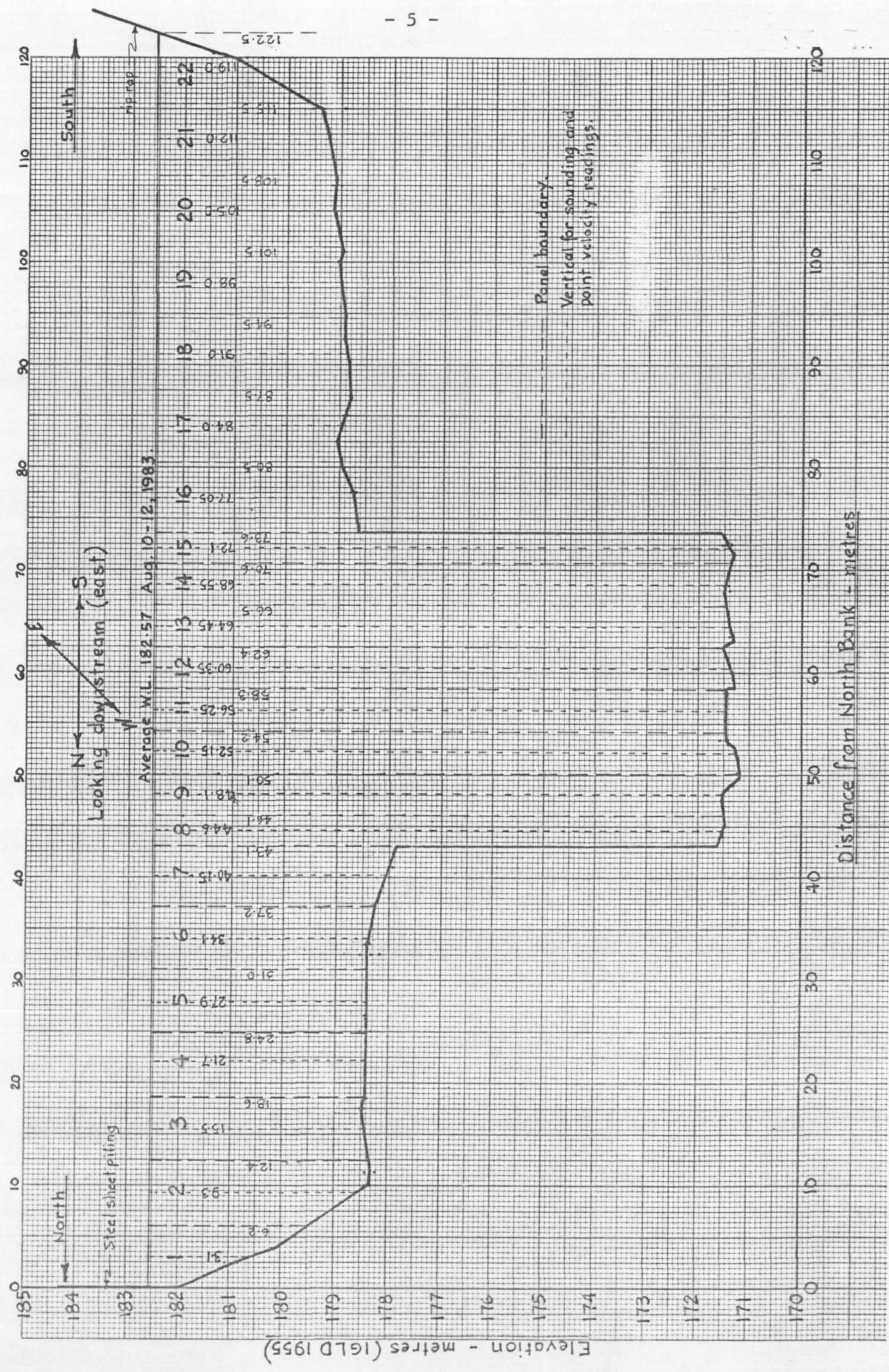
Figure 1 - Location Map (Source - "The St. Marys Redevelopment Project", Great Lakes Power Ltd., 1979)

The cross section profile is shown in Figure 2. The central rectangular section was excavated in 1982 to increase the capacity of the canal.

Different panel distributions were tried in the August measurements, however a standard 22 panel distribution (Figure 2) with 8 panels in the central rectangular section and 7 panels in each of the side sections was used in the October measurements. This provided good definition of the transverse velocity distribution and limited discharge in any one panel to under 8%.

2.2. Section Gauge

A Stevens A-71 water level recorder was set up on August 9 in an Abitibi Price process water intake on the north bank about 20 m below the section. The recorder provided a continuous record of water levels for the period August 10-12. The water level data were used to assess the stability of flow

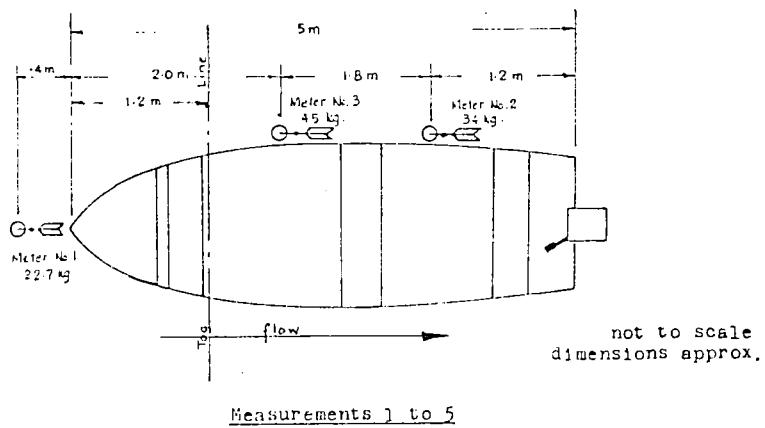


conditions during the measurements. Since the recorder agreed closely with the plant's headwater level gauge, it was not operated during the second set of measurements in October. The water level data are included in Table 1.

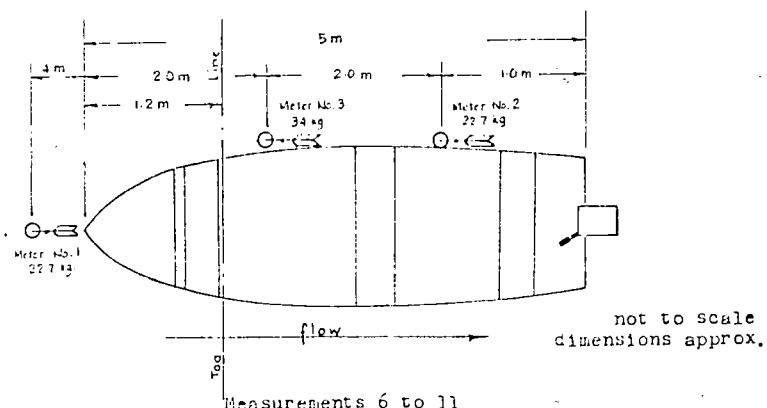
2.3 Data Collection

Measurements were taken from a 5 m aluminum boat equipped with a 10 hp outboard motor. The boat was positioned using a tag line which was strung across the canal at the measuring section. The tag line was marked at 5 m intervals and at the panel points.

Three Price pattern 622AA current meters were suspended 0.3 m above Columbus sounding weights in the combinations shown in Figure 3. The three meters were deployed simultaneously for point velocity readings. The No. 3 meter-weight combination was also used for the soundings.



Measurements 1 to 5



Measurements 6 to 11

Figure 3 - Meter Deployment

TABLE 1
WATER LEVELS DURING DISCHARGE MEASUREMENTS

Measurement No.	1	2	3	4	5
Date Time (EST)	Aug. 10 1420-1605	Aug. 11 0920-1056	Aug. 11 1255-1430	Aug. 12 0805-0932	Aug. 12 1025-1145
Gauge:					
Upper Soo	183.05	183.16	183.19	183.17	183.20
Lower Soo	177.22	177.20	177.18	177.13	177.15
Plant HWL*	182.39	182.47	182.55	182.48	182.55
Plant TWL*	177.28	177.23	177.20	177.16	177.18
Measuring Section	182.50	182.55	182.63	182.56	182.61
Plant Output (MW)*	44.3	45.6	46.9	47.1	47.3

Measurement No.	6	7	8	9	10	11
Date Time (EST)	Oct. 18 1020-1141	Oct. 18 1332-1457	Oct. 18 1502-1612	Oct. 19 0825-0950	Oct. 19 1000-1122	Oct. 19 1139-1243
Gauge:						
Upper Soo	183.25	183.26	183.28	183.16	183.23	183.22
Lower Soo	176.90	176.80	176.82	176.83	176.83	176.81
Plant HWL*	182.70	183.20	183.28	183.08	183.19	183.16
Plant TWL*	176.92	176.80	176.84	176.84	176.83	176.81
Plant Output (MW)*	50.3	31.4	31.2	33.0	33.0	33.1

*Data Supplied by Great Lakes Power Limited

The meters were rated by the National Calibration Service, NWRI, in "as received" condition after each of the two phases of the job. The ratings appear under the measurement input data listings in Appendix A. The positions of velocity readings are shown in Figure 4.

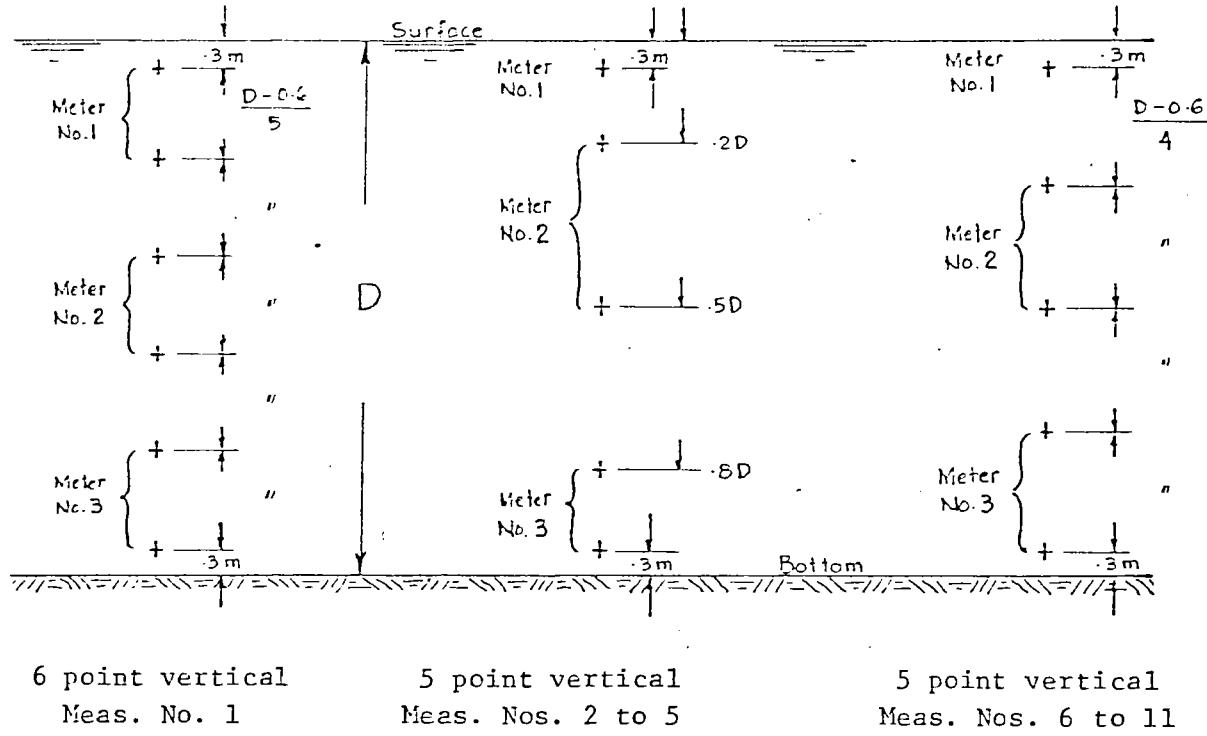


Figure 4 - Positions of Point Velocity Readings in the Verticals.

The number of velocity readings was reduced from six to five after measurement No. 1 because no satisfactory way to reset meter No. 1 could be devised. It was set at a fixed depth of 0.3 m below the surface for the remaining measurements. Readings were taken as close as practicable (0.3 m) from the surface and bottom to minimize extrapolation of the fitted vertical velocity distribution.

All meters were wired to a central multiple counter unit, enabling one person to record all data including depths which were sounded with the No. 3 meter-weight combination. Meters were timed for 1 minute. The average time to complete a measurement was 1 hour and 25 minutes.

Ideal weather conditions and relatively steady water levels prevailed for both sets of measurements. The maximum variation in water level during a measurement was 17 cm at Upper Soo gauge, 24 cm at the plant headwater gauge, 12 cm at the plant tailwater gauge, and 6 cm at Lower Soo gauge.

Great Lakes Power Ltd. cooperated fully in providing steady flow for all measurements. The maximum variation in discharge through any of the turbines was about 16 m³/s (565 cfs) except for a 40 m³/s (1412 cfs) adjustment on turbine No. 2 near the end of measurement No. 3.

3. DATA REDUCTION

3.1 Computation of Mean Velocity in each Vertical

Input data listings for all measurements are included in Appendix A. Observed rpm were converted to velocity in m/s by application of the appropriate meter equation.

A vertical velocity distribution developed by the U.S. Army Corps of Engineers, Lake Survey District, (ref. articles 9 and 10 in Bibliography) was fitted to the point velocity readings in each vertical. The distribution is

$$v = A(1 - \sqrt{d} - \ln(1 - \sqrt{d})) + B \quad \text{Eq. 1}$$

where v is the velocity at any point in the vertical, d is the ratio of point depth to total depth, and A and B are regression coefficients. At each vertical, the distribution was divided into an upper half and a lower half to facilitate the computation of mean velocity. The regression coefficients for the upper half of the distribution, A_u and B_u , were derived by regressing (method of least squares) the point velocity readings in the upper part of the vertical against corresponding values for the expression $(1 - \sqrt{d} - \ln(1 - \sqrt{d}))$. Similarly, the regression coefficients for the lower half of the distribution, A_L and B_L , were derived from the point velocity readings in the lower part of the vertical. In measurement No. 1, A_u and B_u were evaluated using the 4 upper points, while A_L and B_L were evaluated using the 4 lower points. Thus, points 3 and 4 were used in both evaluations. In measurements No. 2 to 11, the upper 3 points were used to evaluate A_u and B_u and the lower 3 points were used to evaluate A_L and B_L . Thus, only the midpoint was used twice.

By integration of Equation 1, the following equation for mean velocity in the vertical was derived:

$$v_{\text{mean}} = .6074A_u + .5B_u + 1.2259A_L + .5B_L \quad \text{Eq. 2}$$

Equation 2 was used with the derived values for A_u , B_u , A_L , and B_L to compute the mean velocity in each vertical. The validity of Equation 2 was

checked by plotting the measured velocities in a number of verticals, visually fitting a smooth curve through the points and estimating the mean. This was done for 3 verticals in each of the first 5 measurements. The estimated mean velocities generally agreed within 1.0% of the mean velocities estimated by Equation 2, thereby confirming the validity of the equation for this project.

For comparison, mean velocities were computed using the logarithmic distribution

$$v = A(\ln(1-d)) + B \quad \text{Eq. 3}$$

which, by integration, gives the following equation for mean velocity:

$$v_{\text{mean}} = -.1534A_u + .5B_u - .8466A_L + .5B \quad \text{Eq. 4}$$

where the symbols are as defined earlier. The mean velocities estimated by Equation 4 were within 0.1% of those estimated by Equation 2.

3.2 Computation of Total Discharge

The discharge in each panel was computed as the product of area (width x depth) and mean velocity estimated by Equation 2. Total discharge was computed by summing the discharges in all panels. Because of the smooth transverse velocity distribution evident in these measurements, the computation and application of transverse velocity coefficients was considered unnecessary. Computer listings of the discharge computations are included in Appendix B. The measured discharges are presented in Table 2.

The discharges recorded by the flowmeters in the plant at the times of the measurements are also presented in Table 2. The flowmeter discharges were derived by visually estimating the mean values on the flowmeter charts for each measurement period. The flowmeter charts are included in Appendix C.

4. DISCUSSION OF RESULTS

All of the measurements satisfy applicable ISO standards (ref. articles 1, 2, and 3 in Bibliography) for streamflow measurements. The standard errors of the measurements by the Herschy formula (ref. article 8 in Bibliography) are:

Measurement No. 1	(19 panels, 6 pt. verticals)	3.0%
Measurements No. 2 to 5	(21 panels, 5 pt. verticals)	2.8%
Measurements No. 6 to 11	(22 panels, 5 pt. verticals)	<u>2.8%</u>
Average		2.8%

Table 2 shows that ten of the eleven discharges from the flowmeter charts were higher than the corresponding measured discharges. The differences between the flowmeter discharges and corresponding measured discharges ranged between $+20 \text{ m}^3/\text{s}$ (706 cfs) and $-4 \text{ m}^3/\text{s}$ (141 cfs). A negative value indicates a flowmeter discharge less than measured discharge. In percentage terms, the differences ranged between $+2.8\%$ of the measured flow and -0.4% of the

TABLE 2

COMPARISON OF MEASURED DISCHARGE AND FLOWMETER DISCHARGE

Measurement No.	1	2	3	4	5
Date Time (EST)	Aug. 10 1420-1605	Aug. 11 0920-1056	Aug. 11 1255-1430	Aug. 12 0805-0932	Aug. 12 1025-1145
Flowmeter Discharge:					
Unit No. 1*	353	376	377	380	382
Unit No. 2*	358	384	364	382	376
Unit No. 3*	<u>362</u>	<u>366</u>	<u>380</u>	<u>380</u>	<u>376</u>
Total	1073	1126	1121	1142	1134
Measured Discharge	1068	1115	1112	1123	1114
Difference, m ³ /s	5	11	9	19	20
Difference, %	0.5	1.0	0.8	1.7	1.8
Measurement No.	6	7	8	9	10
Date Time (EST)	Oct. 18 1020-1141	Oct. 18 1332-1457	Oct. 18 1502-1612	Oct. 19 0825-0950	Oct. 19 1000-1122
Flowmeter Discharge:					
Unit No. 1*	388	184	184	202	200
Unit No. 2*	386	206	204	212	214
Unit No. 3*	<u>344</u>	<u>194</u>	<u>196</u>	<u>211</u>	<u>204</u>
Total	1118	584	584	625	618
Measured Discharge	1122	575	581	619	601
Difference, m ³ /s	-4	9	3	6	17
Difference, %	-0.4	1.5	0.5	1.0	2.8
					11 1.8

*Data Supplied by Great Lakes Power Limited.

measured flow. The differences are roughly normally distributed about a mean value of +9.6 m³/s (339 cfs) and have a standard deviation of 7.2 m³/s (254 cfs). In percentage terms, the mean difference was 1.2% of measured flow.

Much of the 1.2% average difference may be due to measurement/computation error. Possible sources of error were:

- (1) Location of the vertical walls of the central rectangular section. The location of the walls could not be precisely determined by lead weight soundings, therefore the width of the central section was assumed equal to the design width of 30.5 m.
- (2) The vertical velocity distribution (Equations 1 and 2) may slightly underestimate the mean velocity.

5. CONCLUSIONS AND RECOMMENDATIONS

Since all measurements and corresponding flowmeter readings agree within 2.8%, it can be concluded that the flowmeters are accurate for flow conditions where any or all units are operated near full capacity or near 2/3 capacity. These two conditions are close to the normal upper and lower limits of turbine operation at the plant. The accuracy of the flowmeters at intermediate operating conditions should be verified at a later date.

Discharge measurements should be scheduled periodically to confirm the continued reliable operation of the flowmeters.

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APPENDIX A

DISCHARGE MEASUREMENT INPUT DATA

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 1 10 AUGUST 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 K+.3	METER 2 2K+.3	METER 2 3K+.3	METER 3 4K+.3	METER 3 D-.3
1	1420	2.50	0.0	6.25	6.25	1.47	82.	82.	78.	78.	74.	74.
2	1430	10.00	6.25	13.75	7.50	4.17	124.	130.	123.	114.	91.	76.
3	1440	17.50	13.75	21.25	7.50	4.10	160.	156.	160.	145.	141.	101.
4	1443	25.00	21.25	28.75	7.50	4.10	159.	166.	162.	159.	144.	92.
5	1445	32.50	28.75	36.25	7.50	4.20	155.	152.	153.	147.	125.	94.
6	1450	40.00	36.25	43.10	6.85	4.30	155.	160.	156.	150.	136.	106.
7	1455	47.50	43.10	50.00	6.90	10.37	162.	170.	146.	154.	144.	108.
8	1502	52.50	50.00	55.00	5.00	11.22	169.	182.	174.	170.	151.	116.
9	1510	57.50	55.00	60.00	5.00	11.01	178.	178.	170.	167.	136.	99.
10	1515	62.50	60.00	65.00	5.00	10.94	175.	182.	179.	177.	160.	113.
11	1522	67.50	65.00	70.00	5.00	10.96	165.	179.	175.	178.	168.	121.
12	1530	72.50	70.00	73.60	3.60	10.95	154.	163.	157.	157.	147.	109.
13	1535	77.50	73.60	81.25	7.65	3.82	152.	150.	152.	142.	131.	102.
14	1540	85.00	81.25	88.75	7.50	3.53	155.	153.	152.	140.	133.	95.
15	1545	92.50	88.75	96.25	7.50	3.58	155.	161.	147.	147.	120.	92.
16	1550	100.00	96.25	103.80	7.50	3.50	155.	151.	152.	143.	135.	101.
17	1555	107.50	103.80	111.30	7.50	3.50	143.	138.	140.	125.	116.	85.
18	1600	115.00	111.30	117.50	6.25	3.13	109.	112.	126.	111.	103.	86.
19	1605	120.00	117.50	122.50	5.00	2.00	67.	67.	65.	63.	60.	60.

$$K = (D - 0.6)/5$$

METER EQUATIONS

METER NO. 1	0.6666	0.0098
METER NO. 2	0.6571	0.0092
METER NO. 3	0.6676	0.0016

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 2 11 AUGUST 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 .2D	METER 2 .5D	METER 3 .8D	METER 3 D-.3
1	920	3.75	0.0	7.50	7.50	2.45	113.	113.	116.	116.	101.	90.
2	925	11.25	7.50	15.00	7.50	4.34	142.	138.	148.	148.	120.	100.
3	930	15.75	15.00	22.50	7.50	4.17	162.	156.	172.	167.	136.	117.
4	935	26.25	22.50	30.00	7.50	4.11	169.	161.	165.	163.	130.	118.
5	938	33.50	30.00	37.00	7.00	4.20	154.	164.	168.	166.	120.	80.
6	942	40.00	37.00	43.10	6.10	4.30	158.	162.	162.	156.	133.	104.
7	946	44.50	43.10	46.50	3.40	11.00	151.	167.	154.	141.	135.	90.
8	950	48.50	46.50	50.50	4.00	11.01	170.	172.	176.	170.	166.	120.
9	957	53.00	50.50	55.50	5.00	11.12	175.	174.	183.	177.	169.	102.
10	1001	58.00	55.50	60.50	5.00	11.06	180.	180.	186.	176.	161.	118.
11	1005	63.00	60.50	65.50	5.00	11.23	179.	179.	184.	183.	155.	113.
12	1010	68.00	65.50	70.25	4.75	11.15	177.	165.	186.	175.	157.	115.
13	1015	72.50	70.25	73.60	3.35	11.17	159.	161.	152.	154.	146.	110.
14	1020	75.00	73.60	77.50	3.90	3.85	165.	160.	172.	153.	146.	120.
15	1030	80.00	77.50	83.75	6.25	3.50	167.	154.	171.	145.	121.	100.
16	1035	87.00	83.75	90.75	7.00	3.77	155.	164.	168.	152.	124.	116.
17	1040	94.00	90.75	97.75	7.00	3.57	160.	155.	160.	149.	130.	117.
18	1045	101.00	97.75	104.70	6.95	3.51	153.	150.	155.	138.	104.	94.
19	1048	108.00	104.70	111.70	7.00	3.47	129.	135.	144.	142.	126.	114.
20	1052	115.00	111.70	118.50	6.80	2.53	84.	82.	95.	99.	64.	55.
21	1056	120.50	118.50	122.50	4.00	1.13	80.	80.	75.	60.	40.	40.

METER EQUATIONS

METER NO. 1 0.6671 0.0092
 METER NO. 2 0.5666 0.0098
 METER NO. 3 0.6575 0.0016

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 3 11 AUGUST 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 .2D	METER 2 .5D	METER 3 .8D	METER 3 D-.3
1	1255	3.75	0.0	7.50	7.50	2.54	104.	109.	103.	94.	76.	65.
2	1300	11.25	7.50	15.00	7.50	4.27	155.	152.	157.	156.	134.	103.
3	1305	18.75	15.00	22.50	7.50	4.26	162.	162.	163.	151.	135.	99.
4	1309	26.25	22.50	30.00	7.50	4.25	159.	157.	161.	150.	115.	99.
5	1312	33.50	30.00	37.00	7.00	4.24	164.	160.	163.	156.	139.	106.
6	1316	40.00	37.00	43.10	6.10	4.69	154.	157.	158.	155.	138.	98.
7	1322	45.00	43.10	47.50	4.40	11.21	161.	162.	155.	151.	142.	99.
8	1325	50.00	47.50	52.50	5.00	11.49	164.	170.	169.	170.	152.	85.
9	1333	55.00	52.50	57.50	5.00	11.20	173.	168.	174.	166.	152.	102.
10	1338	60.00	57.50	62.00	4.50	11.30	177.	186.	184.	181.	166.	102.
11	1343	64.00	62.00	65.75	3.75	11.27	177.	171.	186.	179.	173.	109.
12	1346	67.50	65.75	69.50	3.75	11.17	170.	158.	170.	174.	174.	110.
13	1350	71.50	69.50	72.50	3.00	11.30	152.	164.	152.	134.	151.	82.
14	1402	73.50	72.50	73.60	1.10	11.07	159.	155.	150.	121.	131.	73.
15	1355	77.50	73.60	80.00	6.40	3.83	165.	158.	169.	149.	141.	104.
16	1407	82.50	80.00	86.25	6.25	3.52	164.	164.	169.	154.	131.	112.
17	1412	90.00	86.25	93.75	7.50	3.75	172.	164.	175.	149.	136.	97.
18	1416	97.50	93.75	101.30	7.50	3.58	159.	167.	164.	157.	121.	107.
19	1420	105.00	101.30	108.80	7.50	3.42	153.	154.	158.	149.	127.	107.
20	1424	112.50	108.80	116.30	7.50	3.31	126.	127.	137.	131.	115.	94.
21	1428	120.00	116.30	122.50	6.25	1.77	66.	75.	66.	70.	29.	44.

METER EQUATIONS

METER NO. 1 0.6671 0.0092
 METER NO. 2 0.6666 0.0098
 METER NO. 3 0.6676 0.0016

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 4 12 AUGUST 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 .2D	METER 2 .5D	METER 3 .8D	METER 3 D-.3
1	805	2.50	0.0	6.25	6.25	1.32	120.	110.	119.	104.	97.	82.
2	810	10.00	6.25	13.75	7.50	4.30	152.	155.	154.	154.	121.	90.
3	814	17.50	13.75	21.25	7.50	4.17	171.	158.	172.	154.	137.	101.
4	817	25.00	21.25	28.75	7.50	4.30	164.	156.	167.	165.	138.	101.
5	821	32.50	28.75	35.00	6.25	4.42	162.	157.	166.	156.	125.	95.
6	825	37.50	35.00	39.25	4.25	4.35	168.	166.	172.	163.	143.	101.
7	830	41.00	39.25	43.10	3.85	4.67	169.	166.	169.	161.	140.	85.
8	835	44.00	43.10	46.50	3.40	11.07	165.	175.	160.	148.	150.	97.
9	839	49.00	46.50	51.25	4.75	11.27	176.	170.	180.	167.	153.	99.
10	843	53.50	51.25	56.00	4.75	11.16	177.	180.	181.	174.	160.	96.
11	846	58.50	56.00	61.00	5.00	11.27	176.	177.	184.	175.	160.	84.
12	849	63.50	61.00	66.00	5.00	11.20	177.	178.	179.	177.	162.	99.
13	853	68.50	66.00	70.50	4.50	11.15	170.	158.	168.	169.	169.	106.
14	900	72.50	70.50	73.60	3.10	11.05	163.	171.	165.	130.	145.	96.
15	910	77.50	73.60	81.25	7.65	3.80	160.	169.	156.	162.	107.	115.
16	914	85.00	81.25	88.75	7.50	3.63	165.	169.	167.	167.	126.	111.
17	918	92.50	88.75	96.25	7.50	3.61	161.	167.	170.	160.	126.	111.
18	920	100.00	96.25	103.80	7.50	3.47	160.	167.	167.	166.	125.	116.
19	924	107.50	103.80	111.30	7.50	3.35	143.	151.	143.	143.	115.	110.
20	928	115.00	111.30	117.60	6.25	3.00	105.	112.	120.	126.	102.	89.
21	932	120.00	117.60	122.50	5.00	1.51	65.	73.	81.	66.	45.	41.

METER EQUATIONS

METER NO. 1 0.6666 0.0098
 METER NO. 2 0.6671 0.0092
 METER NO. 3 0.6676 0.0016

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 5 12 AUGUST 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 .2D	METER 2 .5D	METER 3 .8D	METER 3 D-.3
1	1025	2.50	0.0	6.25	6.25	1.72	117.	116.	112.	108.	95.	86.
2	1030	10.00	6.25	13.75	7.50	4.23	155.	152.	162.	146.	119.	84.
3	1033	17.50	13.75	21.25	7.50	4.13	159.	167.	168.	159.	127.	105.
4	1036	25.00	21.25	28.75	7.50	4.07	173.	163.	172.	158.	132.	105.
5	1040	32.50	28.75	35.00	6.25	4.07	158.	167.	168.	159.	137.	95.
6	1043	37.50	35.00	39.25	4.25	4.35	170.	164.	169.	158.	130.	99.
7	1046	41.00	39.25	43.10	3.85	4.61	172.	161.	166.	163.	127.	90.
8	1050	44.00	43.10	46.50	3.40	11.03	183.	172.	175.	156.	153.	102.
9	1055	49.00	46.50	51.25	4.75	11.27	180.	174.	178.	172.	145.	107.
10	1100	53.50	51.25	56.00	4.75	11.03	184.	188.	184.	176.	150.	108.
11	1104	58.50	56.00	61.00	5.00	11.20	180.	183.	179.	175.	152.	98.
12	1109	63.50	61.00	66.00	5.00	11.20	180.	180.	185.	185.	172.	121.
13	1112	68.50	66.00	70.50	4.50	11.10	167.	161.	173.	163.	164.	109.
14	1115	72.50	70.50	73.60	3.10	11.10	158.	157.	154.	130.	123.	94.
15	1120	77.50	73.60	81.25	7.65	3.85	159.	158.	172.	148.	135.	100.
16	1125	85.00	81.25	88.75	7.50	3.68	157.	165.	170.	147.	128.	112.
17	1129	92.50	88.75	96.25	7.50	3.70	160.	161.	164.	156.	121.	107.
18	1133	100.00	96.25	103.80	7.50	3.60	153.	166.	171.	143.	121.	105.
19	1136	107.50	103.80	111.30	7.50	3.44	129.	131.	134.	124.	110.	85.
20	1140	115.00	111.30	117.50	6.25	3.07	104.	111.	121.	115.	107.	85.
21	1145	120.00	117.50	122.50	5.00	1.65	77.	78.	77.	74.	42.	45.

METER EQUATIONS

METER NO. 1 0.6666 0.0098
 METER NO. 2 0.6671 0.0092
 METER NO. 3 0.6676 0.0016

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 6 18 OCTOBER 1983

PANFL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE						
							METER 1		METER 2		METER 3		
								.3	.3	0+.6	.5D	3D-.6	D-.3
1	1020	3.10	0.0	6.20	6.20	3.31	128.	130.	121.	97.	107.	65.	
2	1025	9.30	6.20	12.40	6.20	4.30	148.	153.	133.	142.	122.	110.	
3	1028	15.50	12.40	18.60	6.20	3.88	163.	157.	158.	146.	143.	116.	
4	1032	21.70	18.60	24.80	6.20	4.13	165.	158.	167.	147.	146.	94.	
5	1036	27.90	24.80	31.00	6.20	4.30	156.	161.	152.	153.	126.	88.	
6	1040	34.10	31.00	37.20	6.20	4.36	160.	158.	158.	148.	138.	104.	
7	1044	40.15	37.20	43.10	5.90	4.78	159.	165.	161.	160.	145.	107.	
8	1048	44.60	43.10	46.10	3.00	11.30	158.	167.	150.	146.	144.	106.	
9	1051	48.10	46.10	50.10	4.00	11.36	165.	166.	170.	167.	158.	108.	
10	1056	52.15	50.10	54.20	4.10	11.31	176.	170.	179.	168.	160.	106.	
11	1100	56.25	54.20	58.30	4.10	11.20	173.	179.	166.	167.	138.	91.	
12	1103	60.35	58.30	62.40	4.10	11.26	190.	161.	185.	157.	165.	109.	
13	1107	64.45	62.40	66.50	4.10	11.10	185.	171.	184.	171.	170.	132.	
14	1111	68.55	66.50	70.60	4.10	11.24	166.	159.	163.	161.	162.	114.	
15	1116	72.10	70.60	73.60	3.00	11.16	172.	159.	167.	125.	158.	85.	
16	1120	77.05	73.60	80.50	6.90	3.86	163.	165.	162.	154.	140.	103.	
17	1124	84.00	80.50	87.50	7.00	3.71	157.	164.	153.	156.	130.	116.	
18	1127	91.00	87.50	94.50	7.00	3.80	164.	161.	157.	142.	135.	103.	
19	1131	98.00	94.50	101.50	7.00	3.74	170.	153.	168.	139.	150.	104.	
20	1134	105.00	101.50	108.50	7.00	3.61	142.	143.	136.	131.	116.	99.	
21	1137	112.00	108.50	115.50	7.00	3.48	125.	136.	117.	118.	98.	77.	
22	1141	119.00	115.50	122.50	7.00	2.07	79.	97.	82.	93.	83.	75.	

METER EQUATIONS

METER NO. 1 0.6672 0.0074

METER NO. 2 0.6690 0.0073

METER NO. 3 0.6767 0.0073

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 7 18 OCTOBER 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 1 $\frac{D+6}{4}$	METER 2 .5D	METER 2 $\frac{3D-6}{4}$	METER 3 D-.3
1	1332	3.10	0.0	6.20	6.20	3.82	55.	53.	52.	51.	46.	27.
2	1336	9.30	6.20	12.40	6.20	4.82	75.	75.	75.	67.	67.	37.
3	1340	15.50	12.40	18.60	6.20	4.84	74.	73.	74.	64.	69.	38.
4	1408	21.70	18.60	24.80	6.20	4.82	76.	76.	77.	72.	69.	51.
5	1412	27.90	24.80	31.00	6.20	4.63	79.	79.	77.	77.	66.	56.
6	1343	34.10	31.00	37.20	6.20	5.00	76.	74.	77.	70.	66.	53.
7	1347	40.15	37.20	43.10	5.90	5.18	71.	72.	71.	65.	66.	39.
8	1351	44.60	43.10	46.10	3.00	11.64	72.	78.	69.	62.	75.	46.
9	1354	48.10	46.10	50.10	4.00	11.34	72.	77.	74.	73.	77.	50.
10	1358	52.15	50.10	54.20	4.10	11.72	83.	79.	81.	71.	77.	46.
11	1419	56.25	54.20	58.30	4.10	11.71	79.	82.	81.	79.	67.	51.
12	1422	60.35	58.30	62.40	4.10	11.72	80.	80.	80.	78.	71.	45.
13	1425	64.45	62.40	66.50	4.10	11.50	88.	83.	89.	87.	86.	50.
14	1429	68.55	66.50	70.60	4.10	11.68	78.	79.	79.	77.	73.	51.
15	1432	72.10	70.60	73.60	3.00	11.65	78.	79.	71.	51.	63.	30.
16	1436	77.05	73.60	80.50	6.90	4.33	71.	76.	70.	76.	64.	51.
17	1440	84.00	80.50	87.50	7.00	4.12	79.	74.	80.	69.	69.	60.
18	1444	91.00	87.50	94.50	7.00	4.24	82.	78.	81.	74.	69.	52.
19	1447	98.00	94.50	101.50	7.00	4.13	77.	77.	77.	74.	62.	60.
20	1450	105.00	101.50	108.50	7.00	4.04	72.	72.	66.	71.	62.	50.
21	1453	112.00	108.50	115.50	7.00	4.00	61.	59.	60.	55.	49.	31.
22	1457	119.00	115.50	122.50	7.00	2.89	54.	44.	53.	38.	43.	29.

METER EQUATIONS

METER NO. 1 0.6672 0.0074

METER NO. 2 0.6690 0.0073

METER NO. 3 0.6767 0.0073

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 8 18 OCTOBER 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 $\frac{D+6}{4}$	METER 2 .50	METER 3 $\frac{3D+6}{4}$	METER 3 D-.3
1	1612	3.10	0.0	6.20	6.20	3.72	53.	48.	51.	51.	41.	30.
2	1609	9.30	6.20	12.40	6.20	4.94	63.	66.	64.	67.	59.	32.
3	1606	15.50	12.40	18.60	6.20	4.83	76.	73.	76.	73.	70.	46.
4	1603	21.70	18.60	24.80	6.20	4.92	76.	76.	76.	74.	71.	41.
5	1600	27.90	24.80	31.00	6.20	4.82	77.	79.	76.	75.	67.	45.
6	1557	34.10	31.00	37.20	6.20	4.89	74.	75.	72.	71.	60.	41.
7	1554	40.15	37.20	43.10	5.90	5.31	76.	74.	77.	75.	68.	43.
8	1550	44.60	43.10	46.10	3.00	11.71	75.	75.	68.	65.	74.	46.
9	1547	48.10	46.10	50.10	4.00	11.85	81.	78.	82.	77.	73.	44.
10	1544	52.15	50.10	54.20	4.10	11.84	82.	79.	84.	79.	75.	37.
11	1541	56.25	54.20	58.30	4.10	11.72	81.	78.	81.	81.	71.	49.
12	1538	60.35	58.30	62.40	4.10	11.80	79.	80.	81.	82.	75.	43.
13	1534	64.45	62.40	66.50	4.10	11.58	83.	81.	85.	79.	83.	47.
14	1531	68.55	66.50	70.60	4.10	11.62	86.	83.	80.	78.	76.	52.
15	1528	72.10	70.60	73.60	3.00	11.80	80.	75.	75.	57.	63.	43.
16	1524	77.05	73.60	80.50	6.90	4.50	77.	79.	79.	70.	73.	51.
17	1521	84.00	80.50	87.50	7.00	4.23	81.	76.	81.	71.	70.	49.
18	1518	91.00	87.50	94.50	7.00	4.35	78.	77.	79.	71.	71.	47.
19	1515	98.00	94.50	101.50	7.00	4.24	74.	75.	74.	73.	60.	57.
20	1511	105.00	101.50	108.50	7.00	4.13	71.	69.	72.	58.	62.	34.
21	1508	112.00	108.50	115.50	7.00	4.00	63.	65.	61.	58.	51.	34.
22	1502	119.00	115.50	122.50	7.00	2.60	49.	43.	42.	37.	37.	33.

METER EQUATIONS

METER NO. 1 0.6672 0.0074

METER NO. 2 0.6690 0.0073

METER NO. 3 0.6767 0.0073

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 9 19 OCTOBER 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 1 $\frac{D+6}{4}$	METER 2 .5D	METER 2 $\frac{3D-6}{4}$	METER 3 D-.3
1	950	3.10	0.0	6.20	6.20	3.45	62.	59.	67.	59.	55.	39.
2	947	9.30	6.20	12.40	6.20	4.57	69.	72.	75.	73.	72.	46.
3	943	15.50	12.40	18.60	6.20	4.52	82.	81.	85.	85.	75.	54.
4	941	21.70	18.60	24.80	6.20	4.60	84.	89.	88.	83.	80.	52.
5	936	27.90	24.80	31.00	6.20	4.55	85.	85.	83.	78.	71.	49.
6	932	34.10	31.00	37.20	6.20	4.60	83.	86.	80.	85.	69.	53.
7	927	40.15	37.20	43.10	5.90	4.90	82.	86.	84.	85.	76.	59.
8	923	44.60	43.10	46.10	3.00	11.40	83.	82.	77.	74.	79.	55.
9	920	48.10	46.10	50.10	4.00	11.58	91.	84.	92.	92.	83.	50.
10	915	52.15	50.10	54.20	4.10	11.48	90.	89.	91.	90.	85.	41.
11	911	56.25	54.20	58.30	4.10	11.47	90.	88.	94.	85.	85.	46.
12	907	60.35	58.30	62.40	4.10	11.55	91.	91.	93.	91.	78.	52.
13	904	64.45	62.40	66.50	4.10	11.45	85.	86.	88.	88.	86.	62.
14	900	68.55	66.50	70.60	4.10	11.50	86.	84.	89.	87.	80.	50.
15	855	72.10	70.60	73.60	3.00	11.51	85.	82.	82.	70.	70.	43.
16	852	77.05	73.60	80.50	6.90	4.31	83.	83.	83.	76.	67.	50.
17	849	84.00	80.50	87.50	7.00	4.15	86.	83.	86.	78.	76.	53.
18	844	91.00	87.50	94.50	7.00	4.18	83.	83.	83.	76.	71.	54.
19	840	98.00	94.50	101.50	7.00	4.15	79.	81.	77.	75.	67.	49.
20	836	105.00	101.50	108.50	7.00	4.15	72.	75.	70.	68.	57.	42.
21	830	112.00	108.50	115.50	7.00	3.96	64.	59.	70.	64.	57.	38.
22	825	119.00	115.50	122.50	7.00	2.75	37.	38.	40.	40.	34.	20.

METER EQUATIONS

METER NO. 1 0.6672 0.0074

METER NO. 2 0.6690 0.0073

METER NO. 3 0.6767 0.0073

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 10 19 OCTOBER 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 <u>D+.6</u> <u>4</u>	METER 2 .5D	METER 3 <u>3D-.6</u> <u>4</u>	METER 3 D-.3
1	1000	3.10	0.0	6.20	6.20	3.52	59.	52.	60.	53.	57.	32.
2	1004	9.30	6.20	12.40	6.20	4.63	71.	71.	73.	75.	70.	42.
3	1008	15.50	12.40	18.60	6.20	4.60	82.	83.	84.	81.	76.	58.
4	1010	21.70	18.60	24.80	6.20	4.74	82.	84.	82.	82.	73.	53.
5	1015	27.90	24.80	31.00	6.20	4.57	78.	86.	78.	77.	67.	46.
6	1020	34.10	31.00	37.20	6.20	4.77	82.	86.	82.	83.	75.	37.
7	1023	40.15	37.20	43.10	5.90	5.02	82.	82.	82.	81.	75.	51.
8	1027	44.60	43.10	46.10	3.00	11.44	86.	81.	80.	80.	73.	51.
9	1031	48.10	46.10	50.10	4.00	11.65	77.	79.	87.	89.	75.	54.
10	1035	52.15	50.10	54.20	4.10	11.63	80.	78.	91.	86.	75.	48.
11	1039	56.25	54.20	58.30	4.10	11.57	77.	78.	86.	83.	80.	51.
12	1042	60.35	58.30	62.40	4.10	11.66	79.	77.	92.	90.	75.	50.
13	1047	64.45	62.40	66.50	4.10	11.54	78.	79.	89.	88.	76.	50.
14	1051	68.55	66.50	70.60	4.10	11.58	76.	71.	85.	79.	78.	49.
15	1055	72.10	70.60	73.60	3.00	11.58	77.	75.	81.	79.	70.	47.
16	1059	77.05	73.60	80.50	6.90	4.28	75.	75.	81.	74.	69.	47.
17	1103	84.00	80.50	87.50	7.00	4.10	71.	77.	77.	83.	68.	55.
18	1107	91.00	87.50	94.50	7.00	4.26	79.	79.	86.	79.	61.	56.
19	1111	98.00	94.50	101.50	7.00	4.13	68.	67.	75.	70.	61.	47.
20	1114	105.00	101.50	108.50	7.00	4.03	66.	68.	73.	73.	58.	50.
21	1118	112.00	108.50	115.50	7.00	3.95	55.	50.	70.	61.	57.	39.
22	1122	119.00	115.50	122.50	7.00	2.67	29.	32.	42.	45.	39.	26.

METER EQUATIONS

METER NO. 1 0.6672 0.0074

METER NO. 2 0.6690 0.0073

METER NO. 3 0.6767 0.0073

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT INPUT DATA - METRIC UNITS

MEASUREMENT NO. 11 19 OCTOBER 1983

PANEL NO.	EST	DIST	START	END	WIDTH	DEPTH	REVS PER MINUTE					
							METER 1 .3	METER 1 .3	METER 2 $\frac{D+6}{4}$	METER 2 .5D	METER 3 $\frac{3D-6}{4}$	METER 3 $D-3$
1	1243	3.10	0.0	6.20	6.20	3.53	57.	57.	57.	54.	47.	26.
2	1240	9.30	6.20	12.40	6.20	4.79	64.	67.	73.	69.	71.	37.
3	1237	15.50	12.40	18.60	6.20	4.73	79.	80.	82.	85.	80.	52.
4	1234	21.70	18.60	24.80	6.20	4.75	85.	82.	82.	79.	71.	48.
5	1231	27.90	24.80	31.00	6.20	4.67	79.	80.	82.	79.	72.	53.
6	1228	34.10	31.00	37.20	6.20	4.78	79.	79.	78.	72.	71.	48.
7	1225	40.15	37.20	43.10	5.90	5.11	82.	83.	84.	81.	72.	49.
8	1222	44.60	43.10	46.10	3.00	11.53	78.	83.	70.	70.	77.	47.
9	1219	48.10	46.10	50.10	4.00	11.60	83.	90.	82.	86.	77.	51.
10	1216	52.15	50.10	54.20	4.10	11.54	85.	86.	87.	87.	76.	56.
11	1213	56.25	54.20	58.30	4.10	11.58	85.	87.	89.	79.	77.	48.
12	1210	60.35	58.30	62.40	4.10	11.63	84.	87.	86.	87.	82.	48.
13	1207	64.45	62.40	66.50	4.10	11.51	87.	86.	87.	89.	85.	56.
14	1204	68.55	66.50	70.60	4.10	11.56	88.	85.	84.	83.	85.	43.
15	1201	72.10	70.60	73.60	3.00	11.59	84.	82.	80.	70.	69.	51.
16	1158	77.05	73.60	80.50	6.90	4.33	83.	79.	84.	72.	71.	53.
17	1155	84.00	80.50	87.50	7.00	4.11	78.	79.	77.	78.	65.	54.
18	1152	91.00	87.50	94.50	7.00	4.22	82.	84.	82.	79.	69.	52.
19	1149	98.00	94.50	101.50	7.00	4.10	83.	83.	82.	78.	76.	51.
20	1146	105.00	101.50	108.50	7.00	4.05	74.	71.	77.	64.	68.	47.
21	1142	112.00	108.50	115.50	7.00	3.94	62.	64.	68.	68.	57.	43.
22	1139	119.00	115.50	122.50	7.00	2.67	39.	34.	45.	36.	42.	21.

METER EQUATIONS

METER NO. 1 0.6672 0.0074

METER NO. 2 0.6690 0.0073

METER NO. 3 0.6767 0.0073

APPENDIX B

DISCHARGE MEASUREMENT REDUCTION DATA

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 1 10 AUGUST 1983

PANEL NO.	EST	DIST.	WIDTH	DEPTH	POINT VELOCITIES							MEAN	AREA	PANEL	DISCHARGE SUM	
					.3	K+.3	2K+.3	3K+.3	4K+.3	D-.3	VEL.					
1	1420	2.50	6.25	1.47	0.921	0.921	0.876	0.876	0.825	0.825	0.862	9.19	7.9	7.9		
2	1430	10.00	7.50	4.17	1.387	1.454	1.377	1.277	1.014	0.847	1.222	31.27	38.2	46.1		
3	1440	17.50	7.50	4.10	1.787	1.743	1.788	1.621	1.570	1.125	1.593	30.75	49.0	95.1		
4	1443	25.00	7.50	4.10	1.776	1.854	1.810	1.777	1.604	1.025	1.616	30.75	49.7	144.8		
5	1446	32.50	7.50	4.20	1.732	1.699	1.710	1.644	1.392	1.048	1.527	31.50	48.1	192.9		
6	1450	40.00	6.85	4.30	1.732	1.787	1.744	1.677	1.515	1.181	1.596	29.45	47.0	239.9		
7	1455	47.50	6.90	10.97	1.810	1.898	1.632	1.721	1.604	1.203	1.661	75.69	125.7	365.6		
8	1502	52.50	5.00	11.22	1.887	2.032	1.944	1.899	1.682	1.292	1.821	56.10	102.2	467.8		
9	1510	57.50	5.00	11.01	1.987	1.987	1.899	1.866	1.515	1.103	1.770	55.05	97.4	565.2		
10	1515	62.50	5.00	10.94	1.965	2.032	1.999	1.977	1.782	1.259	1.869	54.70	102.3	667.5		
11	1522	67.50	5.00	10.96	1.843	1.998	1.955	1.988	1.871	1.348	1.857	54.80	101.8	769.2		
12	1530	72.50	3.60	10.95	1.721	1.821	1.755	1.755	1.637	1.214	1.673	39.42	65.9	835.2		
13	1535	77.50	7.65	3.82	1.699	1.676	1.699	1.588	1.459	1.137	1.528	29.22	44.7	879.8		
14	1540	85.00	7.50	3.63	1.732	1.710	1.699	1.566	1.481	1.070	1.521	27.22	41.4	921.3		
15	1545	92.50	7.50	3.58	1.743	1.799	1.644	1.644	1.337	1.025	1.508	26.85	40.5	961.8		
16	1550	100.00	7.50	3.50	1.732	1.687	1.699	1.599	1.504	1.125	1.535	26.25	40.3	1002.0		
17	1555	107.50	7.50	3.50	1.599	1.543	1.566	1.399	1.292	0.947	1.371	26.25	36.0	1038.0		
18	1600	115.00	6.25	3.13	1.221	1.254	1.410	1.243	1.148	0.958	1.183	19.56	23.1	1061.2		
19	1605	120.00	5.00	2.00	0.754	0.754	0.732	0.710	0.669	0.669	0.709	10.00	7.1	1068.3		
TOTAL			122.50									1.609	664.04		1068.3	

$$K = (D-.6)/5$$

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 2 11 AUGUST 1983

PANEL NO.	EST. DIST.	WIDTH	DEPTH	POINT VELOCITIES					MEAN VEL.	AREA	PANEL	DISCHARGE SUM	
				.3	.2D	.5D	.8D	D-.3					
1	920	3.75	7.50	2.45	1.266	1.299	1.299	1.125	1.003	1.190	18.37	21.9	21.9
2	925	11.25	7.50	4.34	1.566	1.654	1.654	1.337	1.114	1.490	32.55	48.5	70.4
3	930	18.75	7.50	4.17	1.833	1.921	1.365	1.515	1.303	1.710	31.27	53.5	123.8
4	935	26.25	7.50	4.11	1.844	1.843	1.821	1.448	1.315	1.675	30.82	51.6	175.5
5	939	33.50	7.00	4.20	1.833	1.876	1.854	1.337	0.892	1.596	29.40	46.9	222.4
6	942	40.00	6.10	4.30	1.789	1.810	1.743	1.481	1.159	1.616	26.23	42.4	264.8
7	946	44.50	3.40	11.00	1.833	1.721	1.575	1.504	1.003	1.568	37.40	58.6	323.4
8	950	48.50	4.00	11.01	1.910	1.965	1.898	1.849	1.337	1.839	44.04	81.0	404.4
9	957	53.00	5.00	11.12	1.955	2.043	1.975	1.882	1.214	1.881	55.60	104.6	509.0
10	1001	58.00	5.00	11.06	2.010	2.076	1.965	1.793	1.315	1.887	55.30	104.4	613.4
11	1005	63.00	5.00	11.23	1.992	2.054	2.043	1.726	1.259	1.892	56.15	106.2	719.6
12	1010	68.00	4.75	11.15	1.910	2.076	1.954	1.748	1.231	1.854	52.96	98.2	817.8
13	1015	72.50	3.35	11.17	1.788	1.699	1.721	1.626	1.226	1.656	37.42	62.0	879.8
14	1020	75.00	3.90	3.85	1.821	1.921	1.710	1.626	1.337	1.683	15.01	25.3	905.0
15	1030	80.00	6.25	3.50	1.704	1.210	1.521	1.348	1.114	1.560	22.50	35.1	940.1
15	1035	87.00	7.00	3.77	1.844	1.876	1.593	1.381	1.292	1.627	25.39	42.9	983.1
17	1040	94.00	7.00	3.57	1.760	1.787	1.565	1.448	1.303	1.599	25.69	41.1	1024.1
18	1045	101.00	6.95	3.61	1.694	1.732	1.543	1.159	1.048	1.444	25.09	36.2	1060.4
19	1048	108.00	7.00	3.47	1.471	1.610	1.587	1.404	1.270	1.476	24.29	35.9	1026.2
20	1052	115.00	6.80	2.53	0.932	1.065	1.110	0.714	0.514	0.883	17.88	15.8	1112.0
21	1055	120.50	4.00	1.13	0.899	0.843	0.575	0.447	0.447	0.616	4.52	2.8	1114.8
TOTAL				122.50					1.567	668.90			1114.8

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 3 11 AUGUST 1983

PANEL NO.	EST. DIST.	WIDTH	DEPTH	.3	.20	.50	.80	D-.3	POINT VELocities	MEAN VEL.	AREA	DISCHARGE PANEL	SUM
1	1255	3.75	7.50	2.54	1.193	1.154	1.054	0.847	0.725	0.984	19.05	18.7	18.7
2	1300	11.25	7.50	4.27	1.716	1.754	1.743	1.493	1.148	1.593	32.02	51.0	69.8
3	1305	18.75	7.50	4.26	1.810	1.821	1.687	1.504	1.103	1.599	31.95	51.1	120.8
4	1309	26.25	7.50	4.25	1.766	1.799	1.676	1.281	1.103	1.547	31.88	49.3	170.1
5	1312	33.50	7.00	4.24	1.810	1.821	1.743	1.548	1.181	1.637	29.68	48.6	218.7
6	1316	40.00	6.10	4.69	1.738	1.765	1.732	1.537	1.092	1.598	28.61	45.7	264.4
7	1322	45.00	4.40	11.21	1.805	1.732	1.687	1.582	1.103	1.631	49.32	80.4	344.9
8	1325	50.00	5.00	11.49	1.866	1.887	1.898	1.693	0.947	1.748	57.45	100.4	445.3
9	1333	55.00	5.00	11.20	1.905	1.943	1.854	1.693	1.137	1.768	56.00	99.0	544.3
10	1338	60.00	4.50	11.30	2.027	2.054	2.021	1.849	1.137	1.897	50.85	96.5	640.8
11	1343	64.00	3.75	11.27	1.944	2.076	1.998	1.927	1.214	1.901	42.26	80.3	721.1
12	1346	67.50	3.75	11.17	1.833	1.898	1.943	1.938	1.226	1.834	41.89	76.8	797.9
13	1350	71.50	3.00	11.30	1.766	1.699	1.499	1.682	0.914	1.547	33.90	52.4	850.4
14	1402	73.50	1.10	11.07	1.755	1.676	1.354	1.459	0.814	1.437	12.18	17.5	867.9
15	1355	77.50	6.40	3.83	1.805	1.887	1.665	1.570	1.159	1.619	24.51	39.7	907.5
16	1407	82.50	6.25	3.52	1.833	1.887	1.721	1.459	1.248	1.634	22.00	35.9	943.5
17	1412	90.00	7.50	3.75	1.877	1.954	1.665	1.515	1.081	1.619	28.13	45.5	989.0
18	1416	97.50	7.50	3.58	1.821	1.832	1.754	1.348	1.192	1.603	26.85	43.0	1032.1
19	1420	105.00	7.50	3.42	1.716	1.765	1.665	1.415	1.192	1.556	25.65	39.9	1072.0
20	1424	112.50	7.50	3.31	1.416	1.532	1.465	1.281	1.048	1.352	24.82	33.6	1105.5
21	1428	120.00	6.25	1.77	0.793	0.743	0.787	0.324	0.491	0.591	11.06	6.5	1112.1
TOTAL		122.50								1.635	680.06		1112.1

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 4 12 AUGUST 1983

PANEL NO.	EST.	DIST.	WIDTH	DEPTH	POINT VELOCITIES					MEAN VEL.	AREA	PANEL	DISCHARGE SUM	
					.3	.2D	.5D	.8D	D-.3					
1	805	2.50	6.25	1.32	1.287	1.332	1.166	1.081	0.914	1.134	11.37	12.9	12.9	
2	810	10.00	7.50	4.30	1.715	1.721	1.721	1.348	1.003	1.531	32.25	49.4	52.3	
3	814	17.50	7.50	4.17	1.337	1.922	1.721	1.526	1.125	1.638	31.27	51.2	113.5	
4	817	25.00	7.50	4.30	1.843	1.866	1.344	1.537	1.125	1.670	32.25	53.8	157.4	
5	821	32.50	6.25	4.42	1.782	1.855	1.744	1.392	0.947	1.573	27.62	43.5	210.8	
6	825	37.50	4.25	4.35	1.865	1.922	1.821	1.593	1.125	1.687	18.49	31.2	242.0	
7	830	41.00	3.85	4.57	1.871	1.883	1.799	1.559	0.947	1.644	17.98	29.6	271.6	
8	835	44.00	3.40	11.07	1.904	1.788	1.555	1.671	1.031	1.659	37.64	62.4	334.0	
9	839	49.00	4.75	11.27	1.932	2.010	1.366	1.704	1.103	1.787	53.53	95.7	429.7	
10	843	53.50	4.75	11.16	1.993	2.022	1.944	1.782	1.070	1.838	53.01	97.4	527.1	
11	846	53.50	5.00	11.27	1.971	2.055	1.955	1.782	0.936	1.829	56.35	103.1	630.2	
12	849	63.50	5.00	11.20	1.982	1.999	1.977	1.804	1.103	1.852	56.00	103.7	733.9	
13	853	63.50	4.50	11.15	1.832	1.877	1.888	1.882	1.131	1.795	50.17	90.1	824.0	
14	900	72.50	3.10	11.05	1.893	1.844	1.455	1.615	1.070	1.583	34.25	54.2	878.2	
15	910	77.50	7.65	3.80	1.837	1.744	1.810	1.192	1.231	1.601	29.07	46.5	924.7	
16	914	85.50	7.50	3.53	1.865	1.866	1.866	1.404	1.237	1.667	27.22	45.4	970.1	
17	915	92.50	7.50	3.51	1.832	1.899	1.788	1.404	1.237	1.645	27.07	44.5	1014.6	
18	920	100.00	7.50	3.47	1.826	1.866	1.355	1.392	1.292	1.662	26.02	43.3	1057.9	
19	924	107.50	7.50	3.33	1.643	1.592	1.565	1.281	1.226	1.496	25.12	37.6	1095.5	
20	928	115.00	6.25	3.00	1.215	1.343	1.410	1.137	0.992	1.225	18.75	23.0	1118.5	
21	932	120.00	5.00	1.51	0.776	0.910	0.743	0.502	0.458	0.637	7.55	4.8	1123.3	
TOTAL				122.50						1.669	673.02			1123.3

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL

DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 5 12 AUGUST 1983

PANEL NO.	EST.	DIST.	WIDTH	DEPTH	POINT VELOCITIES					MEAN VEL.	AREA	PANEL	DISCHARGE SUM
					.3	.2D	.5D	.8D	D-.3				
1	1025	2.50	6.25	1.72	1.304	1.254	1.210	1.059	0.958	1.132	10.75	12.2	12.2
2	1030	10.00	7.50	4.23	1.721	1.810	1.632	1.326	0.936	1.505	31.72	47.7	59.9
3	1033	17.50	7.50	4.13	1.876	1.877	1.777	1.415	1.170	1.643	30.97	50.9	110.8
4	1036	25.00	7.50	4.07	1.876	1.922	1.766	1.470	1.170	1.656	30.52	50.5	161.3
5	1040	32.50	6.25	4.07	1.871	1.877	1.777	1.526	1.059	1.639	25.44	41.7	203.0
6	1043	37.50	4.25	4.35	1.865	1.888	1.766	1.448	1.103	1.636	18.49	30.3	233.3
7	1046	41.00	3.85	4.51	1.860	1.855	1.821	1.415	1.003	1.627	17.75	28.9	262.2
8	1050	44.00	3.40	11.03	1.982	1.955	1.744	1.704	1.137	1.746	37.50	65.5	327.6
9	1055	49.00	4.75	11.27	1.976	1.988	1.922	1.615	1.192	1.805	53.53	96.6	424.3
10	1100	53.50	4.75	11.03	2.076	2.055	1.966	1.671	1.203	1.861	52.39	97.5	521.8
11	1104	53.50	5.00	11.20	2.026	1.999	1.955	1.693	1.092	1.831	56.00	102.5	624.3
12	1109	63.50	5.00	11.20	2.010	2.066	2.077	1.915	1.348	1.952	56.00	109.3	733.6
13	1112	68.50	4.50	11.10	1.832	1.933	1.821	1.826	1.214	1.774	49.95	88.6	822.2
14	1115	72.50	3.10	11.10	1.815	1.721	1.455	1.370	1.048	1.502	34.41	51.7	873.9
15	1120	77.50	7.65	3.35	1.826	1.922	1.555	1.504	1.114	1.607	29.45	47.3	921.3
16	1125	85.00	7.50	3.58	1.799	1.899	1.644	1.426	1.248	1.605	27.60	44.3	965.5
17	1129	92.50	7.50	3.70	1.793	1.833	1.744	1.348	1.192	1.597	27.75	44.3	1009.9
18	1133	100.00	7.50	3.60	1.782	1.910	1.599	1.348	1.170	1.562	27.00	42.2	1052.0
19	1135	107.50	7.50	3.44	1.442	1.492	1.388	1.226	0.958	1.306	25.80	33.7	1085.7
20	1140	115.00	6.25	3.07	1.204	1.355	1.288	1.192	0.947	1.195	19.19	22.9	1108.7
21	1145	120.00	5.00	1.55	0.871	0.865	0.932	0.469	0.502	0.664	8.25	5.5	1114.1
TOTAL			122.50							1.662	670.47		1114.1

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 6 18 OCTOBER 1983

PANEL NO.	EST. DIST.	WIDTH	DEPTH	.3	POINT VELocities <i>D+.6</i> <i>D-.6</i>	MEAN VEL.	AREA	DISCHARGE PANEL SUM
1	1020	3.10	6.20	3.31	1.442 1.356 1.089 1.214 0.740 1.147	20.52	23.5	23.5
2	1025	9.30	6.20	4.30	1.681 1.490 1.591 1.383 1.248 1.489	26.66	39.7	63.2
3	1028	15.50	6.20	3.88	1.787 1.769 1.635 1.620 1.316 1.618	24.06	38.9	102.1
4	1032	21.70	6.20	4.13	1.803 1.869 1.646 1.654 1.067 1.596	25.61	40.9	143.0
5	1036	27.90	6.20	4.30	1.770 1.702 1.713 1.428 1.000 1.530	26.66	40.8	183.8
6	1040	34.10	6.20	4.36	1.775 1.769 1.657 1.564 1.180 1.588	27.03	42.9	226.7
7	1044	40.15	5.90	4.78	1.809 1.802 1.791 1.643 1.214 1.660	28.20	46.8	273.5
8	1048	44.60	3.00	11.30	1.814 1.680 1.635 1.631 1.203 1.621	33.90	55.0	328.5
9	1051	48.10	4.00	11.36	1.848 1.903 1.869 1.789 1.225 1.774	45.44	80.6	409.1
10	1056	52.15	4.10	11.31	1.931 2.003 1.880 1.812 1.203 1.812	46.37	84.0	493.1
11	1100	56.25	4.10	11.20	1.965 1.858 1.869 1.564 1.034 1.723	45.92	79.1	572.2
12	1103	60.35	4.10	11.26	1.959 2.070 1.758 1.868 1.237 1.803	46.17	83.2	655.5
13	1107	64.45	4.10	11.10	1.987 2.059 1.914 1.925 1.496 1.901	45.51	86.5	742.0
14	1111	68.55	4.10	11.24	1.814 1.825 1.802 1.834 1.293 1.748	46.08	80.6	822.6
15	1116	72.10	3.00	11.16	1.848 1.869 1.401 1.789 0.966 1.582	33.48	53.0	875.5
16	1120	77.05	6.90	3.86	1.831 1.814 1.724 1.586 1.169 1.618	26.63	43.1	918.6
17	1124	84.00	7.00	3.71	1.792 1.713 1.747 1.473 1.316 1.611	25.97	41.8	960.4
18	1127	91.00	7.00	3.80	1.814 1.758 1.591 1.530 1.169 1.564	26.60	41.6	1002.0
19	1131	98.00	7.00	3.74	1.803 1.880 1.557 1.699 1.180 1.603	26.18	42.0	1044.0
20	1134	105.00	7.00	3.61	1.592 1.524 1.468 1.316 1.124 1.402	25.27	35.4	1079.4
21	1137	112.00	7.00	3.48	1.459 1.312 1.323 1.113 0.876 1.213	24.36	29.5	1108.9
22	1141	119.00	7.00	2.07	0.986 0.922 1.044 0.943 0.853 0.925	14.49	13.4	1122.3
TOTAL		122.50			1.624 691.11			1122.3

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 7 19 OCTOBER 1983

PANEL NO.	EST	DIST	WIDTH	DEPTH	.3	POINT VELOCITIES				MEAN VEL.	AREA	DISCHARGE PANEL	DISCHARGE SUM
						.4	.5D	.3D-.4	D-.3				
1	1332	3.10	6.20	3.82	0.608	0.587	0.576	0.526	0.312	0.518	23.68	12.3	12.3
2	1336	9.30	6.20	4.82	0.841	0.844	0.754	0.763	0.425	0.725	29.88	21.7	33.9
3	1340	15.50	6.20	4.84	0.825	0.832	0.721	0.786	0.436	0.717	30.01	21.5	55.4
4	1408	21.70	6.20	4.82	0.853	0.866	0.810	0.786	0.582	0.780	29.88	23.3	78.8
5	1412	27.90	6.20	4.63	0.886	0.866	0.866	0.752	0.639	0.807	28.71	23.2	101.9
6	1343	34.10	6.20	5.00	0.841	0.866	0.788	0.752	0.605	0.772	31.00	23.9	125.8
7	1347	40.15	5.90	5.18	0.802	0.799	0.732	0.752	0.447	0.708	30.56	21.6	147.5
8	1351	44.60	3.00	11.64	0.841	0.777	0.699	0.853	0.526	0.746	34.92	26.0	173.5
9	1354	48.10	4.00	11.34	0.836	0.832	0.821	0.876	0.571	0.804	45.36	36.4	210.0
10	1358	52.15	4.10	11.72	0.908	0.910	0.799	0.876	0.526	0.819	48.05	39.3	249.3
11	1419	56.25	4.10	11.71	0.903	0.910	0.888	0.763	0.582	0.833	48.01	40.0	289.3
12	1422	60.35	4.10	11.72	0.897	0.899	0.877	0.808	0.515	0.826	48.05	39.7	329.0
13	1425	64.45	4.10	11.50	0.958	1.000	0.977	0.977	0.571	0.925	47.15	43.6	372.6
14	1429	68.55	4.10	11.68	0.880	0.888	0.866	0.831	0.582	0.830	47.89	39.8	412.4
15	1432	72.10	3.00	11.65	0.880	0.799	0.576	0.718	0.346	0.670	34.95	23.4	435.8
16	1436	77.05	6.90	4.33	0.825	0.788	0.855	0.729	0.582	0.760	29.88	22.7	458.5
17	1440	84.00	7.00	4.12	0.858	0.899	0.777	0.786	0.684	0.797	28.84	23.0	481.5
18	1444	91.00	7.00	4.24	0.897	0.910	0.832	0.786	0.594	0.802	29.68	23.8	505.3
19	1447	98.00	7.00	4.13	0.864	0.866	0.832	0.707	0.684	0.794	28.91	22.9	528.3
20	1450	105.00	7.00	4.04	0.808	0.743	0.799	0.707	0.571	0.727	28.28	20.6	548.8
21	1453	112.00	7.00	4.00	0.675	0.676	0.621	0.560	0.357	0.575	28.00	16.1	564.9
22	1457	119.00	7.00	2.89	0.552	0.598	0.431	0.492	0.334	0.471	20.23	9.5	574.5
TOTAL				122.50							0.764	751.93	574.5

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 8 18 OCTOBER 1983

PANEL NO.	EST.	DIST.	WIDTH	DEPTH	POINT VELOCITIES						MEAN VEL.	AREA	DISCHARGE PANEL	DISCHARGE SUM	
					.3	D+.6	.5D	D-.6	D-.3	.4					
1	1612	3.10	6.20	3.72	0.569	0.576	0.576	0.470	0.346	0.506	23.06	11.7	11.7		
2	1609	9.30	6.20	4.94	0.725	0.721	0.754	0.673	0.368	0.655	30.63	20.1	31.7		
3	1606	15.50	6.20	4.83	0.836	0.855	0.821	0.797	0.526	0.769	29.95	23.0	54.7		
4	1603	21.70	6.20	4.92	0.853	0.855	0.832	0.808	0.470	0.767	30.50	23.4	78.1		
5	1600	27.90	6.20	4.82	0.875	0.855	0.844	0.763	0.515	0.775	29.88	23.2	101.3		
6	1557	34.10	6.20	4.89	0.836	0.810	0.799	0.684	0.470	0.727	30.32	22.0	123.3		
7	1554	40.15	5.90	5.31	0.841	0.866	0.844	0.774	0.492	0.771	31.33	24.1	147.5		
8	1550	44.60	3.00	11.71	0.841	0.765	0.732	0.842	0.526	0.753	35.13	26.4	173.9		
9	1547	48.10	4.00	11.85	0.891	0.922	0.866	0.831	0.504	0.828	47.40	39.3	213.2		
10	1544	52.15	4.10	11.84	0.903	0.944	0.888	0.853	0.425	0.836	48.54	40.6	253.7		
11	1541	56.25	4.10	11.72	0.891	0.910	0.910	0.808	0.560	0.844	48.05	40.5	294.3		
12	1538	60.35	4.10	11.80	0.891	0.910	0.922	0.853	0.492	0.847	48.38	41.0	335.2		
13	1534	64.45	4.10	11.58	0.919	0.955	0.888	0.943	0.537	0.871	47.48	41.3	376.6		
14	1531	68.55	4.10	11.62	0.947	0.899	0.877	0.864	0.594	0.856	47.64	40.8	417.4		
15	1528	72.10	3.00	11.80	0.869	0.844	0.643	0.718	0.492	0.716	35.40	25.3	442.7		
16	1524	77.05	6.90	4.50	0.875	0.888	0.788	0.831	0.582	0.789	31.05	24.5	467.2		
17	1521	84.00	7.00	4.23	0.880	0.910	0.799	0.797	0.560	0.785	29.61	23.2	490.4		
18	1518	91.00	7.00	4.35	0.869	0.888	0.799	0.808	0.537	0.777	30.45	23.6	514.1		
19	1515	98.00	7.00	4.24	0.836	0.832	0.821	0.684	0.650	0.769	29.68	22.8	536.9		
20	1511	105.00	7.00	4.13	0.786	0.810	0.654	0.707	0.391	0.661	28.91	19.1	556.0		
21	1508	112.00	7.00	4.00	0.719	0.687	0.654	0.582	0.391	0.605	28.00	16.9	573.0		
22	1502	119.00	7.00	2.60	0.519	0.476	0.420	0.425	0.379	0.442	18.20	8.0	581.0		
TOTAL			122.50								0.765	759.60		581.0	

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 9 19 OCTOBER 1983

PANEL NO.	EST.	DIST.	WIDTH	DEPTH	POINT VELOCITIES					MEAN VEL.	AREA	DISCHARGE PANEL	DISCHARGE SUM
					.3	.4	.5D	.6	D-.3				
1	950	3.10	6.20	3.45	0.680	0.754	0.665	0.628	0.447	0.626	21.39	13.4	13.4
2	947	9.30	6.20	4.57	0.791	0.844	0.821	0.819	0.526	0.759	28.33	21.5	34.9
3	943	15.50	6.20	4.52	0.914	0.955	0.955	0.853	0.616	0.862	28.02	24.1	59.0
4	941	21.70	6.20	4.60	0.969	0.988	0.933	0.910	0.594	0.878	28.52	25.1	84.1
5	936	27.90	6.20	4.55	0.953	0.933	0.877	0.808	0.560	0.828	28.21	23.4	107.4
6	932	34.10	6.20	4.60	0.947	0.899	0.955	0.786	0.605	0.847	28.52	24.1	131.6
7	927	40.15	5.90	4.90	0.941	0.944	0.955	0.864	0.673	0.881	28.91	25.5	157.1
8	923	44.60	3.00	11.40	0.925	0.866	0.832	0.898	0.628	0.842	34.20	28.8	185.9
9	920	48.10	4.00	11.58	0.980	1.033	1.033	0.943	0.571	0.948	46.32	43.9	229.7
10	915	52.15	4.10	11.48	1.003	1.022	1.011	0.966	0.470	0.934	47.07	43.9	273.7
11	911	56.25	4.10	11.47	0.997	1.055	0.955	0.966	0.526	0.927	47.03	43.6	317.3
12	907	60.35	4.10	11.55	1.019	1.044	1.022	0.887	0.594	0.946	47.35	44.8	362.1
13	904	64.45	4.10	11.45	0.958	0.988	0.988	0.977	0.707	0.944	46.94	44.3	406.4
14	900	68.55	4.10	11.50	0.953	1.000	0.977	0.910	0.571	0.912	47.15	43.0	449.5
15	855	72.10	3.00	11.51	0.936	0.922	0.788	0.797	0.492	0.803	34.53	27.7	477.2
16	852	77.05	6.90	4.31	0.930	0.933	0.855	0.763	0.571	0.811	29.74	24.1	501.3
17	849	84.00	7.00	4.15	0.947	0.966	0.877	0.864	0.605	0.848	29.05	24.6	525.9
18	844	91.00	7.00	4.18	0.930	0.933	0.855	0.808	0.616	0.827	29.26	24.2	550.1
19	840	98.00	7.00	4.15	0.897	0.866	0.844	0.763	0.560	0.786	29.05	22.8	572.9
20	836	105.00	7.00	4.15	0.825	0.788	0.765	0.650	0.481	0.703	29.05	20.4	593.4
21	830	112.00	7.00	3.96	0.691	0.788	0.721	0.650	0.436	0.653	27.72	18.1	611.5
22	825	119.00	7.00	2.75	0.424	0.453	0.453	0.391	0.233	0.375	19.25	7.2	618.7

TOTAL

122.50

0.841 735.62

618.7

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 10 19 OCTOBER 1983

PANEL NO.	EST.	DIST.	WIDTH	DEPTH	POINT VELOCITIES						MEAN VEL.	AREA	DISCHARGE PANEL	DISCHARGE SUM	
					.3	.4	D+.6	.5D	.3D-.6	D-.3					
1	1000	3.10	6.20	3.52	0.625	0.676	0.598	0.650	0.368	0.571	21.82	12.5	12.5		
2	1004	9.30	6.20	4.63	0.797	0.821	0.844	0.797	0.481	0.750	28.71	21.5	34.0		
3	1008	15.50	6.20	4.60	0.925	0.944	0.910	0.864	0.661	0.862	28.52	24.6	58.6		
4	1010	21.70	6.20	4.74	0.930	0.922	0.922	0.831	0.605	0.847	29.39	24.9	83.4		
5	1015	27.90	6.20	4.57	0.919	0.877	0.866	0.763	0.526	0.794	28.33	22.5	106.0		
6	1020	34.10	6.20	4.77	0.941	0.922	0.933	0.853	0.425	0.820	29.57	24.3	130.2		
7	1023	40.15	5.90	5.02	0.919	0.922	0.910	0.853	0.582	0.842	29.62	25.0	155.2		
8	1027	44.60	3.00	11.44	0.936	0.899	0.899	0.831	0.582	0.853	34.32	29.3	184.5		
9	1031	48.10	4.00	11.65	0.875	0.977	1.000	0.853	0.616	0.896	46.60	41.8	226.2		
10	1035	52.15	4.10	11.63	0.886	1.022	0.966	0.853	0.549	0.886	47.68	42.3	268.5		
11	1039	56.25	4.10	11.57	0.869	0.966	0.933	0.910	0.582	0.877	47.44	41.6	310.1		
12	1042	60.35	4.10	11.66	0.875	1.033	1.011	0.853	0.571	0.904	47.81	43.2	353.3		
13	1047	64.45	4.10	11.54	0.880	1.000	0.989	0.864	0.571	0.894	47.31	42.3	395.6		
14	1051	68.55	4.10	11.58	0.825	0.955	0.888	0.387	0.560	0.845	47.48	40.1	435.7		
15	1055	72.10	3.00	11.58	0.853	0.910	0.888	0.797	0.537	0.824	34.74	28.6	464.3		
16	1059	77.05	6.90	4.28	0.841	0.910	0.832	0.786	0.537	0.779	29.53	23.0	487.3		
17	1103	84.00	7.00	4.10	0.830	0.866	0.933	0.774	0.628	0.809	28.70	23.2	510.5		
18	1107	91.00	7.00	4.26	0.886	0.966	0.888	0.695	0.639	0.819	29.82	24.4	534.9		
19	1111	98.00	7.00	4.13	0.758	0.844	0.788	0.695	0.537	0.723	28.91	20.9	555.9		
20	1114	105.00	7.00	4.03	0.752	0.821	0.821	0.661	0.571	0.727	28.21	20.5	576.4		
21	1118	112.00	7.00	3.95	0.591	0.788	0.687	0.650	0.447	0.625	27.65	17.3	593.7		
22	1122	119.00	7.00	2.67	0.347	0.476	0.509	0.447	0.301	0.395	18.69	7.4	601.1		
TOTAL				122.50						0.811	740.85			601.1	

ST. MARYS RIVER AT SAULT STE. MARIE - CANADIAN POWER CANAL
DISCHARGE MEASUREMENT REDUCTION DATA - METRIC UNITS

MEASUREMENT NO. 11 19 OCTOBER 1983

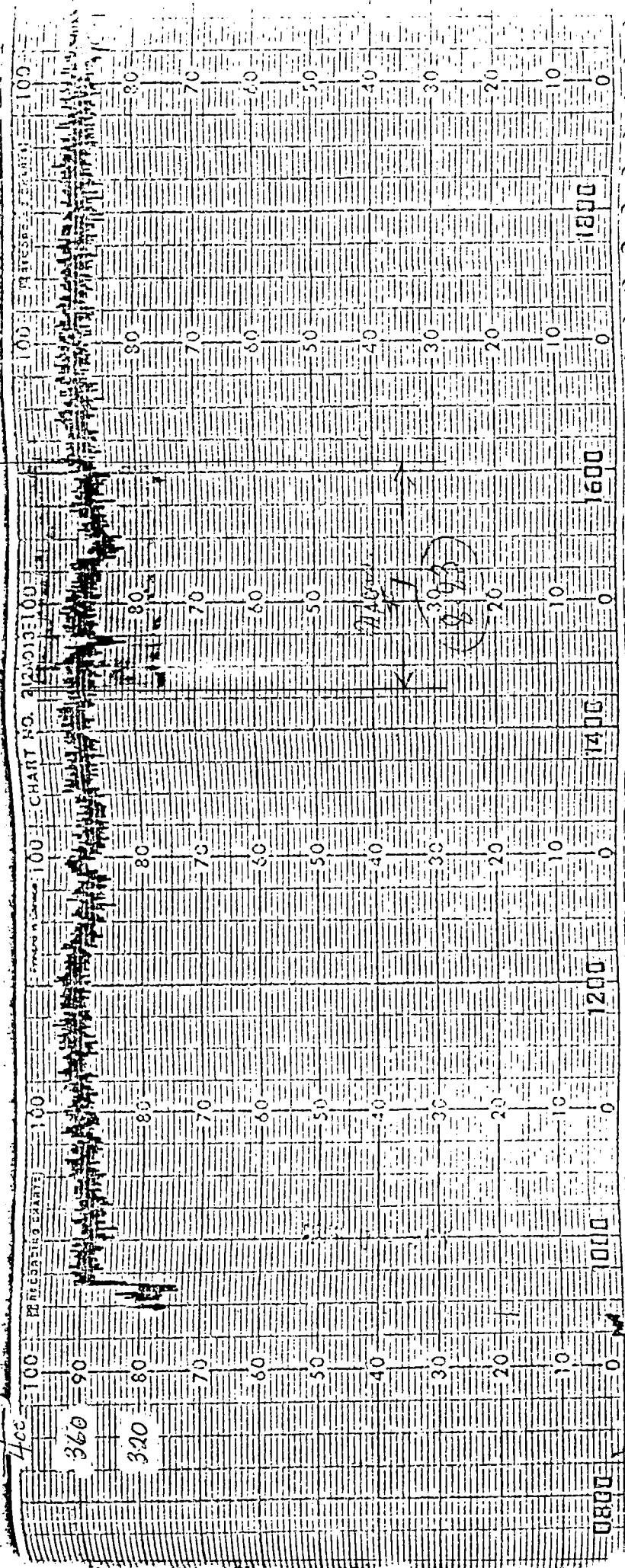
PANEL NO.	FST	DIST.	WIDTH	DEPTH	POINT VELOCITIES					MEAN VEL.	AREA	PANEL	DISCHARGE SUM
					.3	D+.6	.5D	D-.6	D-.3				
1	1243	3.10	6.20	3.53	0.641	0.643	0.609	0.537	0.301	0.538	21.89	11.8	11.8
2	1240	9.30	6.20	4.79	0.736	0.821	0.777	0.808	0.425	0.712	29.70	21.1	32.9
3	1237	15.50	6.20	4.73	0.891	0.922	0.955	0.910	0.594	0.857	29.33	25.1	58.1
4	1234	21.70	6.20	4.75	0.936	0.922	0.888	0.808	0.549	0.824	29.45	24.3	82.3
5	1231	27.90	6.20	4.67	0.891	0.922	0.888	0.819	0.605	0.827	28.95	24.0	106.3
6	1228	34.10	6.20	4.78	0.886	0.877	0.810	0.808	0.549	0.786	29.64	23.3	129.6
7	1225	40.15	5.90	5.11	0.925	0.944	0.910	0.819	0.560	0.838	30.15	25.3	154.9
8	1222	44.60	3.00	11.53	0.903	0.788	0.788	0.876	0.537	0.794	34.59	27.5	182.3
9	1219	48.10	4.00	11.60	0.969	0.922	0.966	0.876	0.582	0.894	46.40	41.5	223.8
10	1216	52.15	4.10	11.54	0.958	0.977	0.977	0.864	0.639	0.910	47.31	43.1	266.9
11	1213	56.25	4.10	11.58	0.964	1.000	0.888	0.876	0.549	0.876	47.48	41.6	308.5
12	1210	60.35	4.10	11.63	0.958	0.966	0.977	0.932	0.549	0.909	47.68	43.3	351.8
13	1207	64.45	4.10	11.51	0.969	0.977	1.000	0.966	0.639	0.938	47.19	44.2	396.1
14	1204	68.55	4.10	11.56	0.969	0.944	0.933	0.966	0.492	0.891	47.40	42.2	438.3
15	1201	72.10	3.00	11.59	0.930	0.899	0.788	0.786	0.582	0.808	34.77	28.1	466.4
16	1158	77.05	6.90	4.33	0.908	0.944	0.810	0.808	0.605	0.811	29.88	24.2	490.6
17	1155	84.00	7.00	4.11	0.880	0.866	0.877	0.740	0.616	0.799	28.77	23.0	513.6
18	1152	91.00	7.00	4.22	0.930	0.922	0.888	0.786	0.594	0.825	29.54	24.4	538.0
19	1149	98.00	7.00	4.10	0.930	0.922	0.877	0.864	0.582	0.831	28.70	23.8	561.8
20	1146	105.00	7.00	4.05	0.814	0.866	0.721	0.774	0.537	0.735	28.35	20.8	582.7
21	1142	112.00	7.00	3.94	0.708	0.765	0.765	0.650	0.492	0.675	27.58	18.6	601.3
22	1139	119.00	7.00	2.67	0.413	0.509	0.409	0.481	0.244	0.389	18.69	7.3	608.6
TOTAL		122.50								0.819	743.43		608.6

APPENDIX C

FLOWMETER CHARTS

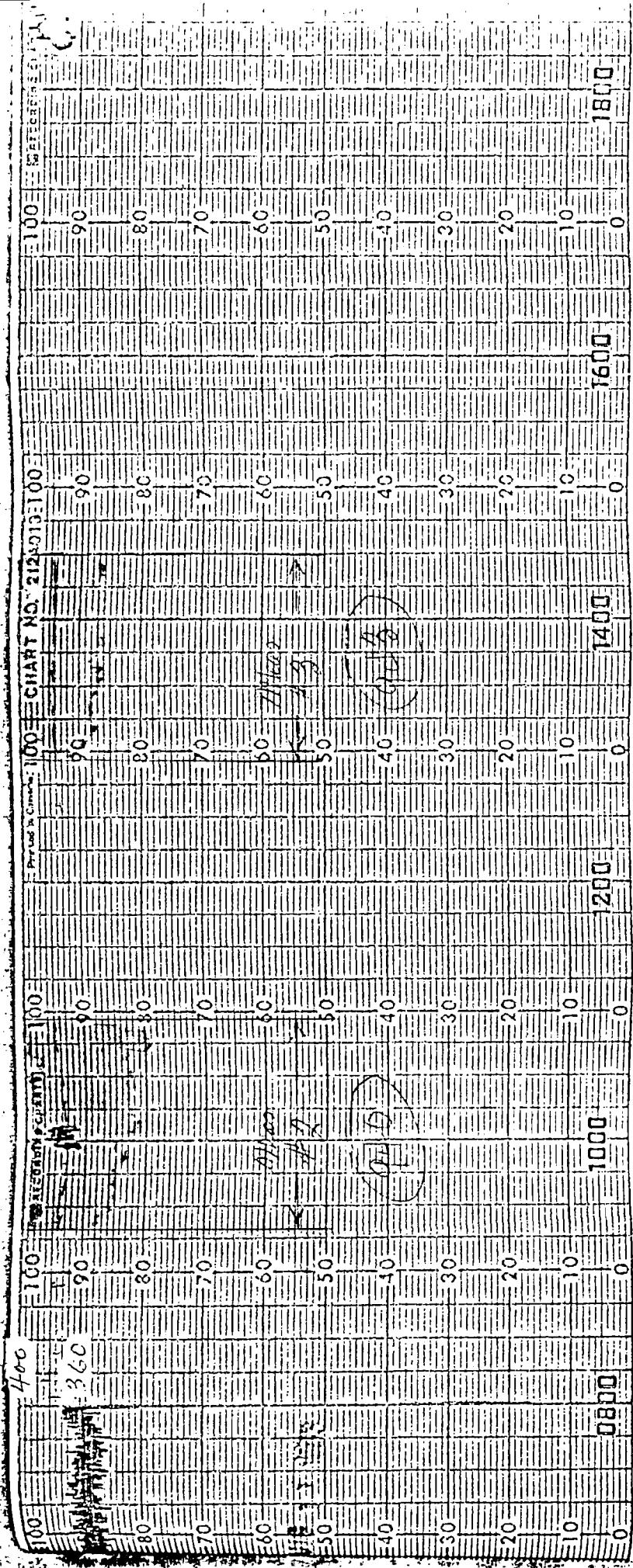
AUG 10, 1983

#1 UNIT. FLOW
EST.

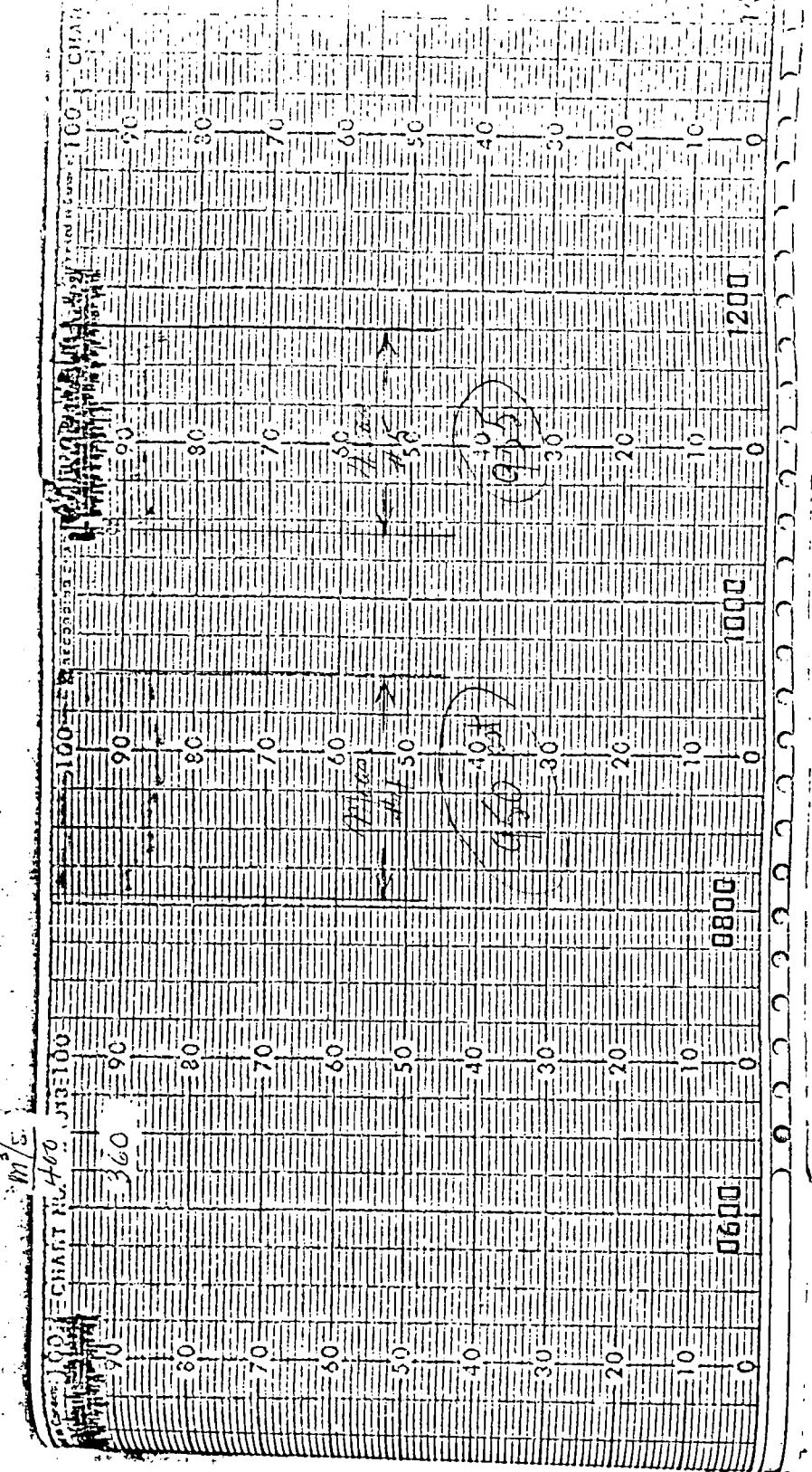


AUG. 11, 1983

#1 UNIT. Flow
E.S.T.

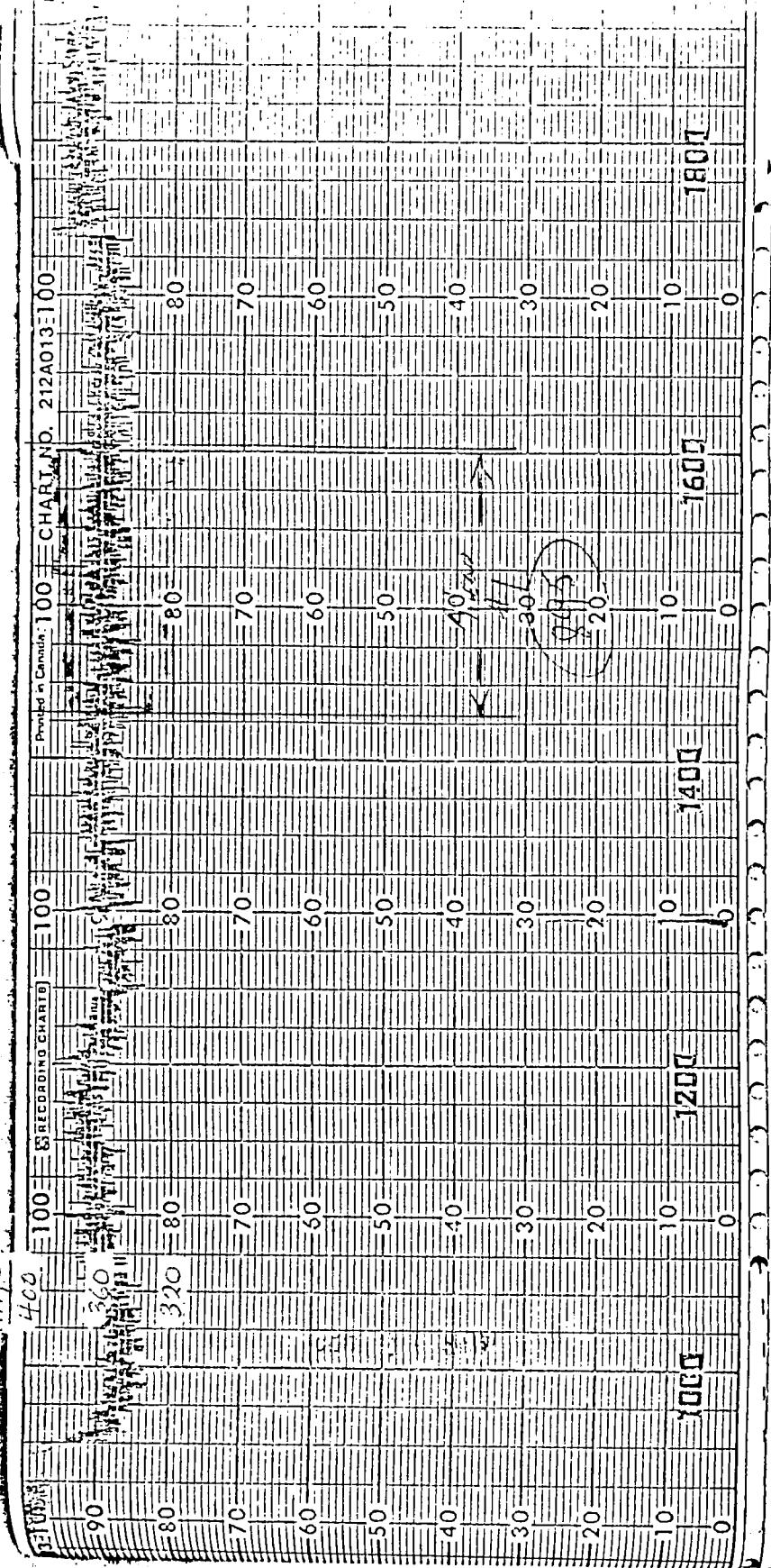


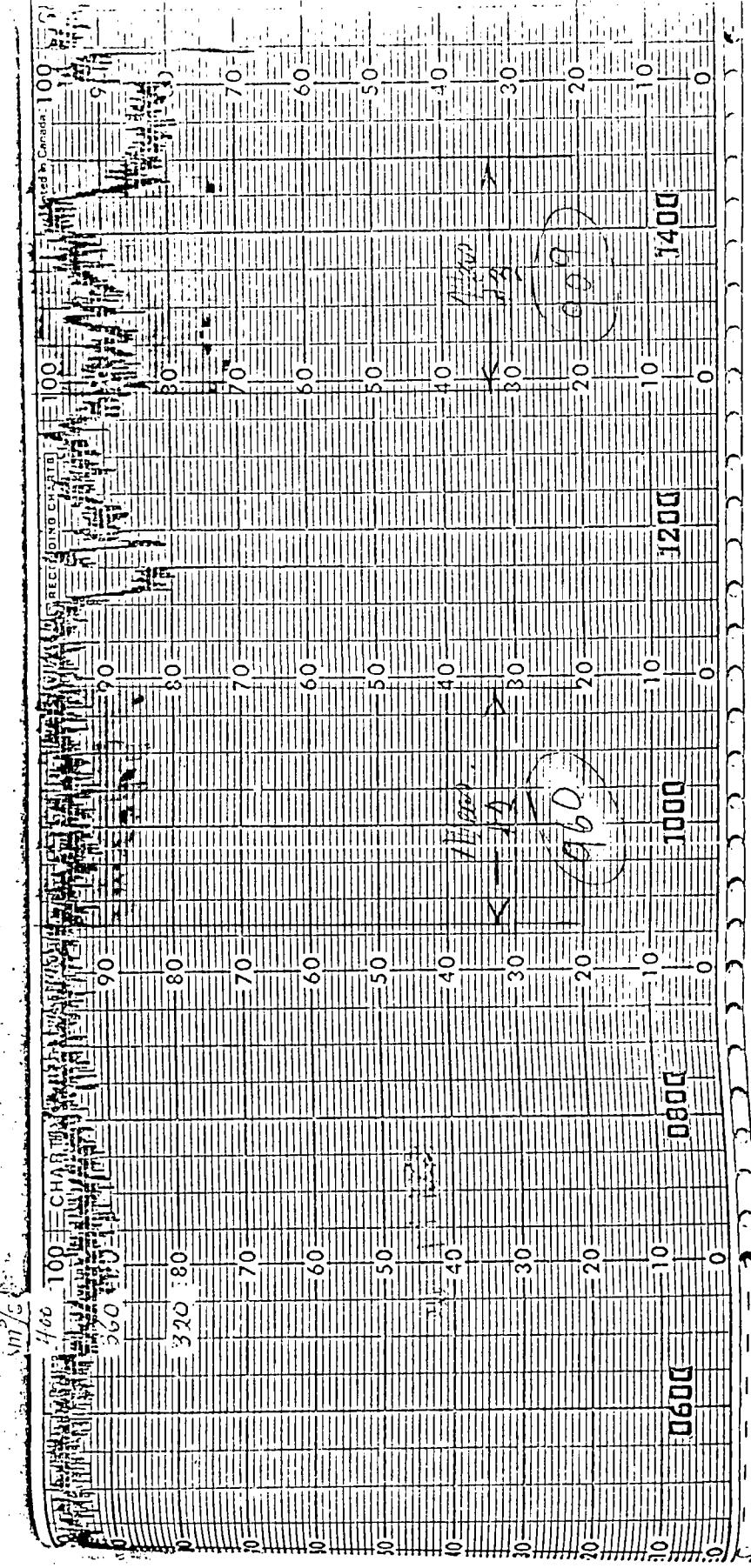
AUG 12, 1983
H, Unit flow
EST.



m/s

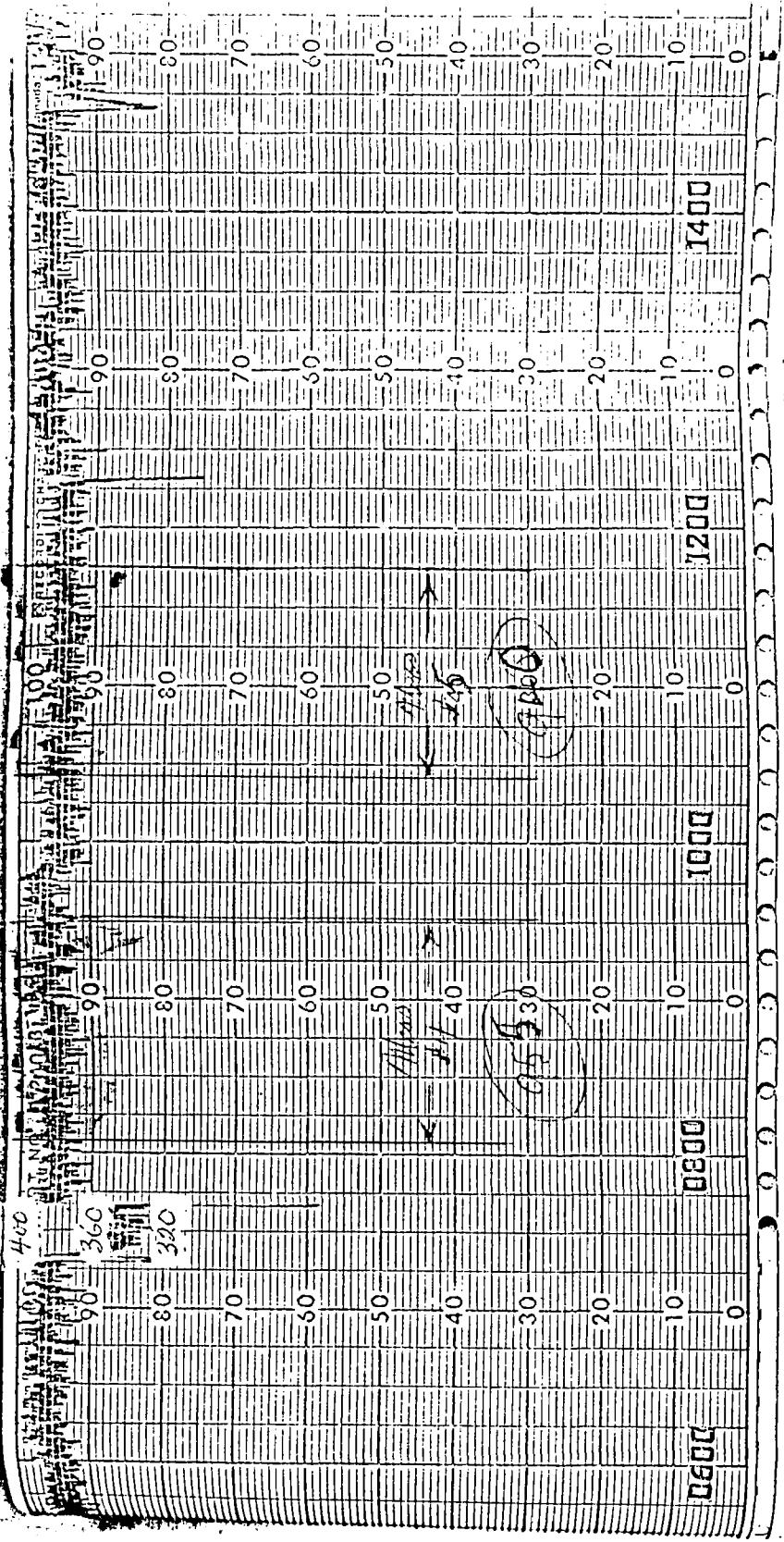
3/2





AUG 11, 1983
#2 UNIT Flow
EST.

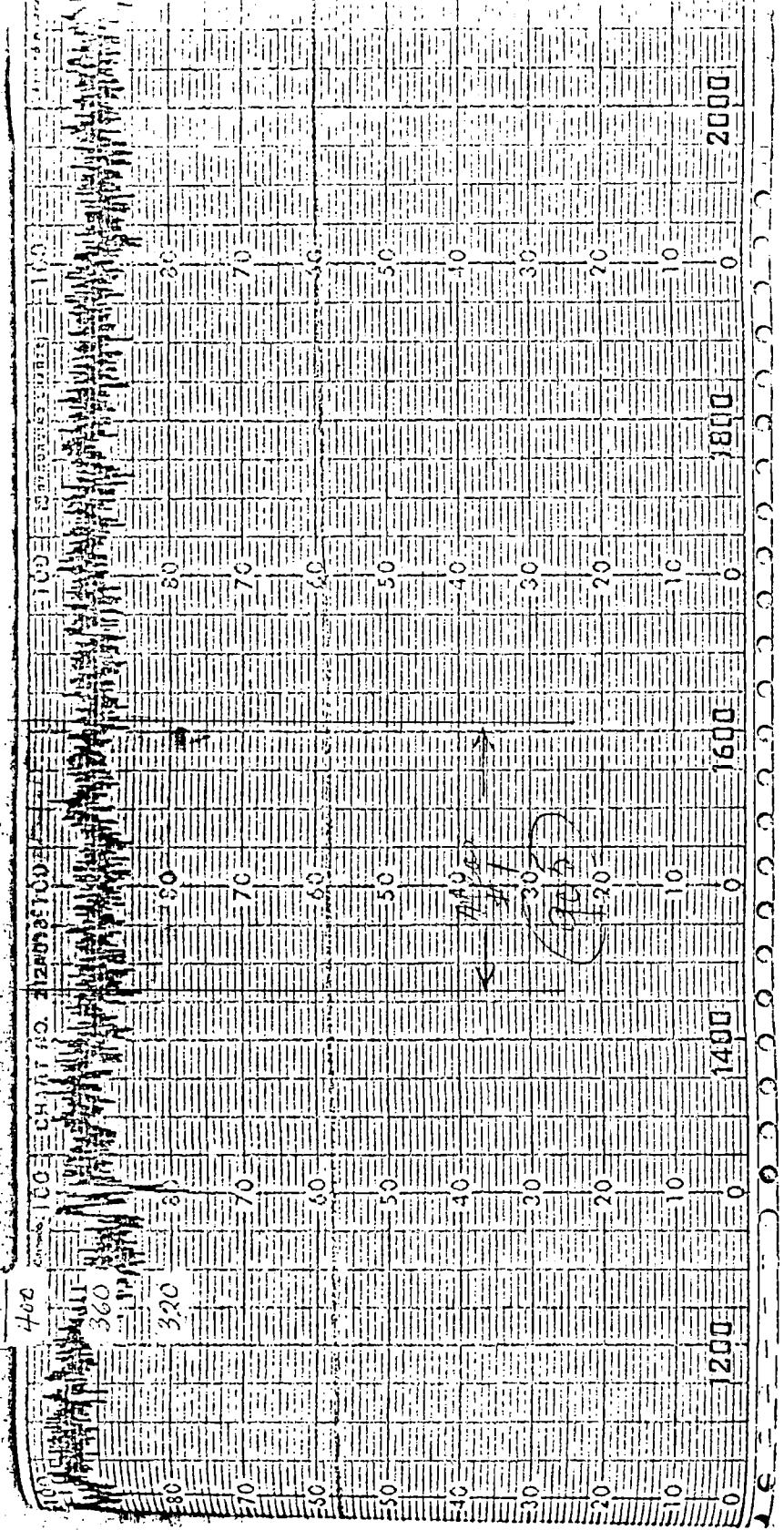
3/5



AUG. 12, 1983
t₂ GWT. FLOW
EST.

AUG. 10, 1983

#3 UNIT FLOW
EST.



m^3/s

400

360

320

280

240

200

160

120

80

40

0

100

140

180

220

260

300

340

380

420

460

500

540

580

620

660

700

740

780

820

860

900

940

980

1020

1060

1100

1140

1180

1220

1260

1300

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1380

1420

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1580

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1700

1740

1780

1820

1860

1900

1940

1980

2020

2060

2100

2140

2180

2220

2260

2300

2340

2380

2420

2460

2500

2540

2580

2620

2660

2700

2740

2780

2820

2860

2900

2940

2980

3020

3060

3100

3140

3180

3220

3260

3300

3340

3380

3420

3460

3500

3540

3580

3620

3660

3700

3740

3780

3820

3860

3900

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3980

4020

4060

4100

4140

4180

4220

4260

4300

4340

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4420

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11860

m³/s

4 hr.

CHART NO. 212-013-100

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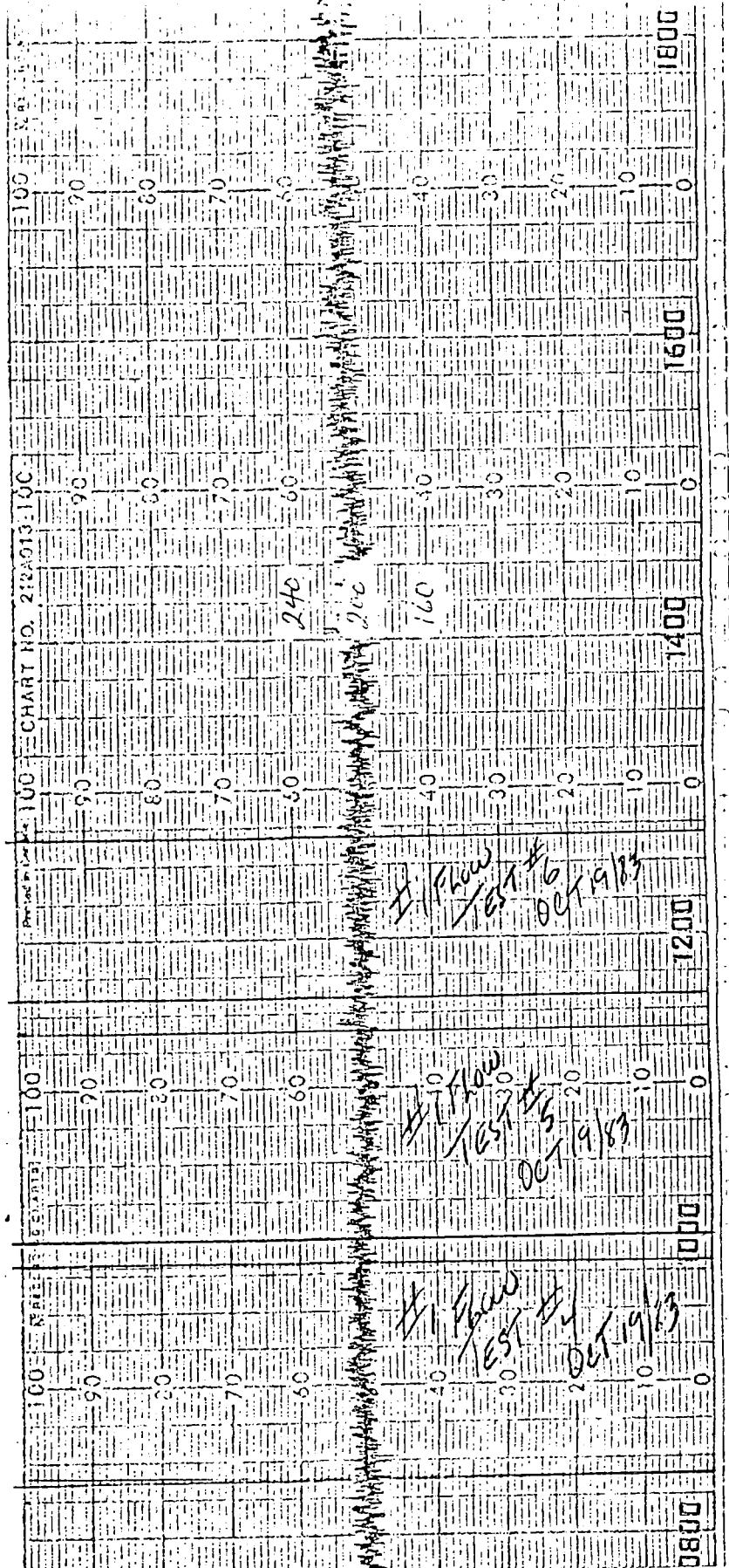
1

3/5

11

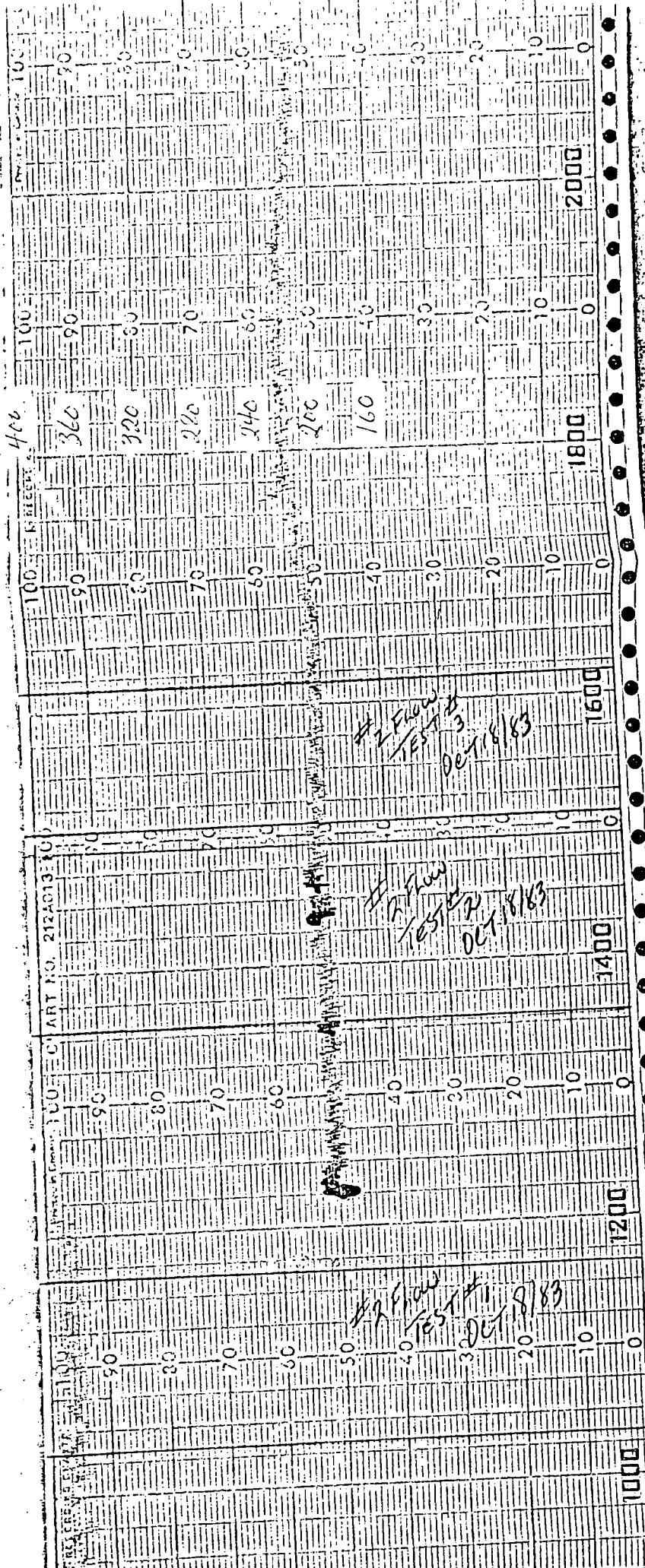
$$m^3/5$$

ପ୍ରକାଶକ ନାମ ଓ ଠିକ୍କା



ES

m³/s



m³/s

m³/c

$$m^3/s$$