Ed Hills
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New Flow Equations for
Clifton Court Gates

During the spring of 1987, the SWP was unable at times to get enough water into Clifton Court Forebay for several reasons. One was the limit on the flow rate through the gates of 12,000 cfs. The other was the South Delta Water Agency operational constraints on the times the Clifton Court gates could be open. The 12,000 cfs limit was established to prevent scour in the Delta channels leading to the forebay.

This indicated that the gate flow equation is over-estimating the flow through the gates. In order to address this concern, hourly operation studies were done for Clifton Court. Eleven days in 1986 and 1987 were selected for these studies. The inflow was calculated two ways for comparison. One was the gate flow equations. The other was by the change in storage plus Banks pumping plus Byron Bethany pumping.

These studies showed the inflow from the gate equation averaged 2,700 cfs higher than the flows by change in storage. The maximum difference between these two methods was 10,000 cfs. The difference between the two flows was less than 1,000 cfs 29 hours of 159 hours the gates were open.

To resolve this discrepancy in flows through the gates, 17 flow measurements were made on three separate days. The measurements were done on December 10, 1987 and January 12 and 13, 1988. Also, two electromagnetic velocity meters were placed in the forebay intake channel. They recorded the average velocity every 15 minutes during this period. New gate equations were developed using these flow measurements plus 15-minute operation studies for these three days. The proposed new equations are:

Gate 1 (most southerly gate)
Flow in cfs = GP $[0.440 + 215.2240\ (\text{US el.} - \text{DS el.})^{0.5}]$

Gate 2
Flow in cfs = GP $[4.460 + 181.8040\ (\text{US el.} - \text{DS el.})^{0.5}]$

Gage 3
Flow in cfs = GP $[4.760 + 173.3780\ (\text{US el.} - \text{DS el.})^{0.5}]$

Gate 4
Flow in cfs = GP $[3.380 + 173.3780\ (\text{US el.} - \text{DS el.})^{0.5}]$

Gate 5 (most northerly gate)
Flow in cfs = GP $[2.380 + 168.7900\ (\text{US el.} - \text{DS el.})^{0.5}]$

GP = Gate Position US el. = outside water elevation
DS el. = inside water elevation

The flows through gate 1 are greater than those through the other gates with the same gate openings. Gate 1 flows are 18.4-27.5 percent higher than the other gates. The reason gate 1 flows are larger is the intake channel to the forebay is deeper on that side.

The attached graphs compare the flow per square foot between the change in storage method of computation, the new proposed equations, and the old gate (existing) equations. If all the points are on the solid line, then there is perfect agreement between the flows computed by each method. The new equations produce flows that are generally about 5 percent higher than the change in storage flows. The old gate equation flows are generally 20 percent higher than the change in storage flows.

The old gate equation is the same for all the gates. It is:

$$\text{Flow in cfs} = 1.0485^{(\text{GA POS})}\ (109.6696)\ (\text{GA POS})\ (\text{US el.} - \text{DS el.})^{0.5}$$

The following equation gives the storage in the forebay:

$$\text{Storage in AF} = 18263.1 + 2153.32534\ (\text{elev}) + 2.13209\ (\text{elev})^2 - 0.00722\ (\text{elev})^3$$

ACCURACY

The 17 velocity (flow) measurements were taken from the top of the gate structure on the upstream side. Each gate was divided into five segments and the velocities taken at two depths per segment. The gates are 20 feet wide. The velocities were high (6-10 ft/sec) and there was a lot of drawdown at the point of the measurement. The exact depth of the water at the point of the velocity measurements was hard to determine because of the drawdown. Also, the telemetered data is what is used in the day-to-day operation. For these reasons, it was decided to use the telemetered gate openings to determine the area. This area and the measured velocity were used to compute the flows for each gate, see the attached spread sheets. This was compared to the flows computed by change in storage. The following table shows these flows.

Measured and Computed Flows (in cfs)

Date	Time (hrs)	Inflow by Ch. Stor.	Measured Flows Gate Pos.	Measured Flows Meas. Depth	Old Gate Equa. Flow
12/10/87	1323	9,260	10,960	15,660	11,550
12/10/87	1407	10,870	5,910	8,510	10,700
12/10/87	1509	8,780	6,000	8,420	9,350
12/10/87	1557	6,810	5,100	7,230	8,340
12/10/87	1627	8,210	5,680	7,970	8,350
12/10/87	1653	8,390	5,670	7,970	8,400
1/12/88	1052	9,850	11,980	11,540	13,370
1/12/88	1133	11,000	11,810	11,930	13,450
1/12/88	1213	12,110	12,200	12,440	13,450
1/12/88	1315	11,300	11,730	12,360	13,550
1/12/88	1353	11,050	11,100	11,890	12,900
1/12/88	1412	9,820	10,270	11,110	12,440
1/13/88	1043	10,320	11,010	10,570	12,650
1/13/88	1111	10,330	11,350	10,860	13,190
1/13/88	1157	10,750	11,670	11,820	13,380
1/13/88	1239	9,660	11,520	12,000	14,420
1/13/88	1304	11,520	11,680	12,190	14,450

All the flows were converted to flow per square foot so all the data is on the same basis by eliminating the variation in gate openings. These flows were plotted against the head across the gates. The December data points were grouped by themselves on the plots except the first measurement. Also, these data points did not agree with the flows by change in storage method. Thus, it was decided not to use these December data points, except the first one, in determining the flow equations for the gates. In developing the equations, zero head and flow points were added to the data set to help force the equations through zero.

The velocity meter data was plotted against the measured flow data and an equation was developed. A weighted average for the two meter velocities was used based on the area that each meter represented of the channel cross section. The weighting factors are 27.8 percent for the northerly one and 72.2 percent for the southerly one. The attached graph compares the inflows computed by this equation to the inflows by change in storage. This graph shows a large scatter of points. It was therefore concluded that this equation is not satisfactory.

The inflows computed by change in storage are not that accurate. A 0.01-foot change in water surface elevation changes the storage by 21.5 AF and the inflow during a 15-minute period by about 1,040 cfs. The operation studies of the forebay show that the inflow varies between -1,000 to 3,000 cfs when the gates are closed. This could be partly due to seepage through the embankment around the forebay, but not very likely. It is probably due to inaccuracies in

the water surface elevations. There is a prevailing wind from the northwest much of the time. This causes the water to be higher at one end of the forebay than the other. Also, the silt deposits near the gates causes the water to mound just inside the gates when there is inflow. During high rates of pumping there can be as much as two feet difference in the water elevation between the gates and Banks Pumping Plant. The water surface gage for Clifton Court is just inside near the gates. This location introduces inconsistencies in the water surface elevations depending if the gates are open, the wind is blowing, and if Banks is pumping.

During the summer of 1988, corrections were made to the reference point elevations of the gaging stations inside and out of Clifton Court. The elevations used for the area capacity table for the forebay might not be the same as those of the gaging stations.

RECOMMENDATIONS

It is recommended that the new equations be adopted to compute the instantaneous inflows into Clifton Court Forebay. This will result in better inflow estimates than now exist.

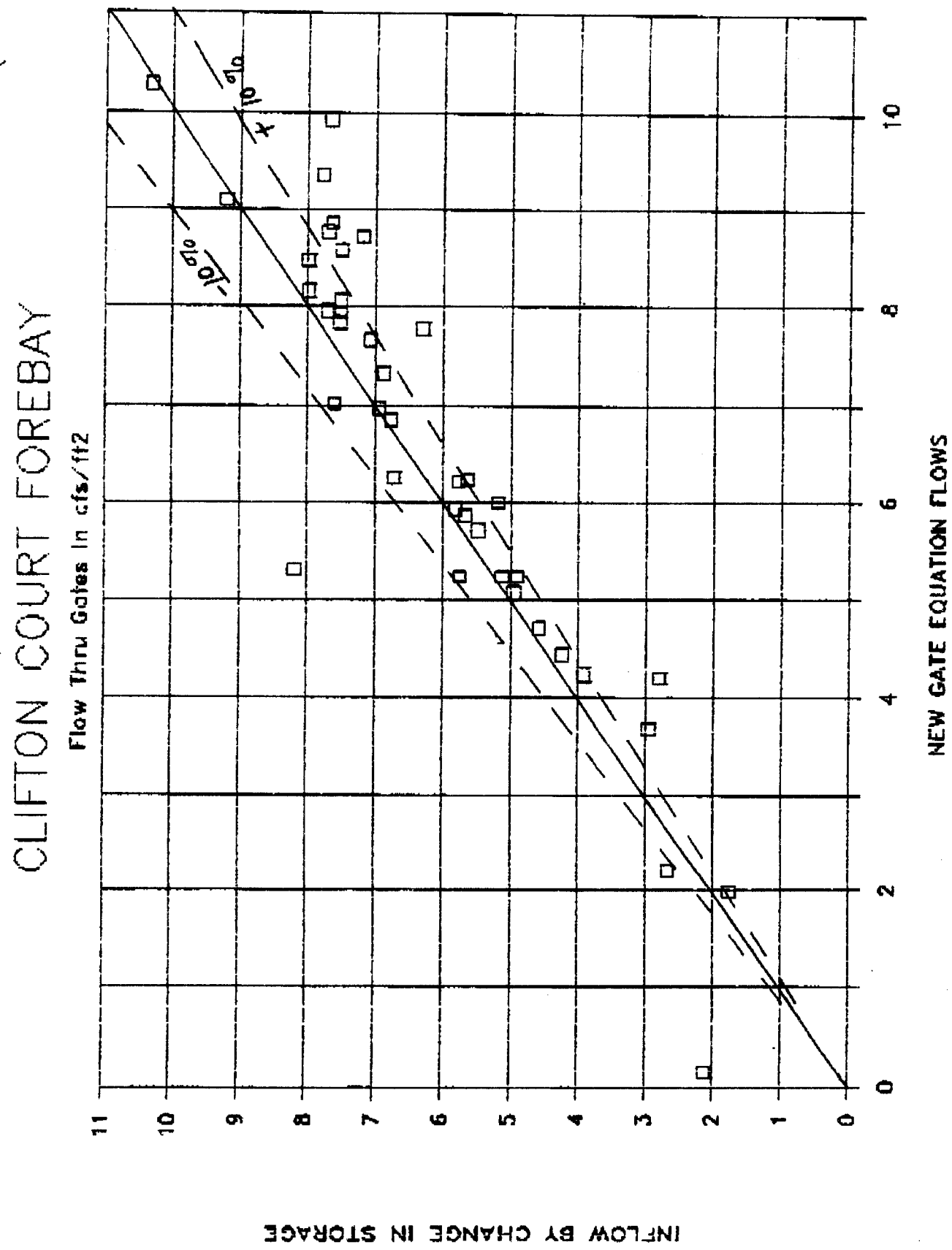
Additional recommendations are as follows:

1. Install two more water surface recorders in Clifton Court. One at the northern end and one at the southern end near the channel leading to Banks Pumping Plant. Then use the average elevation from the three recorders to determine the storage in the forebay. Continue to use the station near the gates to compute the flow through the gates.

2. Run elevations from an established benchmark to check whether the gaging stations and the gate sill elevations agree. Also, compare these elevations to those of the area capacity table for the forebay.

3. Ask thee USGS to use their boat with the doppler effect velocity meter to measure the flow in the intake channel when the gates are open.

Attachments
cc: Joe Kick, O&M
Wayne Wolber, Central District
Dwight Russell, Central Distrit
Marv Niemi, Delta F.D.


CLIFTON COURT FOREBAY
Flow Thru Gates in cfs/ft2
NEW GATE EQUATION FLOWS
INFLOW BY CHANGE IN STORAGE
0
1
2
3
4
5
6
7
8
9
10
11
0
2
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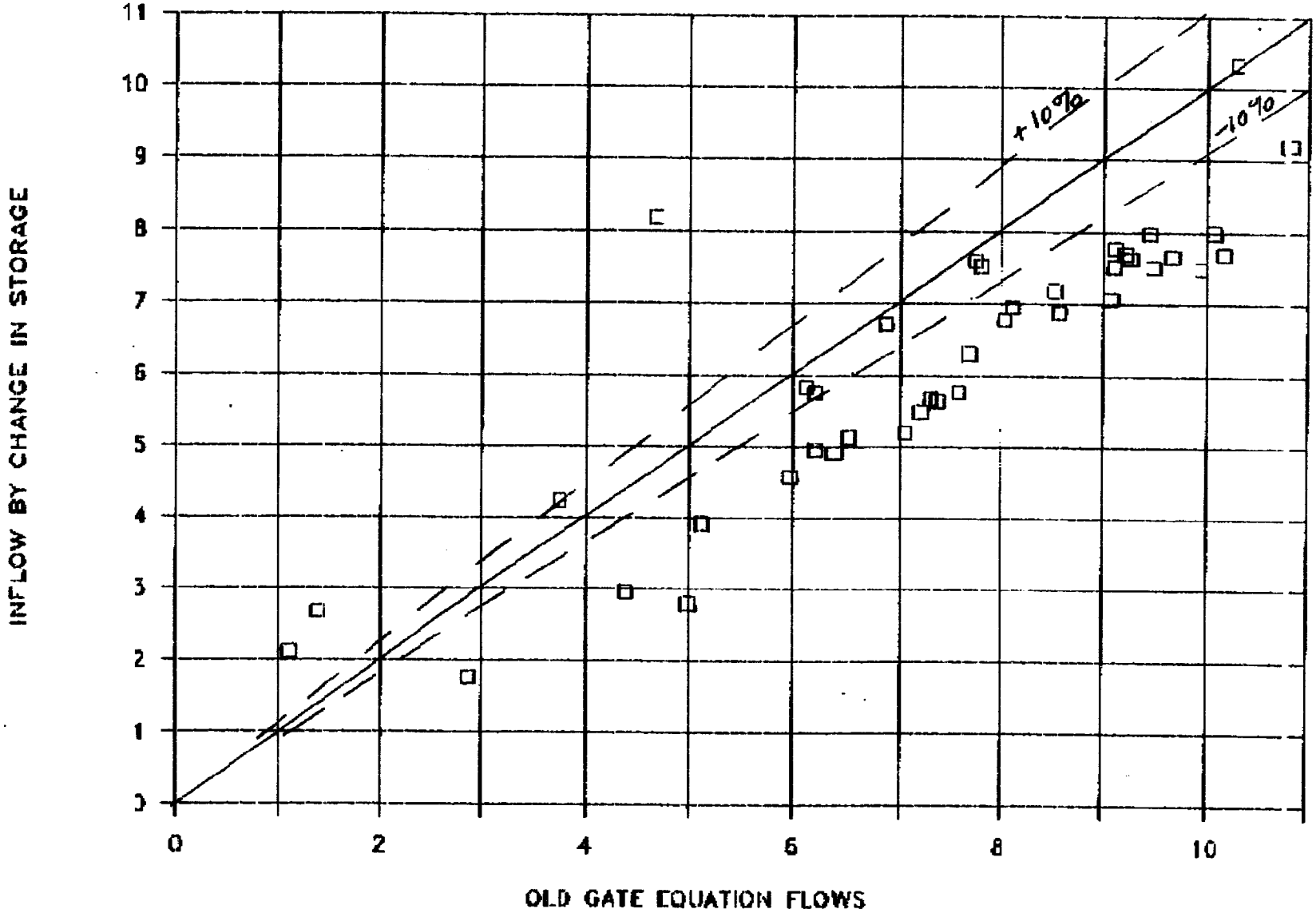
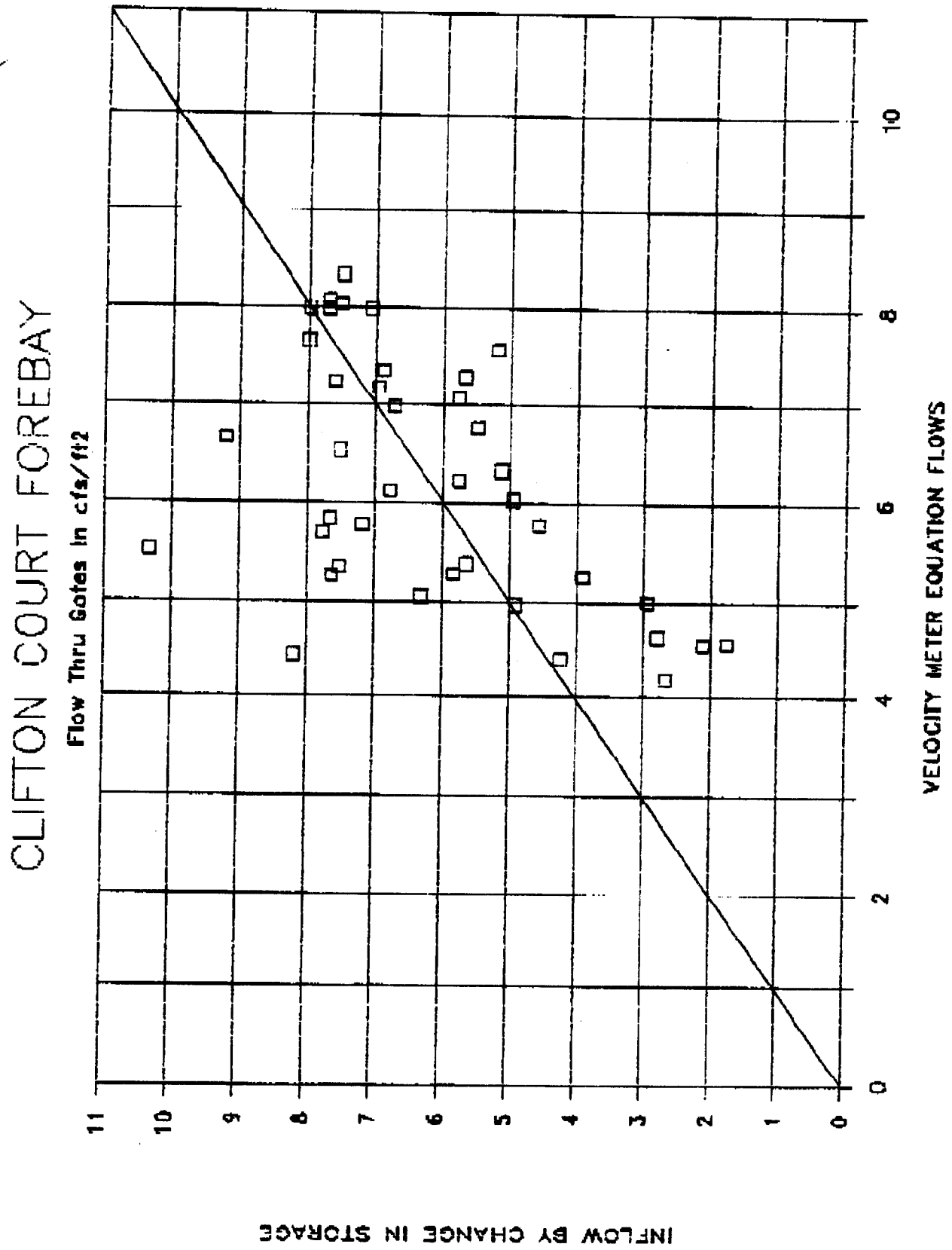
6
8
10

CLIFTON COURT FOREBAY

Flow Thru Gates in cfs/ft2




CLIFTON COURT FOREBAY
Flow Thru Gates in cfs/ft2
VELOCITY METER EQUATION FLOWS
INFLOW BY CHANGE IN STORAGE
0
1
2
3
4
5
6
7
8
9
10
11
0
2
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6
8
10

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPENGATE OPEN		FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
12-10-87	1315	1	10.47	2.50	15.4	16.3	10.0	403.1	486.7	261.8				
12-10-87		1	12.32	5.00	15.4	16.3	10.0	948.6	1004.1	616.0				
12-10-87		1	11.87	5.00	15.4	16.3	10.0	914.0	967.4	593.5				
12-10-87		1	13.22	5.00	15.4	16.3	10.0	1017.9	1077.6	661.0				
12-10-87		1	11.24	2.50	15.4	16.3	10.0	432.7	458.0	281.0	3716.4	3933.6	2413.3	12.066
12-10-87		2	8.82	2.50	15.4	16.0	12.0	339.6	352.8	264.6				
12-10-87		2	10.38	5.00	15.4	16.0	12.0	799.3	830.4	622.8				
12-10-87		2	10.49	5.00	15.4	16.0	12.0	807.7	839.2	629.4				
12-10-87		2	10.62	5.00	15.4	16.0	12.0	817.7	849.6	637.2				
12-10-87		2	9.03	2.50	15.4	16.0	12.0	347.7	361.2	270.9	3112.0	3233.2	2424.9	10.104
12-10-87		3	8.42	2.50	15.4	16.1	10.0	324.2	338.9	210.5				
12-10-87		3	9.91	5.00	15.4	16.1	10.0	763.1	797.8	495.5				
12-10-87		3	10.02	5.00	15.4	16.1	10.0	771.3	806.6	501.0				
12-10-87		3	9.89	5.00	15.4	16.1	10.0	761.5	796.1	494.5				
12-10-87		3	8.41	2.50	15.4	16.1	10.0	323.8	338.5	210.3	2944.1	3077.9	1911.8	9.599
12-10-87		4	8.26	2.50	15.4	16.4	12.0	318.0	338.7	247.8				
12-10-87		4	9.72	5.00	15.4	16.4	12.0	748.4	797.0	583.2				
12-10-87		4	10.75	5.00	15.4	16.4	12.0	827.8	881.5	645.0				
12-10-87		4	9.89	5.00	15.4	16.4	12.0	761.5	811.0	593.4				
12-10-87		4	8.41	2.50	15.4	16.4	12.0	323.8	344.8	252.3	2979.5	3173.0	2321.7	9.674
12-10-87		5	8.06	2.50	15.4	16.2	10.0	310.3	326.4	201.5				
12-10-87		5	9.48	5.00	15.4	16.2	10.0	730.0	767.9	474.0				
12-10-87		5	9.78	5.00	15.4	16.2	10.0	753.1	792.2	489.0				
12-10-87		5	10.12	5.00	15.4	16.2	10.0	779.2	819.7	506.0				
12-10-87	1332	5	8.60	2.50	15.4	16.2	10.0	331.1	348.3	215.0	2903.7	3054.5	1885.5	9.428
										TOTAL	15656	16472	10957	10.166

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPENGATE OPEN		FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
-87	1400	1	5.02	2.50	15.6	10.2	10.0	195.8	128.0	125.5				
-87		1	5.90	5.00	15.6	10.2	10.0	460.2	300.9	295.0				
12-10-87		1	5.55	5.00	15.6	10.2	10.0	432.9	283.0	277.5				
12-10-87		1	5.38	5.00	15.6	10.2	10.0	419.6	274.4	269.0				
12-10-87		1	4.57	2.50	15.6	10.2	10.0	178.2	116.5	114.3	1686.8	1102.9	1081.3	5.406
12-10-87		2	6.48	2.50	15.6	12.0	12.0	252.7	194.4	194.4				
12-10-87		2	7.62	5.00	15.6	12.0	12.0	594.4	457.2	457.2				
12-10-87		2	7.78	5.00	15.6	12.0	12.0	606.8	466.8	466.8				
12-10-87		2	7.54	5.00	15.6	12.0	12.0	588.1	452.4	452.4				
12-10-87		2	6.41	2.50	15.6	12.0	12.0	250.0	192.3	192.3	2292.0	1763.1	1763.1	7.346
12-10-87		3	4.42	2.50	15.6	10.1	10.0	172.4	111.6	110.5				
12-10-87		3	5.20	5.00	15.6	10.1	10.0	405.6	262.5	260.0				
12-10-87		3	5.14	5.00	15.6	10.1	10.0	400.9	259.6	257.0				
12-10-87		3	5.20	5.00	15.6	10.1	10.0	405.6	262.6	260.0				
12-10-87		3	4.42	2.50	15.6	10.1	10.0	172.4	111.6	110.5	1556.9	1008.0	998.0	4.990
12-10-87		4	3.46	2.50	15.6	12.4	12.0	134.9	107.3	103.8				
12-10-87		4	4.07	5.00	15.6	12.4	12.0	317.5	252.3	244.2				
12-10-87		4	4.26	5.00	15.6	12.4	12.0	332.3	264.1	255.6				
12-10-87		4	4.46	5.00	15.6	12.4	12.0	347.9	276.5	267.4				
12-10-87		4	3.79	2.50	15.6	12.4	12.0	147.8	117.5	113.7	1280.4	1017.7	984.9	4.104
12-10-87		5	4.42	2.50	15.6	10.1	10.0	172.4	111.6	110.5				
12-10-87		5	5.20	5.00	15.6	10.1	10.0	405.6	262.6	260.0				
12-10-87		5	5.72	5.00	15.6	10.1	10.0	446.2	288.9	286.0				
12-10-87		5	6.00	5.00	15.6	10.1	10.0	468.0	303.0	300.0				
12-10-87	1422	5	3.10	2.50	15.6	10.1	10.0	198.9	128.8	127.5	1691.0	1094.8	1084.0	5.420
										TOTAL	8507	5987	5911	5.453

CLIFTON COURT RATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
12-10-87	1500	1	4.47	2.50	15.4	10.2	10.0	172.1	114.0	111.8				
12-10-87		1	3.86	5.00	15.4	10.2	10.0	405.0	268.3	263.0				
12-10-87		1	5.00	5.00	15.4	10.2	10.0	385.0	255.0	250.0				
12-10-87		1	4.65	5.00	15.4	10.2	10.0	358.1	237.2	232.5				
12-10-87		1	3.95	2.50	15.4	10.2	10.0	152.1	100.7	98.8	1472.2	975.1	956.0	4.780
12-10-87		2	5.61	2.50	15.4	12.0	12.0	216.0	168.3	158.3				
12-10-87		2	6.60	5.00	15.4	12.0	12.0	508.2	396.0	396.0				
12-10-87		2	6.29	5.00	15.4	12.0	12.0	484.3	377.4	377.4				
12-10-87		2	6.12	5.00	15.4	12.0	12.0	471.2	367.2	367.2				
12-10-87		2	5.20	2.50	15.4	12.0	12.0	200.2	156.0	156.0	1880.0	1464.9	1464.9	6.104
12-10-87		3	3.91	2.50	15.4	10.1	10.0	150.5	98.7	97.8				
12-10-87		3	4.60	5.00	15.4	10.1	10.0	354.2	232.3	230.0				
12-10-87		3	4.60	5.00	15.4	10.1	10.0	354.2	232.3	230.0				
12-10-87		3	4.56	5.00	15.4	10.1	10.0	351.1	230.3	228.0				
12-10-87		3	3.88	2.50	15.4	10.1	10.0	149.4	98.0	97.0	1359.4	891.6	882.7	4.414
12-10-87		4	6.06	2.50	15.4	12.4	12.0	233.3	187.9	181.8				
12-10-87		4	7.13	5.00	15.4	12.4	12.0	549.0	442.1	427.8				
12-10-87		4	7.50	5.00	15.4	12.4	12.0	577.5	465.0	450.0				
12-10-87		4	7.94	5.00	15.4	12.4	12.0	611.4	492.3	476.4				
12-10-87		4	6.75	2.50	15.4	12.4	12.0	259.9	209.3	202.5	2231.1	1796.5	1738.5	7.244
12-10-87		5	3.91	2.50	15.4	10.1	10.0	150.5	98.7	97.8				
12-10-87		5	4.60	5.00	15.4	10.1	10.0	354.2	232.3	230.0				
12-10-87		5	5.02	5.00	15.4	10.1	10.0	386.5	253.5	251.0				
12-10-87		5	5.32	5.00	15.4	10.1	10.0	402.6	268.7	266.0				
12-10-87	1518	5	4.52	2.50	15.4	10.1	10.0	174.0	114.1	113.0	1474.9	967.3	957.7	4.789
										TOTAL	8418	6095	6000	5.466

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
-87	1542	1	4.42	2.50	15.4	10.2	10.0	170.2	112.7	110.5				
12-10-87		1	5.20	5.00	15.4	10.2	10.0	400.4	265.2	260.0				
12-10-87		1	4.96	5.00	15.4	10.2	10.0	381.9	253.0	248.0				
12-10-87		1	4.46	5.00	15.4	10.2	10.0	343.4	227.5	223.0				
12-10-87		1	3.79	2.50	15.4	10.2	10.0	145.4	96.6	94.8	1441.8	955.0	936.3	4.681
12-10-87		2	5.46	2.50	15.4	12.0	12.0	210.2	163.8	163.8				
12-10-87		2	6.42	5.00	15.4	12.0	12.0	494.3	385.2	385.2				
12-10-87		2	6.18	5.00	15.4	12.0	12.0	475.9	370.8	370.8				
12-10-87		2	6.18	5.00	15.4	12.0	12.0	475.9	370.8	370.8				
12-10-87		2	5.25	2.50	15.4	12.0	12.0	202.1	157.5	157.5	1858.4	1448.1	1448.1	6.034
12-10-87		3	3.67	2.50	15.4	10.1	10.0	141.3	92.7	91.8				
12-10-87		3	4.32	5.00	15.4	10.1	10.0	332.6	218.2	216.0				
12-10-87		3	4.42	5.00	15.4	10.1	10.0	340.3	223.2	221.0				
12-10-87		3	4.38	5.00	15.4	10.1	10.0	337.3	221.2	219.0				
12-10-87		3	3.72	2.50	15.4	10.1	10.0	143.2	93.9	93.0	1294.8	849.2	840.8	4.204
12-10-87		4	3.32	2.50	15.4	12.4	12.0	127.8	102.9	98.6				
12-10-87		4	3.91	5.00	15.4	12.4	12.0	301.1	242.4	234.6				
12-10-87		4	4.28	5.00	15.4	12.4	12.0	329.6	265.4	255.8				
12-10-87		4	4.60	5.00	15.4	12.4	12.0	354.2	285.2	274.0				
12-10-87		4	3.91	2.50	15.4	12.4	12.0	150.5	121.2	117.3	1263.2	1017.1	984.3	4.101
12-10-87		5	3.58	2.50	15.4	10.1	10.0	137.6	90.4	89.5				
12-10-87		5	4.21	5.00	15.4	10.1	10.0	324.2	212.8	210.5				
12-10-87		5	4.80	5.00	15.4	10.1	10.0	369.6	242.4	240.0				
12-10-87		5	4.94	5.00	15.4	10.1	10.0	380.4	249.6	247.0				
12-10-87	1612	5	4.20	2.50	15.4	10.1	10.0	161.7	106.1	105.0	1373.7	900.9	892.0	4.460
										TOTAL	7232	5170	5101	4.696

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPEN	GATE OPEN	FLOW IN CFS FIELD D	OBS 6 D	TEL 6 D	TOTAL FLOW IN CFS FIELD D	OBS 6 D	TEL 6 D	FLOW PER SQUARE FT
12-10-87	1620	1	4.32	2.50	15.4	10.2	10.0	166.3	110.2	108.0				
12-10-87		1	5.00	5.00	15.4	10.2	10.0	391.2	259.1	254.0				
12-10-87		1	4.85	5.00	15.4	10.2	10.0	373.5	247.3	242.5				
12-10-87		1	4.46	5.00	15.4	10.2	10.0	343.4	227.5	223.0				
12-10-87		1	3.79	2.50	15.4	10.2	10.0	145.5	96.6	94.8	1420.3	940.7	922.3	4.611
12-10-87		2	5.46	2.50	15.4	12.0	12.0	210.2	163.8	163.8				
12-10-87		2	6.42	5.00	15.4	12.0	12.0	494.3	385.2	385.2				
12-10-87		2	6.29	5.00	15.4	12.0	12.0	484.3	377.4	377.4				
12-10-87		2	6.06	5.00	15.4	12.0	12.0	466.6	363.6	363.6				
12-10-87		2	5.15	2.50	15.4	12.0	12.0	198.3	154.5	154.5	1853.8	1444.5	1444.5	6.015
12-10-87		3	3.79	2.50	15.4	10.1	10.0	145.9	95.7	94.8				
12-10-87		3	4.46	5.00	15.4	10.1	10.0	343.4	225.2	223.0				
12-10-87		3	4.40	5.00	15.4	10.1	10.0	338.8	222.2	220.0				
12-10-87		3	4.42	5.00	15.4	10.1	10.0	340.3	221.2	221.0				
12-10-87		3	3.76	2.50	15.4	10.1	10.0	144.8	94.9	94.0	1313.2	861.3	852.8	4.264
12-10-87		4	3.88	2.50	15.4	12.4	12.0	218.7	176.1	170.4				
12-10-87		4	6.68	5.00	15.4	12.4	12.0	514.4	414.2	400.8				
12-10-87		4	6.75	5.00	15.4	12.4	12.0	519.8	418.5	405.0				
12-10-87		4	7.27	5.00	15.4	12.4	12.0	559.8	450.7	436.2				
12-10-87		4	6.18	2.50	15.4	12.4	12.0	237.9	191.6	185.4	2050.5	1651.1	1597.8	6.658
12-10-87		5	3.54	2.50	15.4	10.1	10.0	135.3	89.4	86.5				
12-10-87		5	4.16	5.00	15.4	10.1	10.0	320.3	210.1	208.0				
12-10-87		5	4.56	5.00	15.4	10.1	10.0	351.1	230.3	228.0				
12-10-87		5	4.80	5.00	15.4	10.1	10.0	369.6	242.4	240.0				
12-10-87	1635	5	4.08	2.50	15.4	10.1	10.0	157.1	103.0	102.0	1334.4	875.2	866.5	4.333
										TOTAL	7970	5773	5684	5.177

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPEN	GATE OPEN	FLOW IN CFS FIELD D	OBS 6 D	TEL 6 D	TOTAL FLOW IN CFS FIELD D	OBS 6 D	TEL 6 D	FLOW PER SQUARE FT
-87	1645	1	4.47	2.50	15.4	10.2	10.0	172.1	114.0	111.8				
-87		1	5.26	5.00	15.4	10.2	10.0	405.0	268.3	263.0				
12-10-87		1	4.92	5.00	15.4	10.2	10.0	378.8	250.9	246.0				
12-10-87		1	4.91	5.00	15.4	10.2	10.0	347.3	230.0	225.5				
12-10-87		1	3.83	2.50	15.4	10.2	10.0	147.5	97.7	95.8	1450.7	960.8	942.0	4.710
12-10-87		2	5.62	2.50	15.4	12.0	12.0	216.4	168.6	168.6				
12-10-87		2	6.61	5.00	15.4	12.0	12.0	509.0	396.6	396.6				
12-10-87		2	6.23	5.00	15.4	12.0	12.0	479.7	373.8	373.8				
12-10-87		2	6.29	5.00	15.4	12.0	12.0	484.3	377.4	377.4				
12-10-87		2	5.33	2.50	15.4	12.0	12.0	208.0	160.5	160.5	1895.4	1476.9	1476.9	6.154
12-10-87		3	3.71	2.50	15.4	10.1	10.0	142.8	92.7	92.8				
12-10-87		3	4.37	5.00	15.4	10.1	10.0	336.5	220.7	218.5				
12-10-87		3	4.46	5.00	15.4	10.1	10.0	343.4	225.2	223.0				
12-10-87		3	4.30	5.00	15.4	10.1	10.0	337.3	221.2	219.0				
12-10-87		3	3.72	2.50	15.4	10.1	10.0	143.2	93.9	93.0	1303.2	854.7	846.3	4.231
12-10-87		4	5.74	2.50	15.4	12.4	12.0	221.0	177.9	172.2				
12-10-87		4	6.75	5.00	15.4	12.4	12.0	519.8	418.5	405.0				
12-10-87		4	6.96	5.00	15.4	12.4	12.0	535.9	431.5	417.6				
12-10-87		4	6.13	5.00	15.4	12.4	12.0	472.0	380.1	367.8				
12-10-87		4	5.21	2.50	15.4	12.4	12.0	200.6	161.5	156.3	1949.3	1569.5	1518.9	6.329
12-10-87		5	3.62	2.50	15.4	10.1	10.0	139.4	91.4	90.5				
12-10-87		5	4.26	5.00	15.4	10.1	10.0	328.0	215.1	213.0				
12-10-87		5	4.75	5.00	15.4	10.1	10.0	365.8	239.9	237.5				
12-10-87		5	4.86	5.00	15.4	10.1	10.0	374.2	245.4	243.0				
12-10-87	1700	5	4.13	2.50	15.4	10.1	10.0	159.0	104.3	103.3	1556.4	890.1	887.3	4.436
										TOTAL	7965	5758	5671	5.172

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPEN	GATE OPEN	FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
01-12-88	1042	1	8.13	2.50	14.45	15.2	15.0	293.7	308.9	304.9				
01-12-88		1	9.56	5.00	14.45	15.2	15.0	690.7	726.6	717.0				
01-12-88		1	9.36	5.00	14.45	15.2	15.0	676.3	711.4	702.0				
01-12-88		1	9.37	5.00	14.45	15.2	15.0	677.0	712.1	702.7				
01-12-88		1	7.96	2.50	14.45	15.2	15.0	287.6	302.5	298.5	2625.2	2761.5	2725.1	9.094
01-12-88		2	7.17	2.50	14.45	15.0	15.0	259.0	268.9	268.9				
01-12-88		2	8.44	5.00	14.45	15.0	15.0	609.0	633.0	633.0				
01-12-88		2	8.38	5.00	14.45	15.0	15.0	605.5	628.5	628.5				
01-12-88		2	8.38	5.00	14.45	15.0	15.0	605.5	628.5	628.5				
01-12-88		2	7.12	2.50	14.45	15.0	15.0	257.2	267.0	267.0	2336.9	2425.9	2425.9	8.086
01-12-88		3	6.73	2.50	14.45	15.0	15.0	243.1	252.4	252.4				
01-12-88		3	7.92	5.00	14.45	15.0	15.0	572.2	594.0	594.0				
01-12-88		3	8.02	5.00	14.45	15.0	15.0	579.4	601.5	601.5				
01-12-88		3	8.38	5.00	14.45	15.0	15.0	605.5	628.5	628.5				
01-12-88	1100	3	7.12	2.50	14.45	15.0	15.0	257.2	267.0	267.0	2257.5	2343.4	2343.4	7.811
01-12-88	1100	4	6.61	2.50	14.45	15.4	15.0	238.8	254.8	247.9				
01-12-88		4	7.78	5.00	14.45	15.4	15.0	562.1	599.1	583.5				
01-12-88		4	8.07	5.00	14.45	15.4	15.0	583.1	621.4	605.3				
01-12-88		4	8.17	5.00	14.45	15.4	15.0	590.3	629.1	612.8				
01-12-88		4	6.94	2.50	14.45	15.4	15.0	250.7	267.2	260.3	2224.9	2371.2	2309.6	7.699
01-12-88		5	6.39	2.50	14.45	15.2	15.0	230.8	242.8	239.6				
01-12-88		5	7.52	5.00	14.45	15.2	15.0	543.3	571.5	564.0				
01-12-88		5	7.60	5.00	14.45	15.2	15.0	549.1	577.6	570.0				
01-12-88		5	7.58	5.00	14.45	15.2	15.0	543.3	571.5	564.0				
01-12-88	1045	5	6.39	2.50	14.45	15.2	15.0	230.8	242.8	239.6	2097.4	2206.3	2177.3	7.257
										TOTAL	11542	12108	11981	7.988

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPEN	GATE OPEN	FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
-88	1125	1	8.41	2.50	14.35	14.2	14.0	301.7	298.6	294.4				
01-12-88		1	9.89	5.00	14.35	14.2	14.0	709.6	702.2	692.3				
01-12-88		1	9.68	5.00	14.35	14.2	14.0	694.5	687.3	677.6				
01-12-88		1	9.89	5.00	14.35	14.2	14.0	709.6	702.2	692.3				
01-12-88		1	8.41	2.50	14.35	14.2	14.0	301.7	298.6	294.4	3717.3	3688.0	3650.9	9.468
01-12-88		2	7.40	2.50	14.35	14.0	14.0	265.5	259.0	259.0				
01-12-88		2	8.71	5.00	14.35	14.0	14.0	624.9	609.7	609.7				
01-12-88		2	8.54	5.00	14.35	14.0	14.0	612.7	597.8	597.8				
01-12-88		2	8.90	5.00	14.35	14.0	14.0	638.6	623.0	623.0				
01-12-88		2	7.56	2.50	14.35	14.0	14.0	271.2	264.6	264.6	2413.0	2354.1	2354.1	8.408
01-12-88		3	6.99	2.50	14.35	15.0	15.0	250.8	262.1	262.1				
01-12-88		3	8.22	5.00	14.35	15.0	15.0	589.8	616.5	616.5				
01-12-88		3	8.38	5.00	14.35	15.0	15.0	601.3	628.5	628.5				
01-12-88		3	8.90	5.00	14.35	15.0	15.0	638.6	667.5	667.5				
01-12-88	1140	3	7.56	2.50	14.35	15.0	15.0	271.2	283.5	283.5	2351.6	2458.1	2458.1	8.194
01-12-88	1140	4	6.78	2.50	14.35	14.4	14.0	243.2	244.1	237.3				
01-12-88		4	7.98	5.00	14.35	14.4	14.0	572.6	574.6	558.6				
01-12-88		4	8.17	5.00	14.35	14.4	14.0	586.2	588.2	571.9				
01-12-88		4	8.71	5.00	14.35	14.4	14.0	624.9	627.1	609.7				
01-12-88		4	7.40	2.50	14.35	14.4	14.0	265.5	266.4	259.0	2292.4	2300.4	2236.5	7.988
01-12-88		5	6.61	2.50	14.35	14.1	14.0	237.1	233.0	231.4				
01-12-88		5	7.78	5.00	14.35	14.1	14.0	558.8	548.5	544.6				
01-12-88		5	7.78	5.00	14.35	14.1	14.0	558.2	548.5	544.6				
01-12-88		5	7.88	5.00	14.35	14.1	14.0	565.4	555.5	551.6				
01-12-88	1125	5	6.70	2.50	14.35	14.1	14.0	240.4	236.2	234.5	2159.3	2121.7	2106.7	7.524
										TOTAL	11933	11923	11806	8.316

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPEN	GATE OPEN	FLOW IN CFS FIELD D	OBS G O	TEL G O	TOTAL FLOW IN CFS FIELD D	OBS G O	TEL G O	FLOW PER SQUARE FT
01-12-88	1203	1	8.41	2.50	14.45	14.2	14.0	303.8	298.6	294.4				
01-12-88		1	9.89	5.00	14.45	14.2	14.0	714.6	702.2	692.3				
01-12-88		1	10.12	5.00	14.45	14.2	14.0	731.2	718.5	708.4				
01-12-88		1	10.36	5.00	14.45	14.2	14.0	748.5	735.6	725.2				
01-12-88		1	8.81	2.50	14.45	14.2	14.0	318.3	312.8	308.4	2816.3	2767.6	2728.6	9.745
01-12-88		2	7.72	2.50	14.45	14.0	14.0	278.9	270.2	270.2				
01-12-88		2	9.08	5.00	14.45	14.0	14.0	656.0	635.6	635.6				
01-12-88		2	8.89	5.00	14.45	14.0	14.0	642.3	622.3	622.3				
01-12-88		2	9.26	5.00	14.45	14.0	14.0	669.0	648.2	648.2				
01-12-88		2	7.87	2.50	14.48	14.0	14.0	284.3	275.5	275.5	2530.6	2451.8	2451.8	8.726
01-12-88		3	7.56	2.50	14.45	15.0	14.9	273.1	283.5	281.6				
01-12-88		3	8.89	5.00	14.45	15.0	14.9	642.3	666.8	662.3				
01-12-88		3	8.89	5.00	14.45	15.0	14.9	642.3	666.8	662.3				
01-12-88		3	8.89	5.00	14.45	15.0	14.9	642.3	666.8	662.3				
01-12-88	1222	3	7.56	2.50	14.45	15.0	14.9	273.1	283.5	281.6	2473.1	2567.3	2560.1	8.558
01-12-88	1225	4	6.79	2.50	14.45	14.4	14.0	245.3	244.4	237.7				
01-12-88		4	7.99	5.00	14.45	14.4	14.0	577.3	575.3	559.3				
01-12-88		4	8.46	5.00	14.45	14.4	14.0	611.2	609.1	592.2				
01-12-88		4	8.80	5.00	14.45	14.4	14.0	635.8	633.6	616.0				
01-12-88		4	7.48	2.50	14.45	14.4	14.0	270.2	269.3	261.8	2339.8	2331.7	2267.0	8.096
01-12-88		5	6.63	2.50	14.45	14.1	14.0	239.5	232.7	222.0				
01-12-88		5	7.80	5.00	14.45	14.1	14.0	563.6	549.9	546.0				
01-12-88		5	8.46	5.00	14.45	14.1	14.0	611.2	596.4	592.2				
01-12-88		5	8.26	5.00	14.48	14.1	14.0	604.0	589.4	585.2				
01-12-88	1205	5	7.11	2.50	14.45	14.1	14.0	256.8	250.6	248.9	2275.2	2220.0	2204.3	7.873
										TOTAL	12435	12338	12202	8.606

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPEN	GATE OPEN	FLOW IN CFS FIELD D	OBS G O	TEL G O	TOTAL FLOW IN CFS FIELD D	OBS G O	TEL G O	FLOW PER SQUARE FT
.2-88	1305	1	8.60	2.50	14.75	14.2	14.0	317.1	305.3	301.0				
-12-88		1	10.12	5.00	14.75	14.2	14.0	746.3	718.5	708.4				
01-12-88		1	10.12	5.00	14.75	14.2	14.0	746.3	718.5	708.4				
01-12-88		1	10.12	5.00	14.75	14.2	14.0	746.3	718.5	708.4				
01-12-88		1	8.60	2.50	14.75	14.2	14.0	317.1	305.3	301.0	2873.3	2766.2	2727.2	9.740
01-12-88		2	7.56	2.50	14.75	14.0	14.0	278.8	264.6	264.6				
01-12-88		2	8.89	5.00	14.75	14.0	14.0	655.6	622.3	622.3				
01-12-88		2	8.89	5.00	14.75	14.0	14.0	655.6	622.3	622.3				
01-12-88		2	8.89	5.00	14.75	14.0	14.0	655.6	622.3	622.3				
01-12-88		2	7.56	2.50	14.75	14.0	14.0	278.8	264.6	264.6	2524.5	2396.1	2396.1	8.558
01-12-88		3	6.99	2.50	14.75	14.0	14.0	257.8	244.7	244.7				
01-12-88		3	8.22	5.00	14.75	14.0	14.0	606.2	575.4	575.4				
01-12-88		3	8.22	5.00	14.75	14.0	14.0	606.2	575.4	575.4				
01-12-88		3	8.71	5.00	14.75	14.0	14.0	642.4	609.7	609.7				
01-12-88	1325	3	7.40	2.50	14.75	14.0	14.0	272.9	259.0	259.0	2365.4	2264.2	2264.2	8.086
01-12-88	1325	4	6.87	2.50	14.75	14.2	14.0	253.3	243.4	240.5				
01-12-88		4	8.08	5.00	14.75	14.2	14.0	595.9	573.7	565.6				
01-12-88		4	8.04	5.00	14.75	14.2	14.0	592.9	570.8	562.8				
01-12-88		4	8.56	5.00	14.75	14.2	14.0	629.8	606.3	597.6				
01-12-88		4	7.26	2.50	14.75	14.2	14.0	267.7	257.7	254.1	2339.7	2252.5	2220.8	7.931
01-12-88		5	6.43	2.50	14.75	14.0	14.0	237.1	225.0	225.0				
01-12-88		5	7.82	5.00	14.75	14.0	14.0	337.6	329.2	329.2				
01-12-88		5	8.07	5.00	14.75	14.0	14.0	595.2	564.9	564.9				
01-12-88		5	8.04	5.00	14.75	14.0	14.0	592.9	562.8	562.8				
01-12-88	1300	5	6.83	2.50	14.75	14.0	14.0	251.9	239.1	239.1	2234.6	2121.0	2121.0	7.575
										TOTAL	12358	11800	11729	8.378

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	FLOW IN CFS OBS G O	FLOW IN CFS TEL G O	TOTAL FLOW IN CFS FIELD D	TOTAL FLOW IN CFS OBS G O	TOTAL FLOW IN CFS TEL G O	FLOW PER SQUARE FT
01-12-88	1345	1	8.23	2.50	15.0	14.2	14.0	308.6	292.2	288.1				
01-12-88		1	9.68	5.00	15.0	14.2	14.0	726.0	687.3	677.6				
01-12-88		1	9.46	5.00	15.0	14.2	14.0	709.5	671.7	662.2				
01-12-88		1	9.46	5.00	15.0	14.2	14.0	709.5	671.7	662.2				
01-12-88		1	8.04	2.50	15.0	14.2	14.0	301.5	285.4	281.4	2755.1	2608.2	2571.5	9.184
01-12-88		2	6.99	2.50	15.0	14.0	14.0	262.1	244.7	244.7				
01-12-88		2	8.22	5.00	15.0	14.0	14.0	616.5	575.4	575.4				
01-12-88		2	8.07	5.00	15.0	14.0	14.0	605.3	564.9	564.9				
01-12-88		2	8.38	5.00	15.0	14.0	14.0	628.5	586.6	586.6				
01-12-88		2	7.12	2.50	15.0	14.0	14.0	267.0	249.2	249.2	2375.4	2220.6	2220.6	7.931
01-12-88		3	6.50	2.50	15.0	14.0	14.0	243.8	227.5	227.5				
01-12-88		3	7.64	5.00	15.0	14.0	14.0	573.0	534.8	534.8				
01-12-88		3	7.98	5.00	15.0	14.0	14.0	598.5	558.6	558.6				
01-12-88		3	8.17	5.00	15.0	14.0	14.0	612.8	571.9	571.9				
01-12-88	1400	3	6.94	2.50	15.0	14.0	14.0	260.3	242.9	242.9	2288.3	2135.7	2135.7	7.628
01-12-88		4	6.46	2.50	15.0	14.2	14.0	242.3	226.3	226.1				
01-12-88		4	7.60	5.00	15.0	14.2	14.0	570.0	532.5	532.0				
01-12-88		4	7.69	5.00	15.0	14.2	14.0	576.8	546.0	538.3				
01-12-88		4	8.30	5.00	15.0	14.2	14.0	622.5	589.3	581.0				
01-12-88		4	7.06	2.50	15.0	14.2	14.0	264.8	250.6	247.1	2276.3	2154.9	2124.5	7.588
01-12-88		5	6.32	2.50	15.0	14.0	14.0	237.0	221.2	221.2				
01-12-88		5	7.43	5.00	15.0	14.0	14.0	557.3	520.1	520.1				
01-12-88		5	7.52	5.00	15.0	14.0	14.0	564.0	526.4	526.4				
01-12-88		5	7.79	5.00	15.0	14.0	14.0	584.3	545.3	545.3				
01-12-88	1345	5	6.61	2.50	15.0	14.0	14.0	247.9	231.4	231.4	2190.4	2044.4	2044.4	7.301
										TOTAL	11889	11164	11097	7.986

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	FLOW IN CFS OBS G O	FLOW IN CFS TEL G O	TOTAL FLOW IN CFS FIELD D	TOTAL FLOW IN CFS OBS G O	TOTAL FLOW IN CFS TEL G O	FLOW PER SQUARE FT
01-12-88	1403	1	7.40	2.50	15.15	14.2	14.0	280.3	262.7	259.0				
01-12-88		1	8.71	5.00	15.15	14.2	14.0	659.8	618.4	609.7				
01-12-88		1	8.89	5.00	15.15	14.2	14.0	673.4	631.2	622.3				
01-12-88		1	8.71	5.00	15.15	14.2	14.0	659.8	618.4	609.7				
01-12-88		1	7.40	2.50	15.15	14.2	14.0	280.3	262.7	259.0	2861.5	2393.4	2359.7	8.428
01-12-88		2	6.61	2.50	15.15	14.0	14.0	250.4	231.4	231.4				
01-12-88		2	7.78	5.00	15.15	14.0	14.0	589.3	544.6	544.6				
01-12-88		2	7.60	5.00	15.15	14.0	14.0	575.7	532.0	532.0				
01-12-88		2	7.78	5.00	15.15	14.0	14.0	589.3	544.6	544.6				
01-12-88		2	6.61	2.50	15.15	14.0	14.0	250.4	231.4	231.4	2255.1	2083.9	2083.9	7.442
01-12-88		3	5.92	2.50	15.15	14.0	14.0	224.2	207.2	207.2				
01-12-88		3	6.96	5.00	15.15	14.0	14.0	527.2	487.2	487.2				
01-12-88		3	7.27	5.00	15.15	14.0	14.0	550.7	508.9	508.9				
01-12-88		3	7.60	5.00	15.15	14.0	14.0	575.7	532.0	532.0				
01-12-88	1422	3	6.46	2.50	15.15	14.0	14.0	244.7	226.1	226.1	2122.5	1961.4	1961.4	7.005
01-12-88	1422	4	5.92	2.50	15.15	14.2	14.0	224.2	210.2	207.2				
01-12-88		4	6.96	5.00	15.15	14.2	14.0	527.2	494.2	487.2				
01-12-88		4	7.18	5.00	15.15	14.2	14.0	543.9	509.8	502.6				
01-12-88		4	7.69	5.00	15.15	14.2	14.0	582.6	546.0	538.3				
01-12-88		4	6.54	2.50	15.15	14.2	14.0	247.7	232.2	228.9	2125.5	1992.3	1964.2	7.015
01-12-88		5	5.80	2.50	15.15	14.0	14.0	219.7	203.0	203.0				
01-12-88		5	6.82	5.00	15.15	14.0	14.0	516.6	477.4	477.4				
01-12-88		5	7.04	5.00	15.15	14.0	14.0	533.3	492.8	492.8				
01-12-88		5	7.27	5.00	15.15	14.0	14.0	550.7	508.9	508.9				
01-12-88	1403	5	6.18	2.50	15.15	14.0	14.0	234.1	216.3	216.3	2054.3	1898.4	1898.4	6.780
										TOTAL	11111	10329	10258	7.334

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	OBS G O	TEL G O	TOTAL FLOW IN CFS FIELD D	OBS G O	TEL G O	FLOW PER SQUARE FT
01-13-88	1039	1	7.40	2.50	14.40	15.3	15.0	266.4	283.1	277.6				
01-13-88		1	8.71	5.00	14.40	15.3	15.0	627.1	666.3	653.3				
01-13-88		1	8.54	5.00	14.40	15.3	15.0	614.9	653.3	640.5				
01-13-88		1	8.56	5.00	14.40	15.3	15.0	616.3	654.8	642.0				
01-13-88		1	7.28	2.50	14.40	15.3	15.0	262.1	278.5	273.0	2386.8	2536.0	2486.3	8.288
01-13-88		2	6.70	2.50	14.40	15.1	15.0	241.2	252.9	251.3				
01-13-88		2	7.88	5.00	14.40	15.1	15.0	567.4	594.9	591.0				
01-13-88		2	7.52	5.00	14.40	15.1	15.0	541.4	567.8	564.0				
01-13-88		2	7.60	5.00	14.40	15.1	15.0	547.2	573.8	570.0				
01-13-88		2	6.46	2.50	14.40	15.1	15.0	232.6	243.9	242.3	2129.8	2233.3	2218.5	7.395
01-13-88		3	6.12	2.50	14.40	15.1	15.0	220.3	231.0	229.5				
01-13-88		3	7.20	5.00	14.40	15.1	15.0	518.4	543.6	540.0				
01-13-88		3	7.26	5.00	14.40	15.1	15.0	522.7	548.1	544.5				
01-13-88		3	7.69	5.00	14.40	15.1	15.0	553.7	580.6	576.8				
01-13-88	1032	3	6.54	2.50	14.40	15.1	15.0	235.4	246.9	245.3	2080.6	2150.2	2136.0	7.120
01-13-88	1052	4	5.98	2.50	14.40	15.4	15.0	215.3	230.2	224.3				
01-13-88		4	7.04	5.00	14.40	15.4	15.0	506.9	542.1	528.0				
01-13-88		4	7.25	5.00	14.40	15.4	15.0	522.7	559.0	544.5				
01-13-88		4	7.60	5.00	14.40	15.4	15.0	547.2	585.2	570.0				
01-13-88		4	6.46	2.50	14.40	15.4	15.0	232.5	248.7	242.3	2024.6	2163.2	2109.0	7.030
01-13-88		5	5.98	2.50	14.40	15.2	15.0	215.3	227.2	224.3				
01-13-88		5	7.04	5.00	14.40	15.2	15.0	506.9	535.0	528.0				
01-13-88		5	7.11	5.00	14.40	15.2	15.0	511.9	540.4	533.3				
01-13-88		5	7.27	5.00	14.40	15.2	15.0	523.4	552.5	545.3				
01-13-88	1035	5	6.18	2.50	14.40	15.2	15.0	222.5	234.8	231.8	1980.0	2090.0	2062.5	6.875
										TOTAL	10572	11175	11012	7.342

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	OBS G O	TEL G O	TOTAL FLOW IN CFS FIELD D	OBS G O	TEL G O	FLOW PER SQUARE FT
[illegible]-88	1105	1	7.63	2.50	14.35	15.3	15.0	273.7	291.8	286.1				
01-13-88		1	8.98	5.00	14.35	15.3	15.0	644.3	687.0	673.5				
01-13-88		1	8.89	5.00	14.35	15.3	15.0	637.9	680.1	666.8				
01-13-88		1	8.98	5.00	14.35	15.3	15.0	644.3	687.0	673.5				
01-13-88		1	7.63	2.50	14.35	15.3	15.0	273.7	291.8	286.1	2476.9	2647.7	2596.0	8.620
01-13-88		2	6.73	2.50	14.35	15.1	15.0	241.4	254.1	252.4				
01-13-88		2	7.92	5.00	14.35	15.1	15.0	568.3	596.0	594.0				
01-13-88		2	7.98	5.00	14.35	15.1	15.0	572.6	602.5	598.5				
01-13-88		2	7.98	5.00	14.35	15.1	15.0	572.6	602.5	598.5				
01-13-88		2	6.78	2.50	14.35	15.1	15.0	243.2	255.9	254.3	2192.1	2312.9	2297.6	7.659
01-13-88		3	6.37	2.50	14.35	15.1	15.0	228.5	240.5	238.5				
01-13-88		3	7.43	5.00	14.35	15.1	15.0	533.1	561.0	557.3				
01-13-88		3	7.34	5.00	14.35	15.1	15.0	526.6	554.2	550.5				
01-13-88		3	7.70	5.00	14.35	15.1	15.0	552.5	581.4	577.5				
01-13-88	1117	3	6.55	2.50	14.35	15.1	15.0	235.0	247.3	245.6	2075.7	2184.2	2169.6	7.233
01-13-88	1117	4	6.09	2.50	14.35	15.4	15.0	218.7	230.3	228.5				
01-13-88		4	7.11	5.00	14.35	15.4	15.0	510.1	537.5	533.3				
01-13-88		4	7.34	5.00	14.35	15.4	15.0	526.6	555.2	550.5				
01-13-88		4	7.60	5.00	14.35	15.4	15.0	545.3	585.2	570.0				
01-13-88		4	6.46	2.50	14.35	15.4	15.0	231.8	248.7	242.3	2030.5	2179.1	2122.5	7.075
01-13-88		5	6.32	2.50	14.35	15.2	15.0	226.7	240.2	237.0				
01-13-88		5	7.43	5.00	14.35	15.2	15.0	533.1	564.7	557.3				
01-13-88		5	7.52	5.00	14.35	15.2	15.0	539.6	571.5	564.0				
01 13 88		5	7.60	5.00	14.35	15.2	15.0	545.3	577.6	570.0				
01-13-88	1105	5	6.46	2.50	14.35	15.2	15.0	231.8	245.5	242.3	2076.4	2199.4	2170.5	7.235
										TOTAL	10085	11513	11346	7.564

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
01-13-88	1148	1	8.42	2.50	14.50	12.2	12.0	305.2	258.8	258.6				
01-13-88		1	9.90	5.00	14.50	12.2	12.0	717.8	503.9	594.0				
01-13-88		1	9.36	5.00	14.50	12.2	12.0	678.6	571.0	561.6				
01-13-88		1	9.68	5.00	14.50	12.2	12.0	701.8	590.5	580.8				
01-13-88		1	8.23	2.50	14.50	12.2	12.0	298.3	251.0	246.9	2701.7	2273.2	2235.9	9.316
01-13-88		2	7.16	2.50	14.50	15.1	15.0	259.6	270.3	268.5				
01-13-88		2	8.42	5.00	14.50	15.1	15.0	610.5	635.7	631.5				
01-13-88		2	8.72	5.00	14.50	15.1	15.0	632.2	658.4	654.0				
01-13-88		2	8.72	5.00	14.50	15.1	15.0	632.2	658.4	654.0				
01-13-88		2	7.41	2.50	14.50	15.1	15.0	268.6	279.7	277.9	2403.0	2502.4	2485.9	8.286
01-13-88		3	6.94	2.50	14.50	15.1	15.0	251.6	262.0	260.3				
01-13-88		3	8.17	5.00	14.50	15.1	15.0	592.3	616.8	612.8				
01-13-88		3	8.07	5.00	14.50	15.1	15.0	585.1	609.3	605.3				
01-13-88		3	8.17	5.00	14.50	15.1	15.0	592.3	616.8	612.8				
01-13-88	1205	3	6.94	2.50	14.50	15.1	15.0	251.6	262.0	260.3	2372.9	2466.9	2351.3	7.838
01-13-88	1205	4	7.11	2.50	14.50	15.4	15.0	257.7	273.7	266.6				
01-13-88		4	8.36	5.00	14.50	15.4	15.0	606.1	643.7	627.0				
01-13-88		4	8.17	5.00	14.50	15.4	15.0	592.3	629.1	612.8				
01-13-88		4	8.28	5.00	14.50	15.4	15.0	600.3	637.6	621.0				
01-13-88		4	7.04	2.50	14.50	15.4	15.0	255.2	271.0	264.0	2311.7	2455.1	2391.4	7.971
01-13-88		5	6.22	2.50	14.50	15.2	15.0	229.1	240.2	237.0				
01-13-88		5	7.43	5.00	14.50	15.2	15.0	538.7	564.7	557.3				
01-13-88		5	7.69	5.00	14.50	15.2	15.0	557.5	584.4	576.8				
01-13-88		5	7.78	5.00	14.50	15.2	15.0	564.1	591.3	583.5				
01-13-88	1148	5	6.61	2.50	14.50	15.2	15.0	239.6	251.2	247.9	2129.0	2231.7	2202.4	7.341
										TOTAL	11818	11829	11667	8.151

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED GATE OPEN	TELEMETER GATE OPEN	FLOW IN CFS FIELD D	OBS G D	TEL G D	TOTAL FLOW IN CFS FIELD D	OBS G D	TEL G D	FLOW PER SQUARE FT
01-13-88	1232	1	6.39	2.50	15.25	12.2	12.0	243.6	194.9	191.7				
01-13-88		1	7.36	5.00	15.25	12.2	12.0	573.4	458.7	451.2				
01-13-88		1	7.12	5.00	15.25	12.2	12.0	542.9	434.3	427.2				
01-13-88		1	6.76	5.00	15.25	12.2	12.0	515.4	412.4	405.6				
01-13-88		1	5.75	2.50	15.25	12.2	12.0	219.2	175.4	172.5	2094.6	1675.7	1646.2	6.868
01-13-88		2	7.56	2.50	15.05	15.1	15.0	284.4	285.4	283.5				
01-13-88		2	8.89	5.00	15.05	15.1	15.0	668.0	671.2	666.8				
01-13-88		2	8.44	5.00	15.05	15.1	15.0	635.1	637.2	633.0				
01-13-88		2	8.14	5.00	15.05	15.1	15.0	612.5	614.6	610.5				
01-13-88		2	6.99	2.50	15.05	15.1	15.0	260.4	261.2	259.5	2461.4	2469.6	2453.3	8.178
01-13-88		3	7.17	2.50	15.05	15.1	15.0	269.4	270.7	268.9				
01-13-88		3	8.44	5.00	15.05	15.1	15.0	635.1	637.2	633.0				
01-13-88		3	8.44	5.00	15.05	15.1	15.0	635.1	637.2	633.0				
01-13-88		3	8.72	5.00	15.05	15.1	15.0	656.2	658.4	654.0				
01-13-88	1247	3	7.41	2.50	15.05	15.1	15.0	278.8	279.7	277.9	2473.0	2483.2	2466.8	8.223
01-13-88	1247	4	7.19	2.50	15.05	15.4	15.0	270.5	276.8	265.6				
01-13-88		4	8.46	5.00	15.05	15.4	15.0	636.6	651.4	634.5				
01-13-88		4	8.62	5.00	15.05	15.4	15.0	648.7	663.7	646.5				
01-13-88		4	8.80	5.00	15.05	15.4	15.0	662.2	677.6	660.0				
01-13-88		4	7.48	2.50	15.05	15.4	15.0	281.4	286.0	280.5	2499.4	2557.6	2491.1	8.304
01-13-88		5	7.12	2.50	15.05	15.2	15.0	267.9	270.6	267.0				
01-13-88		5	8.38	5.00	15.05	15.2	15.0	630.6	636.9	628.5				
01-13-88		5	8.62	5.00	15.05	15.2	15.0	648.7	655.1	646.5				
01-13-88		5	8.62	5.00	15.05	15.2	15.0	648.7	655.1	646.5				
01-13-88	1232	5	7.33	2.50	15.05	15.2	15.0	275.8	278.5	274.9	2471.6	2496.2	2463.4	8.211
										TOTAL	12002	11602	11523	7.357

CLIFTON COURT GATES MEASURED FLOW CALCULATIONS

DATE	TIME	GATE NO.	MEASURED VELOCITY	WIDTH Feet	FIELD DEPTH	OBSERVED TELEMETER GATE OPENGATE OPEN		FLOW IN CFS FIELD D	OBS G O	TEL G O	TOTAL FLOW IN CFS FIELD D	OBS G O	TEL G O	FLOW PER SQUARE FT
01-13-88	1259	1	6.36	2.50	15.35	12.2	12.0	340.2	150.3	187.0				
01-13-88		1	7.37	5.00	15.35	12.2	12.0	565.6	449.6	442.2				
01-13-88		1	7.04	5.00	15.35	12.2	12.0	540.3	429.4	422.4				
01-13-88		1	6.42	5.00	15.35	12.2	12.0	492.7	391.6	385.2				
01-13-88		1	5.46	2.50	15.35	12.2	12.0	209.5	166.5	163.8	2048.5	1629.1	1601.4	6.673
01-13-88		2	7.63	2.50	15.10	15.1	15.0	288.0	288.0	286.1				
01-13-88		2	8.98	5.00	15.10	15.1	15.0	678.0	678.0	673.5				
01-13-88		2	8.44	5.00	15.10	15.1	15.0	637.2	637.2	633.0				
01-13-88		2	8.46	5.00	15.10	15.1	15.0	638.7	638.7	634.5				
01-13-88		2	7.19	2.50	15.10	15.1	15.0	271.4	271.4	269.6	2513.4	2513.4	2496.8	8.323
01-13-88		3	7.48	2.50	15.10	15.1	15.0	282.4	282.4	280.5				
01-13-88		3	8.80	5.00	15.10	15.1	15.0	664.4	664.4	660.0				
01-13-88		3	8.53	5.00	15.10	15.1	15.0	644.0	644.0	639.8				
01-13-88		3	8.46	5.00	15.10	15.1	15.0	638.7	638.7	634.5				
01-13-88	1312	3	7.19	2.50	15.10	15.1	15.0	271.4	271.4	269.6	2500.9	2500.9	2484.4	8.281
01-13-88	1312	4	7.36	2.50	15.10	15.4	15.0	285.4	291.1	283.5				
01-13-88		4	8.89	5.00	15.10	15.4	15.0	671.2	684.5	666.8				
01-13-88		4	8.89	5.00	15.10	15.4	15.0	671.2	684.5	666.8				
01-13-88		4	8.98	5.00	15.10	15.4	15.0	678.0	691.5	673.5				
01-13-88		4	7.63	2.50	15.10	15.4	15.0	288.0	293.8	286.1	2593.8	2645.3	2576.6	8.589
01-13-88		5	7.33	2.50	15.10	15.2	15.0	276.7	278.5	274.9				
01-13-88		5	8.62	5.00	15.10	15.2	15.0	650.8	655.1	646.5				
01-13-88		5	8.62	5.00	15.10	15.2	15.0	650.8	655.1	646.5				
01-13-88		5	8.69	5.00	15.10	15.2	15.0	671.2	675.6	666.8				
01-13-88	1255	5	7.56	2.50	15.10	15.2	15.0	285.4	287.3	283.5	2534.9	2551.7	2518.1	8.394
										TOTAL	12192	11839	11677	8.052

June 9, 1988

New Flow Equations For Clifton Court Gates
by Ed Hills 2-0485

Gate 1 (most southerly gate)

$$\text{Flow in cfs} = GP\left[6.440 + 215.2214\,(\text{U.S. elev} - \text{D.S elev})^{0.5}\right]$$

Gate 2, 3, & 4

$$\text{Flow in cfs} = GP\left[4{,}200 + 176.1867\,(\text{US elev} - \text{DS elev})^{0.5}\right]$$

Gate 5 (most northerly gate)

$$\text{Flow in cfs} = GP\left[2{,}380 + 168.1700\,(\text{US elev} - \text{DS elev})^{0.5}\right]$$

GP = Gate Position

U S elev = Upstream water surface elev. (Old River)

DS elev = Downstream water surface elev. (Clifton Court)

Le, Kate

From: Mierzwa, Michael
Sent: Monday, March 15, 2004 1:45 PM
To: Delta Modeling; Enright, Chris; Miller, Aaron; Le, Kate; Tom, Bradley
Subject: Annual Report

Hi All,

The following is the current summary of topics and authors for the 2004 annual report. It is not a complete list, so if you have an idea for a paper you'd like to see, please let myself, Bob, or Tara know. If you have other suggestions, fire 'em at me. Even the crazy ideas, as those sometimes are the best.

Please note that the "Section" labels will not appear in the annual report, but are my way of sub-dividing papers into topics. You'll notice I don't have a section for study results, as this report is supposed to focus on the methodologies we (DWR) use to estimate flow and salinity. With that in mind, relationships are things that we've traditionally not included (at least in the past few years), but can be extremely useful in estimating flow and salinity, hence the section on modeling approaches looks fairly long.

I'll send out a timeline of due dates and example formats (i.e. an old paper) in the next week. If you are planning on being out of town for an extended period in March, April, or May, please let me know, so I can work around your schedule (I don't see a problem unless people are going to be gone for a really long time).

Cheers,
-Michael

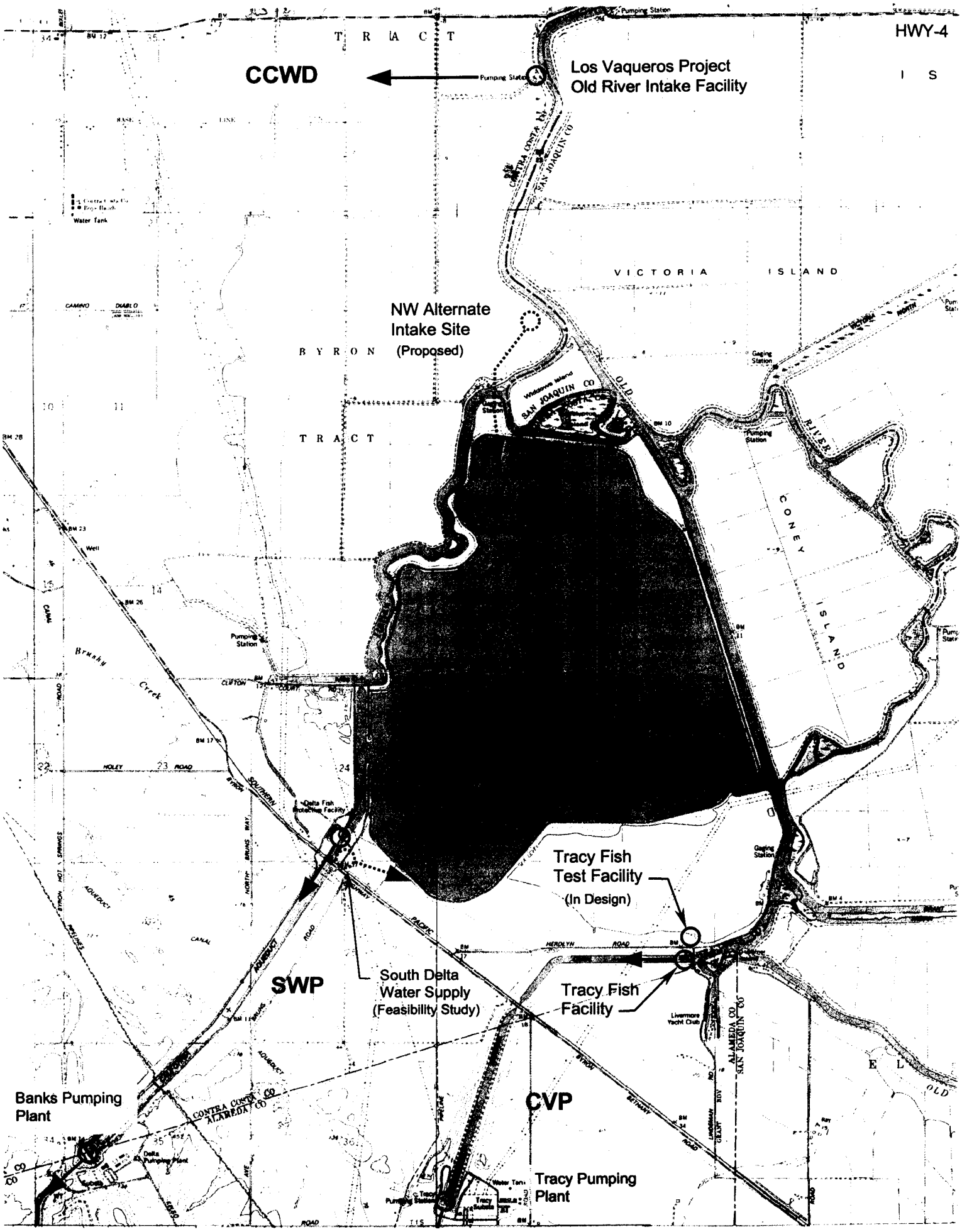
Preliminary Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh 2004 Report Chapters

SECTION 1: Model Development
Chapter 1: REALM Developments
Authors: Ralph and Eli
Update of the work done on REALM in the past year and any significant changes to the previous publicly released work plans.

SECTION 2: Calibration & Validation of Existing Models
Chapter 2: Comparing DSM2 Results with updated USGS Field Data around Franks Tract and in the Suisun Marsh
Authors: Bob, Chris, Jim, and Brad
Validate and document the current performance of DSM2 in regions where we have new field data. Also talk about future plans to improve the DSM2 representation in these regions (i.e. future calibration efforts).

SECTION 3: Developing Boundary Conditions & Field Relationships Chapter 3: Modeling DO & Temperature in Planning Studies
Author: Hari
Explain procedure used to develop 16-year boundary conditions for DO and Temperature data necessary for DSM2 planning runs.

Chapter 4: Calculating Flow through the Clifton Court Forebay Gates Based on Stage Differences
Author: Kate
Describe the field operation of the Clifton Court Forebay Gates and the regressions developed to estimate flow passing through the gates. This paper need not go into detail on the modeling of the gates in DSM2, but if desired can.

SECTION 4: Modeling Tools & Approaches
Chapter 5: Calculating NDO in CALSIM and DSM2
Author: Jamie
Discuss differences in NDO computed in CALSIM and DSM2.

South Delta Export Facilities: Existing and Proposed